

# Role of Human-in-the-Loop Simulation in the Validation Process

Parimal Kopardekar, Ph.D.  
Titan Systems Corporation

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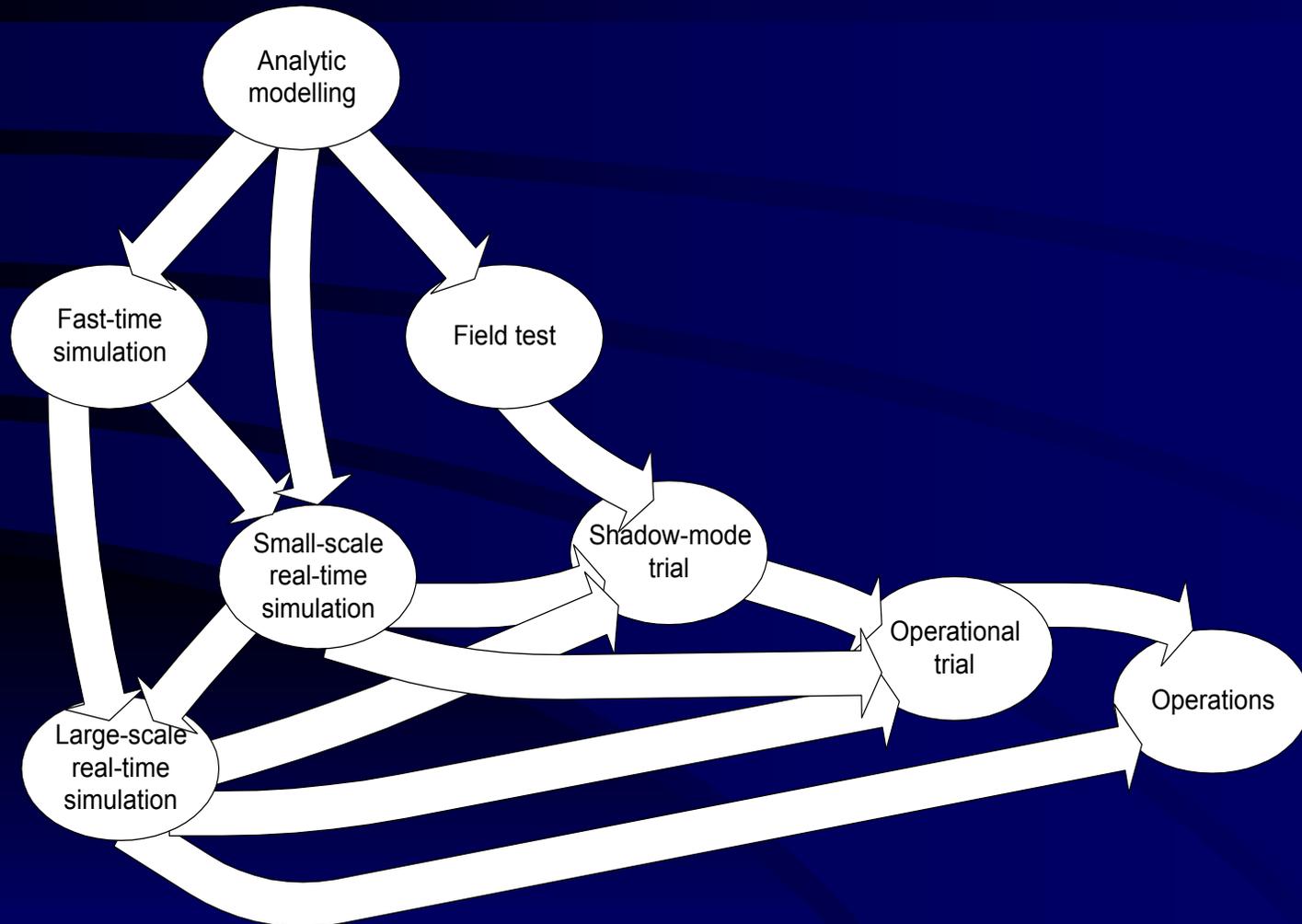
# Validation Process

- The validation process answers the questions:
  - Are these concepts *appropriate* to achieving the objectives?
  - Are they *complete* to achieving the objectives?
- Validation requires examination of measures of effectiveness (MOE)
  - Capacity, fuel efficiency, time savings, delay, workload, situation awareness, safety, etc.

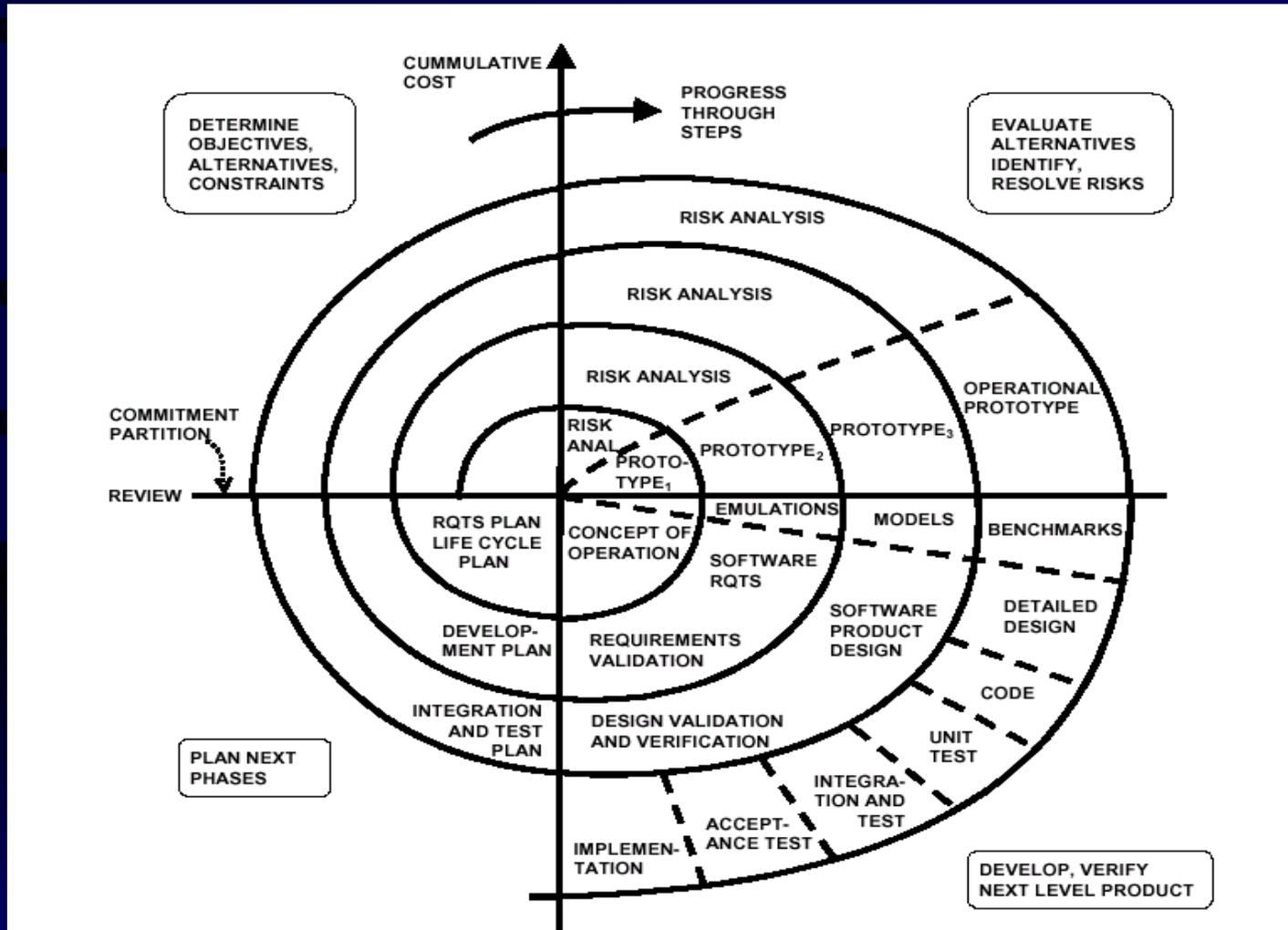
# Validation Process

- Validation process models
  - Banana model of process
  - Waterfall model
  - Spiral model of systems engineering
  - Often iterative process - build a little, demonstrate a little, test a little, and implement a little.....
- Major activities
  - Concept studies: functional decomposition, task analysis
  - Fast-time and modeling studies
  - Real-time HITL studies

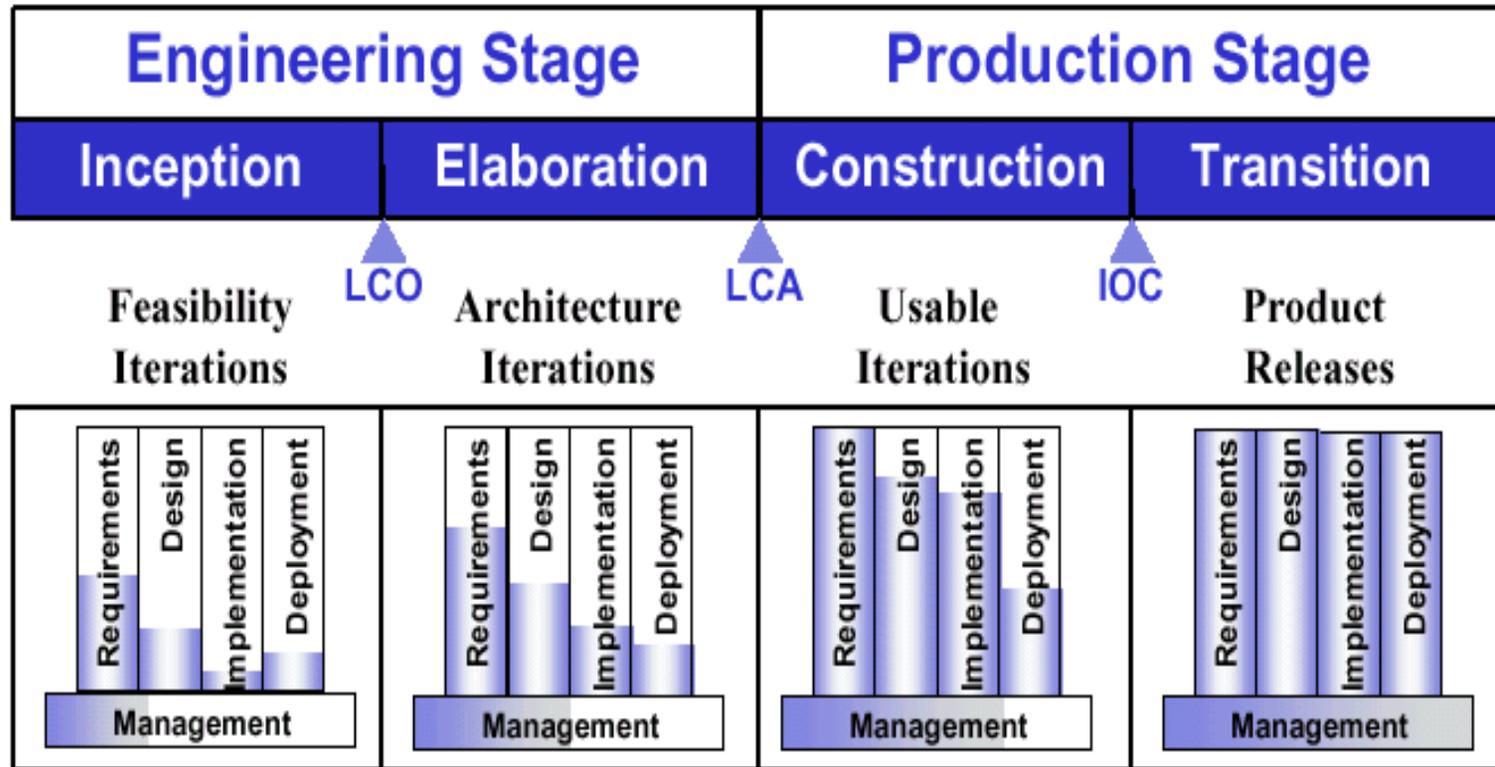
# Banana Model



# Spiral Model



# Anchor Points Model



# Types of Modernization Programs

- Development of decision support tools
  - Traffic Management Advisor
- Procedural changes
  - Reduced Vertical Separation Minima
- Advanced concepts
  - Dynamic Resectorization
- New software/hardware
  - DSR, COTS software/hardware
- Advanced technology
  - GPS, ADS-B, etc.

# Why Human-in-the-loop Studies?

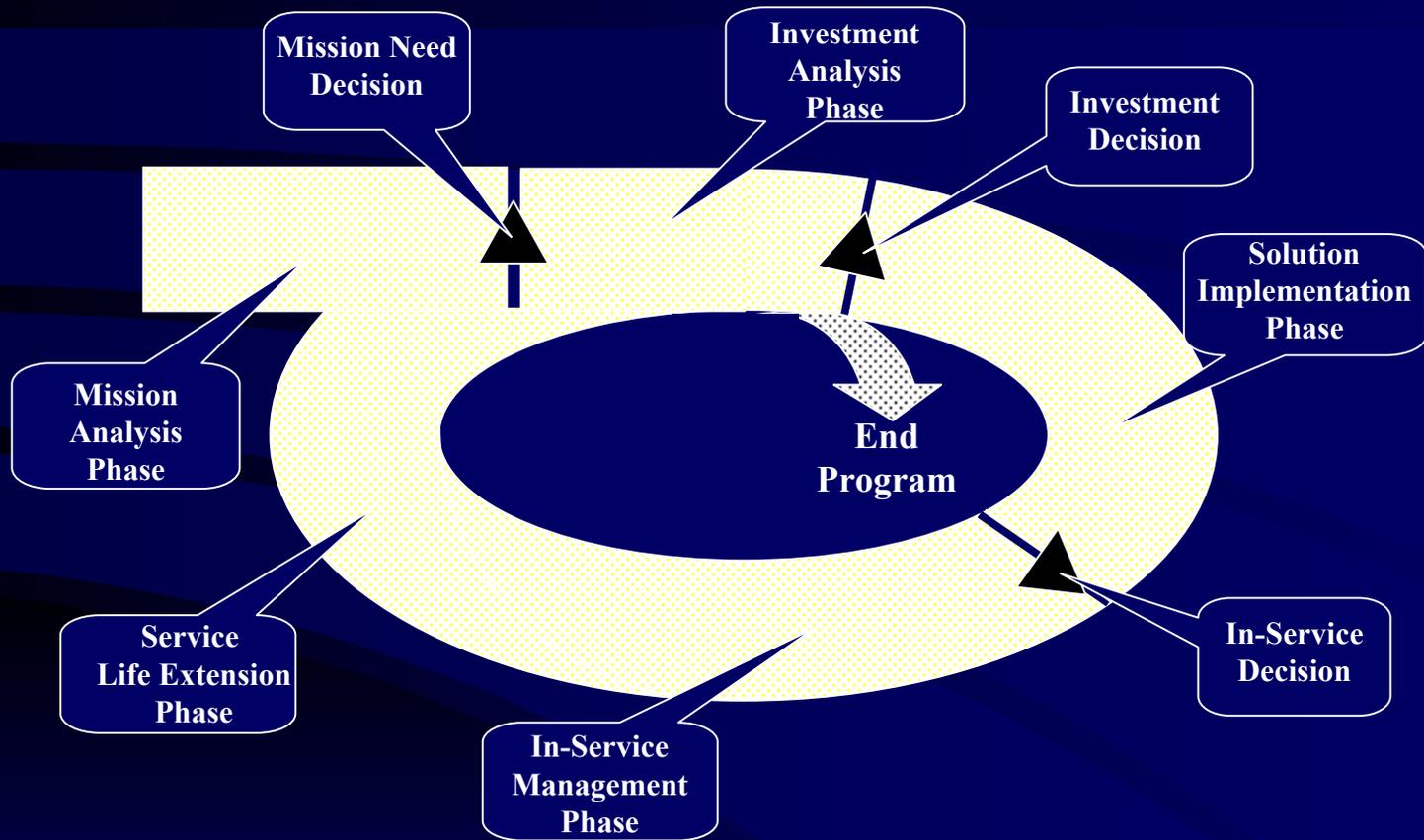
## Potential Considerations

- Human Performance (workload, SA, errors)
- Training
- Functional design
- CHI
- Staffing
- Safety and health
- Skills and Tools
- Workspace
- Displays and controls
- Information requirements
- Information presentation
- Visual/auditory alerts
- I/O devices
- Communications
- Procedures
- Anthropometrics
- Documentation
- Environment
- System performance

# How to Conduct HITL Studies?

- Different types of human-in-the-loop studies
  - Storyboarding
  - Cognitive walkthroughs
  - Early User Involvement Events
  - Prototypes
  - Demonstrations
  - Part-task studies
  - End-to-end studies/Full-mission studies
  - Shadow mode testing
  - Field tests

# When to Conduct HITL Studies?



*Acquisition Management System*

# Considerations

- Mission analysis
  - Concept exploration studies
  - Information, DST, procedural needs
  - System and human performance issues
- Investment analysis
  - Benefits to system and human
- Service life extension
- Solutions implementation
  - Interoperability
  - Procedures
  - Human performance
- In-service decision
  - Training
- Service life extension
  - Human performance

# HITL Simulation- What does it buy?

- Benefits
  - Seeing is believing- Stakeholders experience
  - Works well with iterative process
  - Human-centered design
  - Prototypes can be used for specifications and requirements
  - Gives ideas for procedures and validation
  - Human performance issues can be verified

# HITL Simulation- What it does NOT buy?

- Limitations
  - System benefits and safety are difficult to prove
  - Generalization is a challenge
  - Sometimes focus becomes on user acceptance rather than benefits

# Final Thoughts

- Use HITL from the onset
  - Really early stages: gives a lot of good issues
- Develop iteratively
- Use all HITL methods
- Consider nominal and off-nominal scenarios as well (emergencies, system failures, severe weather)
- Know limitations