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STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

Stevens Institute of Technology
&
Systems Engineering Research Center (SERC)

Modeling and Analysis Framework for Risk-Informed Decision Making for FAA NextGen System of Systems

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Overview: Addressing Panel Questions

- Modeling
  - —Cross-cutting factors to predict cost, schedule and benefits
- Acquire (acquisition)
  - —Support collaborative risk-informed decision-making about selecting mix of SoS capabilities to roll out asynchronously
- Verify
  - —Use historical quantitative data and subjective qualitative “beliefs” about factors
  - —Have used models to predict future costs/schedules - waiting to see results
- Evolve
  - —Update conditional probabilities in model based on use

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What is the FAA NextGen?

Image credit: NextGen Far-Term (2025), To-Be Enterprise-Level Architecture High-level Operational Concept Graphic (OV-1) Version 1.0, January 29, 2010

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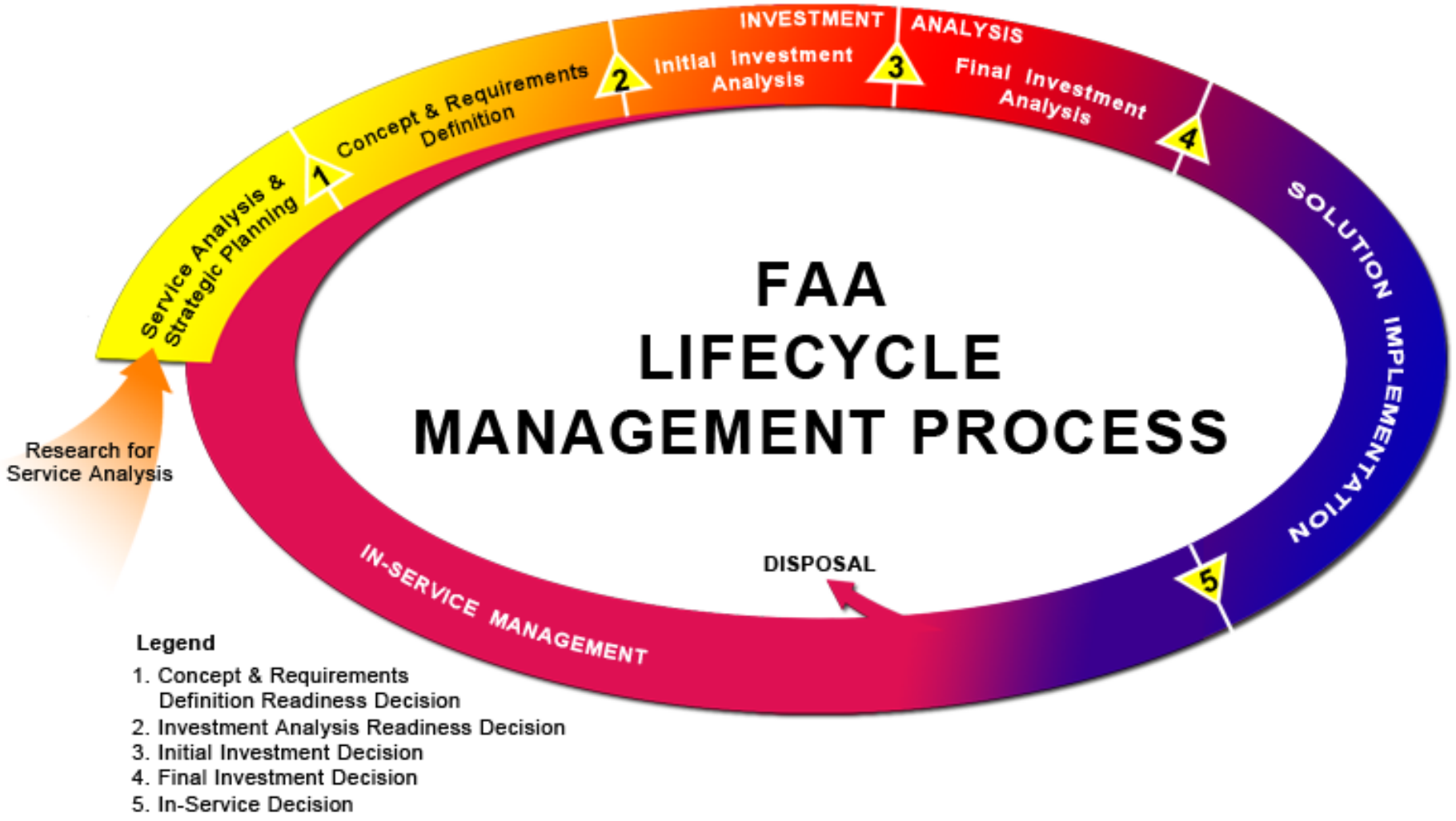
Models Support Decision-Making for Roll Out of SoS Capabilities Aligning with FAA AMS



FAA Acquisition Management System (AMS)
(http://fast.faa.gov/)

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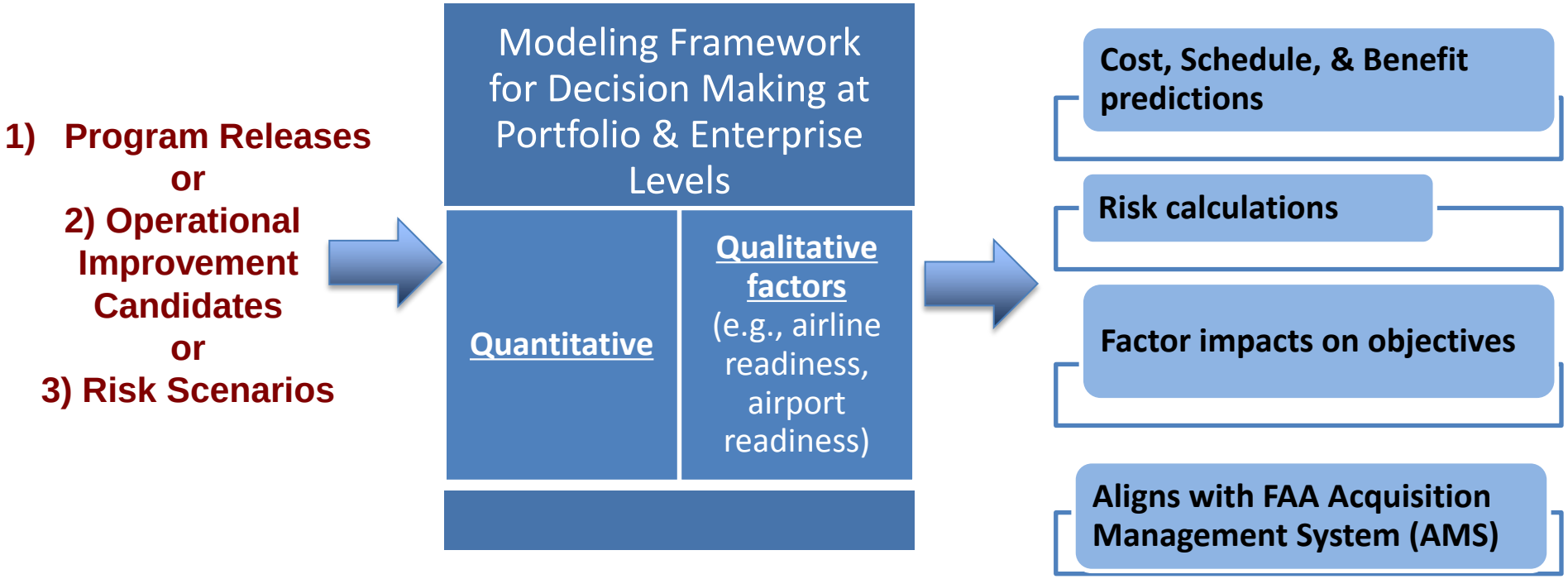
Objective Statement from Kickoff Meeting

- **Develop a modeling and analysis framework** to enable a **process for managing decision-making** that occurs when capabilities must be integrated, deployed and acquired asynchronously
  - —**Predictive Model for Estimating Cost, Schedule, Benefits, with Visualizations to aid in Risk-Informed Decision-making**



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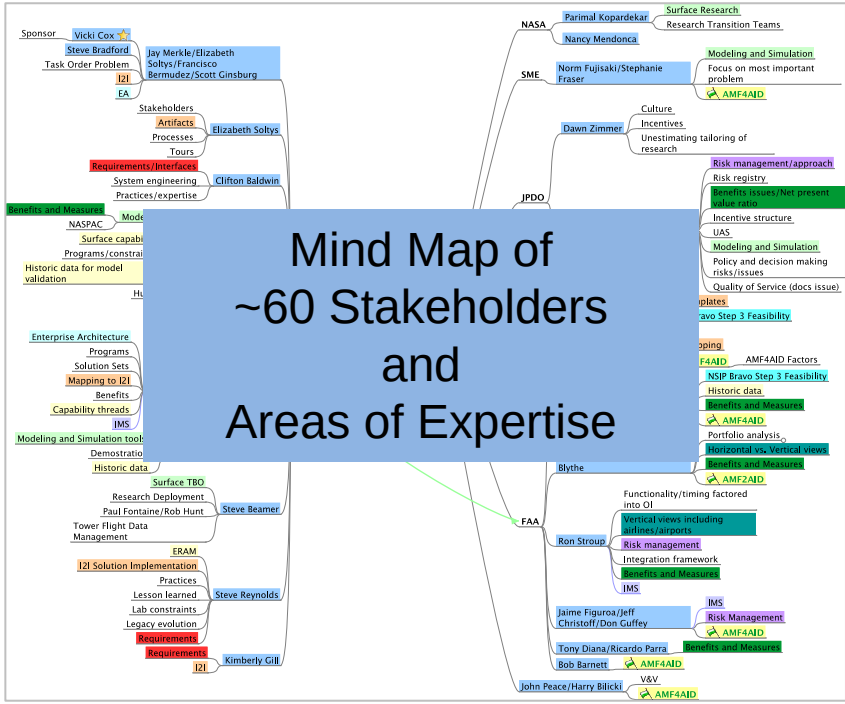
Stakeholders Talked about Various Challenges for the NextGen System of System (SoS)

- After talking with more than 60 success-critical stakeholders, who were very open about the challenges, we found out that:
  - —All component dependencies are not systematically identified
  - —All interface dependencies are not formally tracked (e.g., using databases)
  - —Tradeoff impacts difficult to assess
  - —People can only roughly estimate impact of interdependencies between component functionality
  - —Continually challenging those responsible for planning, developing, and deploying capabilities



"Peoples' internal knowledge is not captured externally or formally"

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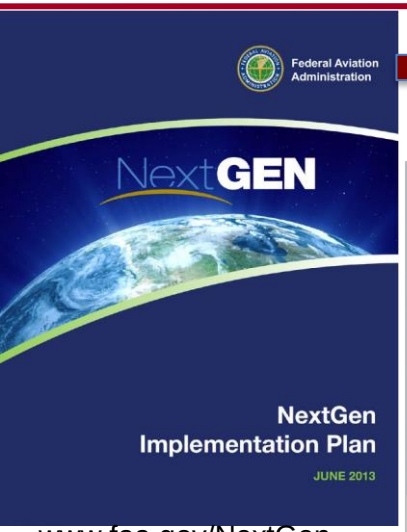
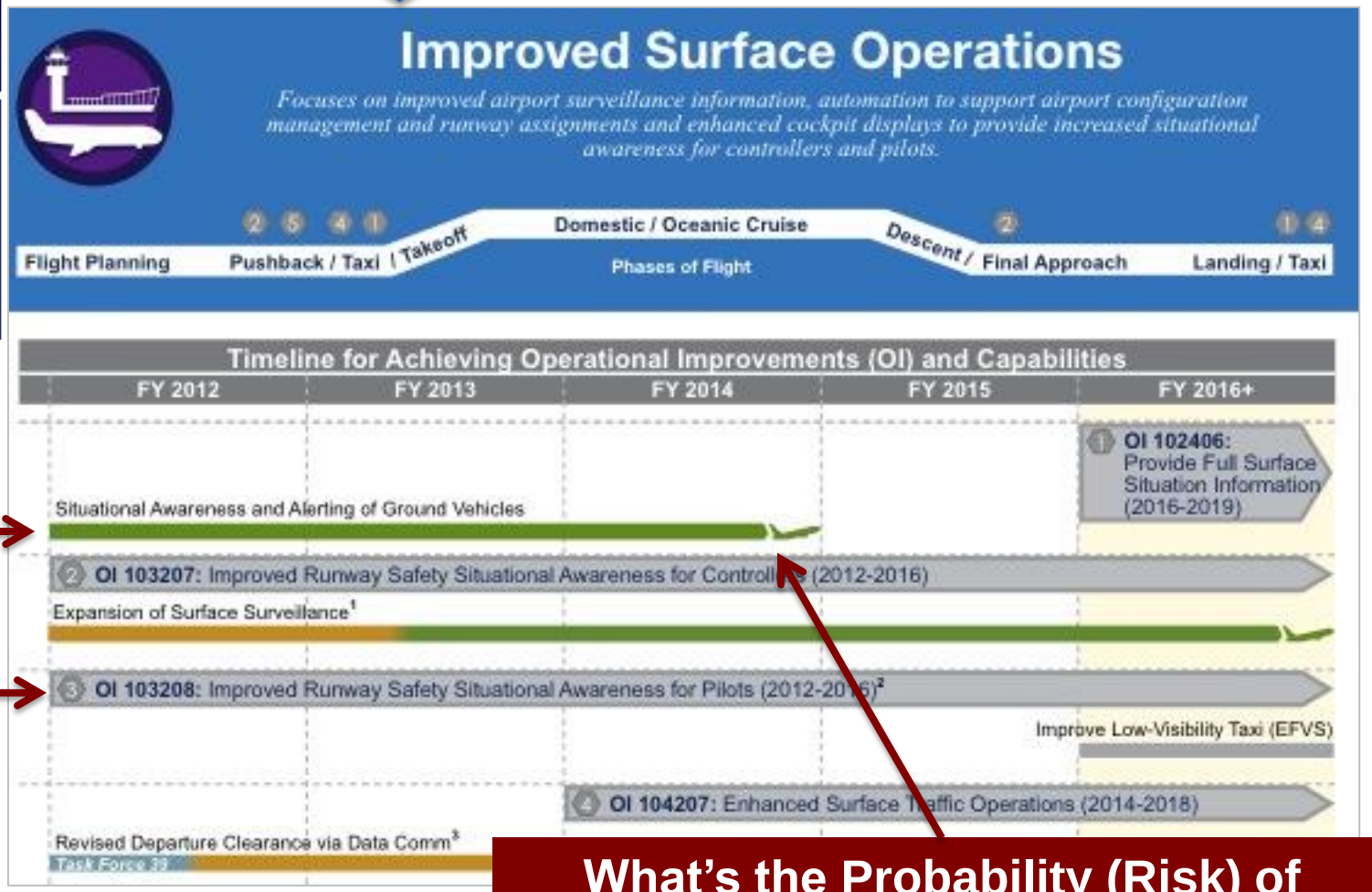
Example Implementation Portfolio From NextGen Implementation Plan



www.faa.gov/NextGen

Portfolio (1 of 10)



Timelines:

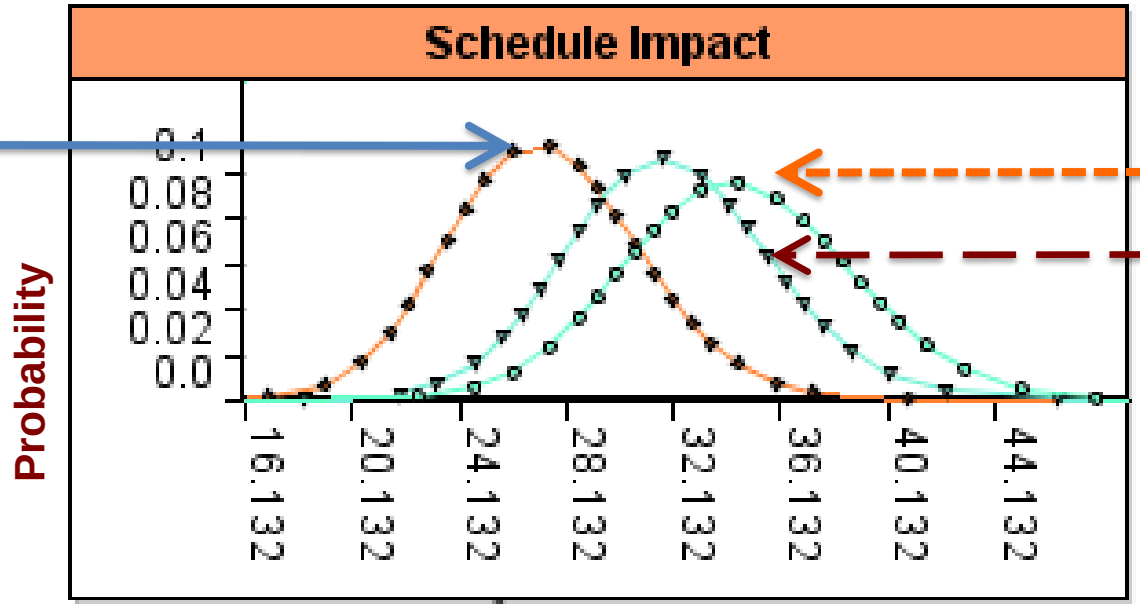
Operational Improvement Increment

Operational Improvement

What's the Probability (Risk) of finishing at this point in time?

Improved Surface Portfolio Example

- Three SME inputs illustrate difference in schedule of ~7 months based on different beliefs in factors



Operational Improvement Increments	Mean (months)
Situational Awareness and Alerting of Ground Vehicles	27.4
	32.0
	34.6

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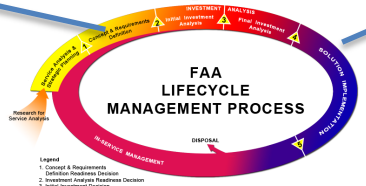
Four Types of Models Predict Risks Based on *Internal Knowledge Not Captured Externally or Formally*

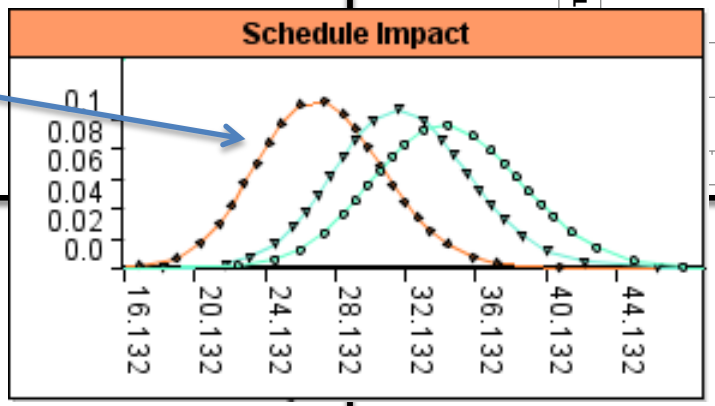
1) Improve Collaborative Decision-Making for CRD & IA supporting NSIP Evolution

Model being applied to NSIP 2014

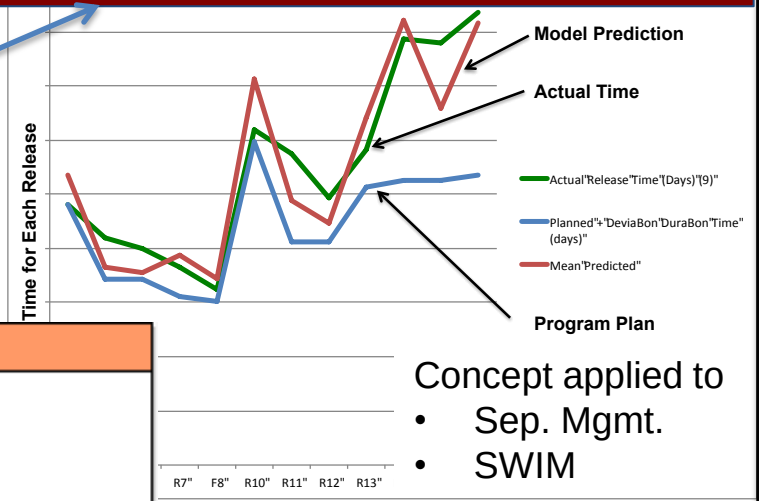
Example:

- Three SME inputs illustrate difference in schedule of ~7 months based on different beliefs in factors for Improved Surface Operations





2) Improve Prediction of Schedule and Cost in Solution Implementations



Concept applied to

- Sep. Mgmt.
- SWIM

3) Improve Collaborative Decision-Making About Systemic Risks and Benefits

Maps to a Quantification of Risk

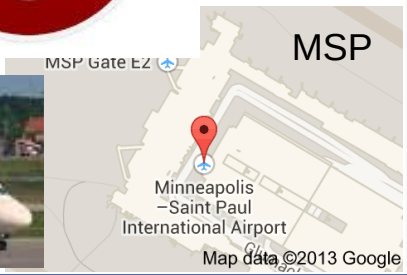
Concept applied to

- ADS-B In
- GBAS and ILS

Risk Matrix						
Likelihood	Near Certainty	E	5	13	20	22	25
	Highly Likely	D	4	12	15	21	24
	Likely	C	3	11	14	17	23
	Low Likelihood	B	2	7	9	16	19
	Not Likely	A	1	6	8	10	18
			1	2	3	4	5
			Very Low	Low	Moderate	High	Very High
			Impact				

4) Improve Risk-Informed Decision Making for NextGen Benefits due to Market Stability

Aircraft not equipped



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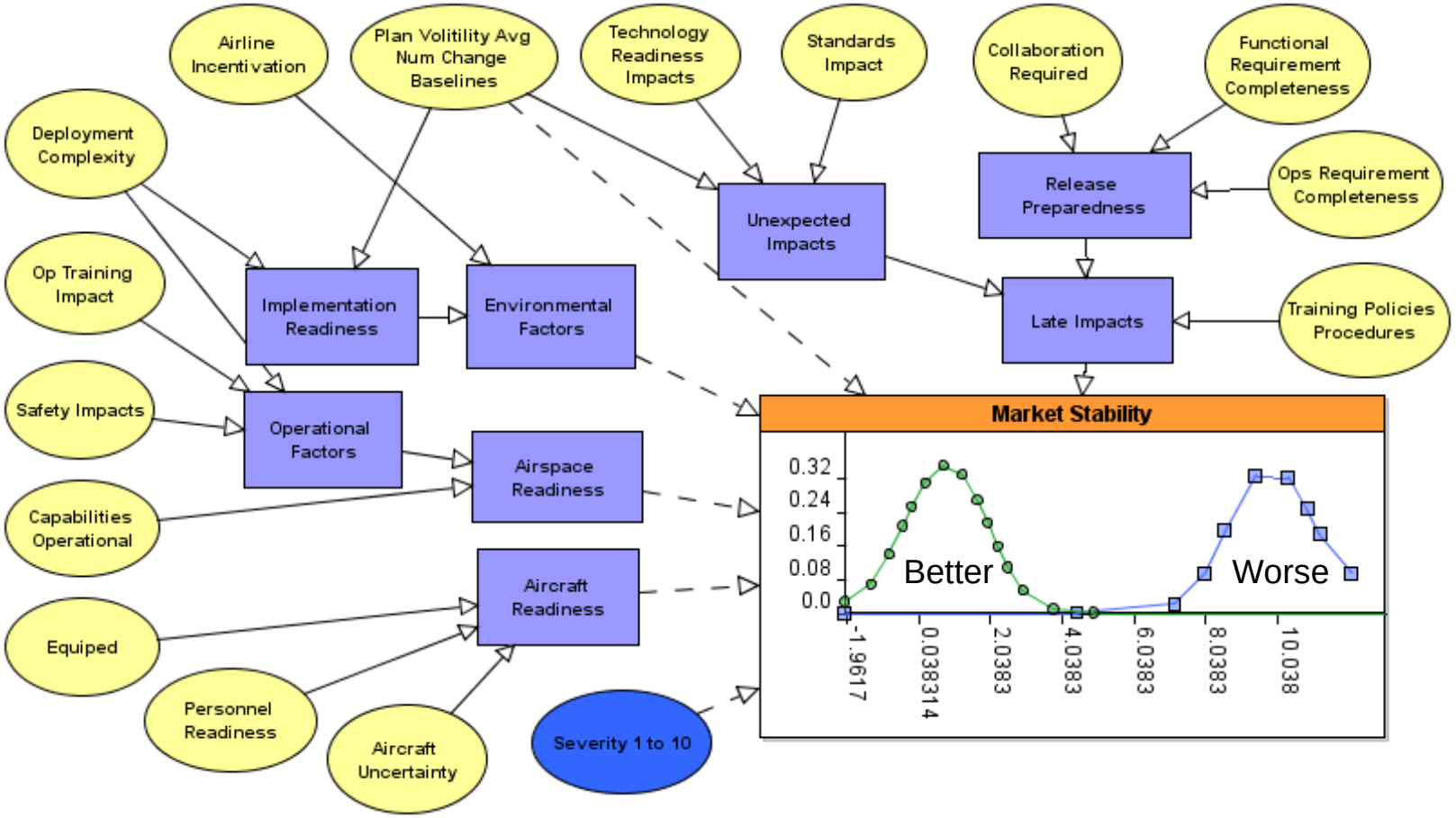
Example Model: Assess Risk of Benefits due to Variability in Market Stability

- Help FAA assess the risk of lost Benefits due to Market Changes:
  - E.g., Delta moves all of their MD80s to Minneapolis – aircrafts don't have technologies to leverage deployed capability at airport



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Summary - Results Support Task Objectives and Research Hypothesis

- Framework models quantitative and qualitative expert judgment about "**Peoples' internal knowledge that is not captured externally or formally"**
- Supports **collaborative process for risk-informed decision-making**
- Helps stakeholders understand cost, schedule, benefits, and risk tradeoffs
- Improves the accuracy of schedule and cost predictions (and reduces the variance)
- Tailored to the decision points of the AMS
- Provides a new approach to **Quantify Risk**