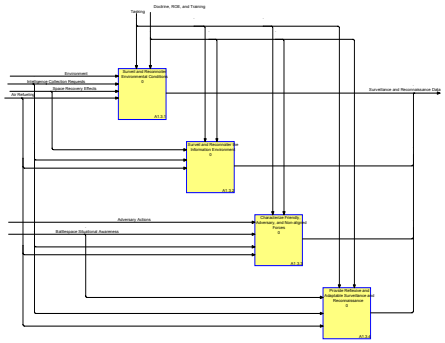
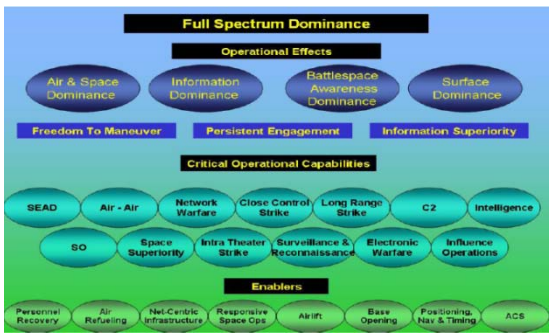
U.S. AIR FORCE

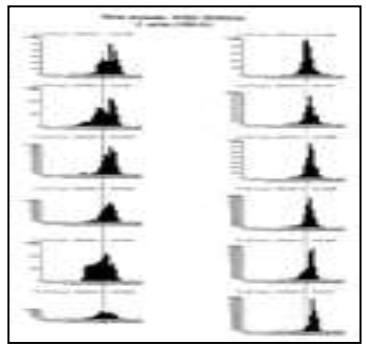
GLOBAL PERSISTENT ATTACK

ARCHITECTURE, PROCESS,

AND RISK ANALYSIS







This Briefing is:
UNCLASSIFIED

Jeff Havlicek, Maj, USAF
SE Ed & Trng Div Chief
937-255-3355 x3348

U.S. AIR FORCE

Shape the future of systems engineering in the AF and DoD to improve our ability to deliver war-fighting capabilities. We will accomplish this by conceptualizing new processes, practices, tools, and resources for the systems engineering workforce through research, education, and consultation.

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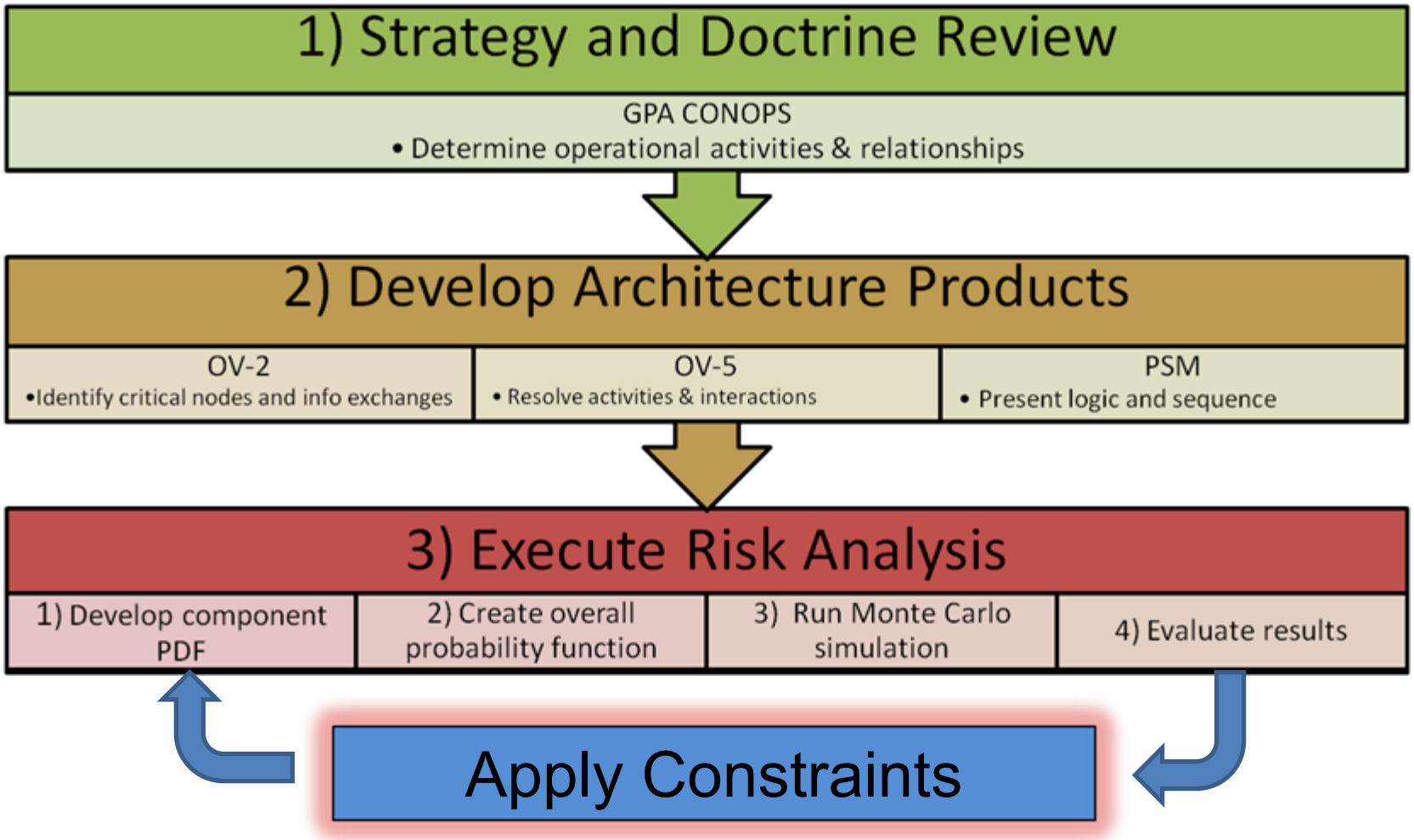
GRP Methodology



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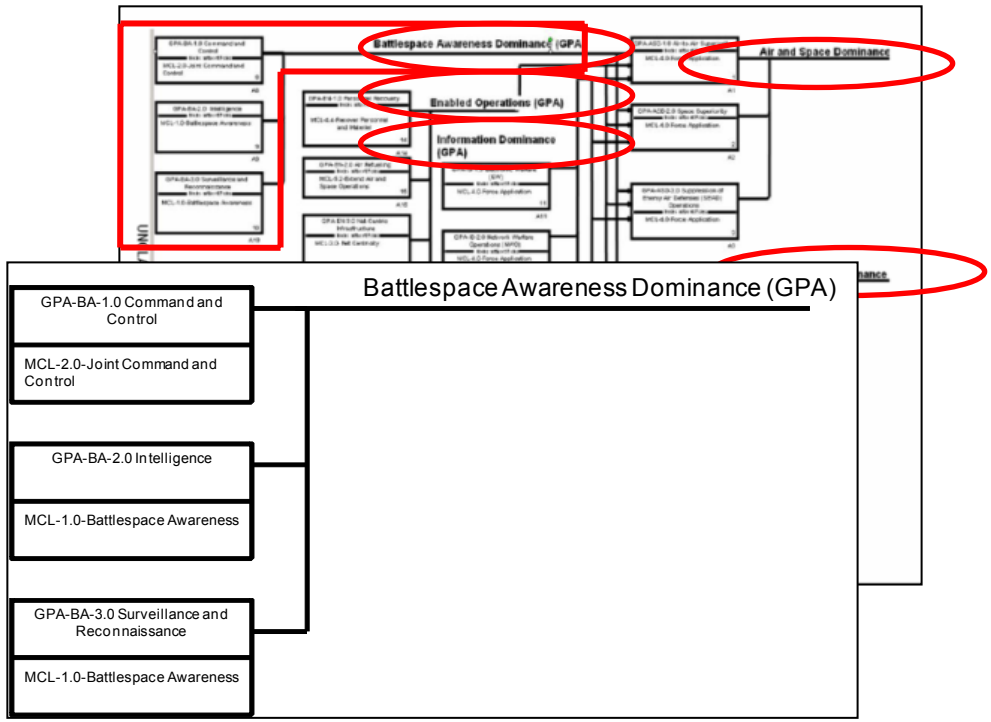
Strategy and Doctrine Review

GPA CONOPS



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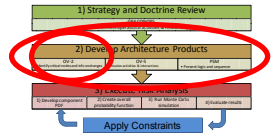
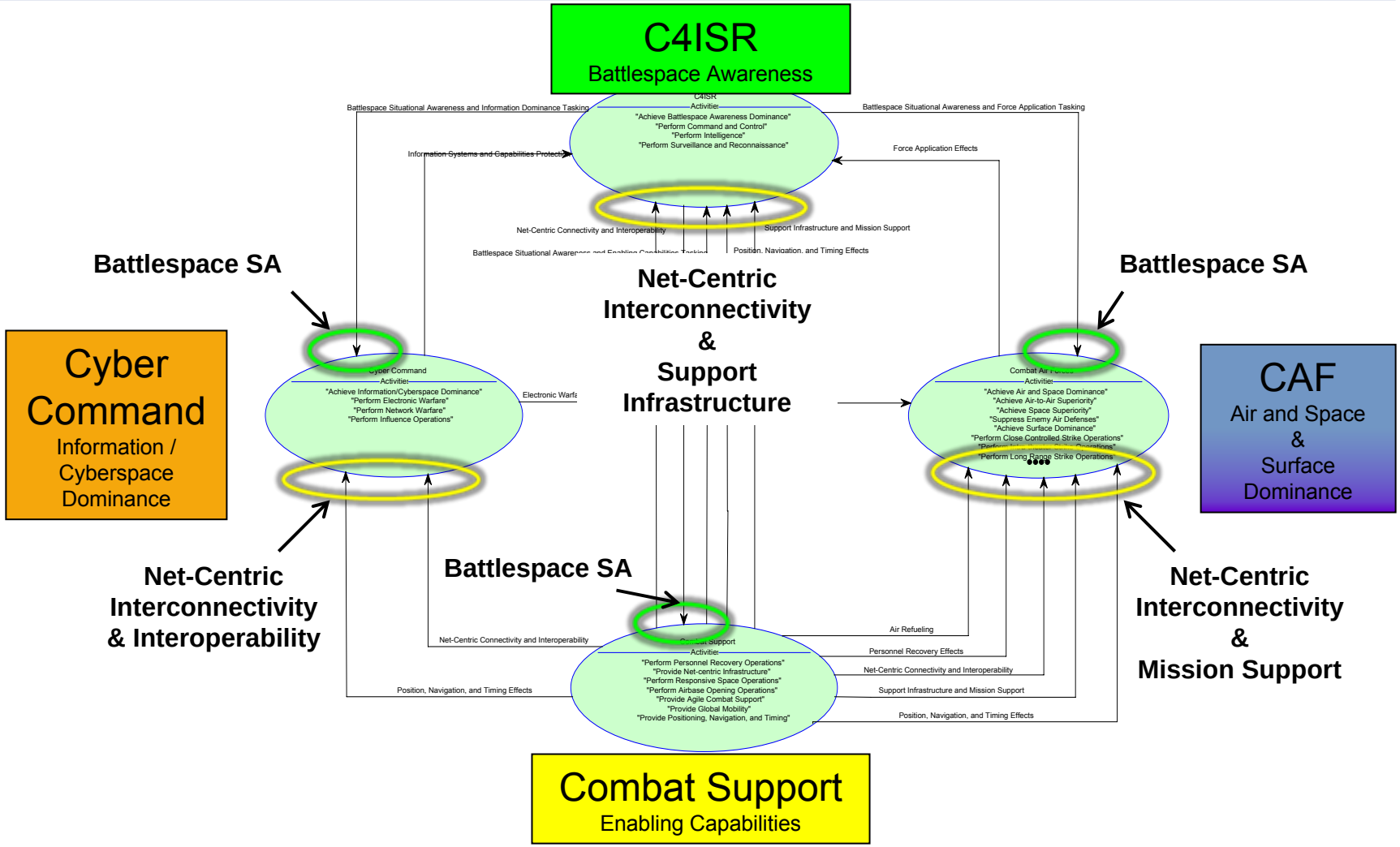
Operational Node Description (OV-2)





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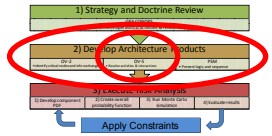
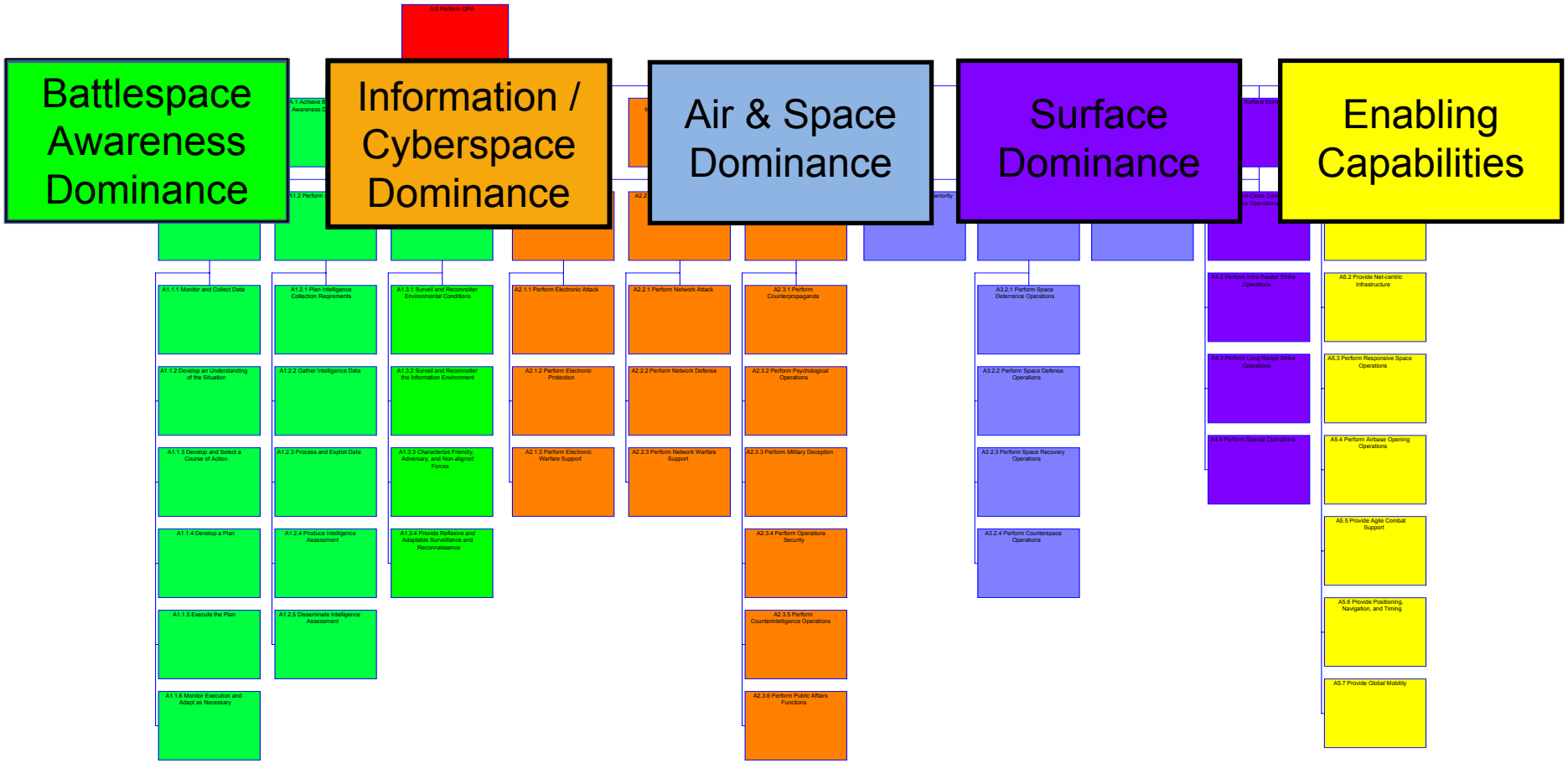
Operational Activity Hierarchy





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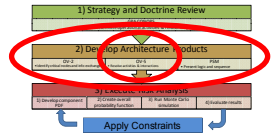
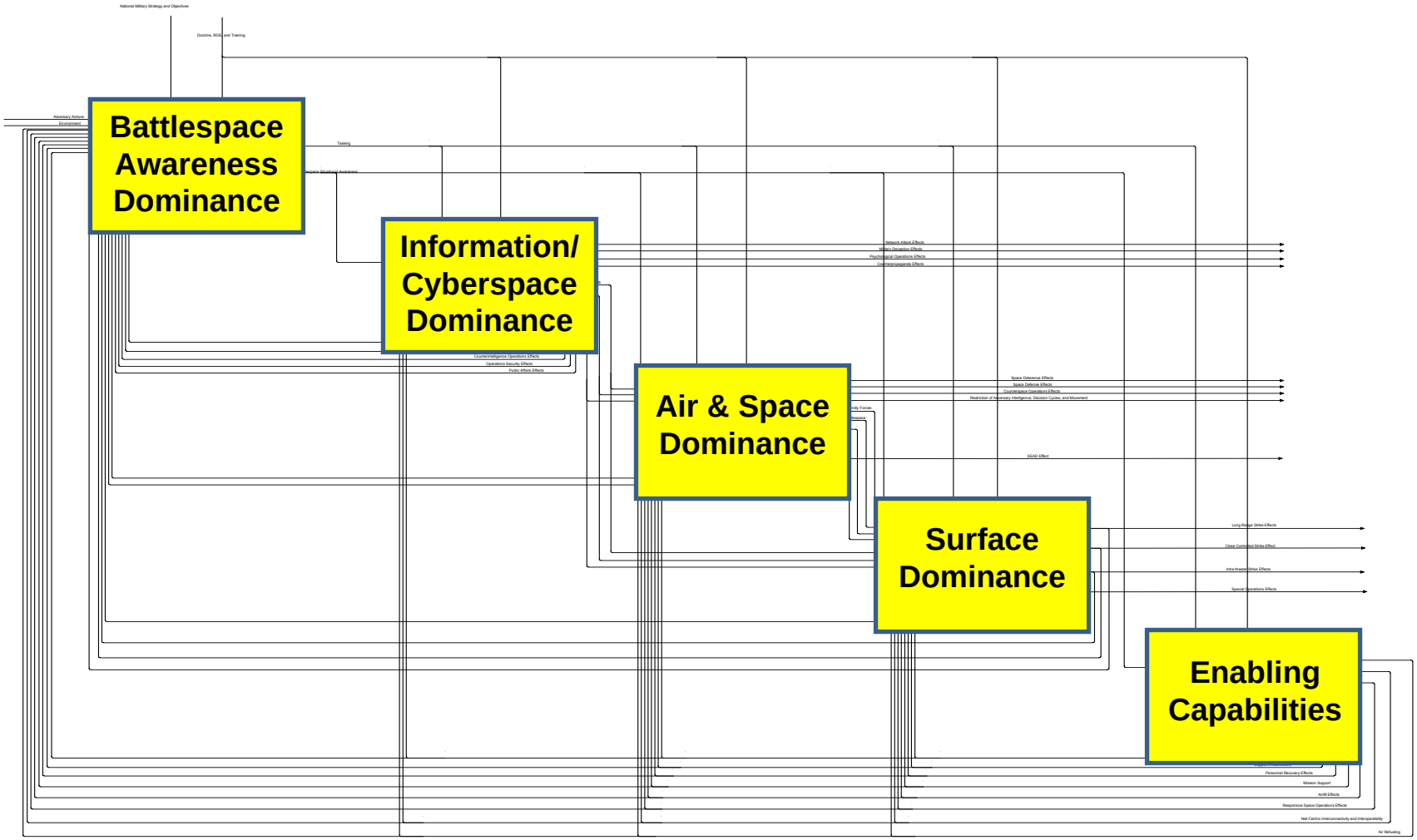
GPA A0 Diagram
(OV-5)





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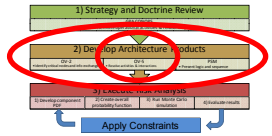
Battlespace Awareness



National Military Strategy and Objectives
Doctrine, ROE, and Training

Public Affairs Effects
Position, Navigation, and Timing Effe
Support Infrastructure
Mission Support
Airlift Effects
Responsive Space Operations Effe
Net-Centric Interconnectivity and Intero
Adversary Actions
Air Refueling
Environment

Command & Control

pace Situational Awareness
Battlespace Situational Awareness
Tasking
Tasking
gence Assessment Receipt Confirmation and Feedback
ander's Guidance

Intelligence

igence Collection Requests
Counterintelligence Operations Effects
Network Warfare Support Effects
Personnel Recovery Effects
Long Range Strike Effects
Close Controlled Strike Effect
SEAD Effect
Special Operations Effects
Operations Security Effects
Network Defense Effects
Intra-theater Strike Effects
Formatted Combat/Effects Assessment
Formatted Adversary Intent Assessment

Surveillance & Reconnaissance

Space Recovery Effects
Surveillance and Reconnaissance Data

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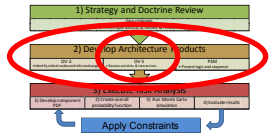
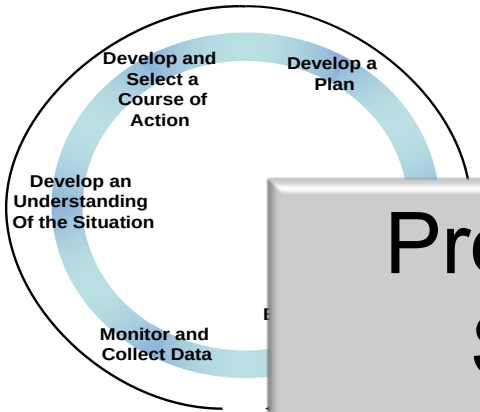
Battlespace Awareness



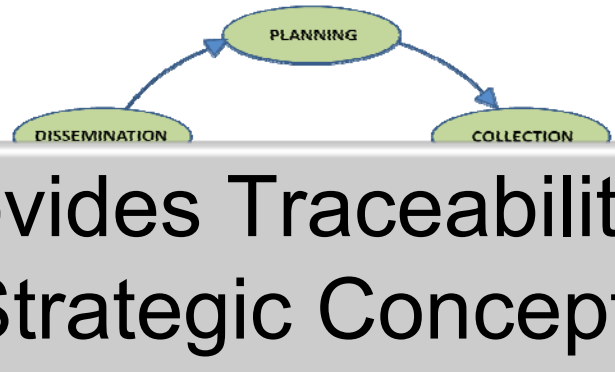
Command and Control

Command and Control JFC



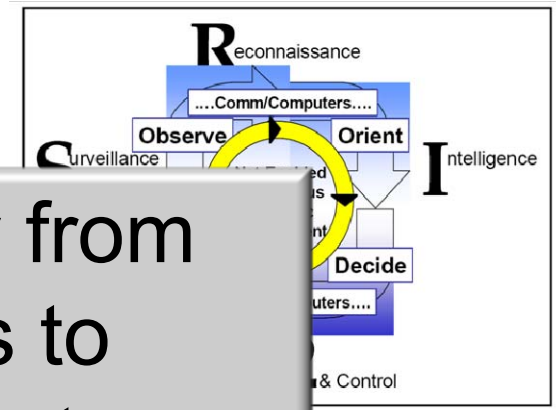
Intelligence

Joint Pub 2-01

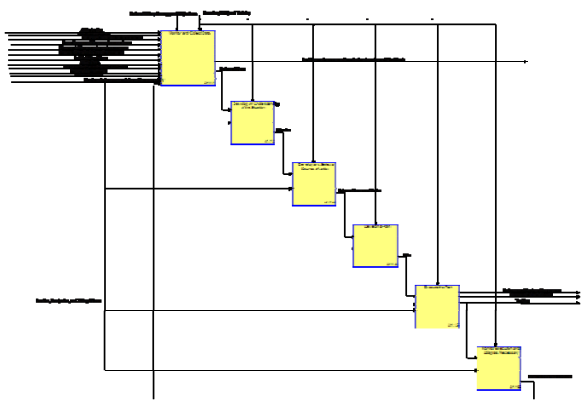


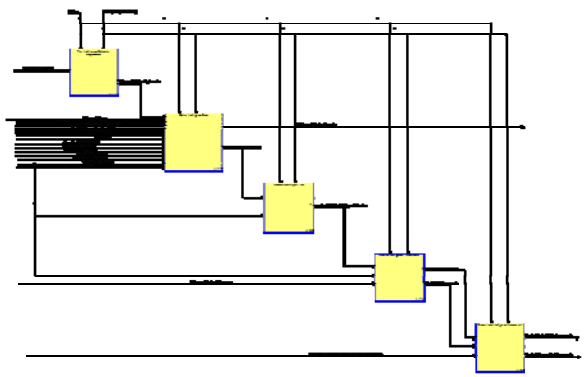
Surveillance and Reconnaissance

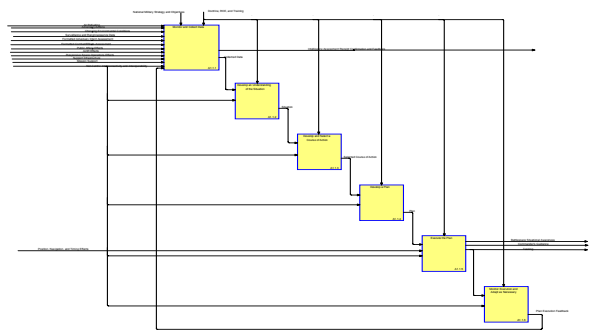
AF C4ISR CONOPS



Provides Traceability from Strategic Concepts to Architectural Products







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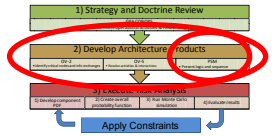
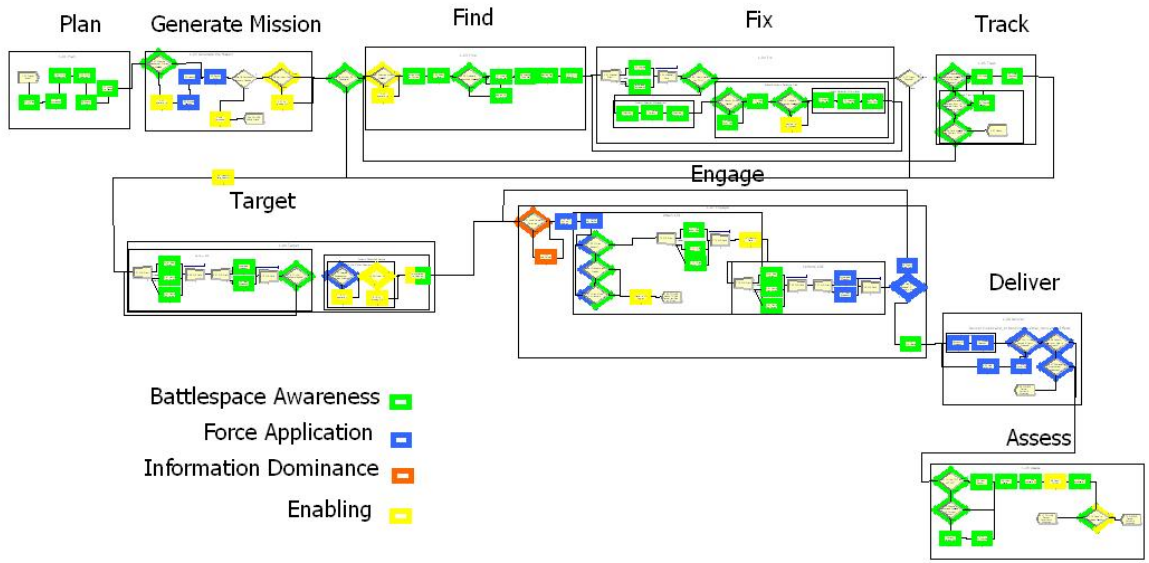
Methodology - PSM



- Apply Sequencing Logic for Risk Quantification
- Based on "Global Power" PSM
  - Uses F2T2EA Framework
  - Adaptable!



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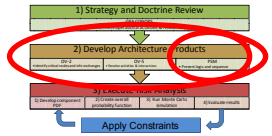
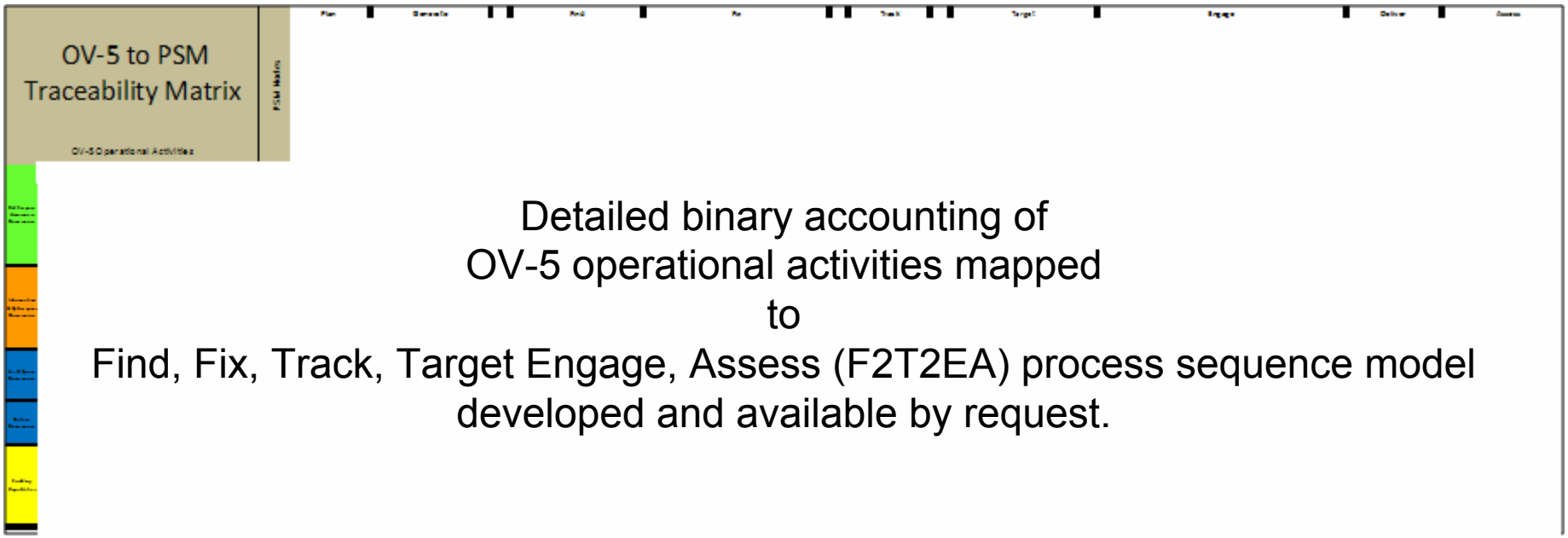
OV-5 to PSM Mapping





Detailed binary accounting of
OV-5 operational activities mapped
to
Find, Fix, Track, Target Engage, Assess (F2T2EA) process sequence model
developed and available by request.

Result: Requirements Traceability!
What needs to happen is mapped to when and how it will happen.

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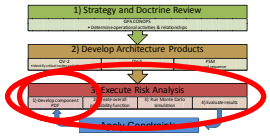
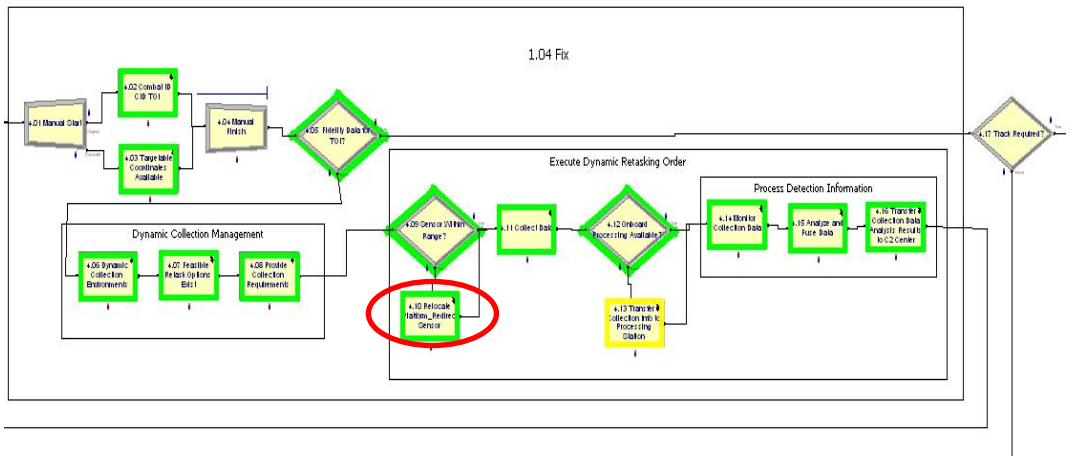
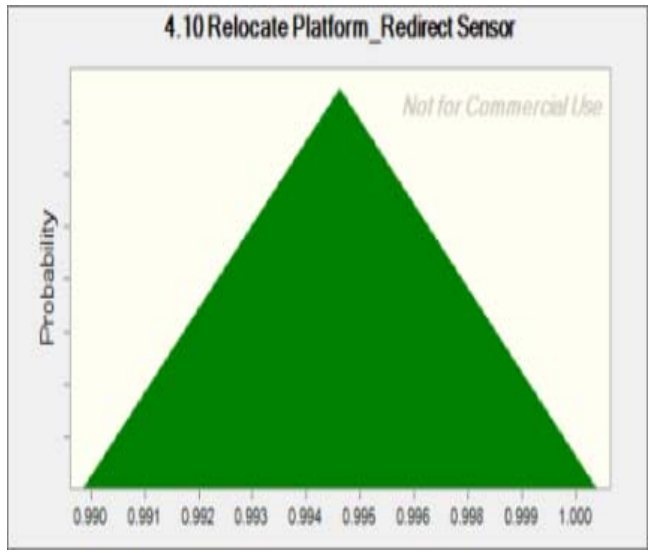
Methodology - PSM



PDF Development

- **P(s) PDF – Probability of successfully completing activity**
- **Based upon available data, SME input, and/or modeling and simulation results**
- **Reflects both capability and sufficiency**
- **Research used Triangular PDFs**





Triangular Distribution:

Minimum:	.99
Likeliest:	.995
Maximum:	1.00

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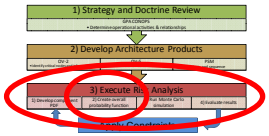
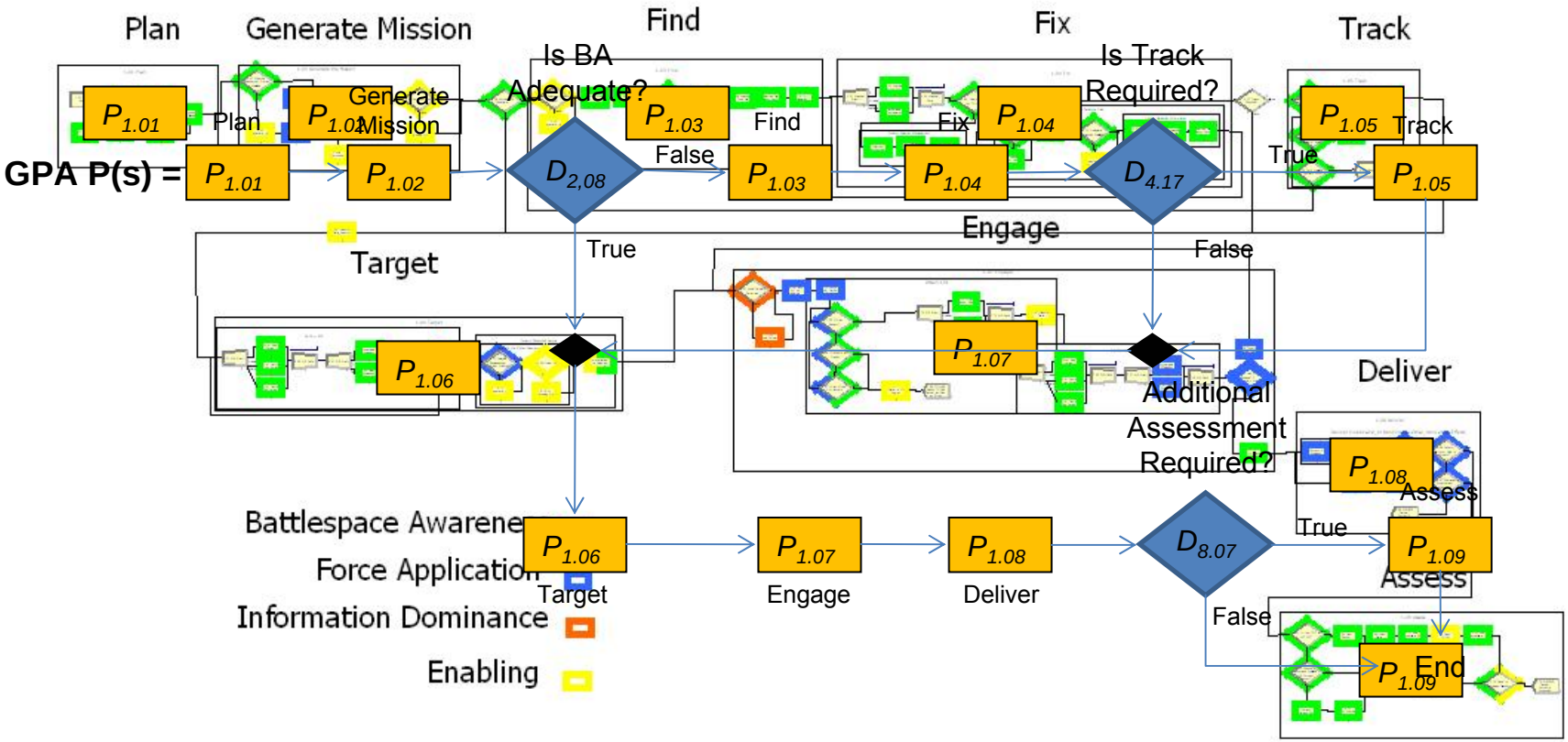
Methodology - PSM



PSM Structure Function



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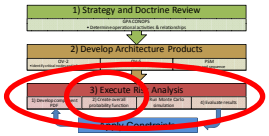
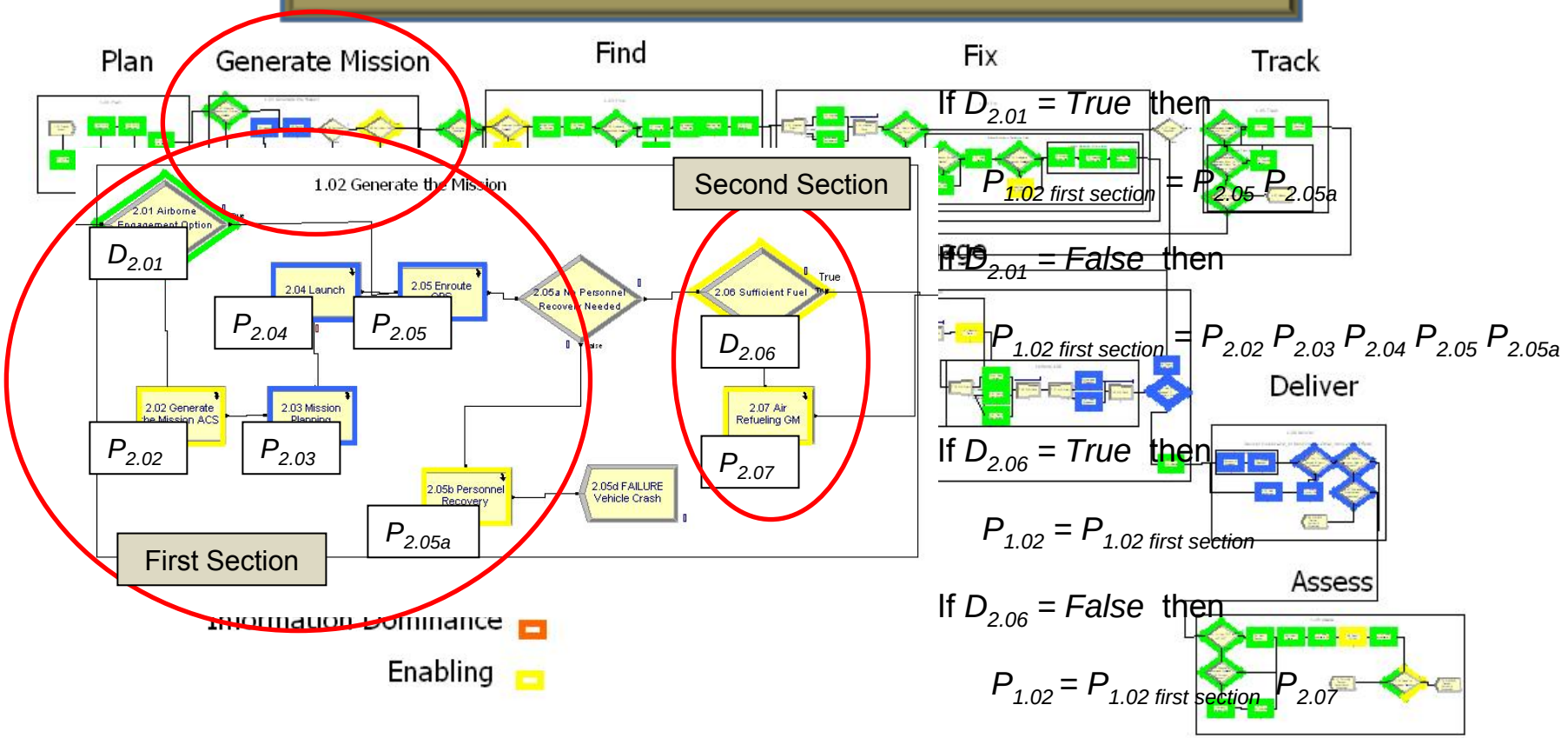
Methodology - PSM



PSM Structure Function



U.S. AIR FORCE

Analysis & Results

Fiscally Constrained Force Assumptions

- **Slipping C2ISR Modernization Program**
- **Closing F-22 Line After Lot 9**
- **Cutting or Slipping F-35 Program**
- **Cutting or Slipping New Tanker Development**
- **Failing to Develop New Long Range Bomber**

Assumptions for Proof of Concept Only

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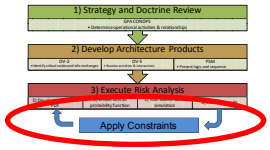
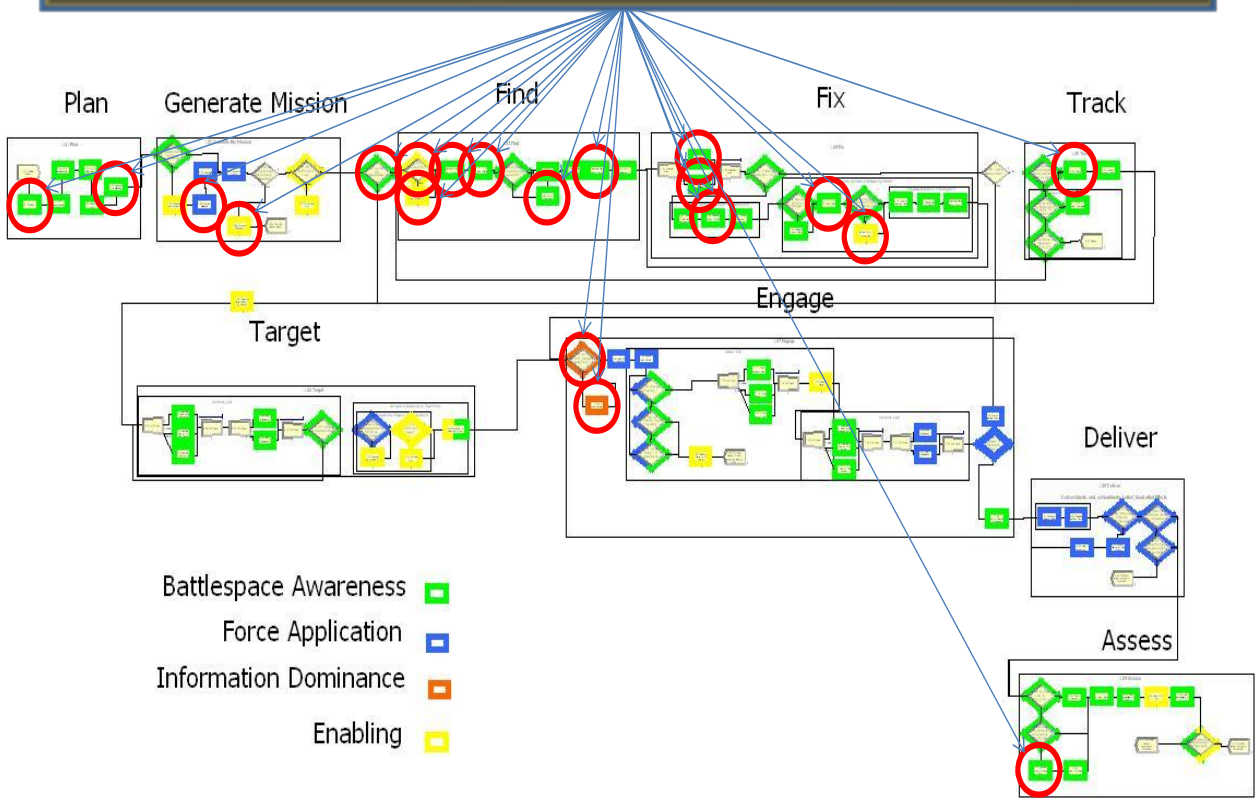
Analysis & Results



C2ISR Affected Nodes



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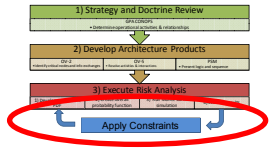
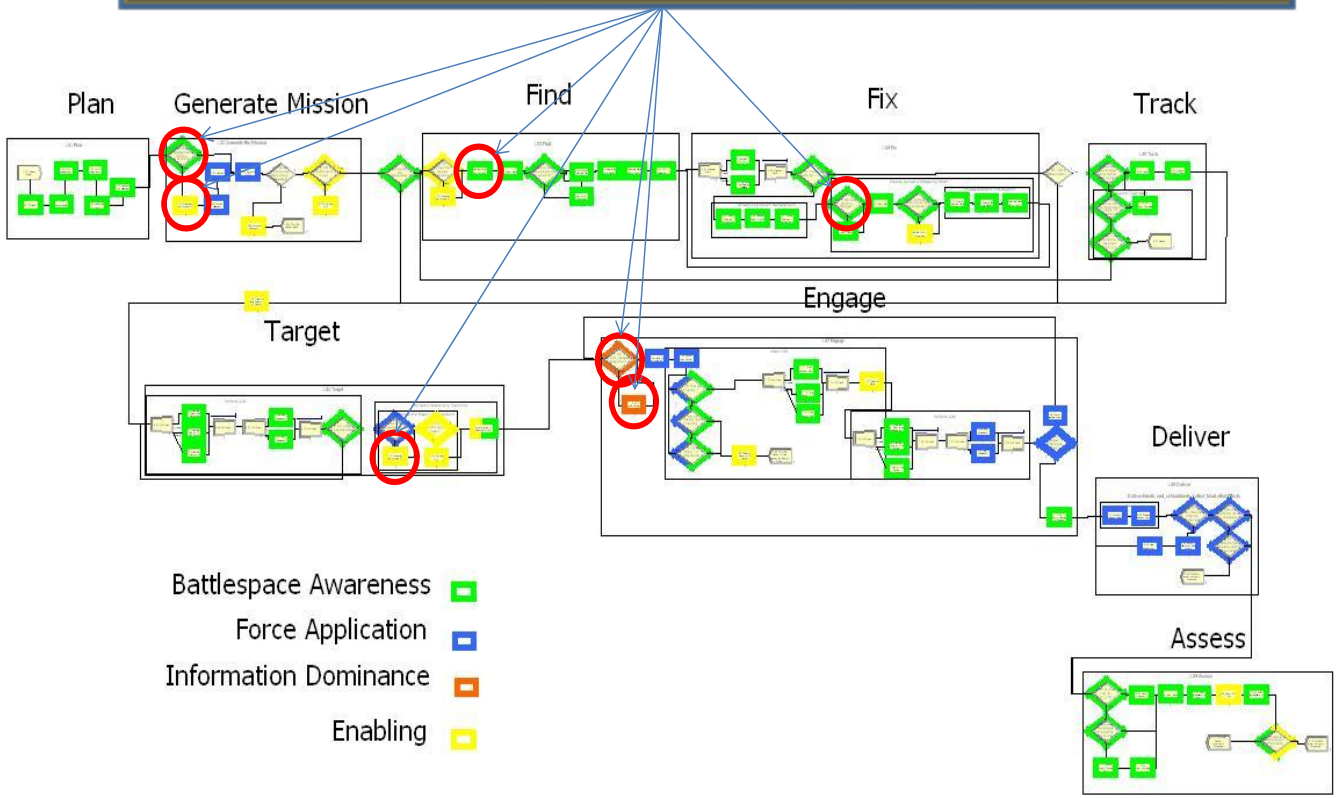
Analysis & Results



F-22 Affected Nodes



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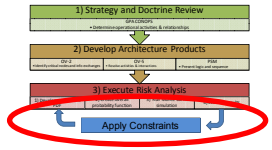
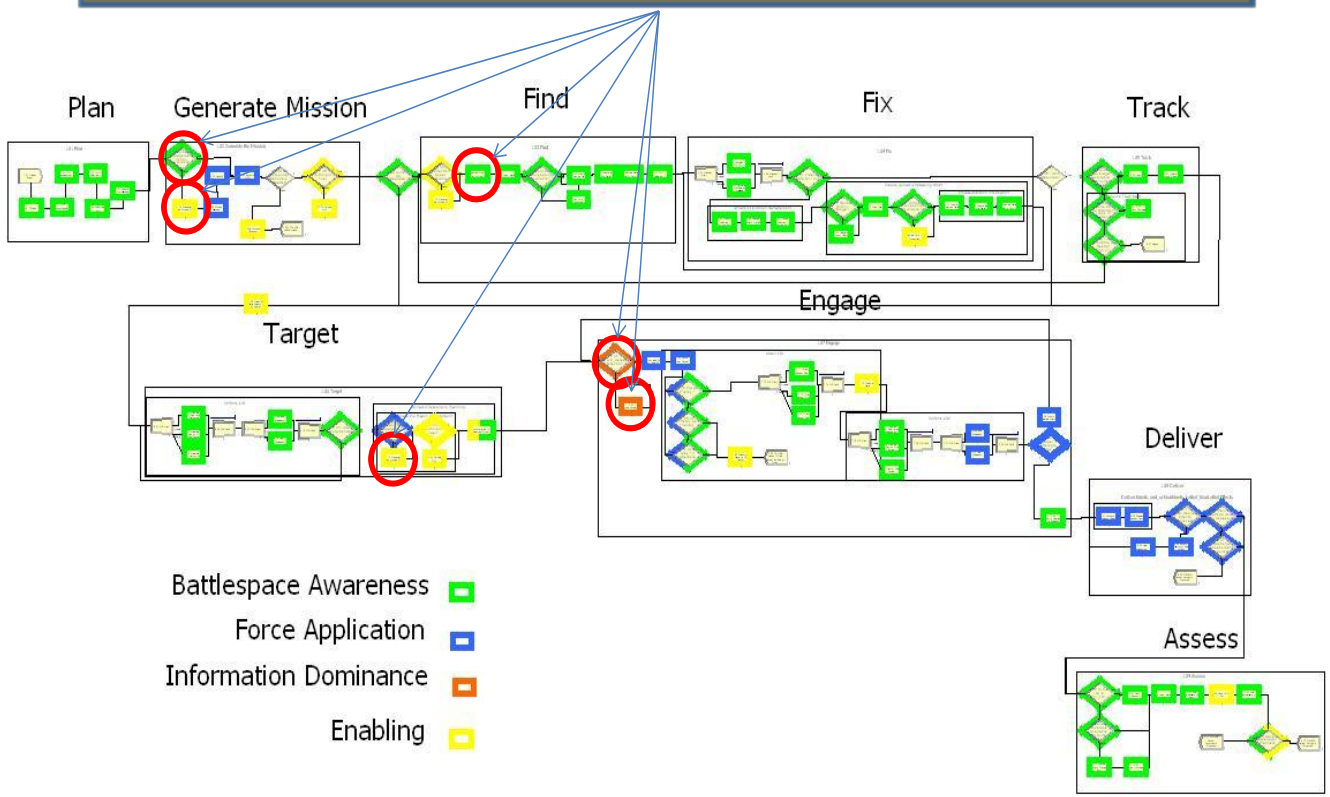
Analysis & Results



F-35 Affected Nodes



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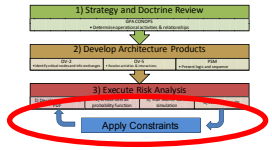
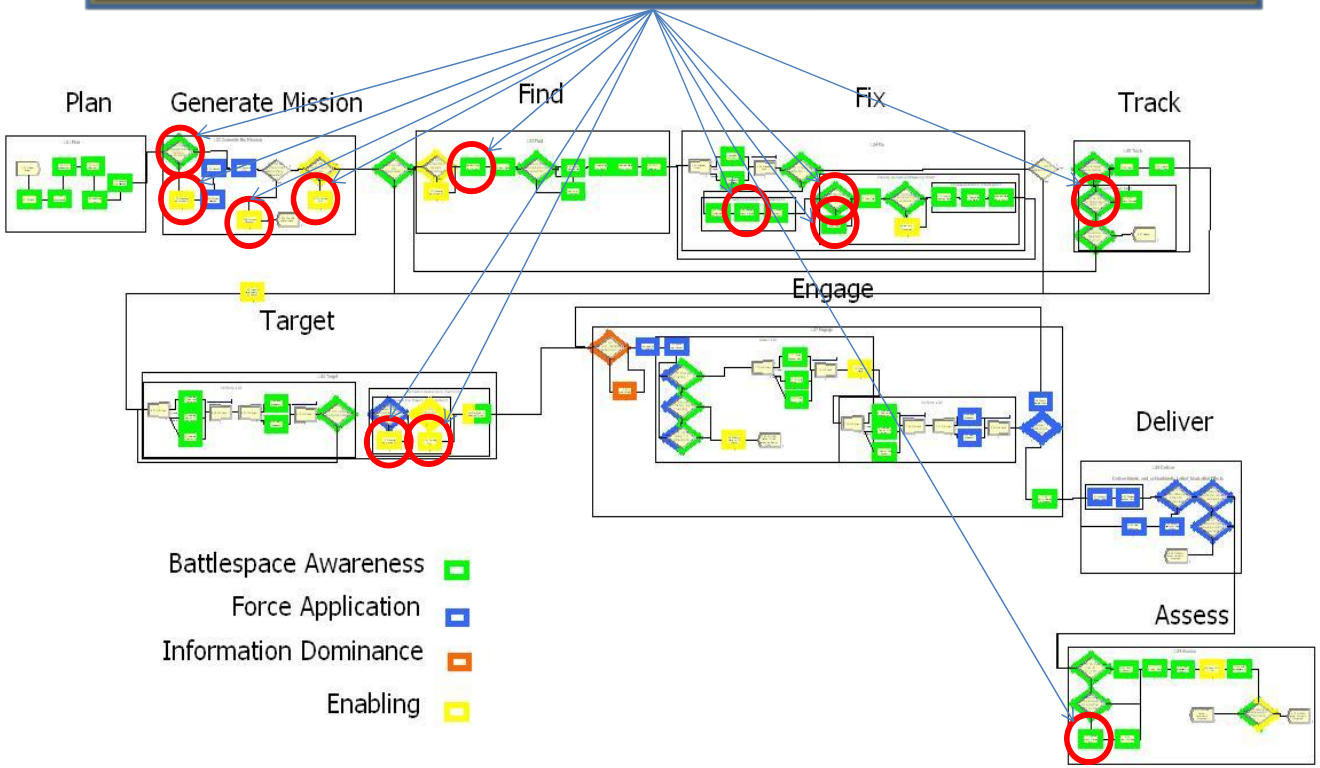
Analysis & Results

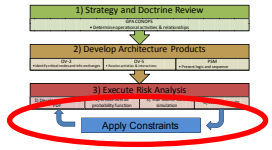


Tanker Affected Nodes

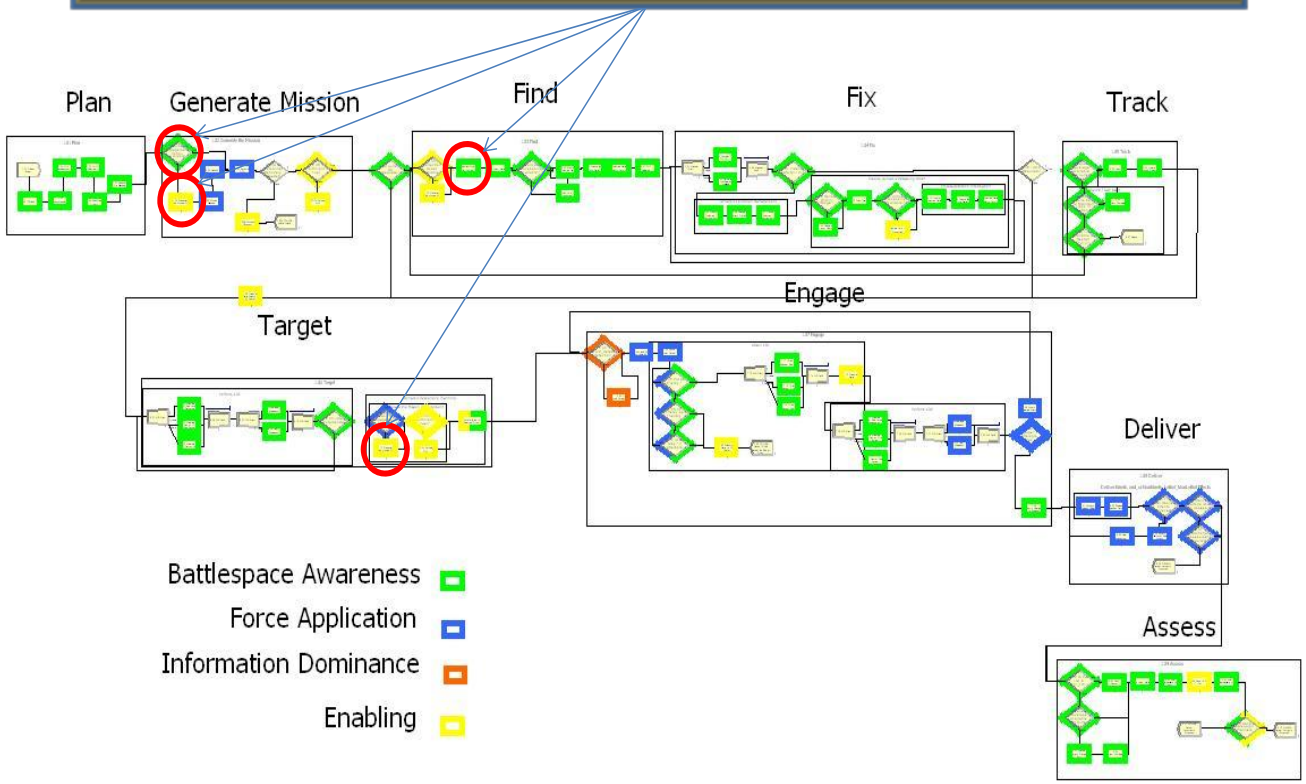


U.S. AIR FORCE

Analysis & Results



Bomber Affected Nodes



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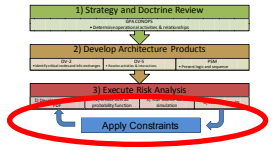
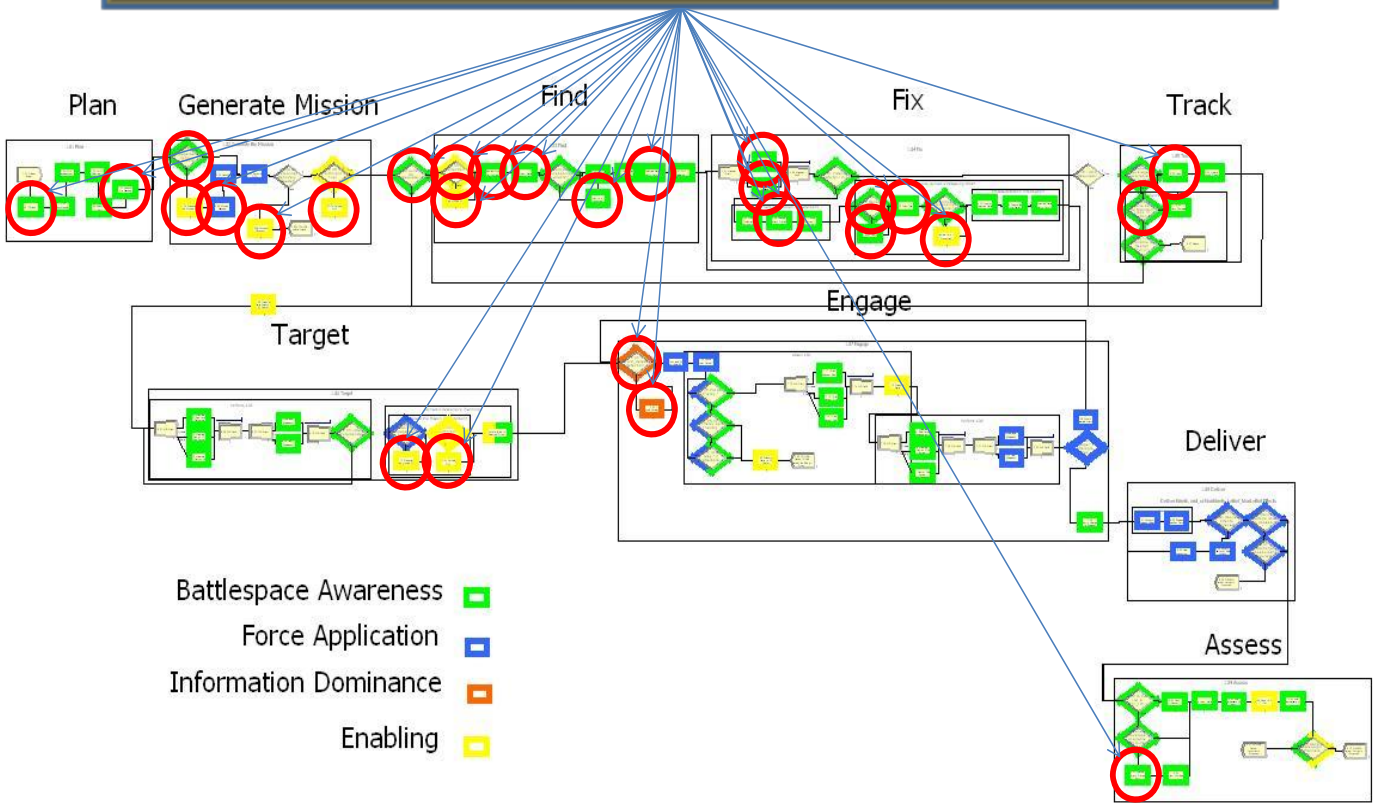
Analysis & Results

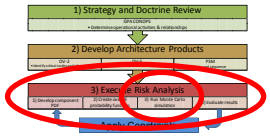


FCF Affected Nodes

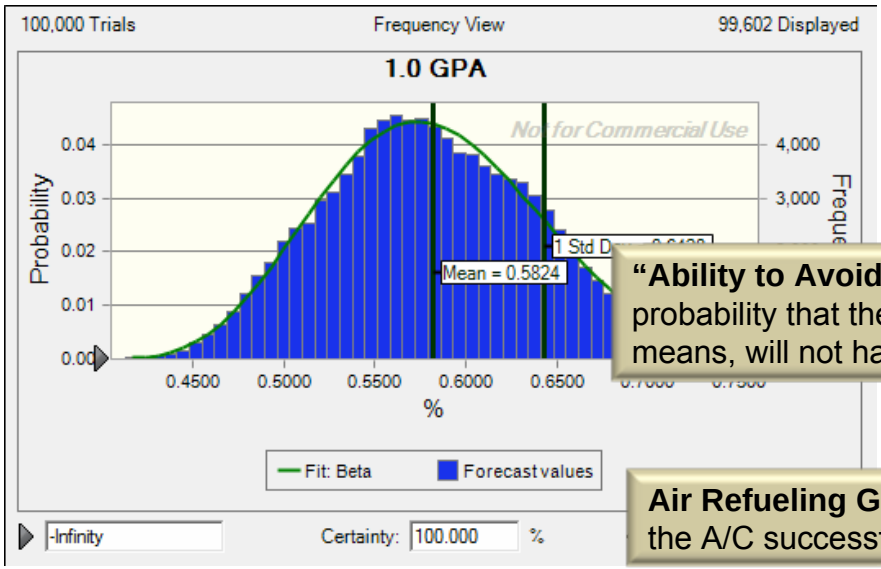


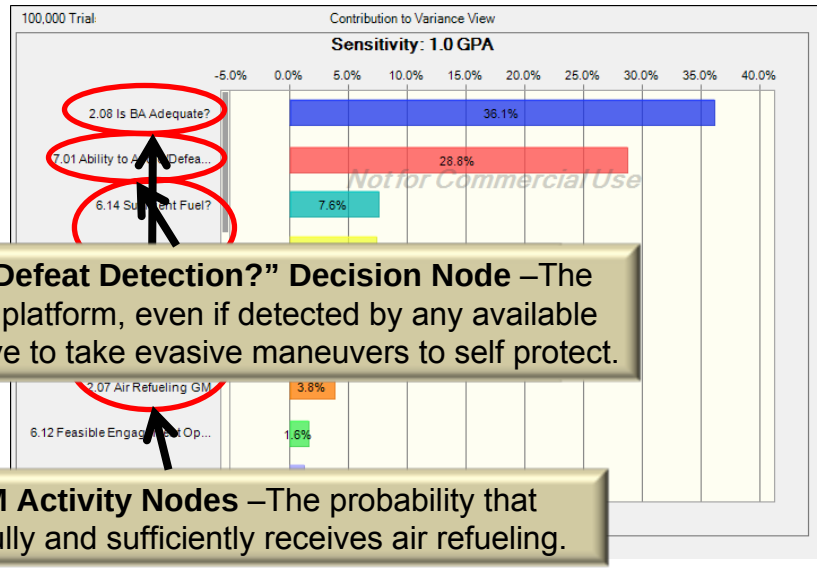
U.S. AIR FORCE

Analysis & Results



Fiscally Constrained Force



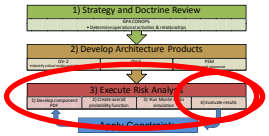


"Ability to Avoid/Defeat Detection?" Decision Node –The probability that the platform, even if detected by any available means, will not have to take evasive maneuvers to self protect.

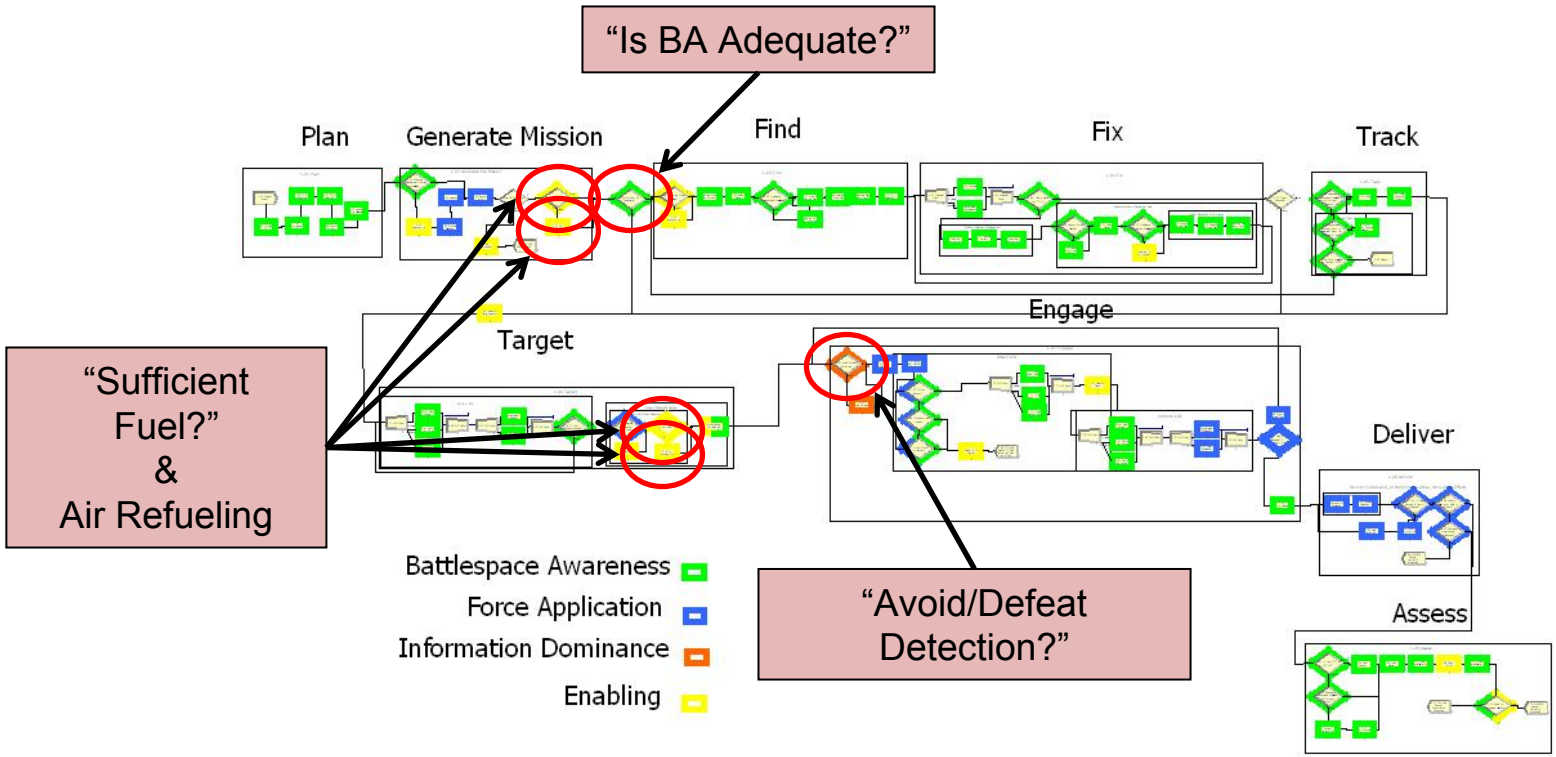
Air Refueling GM Activity Nodes –The probability that the A/C successfully and sufficiently receives air refueling.

U.S. AIR FORCE

Analysis & Results

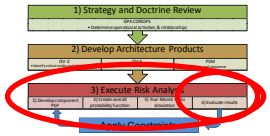


FCF Critical Nodes



U.S. AIR FORCE

Analysis & Results



FCF Independent Analysis of Constraints

1. Tanker
2. C2ISR
3. F-22
4. F-35
5. Bomber

P(s) Distribution Results	Sample Mean (S)					
	SRF	C2ISR	F-22	F-35	Tanker	Bomber
Overall Results	0.8683	0.7551	0.8493		.7123	
Is BA Adequate? = Yes	0.8831	0.7937	0.8672	0.8672	0.7271	0.8754
Is BA Adequate? = No	0.8341	0.7166	0.8081		6774	

8.9% Decrease

1.6% Decrease

0.8% Decrease

11.8% Decrease

2.6% Decrease

1.8% Decrease

P(s) Distribution Results	Sample Standard Deviation (S)					
	SRF	C2ISR	F-22	F-35	Tanker	Bomber
Overall Results	N/A	N/A	N/A	N/A	N/A	N/A
Is BA Adequate? = Yes	± 0.0115	± 0.0175	± 0.0204		0408	
Is BA Adequate? = No	± 0.0137	± 0.0216	± 0.0209	± 0.0208	± 0.0385	± 0.0164

≈ 1.5 times Greater

≈ 1.5 tim Greater

≈ Same ater

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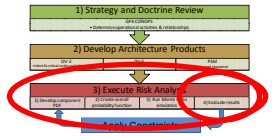
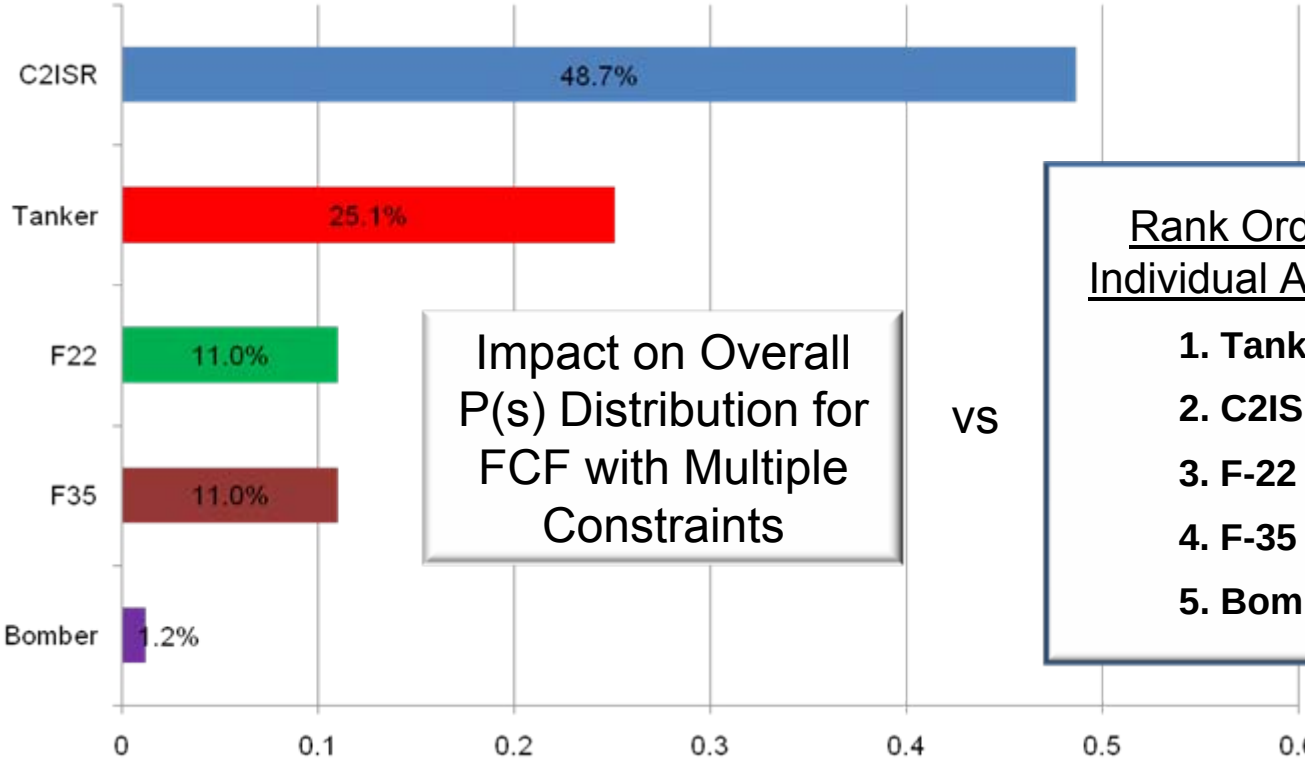
Analysis & Results



FCF Sensitivity by Capability



Impact on Overall P(s) Distribution for FCF with Multiple Constraints

vs

Rank Order of Individual Analysis

1. **Tanker**
2. **C2ISR**
3. **F-22**
4. **F-35**
5. **Bomber**

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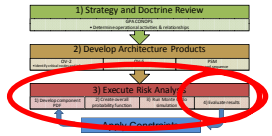
Analysis & Results



Analysis Conclusions

Analysis of individual constraints independently highlighted Tanker constraint as having greatest impact

but

Combined effects of all constraints resulted in C2ISR modernization constraint as most important to overall success!

Based Upon Research Assumptions

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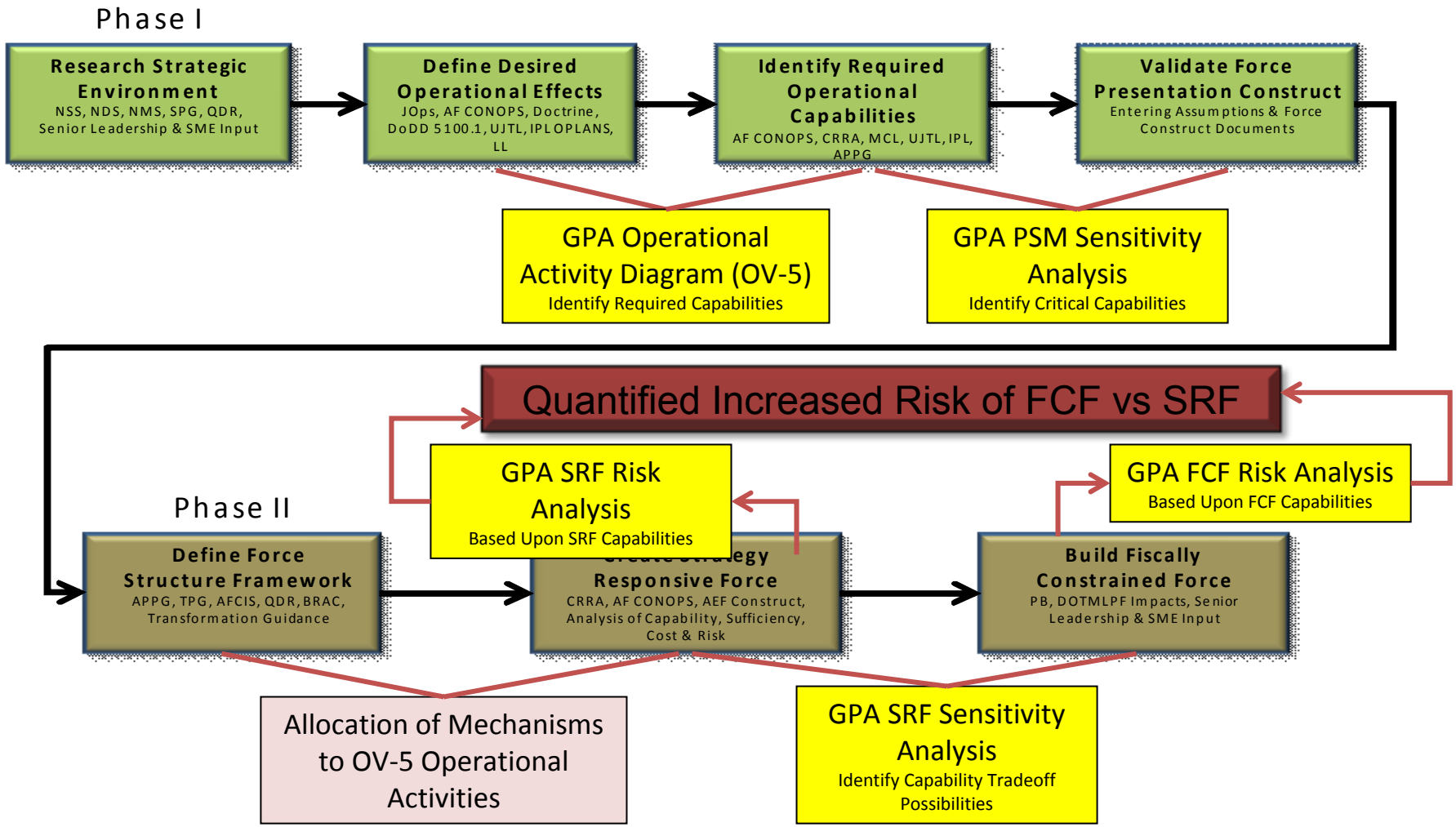
Recommendations



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Summary

- Use Risk Analysis Methodology to Indentify Key SoS Interdependencies to Quantifies Risk and Identify Critical Capabilities
  - Methodology Requires Multiple Iterations!
- Architecture and PSM for GPA SoS
- Risk Analysis of GPA SoS
  - Quantify Risk for Each Force Construct
  - Identify Critical Capabilities
  - Notional Analysis Identified C2ISR as Most Critical
- Integrate Into Force Construct