Practical SysML Applications: A Method to Describe the Problem Space

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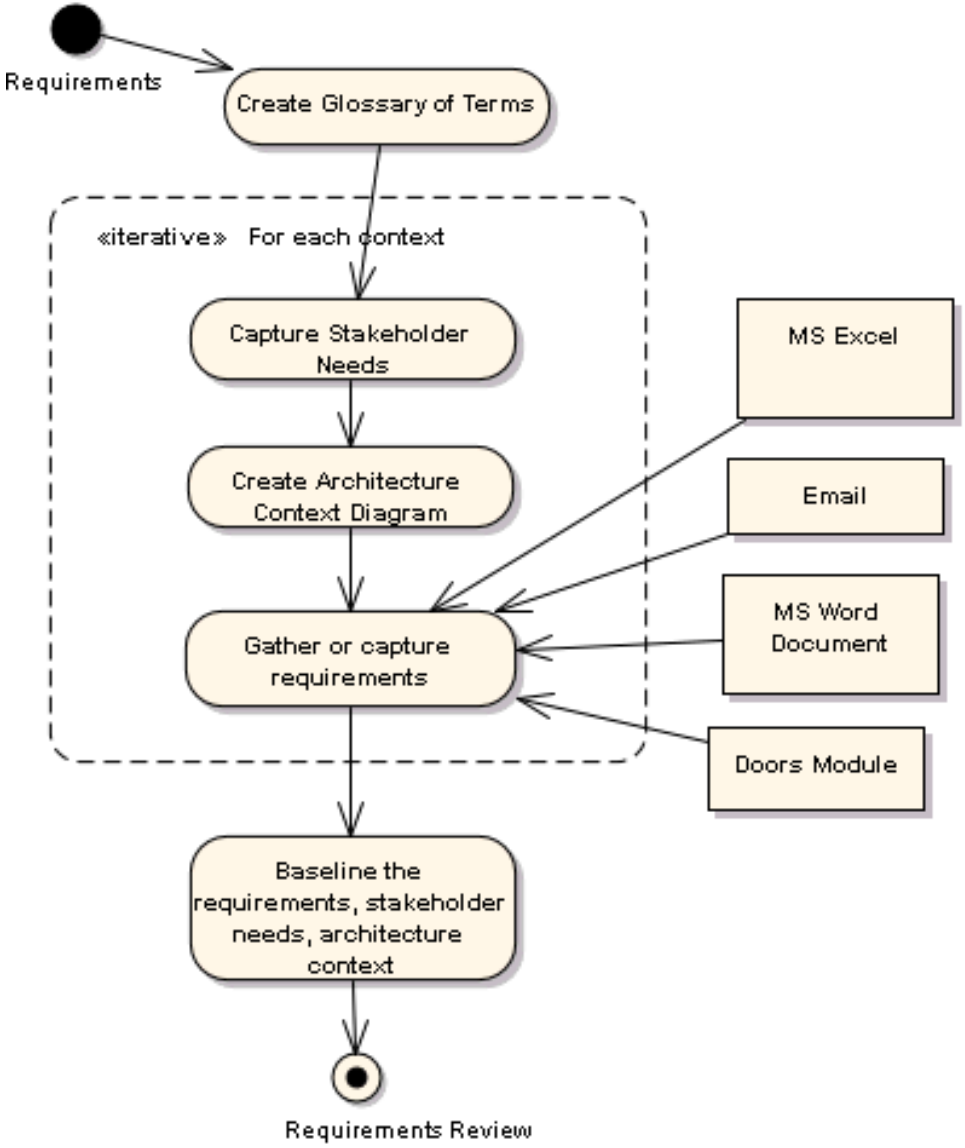
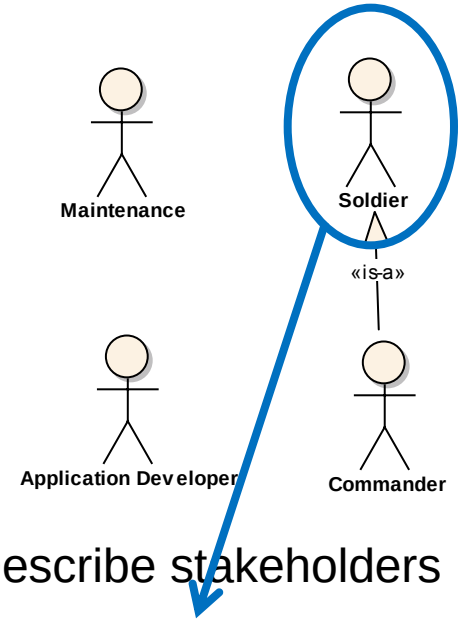
Originating Customer Requirements

- 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 domain model, requirements, and use cases



Stakeholder needs

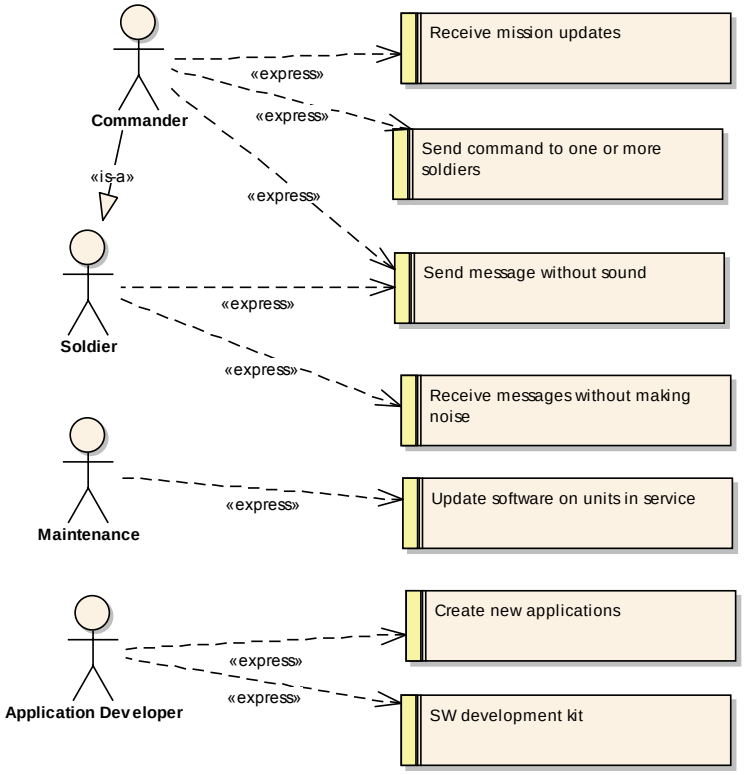
1) Identify stakeholders



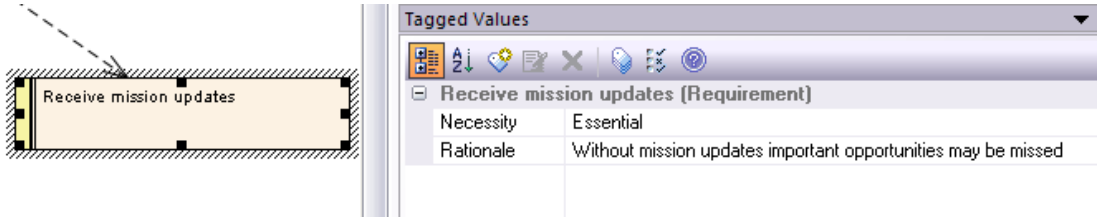
2) Describe stakeholders

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

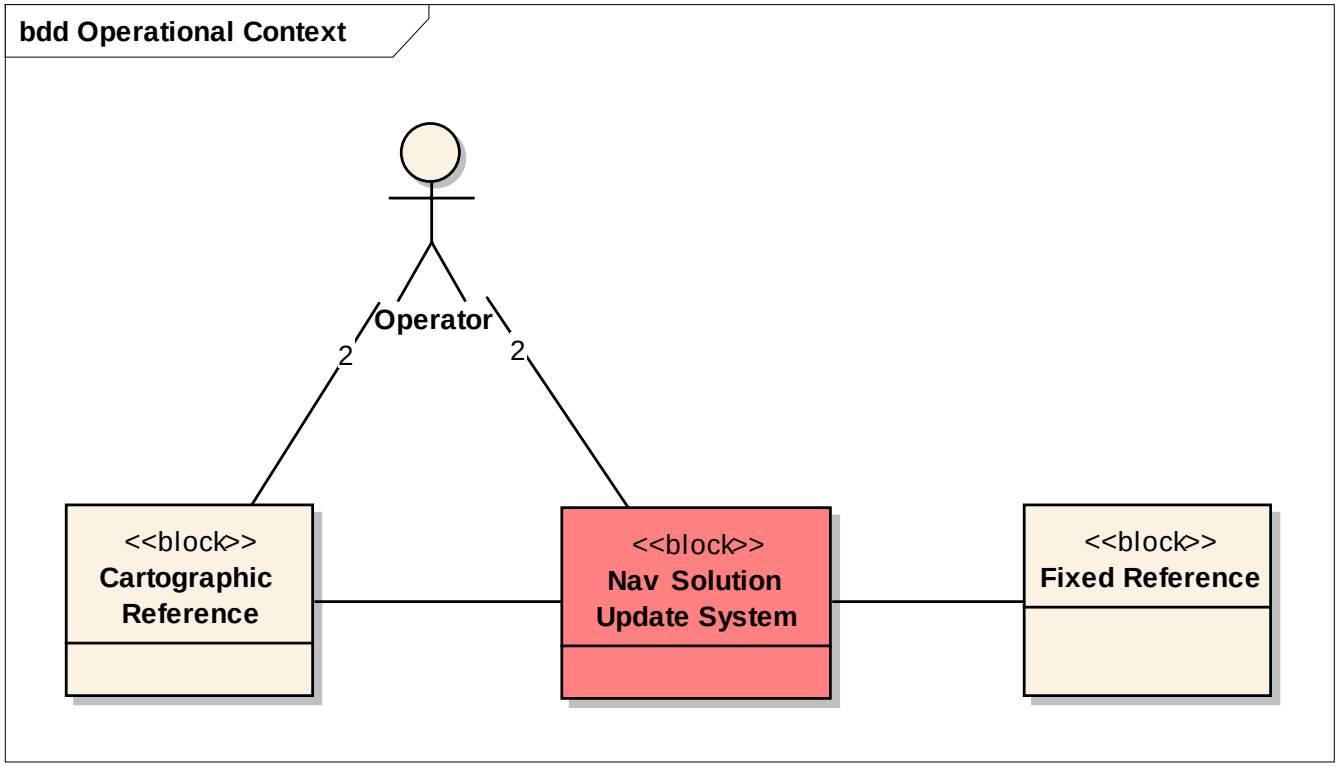


Source Requirements

- Study in the application of SysML concepts to avionics development and TCP workflow
  - INU Update:
    - **3.2.1.8 Weather Radar**
    - The existing weather radar system **SHALL** be integrated into the flight deck and provide control for skin-paint, ground mapping, **and INU update functions** to pilot, co-pilot, and navigator stations.

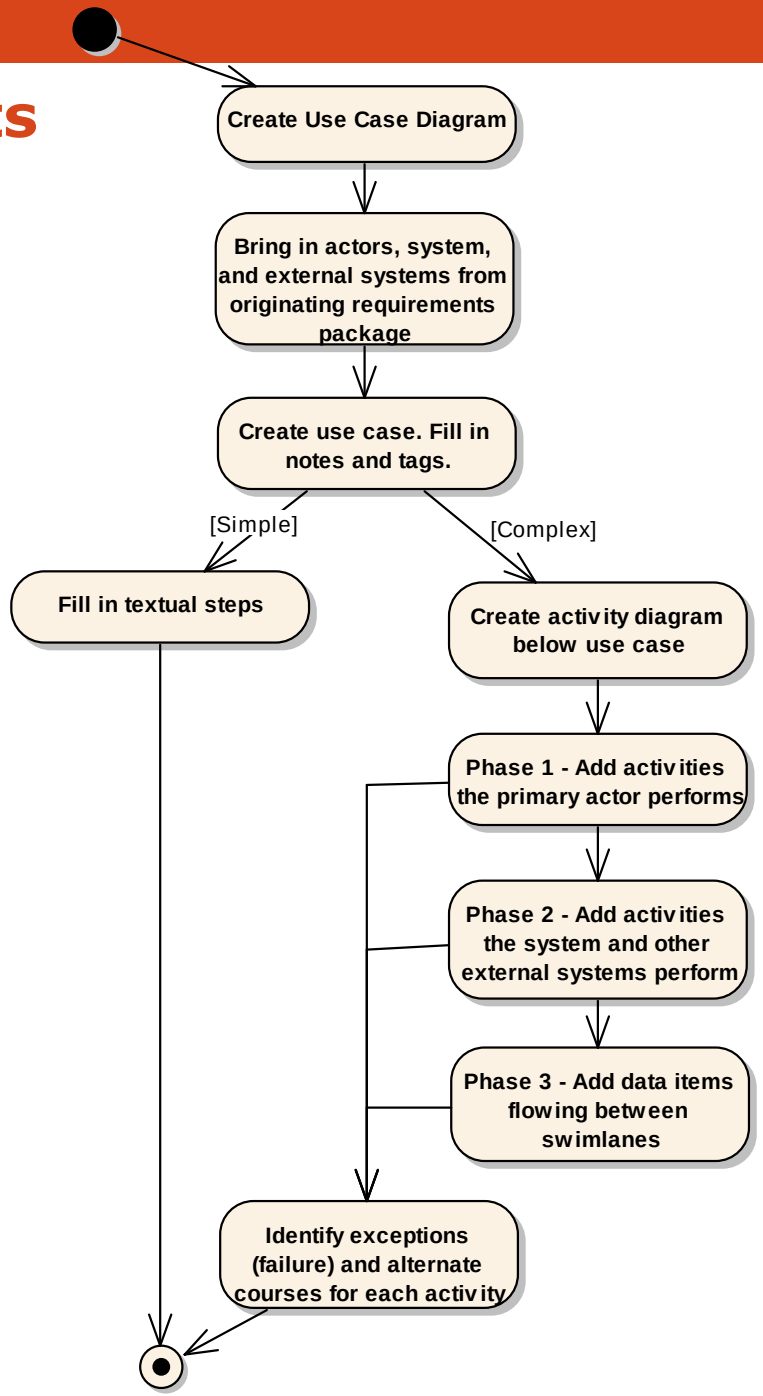
Capture Architectural Context

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

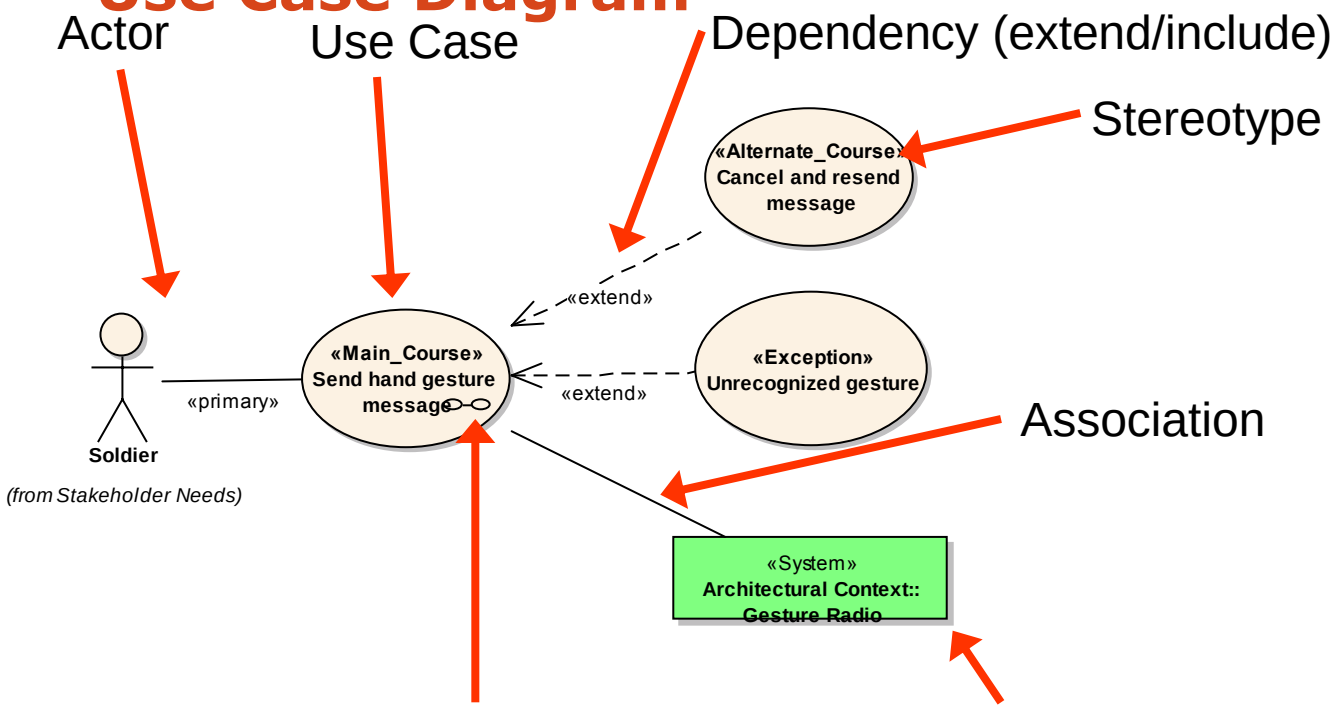


Operational Concepts

- Start with functional requirements and stakeholder needs
- Create a satisfy trace to each activity/action generated from a functional requirement as the diagram is built
- 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

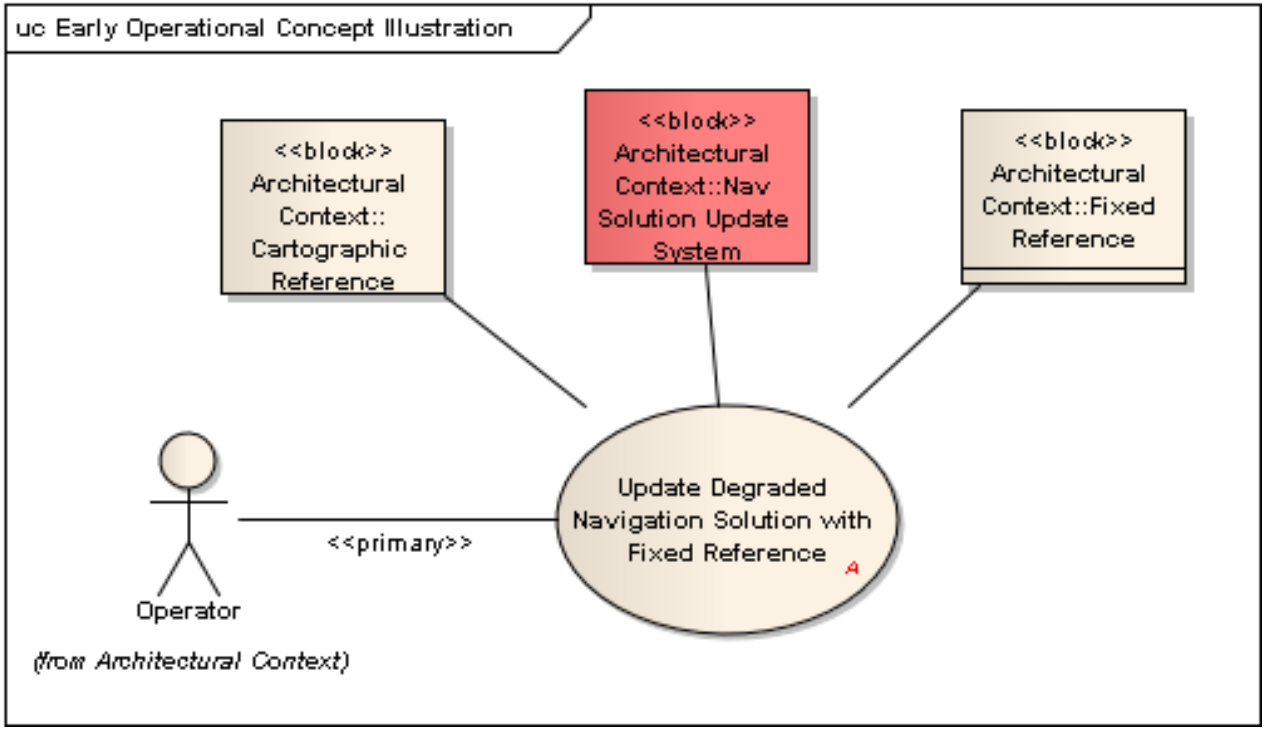


Use Case Diagram



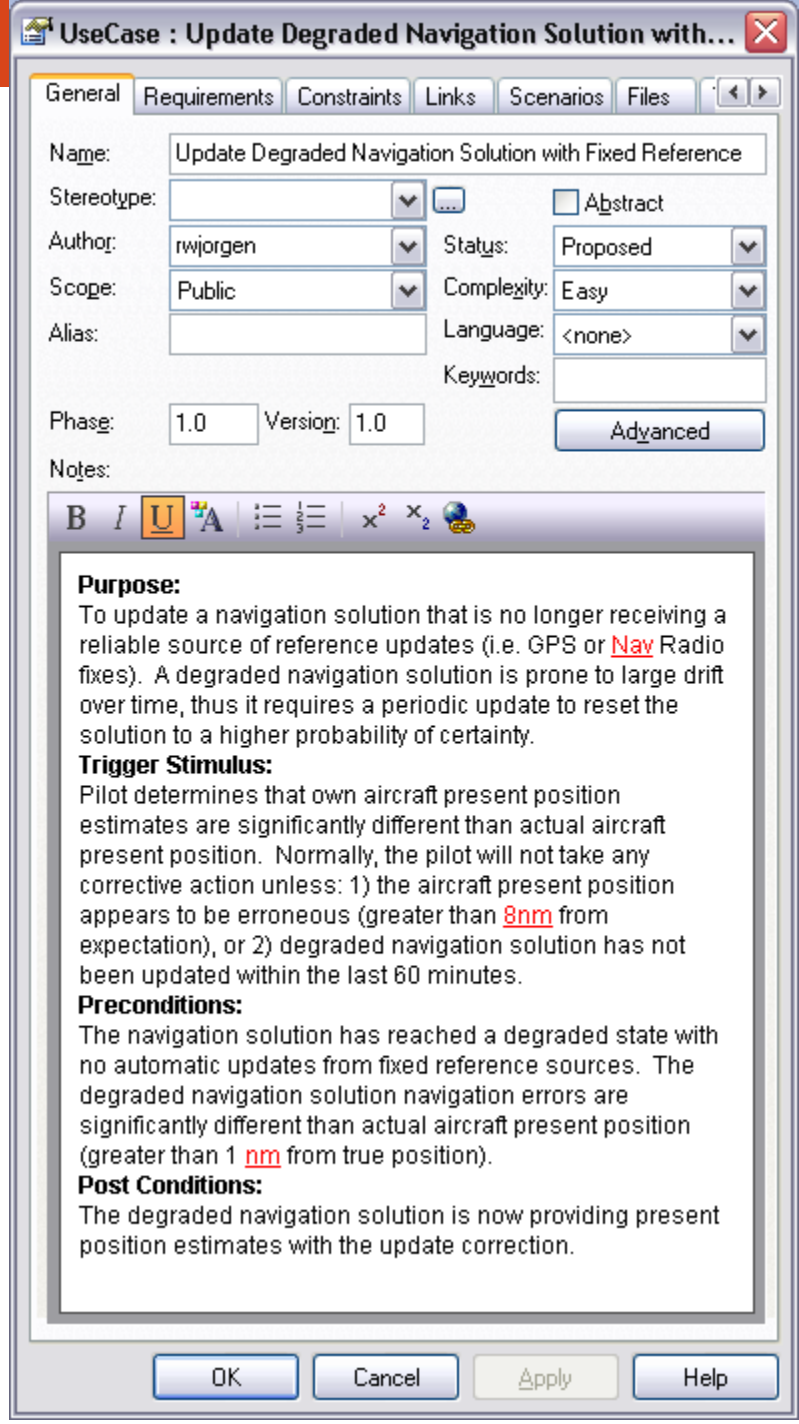
Conduct Use Case Analysis

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

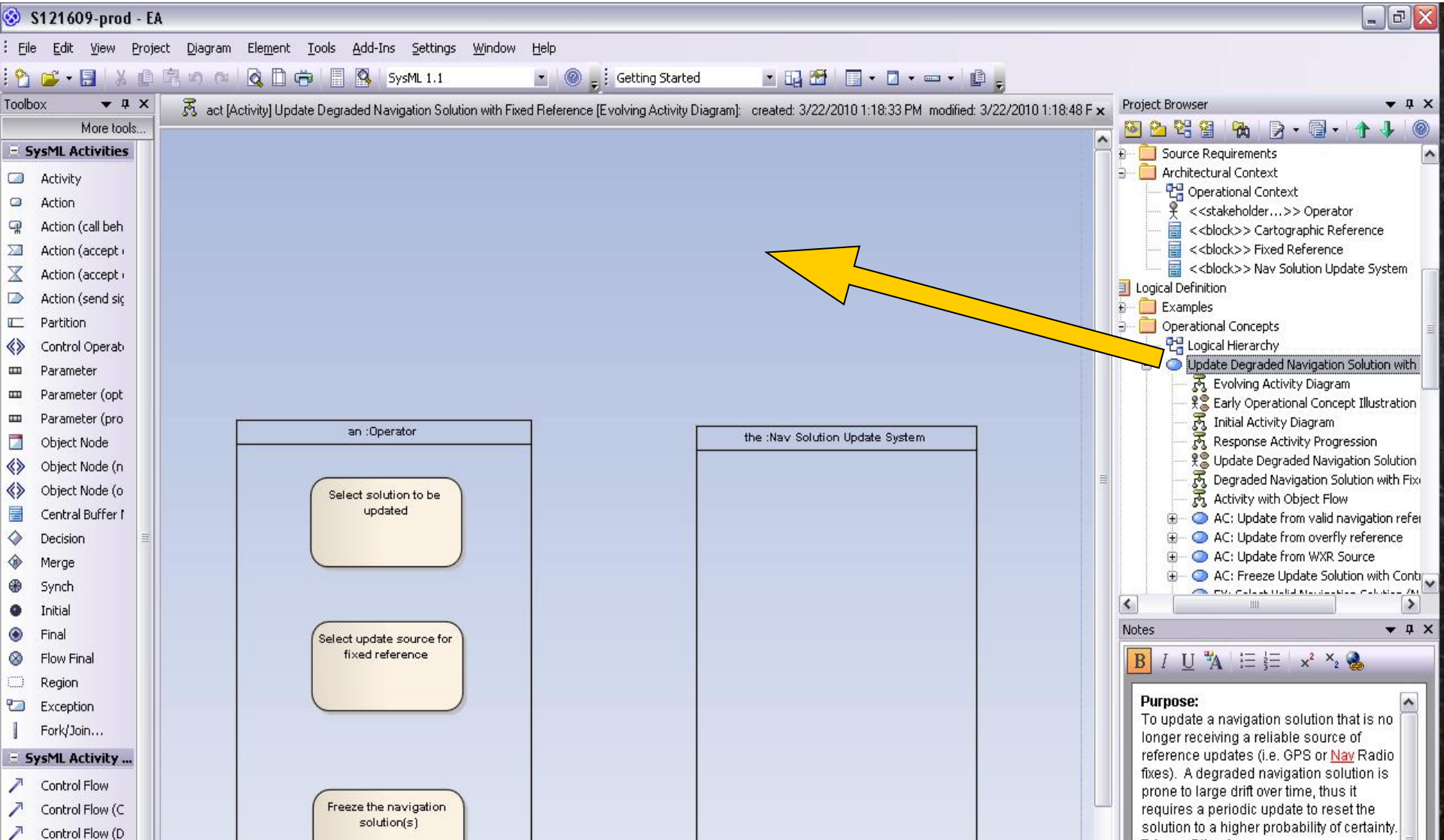


Characterize Use Case

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



Build Activity Diagram (Scenario)



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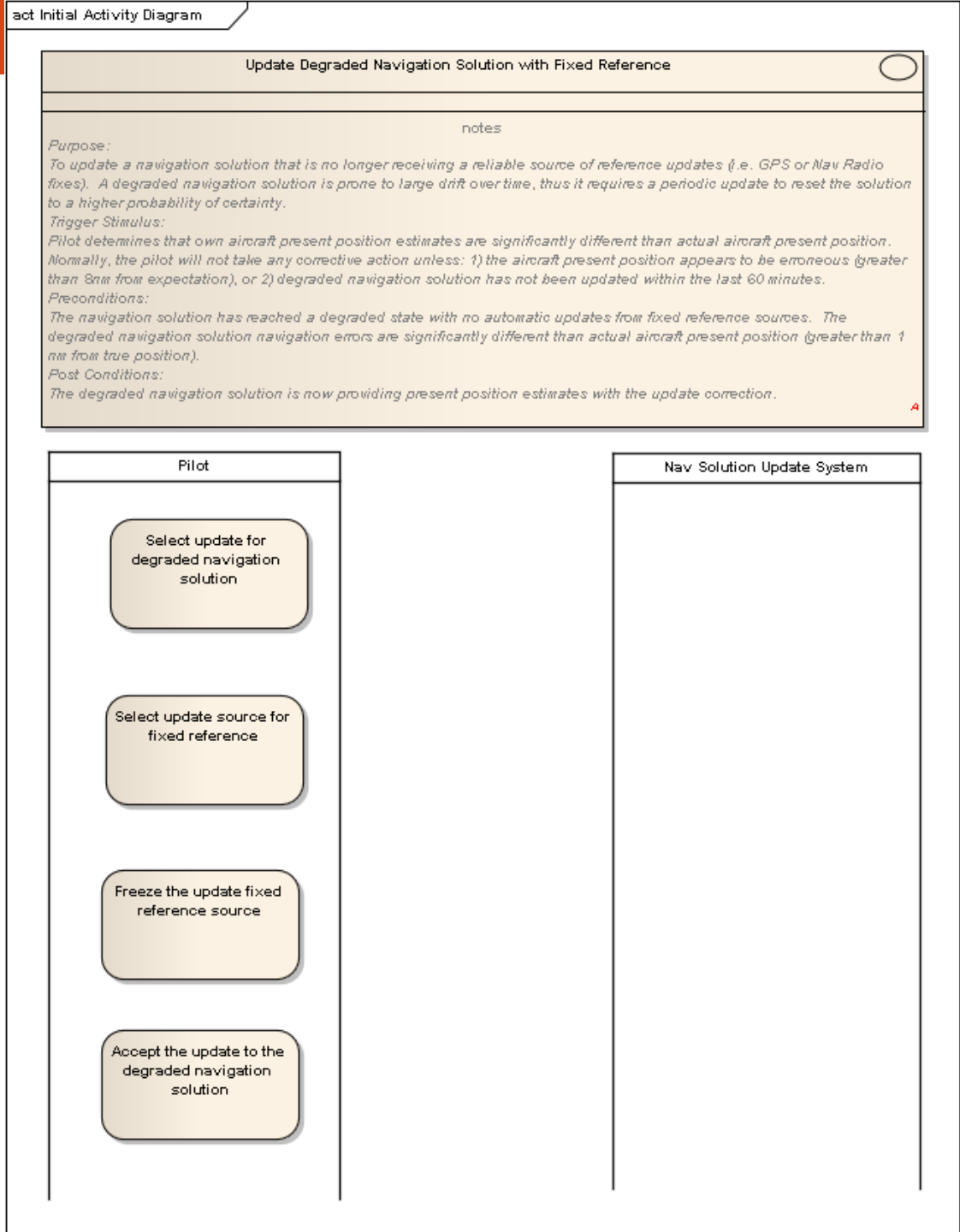
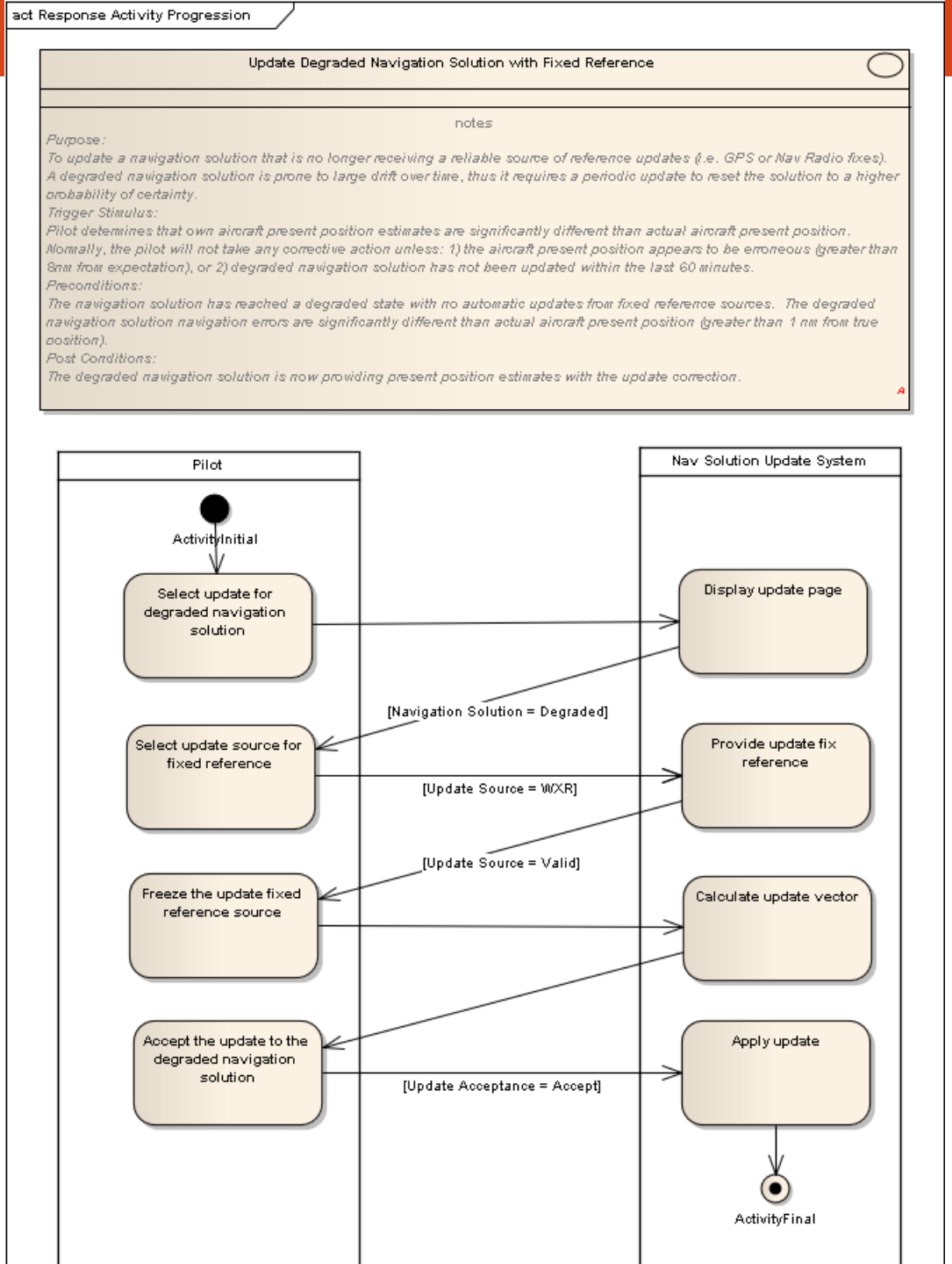
Define Scenario

- Add activities of primary actor



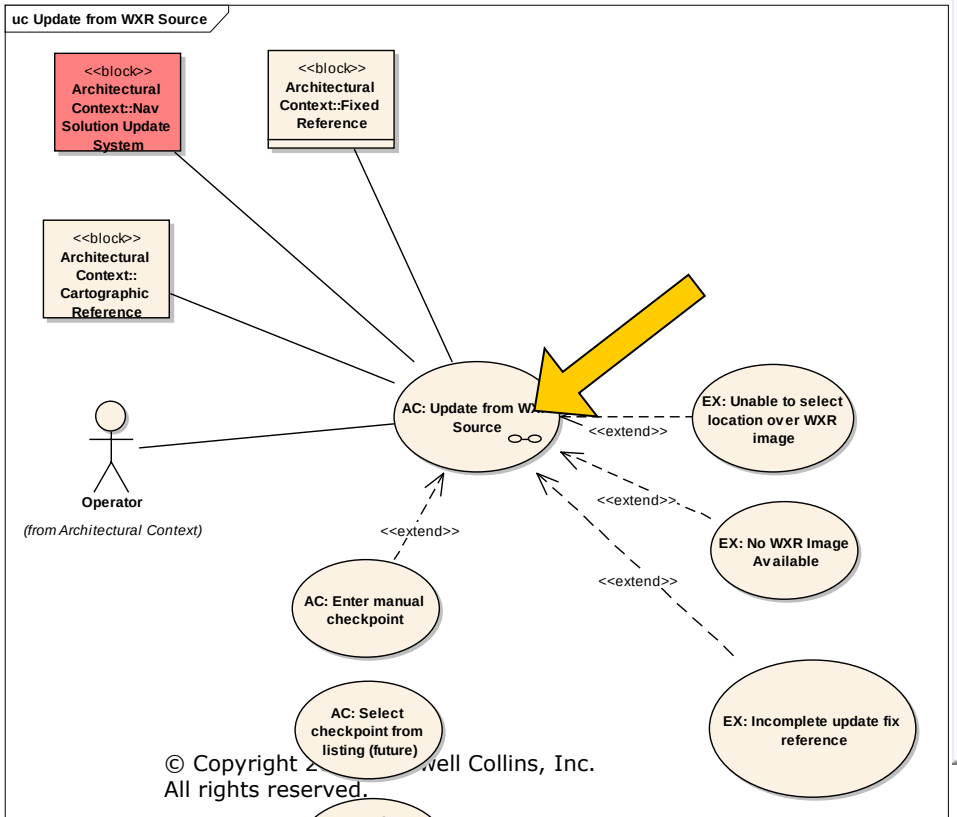
Define Scenario

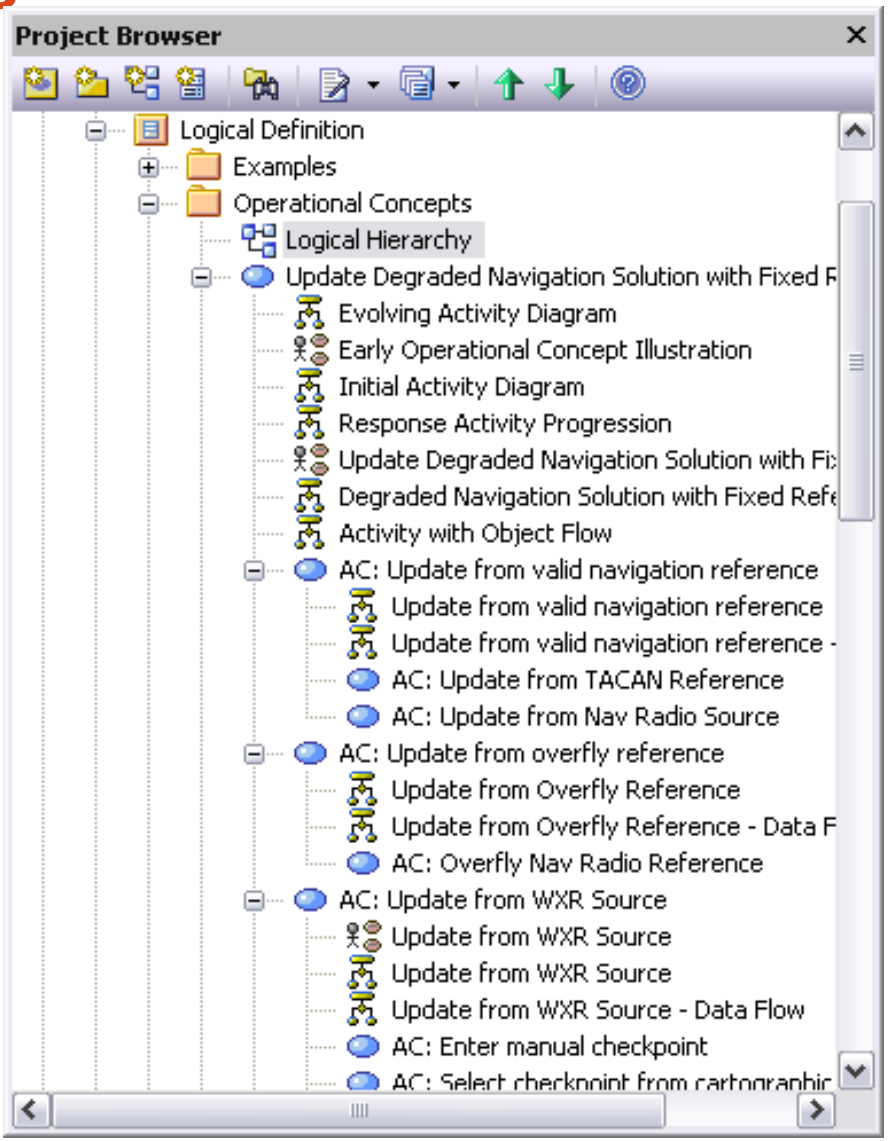
- Add Activities of system of interest and other supporting actors
- Maintain purely "black box" perspective



Organize Model Elements

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





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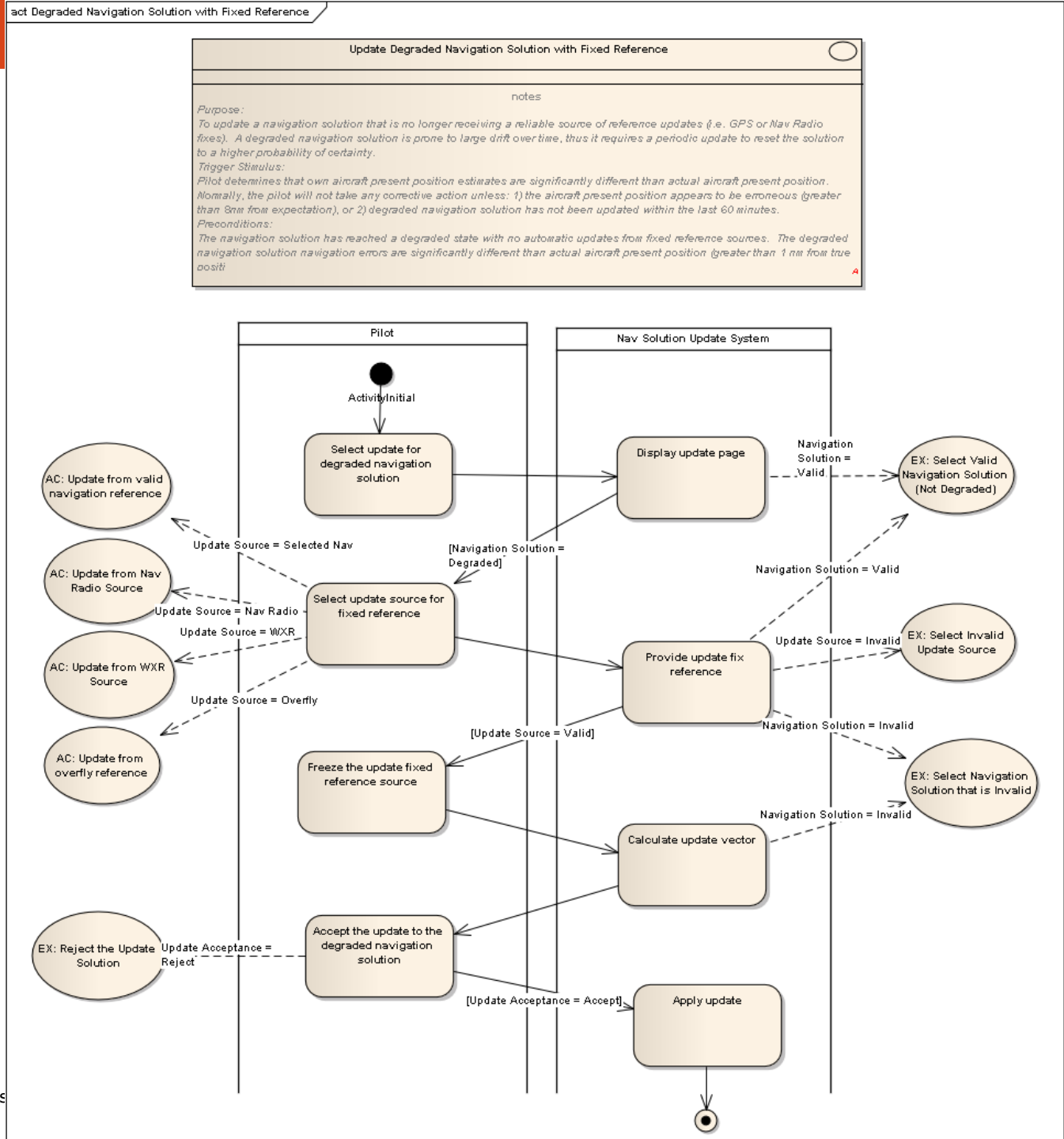
Add Exceptions and Alternate Courses

- 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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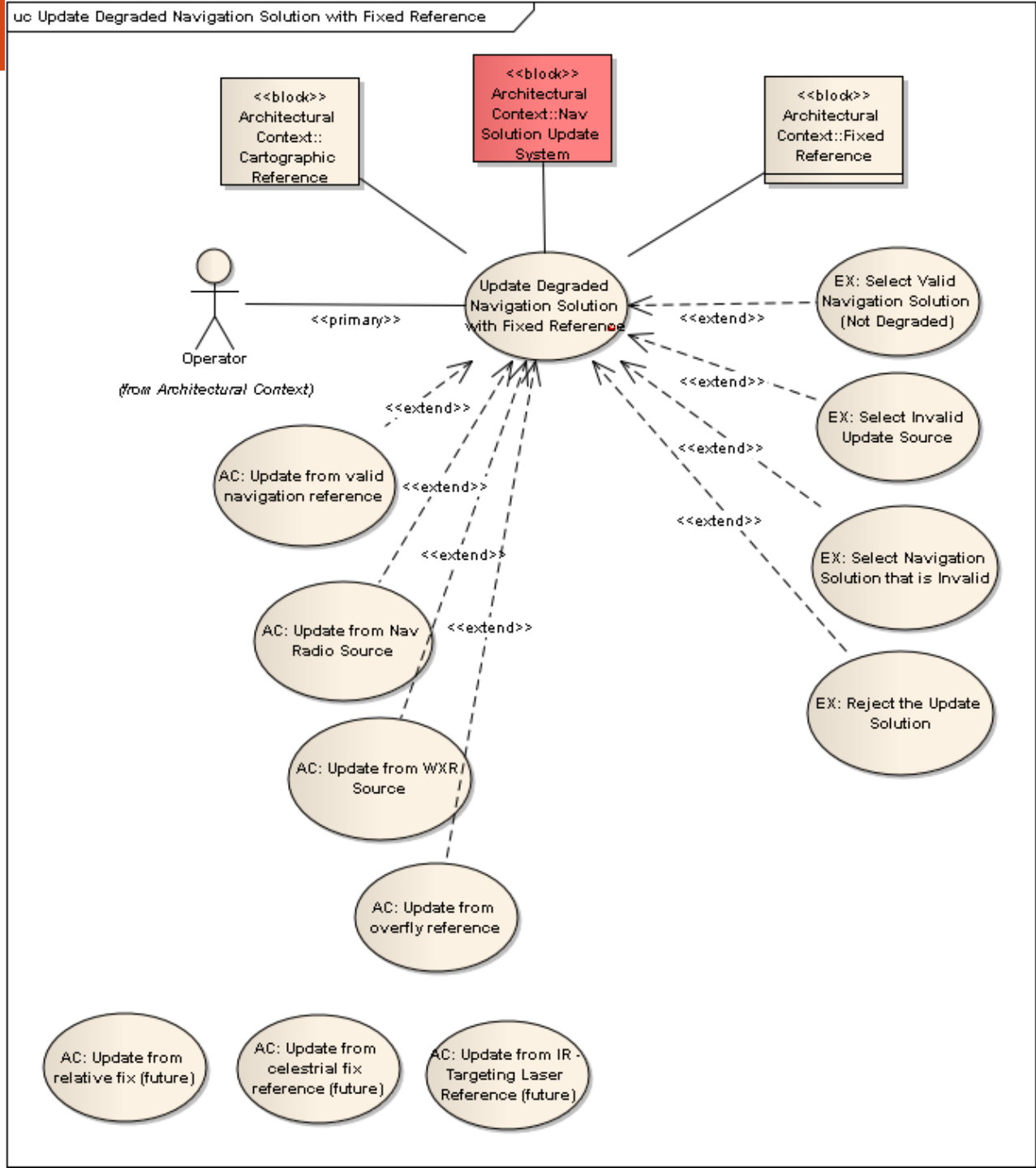
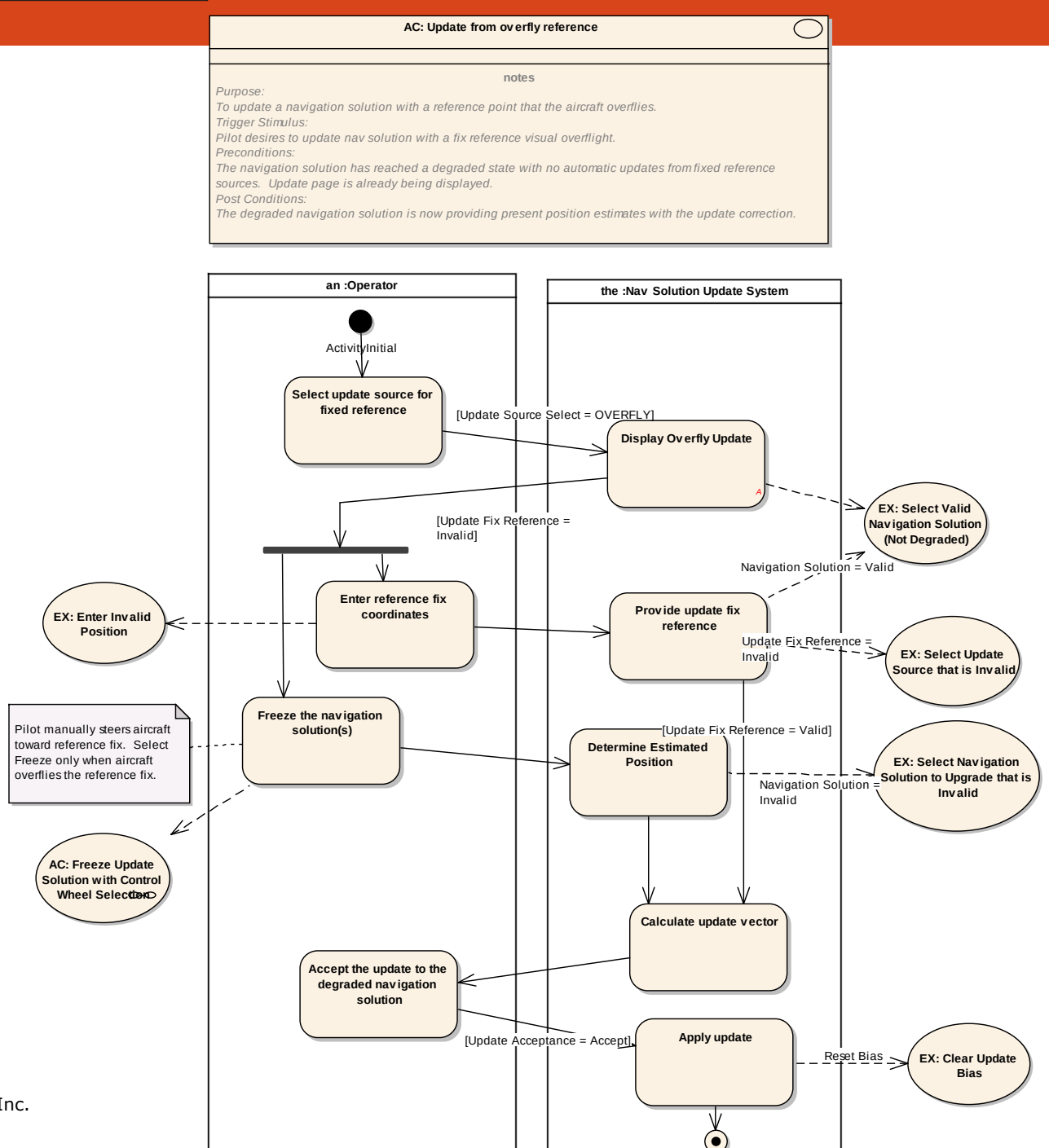
Use Case Extensions

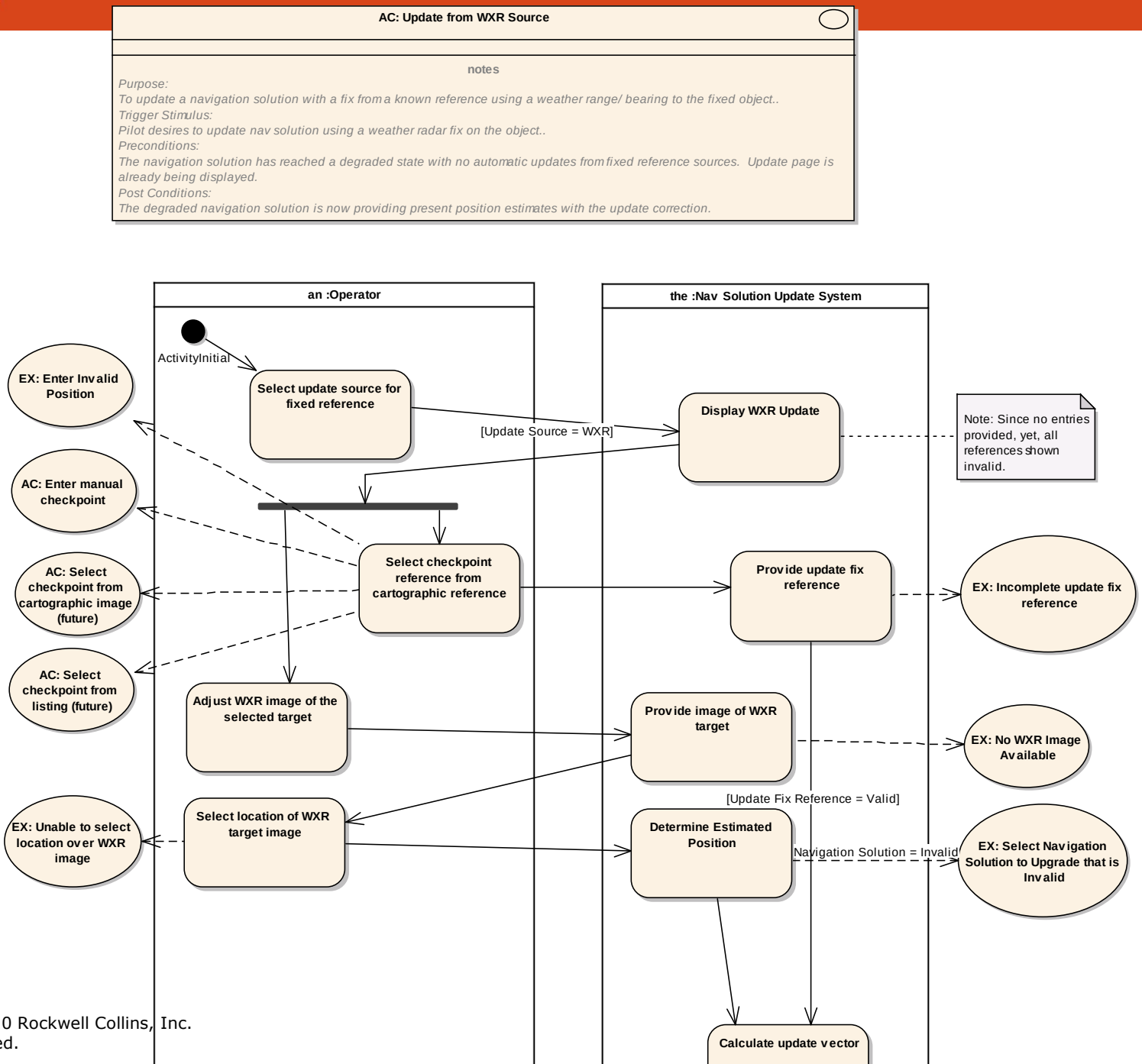
- Add:
  - Alternate Courses
  - Exceptions Cases
  - Extensions
- Maintain singular focus
  - One use case is primary focus of Use Case Diagram



Elaborate Each Extension

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

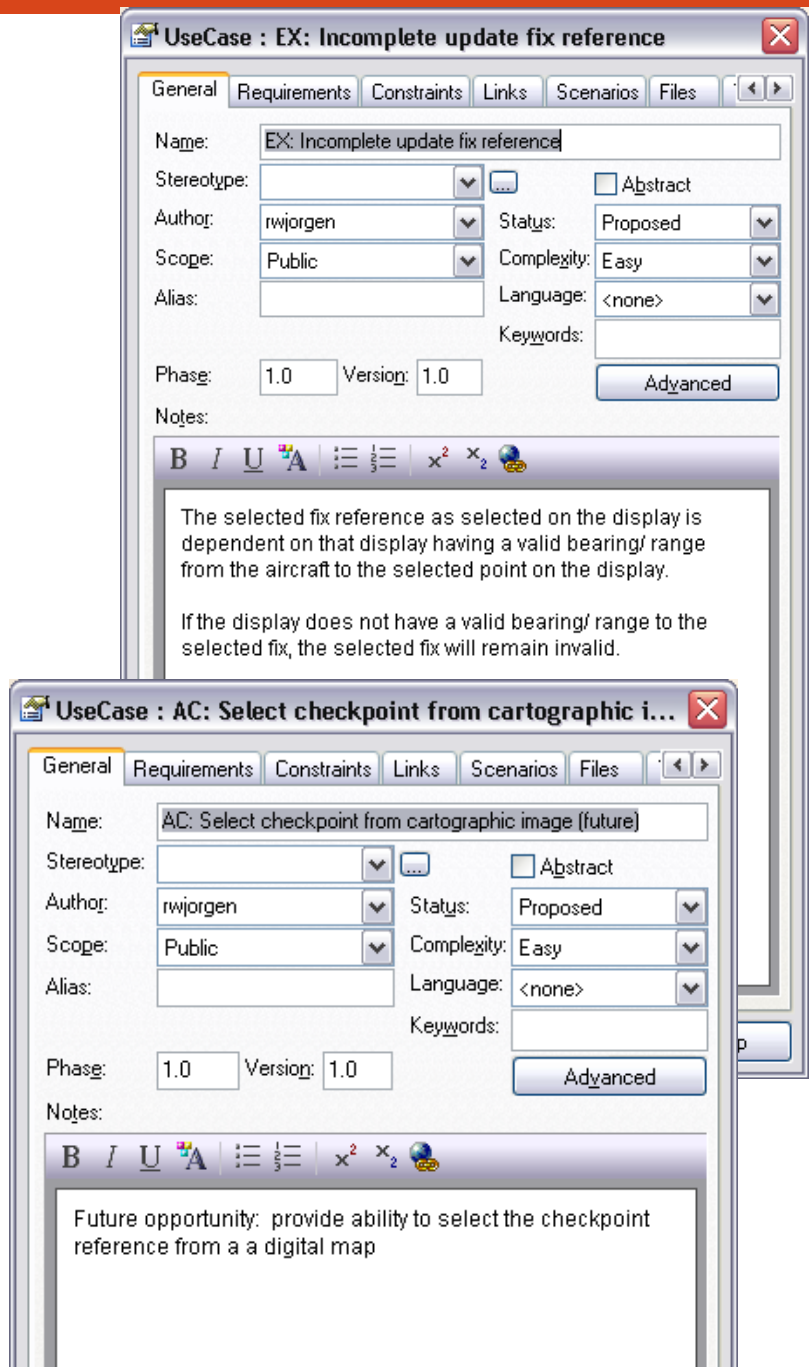




Scenario Diagrams

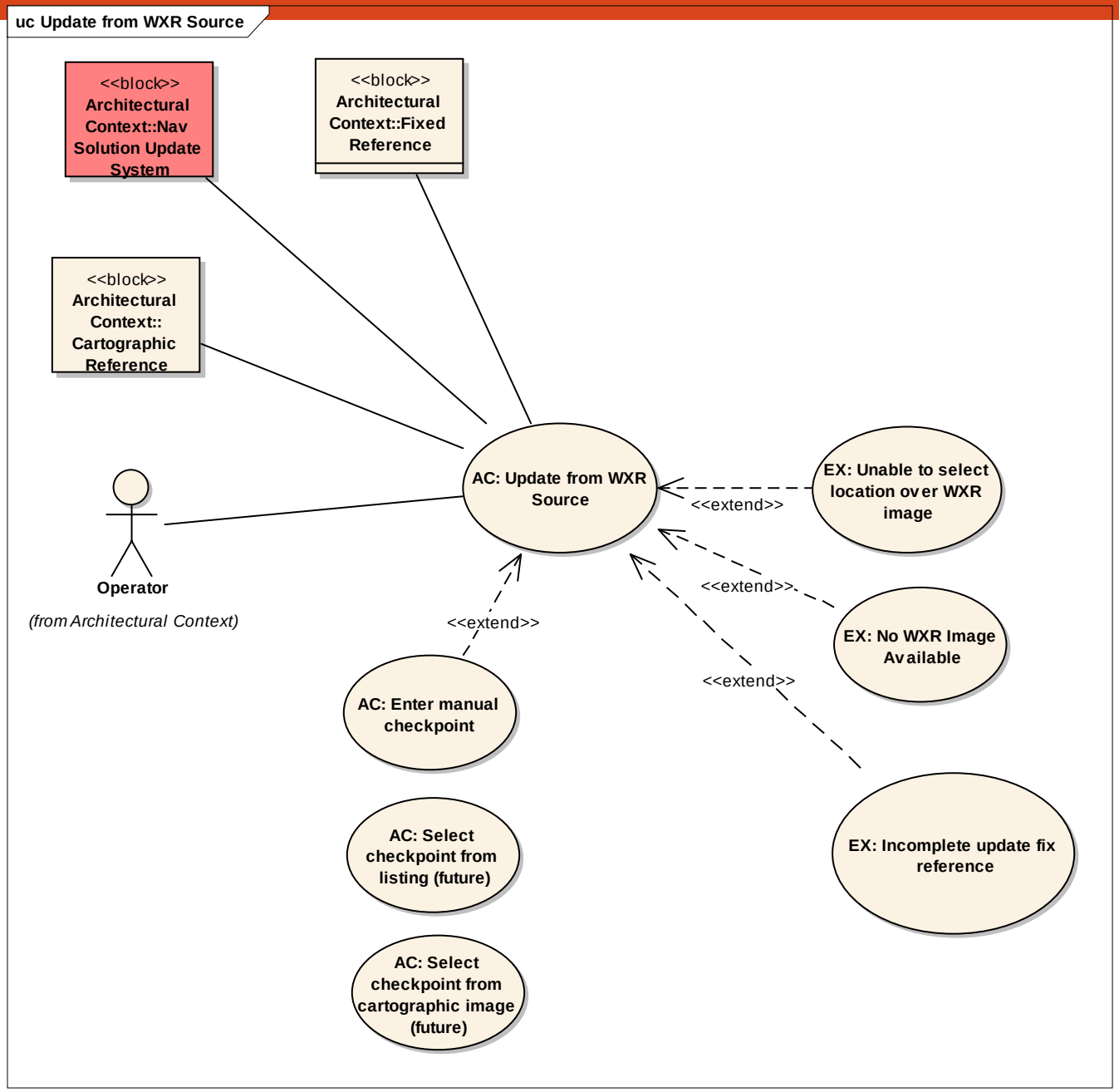
- Generally, use Activity Diagrams to express unique scenarios
- However, if alternate course or exception is “simple”, consider “Notes” narrative

- Use Case Analysis generates future opportunities – capture them!



Repeat Use Case Process

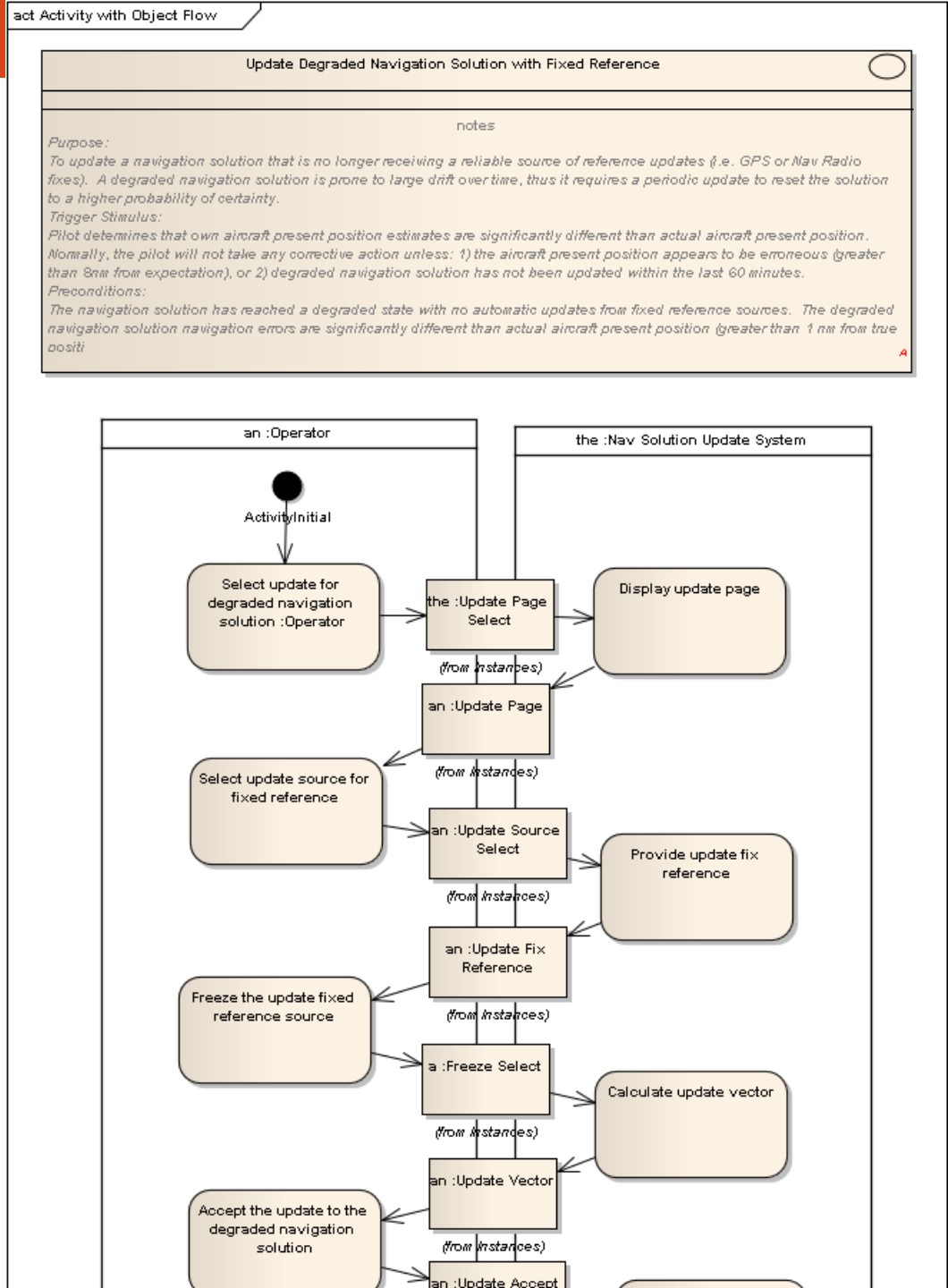
- 1) Use Case identification
- 2) Scenario definition – primary actor
- 3) Scenario definition – system of interest, seconday actors
- 4) Consider alternate courses/ exceptions/ extensions



Add Object Flows

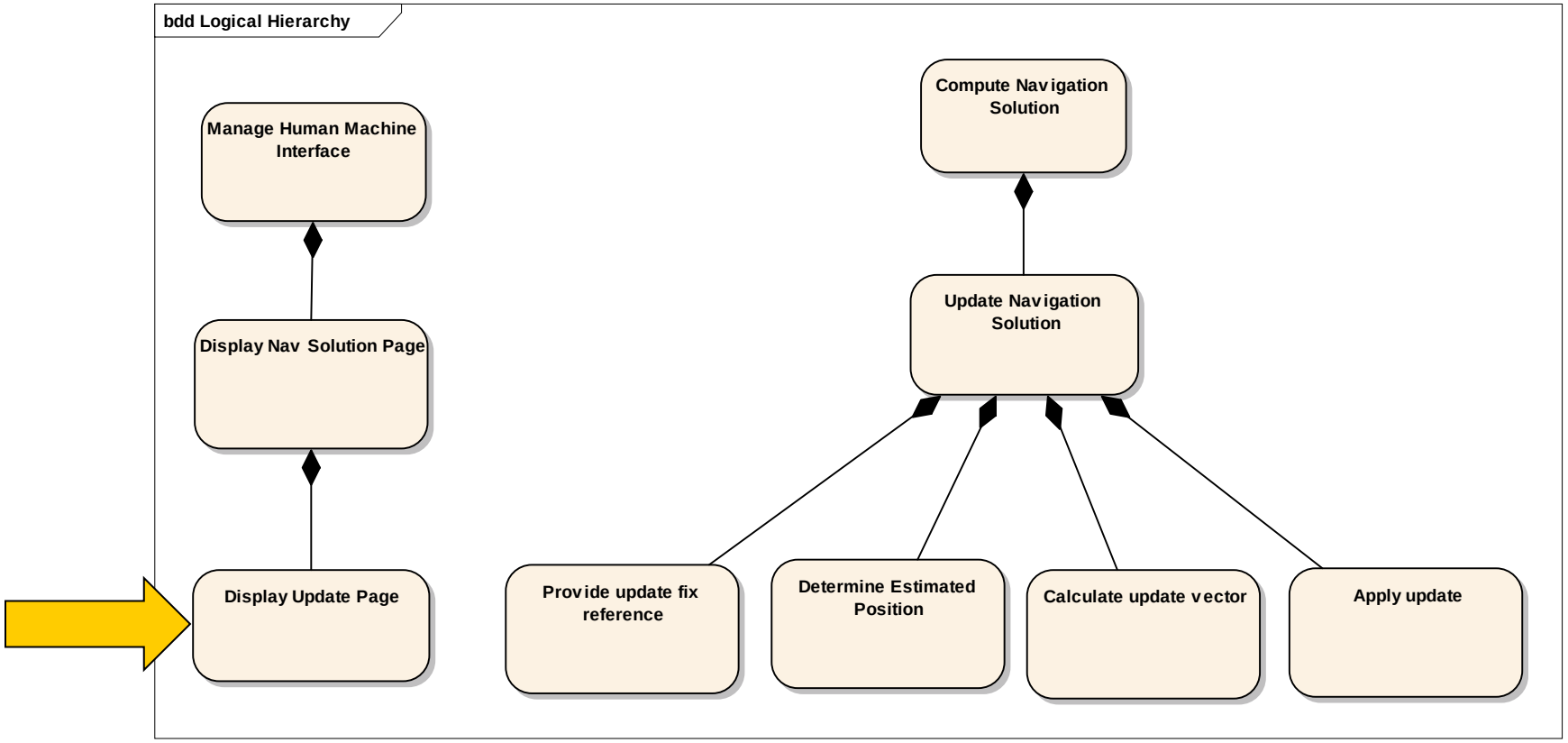
- Add object flow for each interaction
- Two activity diagrams:
  - Sequence flow of scenario
  - Object flow of scenario

- However:
  - Consider transaction "visibility" between actors (swimlanes)
  - Consider activity hierarchy (functional decomposition)



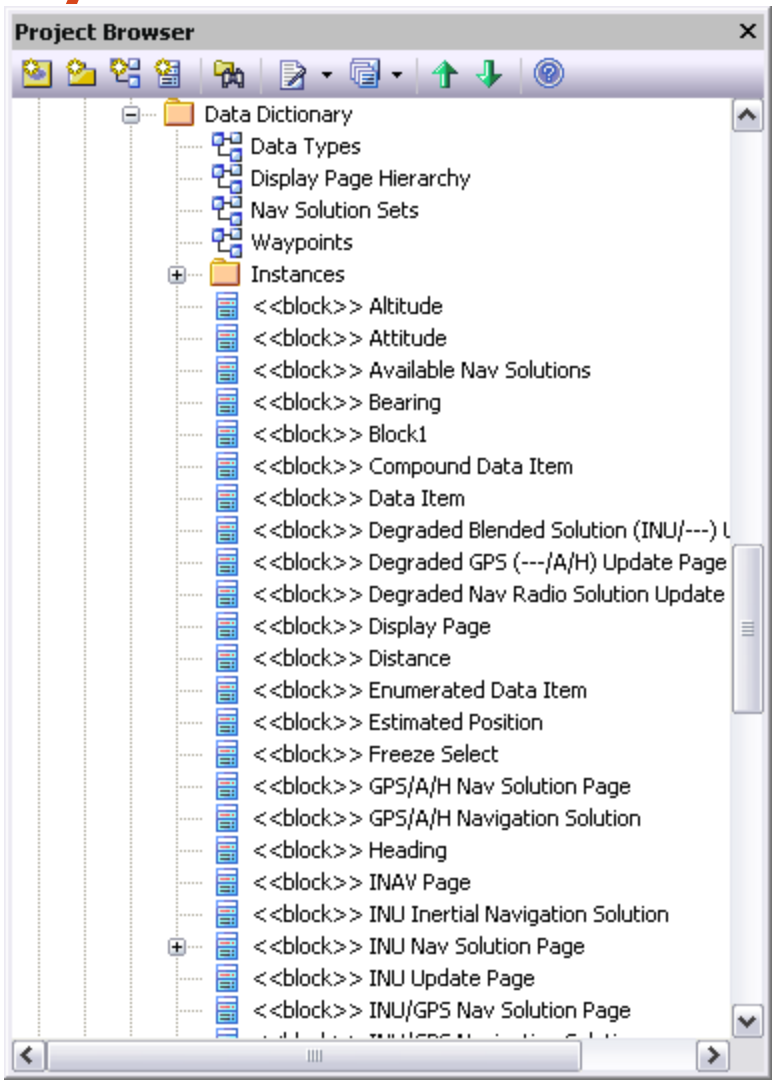
Activity Hierarchy

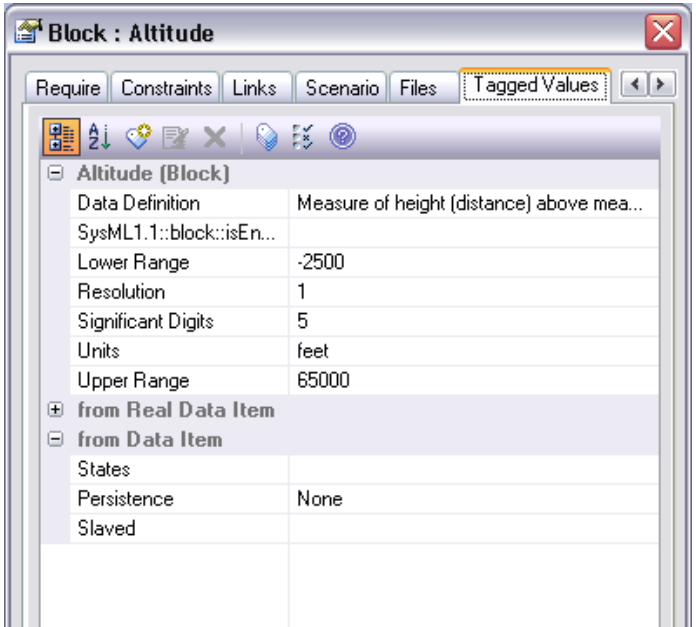
- Functional Decomposition
  - Similar to typical requirements document outline?



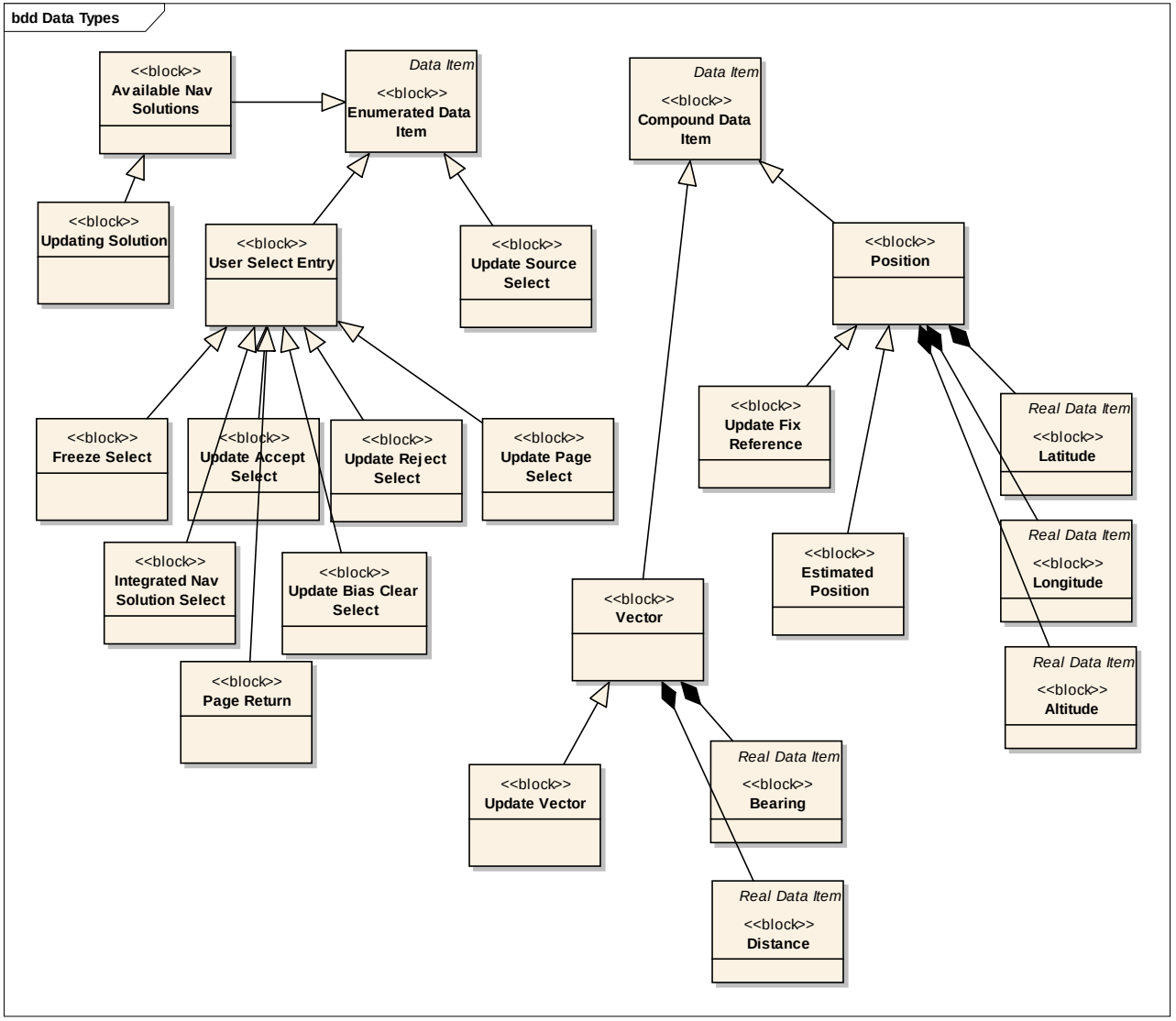
Objects Flows: Data Dictionary

- Manage object flow in a data dictionary
  - Create types, generalizations
- Manage object flow "instances" vs. "building block" types
- Characterize interface requirements

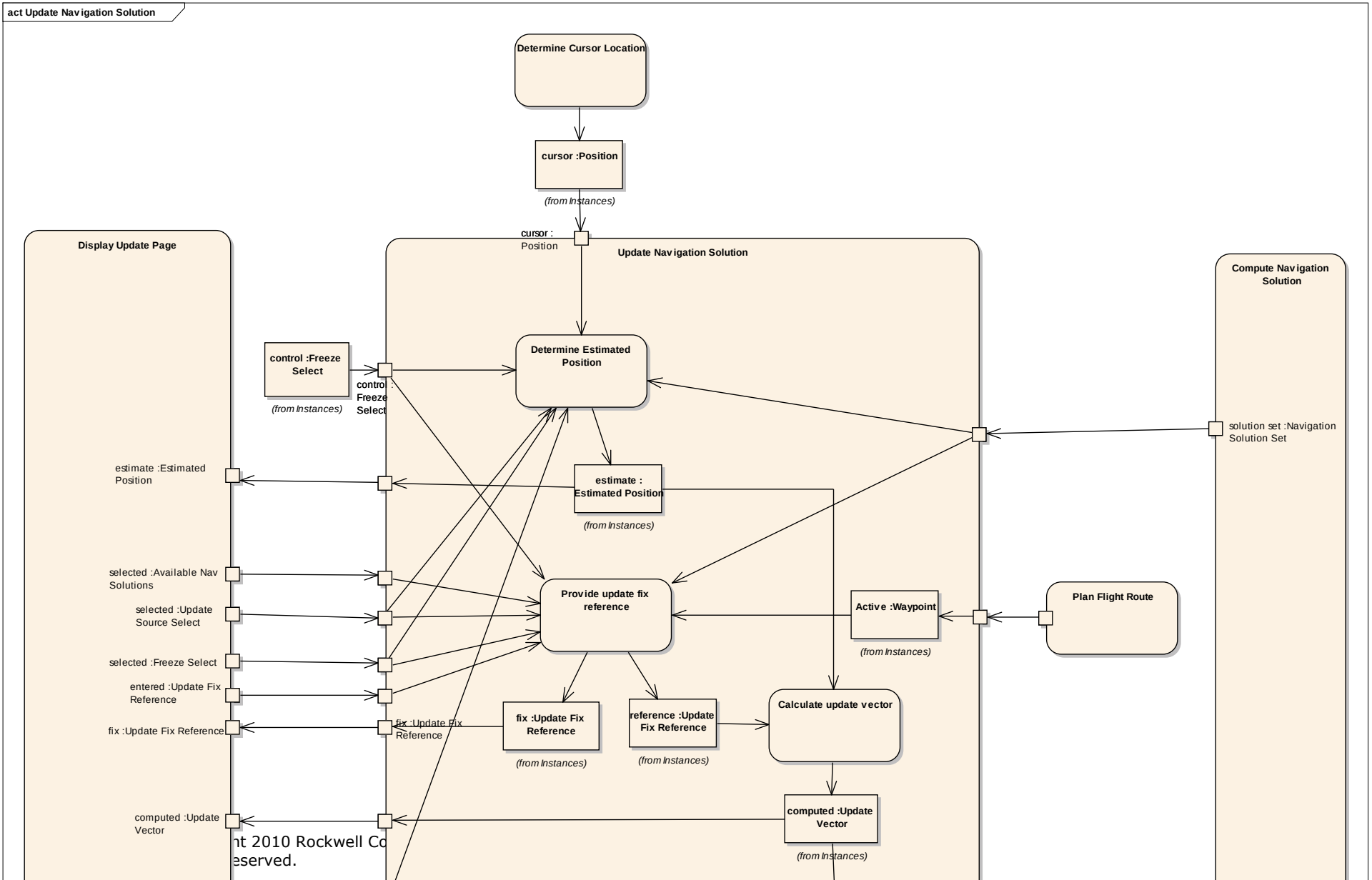


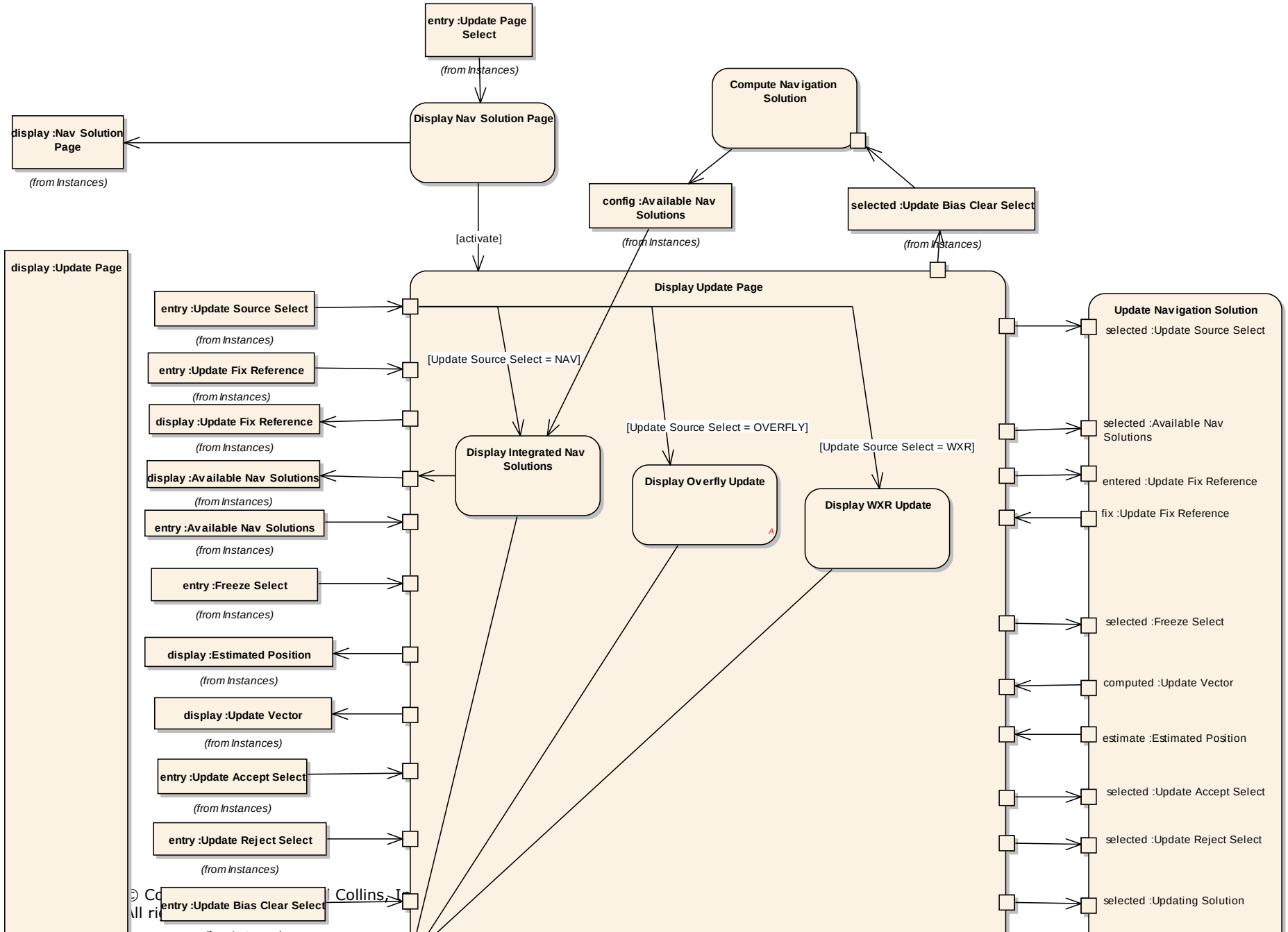


Object Flows: Data Dictionary Diagrams



Logical Architecture – Composite Views of ALL Interactions





Further Consideration

- When to use Actions vs. Activities
- Object Flows vs. Object Nodes
- Extended scenarios – from “black box” problem space into “white box” solution space
- Functional Allocation
  - “Allocate” relationship vs. Tagged Value “Relationship”
  - Inheritance through instantiation
- Interface Allocation
  - Object Flow/ Data Item allocation to Software Data Stream messages
  - Object Flow allocation to Human Machine Interface

Contact Information

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