



Measurement Planning and Data Collection



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Topics



- **Background**
- **Deploy measurement process across programs**
- **Collect measurement usage across the company**
- **Evaluate measures for commonality and standardization**
- **Summary**

Lockheed Martin Aeronautics Overview



29,000 employees across the company and around the world



Background



- **Lockheed Martin Aeronautics measurement process improvements**
 - **Multi site measurement programs – pre 2000**
 - **Programs specific measures and formats – pre 1993**
 - **SEI CMM Level 3 for software – 1993**
 - **SW Standard Metrics**
 - **SEI CMM Level 4 for software – 1999**
 - **SW Quantitative Management**
 - **Common Repository for all SW measurement data**
 - **SEI CMMI Level 3 at company level – 2007 & 2010**
 - **Company wide measurement process**

Use of measures across the company



- **How to collect data on measurements used across the company and provide value added to the programs**
 - **Institutionalize the Measurement & Analysis (M&A) process**
 - **Identify common measurement needs across the programs**
 - **Standardize M&A planning across the company**
 - **Streamline M&A planning for the programs**

Approach



- **Establish a method to collect data on measurement indicators while using it to pre-populate program M&A plans**
 - **Establish Measurement Model Database**
 - **Measurement Objectives, Information Needs, and Measurement Indicators**
 - **M&A planning workshops on site with the programs facilitated data collection and distribution of common measurement planning data**
 - **Pre-populate M&A planning templates using data in the database**

Generate Measurement Matrix for each program

Approach (cont.)



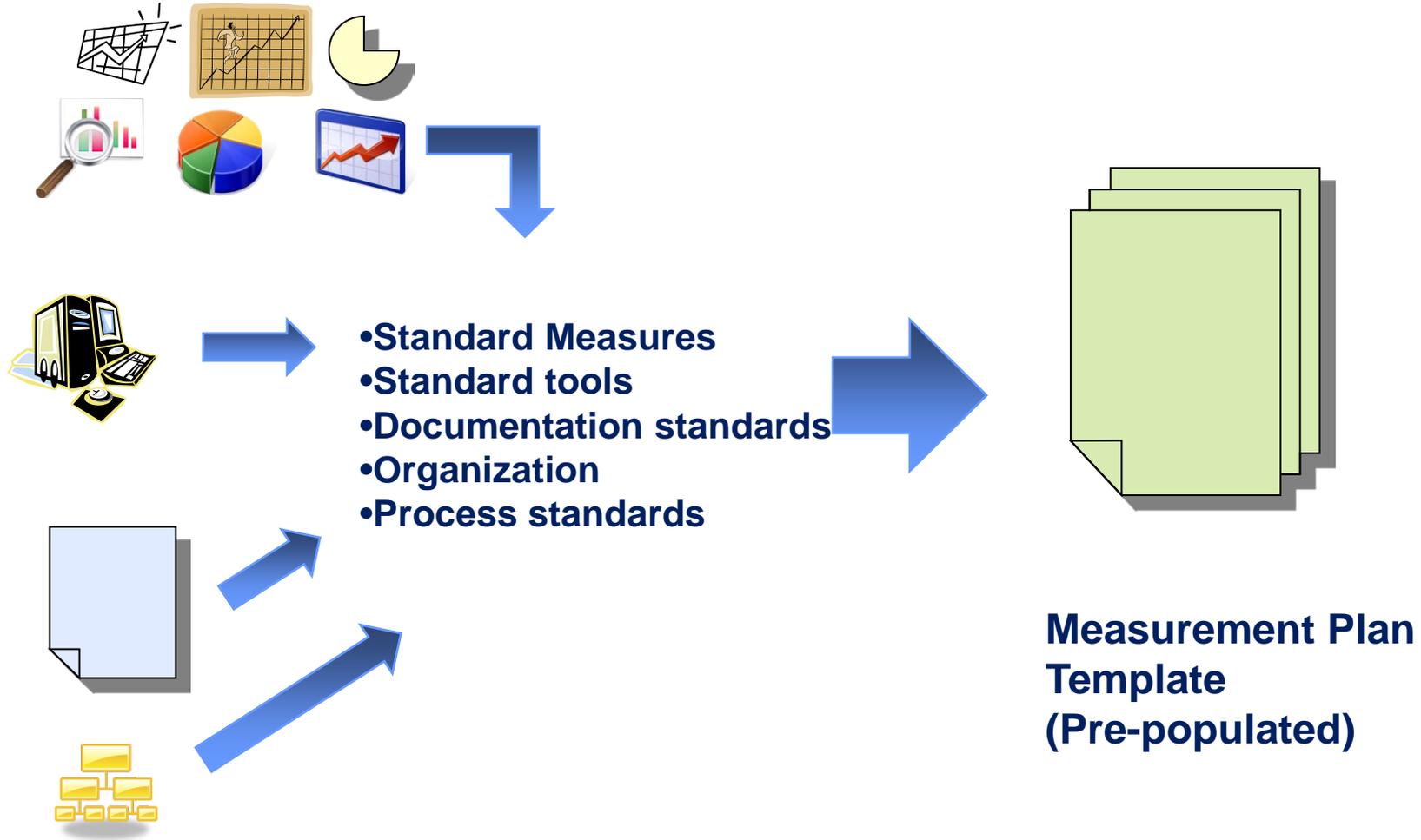
- **Measurement Matrix (MS Excel Work Book)**
 - **Measurement Objectives**
 - **Information Needs**
 - **Measurement Indicators**
 - **Base Measures**
 - **Program briefings where indicators are used**
 - **Program owners of the indicators**
- **Matrix is a part of program M&A plans**
 - **Replaces multiple traceability tables**
- **Matrix is generated from Measurement Model database**

Approach (cont.)



- **Resources:**
 - **Pre-populated M&A plan template**
 - **Common objectives, information needs and measures**
 - **Boiler plate information**
 - **Training**
 - **References to standard process**
 - **Measurement Model Database**
 - **Specification data for standard measures**
 - **Common objectives and information needs**
 - **Able to generate tables for M&A plan**
 - **Collect program specific measures**

Measurement Plan Template



Measurement Model

Enterprise Process Integration
Measurement and Analysis Model

Setup

- Edit Contacts
- Edit Domains
- Edit Functions
- Edit Program Information
- Edit Work Product
- Edit WBS List
- Edit Measurement Tools

Tasks

- View Standard Categories
- LM Measurements Library
- Measurement Menu
- Action Items

Process Overview

Presentation

Program Objectives

Status Report

Program Indicators

Model/Template

Status Report Template

Presentation Document

Plan Check List Analysis Template

Worksheet Presentation

Reports/Output

- Objectives
- Info. Needs
- All Indicators
- All Base Measures
- Analysis Info
- CMMI Info

Stores information about the program

Stores information about the objectives, information needs, indicators and base measures

Tabular reports can be generated consistent with those needed for M&A Planning

Can be used to generate a Measurement Matrix for any program or function

Measurement Model (cont.)

The screenshot displays the 'Measurement and Analysis Model' interface, which is divided into three main sections: Objectives Input, Information Needs Input, and LM Measurements Library. Each section contains a list of items with expandable options.

- Objectives Input:** Contains a list of objectives such as 'Deliver High Quality Aircraft on Schedule', 'Aggressively Manage GFE and DMS Issues', 'Proactively Manage Configuration Control of Each Aircraft and the RERP (C-5M) Baseline', 'Manage timely Procurement of all supplier required products for C-5 programs', and 'Minimize Waste to Affordable Product and Contribute to E...'. A callout box points to this section with the text: 'Collect information about the objectives' and 'List the objectives'.
- Information Needs Input:** Contains a list of information needs such as 'Is the program performing to schedule?', 'Is the aircraft meeting quality expectations?', 'Does the corrective action process work effectively to meet program/project expectations?', and 'How much scrap & rework is being generated?'. A callout box points to this section with the text: 'Collect information about the Information Needs' and 'List the Information Needs'.
- LM Measurements Library:** Contains a list of measurement indicators such as 'Action It...', 'Aircraft A...', 'Aircraft A...', 'Approved CRs', 'Automated Request for Engineering Action', 'BTP Commit Plan', 'BTP Need Plan', 'Cash vs. Time', 'CDRL Status', 'Change Request by Category', 'Closed DRs by Resolution', 'CM CCB CR Cycle Time', and 'CM OOS CR Disposition Index'. A callout box points to this section with the text: 'Collect information about the Measurement Indicators' and 'List the Measurement Indicators'.

Collect information about the objectives
List the objectives

Collect information about the Information Needs
List the Information Needs

Collect information about the Measurement Indicators
List the Measurement Indicators

Measurement Model (cont.)



Descriptions:
Deliver High Quality Aircraft on Schedule

Information Needs:

- Is the program performing to schedule?
- Is the aircraft meeting quality expectations?
- Does the corrective action process work effectively to meet program/project expectations?
- Have the defects been corrected/resolved appropriately for the project's needs?
- How much scrap & rework is being generated?
- Are staffing & skills meeting program needs?

Relates the Objective to appropriate Information Needs

Relates the Information Need to its category, Indicators used to answer it, and the Objectives it is related to

Program/Project objectives/risks/issues

Title: Is the program performing to schedule? Item ID: 1

Assigned To: [Dropdown] Add Domain: [Dropdown] Add Priority: [Dropdown]

Requested By: [Dropdown] Add Function: [Dropdown] Add WorkProduct: [Dropdown]

Category: Schedule and Progress Double Click on Category to view Detail Information WBS: [Dropdown]

Info Type: Program Specific Indicators Selection/Review Delete Current Information Need View Report Format

Description	Measurement Concept	Analysis Requirements	Action Requirements	Comments
Information on performing tasks, releases, and activities according to scheduled or planned completion.				

Objectives:

- Deliver High Quality Aircraft on Schedule
- Aggressively Manage GFE and DMS Issues
- Delete Objective

Indicator:

- CDRL Status
- Development Progress
- Software Requirement Progress
- Software Change Request Status
- Electronic Inh Delay Summary

Measurement Model (cont.)



LM-Aero Library of Indicators - Detail Information Close Form

Measures **Change Status of current measure**

OSP: **Table References:**

Measurement Category: **Appendix:** **Required/Optional:**

This measures Answers Questions Such as:

Implementation Guidance: **Analysis Frequency:** **Review Frequency:**

Storage Requirements: **Org. Repository:**

Collection Level: **Reporting Level:**

Collection Requirements: **Collection Frequency:**

CMMI Process Areas:

OPF: OPD: OT: OPP: OID: PP: PMC: SAM: IPM: RSKM: QPM:

REQM: RD: TS: PI: VAL: VER: CM: PPQA: MA: DAR: CAR:

Purpose:

Delete Current Indicator
 Add New Indicator
 LM Measurement Library
 All Indicators Report
 Current Indicator Report
 Program Indicators Rpt
 Function Indicators Rpt

Base Measure Name

Delete Current BaseMeasure

Indicator Tool

Collect detailed information about each measurement indicator
Can generate specification table for each or all indicators

Measurement Matrix



	Y	Z	AA	AB	AC	AD	AE	AF
1	Measures	Info	Needs	Category	Question	Purpose	Objective	Descriptive
2	Automated Request for Engineering Action Metrics	R	A	Process Performance	E.S. 001	AREA Standard Metrics Deck includes 15 metrics	Track AREAs to	Multiple bar/line
3	BTP Commit Plan	R	A	Process Performance	E.S.001	Tracks performance to the Commit Plan. This	Track BTP perfrc	Chart showing
4	BTP Need Plan	R	A	Process Performance	E.S.001	Tracks performance to Need Plan. The latest	Tracks drawings	Tracks drawin
5	Cash vs. Time	D	A	Resource and Cost	B.S.008; B.S.010	Determine whether program is meeting comp.	Provide executive	Plan vs. Act
6	CM CCB CR Cycle Time	R	A	Process Performance	E.S. 004; E.S. 005; E.S.	Track the performance of the formal change r	Identify potential	This measure
7	CM OOS CR Disposition Index	R	A	Process Performance	E.S. 005; E.S. 006	Tracks the disposition of formal CRs.	Identify potential	Compares th
8	Cost Performance	C	A	Resource and Cost	B.S.001; B.S.002; B.S.0	Provide insight into the actual labor expendit	Identify risks to th	The earned v
9	Cost Performance Index	C	A	Resource and Cost	B.S.001; B.S.002; B.S.0	Represent actual cost expenditure to budget	Identify risks to th	CPI indicat
10	Cost Variance	C	A	Resource and Cost	B.S.001; B.S.002; B.S.0	Identify variance of actual labor expenditures	Indicate if project	This earned v
11	CPU Throughput	C	A	Product Size and Stability	C.S.004; C.S.005; C.S.0	Compare actual to expected computer resour	Identify computer	This measure
12	Defect Burndown	C	A	Product Quality	D.S.003; D.S.006; D.S.0	Identify how long it will take to correct the defe	Identify impacts to	The Defect E
13	Defect Profile Table	R	A	Product Quality	D.S.001; D.S.002; D.S.0	Identify how many defects are detected and in	Represent produc	The defect pr
14	Defects by Category	R	A	Product Quality	D.S.001; D.S.004	Identify the number of defects per defect cate	Provide insight in	Column grap
15	Defects by Severity	C	A	Product Quality	D.S.002; D.S.003	Identify the number of defects per defect seve	Provide insight in	The Defects
16	Delivery Status	D	A	Schedule and Progress	A.S.008; A.S.009	Indicates whether final product deliverables ar	To control final o	Count of plan
17	Earnings Before Interest & Taxes (EBIT) vs. Time	D	A	Resource and Cost	B.S.008; B.S.009	Determine whether program is meeting comp.	Provide executive	Plan vs. Act
18	Input/Output Utilization	C	A	Product Size and Stability	C.S.004; C.S.005; C.S.0	Compare actual to expected utilization of inter	Identify computer	This measure
19	KBPT/MTPI	C	A	Technical Effectiveness	E.S.001; E.S.002; E.S.0	Track the performance of technical improvem	Monitor activity	Key Perform

Generated from the Measurement Model database

Each tab replaces a table in the M&A Plan

- Measurement Objectives and their associated Information Needs
- Information Needs mapped to standard categories and the Indicators used for each Information Need
- Specification details about each Indicator
- Base Measures used for each Indicator

Relationship of Measurement Matrix Tables



Objectives-Info Multiple

Objectives	Source (Company/Program/Customer)	Information Needs
1. Perform to Customer Expectation	Customer	a. What is the customer expectation of program performance? b. How is the delivered aircraft performing? c. Are the delivered services meeting expectations?
2. Manage Scrap & Rework	Company	a. How much scrap and rework is being generated on the program?
3. Perform to Schedule	Program	a. Is the program performing to schedule?
4. Perform to Budget Expectations	Program	a. Is the program performing to budget?
5. Perform to Quality Expectations	Program	a. Do the work products have adequate quality? b. Are the delivered products performing to quality expectations? c. Are the delivered services meeting expectation?

InfoMeasures Once Multiple

Information Needs	Measure
a. What is the customer expectation of program performance?	CPAR Delivery Status Field Reports
b. How is the delivered aircraft performing?	Field Reports FOD found at delivery
c. Are the delivered services meeting expectations?	MTBR Mission Capability Rate
d. How much scrap and rework is being generated on the program?	Scrap and Rework FOD found Lost Tools
e. Is the program performing to schedule?	Schedule Performance Index Schedule Health
f. Is the program performing to budget?	Cost Performance Index Cost Variance

AllMeasures Once Multiple

Measure	Information Category	Base Measures
CPAR	Customer Expectations	Rating color for each element rated.
Delivery Status	Customer Expectations	# of aircraft expected each month # of aircraft delivered each month
Field Reports	Customer Expectations	Defective item Defect severity Defect category Date found
FOD Found at delivery		# of FOD items found each month
MTBR		Date defect found Date repair completed

BaseMeasures Once Once

Base Measures	Measure	OMR	Collection tool
Rating color for each element rated	CPAR	N	PPADB
# of aircraft expected each month	Delivery Status	N	MS Excel
# of aircraft delivered each month	Delivery Status	N	MS Excel
Defective item	Field Reports	Y	ALIS
Defect Severity	Field Reports	Y	ALIS
Date category	Field Reports	Y	ALIS

Match

Match

Match

InformationNeeds Once

Information Need	Category	Measurable Concept	Questions
Rating color for each element rated	Customer Expectations	Identify customer rating to specified criteria on key elements	Are we meeting customer performance expectations?
# of aircraft expected each month	Schedule and Progress	Compare # of aircraft delivered to # of aircraft deliveries planned	Are we delivering the number of aircraft planned?
Defective item	Product Quality		How many defective items have been found?
Cost Performance Index	Resources and Cost	Compare actual cost expended to planned cost expended	Are actual costs within tolerance of expected cost expenditures?

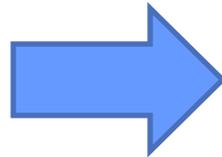
Each Objective may map to multiple Information Needs. Each Information Need can map to multiple Indicators. Each Indicator may use multiple Base Measures. Indicator details includes an owner for each measure and what management briefings include the measure. Indicators can be sorted by owner, briefing, category, etc for program use.

Program Measurement and Analysis Plan



Measurement Matrix is combined with Measurement Plan template to create program Measurement Plan

ID	Measure	Category	Definition	Program	Objectives	Design
1	Customer Satisfaction					
2	Customer Satisfaction					
3	Customer Satisfaction					
4	Customer Satisfaction					
5	Customer Satisfaction					
6	Customer Satisfaction					
7	Customer Satisfaction					
8	Customer Satisfaction					
9	Customer Satisfaction					
10	Customer Satisfaction					
11	Customer Satisfaction					
12	Customer Satisfaction					
13	Customer Satisfaction					
14	Customer Satisfaction					
15	Customer Satisfaction					
16	Customer Satisfaction					
17	Customer Satisfaction					
18	Customer Satisfaction					
19	Customer Satisfaction					
20	Customer Satisfaction					



Organizational Analysis of Measurement Planning Data



- Evaluate which measures are common across programs
- Used M&A Working Group to down select those to add to the company standard set of measures

ID	Measure	Program	Category	Question	Program	Objective	Description
1	Automated Integration Engineering Action Matrix	PA	A	Process Performance	E.3.00	AFSA Standard Metrics Deck Includes B Item	Track AFSA to Address Item
2	ETP Control Plan	PA	A	Process Performance	E.3.00	Track performance to the Control Plan, The	Track ETP per the Chart above
3	ETP Meet Plan	PA	A	Process Performance	E.3.00	Track performance to Meet Plan, The Level	Track & Report; Track & Report
4	ETP Meet Plan	PA	A	Process Performance	E.3.00	Track performance to Meet Plan, The Level	Track & Report; Track & Report
5	Life in Time	PA	A	Process and Cost	E.1.00, E.1.00	Identify whether program is meeting comp	Identify whether program is meeting
6	Operating Cost/Line Item	PA	A	Process Performance	E.1.00, E.1.00, E.1.00	Track the performance of the budgeted line	Identify whether program is meeting
7	Operating Cost/Line Item	PA	A	Process Performance	E.1.00, E.1.00	Track the performance of the budgeted line	Identify whether program is meeting
8	Operating Cost/Line Item	PA	A	Process Performance	E.1.00, E.1.00	Track the performance of the budgeted line	Identify whether program is meeting
9	Cost Performance Index	CA	A	Resource and Cost	B.3.00, B.3.00, B.3.00	Report actual cost expenditure to budget	Identify whether program is meeting
10	Cost Variance	CA	A	Resource and Cost	B.3.00, B.3.00, B.3.00	Identify variance of actual line expenditure	Identify whether program is meeting
11	CPI Throughput	CA	A	Product Size and Quality	C.3.00, C.3.00, C.3.00	Compare actual to expected computer second	Identify whether program is meeting
12	Defect Burden	CA	A	Product Quality	D.3.00, D.3.00, D.3.00	Identify whether program is meeting	Identify whether program is meeting
13	Cost Variance	CA	A	Resource and Cost	B.3.00, B.3.00, B.3.00	Identify variance of actual line expenditure	Identify whether program is meeting
14	CPI Throughput	CA	A	Product Size and Quality	C.3.00, C.3.00, C.3.00	Compare actual to expected computer second	Identify whether program is meeting
15	Defect Burden	CA	A	Product Quality	D.3.00, D.3.00, D.3.00	Identify whether program is meeting	Identify whether program is meeting
16	Defect Burden	CA	A	Product Quality	D.3.00, D.3.00, D.3.00	Identify whether program is meeting	Identify whether program is meeting
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49	Operating Cost/Line Item	PA	A	Process Performance	E.1.00, E.1.00	Track the performance of the budgeted line	Identify whether program is meeting
50	Operating Cost/Line Item	PA	A	Process Performance	E.1.00, E.1.00	Track the performance of the budgeted line	Identify whether program is meeting



Final update approved by Enterprise Process Board

Programs are represented on M&A WG



Summary



- **Deployed Measurement and Analysis (M&A) process to all programs**
- **Streamlined Measurement and Analysis planning for the programs**
- **Standardized M&A Planning across the programs**
- **Collected measurement usage across the company**
- **Updated the set of standard measures based on results**

Contact Information



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