



# Technical Performance Measures

Connecting Technical and Management  
Progress

Jim Armstrong  
September 16, 2008



# Agenda

- Typical Management Measures
- Technical Performance Measures
- TPM Life-cycle
- Developing TPMs
- Uses of TPMs
- Things to avoid
- Wrap-up
- References



# Typical Management Measures

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- Cost and schedule related
  - Schedules
  - EVMS
  - Number of drawings released
  - Lines of code
  - Tests completed
- Track work progress
- Was the technical progress achieved?





# EVMS Issues

- Requirement for defining task completion is weak
  - **NASA: “Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.” -**
  - ANSI EIA-748A: it cost \$ to see it



# Agenda

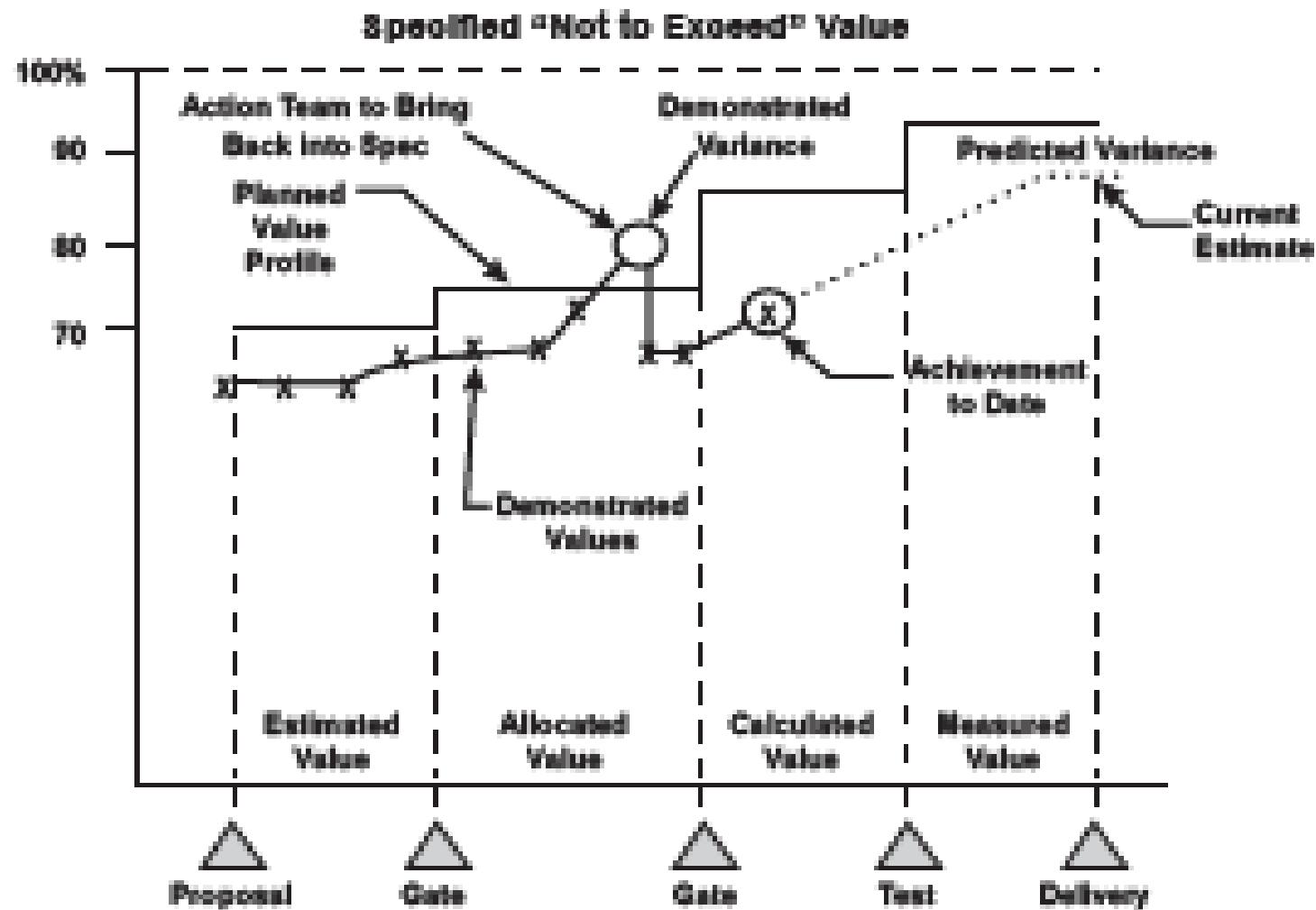
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# Technical Performance Measures (TPM)

- Focus on the critical technical parameters of specific system elements
  - Examples include accuracy, throughput, weight, size, availability, etc
- Derived from the top level technical objectives
- Tied to risks
- Set expectations of acceptable progress and how it is measured

# INCOSE Handbook





# Key Points

- Measured as solution is designed and implemented
- Track design progress against prediction
  - Are we on plan to meet requirements?
- Support the technical quality of the work completed
  - Is the earned value taken of real value?



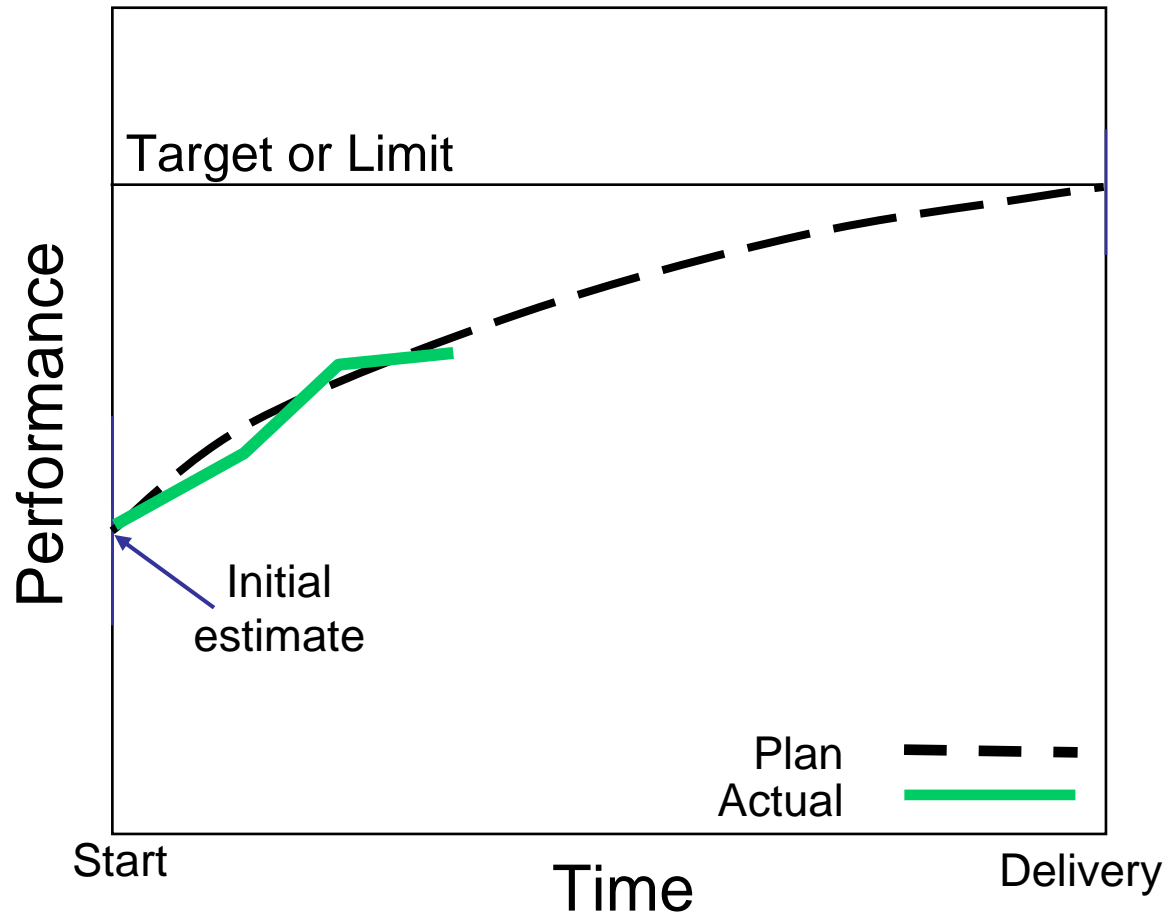
# DAG, Chapter 4

## 4.5.5 Technical Performance Measurement

Systems engineering uses technical performance measurements to balance cost, schedule, and performance throughout the life cycle. Technical performance measurements compare actual versus planned technical development and design. They also report the degree to which system requirements are met in terms of performance, cost, schedule, and progress in implementing risk handling. Performance metrics are traceable to user-defined capabilities.

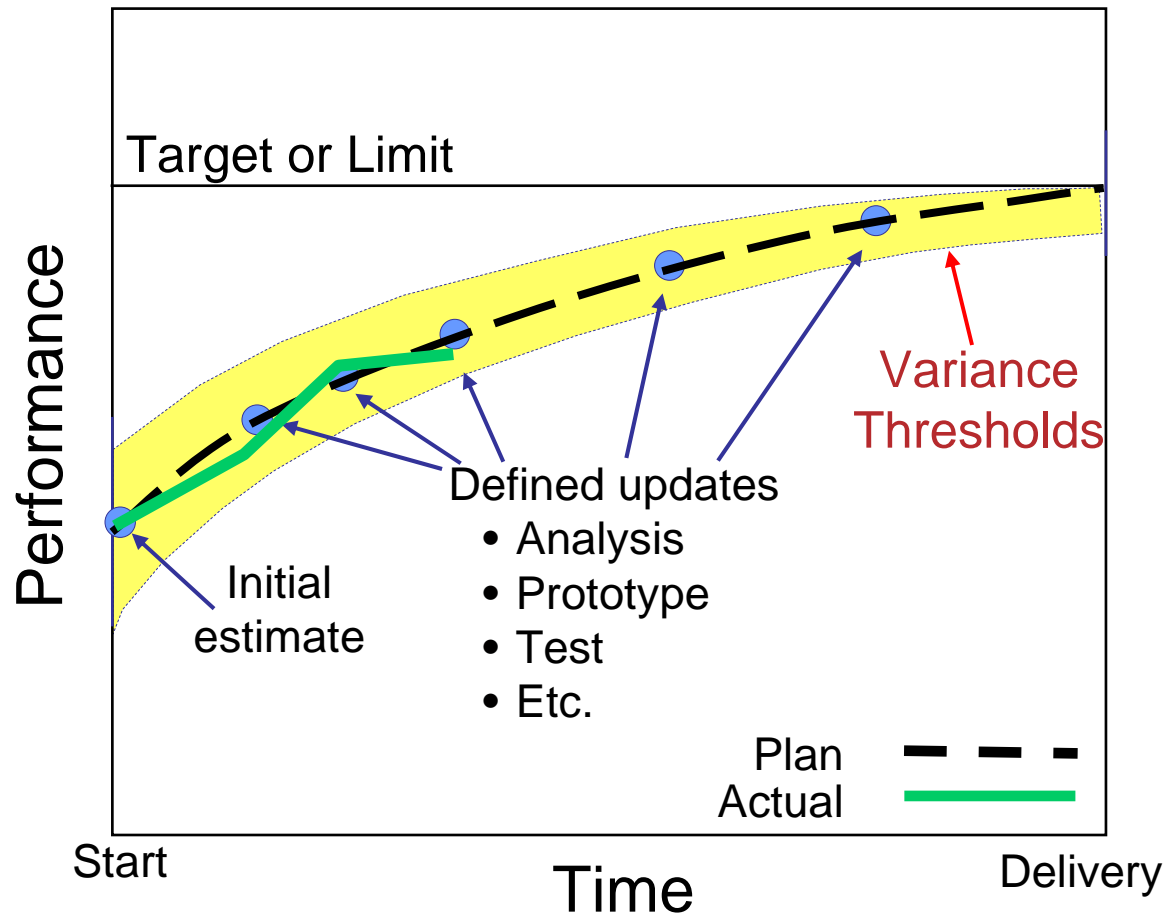


# Minimal Content





# More Complete TPM



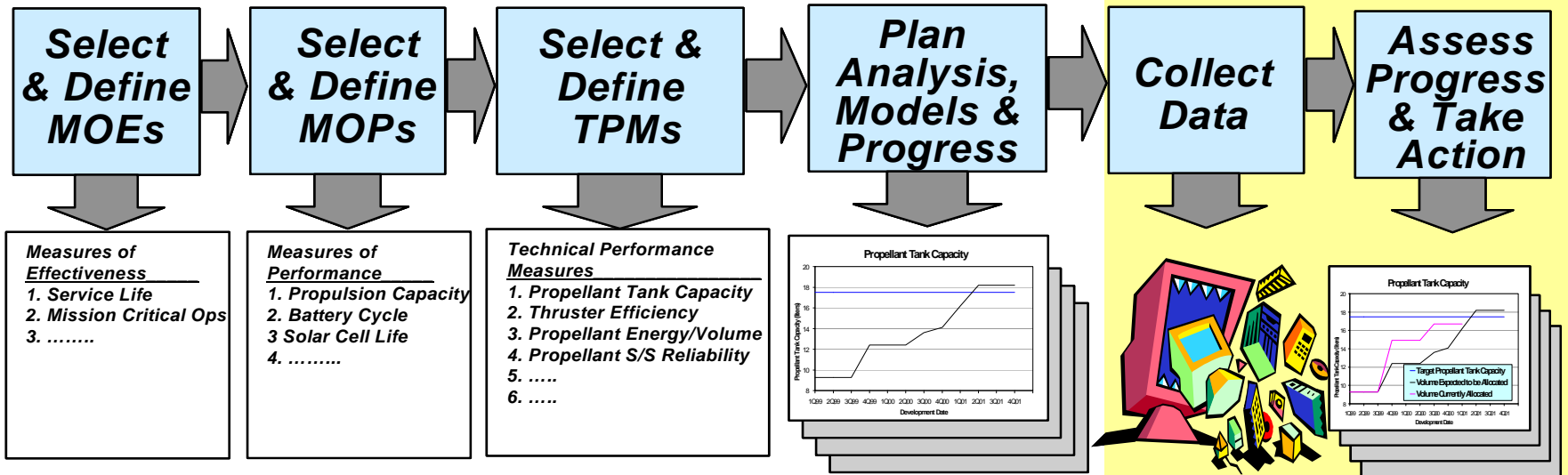


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# Technical Measurement Life Cycle Process



**Tailoring Measurement**

**Applying Measurement**

Ref: Garry Roedler, Principal Systems Engineer, Lockheed Martin



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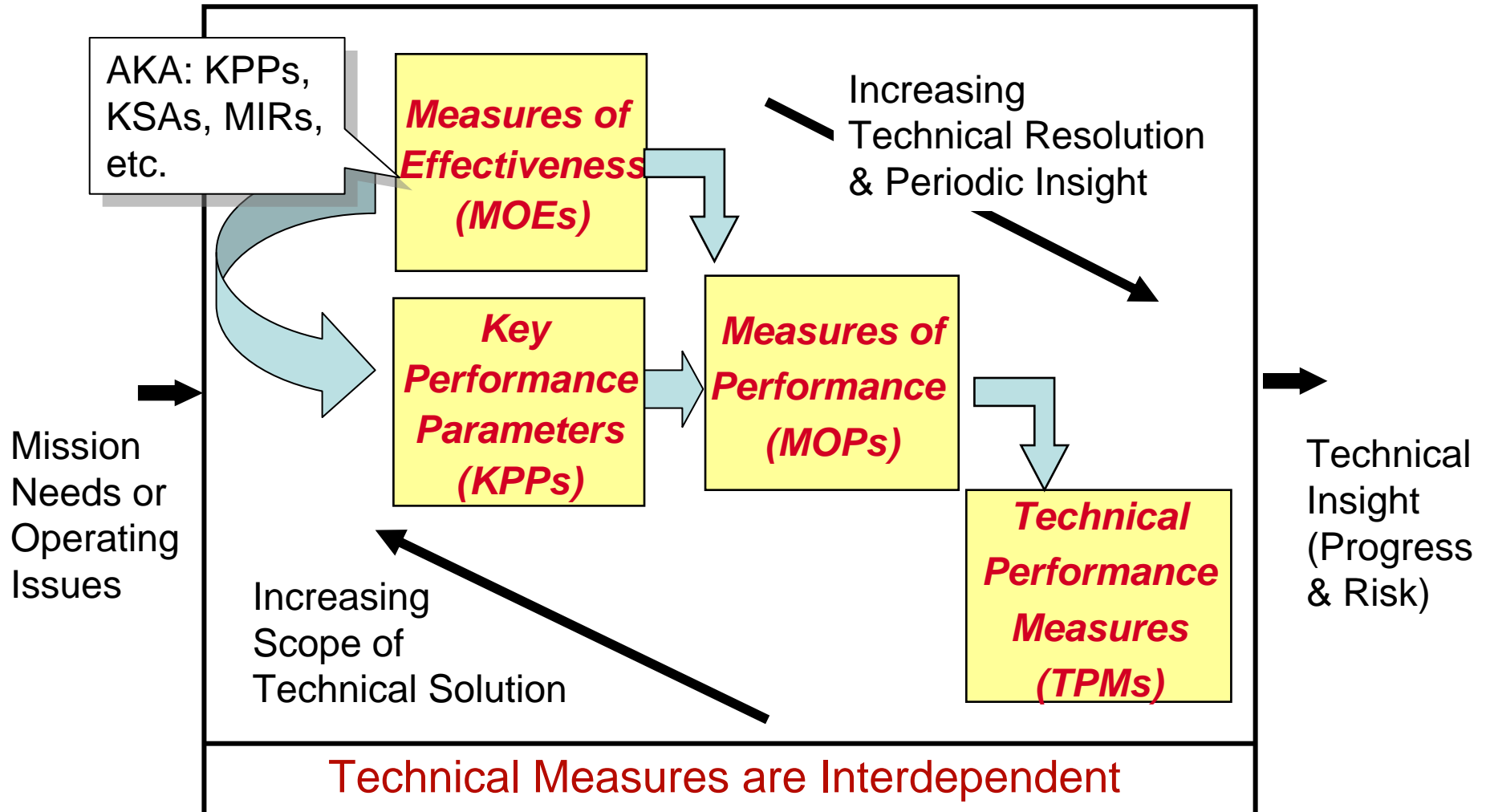


# Developing Technical Performance Measures

- Select TPMs as critical technical parameters
  - Tie to program success

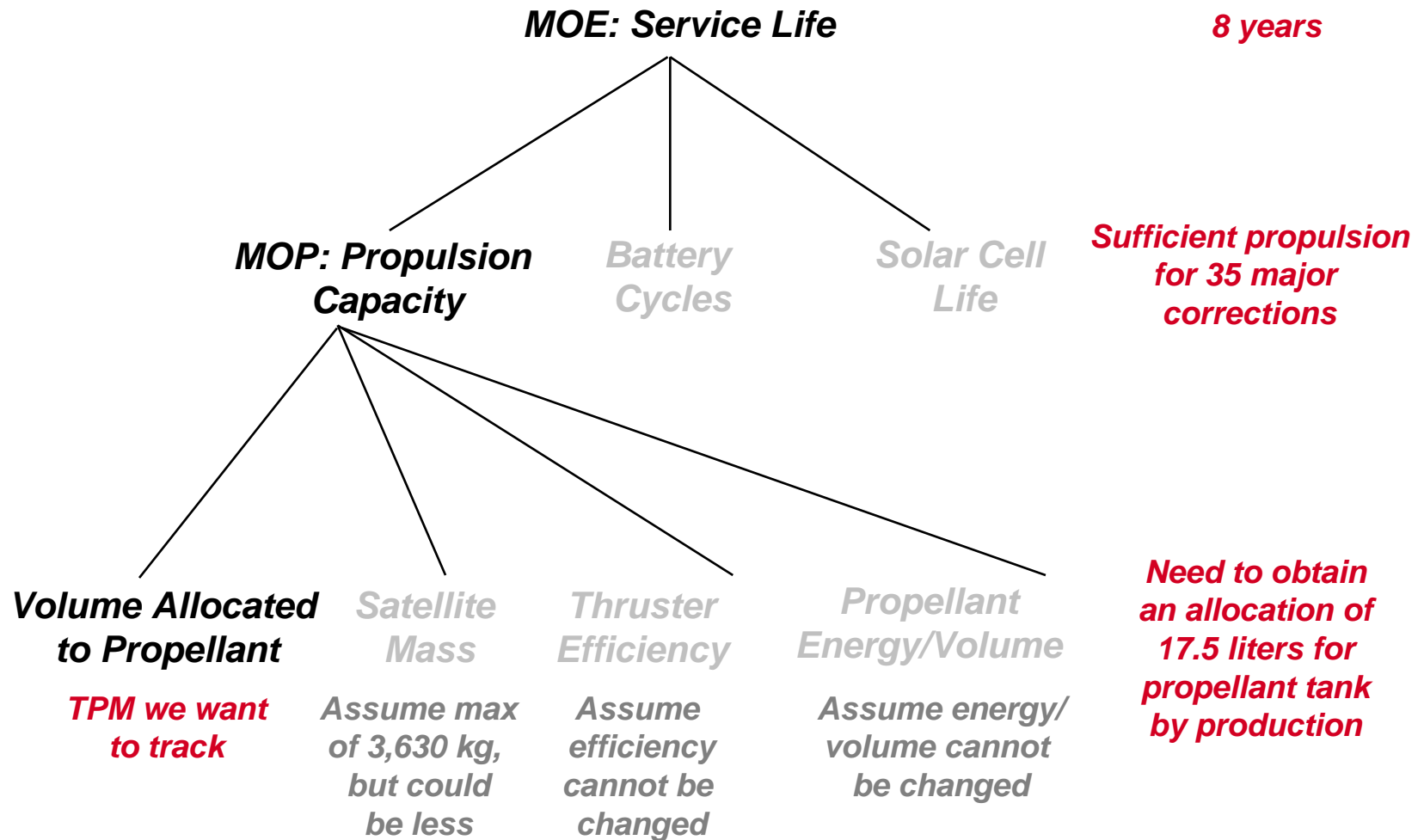


# Types of Technical Measures and Their Relationships





# Notional Example in Satellite Development





# Developing Technical Performance Measures

- Select TPMs as critical technical parameters
  - Tie to program success
  - Tie to risks



# Risk Matrix

			1	
		2	1	
			4	
	3			5

Risk #1: Insufficient propellant capacity results in below spec system life.

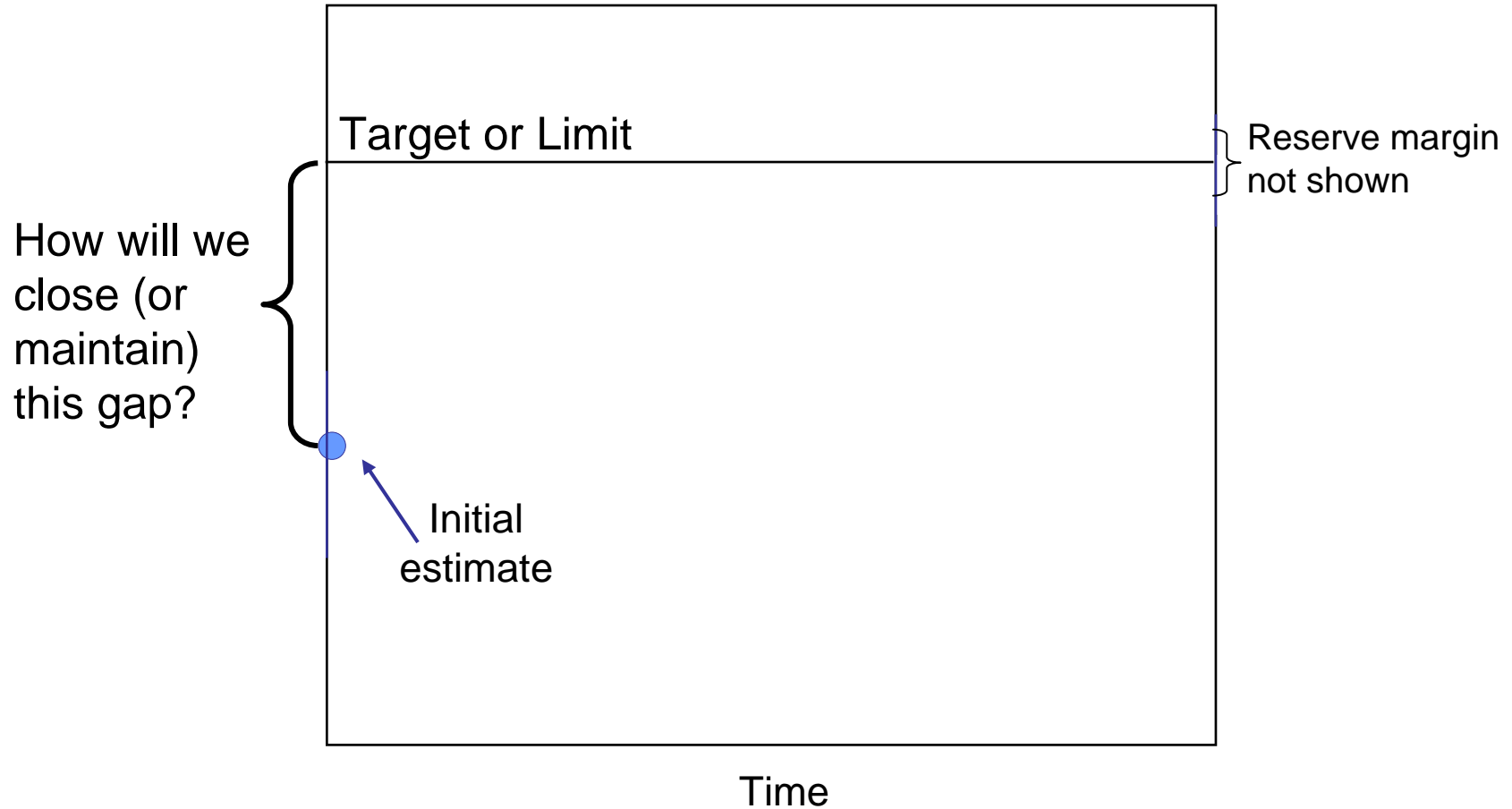


# Developing Technical Performance Measures

- Select TPMs as critical technical parameters
  - Tie to risks
  - Tie to program success
- Predict progress in achieving TPMs



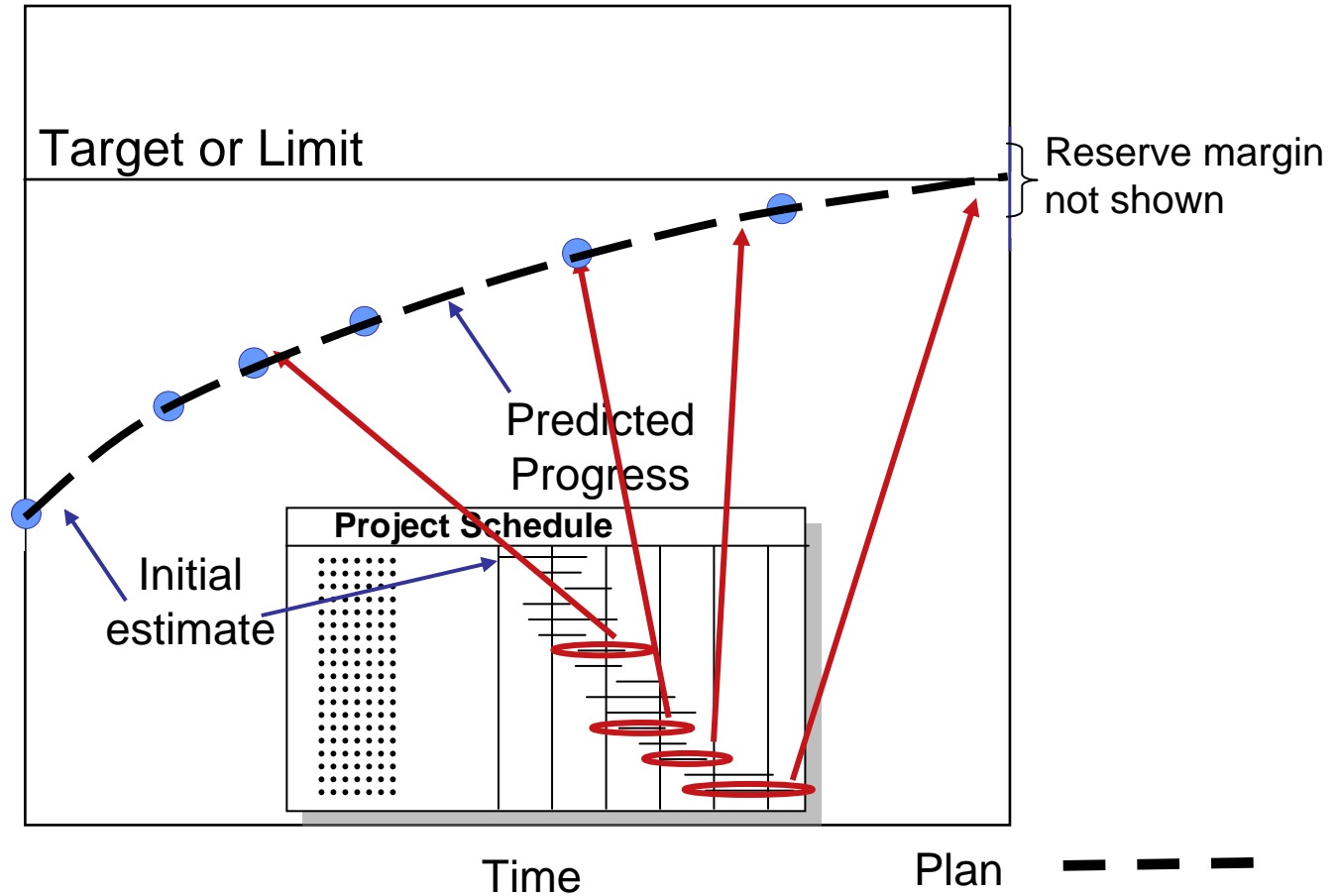
# Enter Current Estimate





# Add Predictions to TPM

Estimate results at each task completion and map to graph



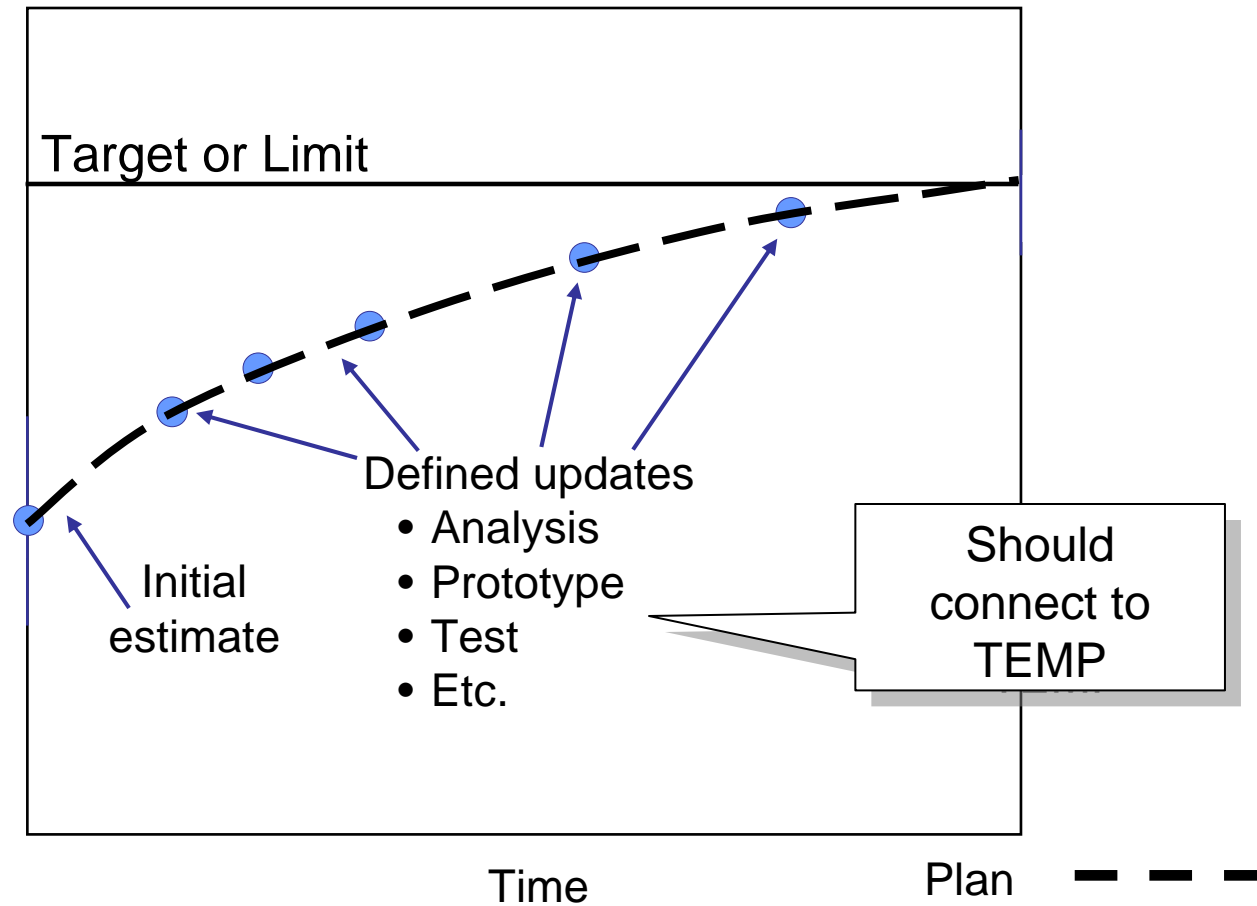


# Developing Technical Performance Measures

- Select TPMs as critical technical parameters
  - Tie to program success
  - Tie to risks
- Predict progress in achieving TPMs
- Establish methods of determining values — Key
  - Estimates
  - Analysis
  - Models or prototypes
  - Tests
  - Etc.



# Specify Measurement Methods



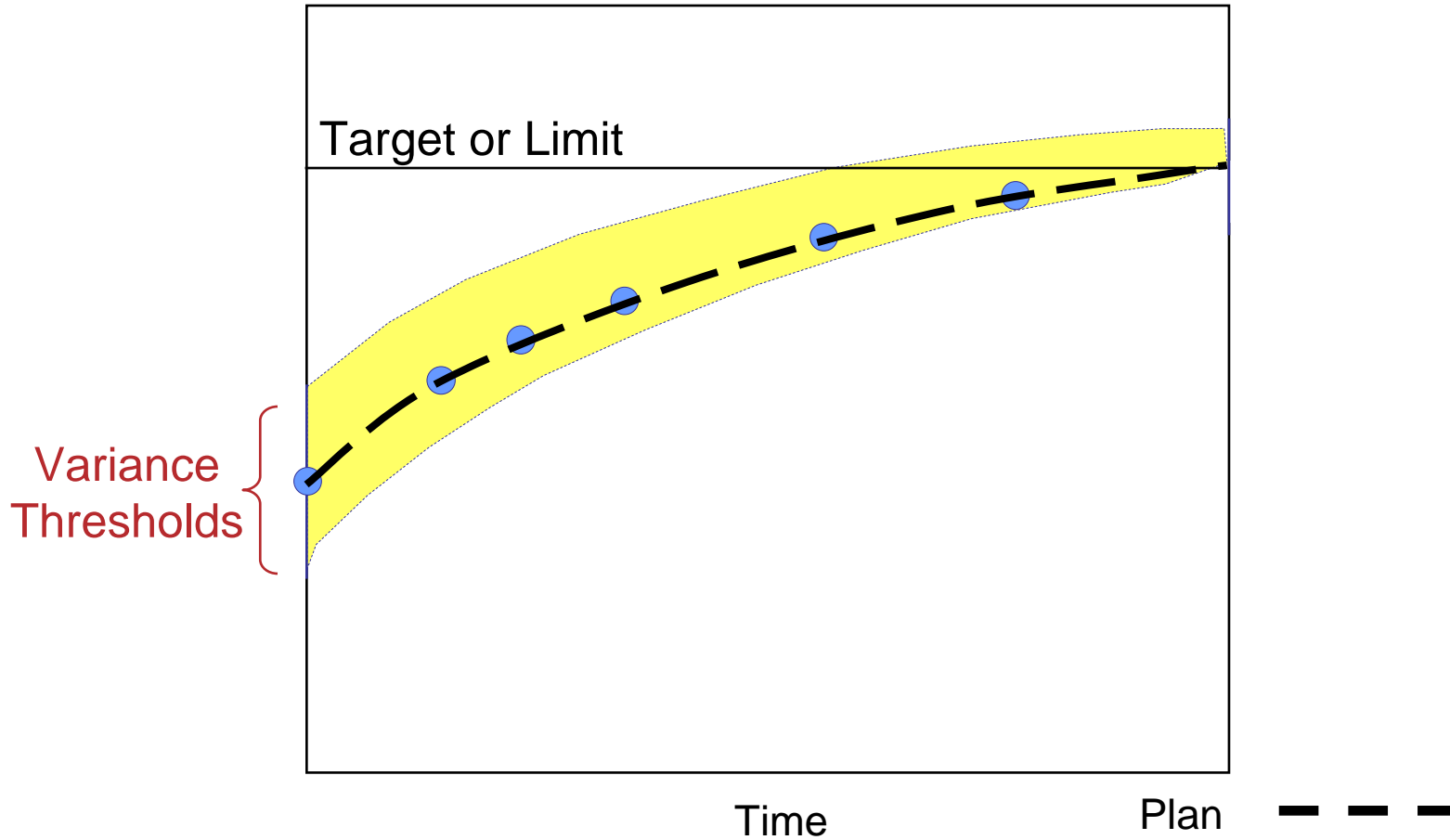


# Developing Technical Performance Measures

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  - Etc.
- Establish limits for acceptable TPM values



# Define Action Limites

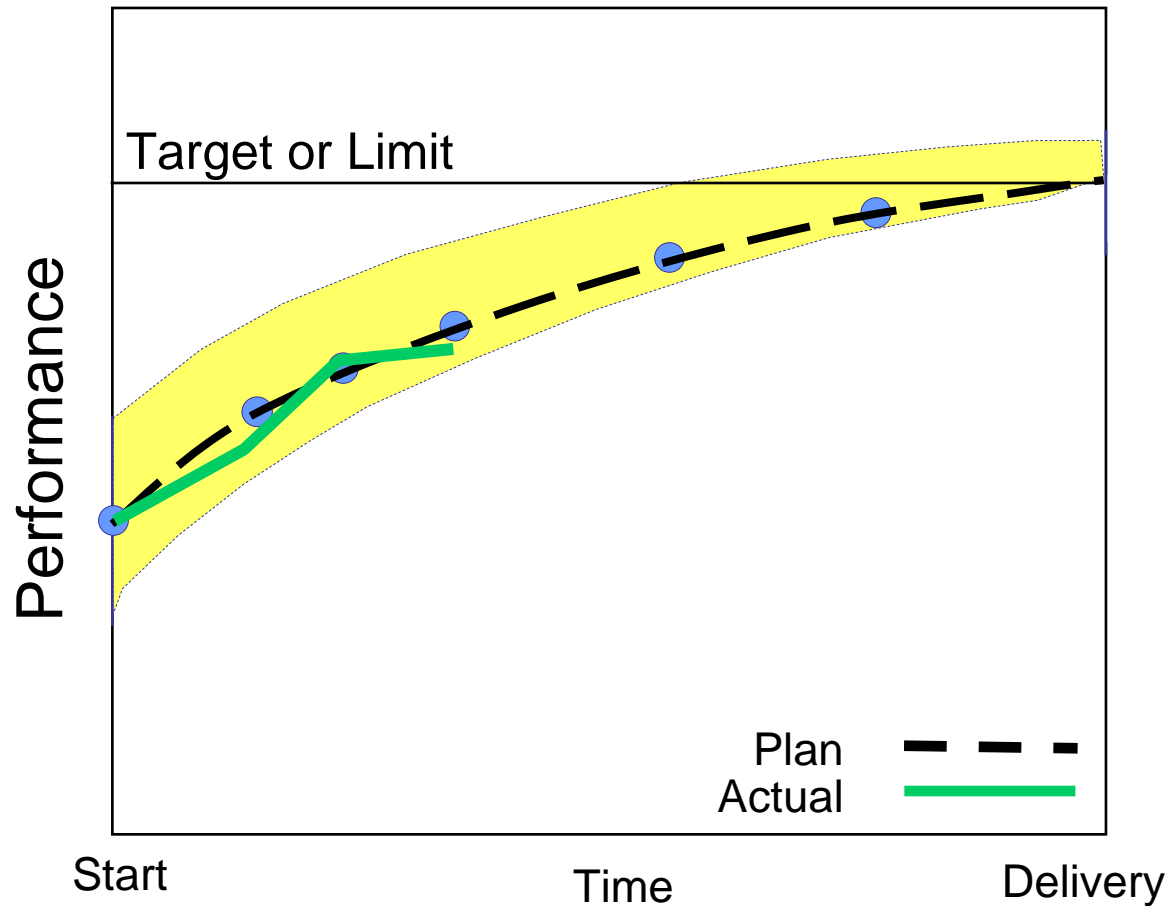




# Developing Technical Performance Measures

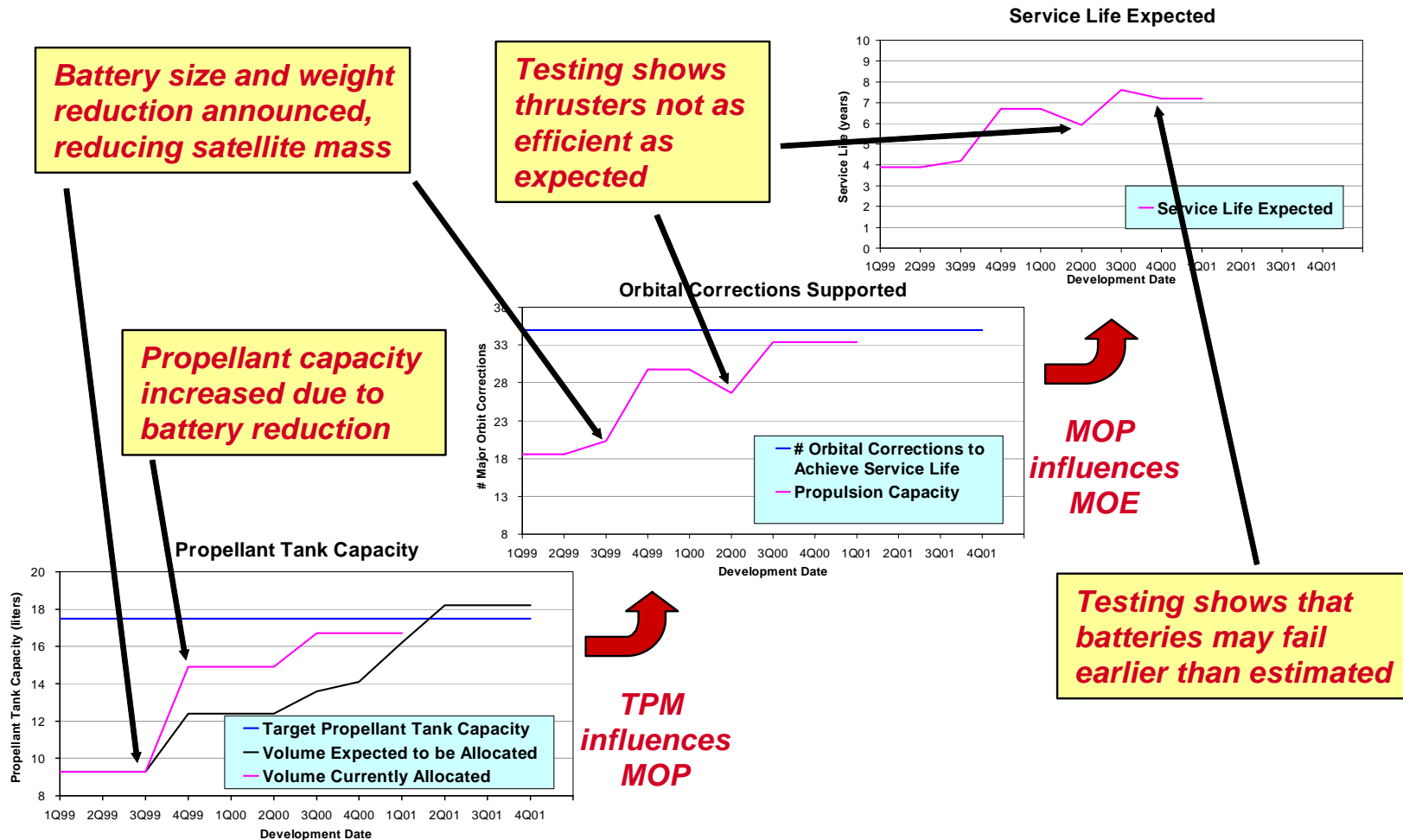
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- Establish methods of determining values — Key
  - Estimates
  - Analysis
  - Models or prototypes
  - Tests
  - Etc.
- Establish limits for acceptable TPM values
- Track TPMs throughout development
- Take actions as required

# Track Performance





# Notional Example from Satellite Development



Ref: Technical Measurement – PSM/INCOSE Tech Report Dec 27, 2005



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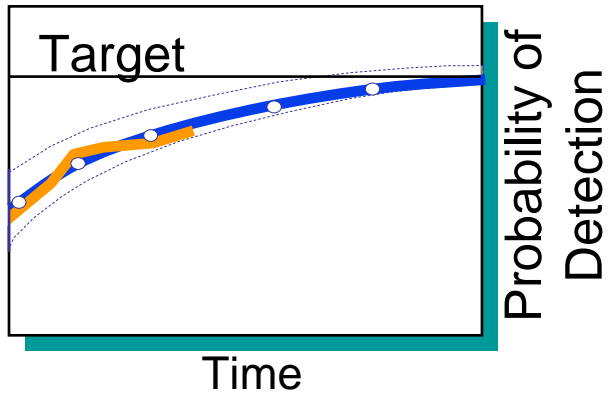
# Uses of TPMs

- TPMs are used to:
  - Forecast the values to be achieved
  - Identify differences between actual versus planned performance
  - Assess and predict progress towards achieving the performance values
  - Determine the impact of these differences on system effectiveness
  - Provide an indicator of risks and problems requiring management attention (early identification)
  - Determine where opportunities exist to make design trades to reduce overall risks (e.g. where positive margins exists)

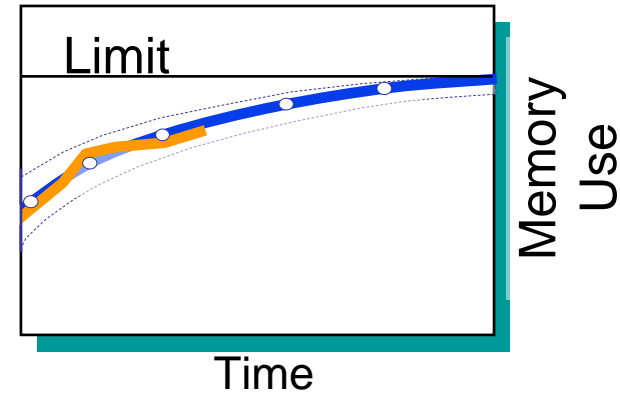


# TPM Use Examples

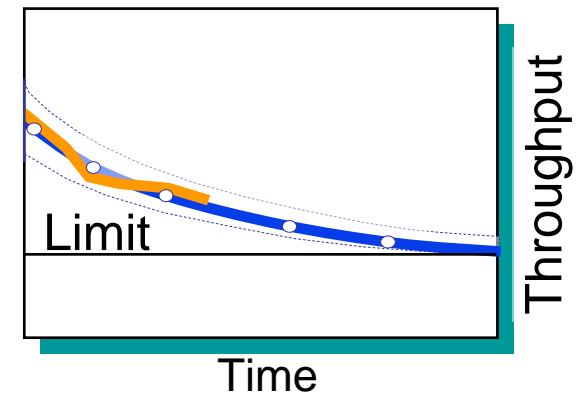
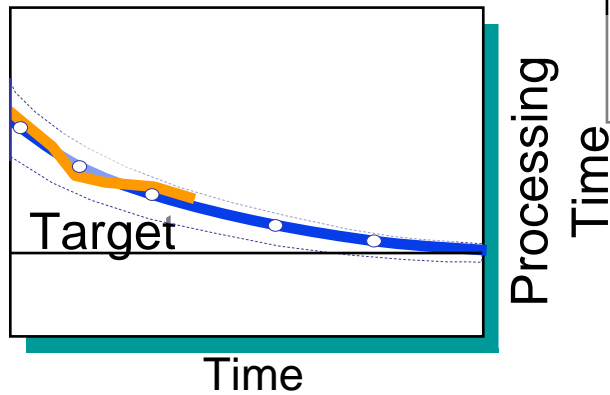
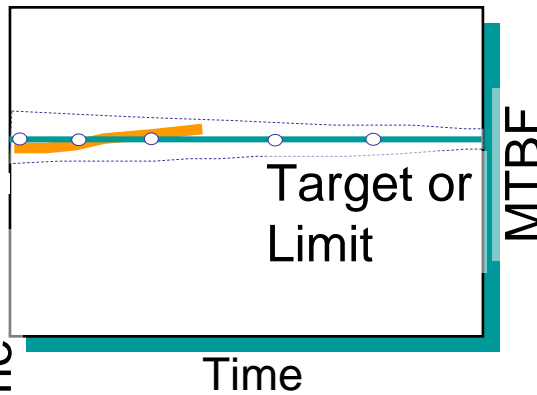
## Manage Improvement



## Manage Margin



## Maintain Level





# Value of Technical Measures

Radar Radiator subassembly example:

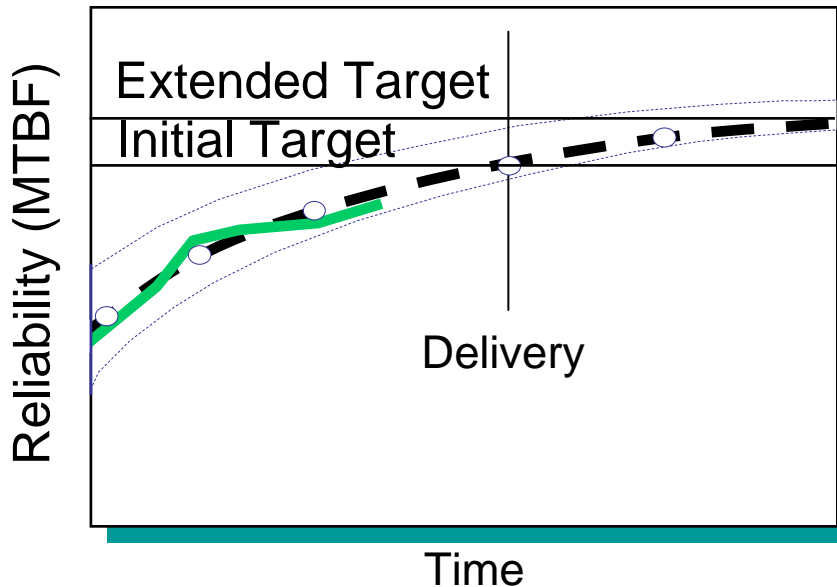
- The attainment of Six Sigma plus design electrical performance.
- Reduced unit production costs by 58%.
- Achieved current contract cost savings of \$5M +.
- Achieved follow-on contract cost reductions of \$30M +.
- Increased business profit margin for both ourselves and our supply chain partner.

- Hamman and Mackertich, INCOSE 2007



# After Deployment

- May continue through life of program
  - E.g., reliability improvement program
- Not the focus of this discussion





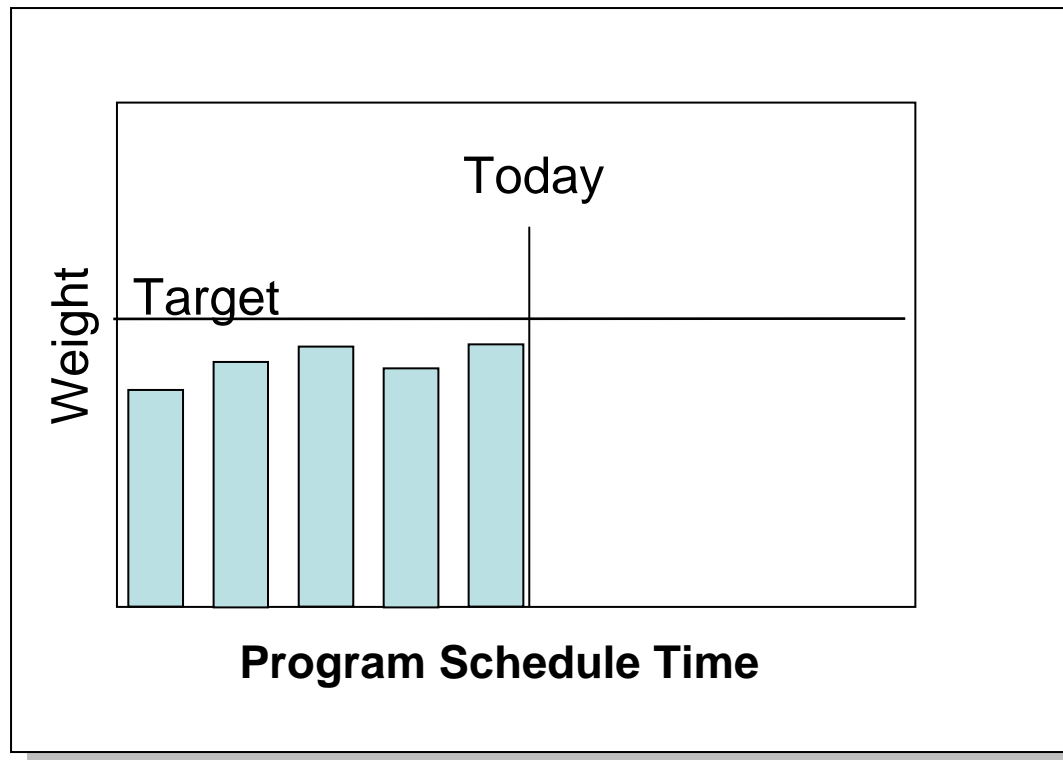
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# Things to Avoid

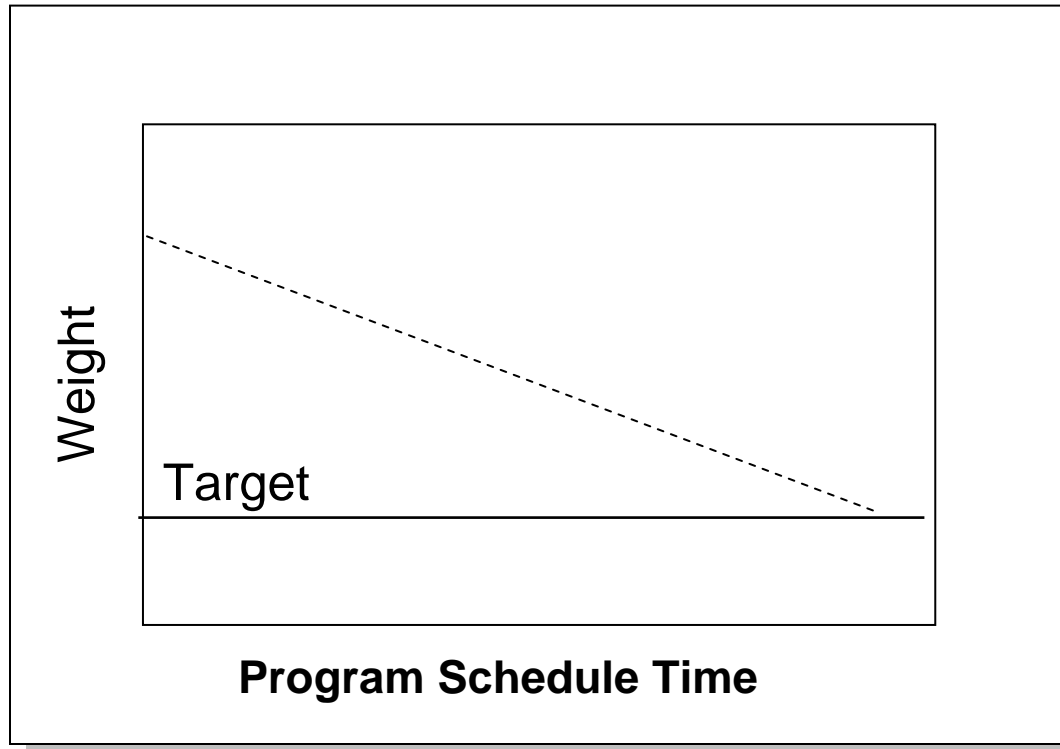
## Rear View Mirrors





# More Things to Avoid

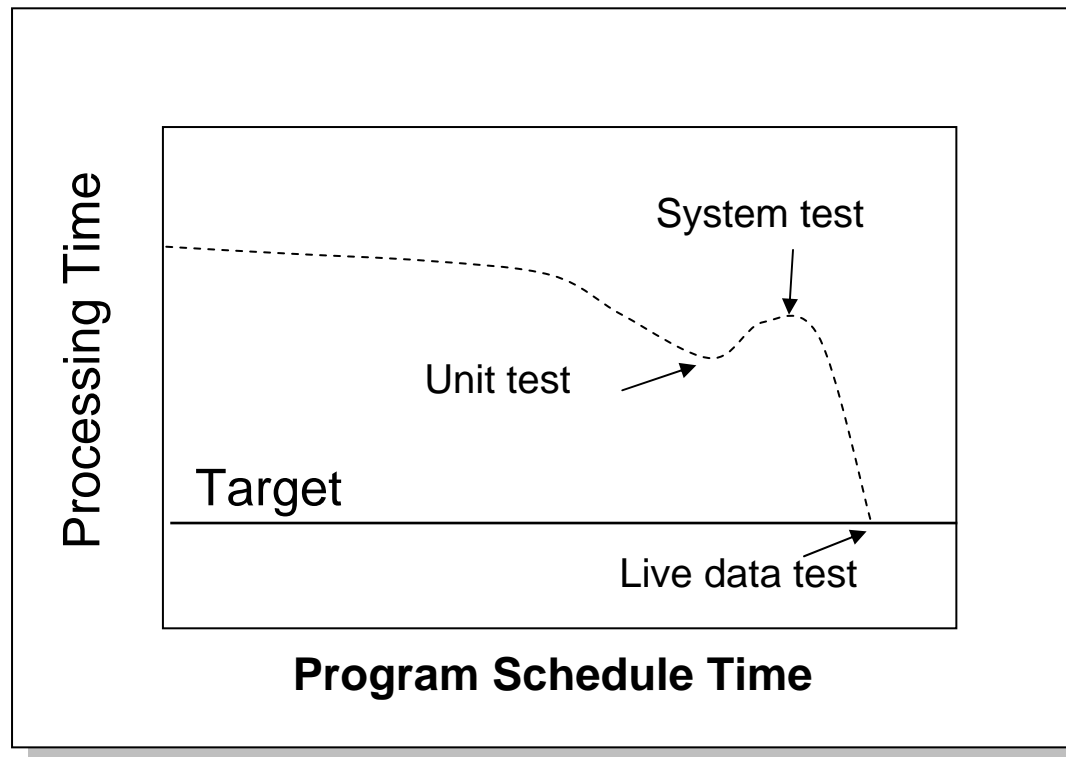
## Straight Line Predictions





# And Yet More Things to Avoid

## Unrealistic Miracles



- USAF TPM Guide Example

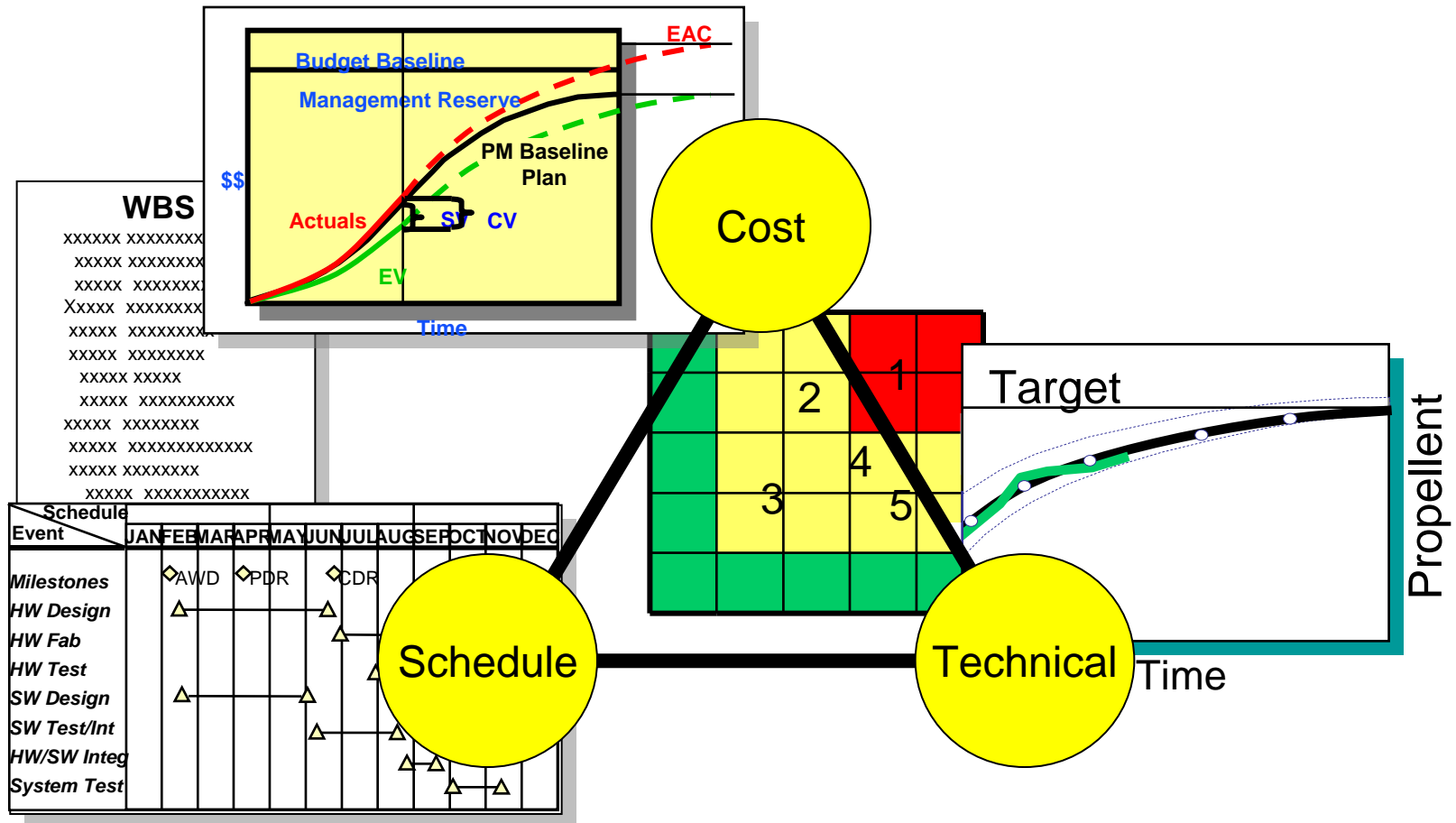


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# The Triangle Completed





# Wrap-up

- Technical Performance Measurement
  - Reflects state-of-practice in industry
    - Proven method to accomplish technical measurement
    - Both good and bad application exists
  - Provides insights in the development of the technical solution and associated risks
  - Guidance is weak
  - Tie to EVMS is generally missing
- Important to successful execution of the program



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# References

- INCOSE SE Handbook, v3.1
- DAR, Chapter 4
- ANSI/EIA 749B
- Technical Measurement – Collaborative Project of PSM, INCOSE and Industry, Dec 27, 2005
- Systems Engineering Fundamentals, DSMC
- INCOSE Measurement Primer, INCOSE MWG
- Practical Software and Systems Measurement  
<http://www.psmc.com>

