

# System Engineering Metrics



**26 Oct 05**

James C. Miller  
Chief Engineer  
327<sup>th</sup> CLSG  
Phone: 736-4294  
[james.c.miller@tinker.af.mil](mailto:james.c.miller@tinker.af.mil)

# Why Measure Systems Engineering?

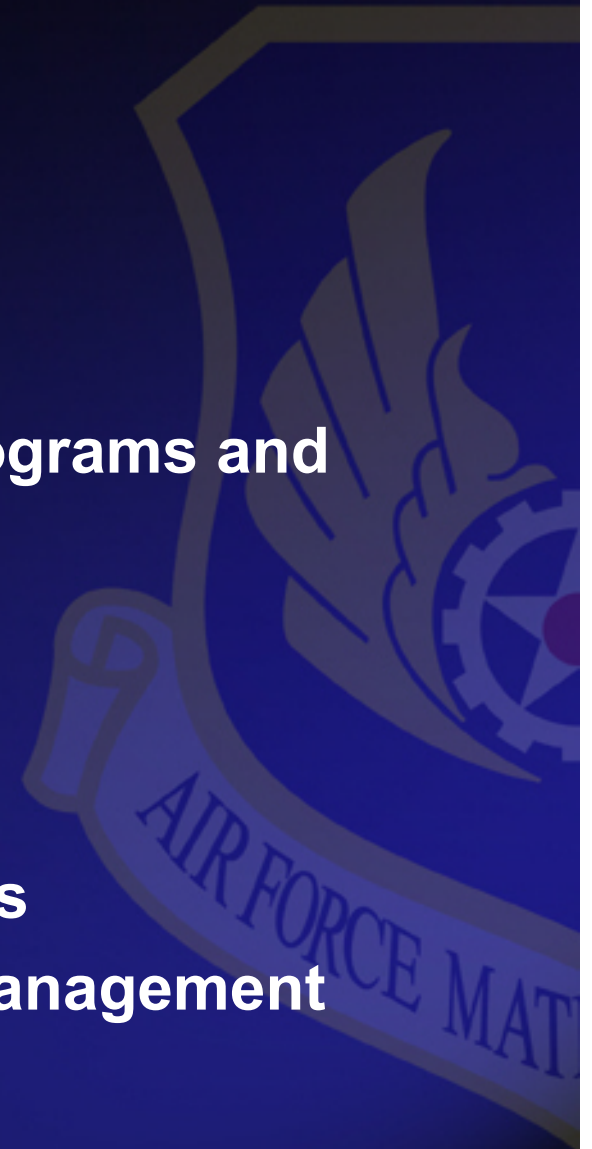
- When performance is measured ... **performance improves**
- When performance is measured and reported ... **the rate of performance improves**
- When performance is measured, reported, and compared ... **the rate of performance continues to improve**



# Problem

---

- **Sys Eng Scope is Huge, So ...**
  - What tenets should be measured?
  - What are the key characteristics?
  - How can it apply across different programs and organizations?
- **Sys Eng Important, But ...**
  - No accepted, standard metrics
  - No measure of sys eng current status
  - No metrics for both PM and upper management




# **Sys Eng Metrics Key Characteristics**

---

- **Must Measure Major Components of Sys Eng**
- **Must Be Targeted for Management**
- **Must Be Few in Number**
- **Must Describe Current Status, Not Lagging**
- **Must Allow For Comparison Between Programs, Organizations, and Time**
- **Must Be Cumulative (Ability to Roll-Up)**
- **Must Avoid Extensive Data Collection Efforts**

# **Solution: Sys Eng “Dashboard”**

---

- **Measure Five Key Areas of Sys Eng:**
    - Requirements Management
    - Risk Management
    - Incentivizing Contractors
    - Robustness/LCC
    - Process Management
  - **Used on All Programs**
  - **Regularly Shown at Organization Staff Meetings**
- 
- The logo of the Air Force Materiel Command is visible in the background on the right side of the slide. It features a stylized hand holding a gear, with a banner below it that reads "AIR FORCE MATERIEL".



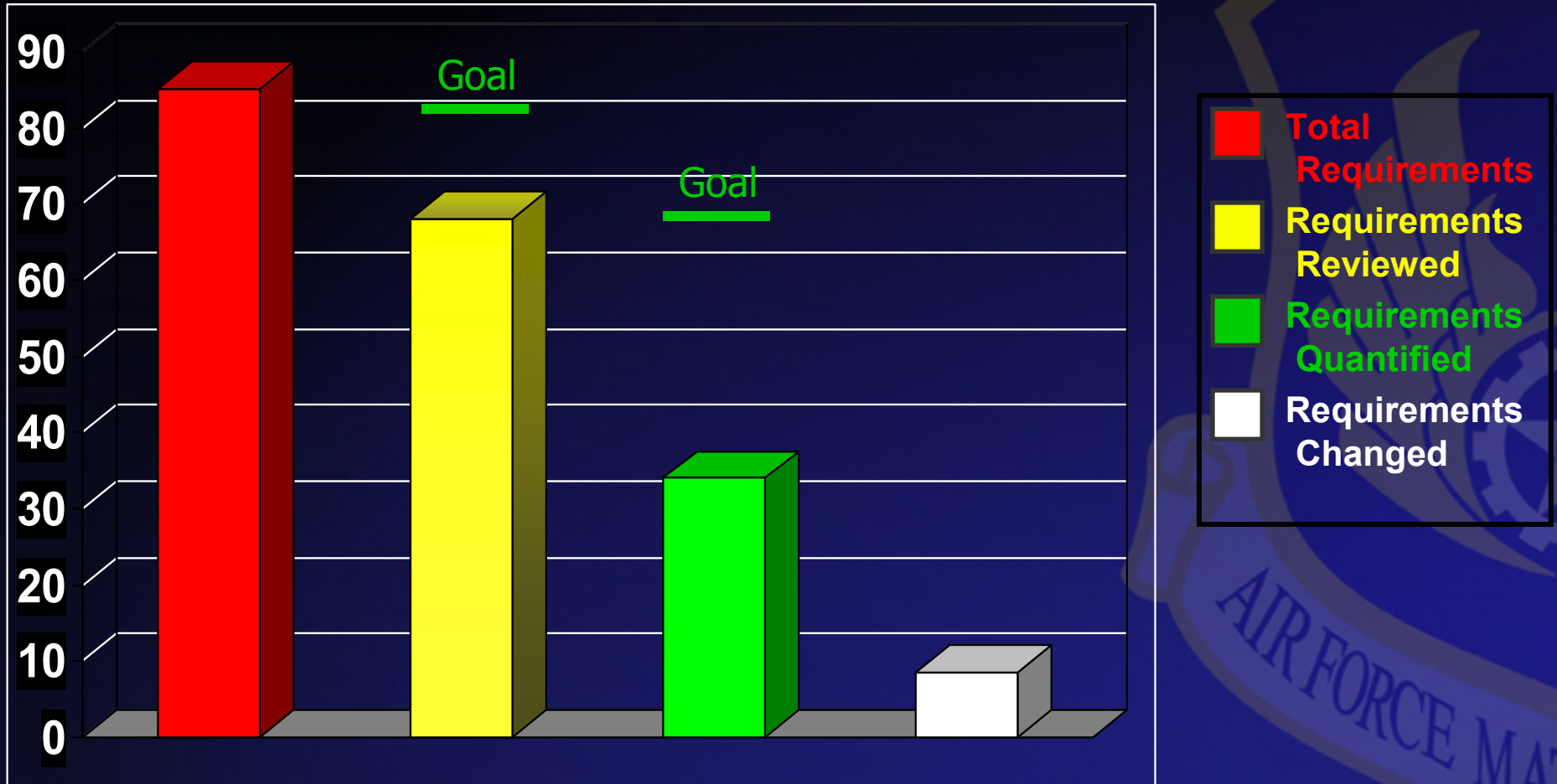
# 1. Requirements Management Metric

---

- **Most Important Area**
- **Quantify, quantify, quantify**
- **Level of Detail**
  - Appropriate to Life Cycle
  - Examples
- **Objective Review**
- **Agreement & Understanding**
  - User
  - Contractor
  - Program Manager
- **Sources**



# Requirements Management Metric



AIR FORCE MAT

## 2. Risk Management Metric

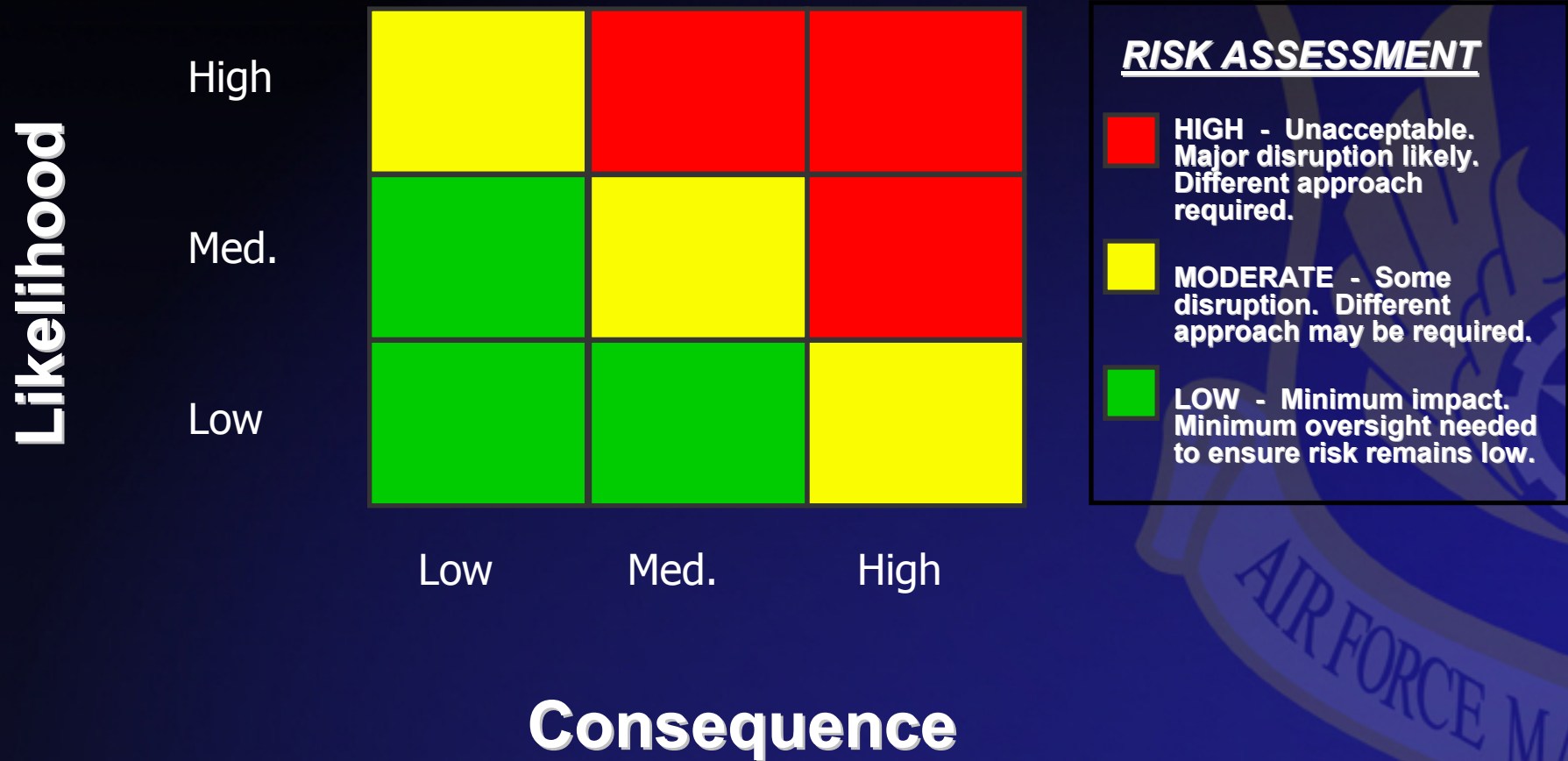
---

- **Proactive**
- **Dynamic**
- **Reviewed Regularly**
- **Tangible Reduction Plan**
- **Tracked**





# Basic Risk Rating Chart



AIR FORCE MAT

# Risk Assessment Metric

Likelihood

High

Med.

Low

0	4	2
6	1	4
3	4	3

Low

Med.

High

Consequence

# of Risks

10

4

13

AIR FORCE MAT

# Risk Management Metric

Likelihood

High

Med.

Low

0	2/4	1/2
1/6	0/1	3/4
1/3	2/4	2/3

Low

Med.

High

Consequence

% With Plan

60%

50%

30%

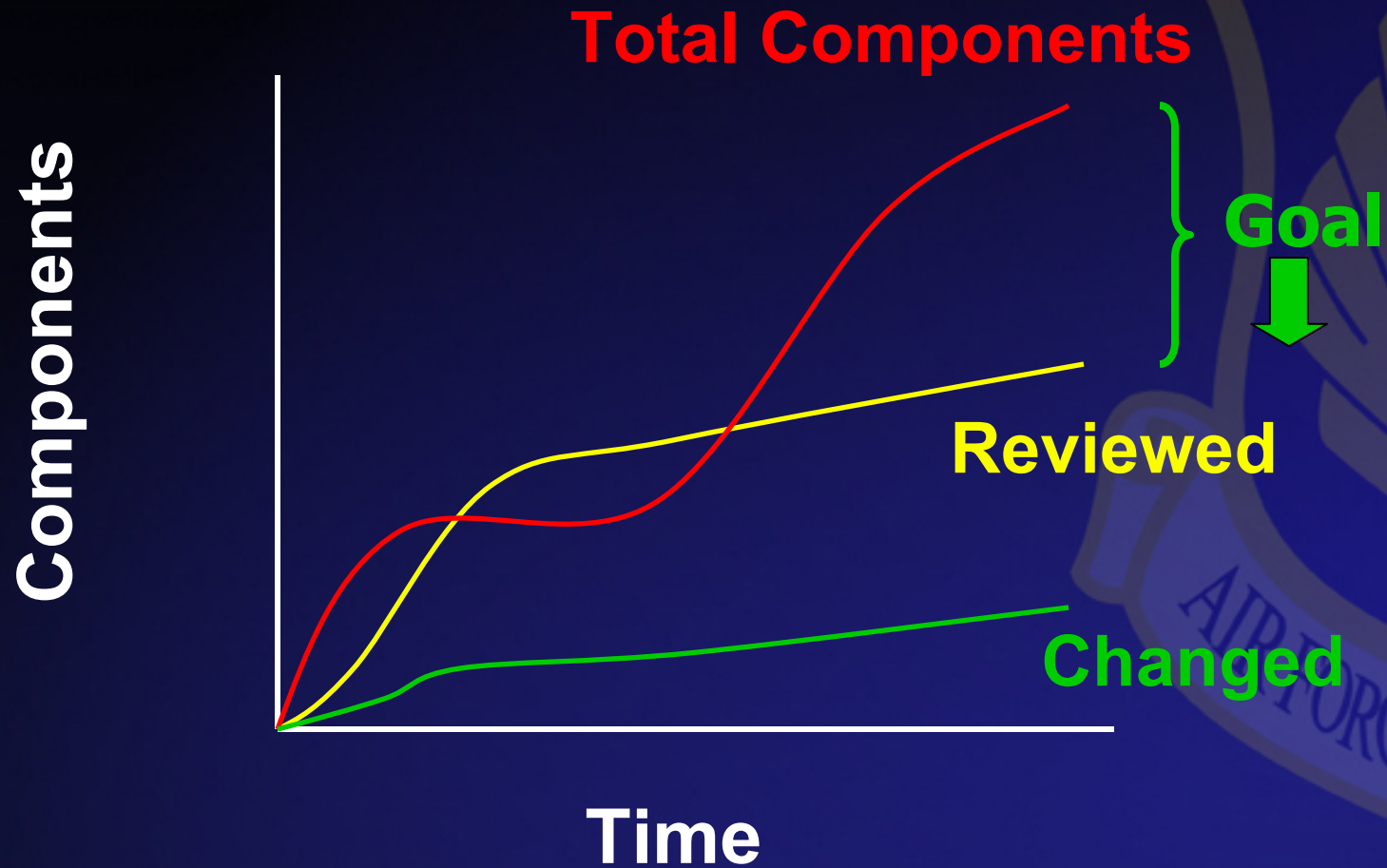
AIR FORCE MAT

# 3. Robustness/LCC Metric

- **Hard to Measure**
- **Measures More the “Attempt” or Effort**
- **Can Include Underlying Processes**
  - Example: Type of paint or the paint application process
- **Need “Toolbox” Vice One Approved Way**
  - Lean processes
  - Trade studies
  - Benchmarks
  - Combining components
  - COTS
  - Pareto Charts
  - Etc.



# Robustness/LCC Metric

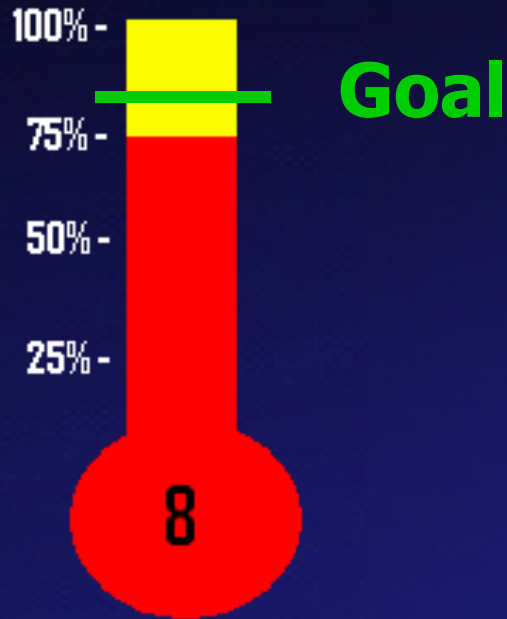




# 4. Incentivizing Contractors Metric

- **Required for USAF by Policy**
  - Policy Memo 03A-005, 9 Apr 03
  - Subject: “Incentivizing Contractors for Better Systems Engineering”
  - Signed by Marvin R. Sambour, Assistant Secretary of the Air Force (Acquisition)
- “A more robust SE environment can only be achieved through joint cooperative efforts with our contractors.”
- “...incentivize your contractors to perform robust SE...”

# Incentivizing Contractors Metric



**% of Contracts with  
Sys Eng Incentives**



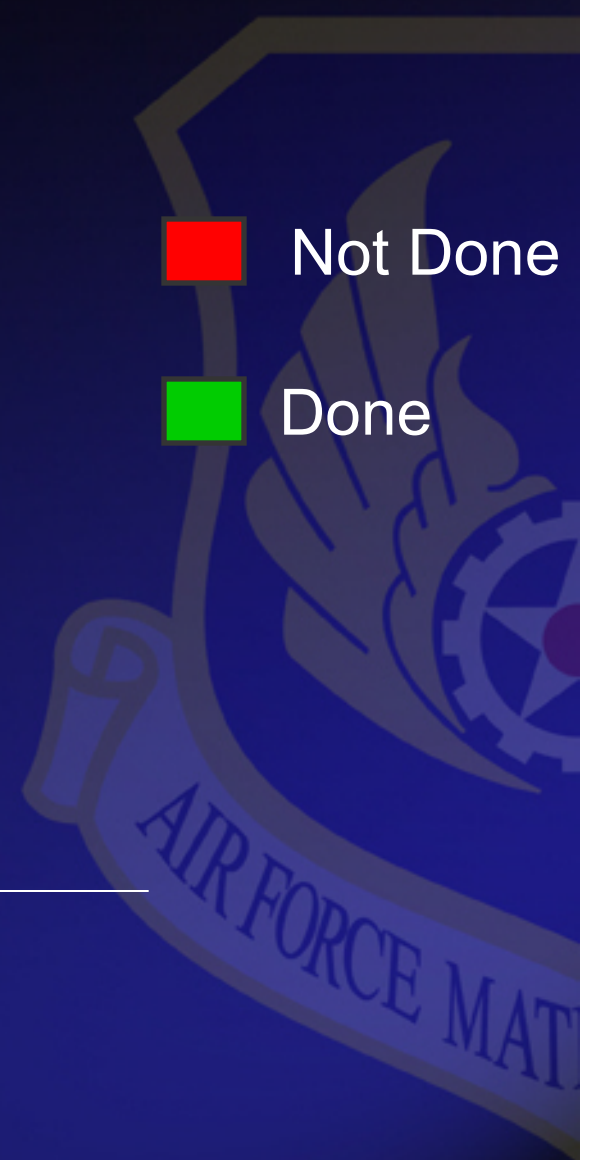
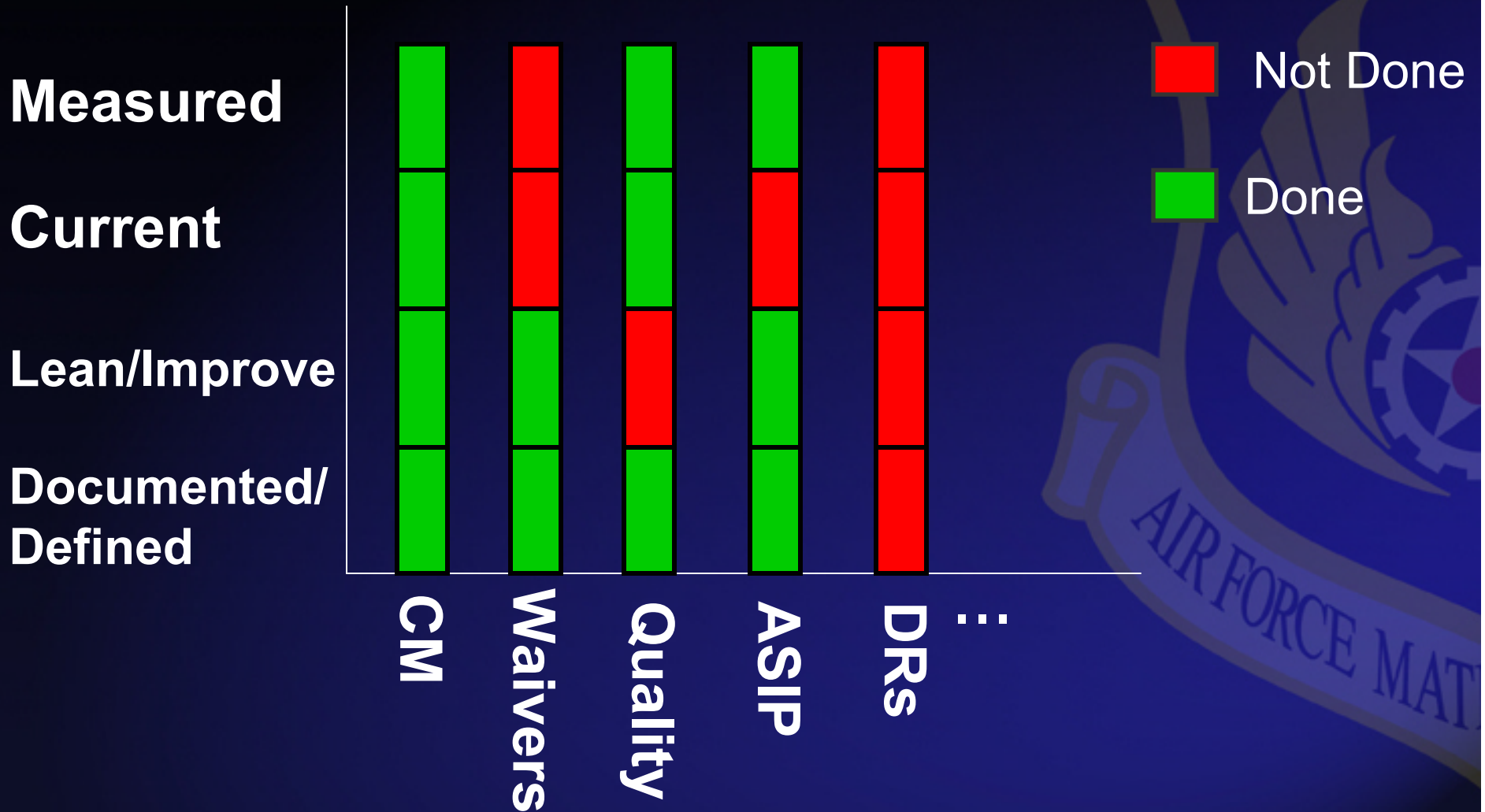
# 5. Process Management Metric

---

- **List Program's Key Processes**
  - Configuration Management
  - Waivers
  - Quality
  - Aircraft Structural Integrity Program
  - Deficiency Reviews
  - Etc.
- **Each Program Does Own Processes**
- **For Each Process, 4 "Steps"**
  - Define & Document
  - Lean, Improve or Refine
  - Keep Current by Periodic Reviews
  - Measure the Process



# Process Management Metric



# Program Sys Eng Dashboard

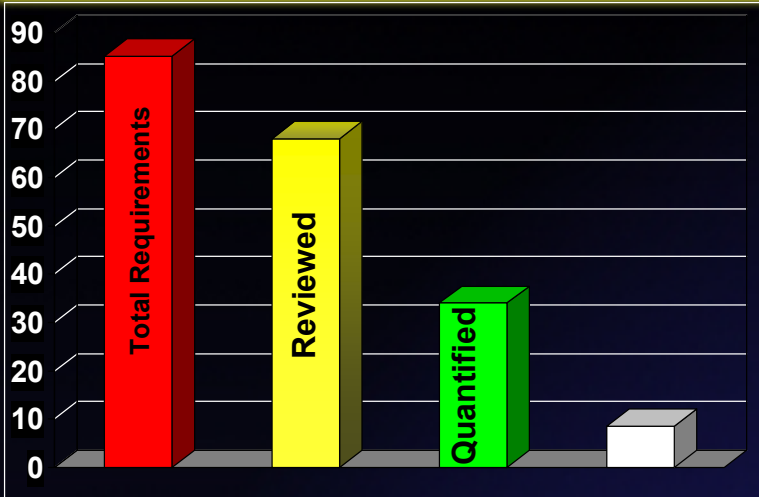
---

- **Developed Individual Metrics for the Five Key Areas of Systems Engineering:**
  - Requirements Management
  - Risk Management
  - Incentivizing Contractors
  - Robustness/LCC
  - Process Management
- **Now Put it All Together For the Proposed Program's Sys Eng Dashboard...**





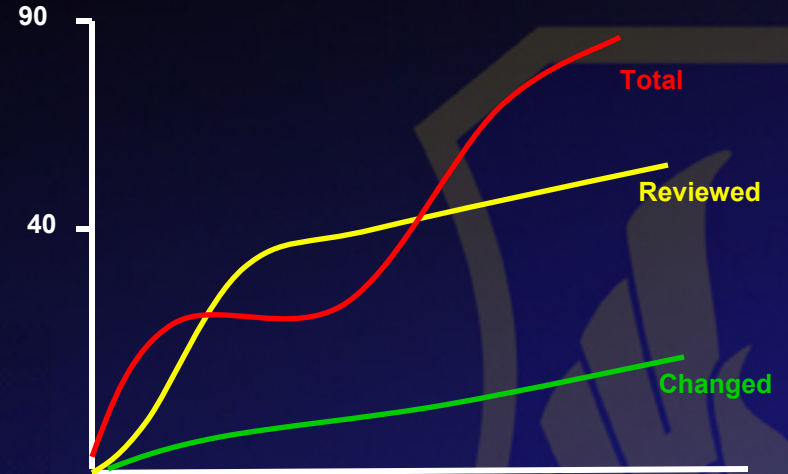
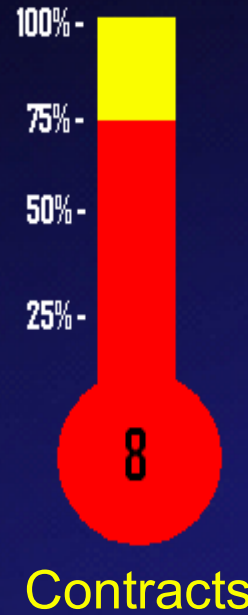
# Program Sys Eng Dashboard



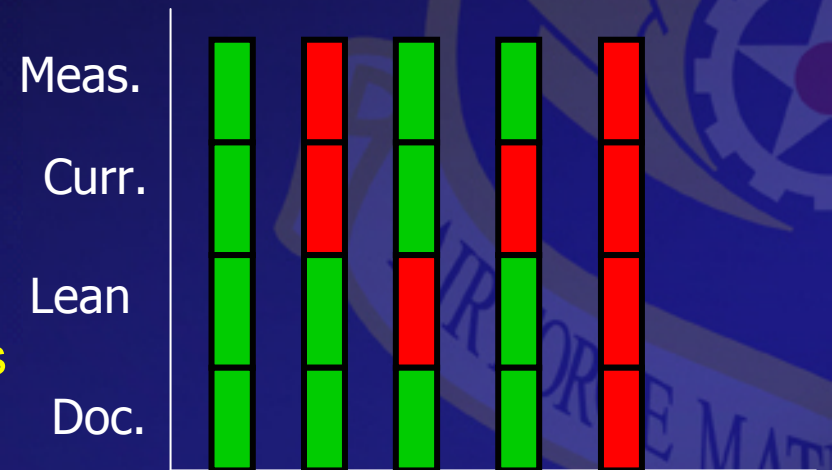
Requirements

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

Risk



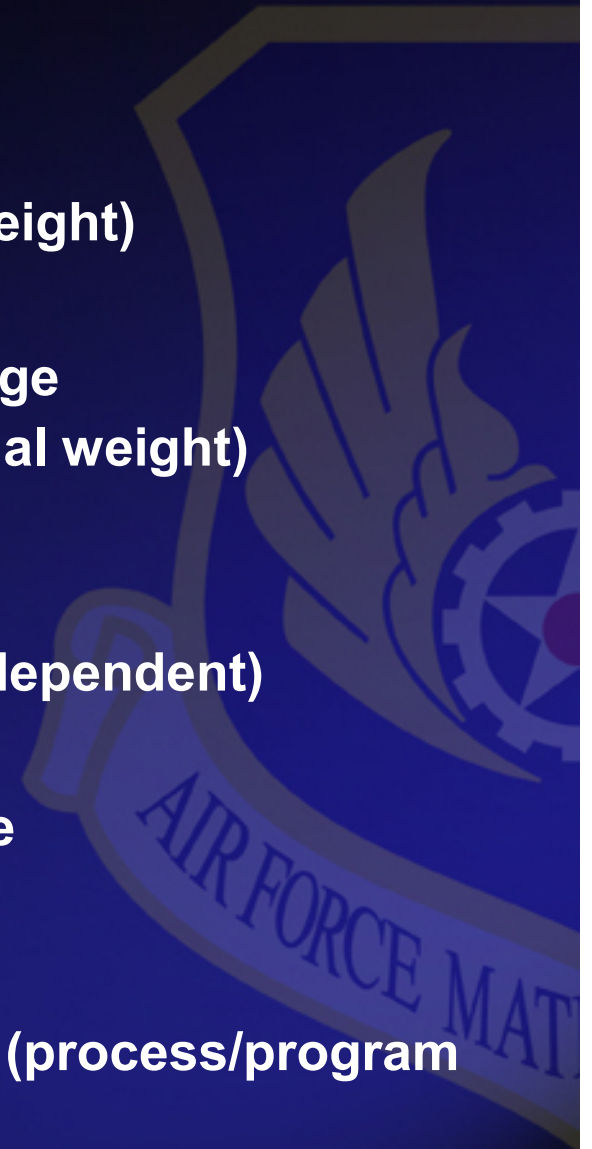
LCC/Robust



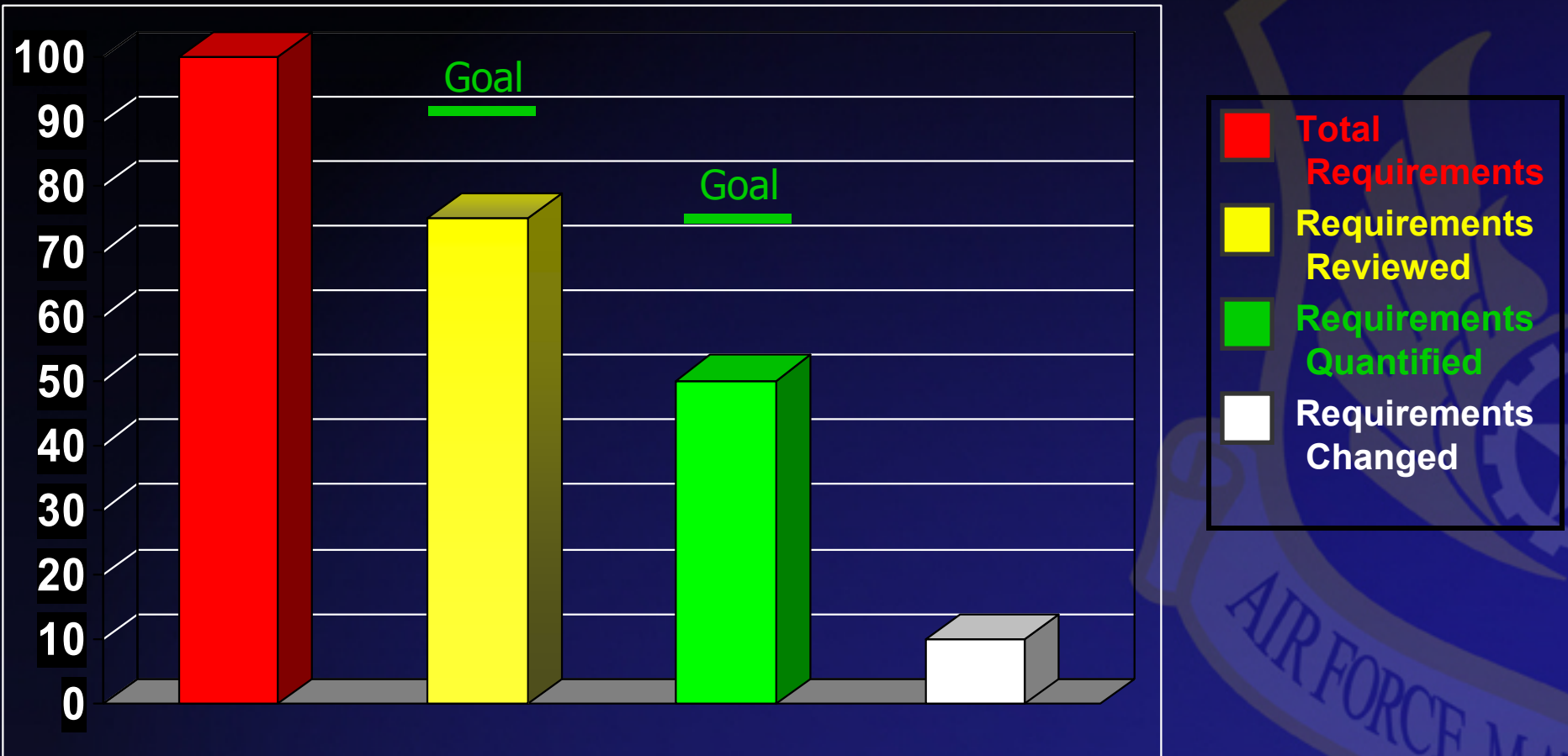
Processes

# How to Roll-Up from Program to Organization

- **Requirements Management**
  - Convert each program to a percentage
  - Display average (each program has equal weight)
- **Risk Management**
  - Convert each program “square” to percentage
  - Display average “square’s” percentage (equal weight)
- **Incentivizing Contractors**
  - Bottom number equals sum of contracts
  - Depict percentage of contracts (program independent)
- **Robustness/LCC**
  - Calculate received/changed as a percentage
  - Display avg percentage (equal weight)
- **Process Management**
  - Depict overall percentage for each category (process/program independent)



# Organization Requirements Metric (%)



# Organization Risk Metric (%)

Likelihood

High	20	40	80
Med.	5	50	60
Low	10	5	40
	Low	Med.	High

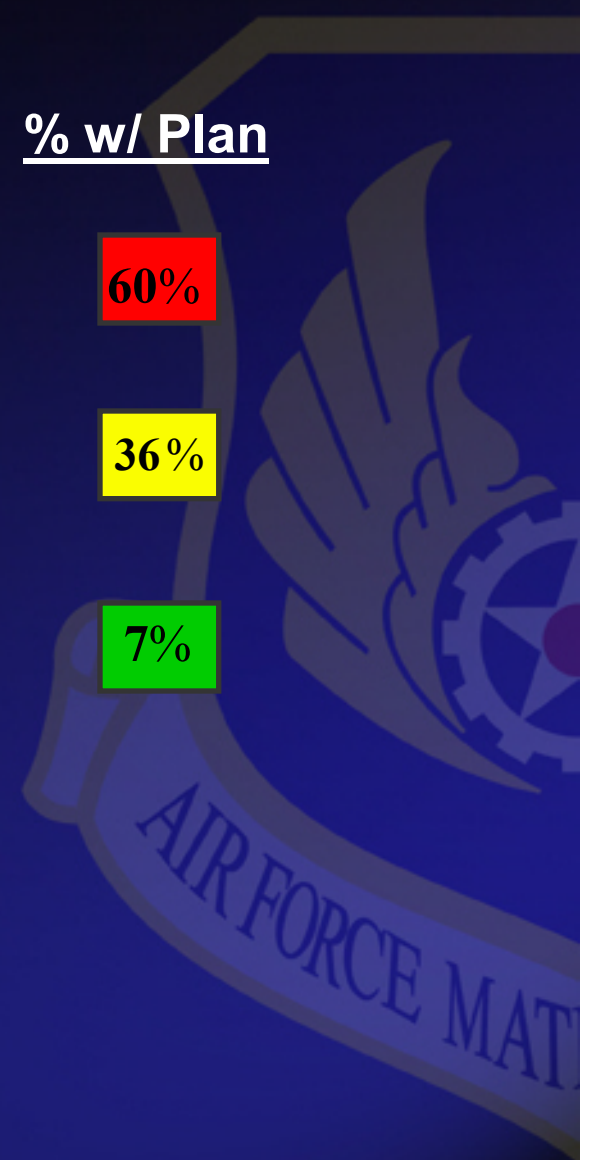
% w/ Plan

60%

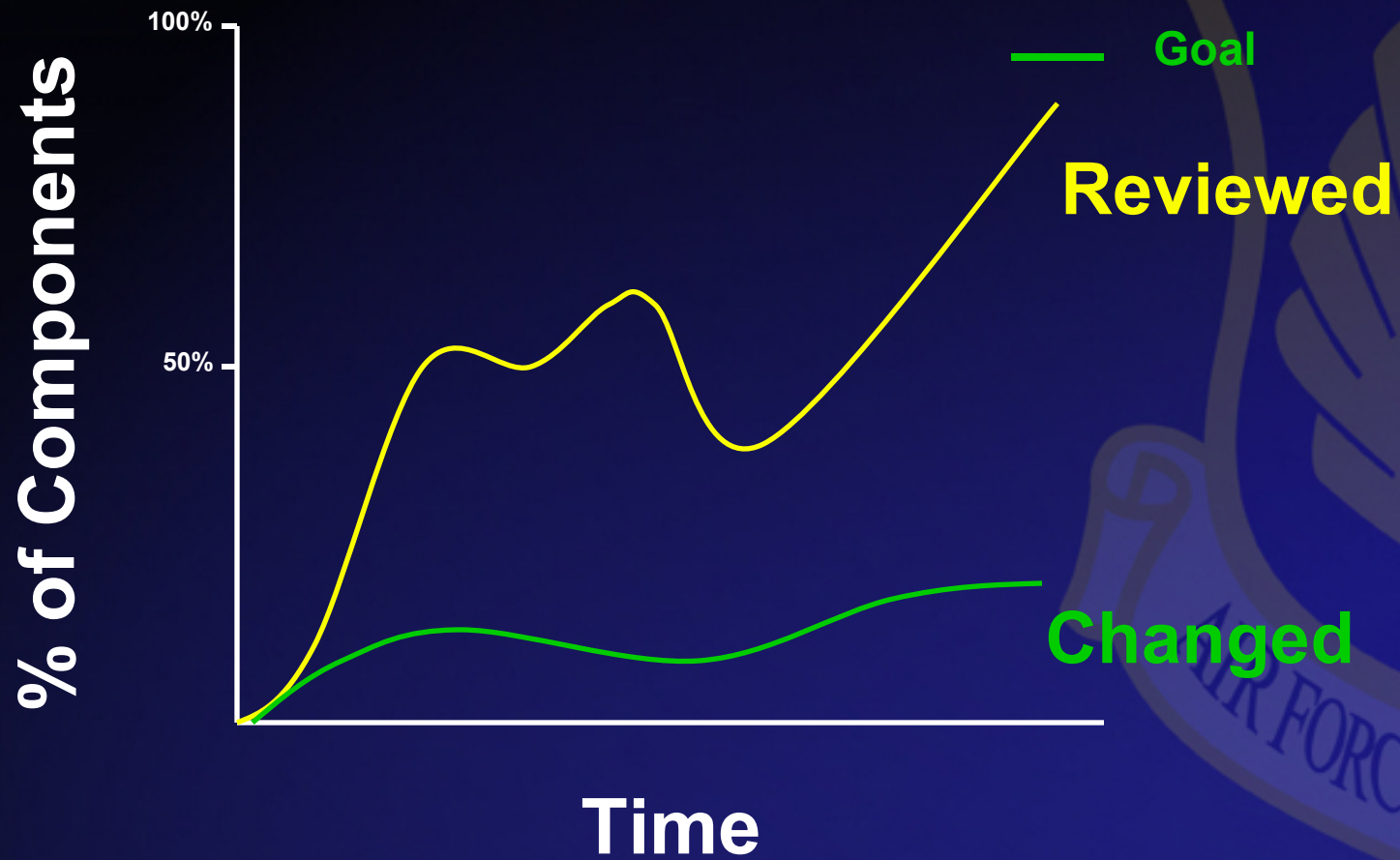
36%

7%

Consequence

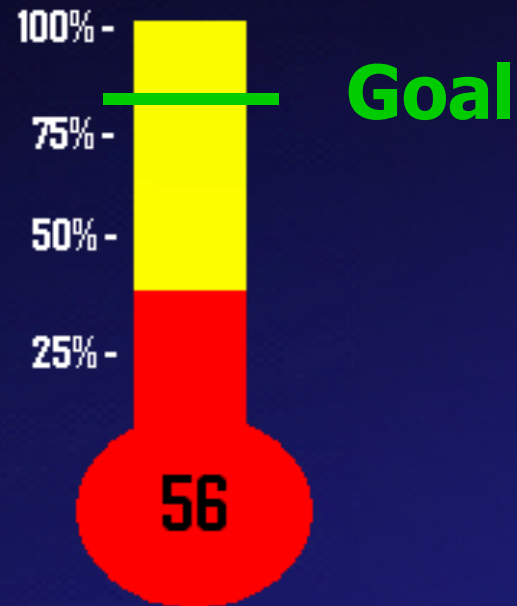


# Organization Requirements Metric (%)





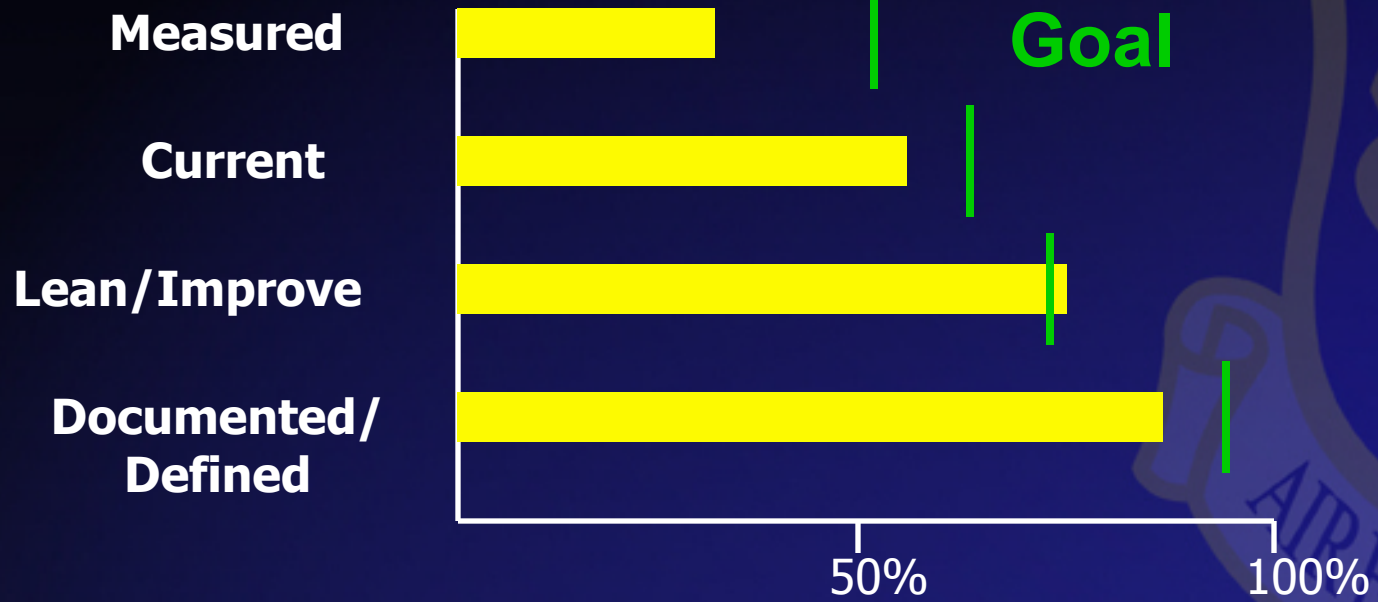
# Organization Incentivizing Contractors Metric



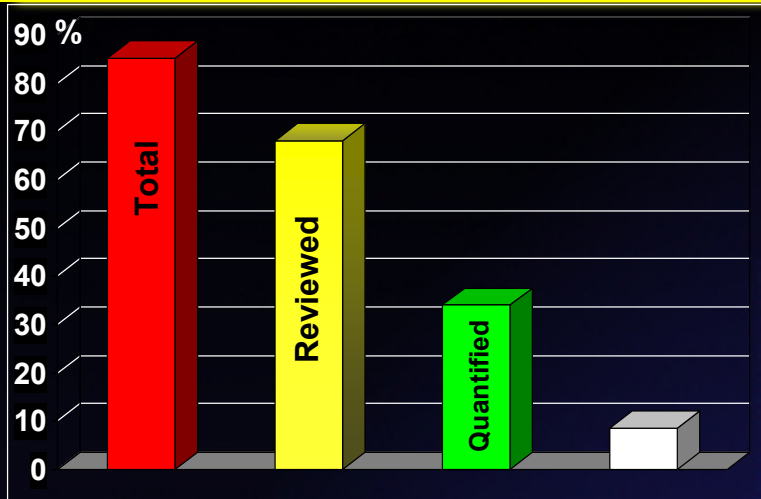
**% of Contracts with  
Sys Eng Incentives**



# Organization Process Metric (%)



# Organization Sys Eng Dashboard



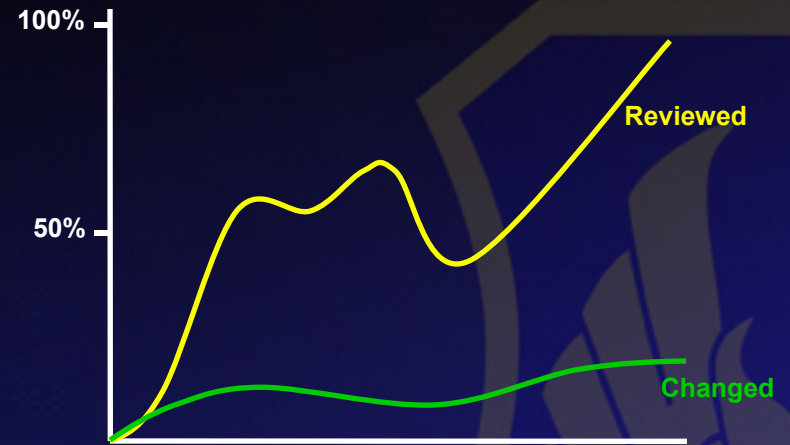
Requirements

High	20	40	80
Med.	5	50	60
Low	10	5	40
	Low	Med.	High

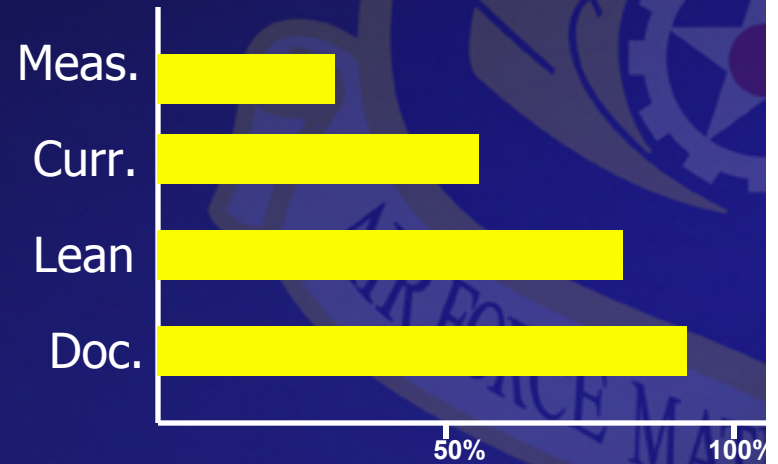
Risk



Contracts



LCC/Robust



Processes

# Summary

---

- **Sys Eng Important, but No Consistent Way to Measure...Until Now**
- **Need Concurrent Metrics...Not Lagging**
- **Metrics For Management...Essential to Drive Action**
- **What to Measure...Sys Eng “Dashboard”**
- **Means To Use...Regular Part of an Organization’s Overall Management Indicators**
  
- **Allows Comparison...Drives Improvement**

---

Questions?



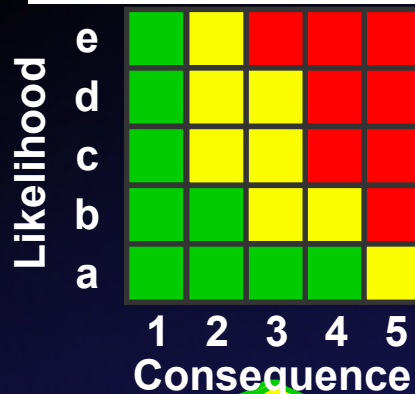


# Sample: 5 - Level Risk Rating Chart

## RISK ASSESSMENT

- **HIGH** - Unacceptable. Major disruption likely. Different approach required. Priority management attention required.
- **MODERATE** - Some disruption. Different approach may be required. Additional management attention may be needed.
- **LOW** - Minimum impact. Minimum oversight needed to ensure risk remains low.

## ASSESSMENT GUIDE



### LIKELIHOOD:

Level	What Is The Likelihood The Risk Will Happen?
a	Remote
b	Unlikely
c	Likely
d	Highly Likely
e	Near Certainty



### CONSEQUENCE:

Given The Risk Event is Realized, What is the Magnitude of the Impact?

Level	Technical Performance	and/or	Schedule	and/or	Cost	and/or	Impact on Other Teams
1	Minimal or no impact		Minimal or no impact		Minimal or no impact		None
2	Acceptable with some reduction in margin		Additional resources required; able to meet need dates		< 5%		Some impact
3	Acceptable with significant reduction in margin		Minor slip in key milestone; not able to meet need dates		5 - 7%		Moderate impact
4	Acceptable, no remaining margin		Major slip in key milestone or critical path impacted		> 7 - 10%		Major impact
5	Unacceptable		Can't achieve key team or major program milestone		> 10%		Unacceptable

# Risk Handling Plan - "Waterfall"

