Practical SysML Applications: A Method to Describe the Problem Space

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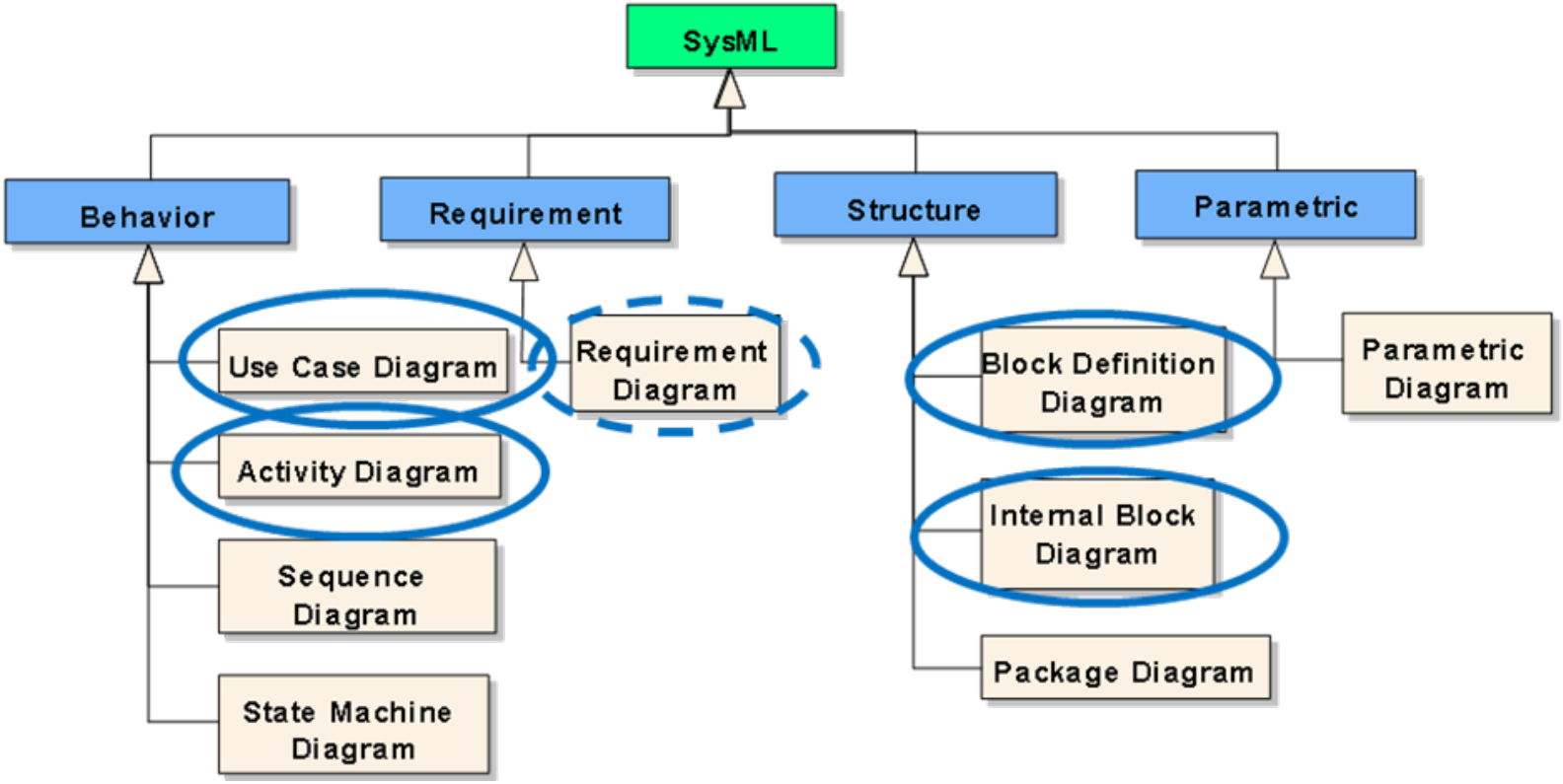
Problem Space

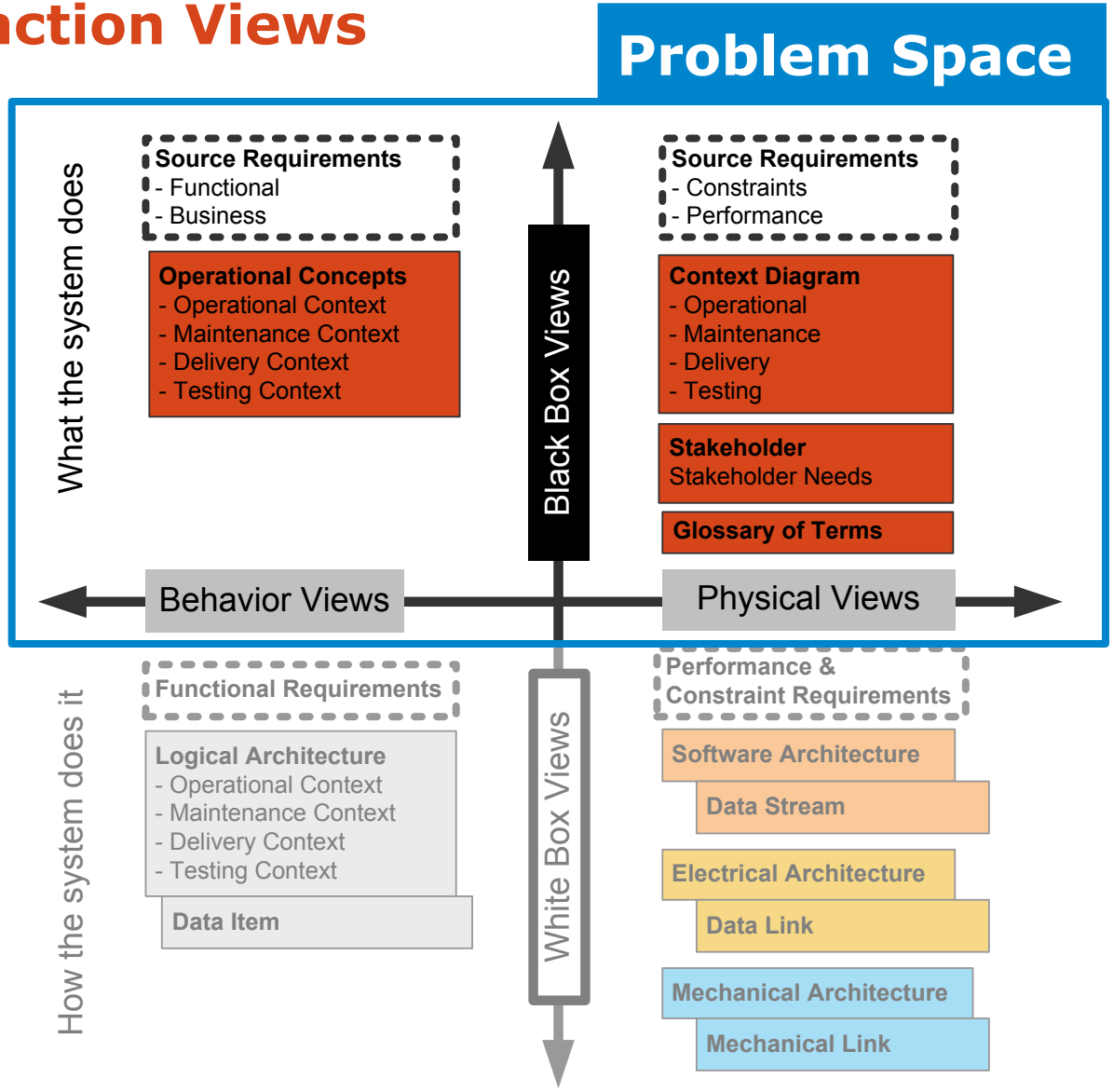
- Answers the question
  - What does the customer want and why?

- What is unique about this method?
  - This method
    - Identifies the customer (stakeholder)
    - Describe the problem facing the customer(s)
    - Keep the problem and the solution separate
      (adding solution ideas early constrains the possible solutions)
    - Starts to clarify the handoffs between teams
      (organizational hierarchy)

SysML Diagrams for the Problem Space

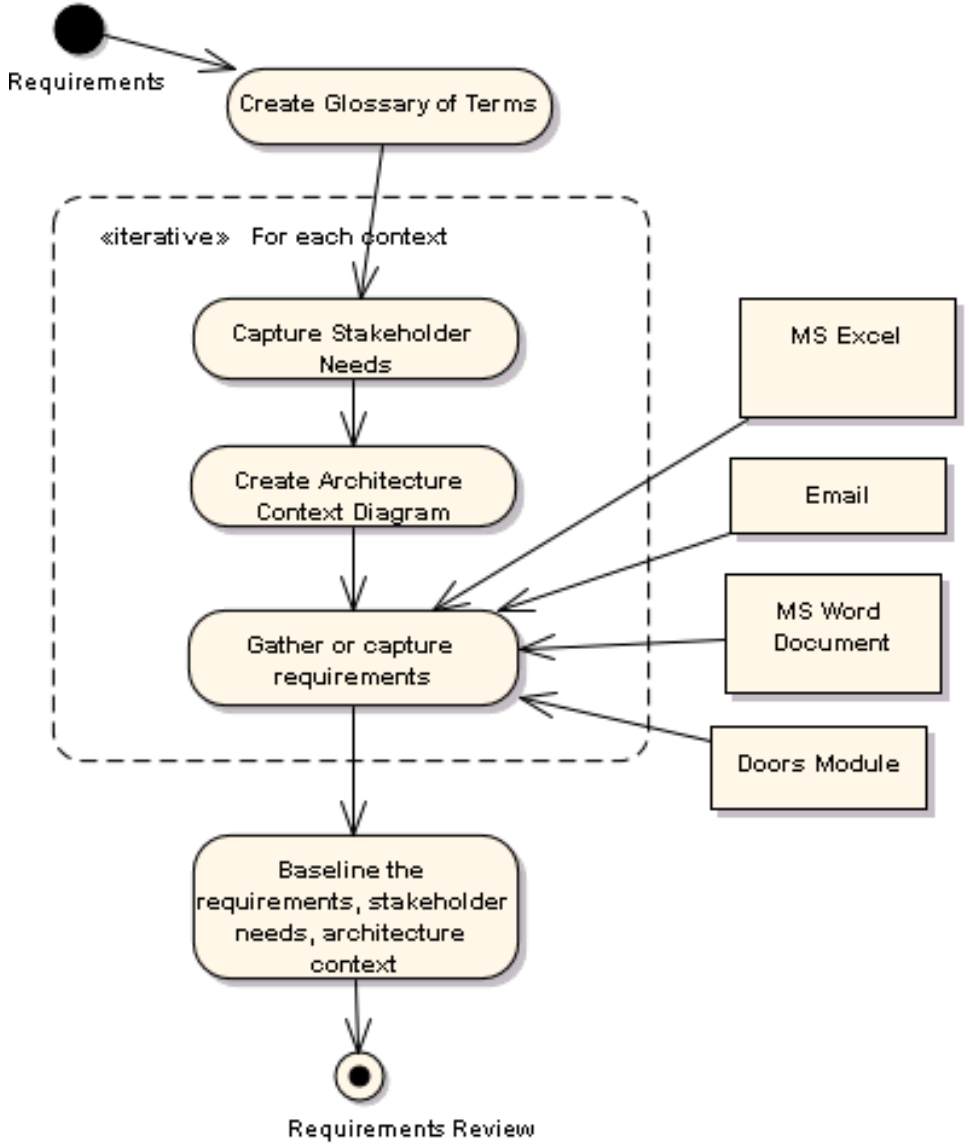


Abstraction Views



Originating Customer Requirements

- Answer the questions:
  - What is the problem?
  - What are the users doing?
  - What are the objects in the real world?
- Work from the user requirements inward
- Ends with requirements review
  - Vocabulary consistent between stakeholder needs, context diagram, & requirements

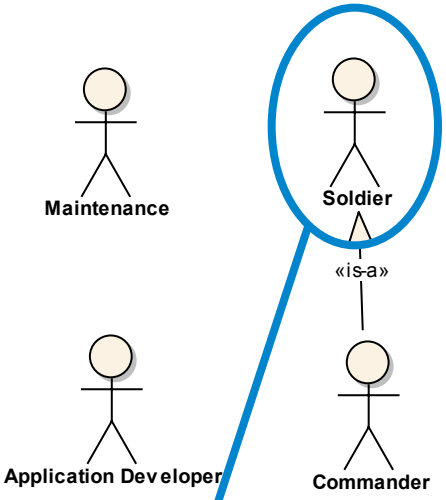


Glossary of terms

- Any noun or acronym used in the source requirements
- Stakeholder focused and not designer or implementer focused

Stakeholder needs

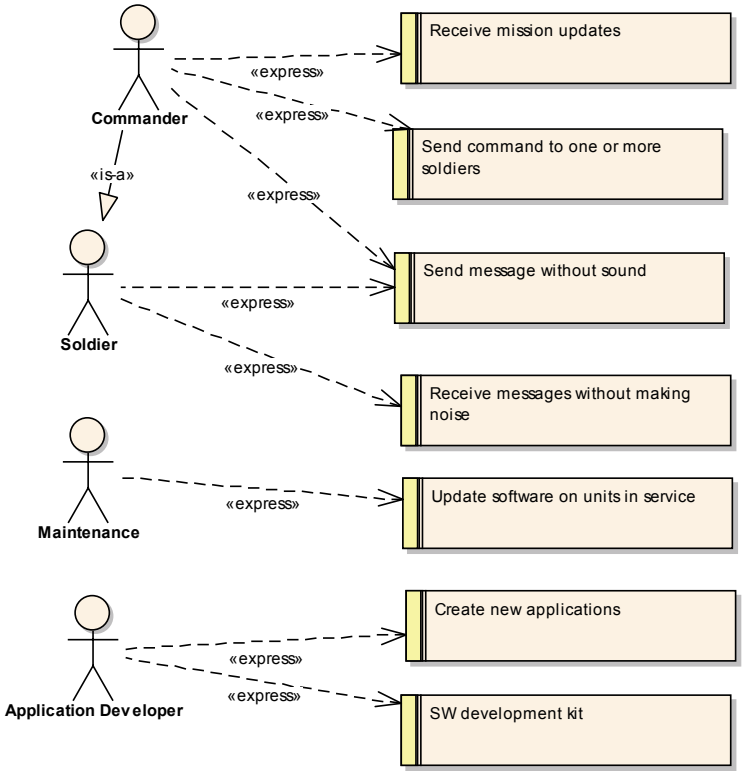
1) Identify stakeholders



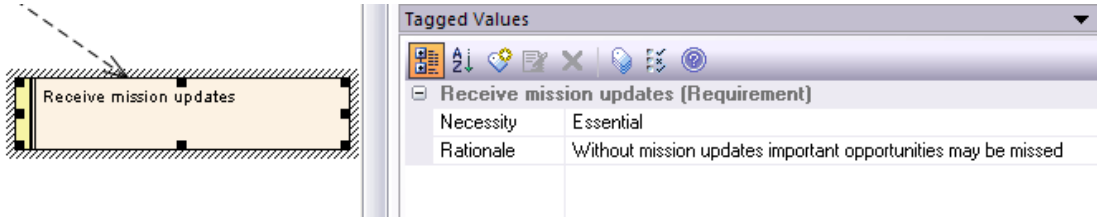
2) Describe stakeholders

Roles: Describe the role the stakeholder plays. There may be more than one role each stakeholder operates in.
Authority: Describe the authority of the stakeholder in each of their roles.
Knowledge: Describe the level of knowledge the stakeholder has.

3) Identify Stakeholder Needs

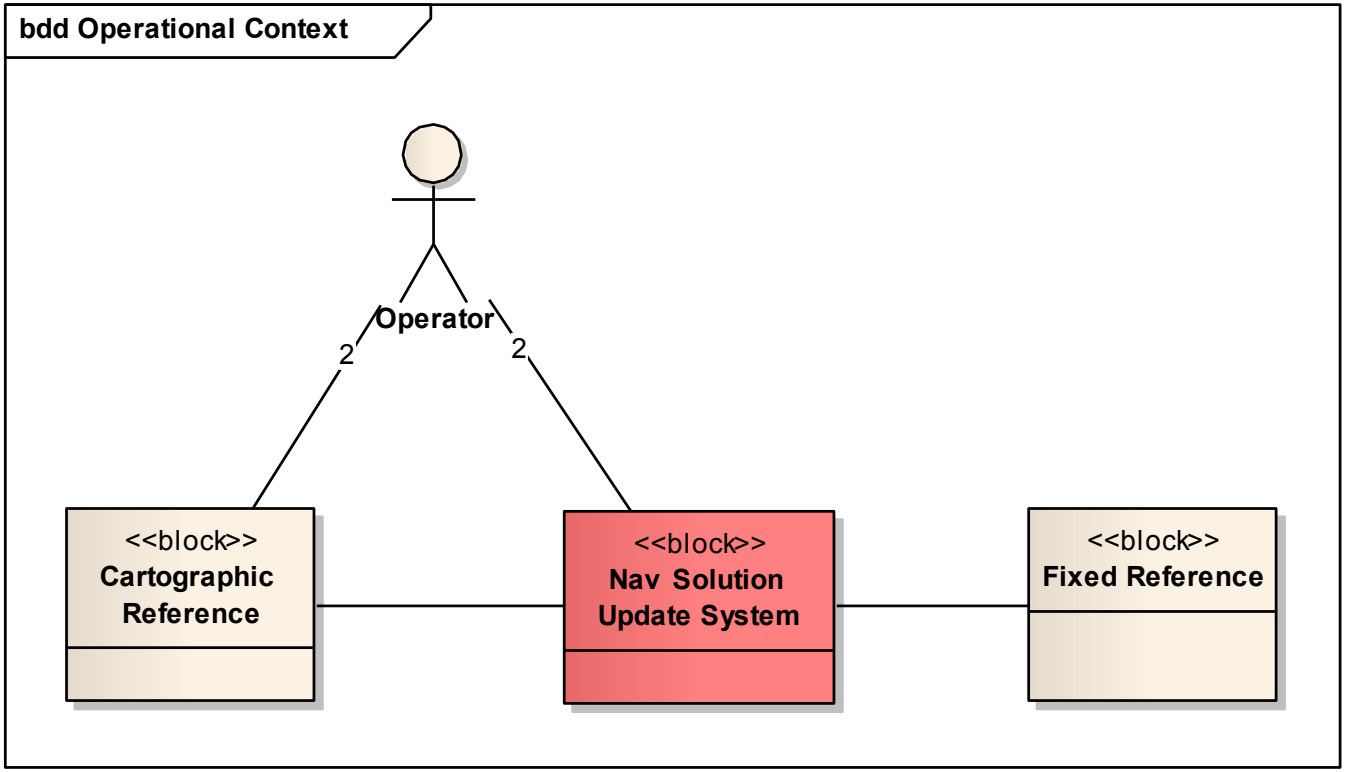


4) Add need necessity & rational



Capture Architectural Context

- Show actors and association with system of interest
- Purely “black box” perspectives



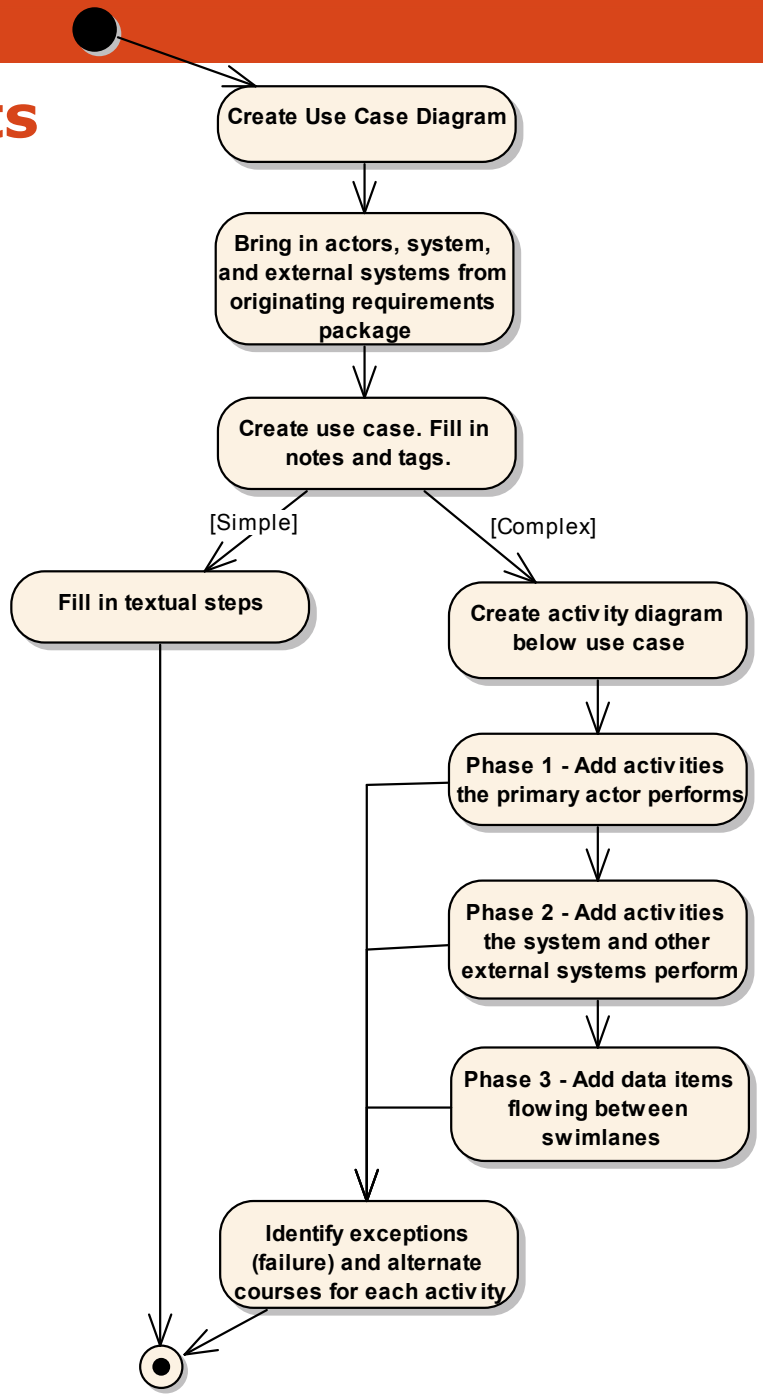
Source Requirements

- Source requirements are requirements provided by external stakeholders, not by the designers
- This task involves gathering and organizing the requirements
- In an ideal world, the external stakeholders
  - Provide requirements at the black-box level (do not over-constrain the solution)
  - Elaborate the requirements with use cases

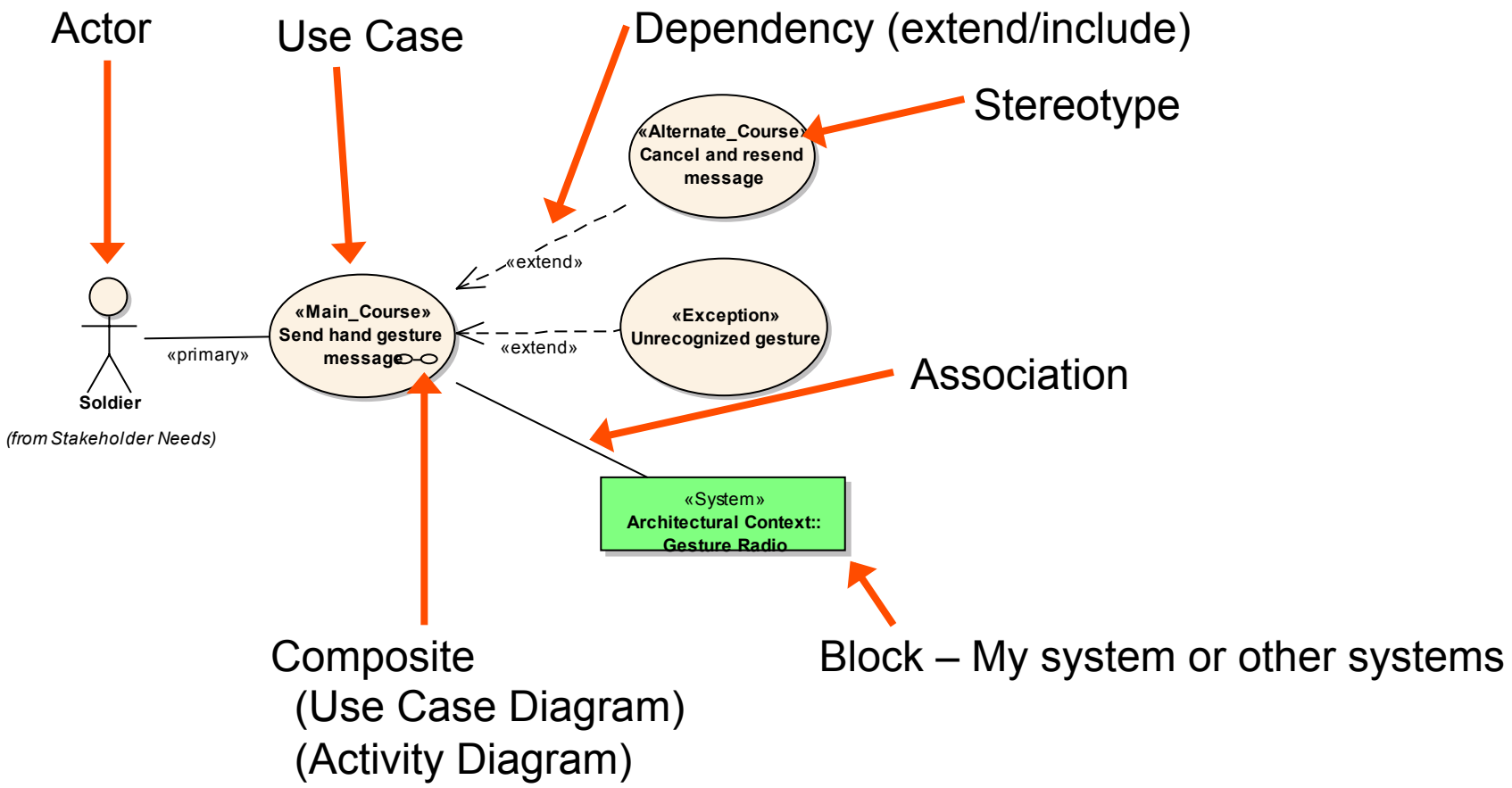
Operational Concepts

- Start with source requirements and stakeholder needs

- Re-use actors and external systems from the stakeholders and architecture context packages
  - If you discover a new actor or system, add it to the stakeholder/architecture context also

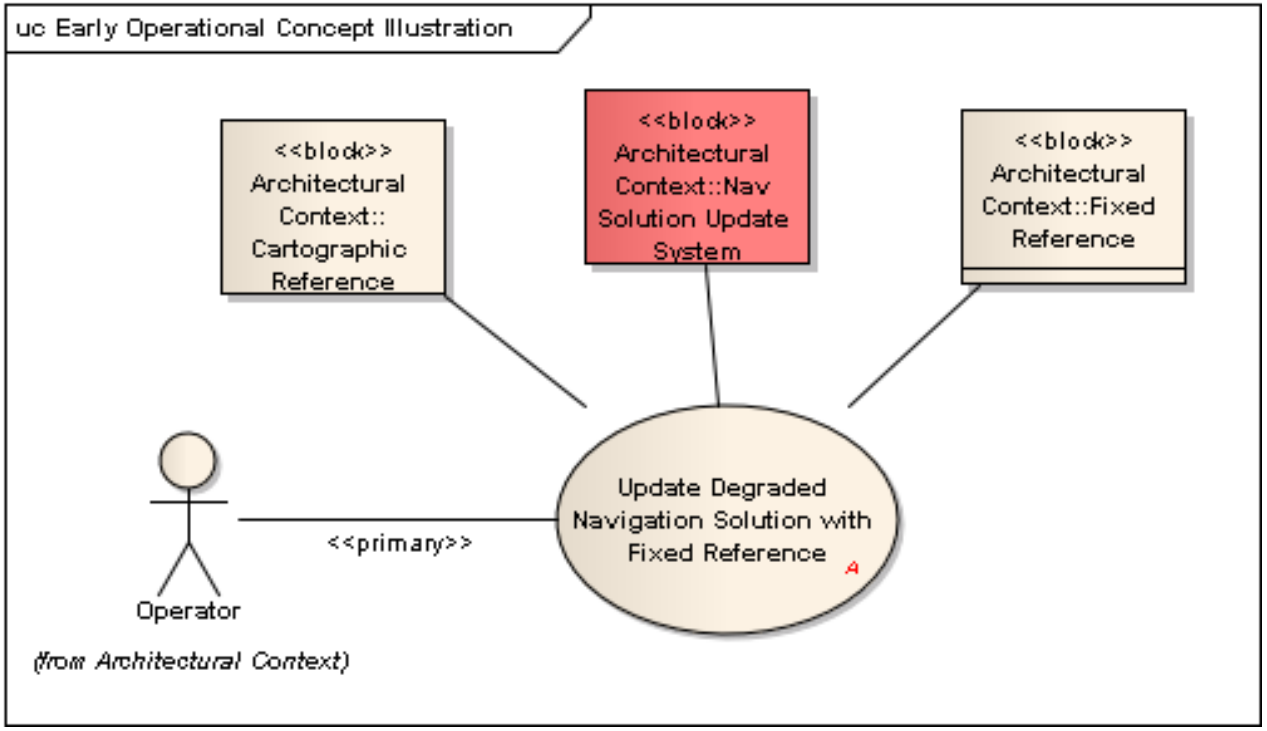


Use Case Diagram



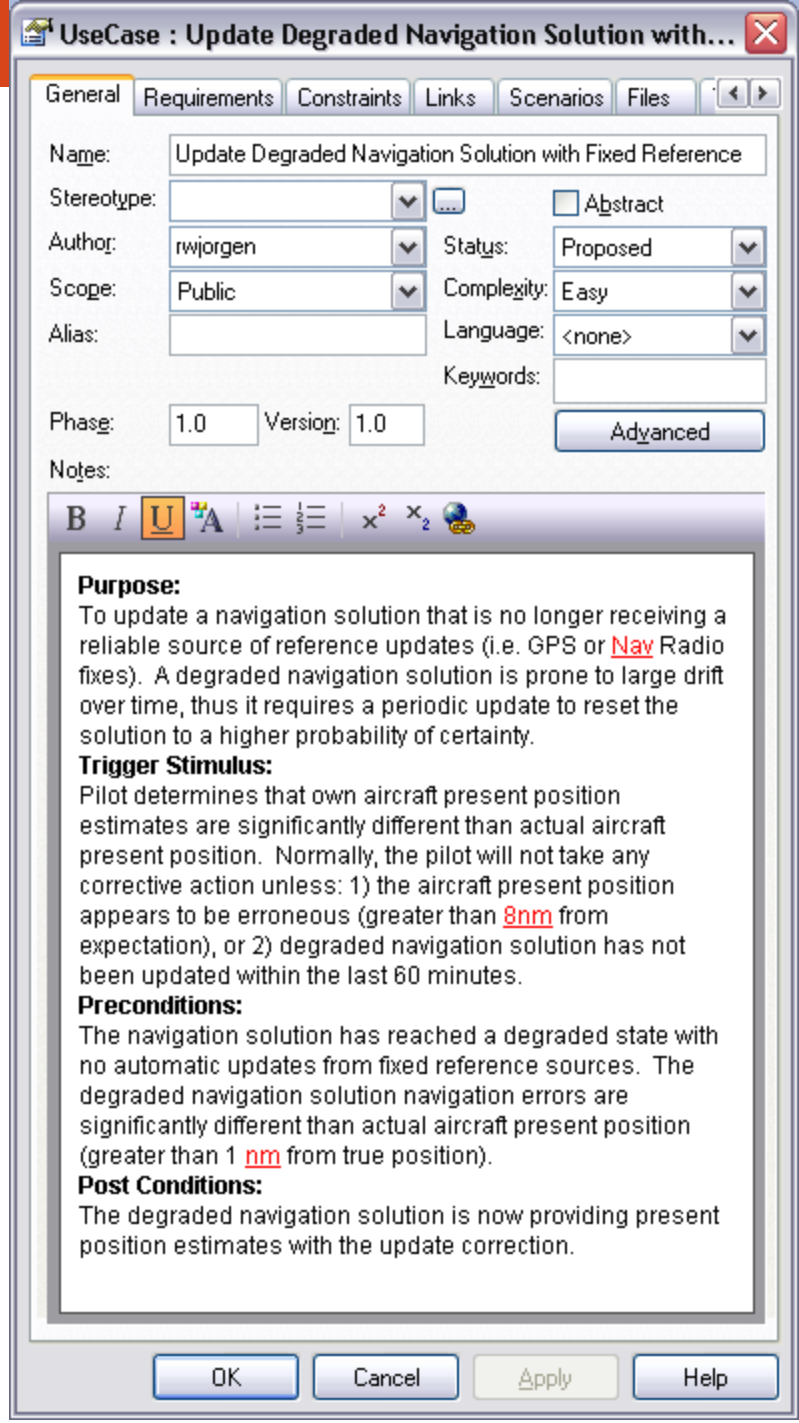
Conduct Use Case Analysis

- Identify prospective Use Case: "verb-noun" convention
- Primary actor identification

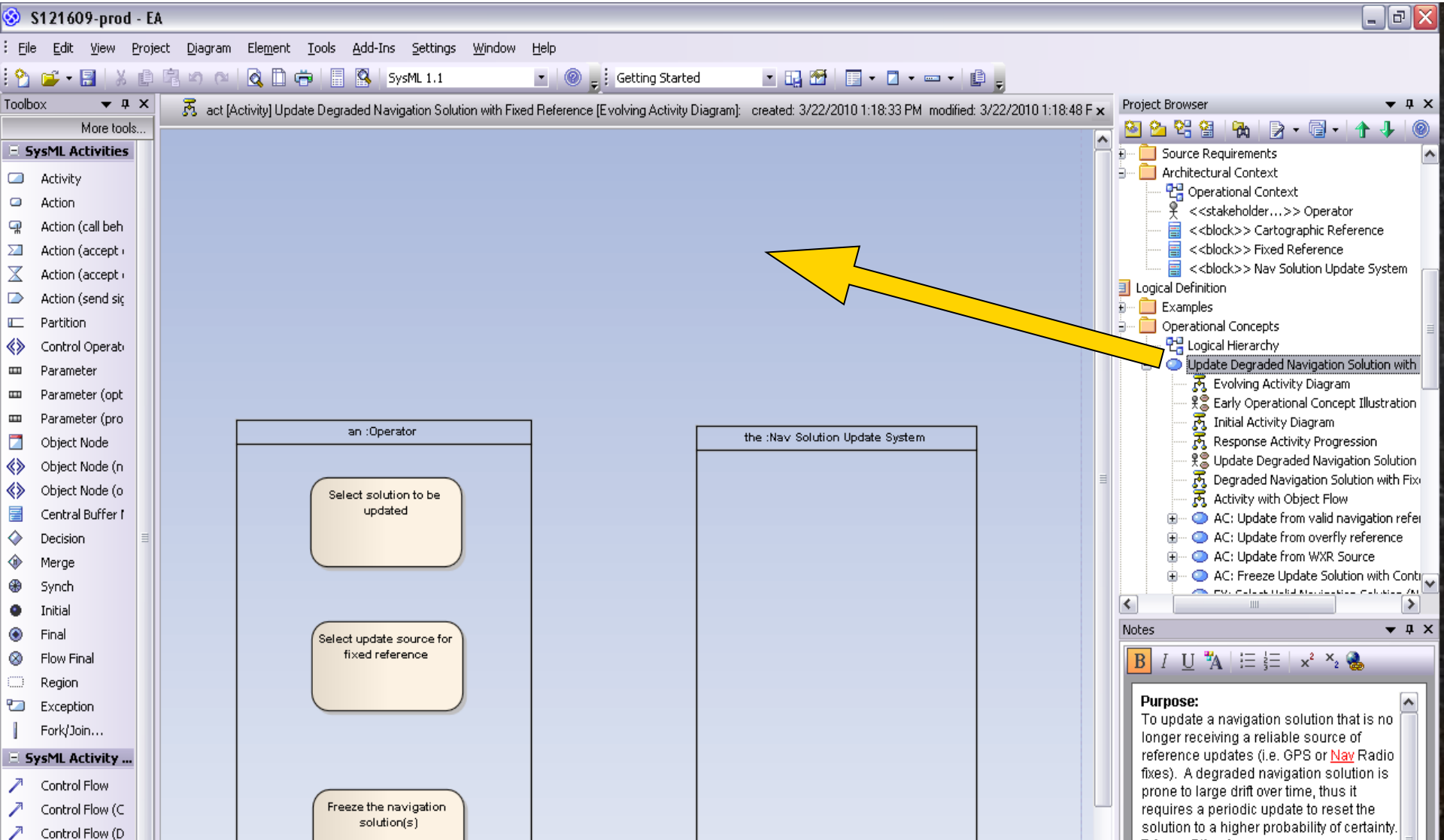


Characterize Use Case

- Purpose, Goal, or Objective
- Trigger Stimulus
- Preconditions
- Post Conditions



Build Activity Diagram (Scenario)



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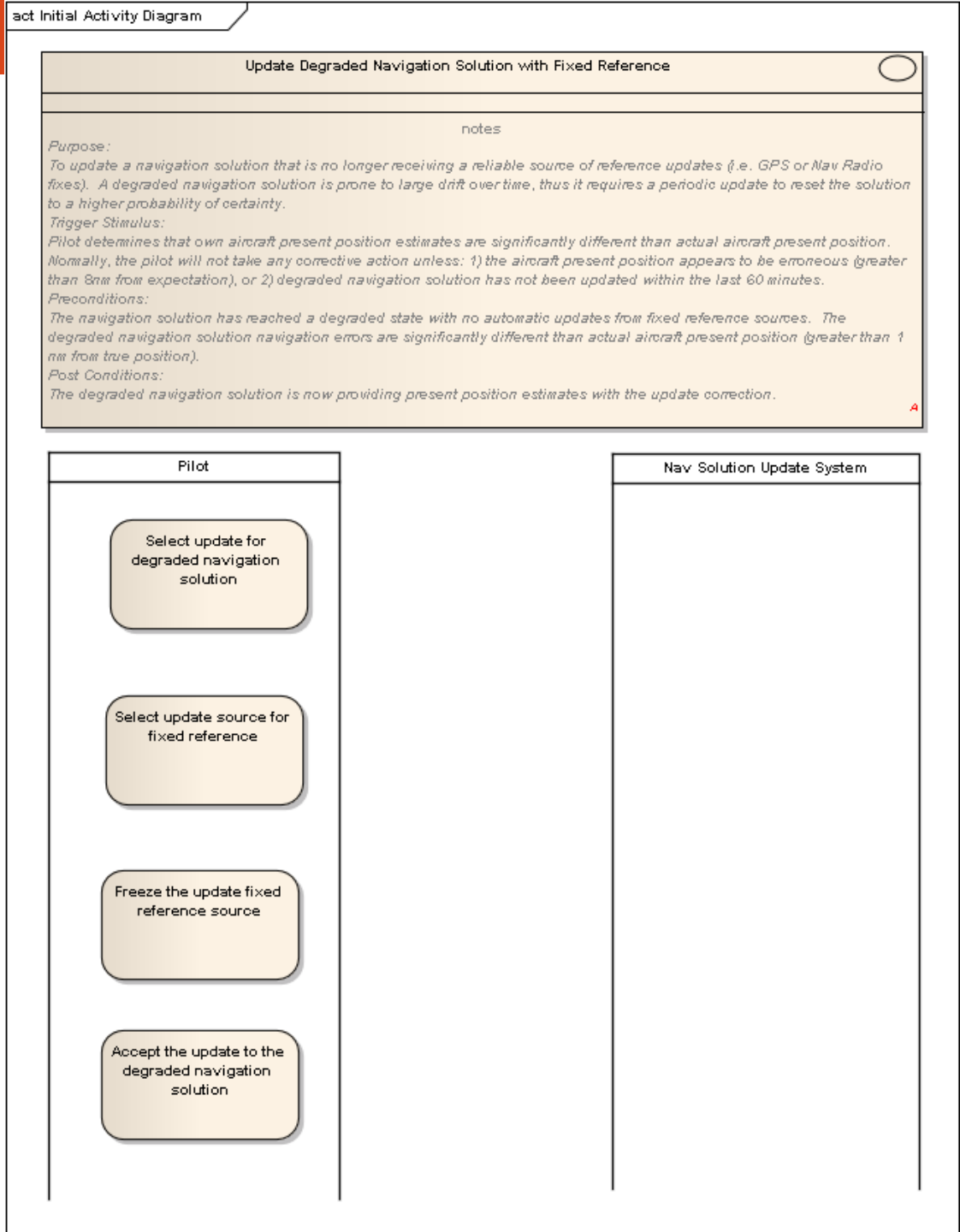
Define Scenario

- Add activities of primary actor



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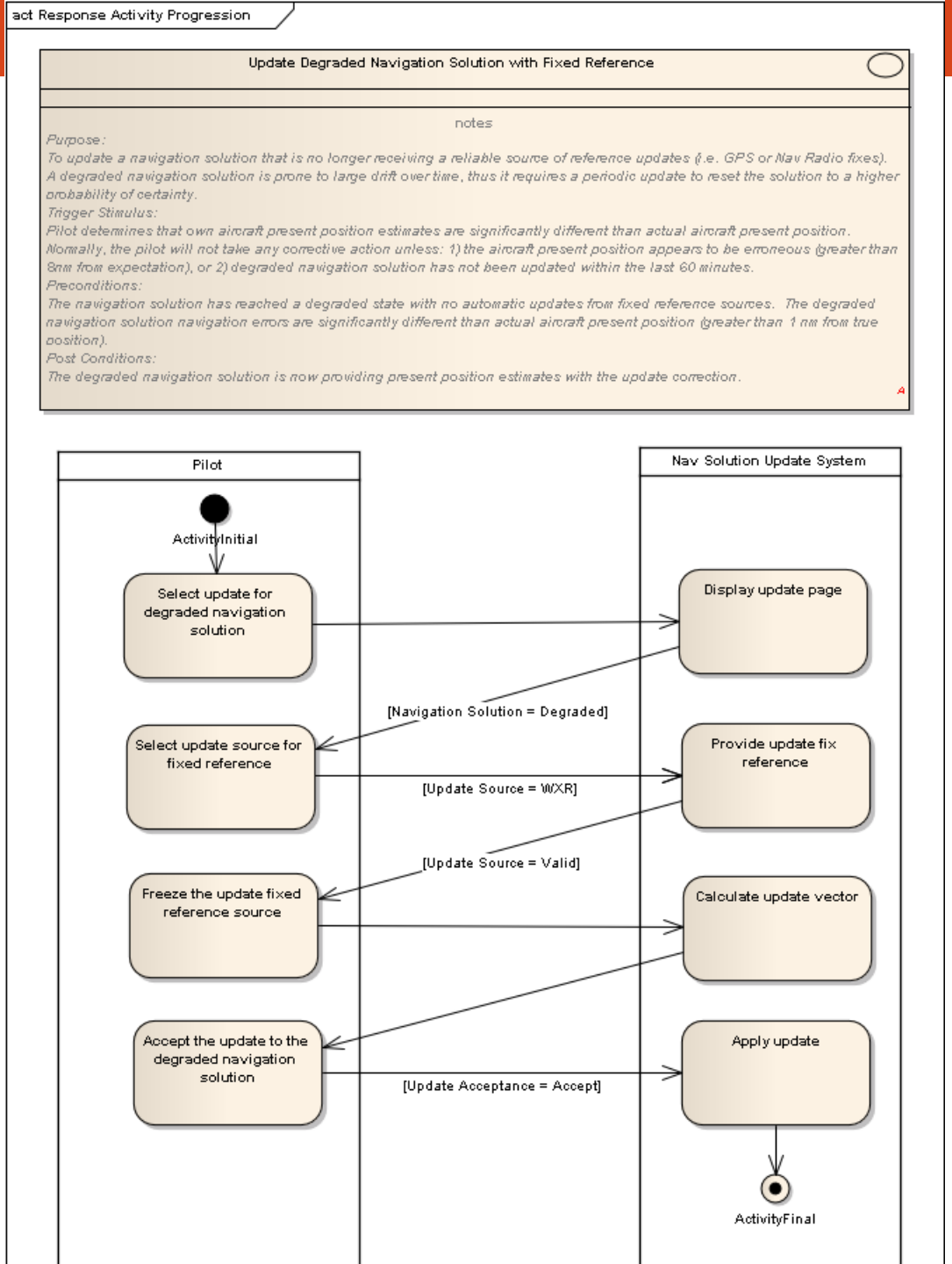
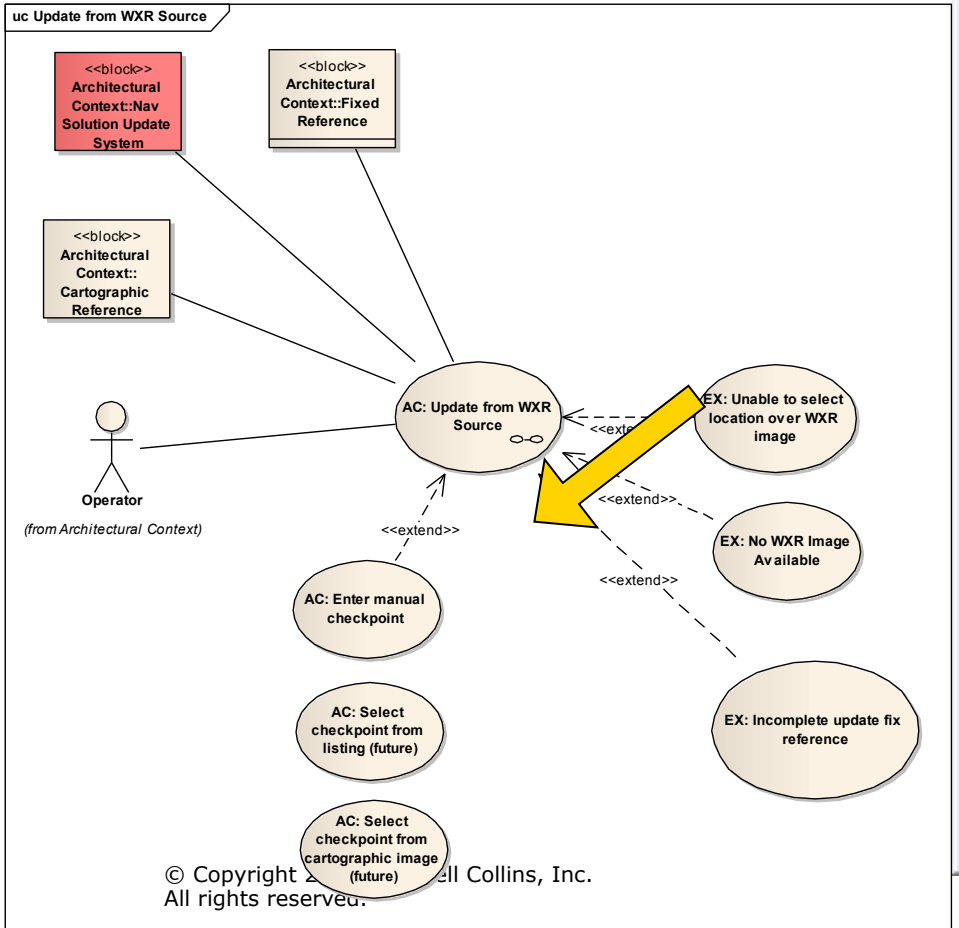
Define Scenario

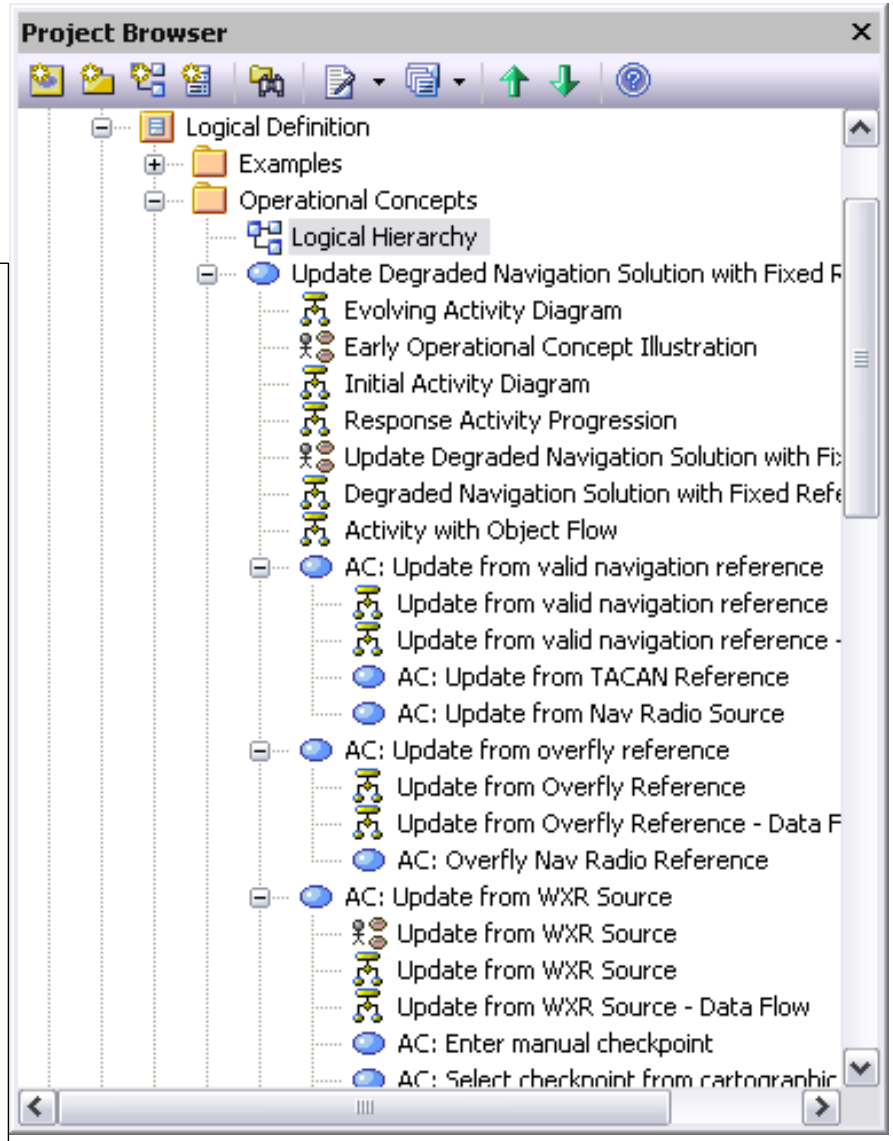
- Start with functional requirements
- Add activities/actions to satisfy the requirement
- Each action is traced to one or more requirements
- Derive new requirements as needed
- Maintain purely “black box” perspective



Organize Model Elements

- Activity Diagrams (Scenarios) under Use Case elements
- Make Use Case “composite” – double click opens scenario





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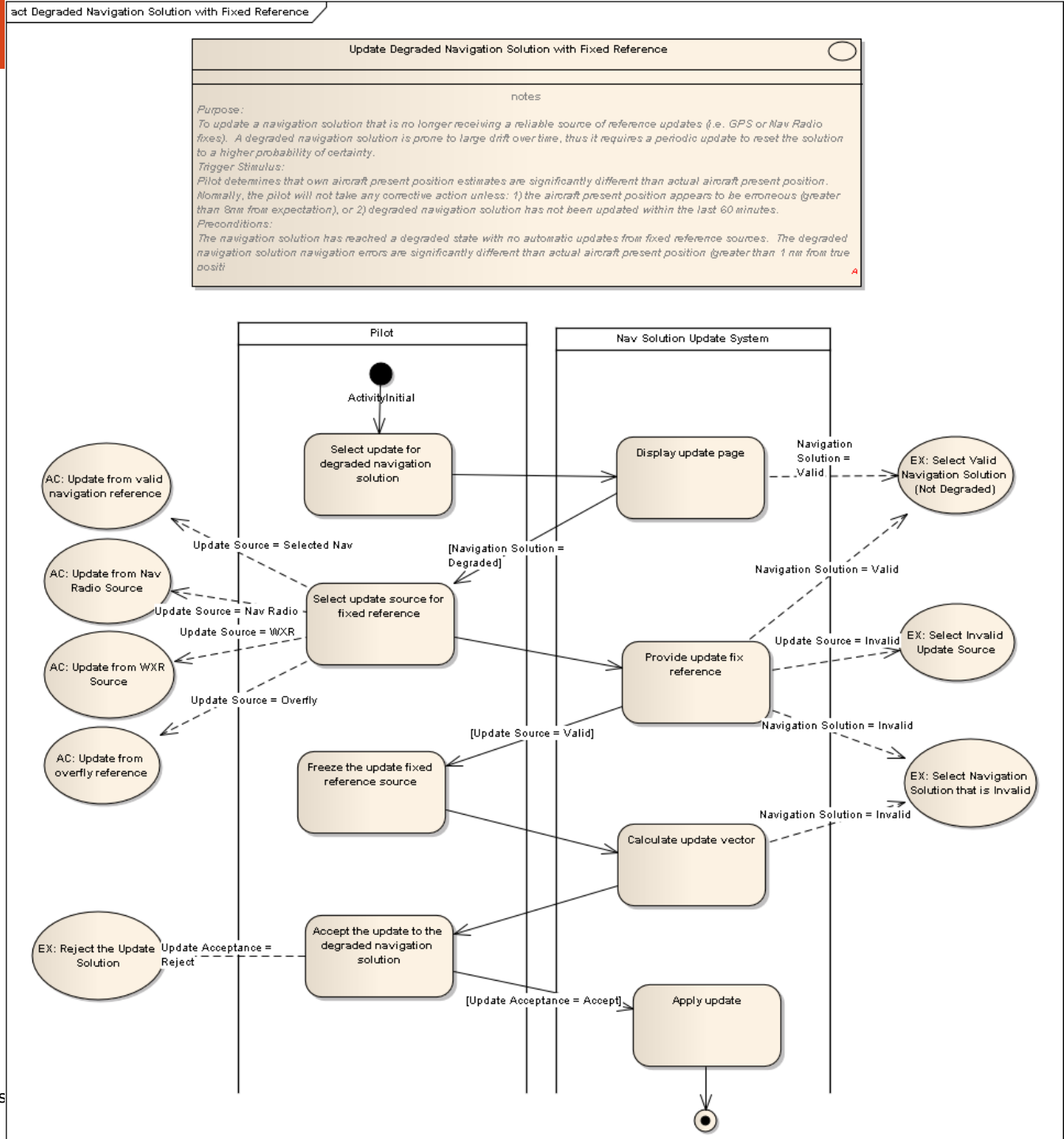
Add Exceptions and Alternate Courses

- Examine each “happy day” step (activity)
- What can go wrong?
- What else might the actor do?
- Does the step itself require further elaboration (extension)?

- Simple dependency relationship from activity to use case



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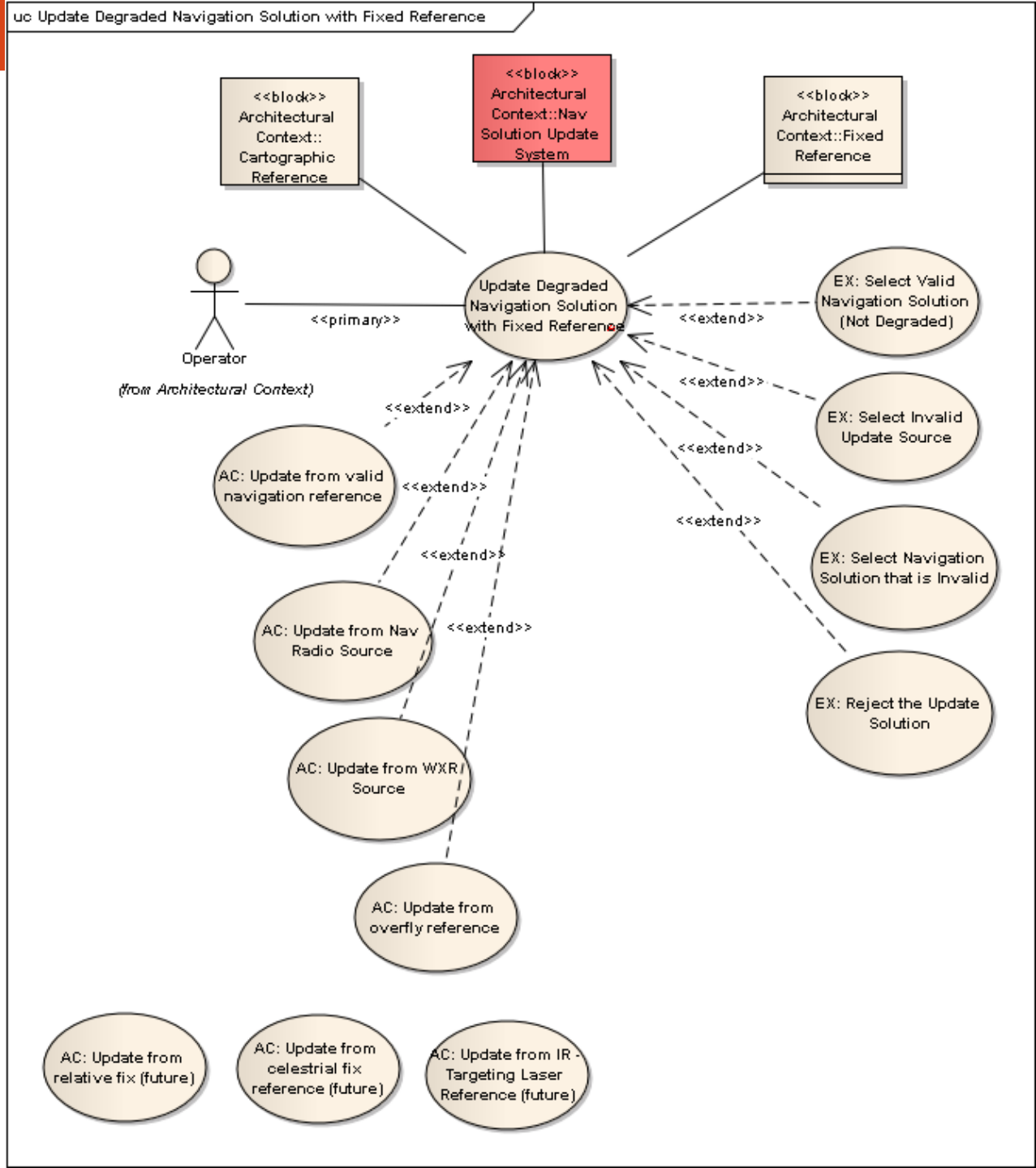
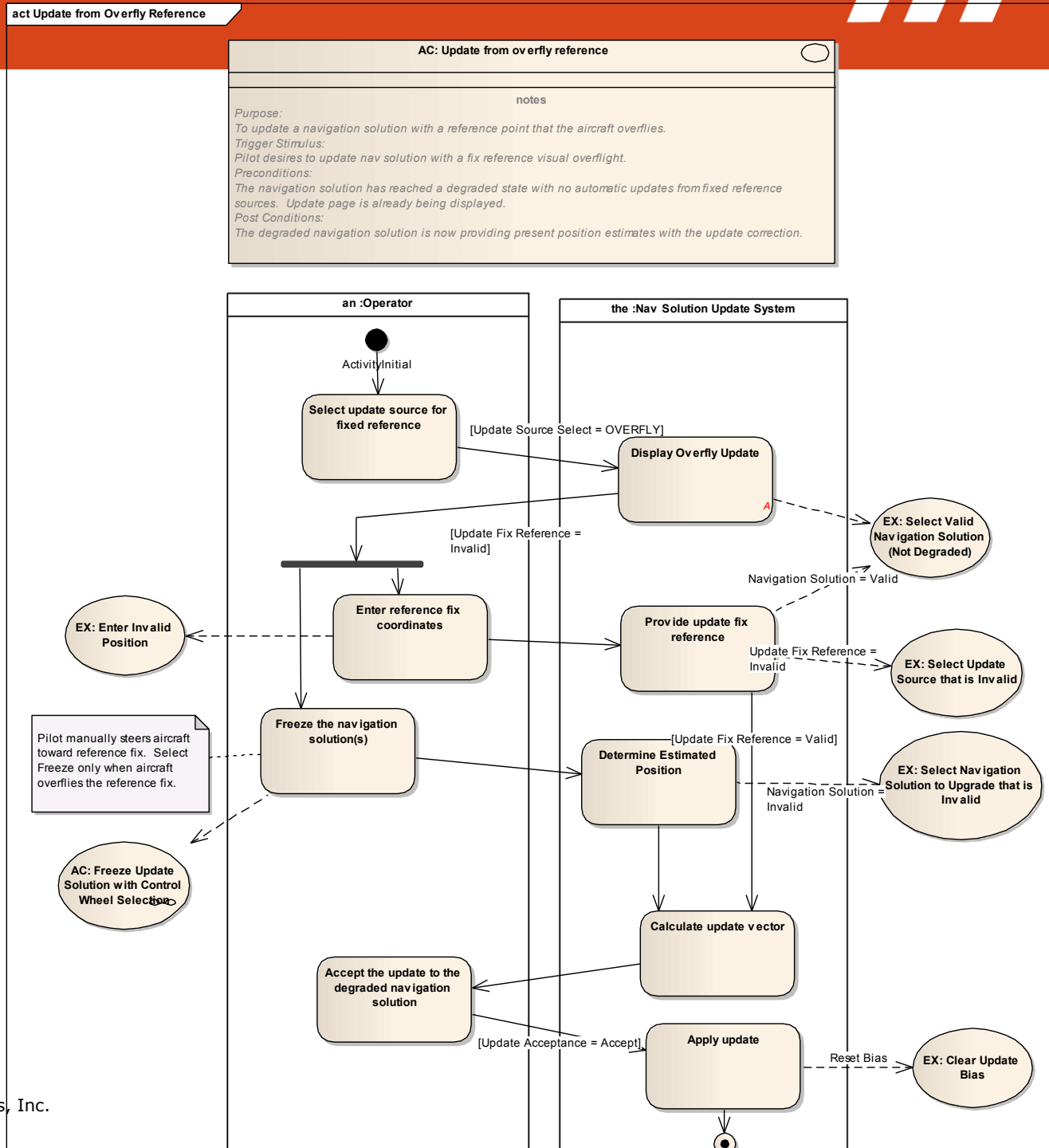
Use Case Extensions

- Add:
  - Alternate Courses
  - Exceptions Cases
  - Extensions
- Maintain singular focus
  - One use case is primary focus of Use Case Diagram



Elaborate Each Extension

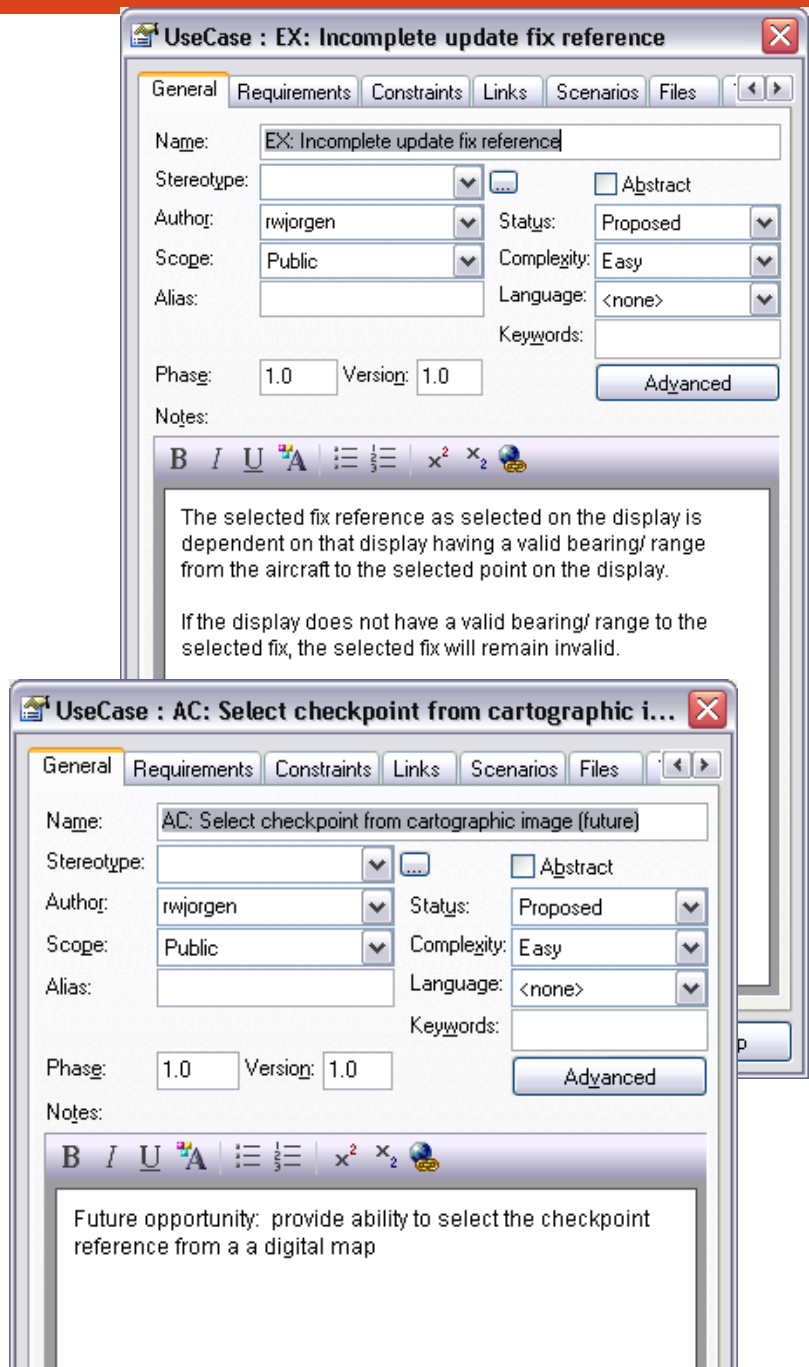
- Activity diagram (scenario) for each AC or EX
- May be variant of original use case scenario



Scenario Diagrams

- Generally, use Activity Diagrams to express unique scenarios
- However, if alternate course or exception is “simple”, consider “Notes” narrative

- Use Case Analysis generates future opportunities – capture them!



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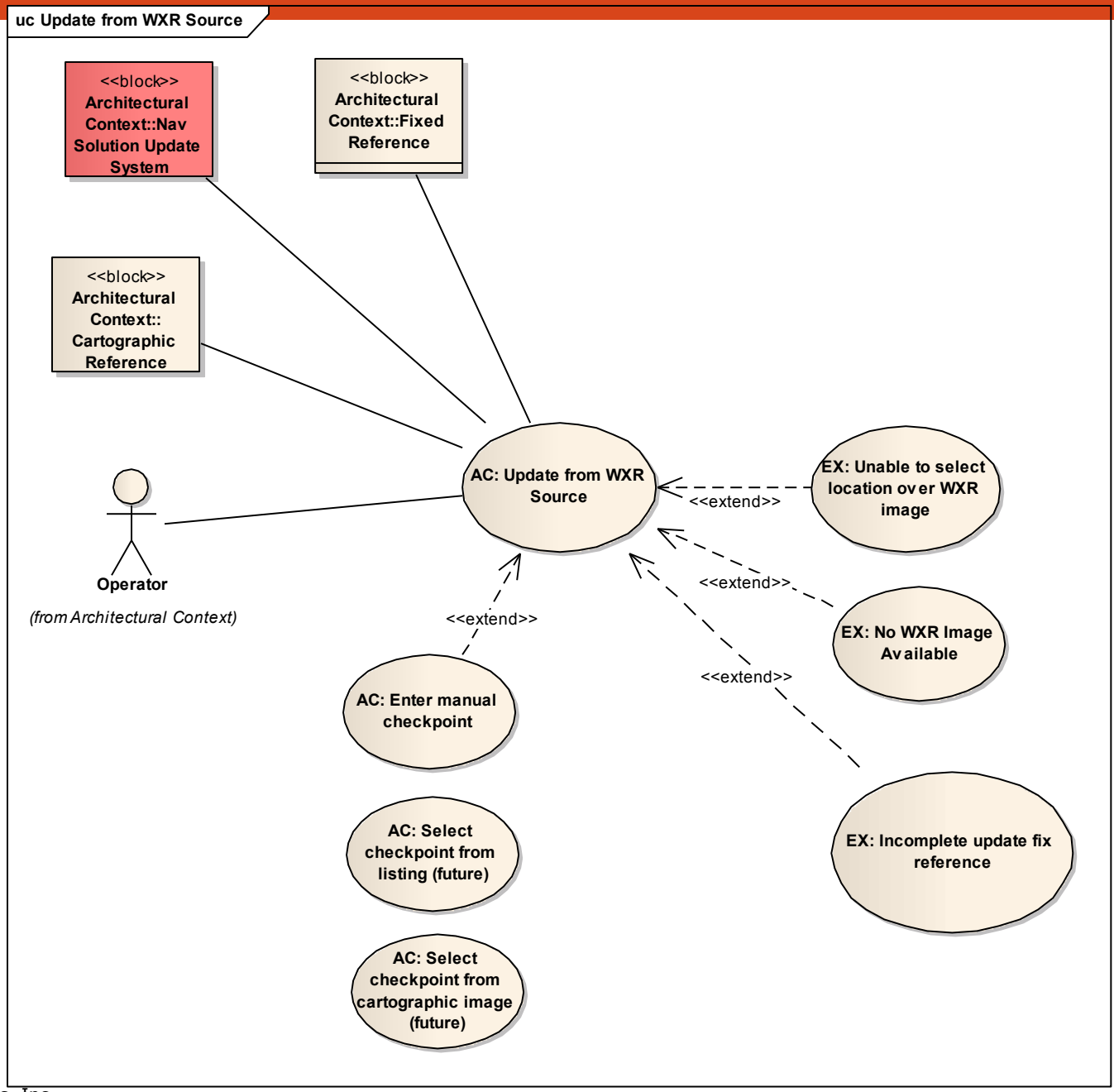
Repeat Use Case Process

- Use Case identification
- Scenario definition – primary actor
- Scenario definition – system of interest, secondary actors
- Consider alternate courses/ exceptions/ extensions



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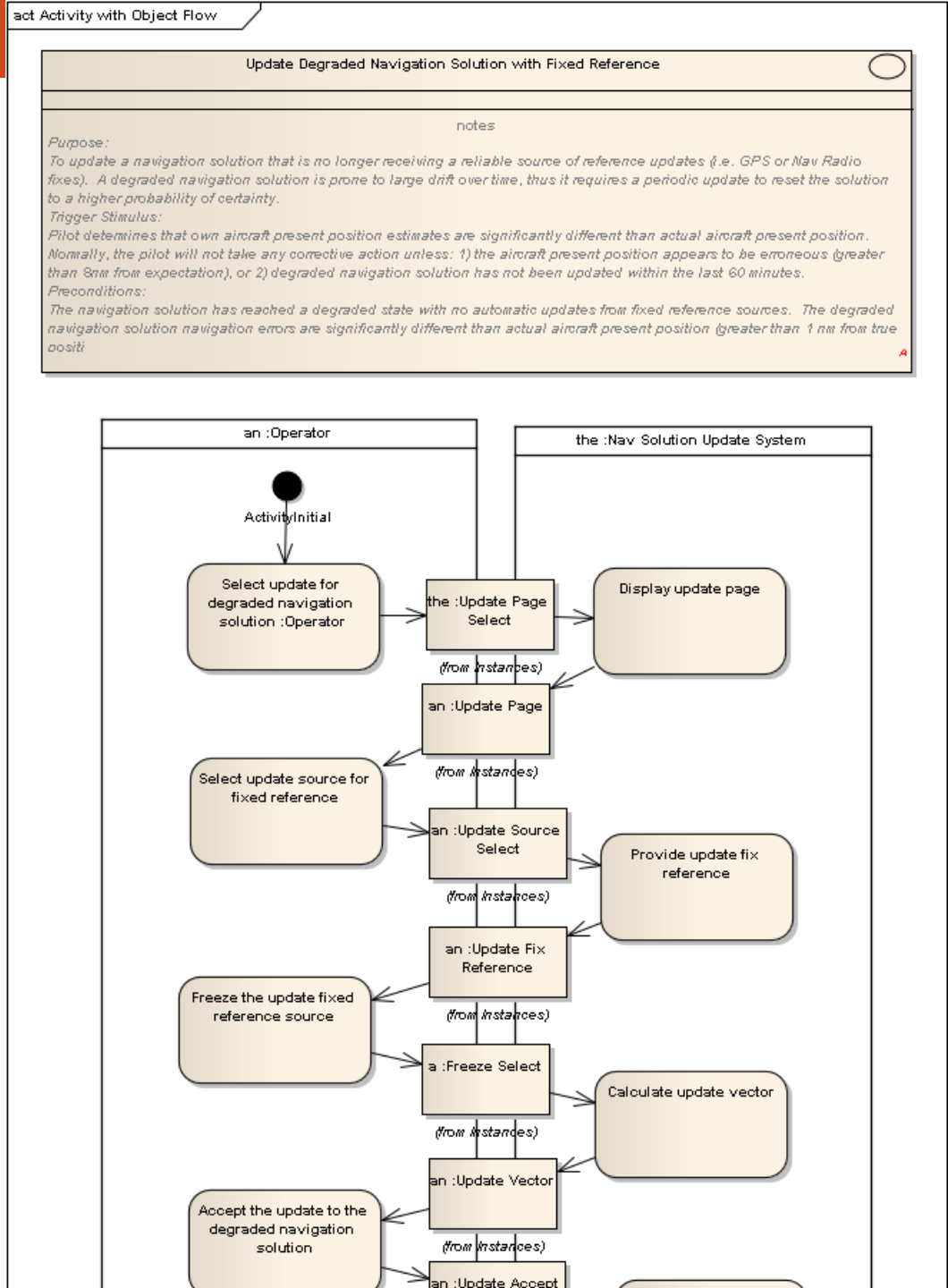
Add Object Flows

- Add object flow for each interaction
- Two activity diagrams:
  - Sequence flow of scenario
  - Object flow of scenario
- However:
  - Consider transaction “visibility” between actors (swimlanes)
  - Consider activity hierarchy (functional decomposition)
- Refine the object flow definition
  - Classify to a block
  - Stereotypes
    - User Interface
    - Data Item
  - Tagged values
    - Engineering Units
    - Max/Min Values



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Conclusion

- Answers the question
  - What does the customer want and why?
- Look at from a black box perspective
  - Operational Concepts
  - Stakeholders & stakeholder needs
  - Source Requirements