When and Where to Apply the Family of Architecture-Centric Methods

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This material is based upon work funded and supported by Department of Homeland Security Wireless Emergency Alerts Program; Department of Defense Next Generation Cruiser Program; Department of Defense Common Link Integration Processor Program; additional DoD programs under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center sponsored by the United States Department of Defense.

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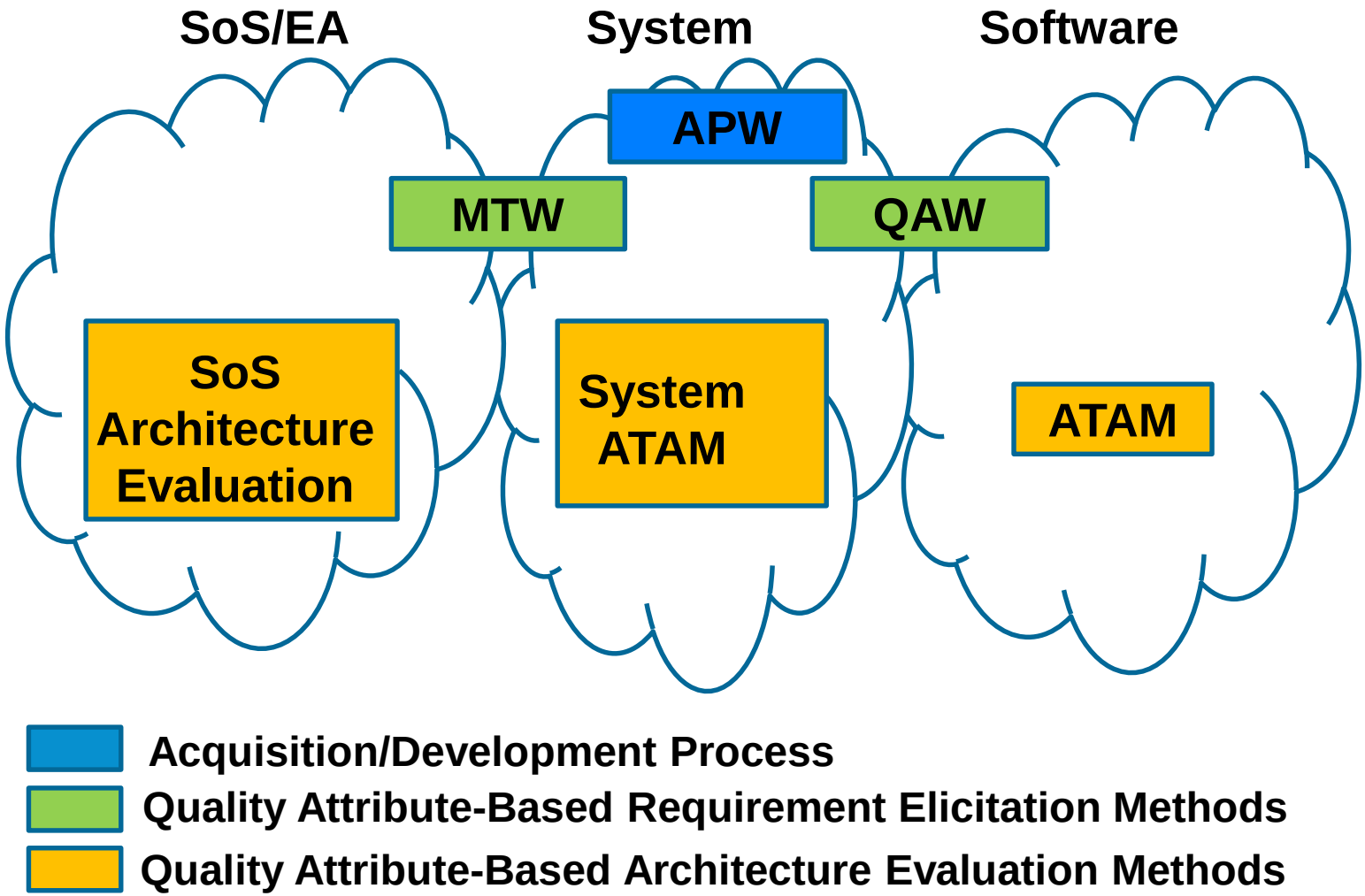
DM-0002351

Scope of the Presentation

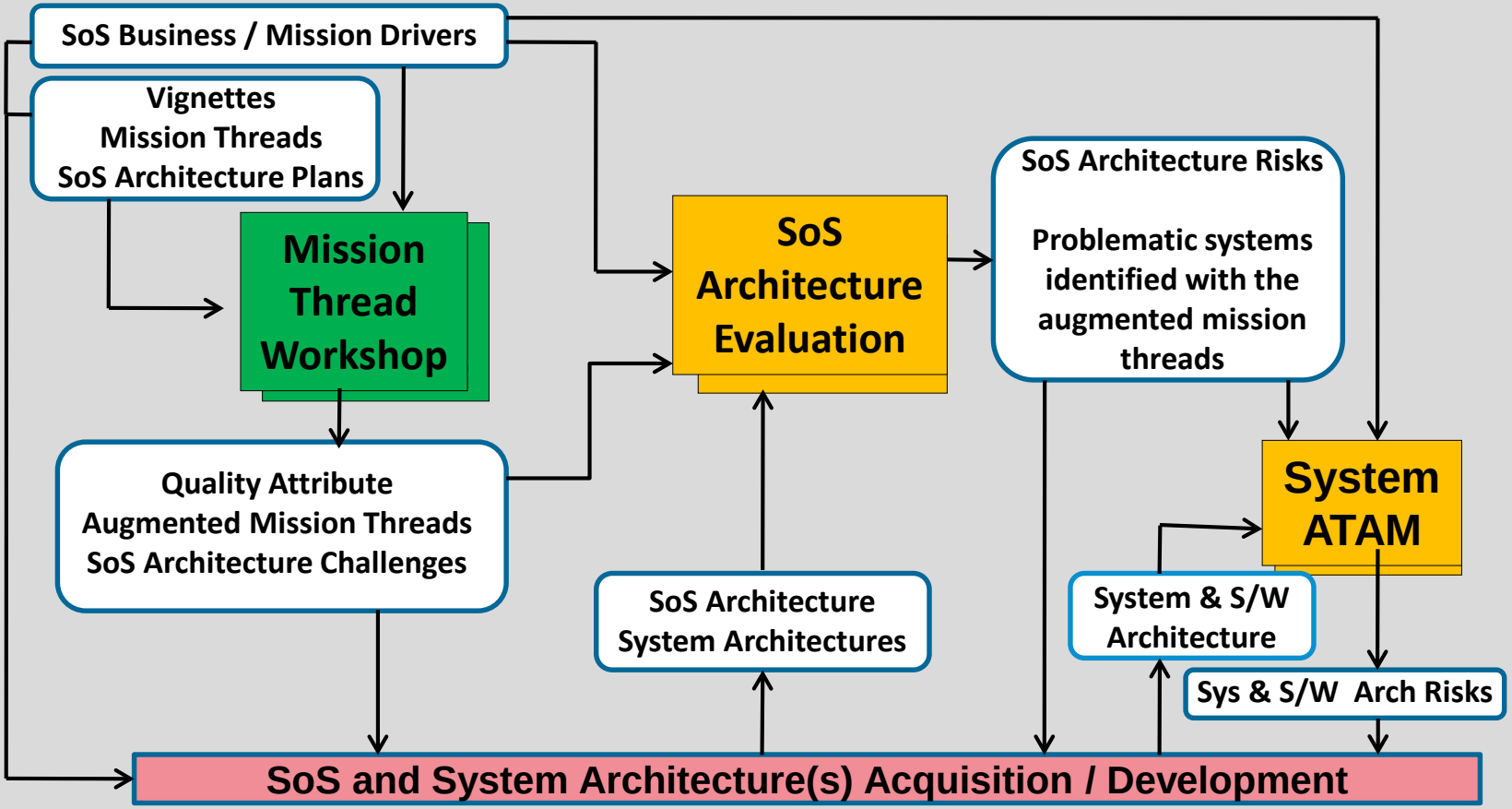
- Architecture products are used throughout the lifecycle, with the primary focus on the left side of the architecture engineering cycle.
- Specific SEI methods are not the emphasis; instead, the emphasis is on developing the products that are associated with the methods and their use in the lifecycle.
- We illustrate these points using examples from DoD programs, but everything that we will discuss has been applied and implemented in non-DoD and commercial programs also.
- For example, the term *acquisition* is used to cover broad activities including the development process and timelines, development products, milestones, and envisioned development organization.

Family of Architecture-Centric Methods

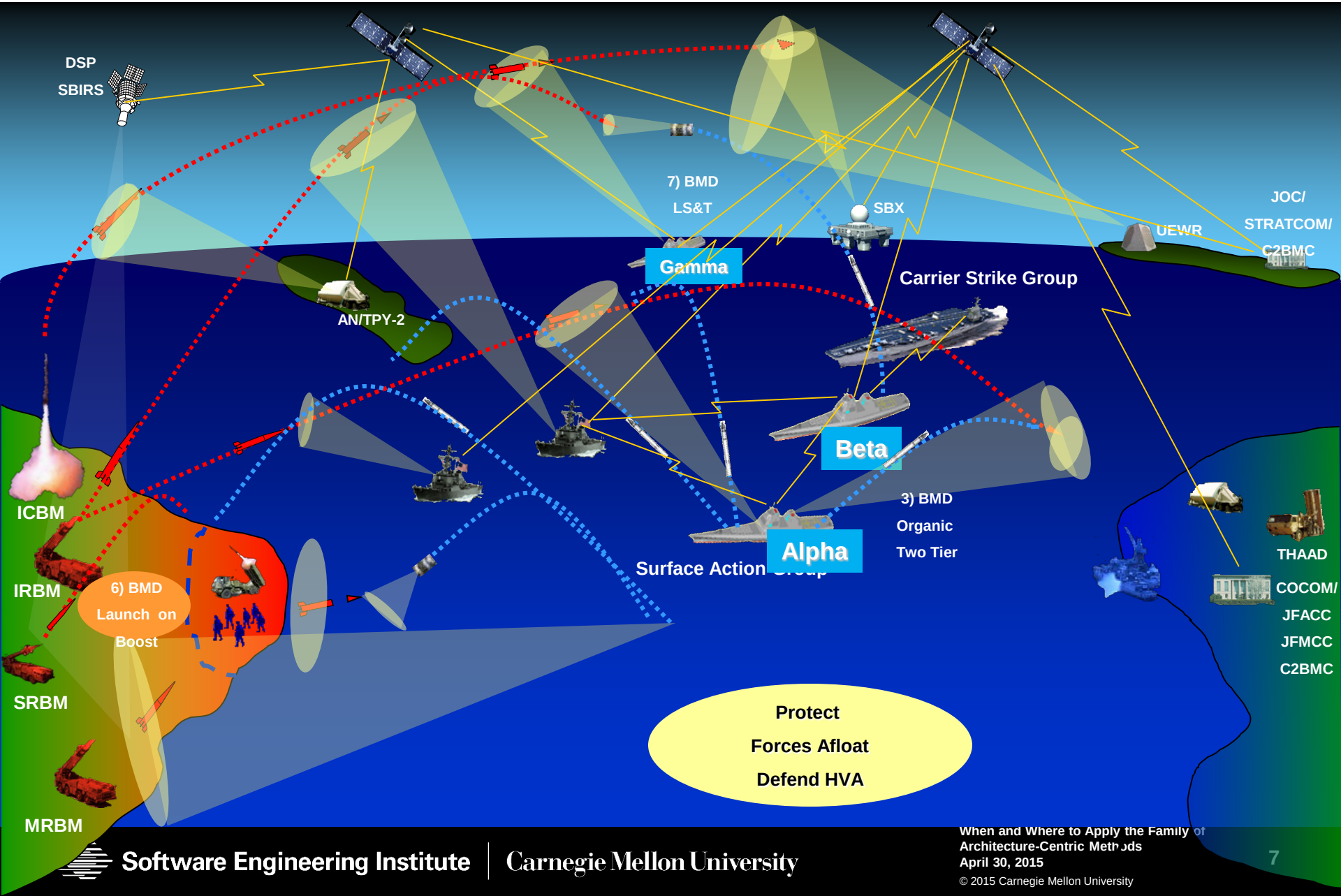


SoS Architecture Quality Attribute Specification and Evaluation Approach

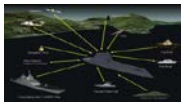
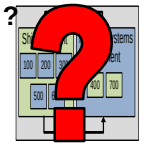
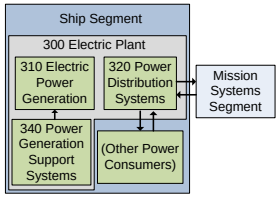
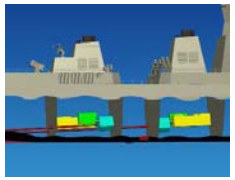
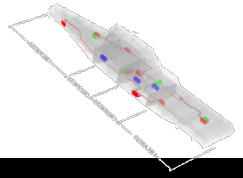
- Early elicitation of quality attribute considerations
- Early identification and addressing of architecture challenges
- Early identification and mitigation of architectural risks



Ballistic Missile Defense (BMD) OV-1 Example



Example Ship's SoS Tier Definition

Tier Definition	Software Work Breakdown Structure (SWBS)
 **Tier 0 – Operational Context** • NR-KPP, CDD, and ISP documentation	**NA**
 **Tier 1 – Ship Platform Context** • Describes the system interaction with external entities	**NA**
 **Tier 2 –Segment and Group Context** • Internal to the Ship System • Describes major system segments (Mission Systems and Ship Systems) functionality and SWBS Level IV Groups	**1-digit**
 **Tier 3 – Element Context** • Describes major ship system type functionality and interactions with other major system types • 2-digit SWBS level of fidelity (i.e., Power Distribution System interface with Surveillance Systems)	**2-digit**
 **Tier 4 – Component Context** • Describes Ship System functionality and interactions with other systems • 3-digit SWBS level of fidelity (i.e., Seawater Cooling System interface with Emergency Diesel Generator)	**3-digit**
 **Tier 5 – Unit Context** • Defines the functionality and interaction of the components within a ship subsystem • 5-digit SWBS level of fidelity (i.e., interface of Specific System A to Specific System B)	**4/5-digit**

Mission Threads Flow from Vignettes – Example (Non-Augmented)

1. 20 land-based missiles launched – X-minute window
2. Satellite detects missiles; cues CMDR
3. CMDR executes replanning; reassigns Alpha and Beta
4. Satellite sends track/target data – before they cross horizon
5. Ships' radars are focused on horizon crossing points

…

N. Engagement cycle is started on each ship

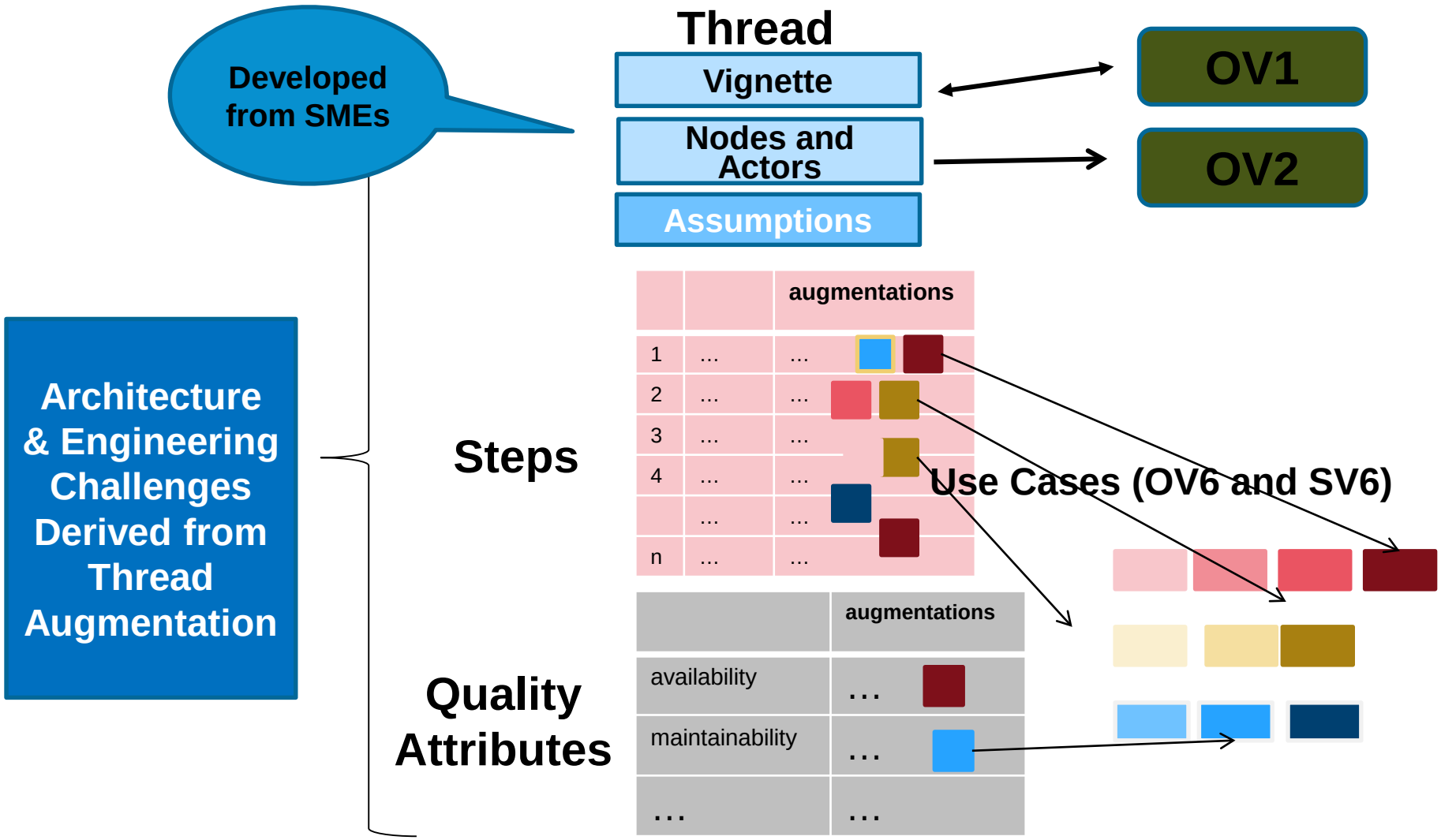
N+1. Aircraft are detected heading for fleet

N+2. SA detects missile launches; tells CMDR

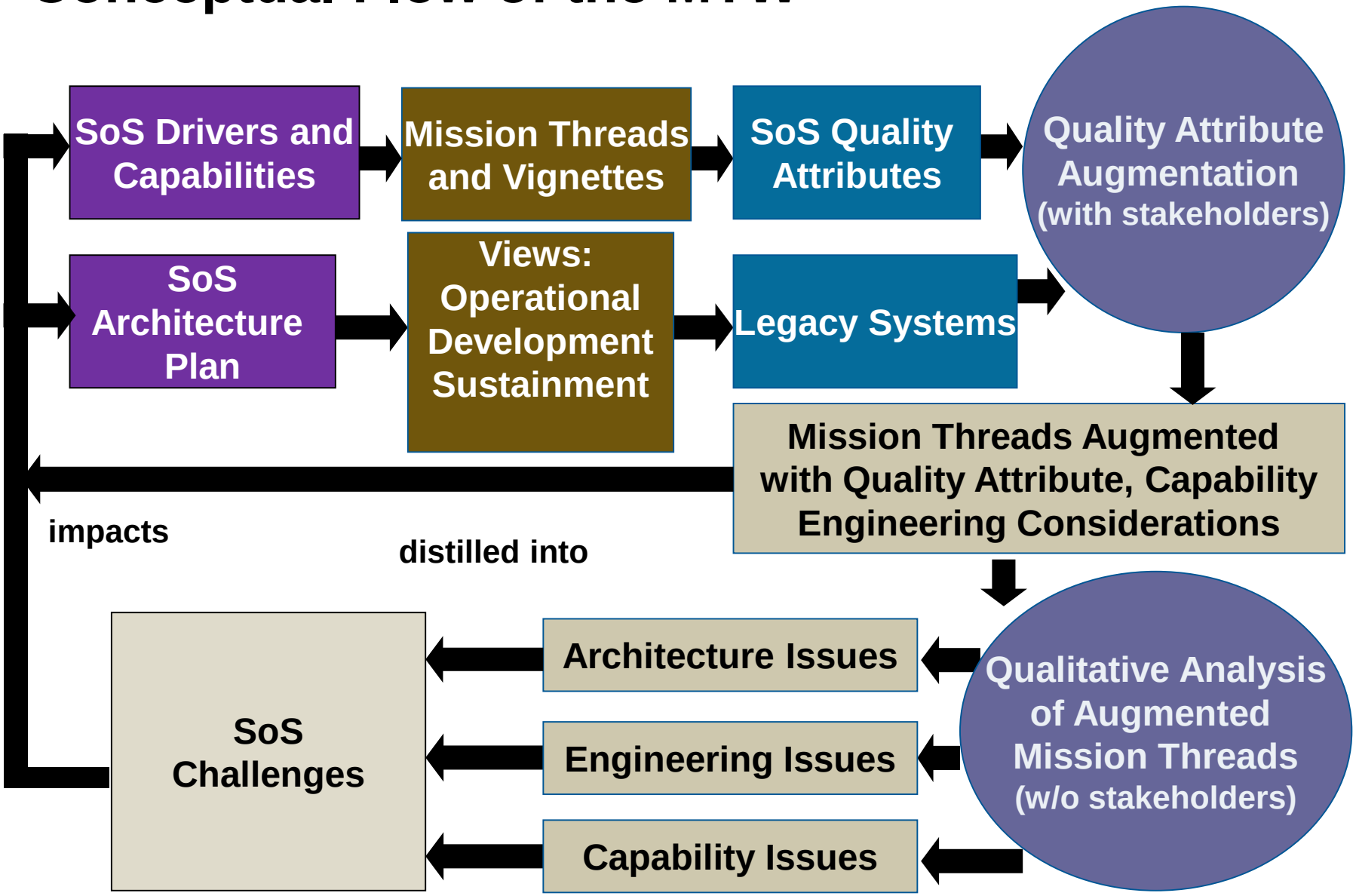
N+3. CMDR does replanning; UAVs are redirected

N+4. FCQ tracks are developed from UAV inputs

Mission Thread
(augmented via the Mission Thread Workshop)

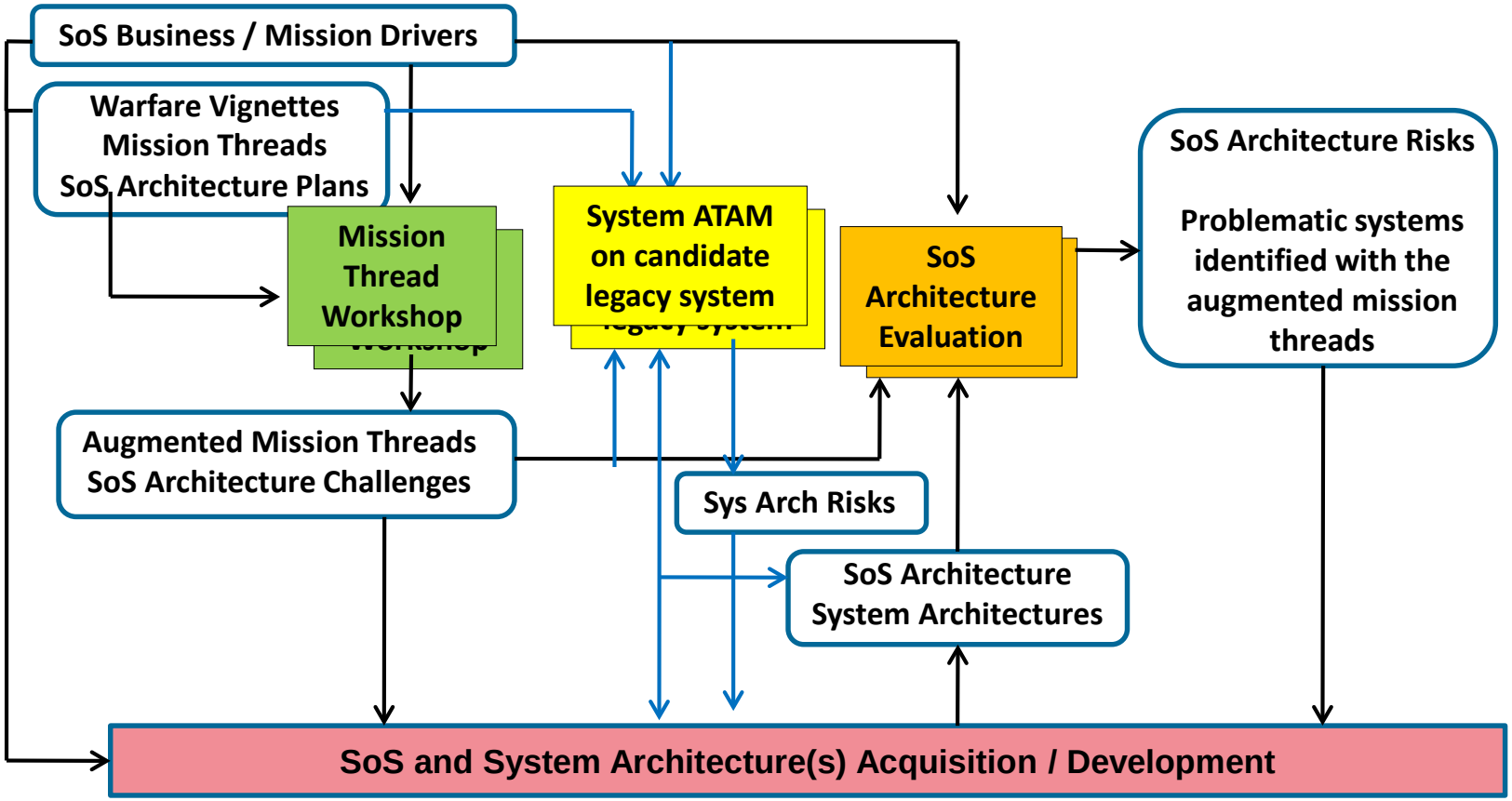


Conceptual Flow of the MTW

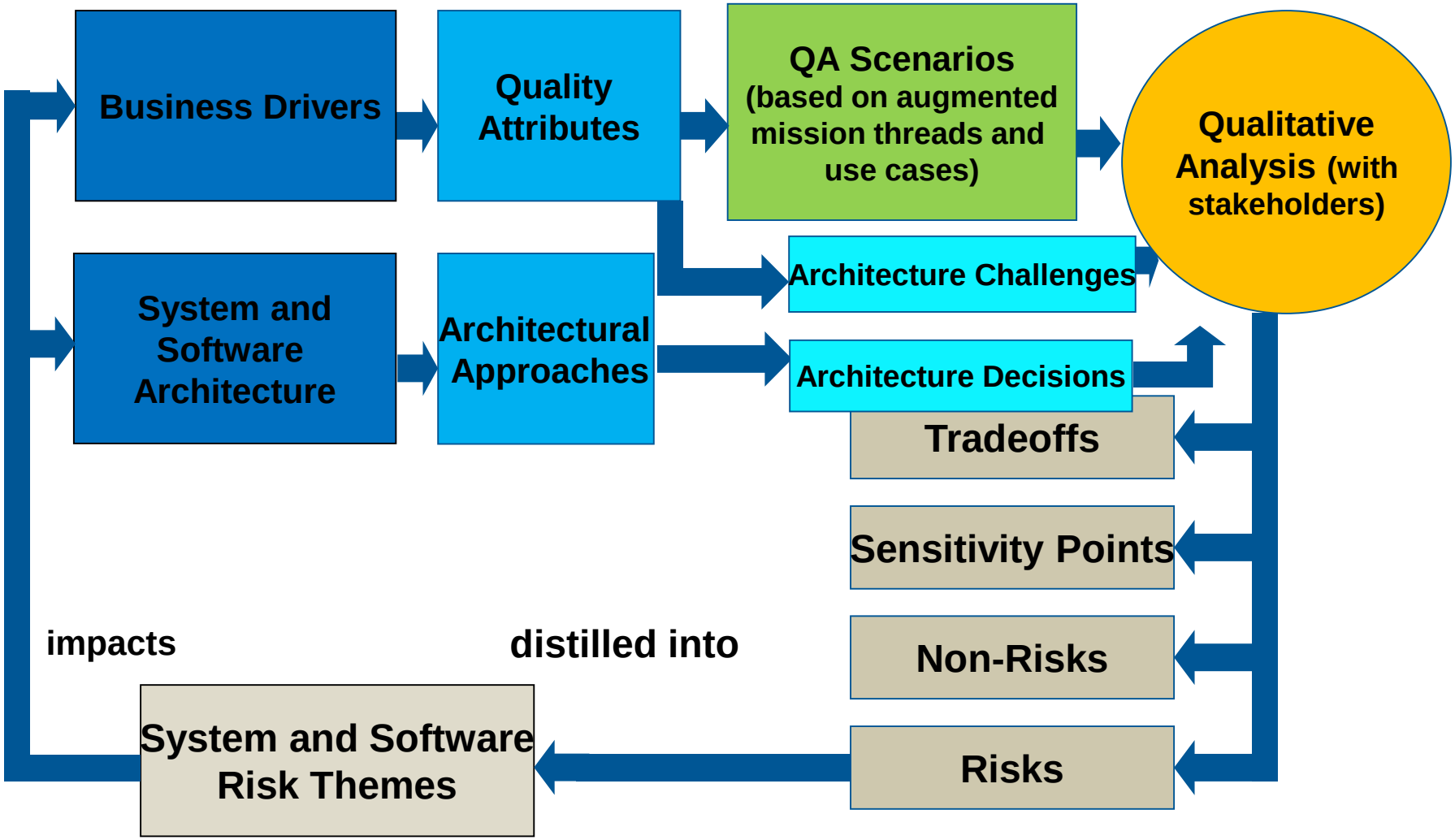


Legacy System Architecture Evaluation – Early

- Early elicitation of quality attribute considerations
- Early identification and addressing of architecture challenges (e.g., architecture evaluation of candidate legacy system)
- Early identification and mitigation of architectural risks



Conceptual Flow of System ATAM



Is a System ATAM Variant Appropriate for a Defensive Engagement System?

Comments from augmented mission thread:

- The Defensive Engagement System may not be able to support the deconfliction timeline for 5 incoming missiles.
- The Defensive Engagement System may not have the capability to acknowledge Beta's acceptance of its assignment of 2 missiles.
- Is the Defensive Engagement System capable of sending track updates to the interceptor missiles that Beta had launched within the intercept timeline?

In Phase 0, the System ATAM lead meets with SoS and appropriate system architects to discuss what is in and out of scope concerning the system under analysis and if appropriate documentation exists

Agree on scenarios based on the augmented mission thread, with the understanding that additional scenarios can be added during Phase 2 of the System ATAM

Examples of Scenarios

Scenarios address both system and software aspects:

- **Use case scenario**

  The Defensive Engagement System (DES) is able to support deconfliction of 7 incoming missiles using own-ship and external information within XX seconds.

- **Growth scenario**

  An upgraded DES is able to reduce the confliction time by 40% of 7 incoming missiles with no loss of existing functionality.

- **Exploratory scenario**

  The DES is able to operate at up to 80% of its time budget for deconfliction of 7 incoming missiles with 8 coalition UAVs and 3 coalition helicopters operating in its vicinity.

ATAM Phase 2 Specifics

Stakeholders will consist of

- System Architects of associated systems relevant to the system under evaluation
- SoS Architects who know the total system and how the system under evaluation is envisioned to fit in
- Relevant stakeholders of the system under evaluation in the areas of requirements, development, T&E, sustainment, and M&S

ATAM evaluators will look to identify/expose potential system and software architecture risks, with the help of the stakeholders.

Subject-matter experts may be used on the evaluation team, if necessary.

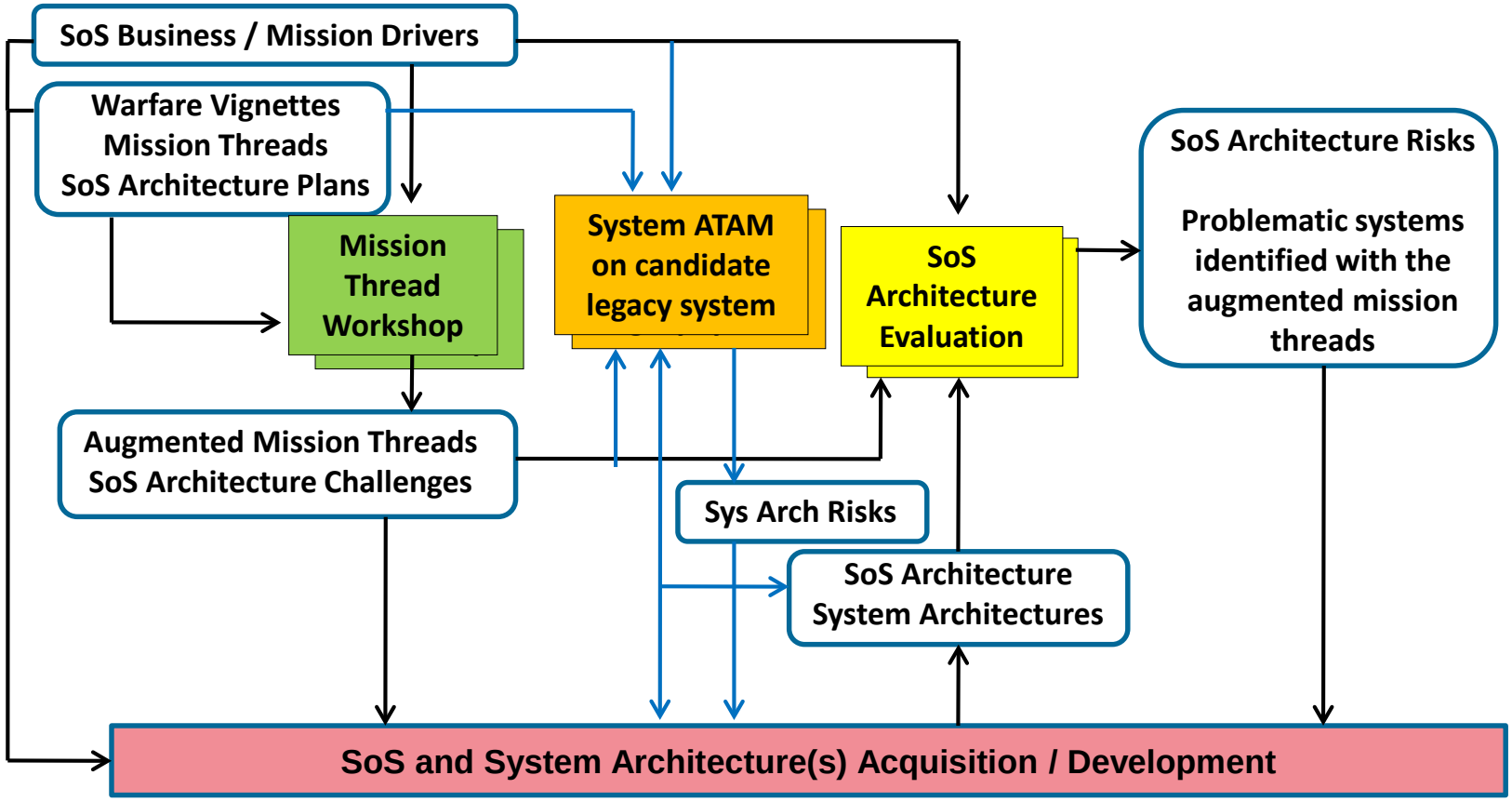
Walk-through of a scenario derived from augmented MT

The Defensive Engagement System (DES) is able to support deconfliction of 7 incoming missiles using own-ship and external information within XX seconds.

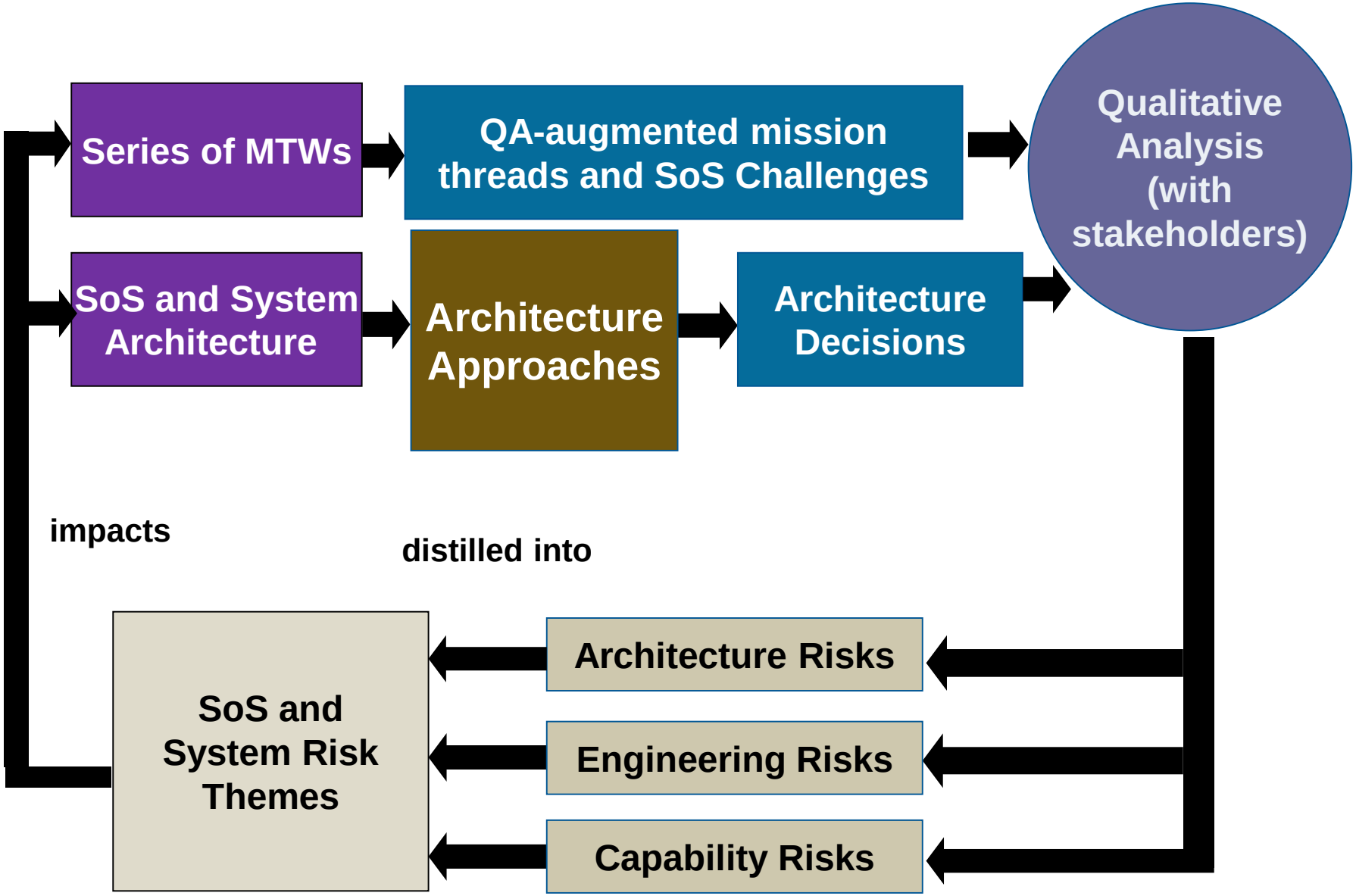
- System architect identifies that currently DES can support 3 incoming missiles with 25% spare capacity given the existing hardware.
- The architect also states that the system has a monolithic software architecture, which is tightly coupled to the hardware.
- The architect identifies that upgraded hardware is available for the system, which will improve performance, but the software will need to be redesigned to support it.

Focus on SoS Architecture Evaluation

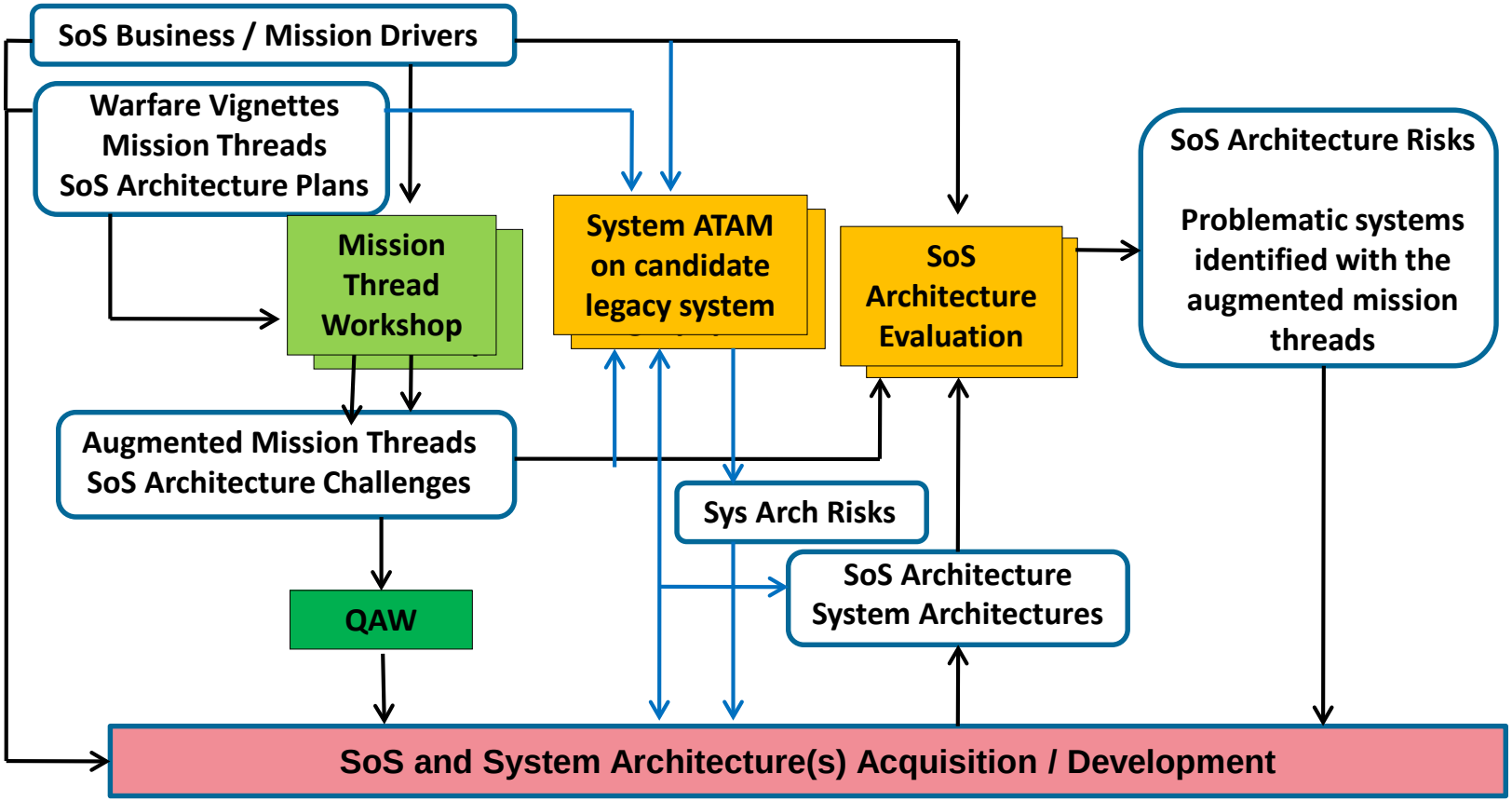
Early identification and mitigation of architectural risks



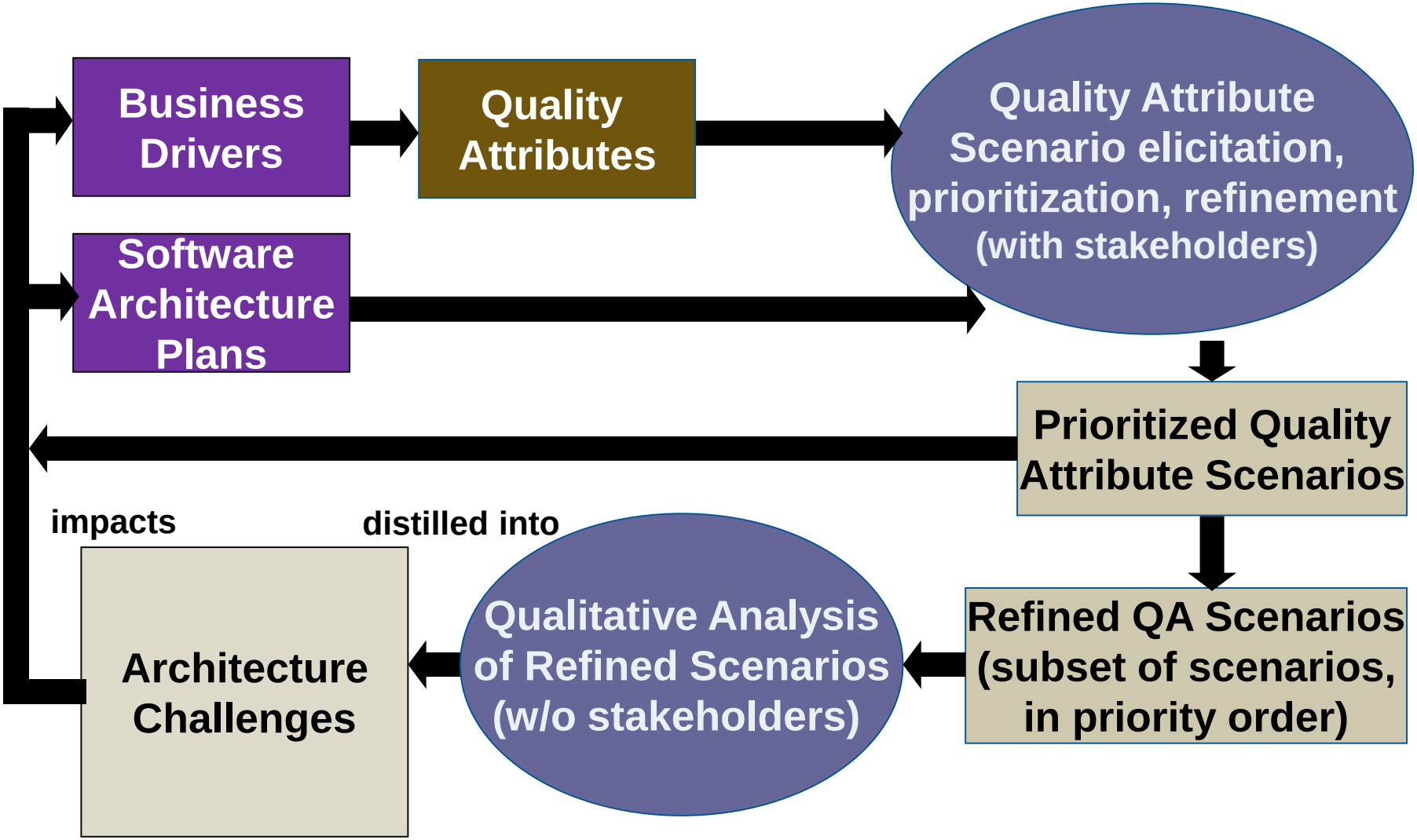
Conceptual Flow of SoS Architecture Evaluation



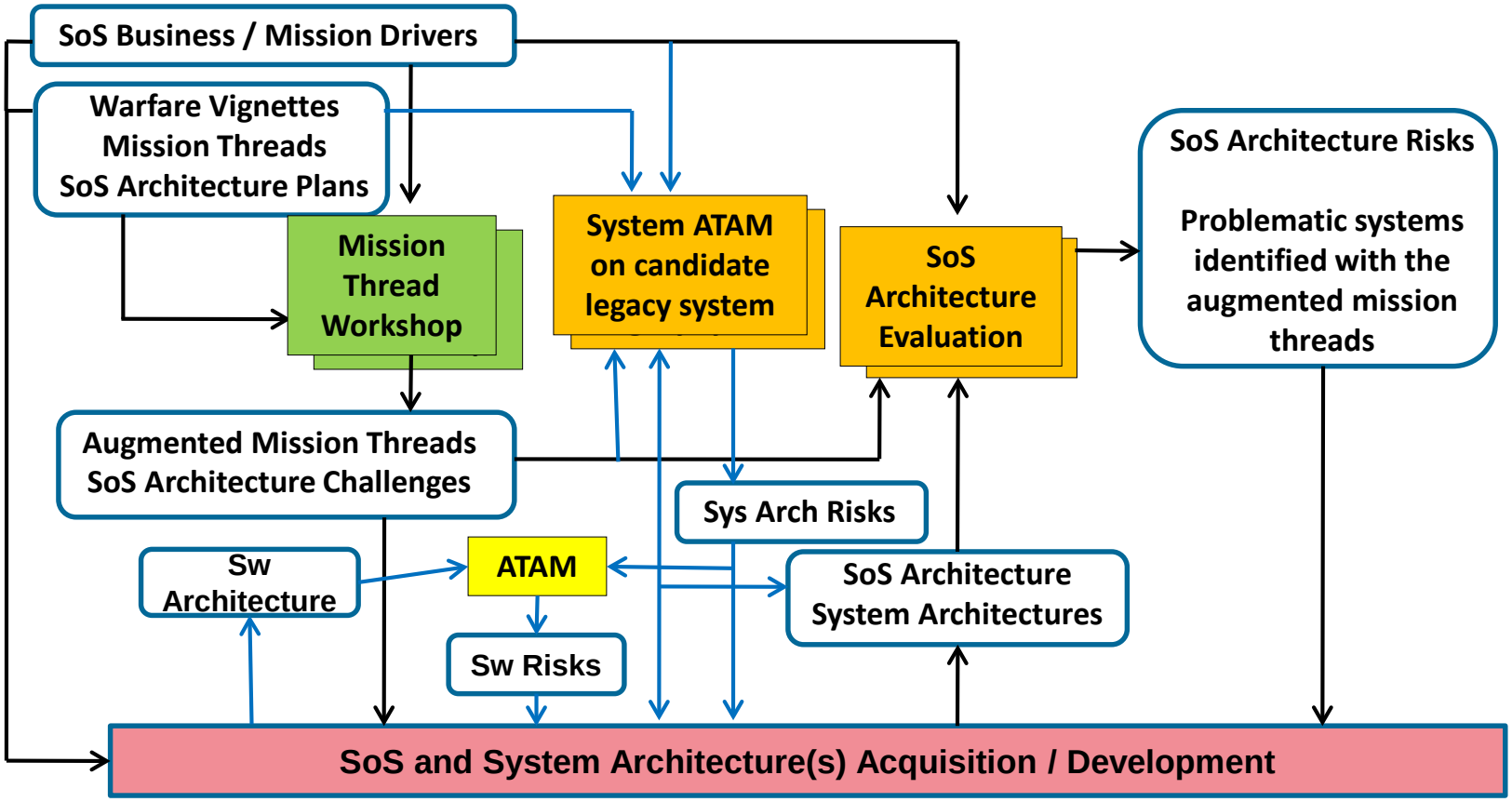
Focus on QAW



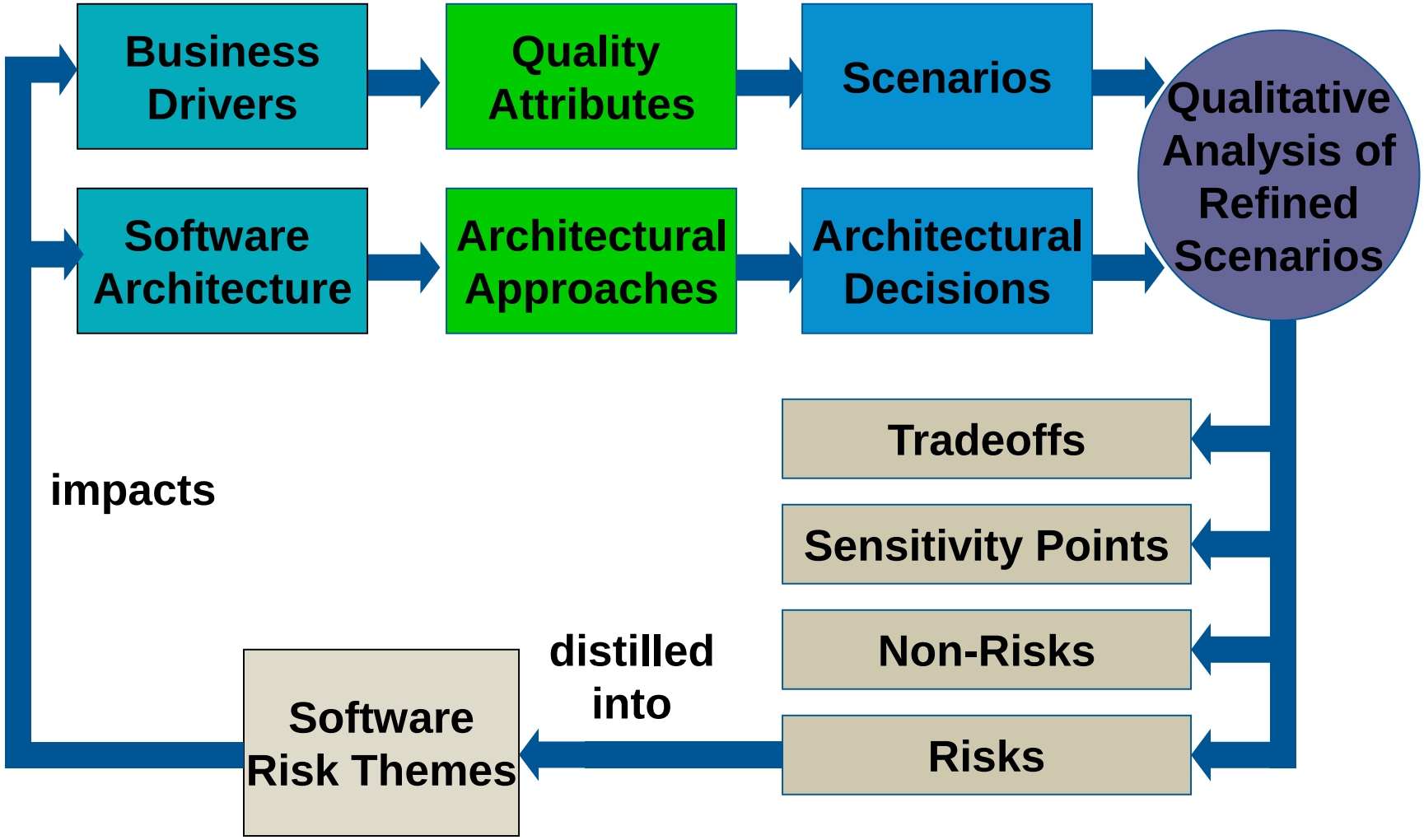
Conceptual Flow of the QAW



Focus on ATAM

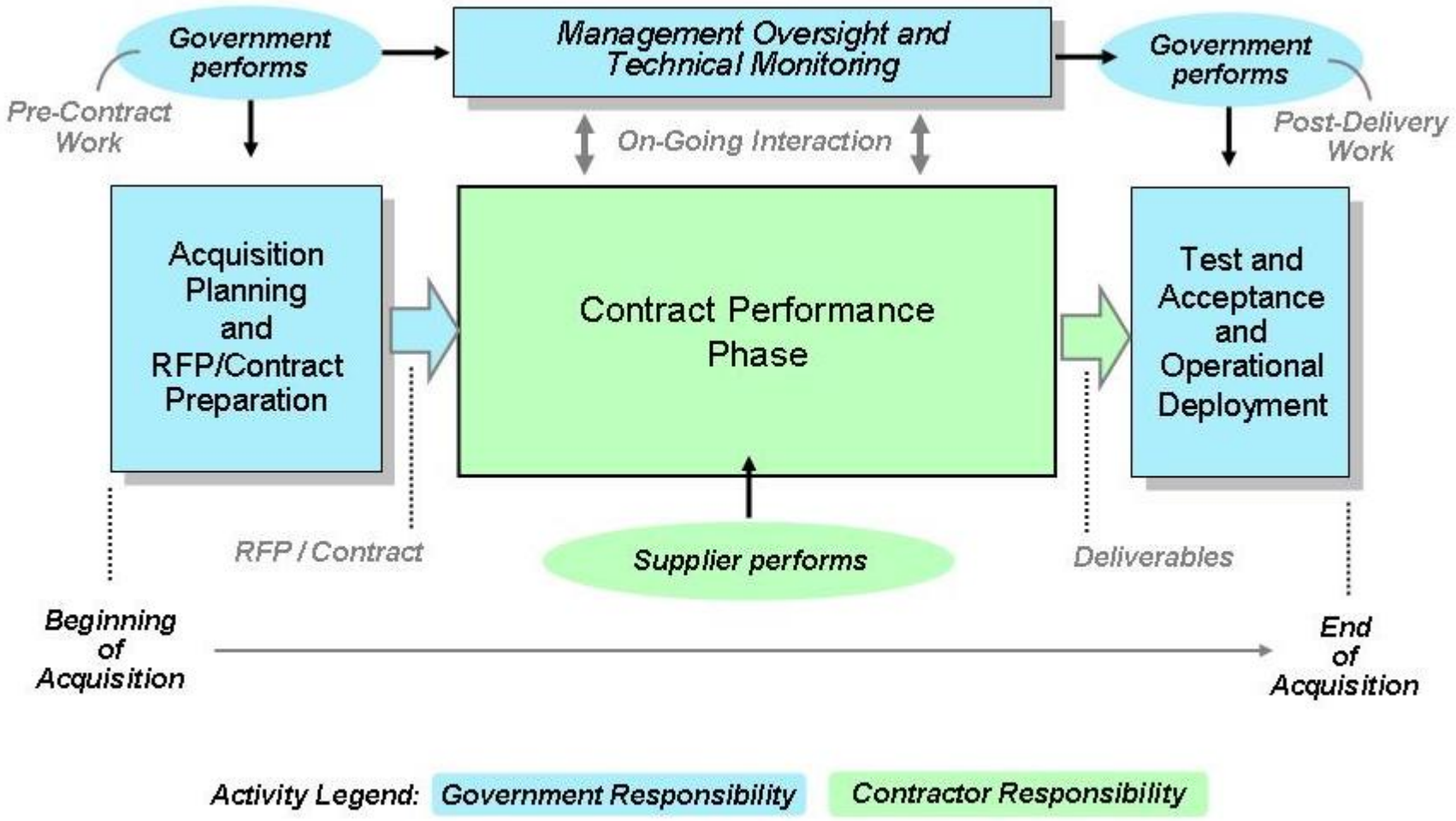


Conceptual Flow of the ATAM

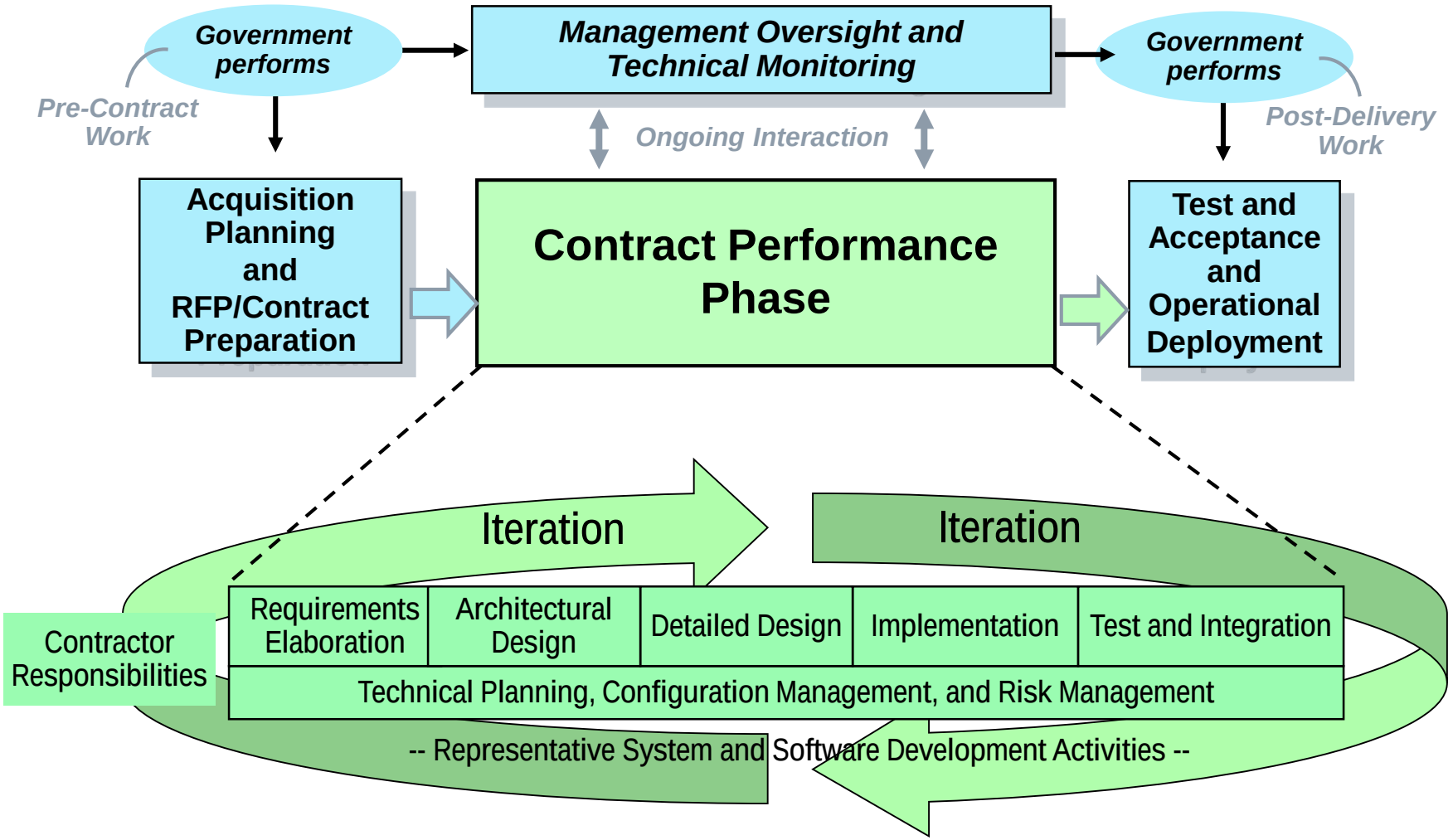


Acquisition/Development Aspects

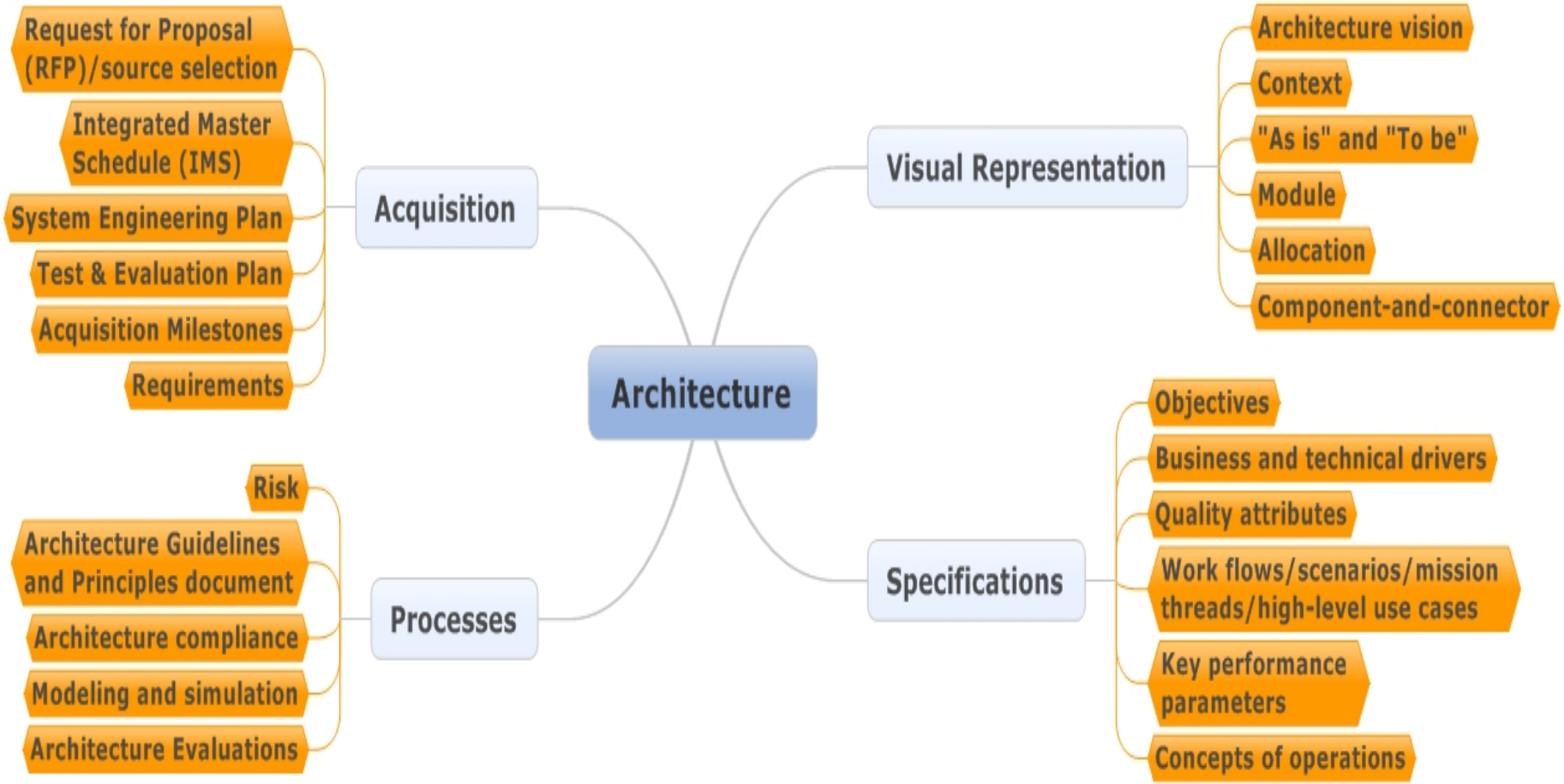
Responsibilities of an Acquisition Organization



Representation of Contract Performance Phase



Artifacts Impacted by Architecture-Centric Methods



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