Implementing a Systems Engineering Risk Program in a Sustainment Environment

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What Sustainment Environment?

727th Aircraft Sustainment Group

Col. James Fulton
Commander

Ms. Jerri Hulme
Deputy Director

Mr. James Miller
Chief Engineer

PROVIDING EFFECTIVE & EFFICIENT WEAPON SYSTEM SUPPORT

727 ACSG Mission

- Single Manager for Sustainment and Modernization of
  - 400+ USAF Commercial-Derivative Aircraft
  - HF Global Communications System Network
- Preserves FAA Certification and Operational Safety, Suitability & Effectiveness (OSS&E) of Commercial Derivative Aircraft
- 4 Squadrons Manage Services Acquisition

"Cradle-to-Grave CLS Support"

Weapon System Support

727th Aircraft Sustainment Group
Contractor Logistics Support (CLS)

Weapon Systems
- KC/KDC-10
- VC-25
- E-4B
- C-9
- C-12
- C-20
- C-21
- C-26
- C-38
- E-9
- T-41
- T-43
- T-51
- TG-10
- TG-15
- UV-18
- Peace Lotus
- HFGCS

Customers
- AMC
- ACC
- ANG
- AFRC
- AETC
- USAFE
- PACAF
- AFMC
- USAF ACADEMY
- AF FLIGHT STD AGENCY
- ARMY
- NAVY
- US MARINE CORP
- DIA
- DSCA
- FMS
- USSOCOM

727 ACSG Responsibilities

Weapon System's Missions

So What is the Problem?

- Numerous classes, training, & regulations on risk
  - Most aimed at acquisition, not sustainment
  - No detailed direction for a workable, grass-roots approach
- Sustainment different
  - Not one big pass/fail
  - Most new risk associated with mods or unique events
- Our organization had insufficient direction, documentation, and procedures to implement an effective, comprehensive Systems Engineering risk program

So What Are Doing About It?

- Instigated a step-by-step Operating Instruction to implement risk management throughout the organization
- Trained the workforce for common SE baseline
- Implemented tangible approach that is:
  - Aimed at the working level
  - Applicable throughout entire organization
  - Accounts for progress through metrics
  - Always starts with requirements

Workforce Training

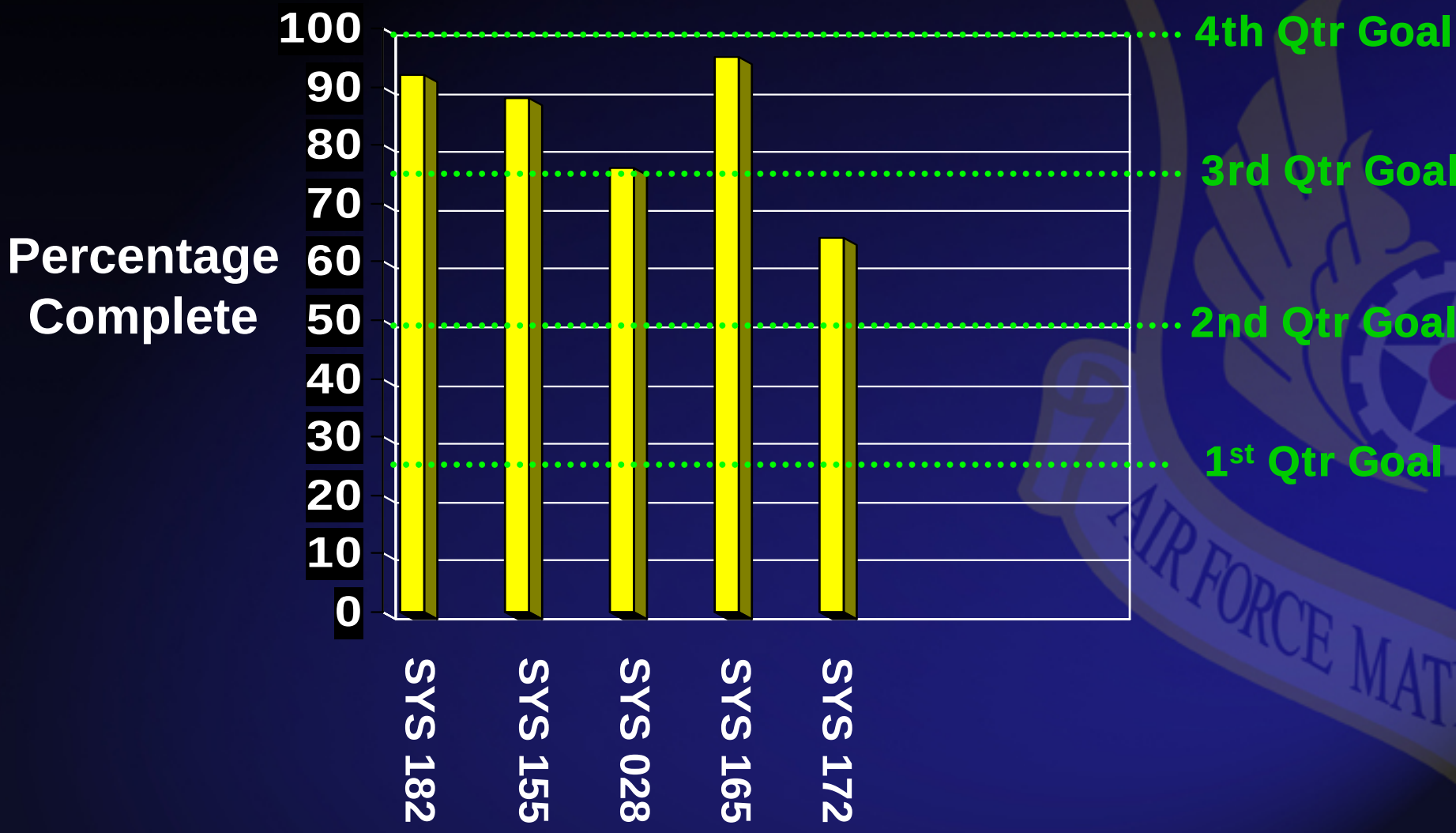
Courses Selected for First Year (All CBT):

- SYS 182 Intro to Systems Engineering ~ 3 hrs
- SYS 172 Modification Management Process ~ 6 hrs
- SYS 155 Operational Safety, Suitability & Effectiveness ~ 9 hrs
- SYS 028 Intro to Configuration Management ~ 16 hrs
- SYS 165 Intro to Risk Management ~ 21 hrs

Who: All PM's, Equipment Specialists and Engineers
When: Complete in 12 months

Workforce Training Metric

Org A Training Progress (45 People)



Risk Management Process

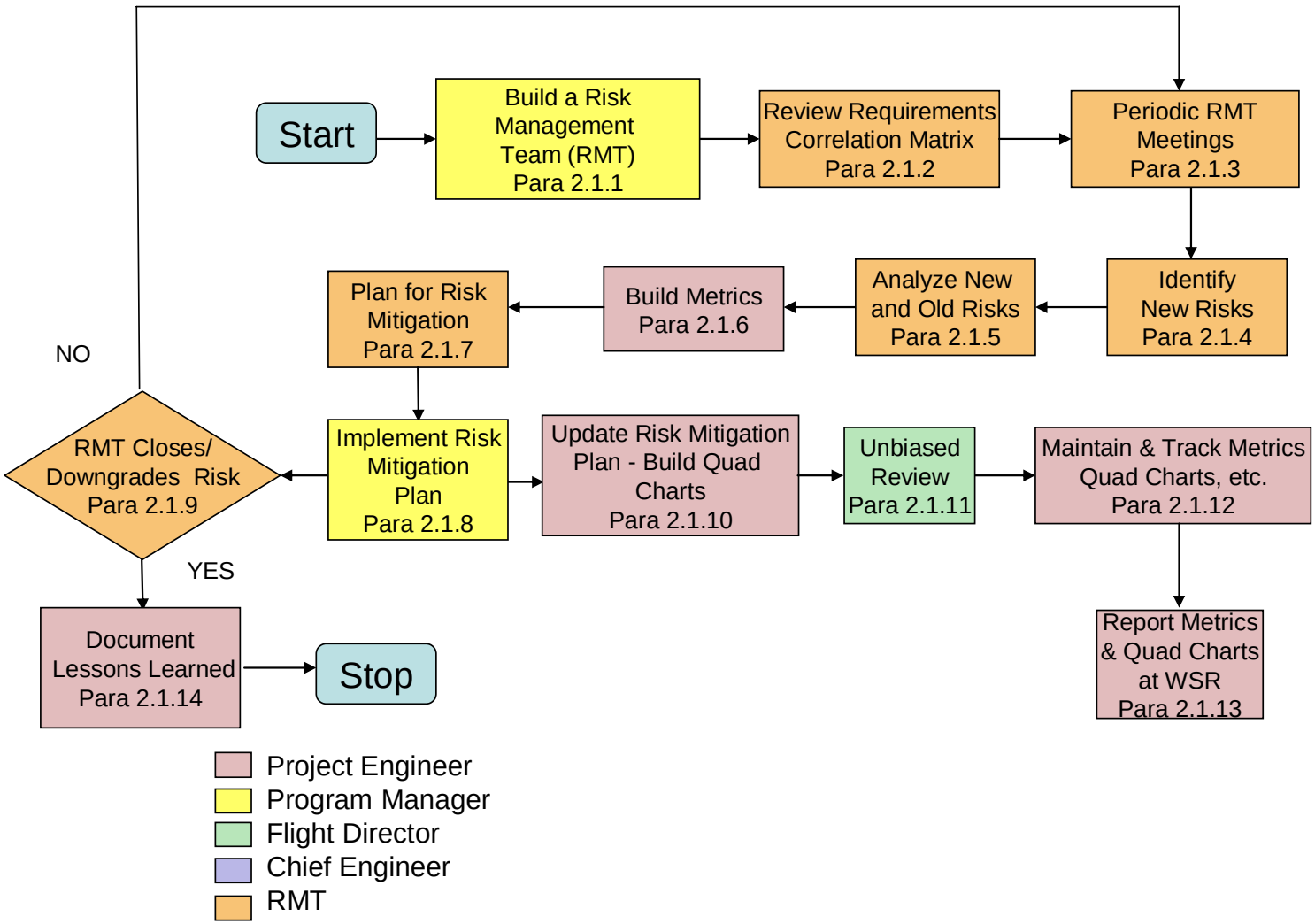


Figure 1. Flowchart for Risk Management Process

Step 1: Build a Risk Management Team

- Program Manager formally establishes RMT in writing
- RMT consists of, at a minimum:
  - Program Manager
  - Project Engineer
  - Representative from the customer
  - Representative from the contractor

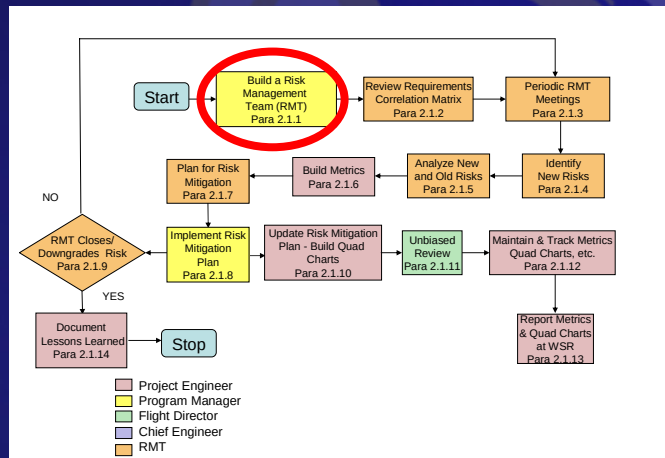


Figure 1. Flowchart for Risk Management Process

Step 2: Review Requirements Correlation Matrix

- Review established RCM
  - Review all initial identified risks assessments
  - Verify initial assessment
  - Determine if all risks have been identified

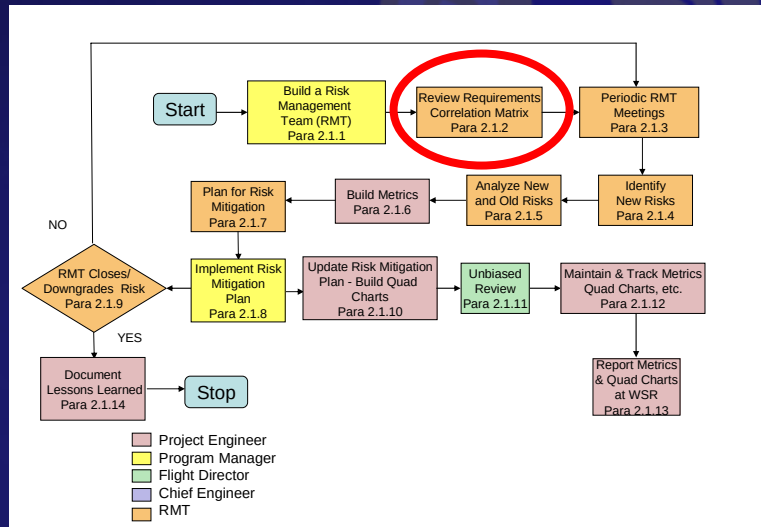


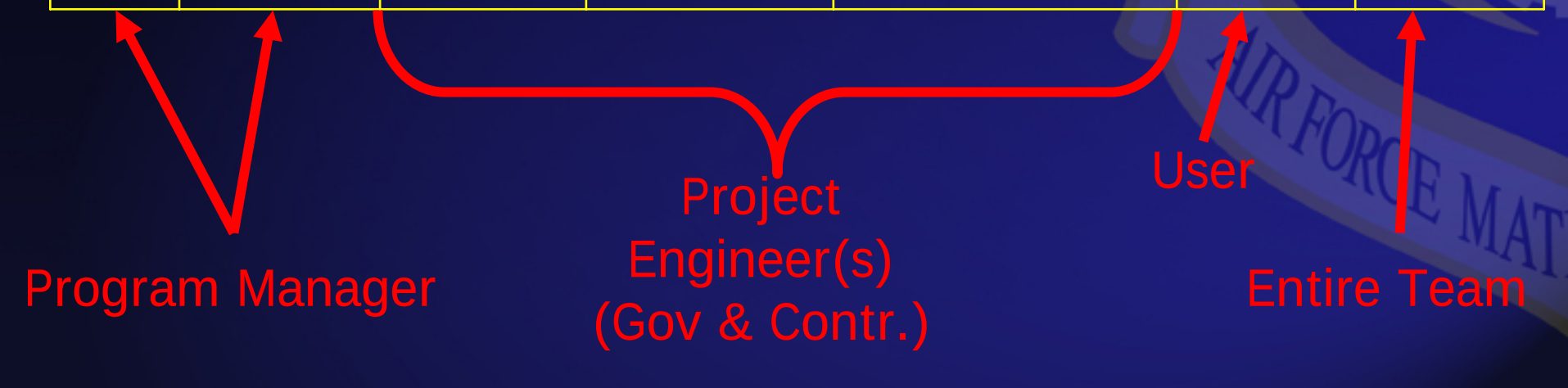
Figure 1. Flowchart for Risk Management Process

Define Requirements

- Break requirements down in a Requirements Correlation Matrix (RCM):
- Spreadsheet with following columns:
  - Requirement
  - Requirement Source
  - Derived Requirements
  - Quantification
  - Operational Conditions
  - Initial Risk Assessment
- Give RCM to
  - Test Team for their planning
  - Risk Mngt Team for their planning

RCM

Req Title	Req Source	Derived Req	Req Definition	Quantification	Op Cases	Risk (R/Y/G)



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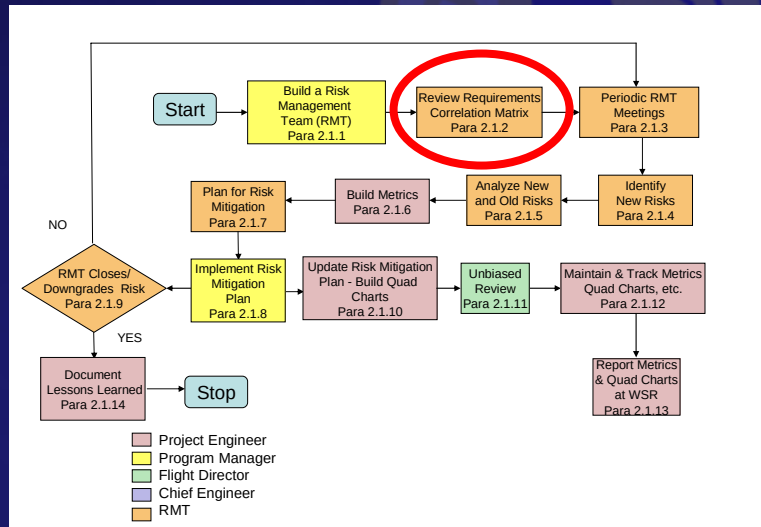

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Step 3: Periodic RMT Meetings

- Project Engineer shall chair meeting
  - Determine frequency
  - Not less than quarterly to support Weapon System Review (WSR)
- Purpose to:
  - Review all risks
  - Review all mitigation plans
  - Identify new risks
  - Build and update quad charts
  - Close risks

Step 4: Identify New Risks

- Identify any new technical risks
  - Documented requirements
  - Other sources
- RMT can provide input back to RCM
- Other opportunities to identify risks
  - Event driven technical reviews
  - Program management reviews
  - Design reviews

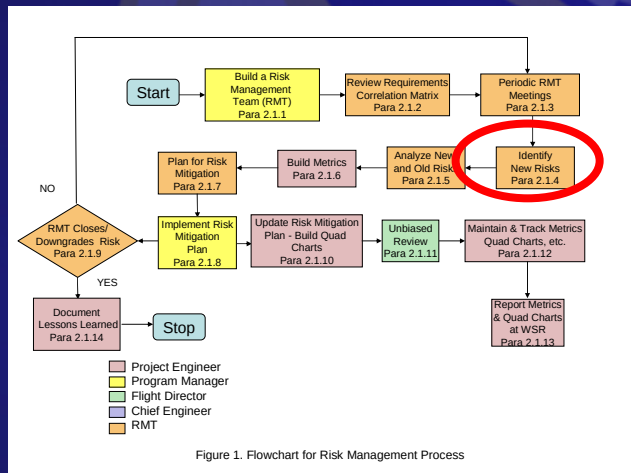


Figure 1. Flowchart for Risk Management Process

Step 5: Analyze Old & New Risks

- Analyze each identified risk
- Use 5 by 5 matrix
  - Consequence if occurs
  - Likelihood of occurring
- Perform Root Cause Analysis for all “red” and “yellow” risks

Step 6: Build Metrics

- Two minimum metrics
  - Risk Assessment Matrix
  - Risk Mitigation Plan Roll-up
- Quad Chart for each yellow/red risk
- Metrics shown to management at quarterly Weapon Systems Review

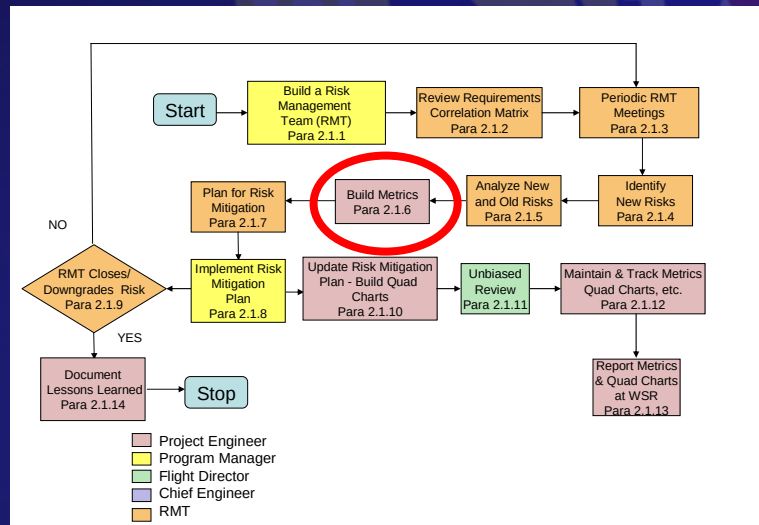
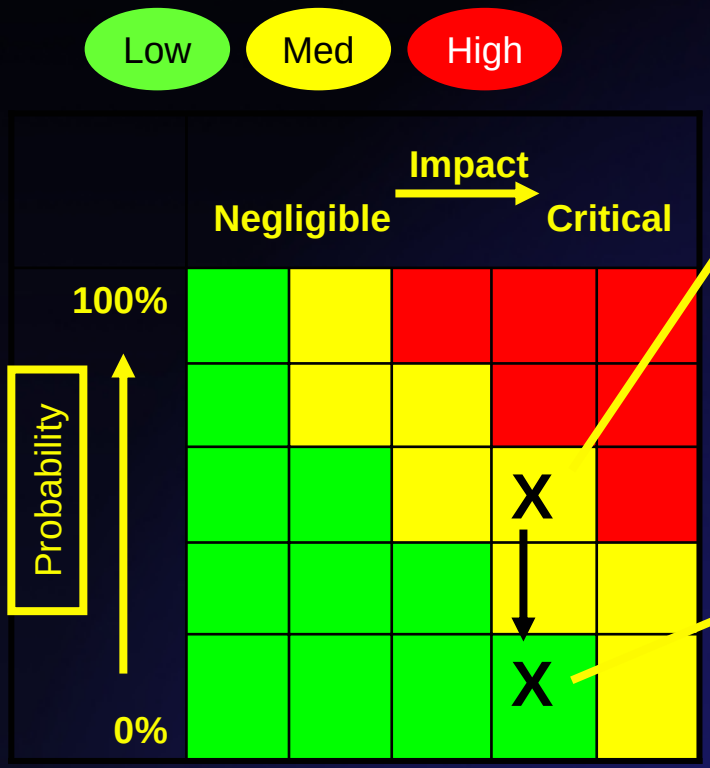


Figure 1. Flowchart for Risk Management Process

Risk #1 Assessment Matrix



Technical Risk: If software complexity increases on MCS then failure of modifications could result.

Mitigation Plan:

- Contractor is currently Capabilities Maturity Model Integration (CMMI) software level 3 certified and has plan to reach level 5 by contract award
- Government will ensure contractor will work with ground agencies to ensure software is interoperable
- Government will follow disciplined requirement matrix process outlined in 727 ACSG Operating Instruction (O.I.) to prevent unplanned requirements/complexity increases & track via established metrics

Risk Workshop Completed – 14 Mar 07

Rick Quad Chart

Risk Title

Risk Tracking Number

G

Risk Color Code

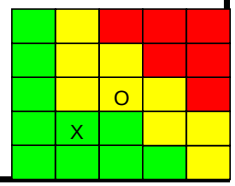
Background

Description of problem

- **Item 1**
- **Item 2**
- **Item 3**

Risk Mitigation Plan

- **Proposed solution for implementation and risk mitigation.**



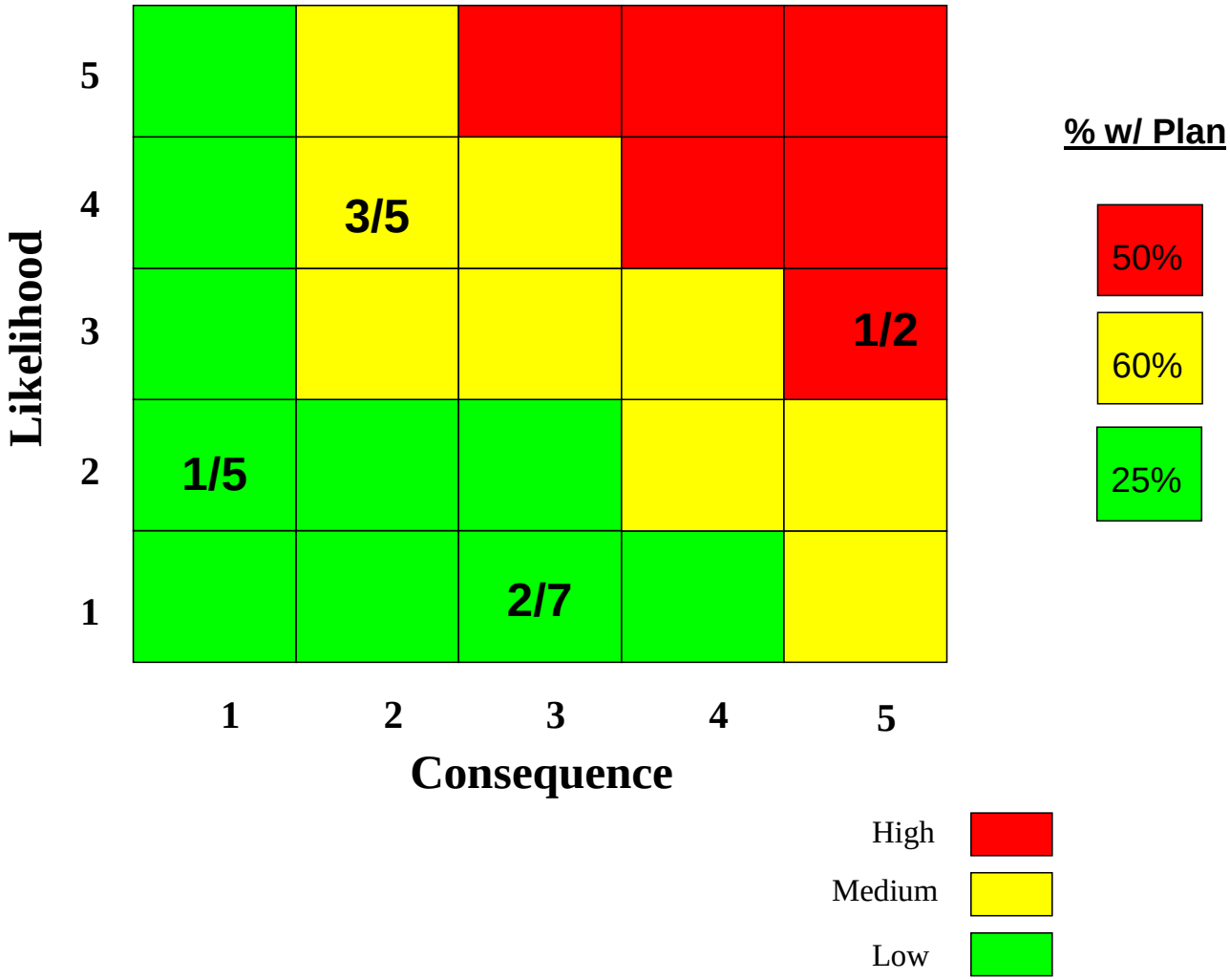
Actions to Date

	Date
• **Established Risk Assessment**	**Date 1**
• **Completed Mitigation Plan**	**Date 2**
• **Completed details of mitigation incorporation with contractor**	**Date 3**
• **Received effort impact (cost and schedule)**	**Date 4**

Future Action

	Proj.Date
• **Contract Award for implementation**	**Date 1**
• **Mitigation Plan Completion (or any significant milestones)**	**Date 2**
• **Etc…**	

Risk Mitigation Plan Roll-Up



Step 7: Develop Risk Mitigation Plan

- Risk Mitigation Plan shall consider:
  - Cost
  - Schedule
  - Safety
  - Effectiveness
- Plan should delineate:
  - Definite courses of action
  - Address the root cause
- Plan should be timely:
  - Within 14 days for high, or red, risk
  - Within 60 days for medium, or yellow, risk

Step 8: Implement Risk Mitigation Plan

- **Program Manager will:**
  - **Work with contractor and/or customer as applicable**
  - **Incorporate into Integrated Master Schedule**
  - **Budget funds accordingly**
  - **Schedule technical interchange meetings as required**

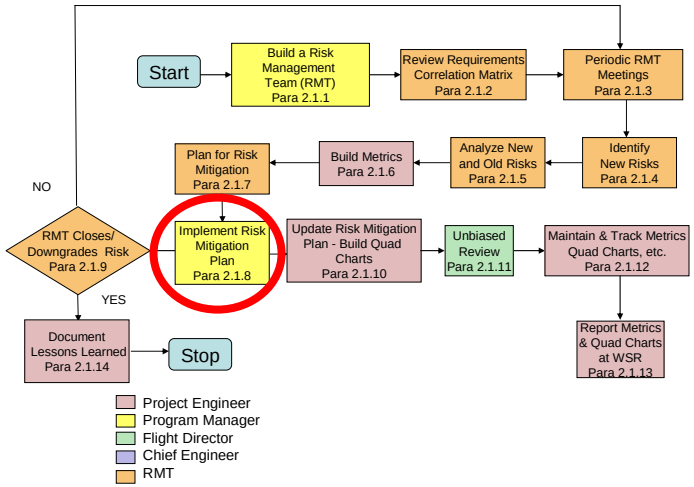


Figure 1. Flowchart for Risk Management Process

Step 9: Update Mitigation Plans/Quad Charts

- Project Engineer will update:
  - Risks
  - Risk Mitigation Plans
  - Quad Charts
  - Metrics
- Quad charts and metrics will be briefed at:
  - Weapon System Reviews
  - Program Management Reviews
  - Others as determined by PM

Step 10: Unbiased Review

- Project Engineer's boss will set up
- Review will include at a minimum:
  - Chief Engineer
  - Program Manager
  - SMEs within the organization
  - SMEs outside the organization
- Will go thru all risks, mitigation plans, quad charts, and metrics
- Project Engineer will incorporate feedback from review

Step 11: Track Metrics, Charts, Reports

- Project Engineer and Program Manager will update throughout process
- PM will ensure information reported in various venues (WSRs, PMRs, etc)

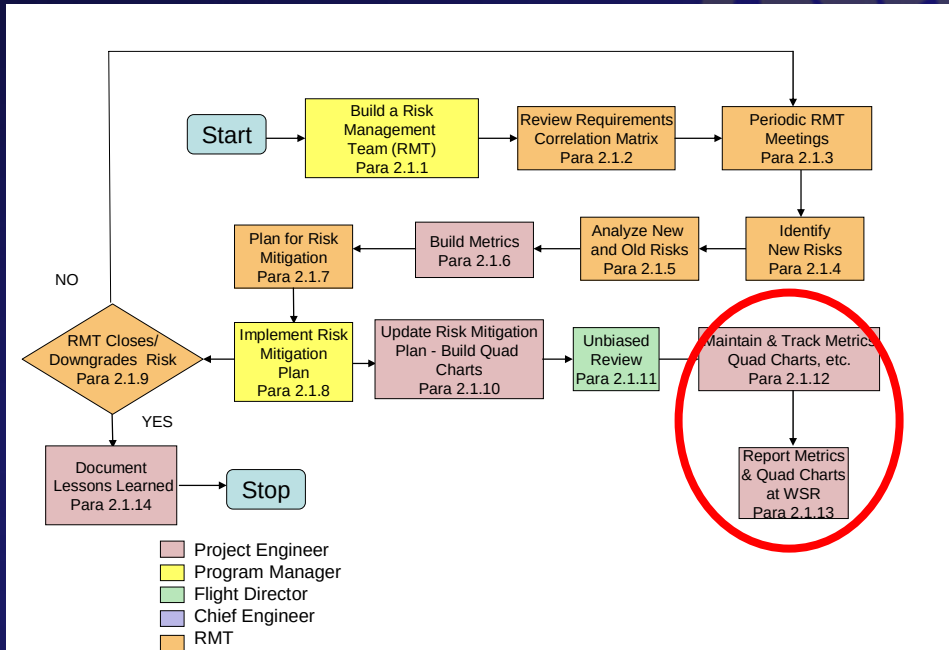


Figure 1. Flowchart for Risk Management Process

Step 12: Lessons Learned

- Risks are not snowflakes
- Mitigation Plans are not either
- Lessons Learned repository contains:
  - Possible risks to consider
  - Potential mitigation plans
- Repository is not program specific, but for entire organization
- Future plans are to make the lessons learned repository a database with keyword searches

What's Next

- Continue implementation throughout organization
- Continue Measure/Track results
- Populate Lessons Learned database
- Refine as needed
- Document successes
  - We are having some!

Risk Management can be implemented, applied AND make a difference

Summary

- 727th ACSG developed grass-roots means to implement Risk Management as part or our Systems Engineering in Sustainment Environment
- Clear-cut, tangible processes steps for the working-level
- Metrics to measure progress for management
- It works

In Place and In Use Now

Questions ?

Questions ?

Major Modification Programs

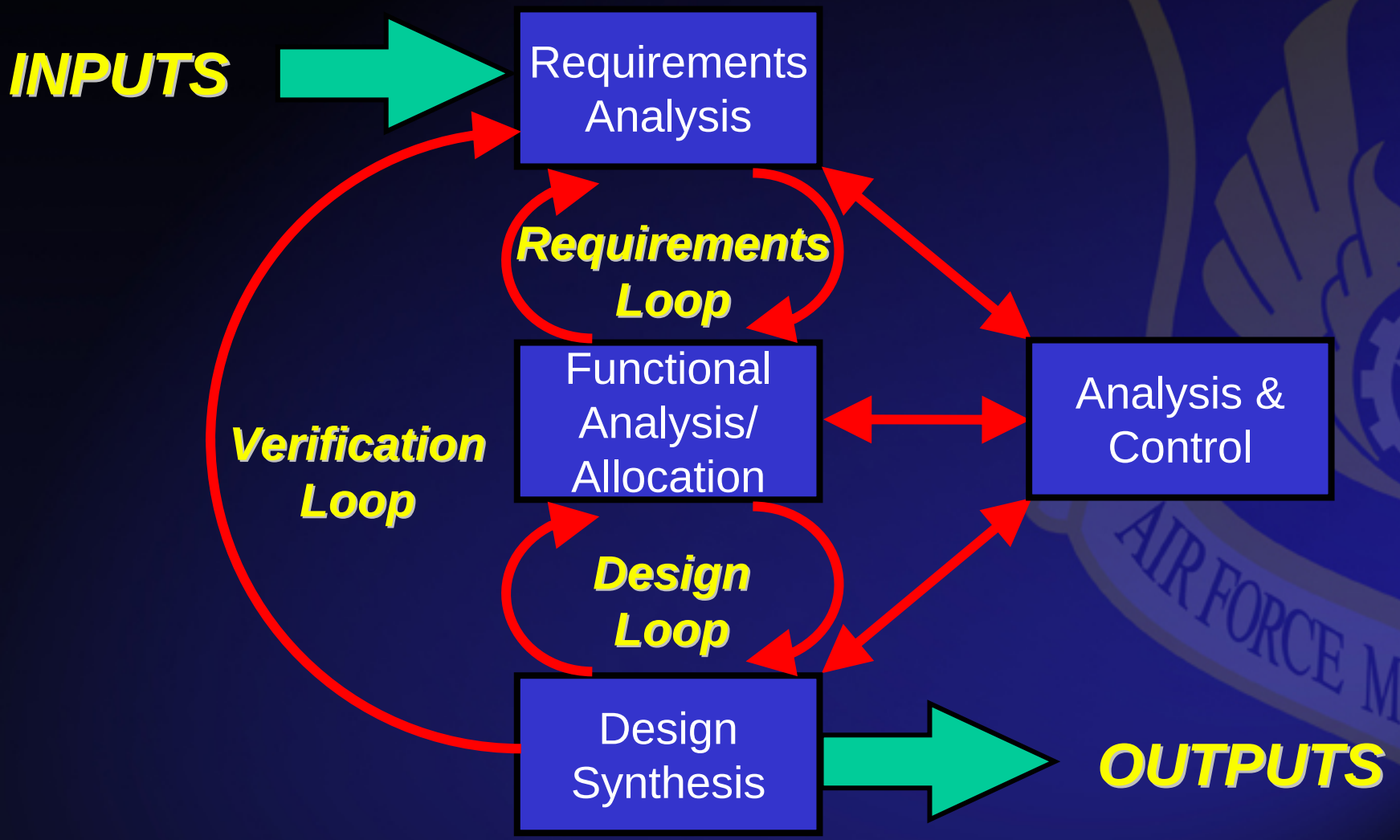
17 Current Programs

Y	KC-10 AMP – ASC Lead (ACAT II)	$1.03B
G	KC-10 Dual 406 MHz ELT Upgrade (ACAT III)*	$2.4M
G	KC-10 Iridium Phone (ACAT III)*	$2.7M
G	KC-10 UHF SATCOM Antenna (ACAT III)*	$2.6M
G	VC-25 Forward Lower Lobe (FLL) Cooling (ACAT III)	$14.4M
G	VC-25 Presidential Data System (PDS) (ACAT III)*	$223.3M
G	VC-25 CNS/ATM (ACAT III)*	$41.8M
G	C-20 Gulfstream Test Vehicle (GTV) (ACAT III)*	$8.7M
G	E-9 Telemetry Sys Upgrade (ACAT III)*	$5.9M
G	E-4B Mod Block I (ACAT II) *	$421.4M
G	E-4B 256 Kbps High Speed Data via INMARSAT (ACAT III)*	$8.4M
R	C-12 EFIS (ACAT III)	$77.7M
Y	HFGCS Network Control Station – West (ACAT III)*	$23.2M
Y	HFGCS AFSPC Test Range HF Modernization (ACAT III)*	$3.9M
G	HFGCS Network Optimization – Spiral II (ACAT III)*	$7.1M
G	HFGCS Navy Consolidation (ACAT III)*	$6.4M
G	HFGCS Audit Log Upgrade (ACAT III)*	$189K

*Program is fully funded

Phase 4: Identify and Define Processes

Basic Systems Engineering Process



Systems Engineering Implementation Phases

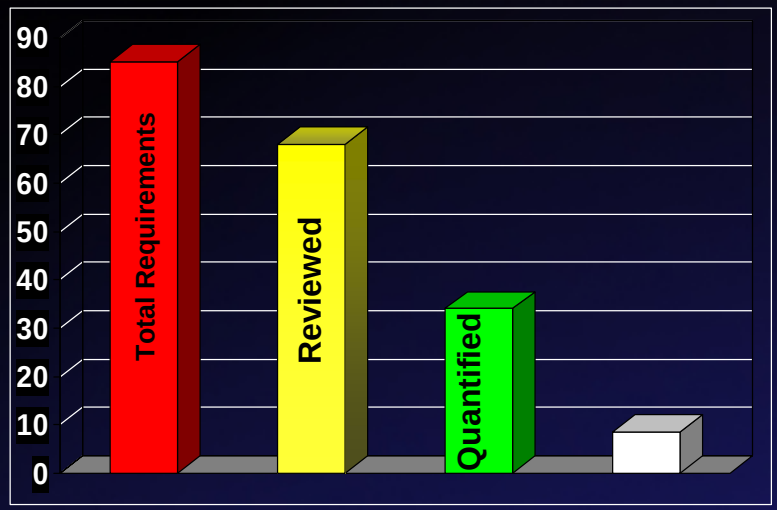
- Phase 1: Awareness of Need
- Phase 2: Workforce Training
- Phase 3: Identify Applicable Programs/Orgs
- Phase 4: Identify and Define Processes
- Phase 5: Incentivize Contractors/Partners
- Phase 6: Develop Library of Tools
- Phase 7: Track Progress via Metrics

Phase 6: Develop Library of Tools

- Need good SE "toolbox"
  - Templates
  - Metrics
  - How-to's (fishbone, 5-whys, paredo, …)
  - Lessons Learned
  - Explanations
  - Best Practices
  - Peer Review
  - Case Studies
  - Life Cycle Cost consideration
  - Contractual language
  - Etc…

Functional Office to Develop/Obtain….Not Started Yet

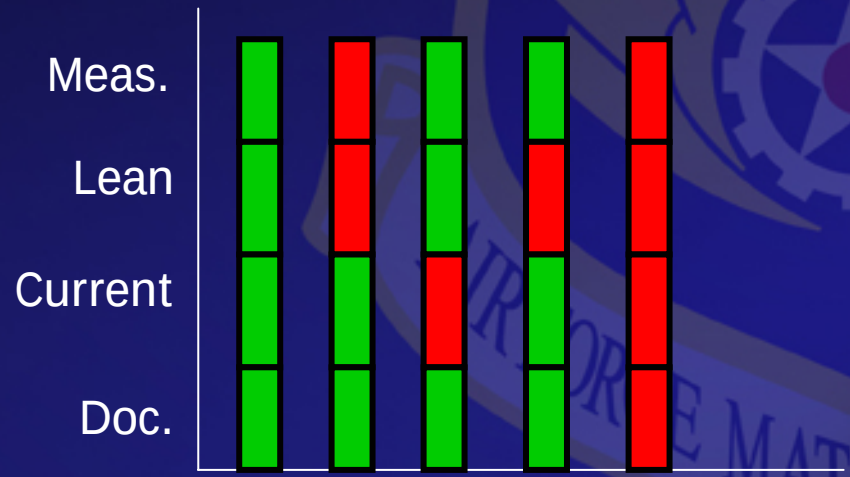
Phase 4: Identify and Define Processes



Requirements

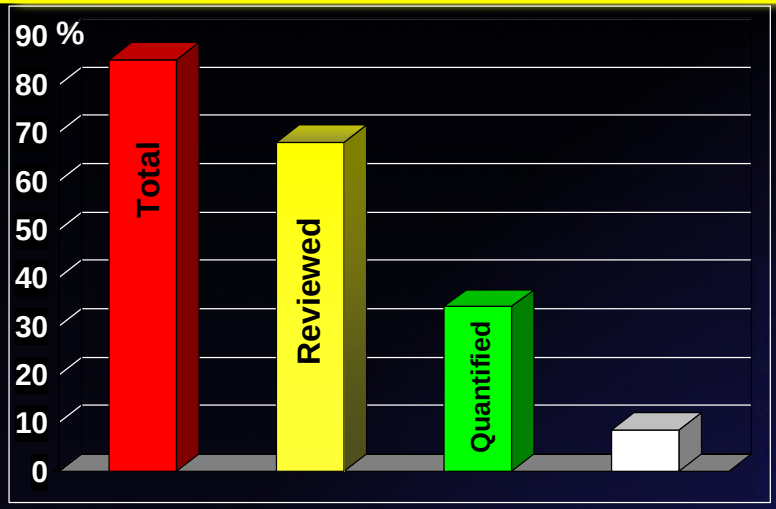
	Low	Med.	High
High	0	2/4	1/2
Med.	1/6	0/1	3/4
Low	1/3	2/4	2/3

Risk



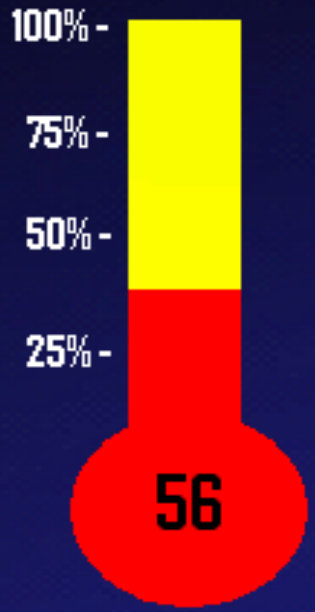
Processes

Sample Organization Sys Eng "Dashboard"

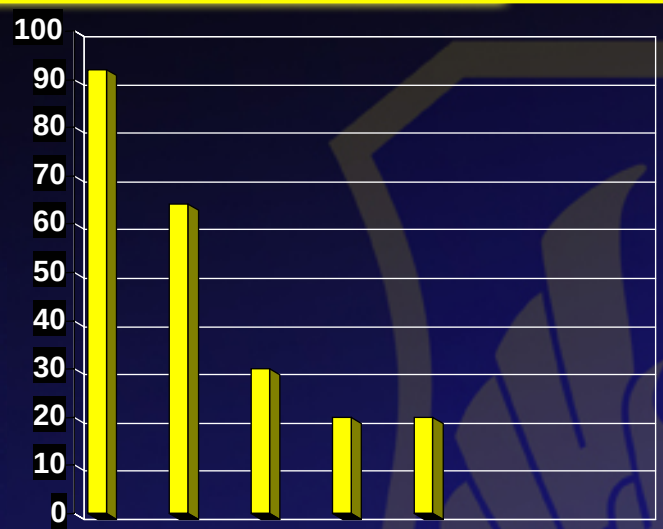


Requirements (%)

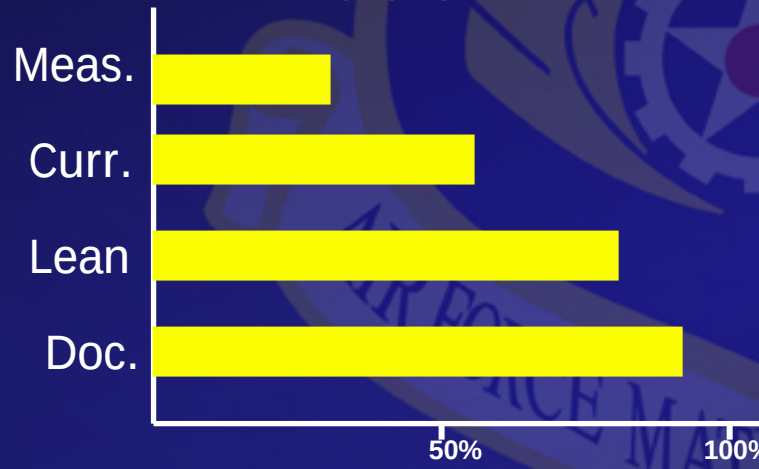
Risk (%)



Contracts

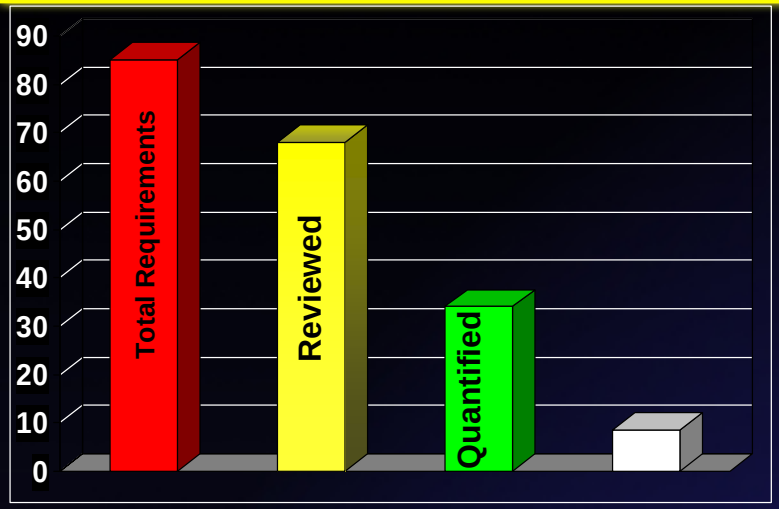


Training (%)

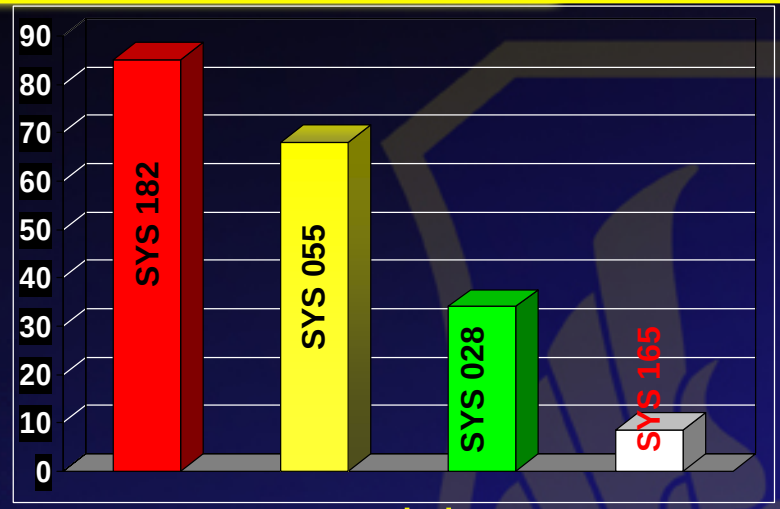


Processes (%)

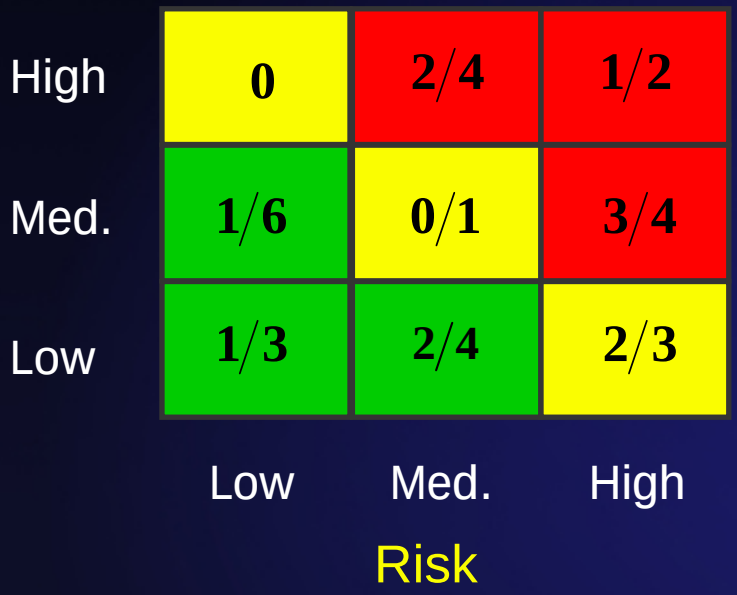
Sample Program Sys Eng "Dashboard"



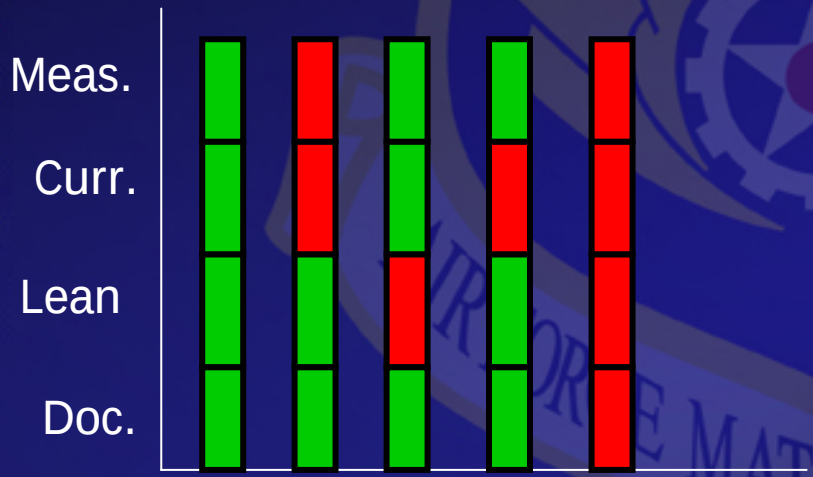
Requirements



Training

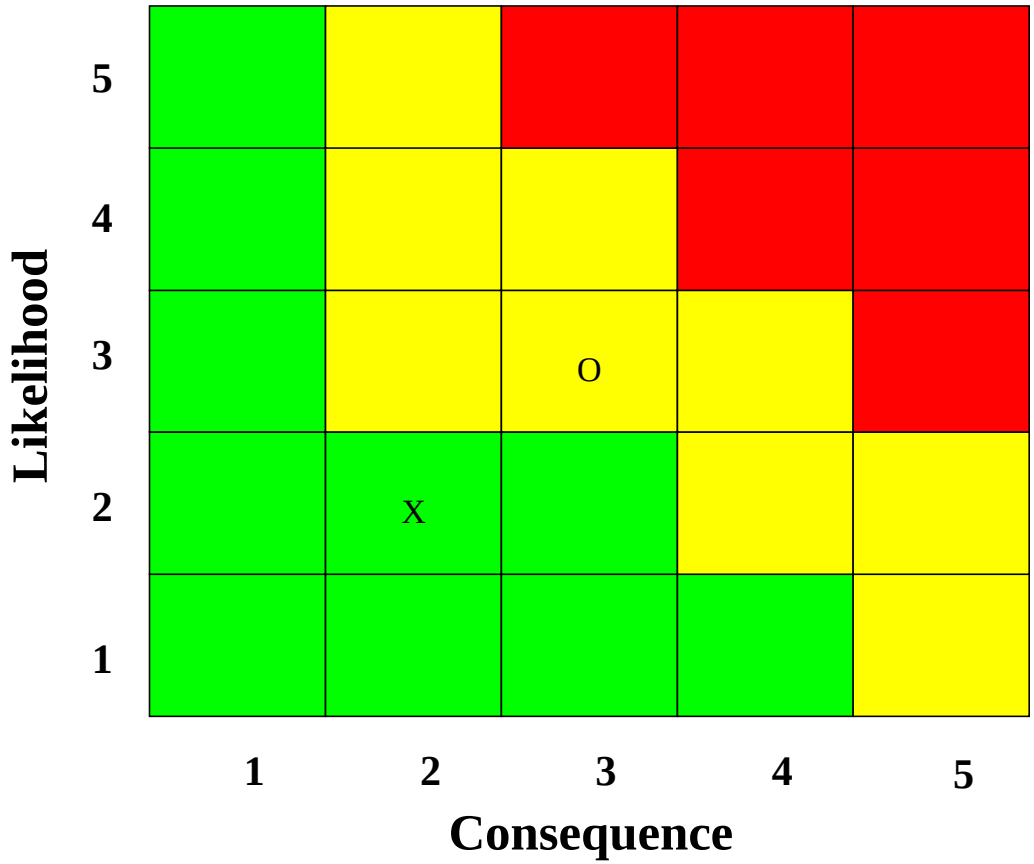


Contracts



Processes

Risk Assessment Matrix



O - Original

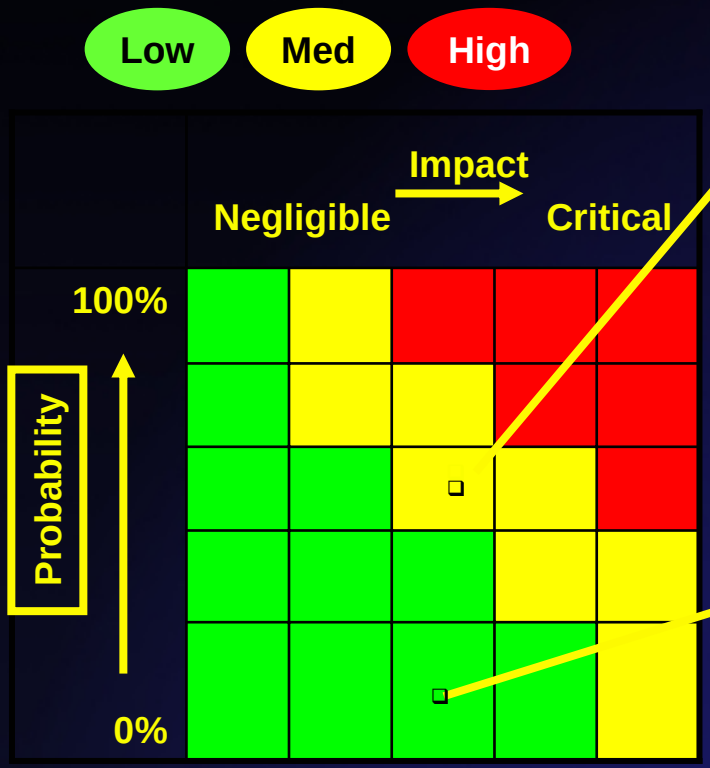
X - Current

High

Medium

Low

Technical Risk #2



Technical Risk: If contractor fails to adequately perform systems engineering then modifications and upgrades could be impacted/delayed.

Mitigation Plan:

- Contractor has Quality Assurance Plan and Program Management Plan on current contract. Plans will be updated for new contract
- Government will require contractor to submit requirements correlations matrix (RCM) for modification/upgrade efforts
- Government will require contractor to use an approved risk management program for modification/upgrade efforts
- Government will follow disciplined requirement matrix process outlined in 727 ACSG O.I. to prevent unplanned requirements/complexity increases & track via established metrics

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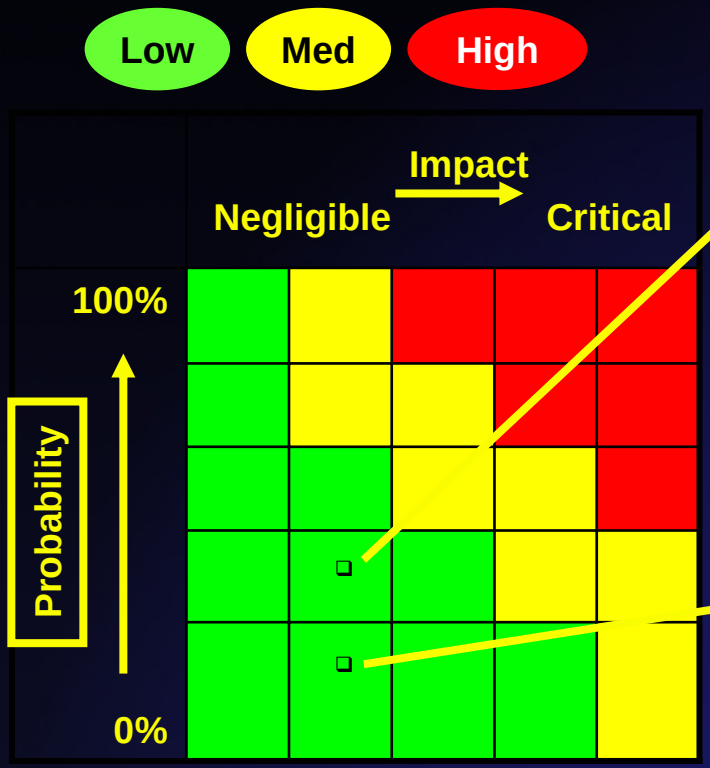
Technical Risk #3



Technical Risk: If configuration management for communication equipment is not maintained then system interoperability could be hindered.

Mitigation Plan:

- Government will require current contractor configuration management plan will be updated for new contract
- SPO will work with users and contractor to ensure regular configuration inventories are occurring to ensure configuration reports are accurate
- Government will conduct test planning criteria and resource requirements at the start to minimize potential interoperability conflicts and/or oversights

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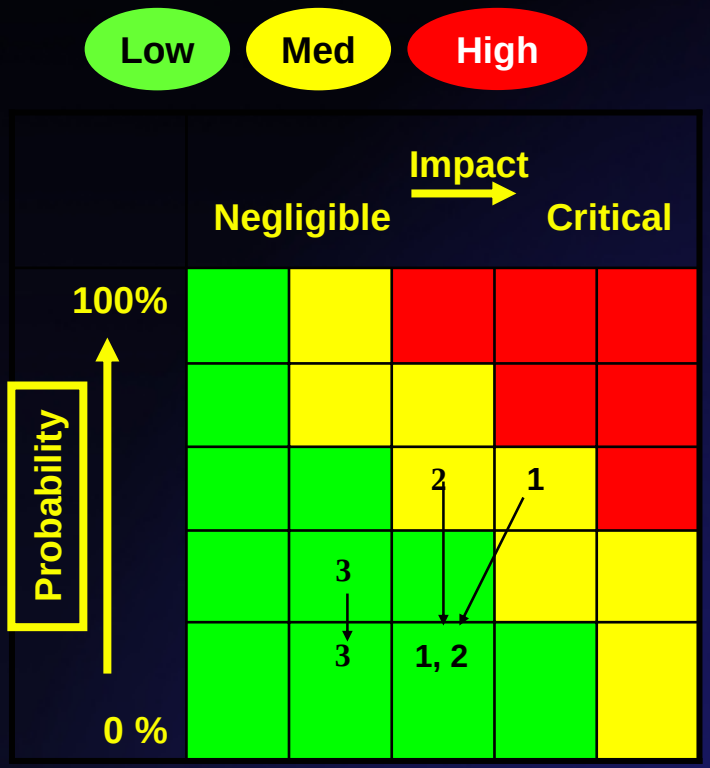
Technical Risk Summary



OVERALL TECHNICAL RISK IS LOW

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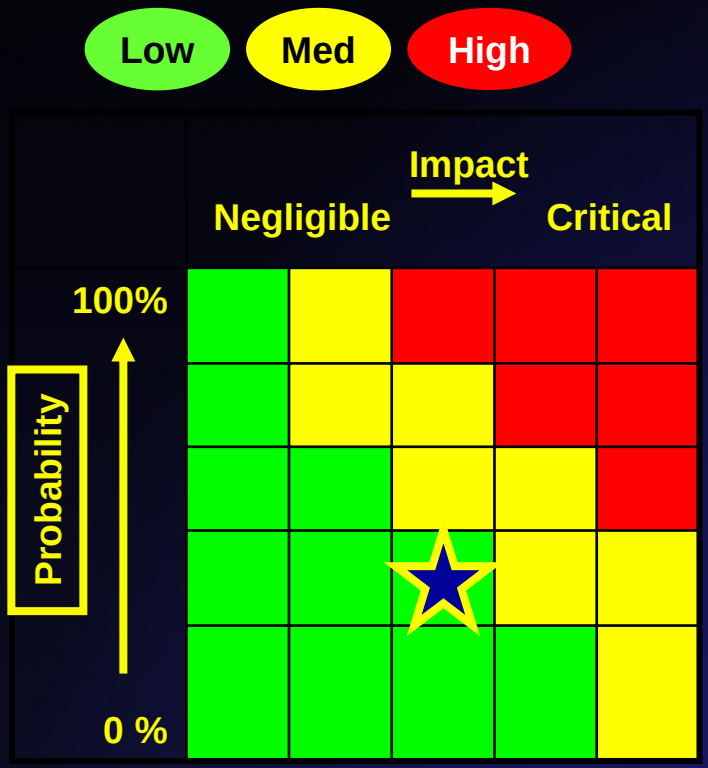
Program Risk Summary



Program Risk: Five (5) Cost and three (3) Technical risks have been identified

Mitigation Plan:

- Mitigation plans have been put into practice for all identified risks

OVERALL PROGRAM RISK IS LOW

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Tracking Progress via Metrics

- ✓ Metrics developed to track progress
- ✓ Metrics shown regularly to upper management
  - ❑ 1st staff meeting of month
  - ❑ Quarterly Weapon System Reviews
  - ✓ Metrics must be able to roll up
- ✓ Metrics will track:
  - ✓ Systems Engineering Implementation
  - ✓ Requirements
  - ✓ Risk
  - ✓ Processes
  - ✓ Training
  - ✓ Contracts