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# **Systems of Systems Integration and Verification Strategy Workshop Approach**

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# Abstract

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Systems Integration and Verification Planning Workshops have been successfully conducted to define the overall strategy for a Systems of Systems program and define the roles and responsibilities for the teams. The purpose of these workshops is to translate individual system planning displays into a comprehensive integration and verification strategy that avoids duplication of effort and prevents gaps. The workshop focuses on who does what when and plans for “what if”. Components of the workshops have been implemented on Systems of Systems programs at Raytheon.



*If you compared your integration and test effort to a soccer team, would it be the way 8 year olds play or the way professionals play?*



*How much does your success depend on SMEs and heroes?*



**Workshop approach  
transitions  
luck and heroics  
into strategy**





**SPACER/Ice Breaker**  
**Principles**  
**Wall Workshop**  
**(Activity Sequence)**

**Interface Ranking**  
**Proactive Contingency Planning**

**Floor Workshop**  
**(Resource Constraints)**

**SoS Storyboards**

**Action Plans**

Capture Throughout Workshop:

- Discussion Topics
- Candidate Opportunities
- Action Items

Develop Into Action Plans

# SPACER

**S**afety

**P**urpose

**A**genda

**C**onduct

**E**xpectations

**R**oles and Responsibilities

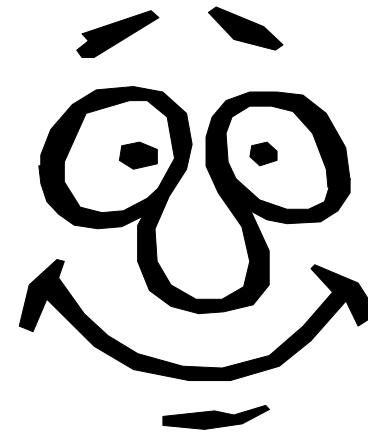
*Expectations  
NOT*

"I hope today  
is not going to be  
"



*Expectations*

"I hope today  
we are able to  
"





# 4 Corner Introductions

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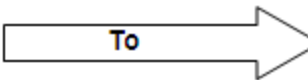
**Find the corner that best represents your response  
to the upcoming questions**

**Introduce yourself to someone you don't know**  
*If you know everyone,  
say hello to the person you see the least often*



# Wall: Activity Sequence

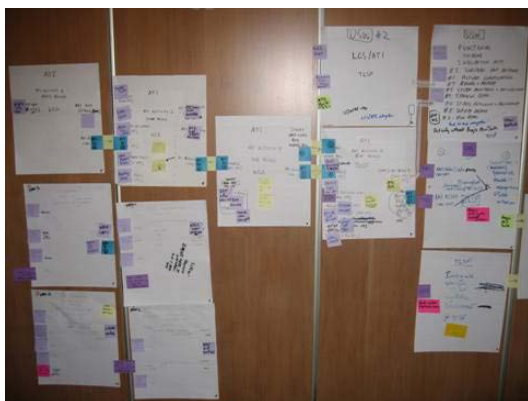
Location: \_\_\_\_\_ Activity Owner: \_\_\_\_\_

From  **WHY**  To

**WHO**

**WHAT (Current)**

**OUTPUT/DECISION (Current)**



**Look for:**  
Dependencies  
Duplications  
Gaps



Month  
#

# Activity or Milestone

**Raytheon**

Location: \_\_\_\_\_

Activity Owner: \_\_\_\_\_

From 

To 

**WHY**

**WHO**

**WHAT (Current)**

**OUTPUT/DECISION (Current)**

**CHANGES TO OPTIMIZE ACTIVITY FLOW**

# Interface Ranking Technique

Academic Example of Attributes

Familiarity Metric		
Connection A	Connection B	Rank
No specs, uncharacterized, black box	Any	1
New with specs	New with Specs	2
New with specs	Modified with Specs	3
New with specs	Existing with specs	4
Modified with Specs	Modified with Specs	5
Modified with Specs	Existing with Specs	6
Industry Standard, COTS	Industry Standard, COTS	7
Existing / Operational	Existing / Operational	8

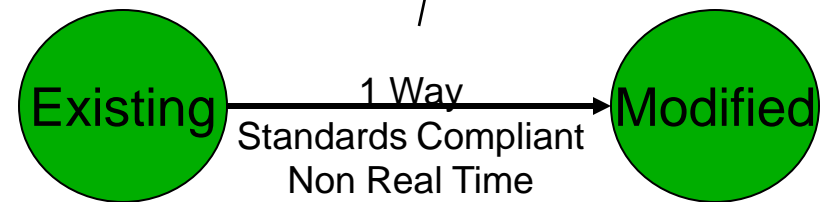
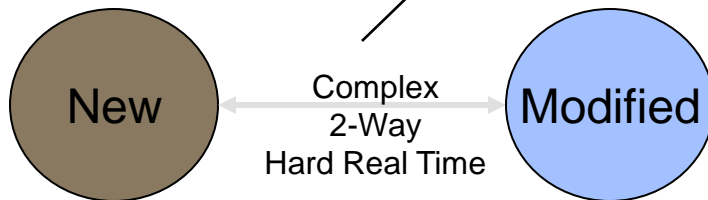
Sophistication Metric	
Timing and Sophistication	Rank
Closed Loop Hard Real Time using an unknown or custom protocol, bi-directional	A
Closed Loop Hard Real Time using a known, standard protocol, bi-directional	B
Closed Loop Soft Real Time, using an unknown or custom protocol, single direction	C
Closed Loop Soft Real Time, using a standard protocol, single direction	D
Open Loop, Real Time using an unknown or custom protocol, single direction	E
Open Loop, Real Time, using a standard protocol, single direction	F
Non-Real Time, using an unknown or custom protocol	G
Non-Real Time, using a known protocol	H

	1	2	3	4	5	6	7	8
A	Red	Red	Red	Red	Red	Red	Yellow	Yellow
B	Red	Red	Red	Red	Red	Yellow	Yellow	Yellow
C	Red	Red	Red	Red	Red	Yellow	Yellow	Green
D	Red	Red	Red	Red	Yellow	Yellow	Green	Green
E	Red	Red	Red	Red	Yellow	Yellow	Green	Green
F	Red	Red	Red	Yellow	Yellow	Yellow	Green	Green
G	Red	Red	Yellow	Yellow	Yellow	Green	Green	Green
H	Red	Yellow	Yellow	Yellow	Green	Green	Green	Green
Interface	Risk	Key						
HIGH	Red							
MEDIUM	Yellow							
LOW	Green							

Rate familiarity of 2 entities being brought together  
 Rate complexity of interface between the entities

# Interface Risk Assessment

		Compatibility Level						
		1	2	3	4	5	6	7
Complexity Level	A	1A^	2A	3A	4A	5A	6A	7A
	B	*^	2B	3B	4B	5B	6B	7B
	C	*^	2C	3C	4C	5C	6C	7C
	D	*^	2D	3D	4D	5D	6D	7D
	E	*^	2E	3E	4E	5E	6E	7E
	F	*^	2F!	*!	*!	*!	*!	*!



# Proactive Contingency Planning Matrix

Uh-Oh Moment	Impact if it happens	Likelihood it may happen	Work-around
A is late			
B is broken			
C is less mature than planned			
D has extra features			
E and F don't recognize each other			

1. Brainstorm what could go wrong
2. Use planning strategy displays to determine impact
3. Use planning strategy displays and history to determine likelihood
4. Determine if impact and/or likelihood would benefit from a work-around
5. Describe work-around
6. Assess work-around (reduces impact and/or reduces likelihood)

# Proactive Contingency Planning Matrix

## Work-around needed if Impact or Likelihood is High

- Make sure potential problems are being proactively addressed and included in rolling wave planning
- Make sure real problems are being addressed (not problem from the last program)

Uh-Oh Moment if __	Likelihood	Impact	Work-around
A	High	High	Define existing or identify new strategies to: a) Reduce likelihood and b) Reduce impact if it happens
B	Medium	High	Define existing or identify new strategies to: Reduce impact if it happens <i>Consider strategy to reduce likelihood</i>
F	High	Low	Define existing or identify new strategies to: Reduce likelihood
C	Low	High	Define existing or identify new strategy to: Reduce impact if it is happens
D	High	Medium	Define existing or identify new strategies to: Reduce likelihood <i>Consider strategy to reduce impact</i>
E	Medium	Medium	<i>Consider strategies to</i> a) <i>Reduce likelihood and</i> b) <i>Reduce impact if it is happens</i>
G	Low	Medium	<i>None needed</i>
H	Medium	Low	<i>None needed</i>
I	Low	Low	<i>None needed</i>

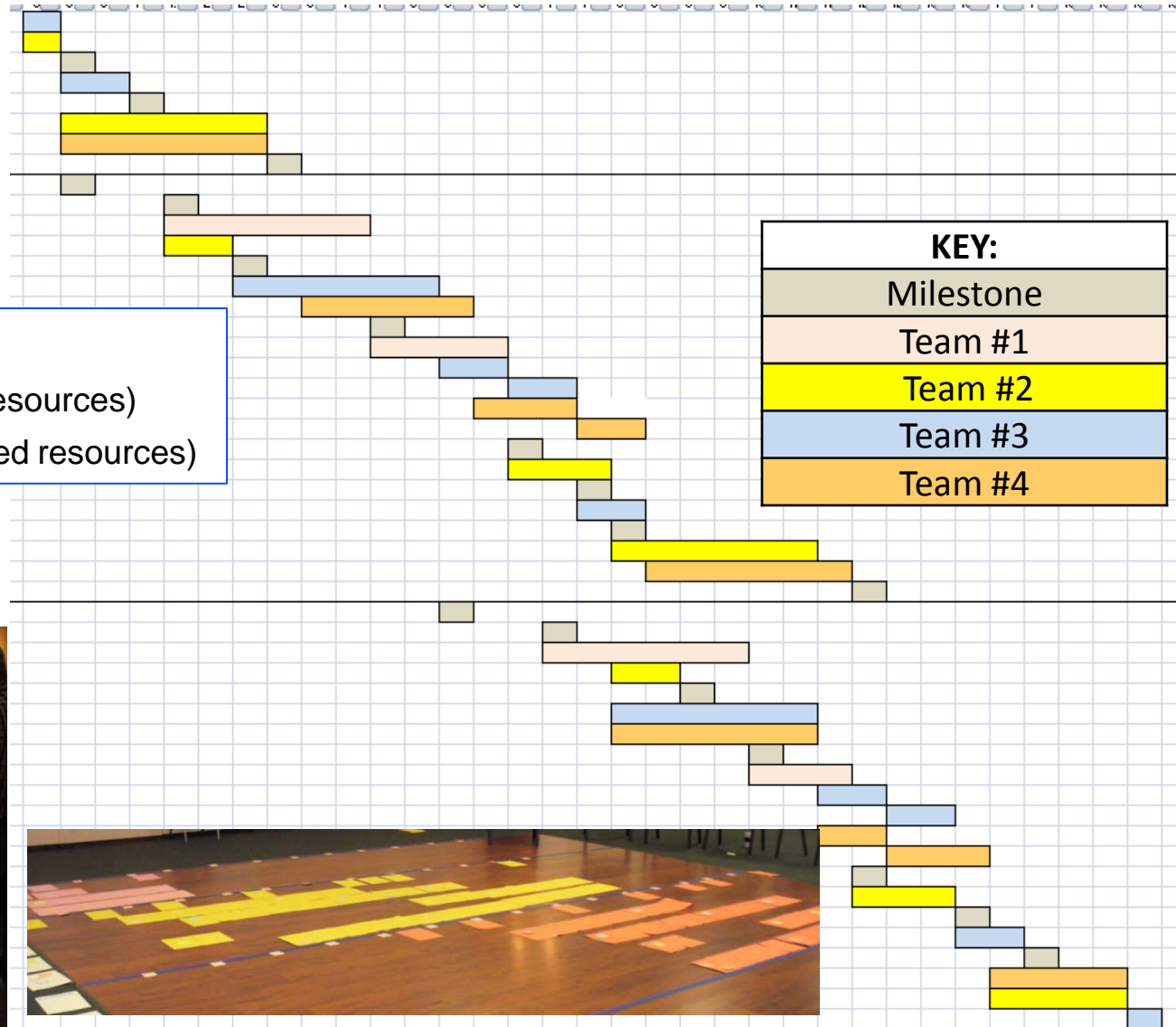
# Floor: Resource Constraints

**Arranged by:**

1. Builds
2. Teams
3. Location

**Look for:**

Cloning (overscheduled resources)  
 Freeze-drying (underused resources)



# Handoff Criteria

- **Handoff Strategy from System to SoS**
  - Detailed in Integration Storyboards
  - Focus on System -> SoS handoff necessary for integration objectives
  - System Storyboard Exit/SoS Storyboard Entrance Criteria defined by priority
- **Criteria defined by negotiations for set objectives**
  - **CRITICAL: must have for handoff**
    - Mandatory show-stopper
    - SoS only to accept if directed by management
  - **NECESSARY: will consider workarounds**
    - SoS will consider workarounds to maintain program schedule
    - Notify management on impact to SoS cost and schedule
  - **NEGOTIABLE: SoS can start without**
    - SoS can live without it/start without it
    - Negligible impact (if any) to cost and schedule
  - **OPTIONAL: Would make it easier for SoS**
    - Nice to have to make integration easier
    - Could be opportunity to cost and schedule

# Integration Storyboards

## 1.1 Activity (# and Name)

### 1.1.1 Summary

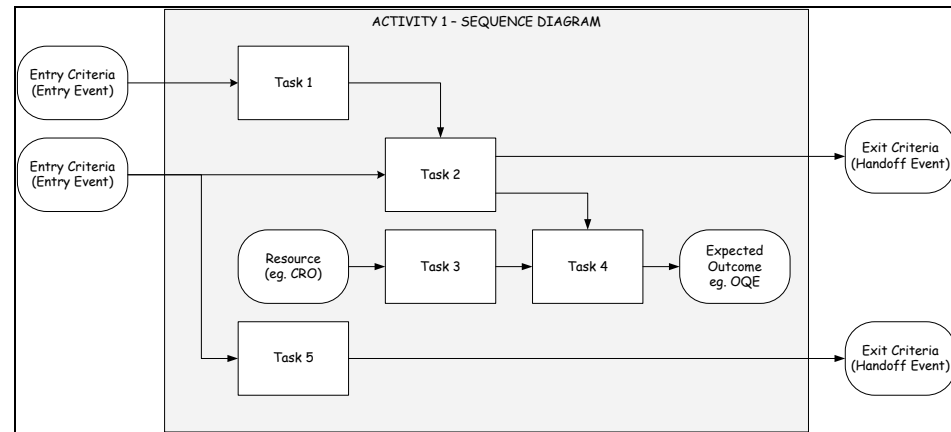
### 1.1.2 Sequence

### 1.1.3 Objective – Task 1

#### 1.1.3.1 Known Issues

#### 1.1.3.2 Expected Outcomes

### 1.1.4. Objective – Task 2



**Activities are defined by hand-offs to different teams**

**Entry Criteria is negotiated between teams**

**Tasks are within an activity**  
**Objectives and expected outcomes are defined for each task**

No.	
Title	
Summary of Purpose	
Summary of Tasks	<ol style="list-style-type: none"> <li>1. Task 1</li> <li>2. Task 2             <ol style="list-style-type: none"> <li>1. Sub Task 1</li> <li>2. Sub Task 2</li> </ol> </li> </ol>
Entry Criteria	CRITICAL: must have for handoff NECESSARY: will consider workarounds NEGOTIABLE: Integration can start without OPTIONAL: Would make it easier for Integration
Resources Required	Site: Equipment / Tools: People:
Exit Criteria	
Notes	



# Discussion: Topic

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<b>Issues</b>	
<b>Approach &amp; Techniques</b>	
<b>Concerns</b>	
<b>Need to Do</b>	

# Opportunity: Title

<b>Description</b>	
<b>Champion</b>	
<b>Team</b>	

<b>ACTION PLAN</b>		
<b>Activity</b>	<b>Output</b>	<b>Completion Date</b>

# Action: Title

<b>Explanation of Action</b>	
<b>Due Date</b>	
<b>What Does “Done” Look Like?</b>	

	<b>Volunteer</b>	<b>Recommend</b>
<b>Assignee</b>		
<b>Validator</b>		
<b>Helper</b>		



*Plus*

*Delta*

