

Integrating CMMI® and Six Sigma in Software and Systems  
Engineering

**M. Lynn Penn**

**Lockheed Martin Integrated Systems and Solutions**

**SEPG 2005**

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# Agenda

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**Introduction**

**IS&S Overview**

**Integrated Process Improvement**

**Lean Thinking**

**Technology/ Process Change Management Evolution –  
a Case Study**

# **M. Lynn Penn**

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**Director Quality Systems & Process Management**  
**Chair Executive Process Steering Committee**  
**Maintain the IS&S Standard Operating Process**  
**Maintain IS&S compliance to industry standards**  
**Maintain Organizational Performance Database**  
**Maintain Program Database**  
**Maintain Corrective Action Database**  
**Manage ISO and CMMI Maintenance Programs**  
**ISO - Internal Audits & Surveillance**  
**CMMI – SCAMPI B&C**

## **Credentials**

**CMMI Candidate SCAMPI Lead Appraiser**  
**CMMI Instructor**  
**ISO Lead Auditor**  
**Six Sigma Certified Black Belt**  
**SEI Affiliate**



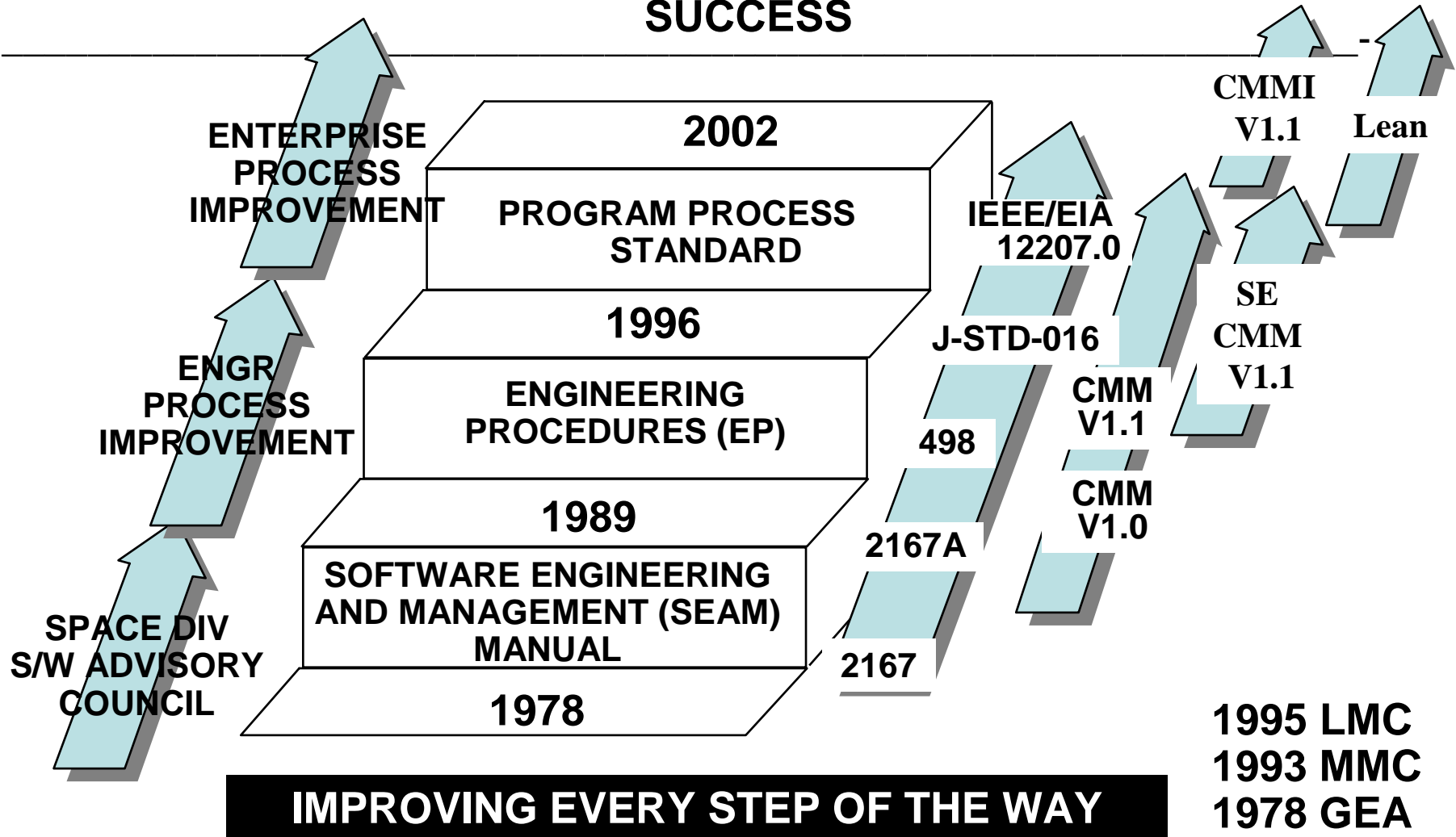
# Lockheed Martin

## Integrated Systems & Solutions

### **Integrated Systems & Solutions (IS&S)**

- 15,000 employees
- Four primary geographic regions (40+ sites)
- Seven Lines of Business
- Process Foundation
  - Management & Data Systems Recognized Standard Operating Process (Program Process Standard) across all programs
  - Mandated by senior management
  - Maintain the CMMI Maturity Level 5 through mergers and acquisitions

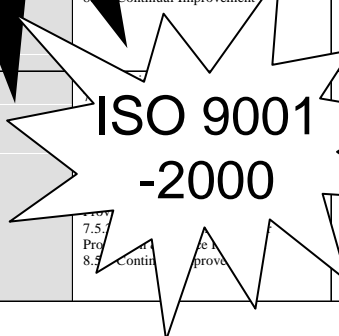
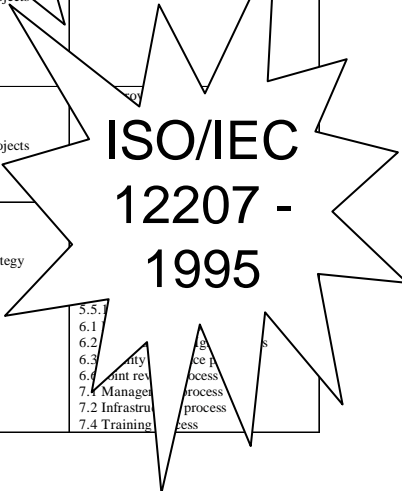
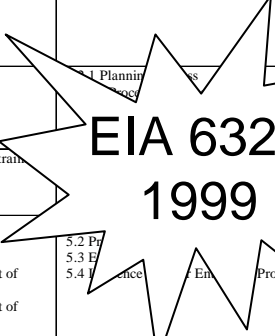
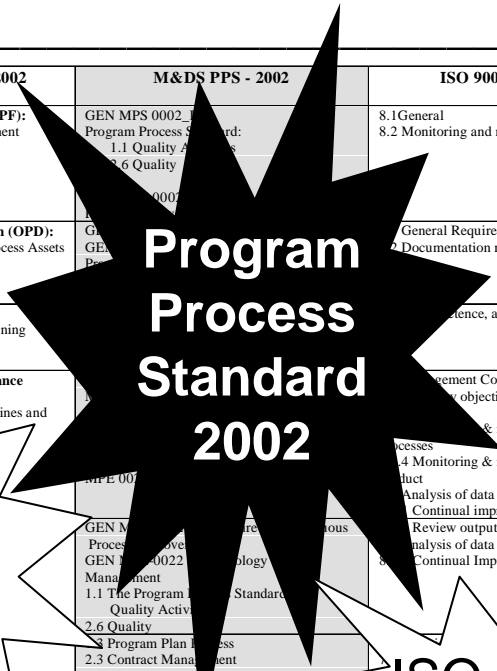
MISSION  
SUCCESS





# LMC IS&S Process Standard Roadmap

CMMI SE/SW v1.1 - 2002	M&DS PPS - 2002	ISO 9001 - 2000	EIA-632-1999	ISO/IEC 12207 - 1995
<b>Organizational Process Focus (OPF):</b> SG1: Determine Process Improvement Opportunities SG2: Plan and Implement Process Improvement Activities	GEN MPS 0002 Program Process Standard: 1.1 Quality Assurance 2.6 Quality Improvement	8.1 General 8.2 Monitoring and measurement	4.5.3 System Verification Process R32: Enabling Product Readiness	7.3 Improvement process
<b>Organizational Process Definition (OPD):</b> SG1: Establish Organizational Process Assets	GEN MPS 0003 Program Process Standard: 1.1 Quality Assurance 2.6 Quality Improvement	General Requirements Documentation requirements	4.1 Planning 4.2 Requirements Management	5.3.1 Process implementation 7.3 Improvement process
<b>Organizational Training (OT):</b> SG1: Establish Organizational training Capability SG2: Provide Necessary training	GEN MPS 0004 Program Process Standard: 1.1 Quality Assurance 2.6 Quality Improvement	8.5 Competence, awareness & training	5.1 Enterprise Factors 5.2 Project Factors 5.3 External Factors 5.4 Influence of other Enterprise Projects	5.2.4 Planning 5.2.5 Execution & control 5.4 Training process 6.8 Problem resolution process 7.3 Improvement process
<b>Organizational Process Performance (OPP):</b> SG1: Establish Process Baselines and	GEN MPS 0005 Program Process Standard: 1.1 Quality Assurance 2.6 Quality Improvement	8.6 Management Commitment 8.7 Measurement of performance 8.8 Monitoring & measurement of processes 8.9 Analysis of data 8.10 Continual improvement 8.11 Review output 8.12 Continual Improvement	5.2 Project Factors 5.3 External Factors 5.4 Influence of other Enterprise Projects	5.1 Enterprise Factors 5.2 Project Factors 5.3 External Factors 5.4 Influence of other Enterprise Projects
	GEN MPS 0006 Program Process Standard: 1.1 Quality Assurance 2.6 Quality Improvement	8.11 Review output 8.12 Continual Improvement	4.1.1 Supply Process R1: Product Supply R2: Training Process R5: Technical Effort Definition R6: Schedule & Organization Technical Plans R7: Network Directives	5.5.1 6.1 6.2 6.3 6.4 6.5 6.6 6.7 7.4 Training



**Six Sigma links:  
Level 2 Measurement & Analysis PA, Level 4/5 PAs**



# LMC IS&S Implementation

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## IS&S Program Process Standard (PPS)

- minimum mandatory set of development processes
- updated using industry standards in which certifications were desired
- **ENABLER** for Process Standard Compliance
- Lean versus Six Sigma implementation

## Example: Quantitative Management

- Key elements
  - program process standards
  - metrics program
- Map to CMMI Organizational Process Performance (OPP)
  - SG1: Establish performance baselines and models
- Map to ISO 9001 – 2001
  - 5.1 Management Commitment
  - 5.4.1 Quality Objectives....
- and so on



# IS&S Lean Methodology

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“An organization working together to make continuous improvements without large capital investment”

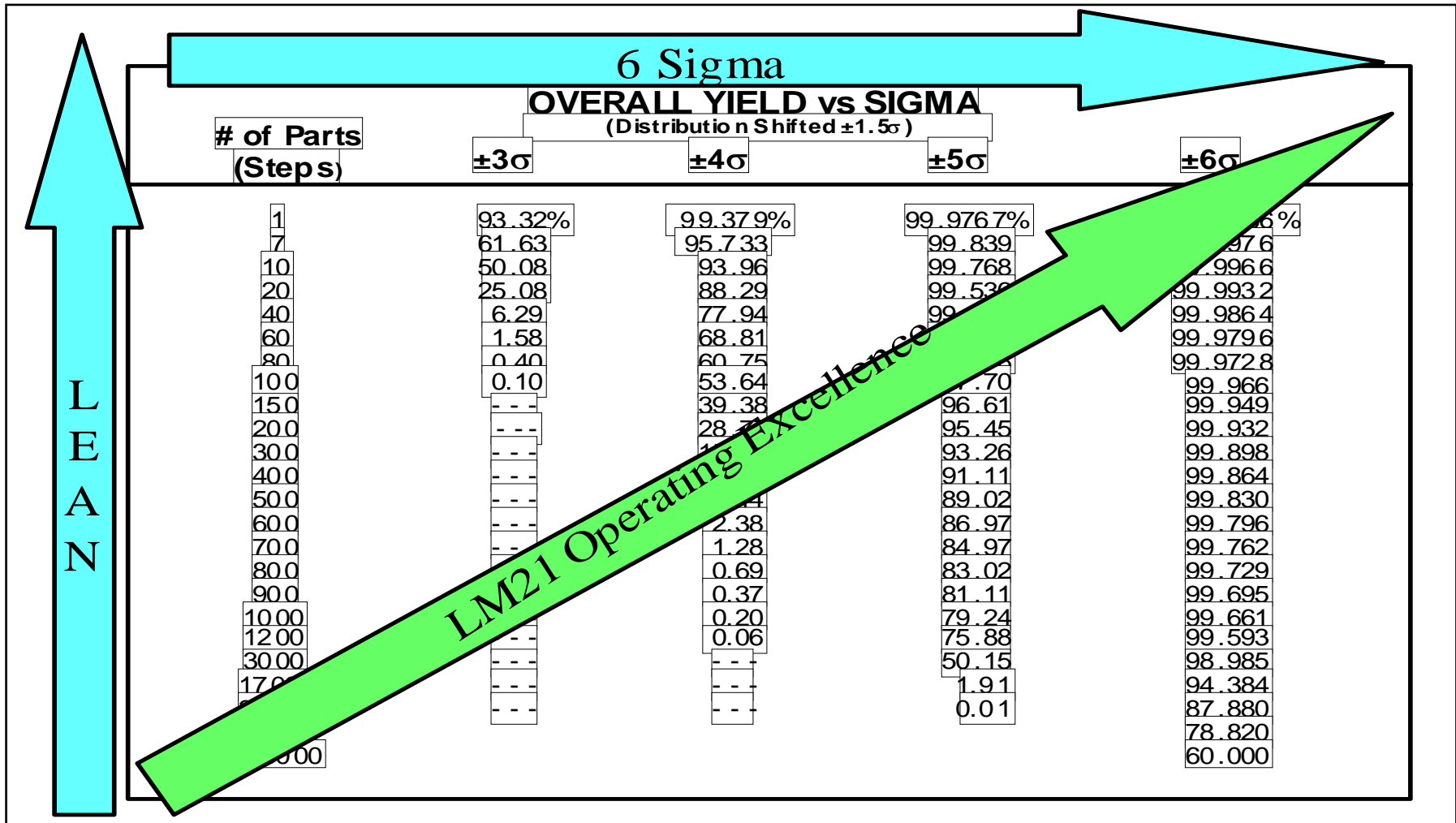
## Purpose

- brings the right people together to understand the process and make immediate improvements to the process.
- evaluates opportunities to reduce cycle time, cost, inventory and eliminate all waste.





# Lean: Six Sigma Representation





# LMC IS&S Lessons Learned

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## **Six Sigma is more than statistical analysis**

- It is a tool box of methodologies that align with an organization's process improvement.
- The alignment is directly related to high maturity but is not restricted to that.
- Combining with Lean Methodology gives a more visible value stream.



# LMC IS&S Training & Implementation

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## Process Orientation Training

- All employees – overview of Process Asset Library
- Overview of Program Process Standard

## Executive Lean Training

- Top Executives – one week off site
- Must understand and promote
- Set goals associated with savings \$ & Time

## Green Belt Training

- One week course (corporate initiated/ unit led)
- Certification (completion of course, 1 event, Black Belt Mentor)
- Considering expanding Green Belt training to keep Black Belt training at three weeks

## Black Belt Training

- Three week DFSS/Lean course (corporate initiated)
- Certification (completion of course, 3 events, mentored one greenbelt to certification)



# LMC IS&S Training & Implementation

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## Lean Event Training

- 2-hour training session opens each lean event
- covers tools and methodologies
- geared for those without previous experience

## Organizational Training Goals

- green belts to be trained set annually
- black belts to be trained set annually
- \$\$\$ challenge based on process changes
  - Functional/ business/ project



# LMC IS&S – Strategy

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## Analyzed Principles

- Value from the customers' perspective
- Value Stream – measured
- Flow
- Pull
- Perfection – rapid feedback / mistake proofing

## World-wide Benchmarking Results

- A 4 Sigma company will spend > 10% of revenue on internal and external repair.
- A 6 Sigma company will spend < 1 % of revenue on internal and external repair.

## IS&S Analysis

- Associate Sigma values to the appropriate level of aggregation – enterprise versus product line versus program.



# LMC IS&S Project Selection

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1. Process Improvement Recommendation (PIR)
  - any one can submit
  - process suggestion passed to Process Owner to evaluate, determine feasibility, determine level of institutionalization (and determine if pilot is necessary)
  
2. E-Transformation
  - all business processes that affect overhead are applicable
  - selection based on ROI and relevance to business – firm understanding of the before state
    - Just do it Projects
    - Kaizen event with rollout plan
  - require use of Six Sigma methodologies/ tools to pursue optimization
  
3. Technology Change Management Working Group (TCMWG) – **Case Study**
  - once a year call for ideas – process oriented
  - can also be used to pilot ideas from PIRs
  - selection based on understanding the before state to measure the after state
  - modeling techniques implementing a six sigma target



# LMC IS&S Technology Change Management

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## **Purpose (M&A, RSKM, TS, QPM, OPP, OID)**

- identify and assess emerging process-related technologies (e.g., Tools, Commercial Practices)
- guide those having benefit into our development activities in an orderly manner

## **Implementation (OID)**

- Technology Change Management (TCM) Working Group (TCMWG) formed to identify process improvement needs and oversee the planning, progress, and application of solutions
- each functional organization represented on TCMWG
- annual call for TCM project proposals
  - parallel effort with call for Independent Research And Development (IRAD) projects
  - based on needs expressed in the strategic plan
- meets monthly to review ongoing projects, assess new business needs, and communicate new technology



# LMC IS&S Technology Change Management

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## Definition

- process-centric (as opposed to product-centric)
- separation of former and latter based on legal barriers
- Technology changes for product is accomplished by extensive IRAD effort
- enterprise wide

## Focus on TCM motivated by Acquisition Reform in 1995

- considerable maturing of TCM process in six years
- business results rather than just “ticket punching”
- utilizes value added methodology – 6 Sigma Tools

## Driven by LMC IS&S Strategic Plan

- TCM participants contribute to Strategic Plan

## Harmonious with company-wide process philosophy





# **LMC IS&S TCM Summary**

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**The TCM Program is driven by the strategic process needs of our product lines.**

**TCM projects have had a positive impact on new business pursuits.**

**TCM projects have resulted in cost savings as well as cost avoidance.**

**TCM projects can result in changes to the standard processes.**

**Our business leaders are encouraged to push process boundaries through TCM.**

**Lean and Six Sigma Activities have resulted in an increase in award fee, increased software productivity, and earlier detection of defects.**



# Implementation Lessons Learned

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**Process initiatives must be integrated into the business rhythm**

**Process Initiatives should be run like a program**

**Specific process initiatives can accelerate the adoption of other processes**

**Evidence of Six Sigma and CMMI adoption**

**Process Initiatives will mature each other**

**Difference in TCM as CMMI Maturity was realized**