Carnegie Mellon
Software Engineering Institute

Pittsburgh, PA 15213-3890

Achieving Success via Multi-Model Process Improvement

Jeannine M. Siviy
M. Lynn Penn
Robert Stoddard

SEPG 2007

Sponsored by the U.S. Department of Defense

Outline

- Value Proposition
  - Our (Your) Multi-Initiative Reality
  - Six Sigma & Lean Fundamentals
  - Six Sigma as a Strategic Enabler
- Multi-Initiative Implementation
  - Case Profiles
  - Strategies
  - Tactical Connections
- Identifying Your Solution
  - Process
  - Emerging Research
  - Existing best practices to leverage today
- Summary

What Drives Process Improvement?

Performance issues: product, project—
and, eventually, process issues

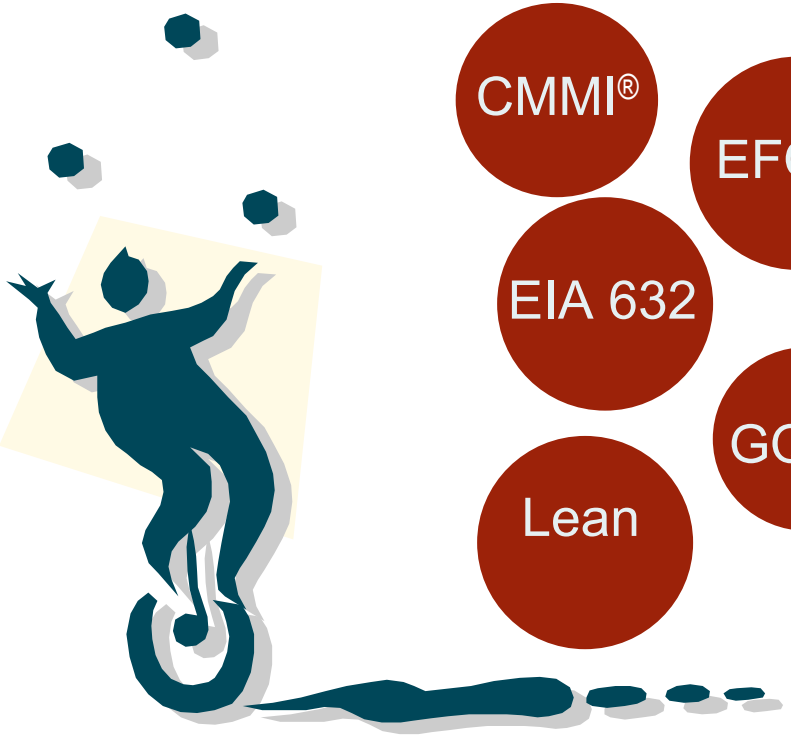
Regulations and mandates
- Sarbanes Oxley
- “Level 3” requirements to win contracts

Business issues and “burning platforms”
- lost market share or contracts
- continuous cost and cycle time improvement
- capitalizing on new opportunities

There is compliance-driven improvement,
and there is performance-driven improvement.

Many Solutions

(not an exhaustive list)



RUP
Agile
Score-card
CMMI®
EFQM
ISO 9000
COBIT
EIA 632
ISO 12207
ITIL
GQIM
Lean
Six Sigma
TSP^SM
PSM

What solutions is your organization implementing?
How do they support your organization's mission?

Your Expectations / Our Objectives

Ask the Audience

- What are your questions? Your current challenges?
- What are your expectations for today?

Our Objectives

- Use CMMI + Six Sigma implementations and research as a springboard for considering the broader topic of multi-model process improvement
- Enrich our views of what SEPGs (and their equivalents) do and how they do it, to enable efficient and effective multi-model process improvement

Frequently Asked Questions

about applying Six Sigma in Software

How do I leverage Six Sigma with software process improvement initiatives already underway in my organization?

Should I pick Six Sigma or CMMI? Or, how do I convince my management that it's not an either/or decision?

What evidence is there that Six Sigma works in software and systems engineering? In IT?

How do I train software engineers when Six Sigma training is geared for manufacturing?

What are examples of Six Sigma projects in software? In IT?

Isn't Six Sigma only about advanced statistics?

Exactly what is a software "opportunity"? And, how do I calculate sigma?

Myths

about applying Six Sigma in Software

Six Sigma is only for high maturity organizations.

It's all about statistics.

"Six" Sigma is the right performance goal.

Everything has to be six sigma (or x sigma) performance.

It's not for government contractors who "don't focus on profitability."

"Sigma level" corresponds to defect density.

It is all about defect density.

"We're Level 5 therefore we must be Six Sigma."

"We're doing Six Sigma therefore we must be Level 4."

What Is Six Sigma?

a business improvement strategy

a philosophy

a performance measurement

an improvement framework

a set of improvement tools

a critical mass of highly trained individuals who serve as analysts, problem solvers, change agents

Six Sigma Philosophy

Improve customer satisfaction by reducing and eliminating defects

Greater Profits

What is a Defect?

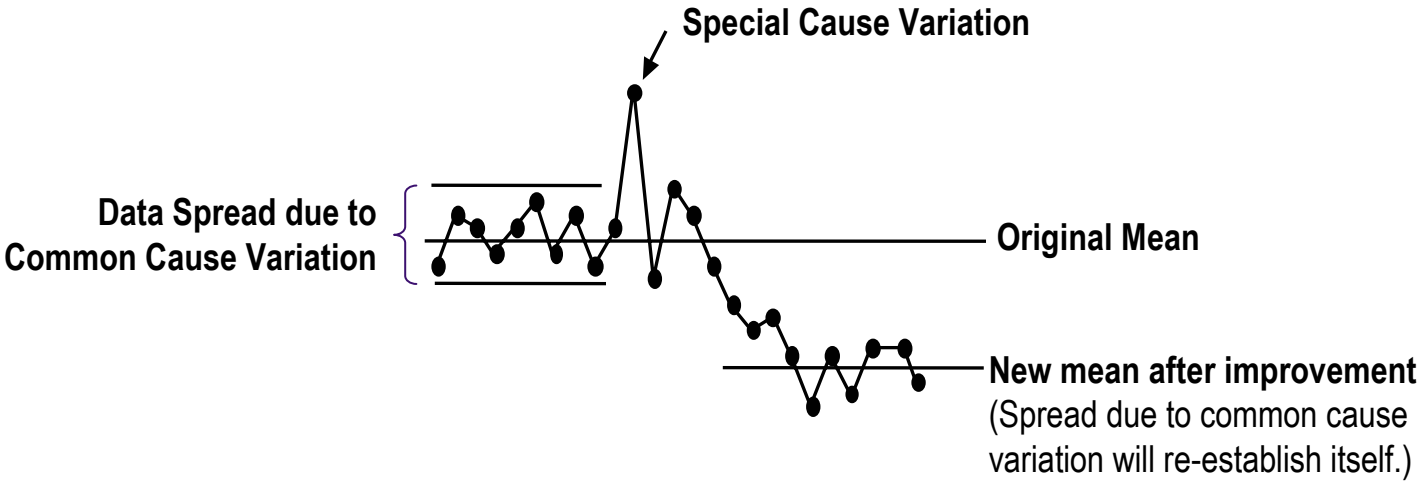
Six Sigma:

Any product, service, or process variation which prevents meeting the needs of the customer and/or which adds cost, whether or not it is detected.

- A non-conformance to a customer-driven specification
- A non-conformance or interruption of the flow or an intervention in the flow

Statistical Thinking

- Everything is a process
- All processes have inherent variability
- Data is used to understand variation and to drive decisions to improve the processes



[ASQ 00], [ASA 01]

Six Sigma Metrics

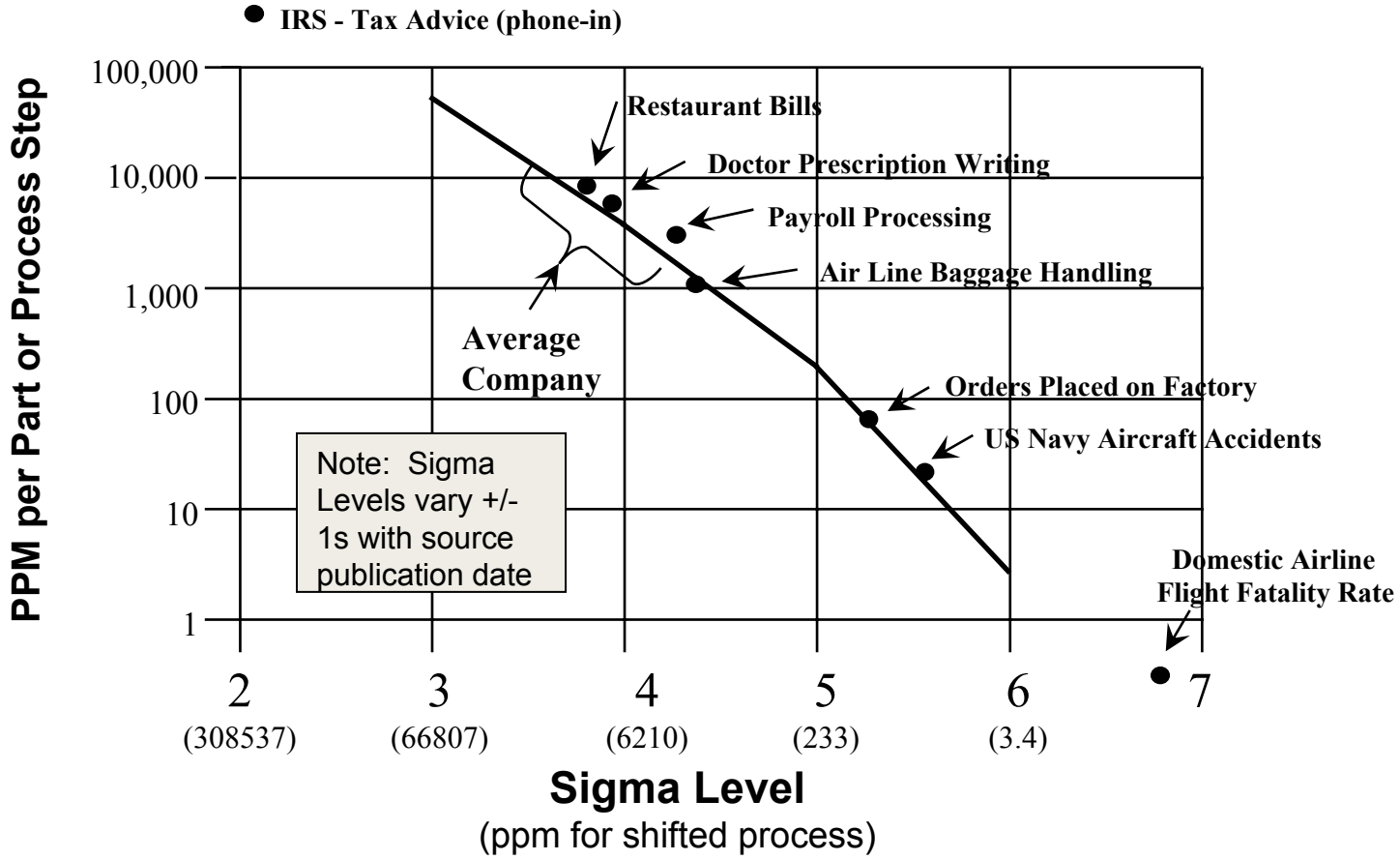
Defect Measures

- Defect Rate, parts per million (ppm)
  - "3.4 ppm" – most-cited metric
- Sigma Level
- Defects per Unit (dpu)
- Defects per Million Opportunities (dpmo)
- Yield

Practitioner Project Measures

- Defect measures
- Cycle time, cost, product performance, variability….
- Bottom-line savings

Example Sigma Levels



[Harrold 98], [Harry 00]

Six Sigma Improvement Frameworks

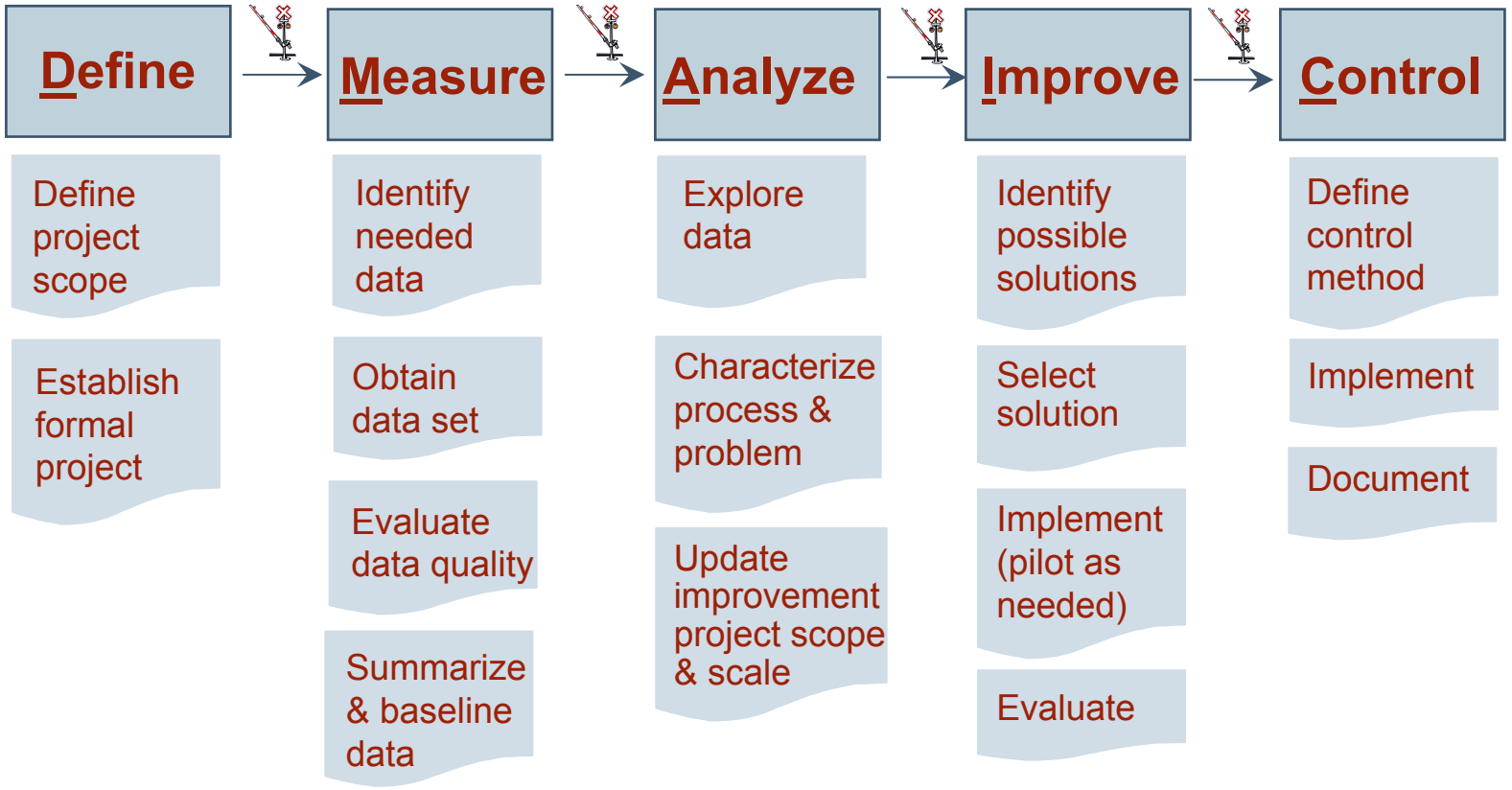
DMAIC: Define – Measure – Analyze – Improve – Control
- improve existing processes and products by focusing on defects & variation

Design for Six Sigma (DFSS)
- design new products and processes
- redesign a process that is optimized but still does not meet specifications
- there are several approaches to DFSS, incl
  - DAMDV: Define – Measure – Analyze – Design – Verify
  - IDDOV: Identify – Design – Develop – Optimize - Validate
  - CDOV: Concept – Design – Optimize – Verify [Creveling]
  - I2DOV: Invention & Innovation – Develop – Optimize – Verify [Creveling]

Lean / Lean Six Sigma
- Improve existing processes by focusing on time & waste
  - Complements DMAIC
- Leverages seminal Lean principles*: value, value stream, value flow, customer pull, perfection

* Womack, James P. & Jones, Daniel, T. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Simon & Schuster: New York, NY: 1996.

DMAIC Roadmap



[MPDI]

Phase Exit Review

Six Sigma Toolkit

Define	Measure	Analyze	Improve	Control
• Benchmark • **Baseline** • Contract/Charter • Kano Model • **Voice of the Customer** • Voice of the Business • Quality Function Deployment • **Process Flow Map** • Project Management • **"Management by Fact"** **-4 What's**	• **7 Basic Tools** • Defect Metrics (i.e., "ppm") • Data Collection Forms, Plan, Logistics • Sampling Techniques	• Cause & Effect Diagrams • Failure Modes & Effects Analysis • Decision & Risk Analysis • Statistical Inference • Control Charts • Capability • Reliability Analysis • **Root Cause Analysis** **-5 Why's** • Systems Thinking	• Design of Experiments • Modeling • Tolerancing • Robust Design	Statistical Controls: • Control Charts • Time Series methods Non-Statistical Controls: • Procedural adherence • Performance Mgmt • Preventive activities

What About Lean?

Seminal work in the automotive industry

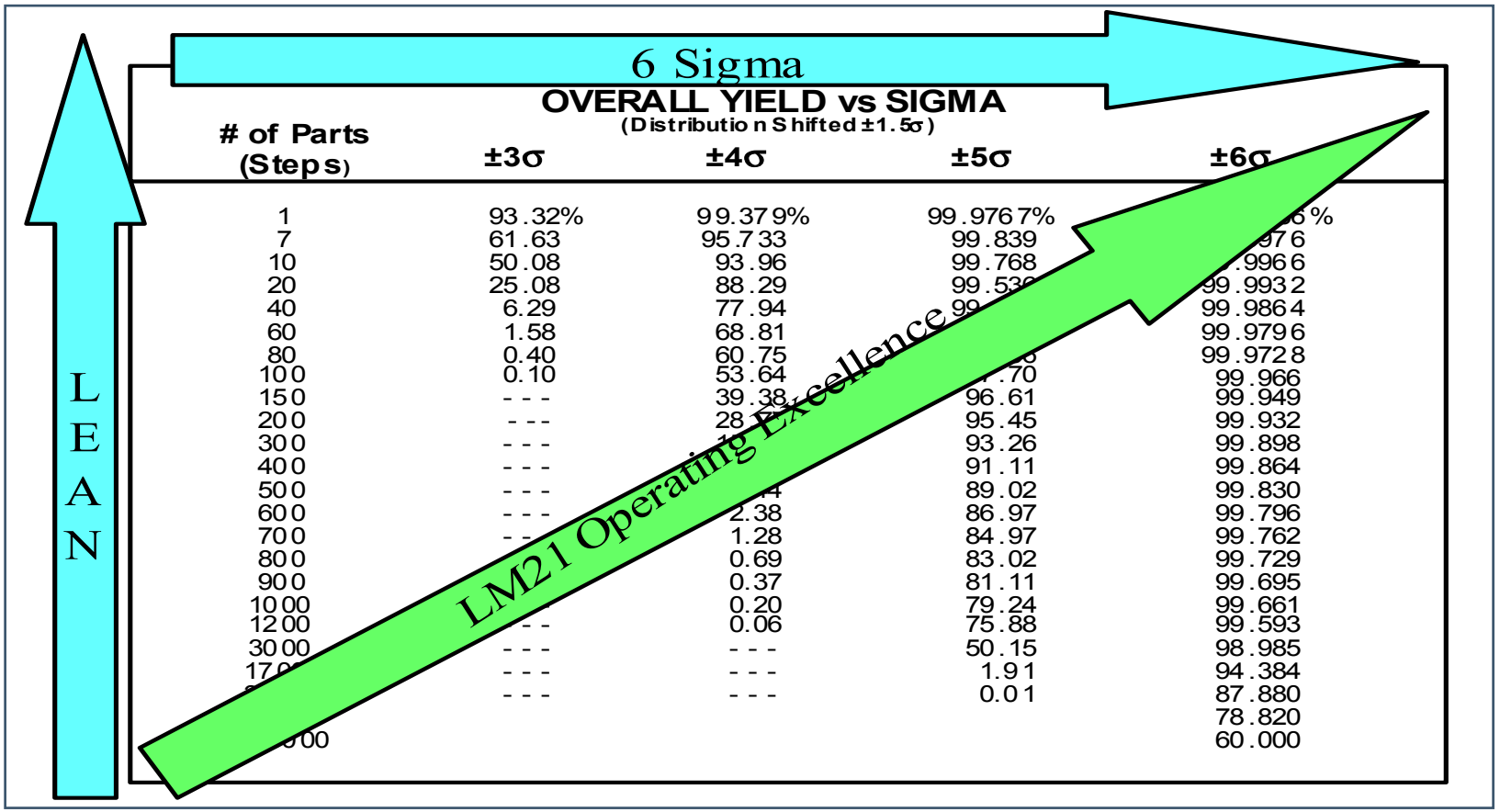
Principles, per Womack

- articulate value for a product,
- identify the value stream,
- make the value flow,
- establish a customer pull system and
- pursue perfection.

Often coupled with Six Sigma

- Lean: focus on time, waste
- Six Sigma: focus on defects, variation
- Overlapping analytical toolkits

Lean: Six Sigma Representation



OVERALL YIELD vs SIGMA
(Distribution Shifted ±1.5σ)

# of Parts (Steps)	±3σ	±4σ	±5σ	±6σ
1	93.32%	99.379%	99.9767%	[illegible]%
7	61.63	95.733	99.839	[illegible]976
10	50.08	93.96	99.768	[illegible].9966
20	25.08	88.29	99.536	99.9932
40	6.29	77.94	99.[illegible]	99.9864
60	1.58	68.81	[illegible]	99.9796
80	0.40	60.75	[illegible]	99.9728
100	0.10	53.64	[illegible].70	99.966
150	- - -	39.38	96.61	99.949
200	- - -	28.[illegible]	95.45	99.932
300	- - -	[illegible]	93.26	99.898
400	- - -	[illegible]	91.11	99.864
500	- - -	[illegible].4	89.02	99.830
600	- - -	2.38	86.97	99.796
700	- -	1.28	84.97	99.762
800		0.69	83.02	99.729
900		0.37	81.11	99.695
1000		0.20	79.24	99.661
1200	- -	0.06	75.88	99.593
3000	- - -	- - -	50.15	98.985
17[illegible]	- - -	- - -	1.91	94.384
[illegible]	- - -	- - -	0.01	87.880
[illegible]000				78.820
				60.000

[Penn&Siviy 03]

Lean Tactics: Kaizen Events

Kaizen - Make people's jobs easier by taking them apart, studying them, and making improvements.

- "KAI" - take apart and make anew
- "ZEN" - think, make good the actions of others, do good deeds and help others

Kaizen tips (VAL, M&A, QPM, CAR, OPP)

- Get rid of old assumptions.
- Look for ways to make things happen now.
- Say "NO" to the status quo.
- Don't worry about being perfect.
- It doesn't have to cost money.
- If something's wrong, fix it on the spot.
- Ask "WHY" five times to get to the root cause.
- Look for wisdom from many people rather than one.
- Never stop improving.
- Full-time participation of team members.
- Keep all affected employees informed of changes.

[Penn&Siviy 03]

Lean Tools

Many tools shared with “traditional” Six Sigma

- brainstorming, the 7 basic tools and so on

Tools typically associated with Lean

- value stream mapping*
- cycle time and throughput analysis, Little’s Law*
- process dynamics analysis*
- pull systems (kanban)
- setup reduction methods
- mistake-proofing (poka yoke)
- 5S Housekeeping (sort, set in order, shine, standardize, sustain), and
- total productive maintenance (i.e., optimizing scheduled downtime

CMMI Process Areas

(for reference)

Category	Process Areas
Process Management	Organizational Process Focus (OPF) Organizational Process Definition (OPD) Organizational Training (OT) Organizational Process Performance (OPP) Organizational Innovation and Deployment (OID)
Project Management	Project Planning (PP) Project Monitoring and Control (PMC) Supplier Agreement Management (SAM) Integrated Project Management Risk Management (RSKM(Quantitative Project Management (QPM)
Engineering	Requirements Management (REQM) Requirements Development (REQD) Technical Solution (TS) Product Integration (PI) Verification (VER) Validation (VAL)
Support	Configuration Management (CM) Process and Product Quality Assurance (PPQA) Measurement and Analysis (MA) Causal Analysis and Resolution (CAR) Decision Analysis and Resolution (DAR)

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Summary

Six Sigma as Strategic Enabler

The SEI conducted a research project to explore the feasibility of Six Sigma as a transition enabler for software and systems engineering best practices.

Hypothesis

- Six Sigma used in combination with other software, systems, and IT improvement practices results in
  - better selections of improvement practices and projects
  - accelerated implementation of selected improvements
  - more effective implementation
  - more valid measurements of results and success from use of the technology

Achieving process improvement… better, faster, cheaper.

Primary Conclusions

Six Sigma is feasible as an enabler of the adoption of software, systems, and IT improvement models and practices (a.k.a., “improvement technologies”).

The CMMI community is more advanced in their joint use of CMMI & Six Sigma than originally presumed.

Noting that, for organizations studied, Six Sigma adoption & deployment

- was frequently decided upon at the enterprise level, with software, systems, and IT organizations following suit
- was driven by senior management’s previous experience and/or a burning business platform
- was consistently comprehensive
- was consistently considered part of their “competitive edge” with respect to software and systems

Because of the proprietary nature of our data and the non-disclosure agreements in place, the results in this public briefing are intentionally at a high level.

[IR&D 04]

Selected Supporting Findings

Six Sigma helps integrate multiple improvement approaches to create a seamless, single solution.

Rollouts of process improvement by Six Sigma adopters are mission-focused, flexible, and adaptive to changing organizational and technical situations.

Six Sigma is frequently used as a mechanism to help sustain—and sometimes improve—performance in the midst of reorganizations and organizational acquisitions.

Six Sigma adopters have a high comfort level with a variety of measurement and analysis methods.

- adopters report quantitative performance benefits using measures they know are meaningful for their organizations and clients. For instance, ROI of 3:1 and higher, reduced security risk, and better cost containment

[IR&D 04]

CMMI-Specific Findings

Six Sigma is effectively used at all maturity levels.

Participants assert that the frameworks and toolkits of Six Sigma exemplify what CMMI high maturity requires.

Case study organizations do not explicitly use Six Sigma to drive decisions about CMMI representation, domain, variant, and process-area implementation order. However, participants agree that this is possible and practical.

CMMI-based organizational assets enable Six Sigma project-based learnings to be shared across software and systems organizations, enabling a more effective institutionalization of Six Sigma.

[IR&D 04]

IT-Specific Findings

High IT performers (development, deployment, and operations) are realizing the same benefits of integrated process solutions and measurable results.

- However, they are using the technologies and practices specific to their domain (ITIL, COBIT, and sometimes CMMI).

CMMI-specific findings apply to IT organizations who have chosen to use CMMI.

[IR&D 04]

Architecture-Specific Findings

Multiple organizations are pursuing the joint use of Six Sigma, CMMI, and ATAM, noting the strong connections among DFSS, ATAM, and the engineering process areas of CMMI.

Many survey respondents are in organizations currently implementing both CMMI and Six Sigma DMAIC, and many are in organizations progressing with DFSS.

- Of those implementing DFSS, the majority are at least progressing with CMMI (but some are not using CMMI at all), and none are using ATAM*

There is much untapped potential here!

ATAM = Architecture Tradeoff Analysis Method
*At the time this research project was conducted
[IR&D 04]

Why Six Sigma needs CMMI 1

CMMI offers mechanisms to institutionalize practices for long term organizational adoption

CMMI offers a complete, mature and proven mechanism/process to appraise project and organizational implementation

CMMI offers organizational learning practices

CMMI and Team Software Process offer strong teaming practices and processes within a Software and Systems context

CMMI offers a formalized process approach to overall decision-making within projects and the organization via the DAR Process Area

Why Six Sigma needs CMMI 2

CMMI is uniquely both an improvement and product development model that helps integrate Six Sigma into a client's existing product development lifecycle model

The CMMI and TSP provide a rich context of information to help target Six Sigma solutions (e.g. CMMI offers domain context and both continuous and staged representations)

CMMI offers a complete discussion of stakeholder involvement within relevant Process Areas

CMMI Process Areas (QPM, OPP, OID) add deeper dimensions to concept of Six Sigma critical parameter management

Why Six Sigma needs CMMI 3

CMMI investments produce well-placed, trained software/systems change agents and appraisers who should be great candidates as Software Six Sigma Black Belts

Existing CMMI initiatives and investment can be significantly leveraged for deployment of Six Sigma within Software/Systems organizations (economies of scale)

Existing CMMI implementations provide a language with stakeholders that can be leveraged to explain Six Sigma concepts

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Summary

Profile: Lockheed Martin Integrated Systems & Solutions (IS&S)

BACKGROUND, OVERVIEW

Current organizational context

- Four primary geographic regions (40+ sites)
- Seven Lines of Business
- 15,000 employees
- Standard Operating Process (Program Process Standard) across all programs
- Maintain the CMMI Maturity Level 5 through mergers and acquisitions

Fifteen years ago....

- Executive VP with a “passion for process”
- “Software Engineering & Management Manual”
- DoD requirements to be “Level 3” (currently SW CMM Level 2)
- Separate implementations of CMM, SE CMM, ISO 9000

IS&S Strategy

Strategy: Program Process Standard (PPS)
- minimum mandatory set of development processes
- updated using industry standards in which certifications were desired

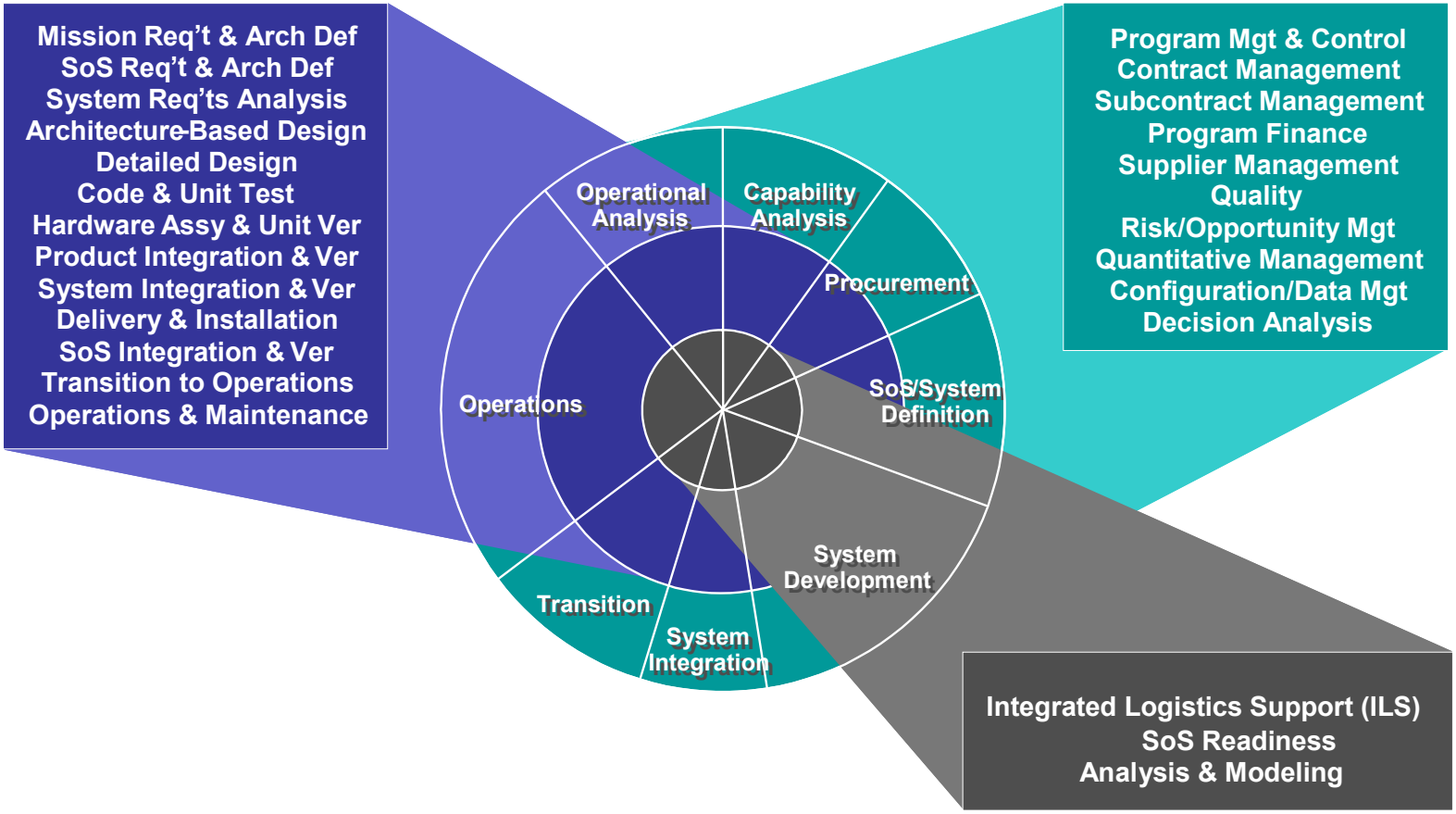
---

Establishing a Process Architecture
- New organizational structure
- The “Required Development Process” (RDP)

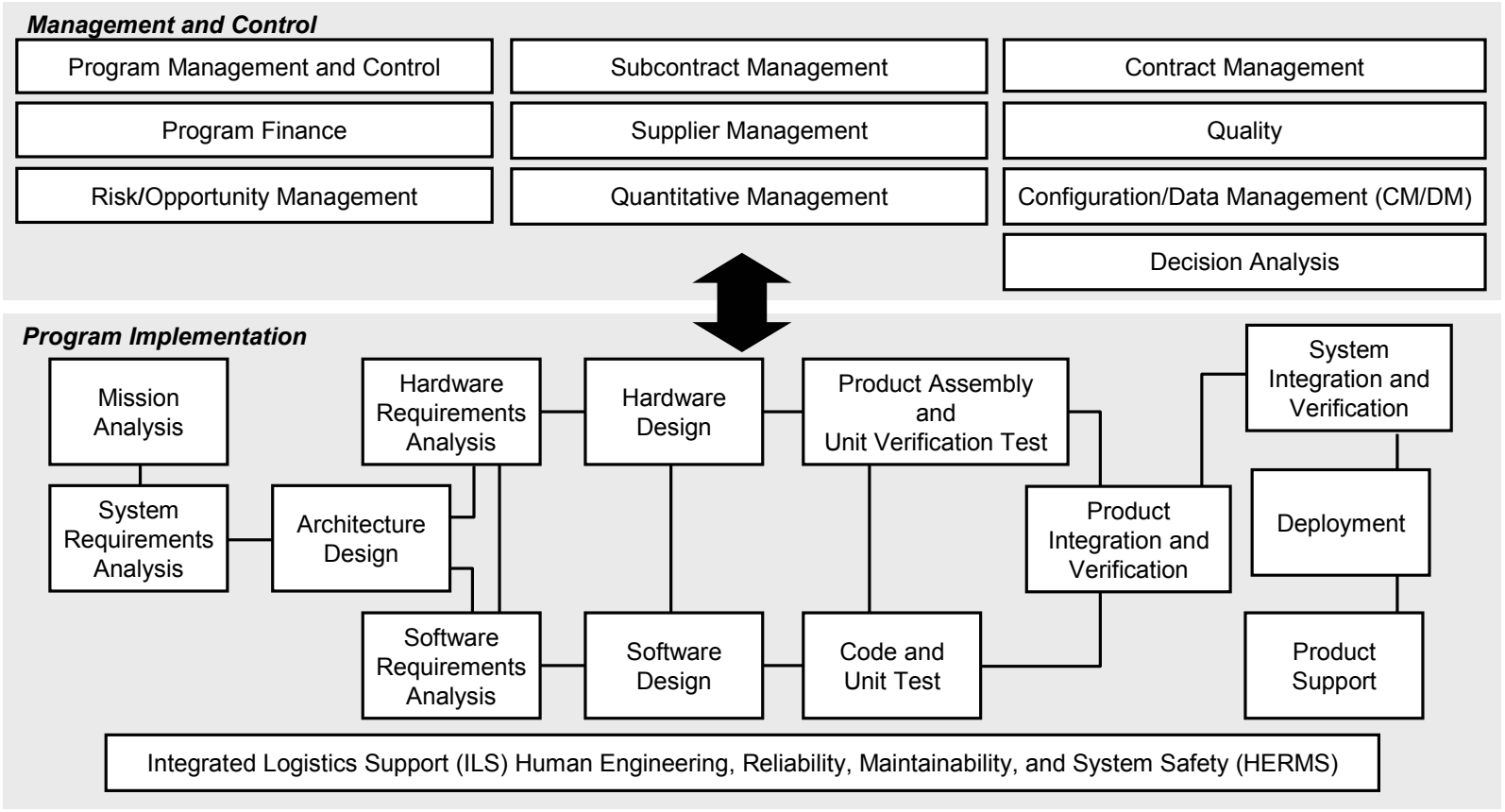
Lean (& Six Sigma) en route to high maturity
- RDP expanded to full-fledged PPS
- Measurement infrastructure (PSM; DMAIC implicit)
- New process methods such as architecture based design
- New Corporate Initiative: Lean
  - Enabled by CMM
  - Accelerated new CMMI PA implementation (lo & hi mat.)
  - Addressed biz processes outside of CMMI
  - Applied to appraisals

Growth & Sustainment
- CMMI
- Lean applied to appraisals

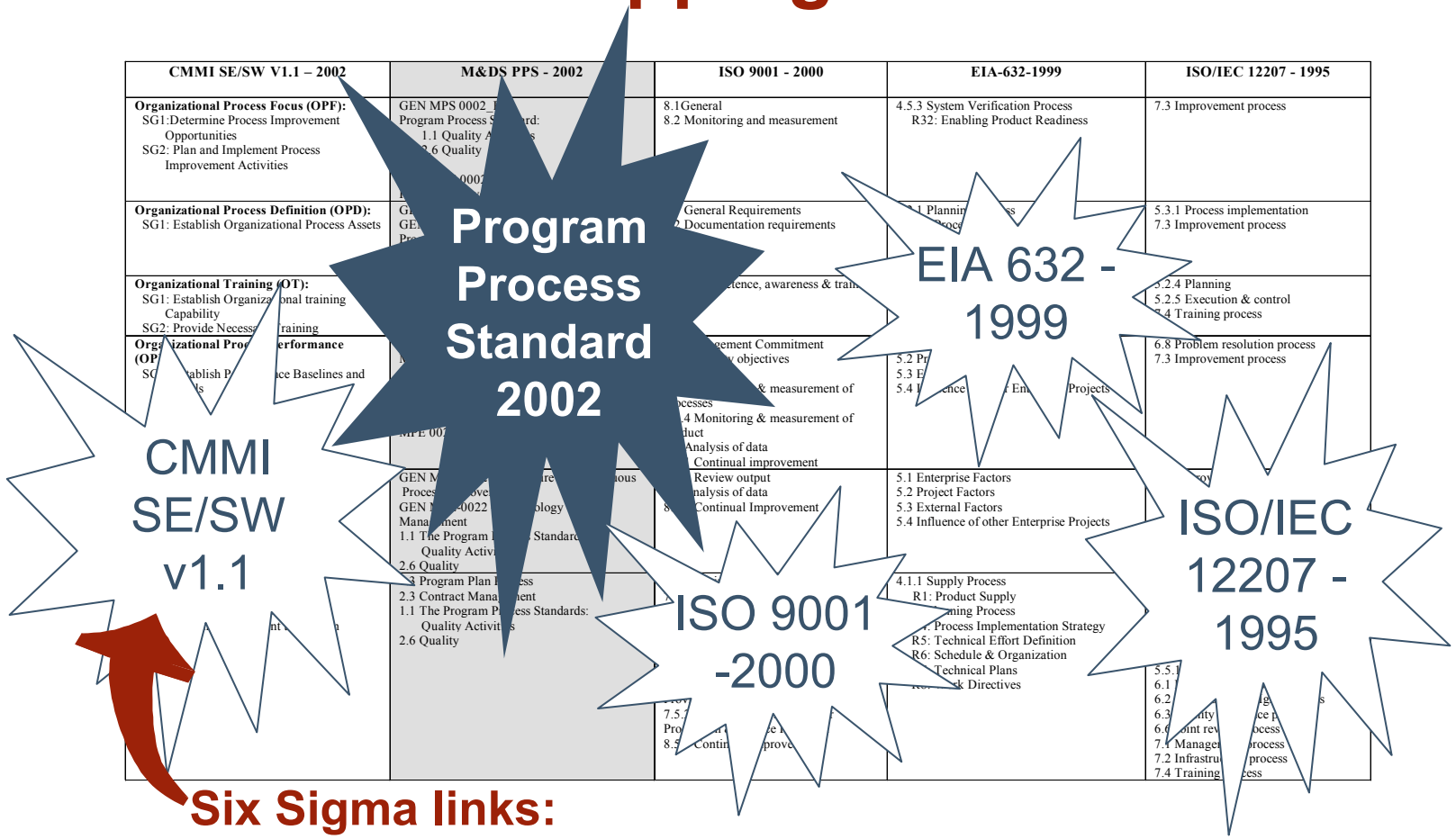
IS&S Process Architecture



IS&S PPS



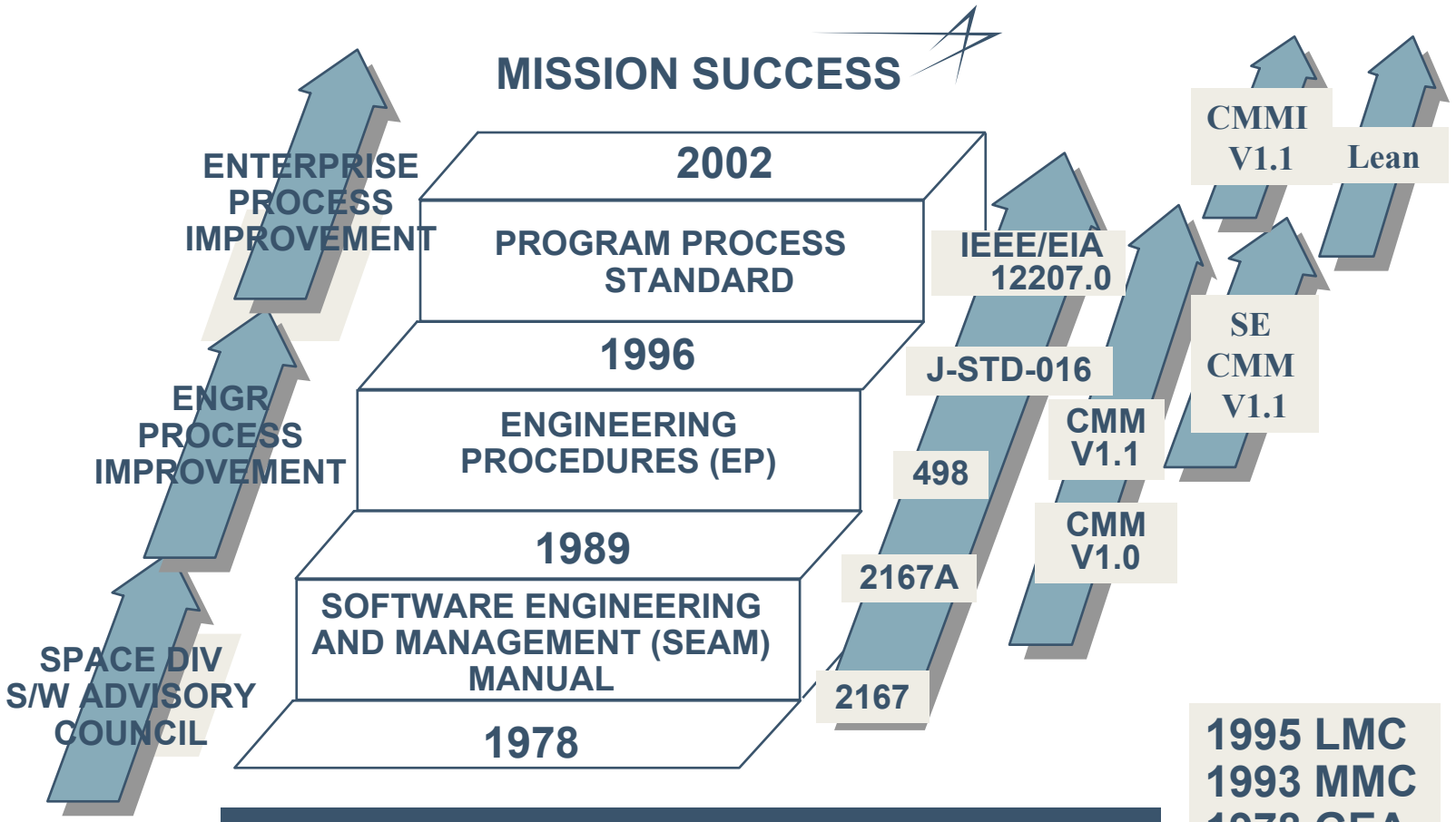
IS&S PPS Mappings



CMMI SE/SW V1.1 – 2002	M&DS PPS - 2002	ISO 9001 - 2000	EIA-632-1999	ISO/IEC 12207 - 1995
Organizational Process Focus (OPF): SG1:Determine Process Improvement Opportunities SG2: Plan and Implement Process Improvement Activities	GEN MPS 0002_[illegible] Program Process S[illegible]rd: 1.1 Quality A[illegible]s 2.6 Quality [illegible]0007	8.1General 8.2 Monitoring and measurement	4.5.3 System Verification Process R32: Enabling Product Readiness	7.3 Improvement process
Organizational Process Definition (OPD): SG1: Establish Organizational Process Assets	GE[illegible] Pr[illegible]	General Requirements Documentation requirements	[illegible]1 Planni[illegible]s [illegible]roce	5.3.1 Process implementation 7.3 Improvement process
Organizational Training (OT): SG1: Establish Organizational training Capability SG2: Provide Necessa[illegible]raining		[illegible]ence, awareness & trai[illegible]		5.2.4 Planning 5.2.5 Execution & control 7.4 Training process
Orga[illegible]izational Proc[illegible]erformance (OP[illegible] SG[illegible]tablish P[illegible]ce Baselines and [illegible]s	[illegible]	[illegible]gement Commitment [illegible]y objectives [illegible]& measurement of [illegible]ocesses [illegible].4 Monitoring & measurement of [illegible]duct Analysis of data Continual improvement	5.2 Pr[illegible] 5.3 E[illegible] 5.4 I[illegible]ence [illegible] En[illegible] Projects	6.8 Problem resolution process 7.3 Improvement process
	GEN M[illegible]re[illegible]ious Proces[illegible]ove[illegible] GEN [illegible]0022 [illegible]ology Manag[illegible]ment 1.1 The Program [illegible] Standard[illegible] Quality Activi[illegible] 2.6 Quality	Review output [illegible]nalysis of data 8[illegible] Continual Improvement	5.1 Enterprise Factors 5.2 Project Factors 5.3 External Factors 5.4 Influence of other Enterprise Projects	[illegible]oy[illegible]
	[illegible]3 Program Plan [illegible]ess 2.3 Contract Mana[illegible]ment 1.1 The Program P[illegible]ess Standards: Quality Activit[illegible]s 2.6 Quality	[illegible]	4.1.1 Supply Process R1: Product Supply [illegible]ning Process [illegible]. Process Implementation Strategy R5: Technical Effort Definition R6: Schedule & Organization [illegible] Technical Plans [illegible]k Directives	5.5.1 [illegible] 6.1 [illegible] 6.2 [illegible]g [illegible]s 6.3 [illegible]ality [illegible]ce p[illegible] 6.6 [illegible]oint rev[illegible]ocess 7.1 Manage[illegible]rocess 7.2 Infrastru[illegible] process 7.4 Training [illegible]ess
		7.5.[illegible] Pro[illegible]ce [illegible] 8.5 [illegible]Contin[illegible]prove[illegible]		

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

IS&S Timeline



IS&S Results & Benefits

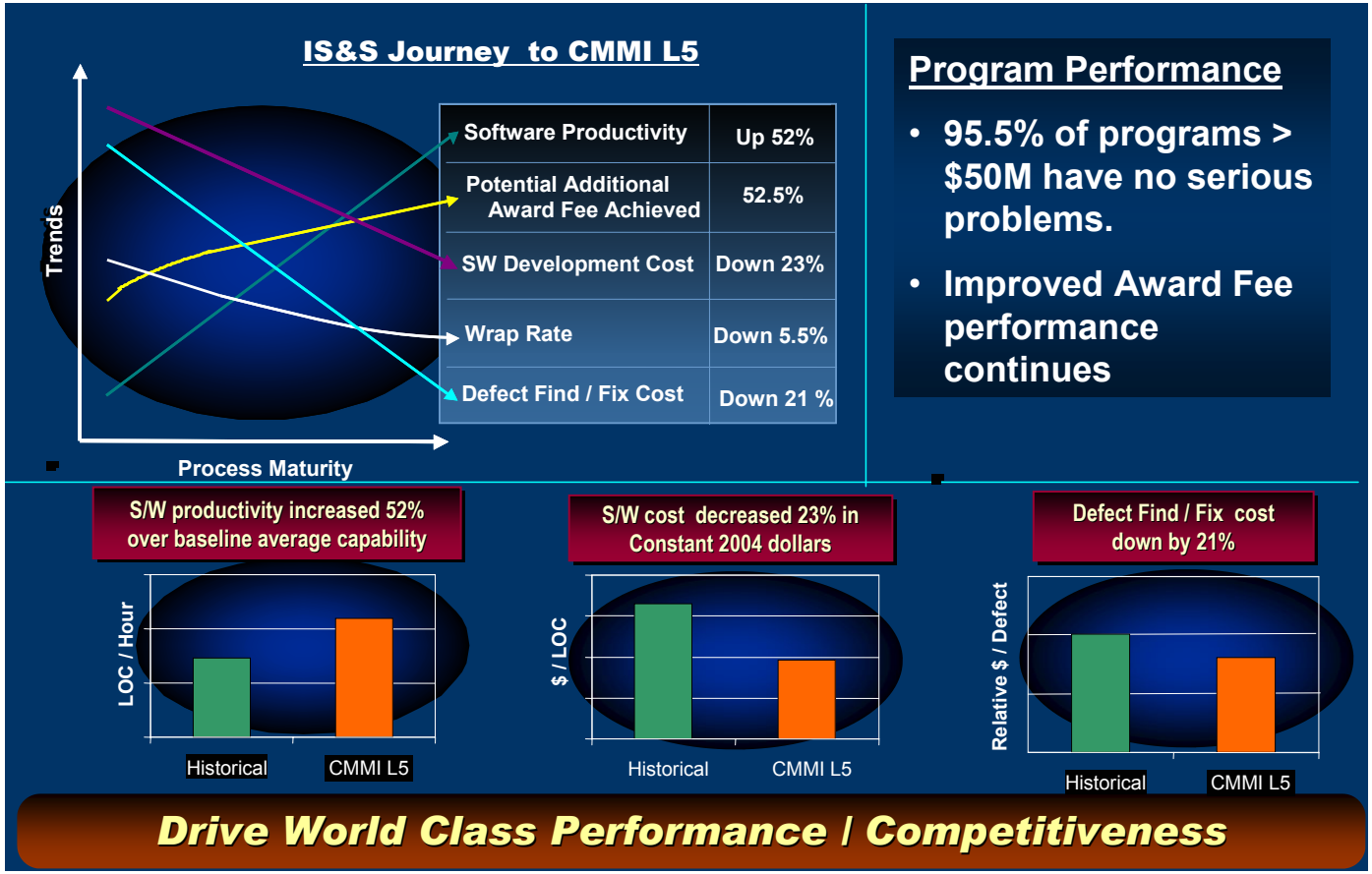
Benefits of chosen strategy

- Project example: 30% cycle time reduction - idea to proposal
- Robust; easy to build in new models, practices
- Distinct contribution of any individual model difficult to extract
  - all worked together to achieve performance shown on next slide

Success Factors

- Built the vision while at “low maturity”
- Sr. Management sponsorship
- Key personnel with needed systems and strategic outlooks as well as breadth of experience

IS&S Results & Benefits



Motorola

The CMMI adoption decision: Will it benefit existing Six Sigma initiatives?

Executive sponsorship and ***engagement***

- Benchmarked with execs from a successful company: to witness the benefits first hand
- Execs gave the sales pitch -- their personal leadership sold it
- Established upward mentoring: MBB coach & CMMI expert for each exec

Deployment - Leveraging executive "pull"

- Execs controlled adoption schedule, to meet critical business needs
- Modified the reward and recognition structure
- "Rising star" program for both technical and management tracks
- Training began at the top and worked its way down

Execution – Speaking the language of executives and the business

- Calculated costs & benefits of all proposals; listed the intangibles
- Risk reduction: Start small, pilot, and build on successes

[Siviy-Hefner 06]

Exercise

Purpose: Share & Prioritize Ideas

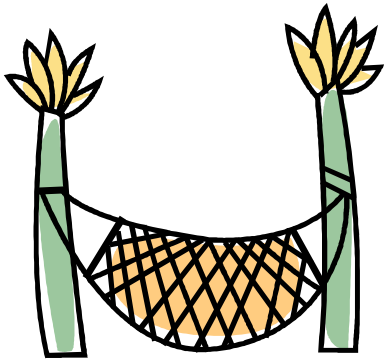
Step 1: Please write down on a piece of paper:

- "The Biggest Obstacle in my organization to implementing what I have heard in this tutorial is ____"

Steps 2+ *will be described after Step 1 is completed*

Results will be shared after break

BREAK



After break:

Strategic & Tactical Connections

Later today:
Considerations for YOUR multi-model approach

If you would like copies of our final slides,
add your name to our signup sheet, or
send an email to Debra Morrison, dtm@sei.cmu.edu.

- Put "SEPG Tutorial" in the subject line.

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Summary

Integrating Initiatives: Field Notes [1]

(public domain literature)

Northrop Grumman Mission Systems

- "Northrop Grumman was able to accelerate achievement of Levels 4 and 5 using Six Sigma"
- "Six Sigma is an enabler for measuring the value of specific improvements"
- "Six Sigma provides a way to connect process improvement and business value"
- "Six Sigma projects can help focus and measure CMMI-driven process improvements"
- "..conducting Level 5 SCAMPI appraisals in 5-6 days… significant cost savings"

[Facemire 04], [Hefner 04]
Presentations available at http://seir.sei.cmu.edu

Integrating Initiatives: Field Notes 2

(public domain literature)

Tata Consultancy Services

- "…a development Center…. used SW-CMM and Six Sigma concepts to reduce its in-process failure costs from 5 to 1 percent…."

Wipro

- Enterprise integrated system, includes ISO 9001, CMM, P-CMM, TL9000, British Standard 7799, Six Sigma
  - "…Six Sigma methodologies brought in quantitative understanding, cost savings, and performance improvement towards product quality."
  - "Six Sigma… brought about a focused customer-centric and data-driven paradigm to product and process quality…"
- 'Defects are steadily falling in cylinder manufacturing,' Bagchi says. 'In the fixed deposits area of our financial services division, we have a process in place to eliminate non-value adding steps and mistake-proof the system. We're projecting a 30 per cent cycle time reduction in our computer business. The estimated short-term gains will be six to eight times the total investment we put into six sigma'

[Keeni 03], [Wipro 04], [Wipro 01]

Strategic Approaches

Observed Patterns in the Joint Implementation of CMMI and Six Sigma

Implement CMMI process areas as “Six Sigma projects”

Use Six Sigma as the tactical engine for high capability and high maturity.

Apply Six Sigma to improve or optimize an organization’s improvement strategy and processes.

Integrate CMMI, Six Sigma, and other improvement models/references into a process standard to be used by every project throughout its life cycle

[Siviy 05-1]

Specific DMAIC-CMMI Relationships 1

Overall

- DMAIC: a problem solving approach
- CMMI: a process & measurement deployment approach

PAs that align with DMAIC include the following:

- MA, GPs
- QPM, CAR, OID (either “continuous” or high-maturity view)

A DMAIC project may leverage these existing processes:

- PP, PMC, IPM
- OPP for organization level execution, mgmt, oversight

PAs through which DMAIC may be incorporated into organizational process definition include the following:

- OPF, OPD

[Siviy 05-1]

Specific DMAIC-CMMI Relationships 2

PAs "eligible" for DMAIC-based improvement

- all

PAs with links to the analytical toolkit include

- Decision Analysis & Resolution
  - e.g., concept selection methods, such as Pugh's
- Risk Management
  - e.g., Failure Modes & Effects Analysis (FMEA)
- Technical Solution
  - e.g., Design FMEA, Pugh's

[Siviy 05-1]

DFSS & CMMI

How DFSS Enables CMMI Rigor

As organizations transition from the SEI CMM to the SEI CMMI model, they will find that DFSS offers methods and tools for all new and emphasized processes.

Although not shown, Six Sigma DMAIC offers excellent support in the areas that DFSS may show less than complete coverage.

Together, Six Sigma DMAIC and DFSS provide the means to accomplish a multi-model implementation for process improvement!

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Specific DFSS-CMMI Relationships

Example using IPM

For Integrated Project Management, SSPD includes:

- Organizational process of tools, tasks and deliverables for managing the project and involving relevant stakeholders
- Estimation and planning using a measurement repository of quantitative baselines with confidence intervals
- Scorecards
- Gate-keeping Reviews with relevant stakeholders
- Critical dependencies and critical path measured with risk distributions

CMMI Process Area	CMM Satisfy	DFSS Satisfy
Organizational Process Focus		
Organizational Process Definition		
Organizational Training		
Organizational Process Performance		
Organizational Innovation and Deployment		
Project Planning		
Project Monitoring and Control		
Supplier Agreement Management		
Integrated Project Management		
Risk Management		
Integrated Teaming		
Integrated Supplier Management		
Quantitative Project Management		
Requirements Management		
Requirements Development		
Technical Solution		
Product Integration		
Verification		
Validation		
Configuration Management		
Process and Product Quality Assurance		
Measurement and Analysis		
Decision Analysis and Resolution		
Organizational Environment for Integration		
Causal Analysis and Resolution		

NOTE: An example of one anonymous organization mapping their CMM implementation and DFSS tools into the CMMI Process Areas that were being newly-adopted.

Specific Lean-CMMI Relationships

Two basic relationships between the two:

- Process Definition
- Process Improvement

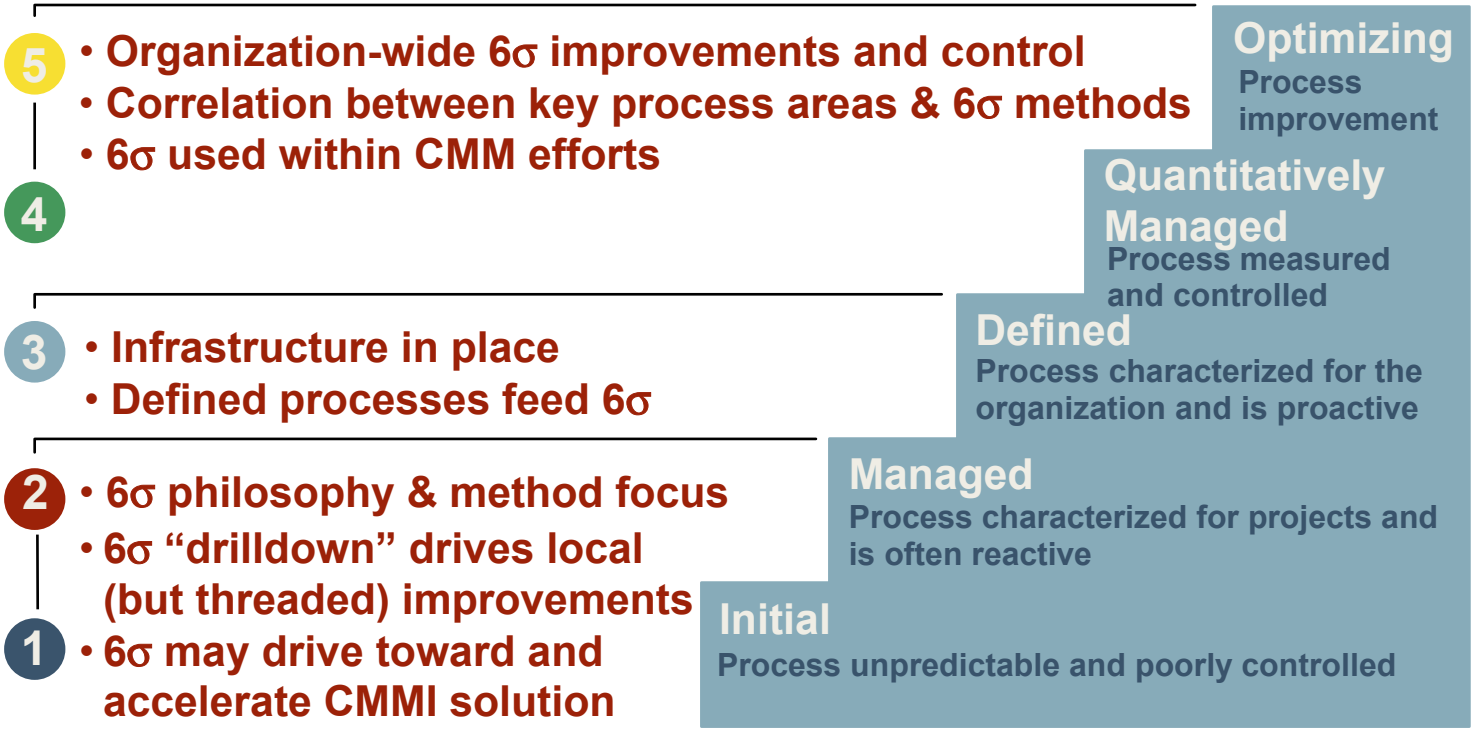
Process Definition

- OPF, OPD can be implemented using Lean techniques and methods
- All PAs can use Lean to assist in documenting the process most efficiently

Process Improvement

- All PAs can use Lean to improve (GP3.2)
- CAR, OID specifically will find Lean the method of choice
- QPM can also use Lean in their process modeling

CMMI Staged and Six Sigma

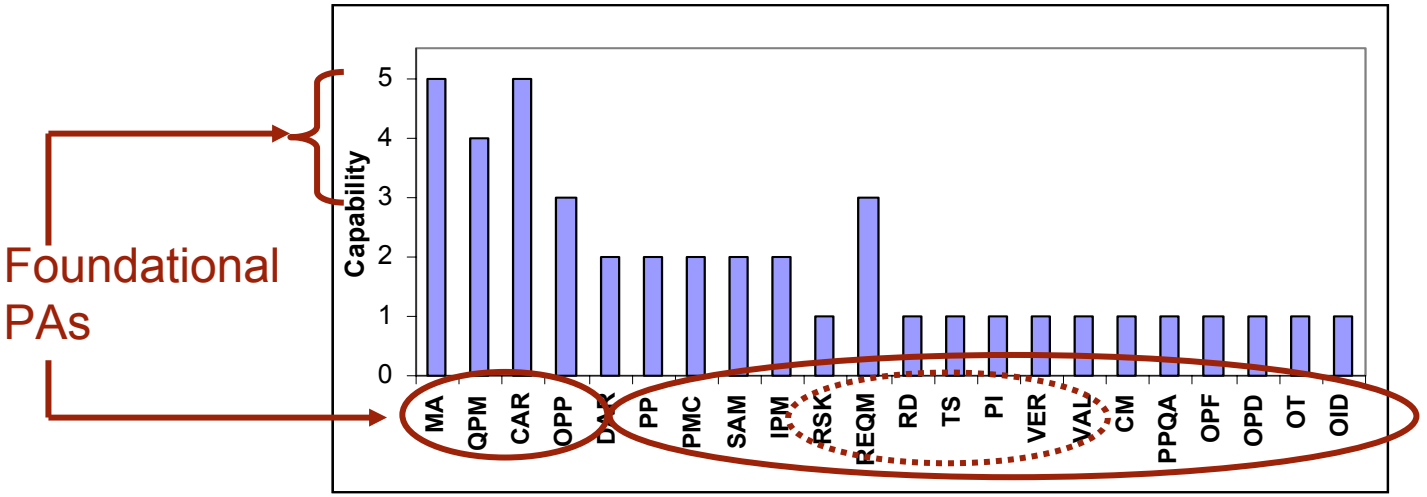


Six Sigma is enterprise wide.
Six Sigma addresses product and process.
Six Sigma focuses on "critical to quality" factors.

Six Sigma and CMMI Continuous

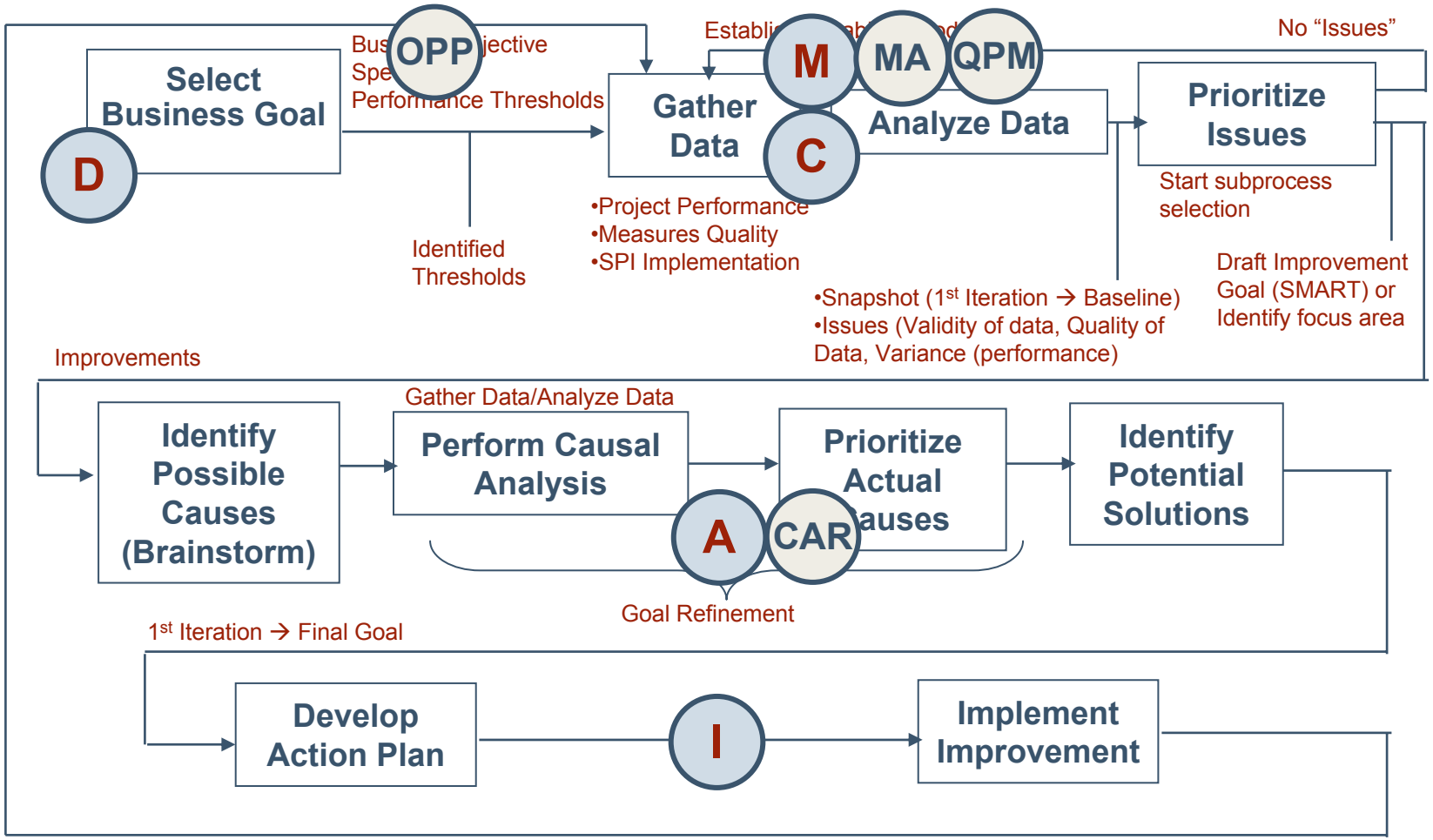
One *possible* approach:

- Achieve high capability in PAs that build Six Sigma skills, such as MA, QPM, CAR, OPP
- Use capability to help prioritize remaining PAs



Remaining PAs ordered by business factors, improvement opportunity, etc. which are better understood using foundational capabilities. CMMI Staged groupings and DMAIC vs. DMADV are also factors that may drive the remaining order. [Vickroy 03]

Example M&A Process



Outline

Value Proposition
- Our (Your) Multi-Initiative Reality
- Six Sigma Fundamentals
- Six Sigma as a Strategic Enabler

Multi-Initiative Implementation
- Case Profiles
- Strategies
- Tactical Connections

Identifying Your Solution
- Process
- Emerging Research
- Existing best practices to leverage today

Summary

Determining YOUR Approach

Key Questions

- What is your mission? What are your goals?
- Are you achieving your goals? What stands in your way?
- What process features are needed to support your goals?
  - What technologies provide or enable these features?
- What is the design of a cohesive (integrated), internal standard process that is
  - rapidly and effectively deployed
  - easily updated
  - compliant to models of choice

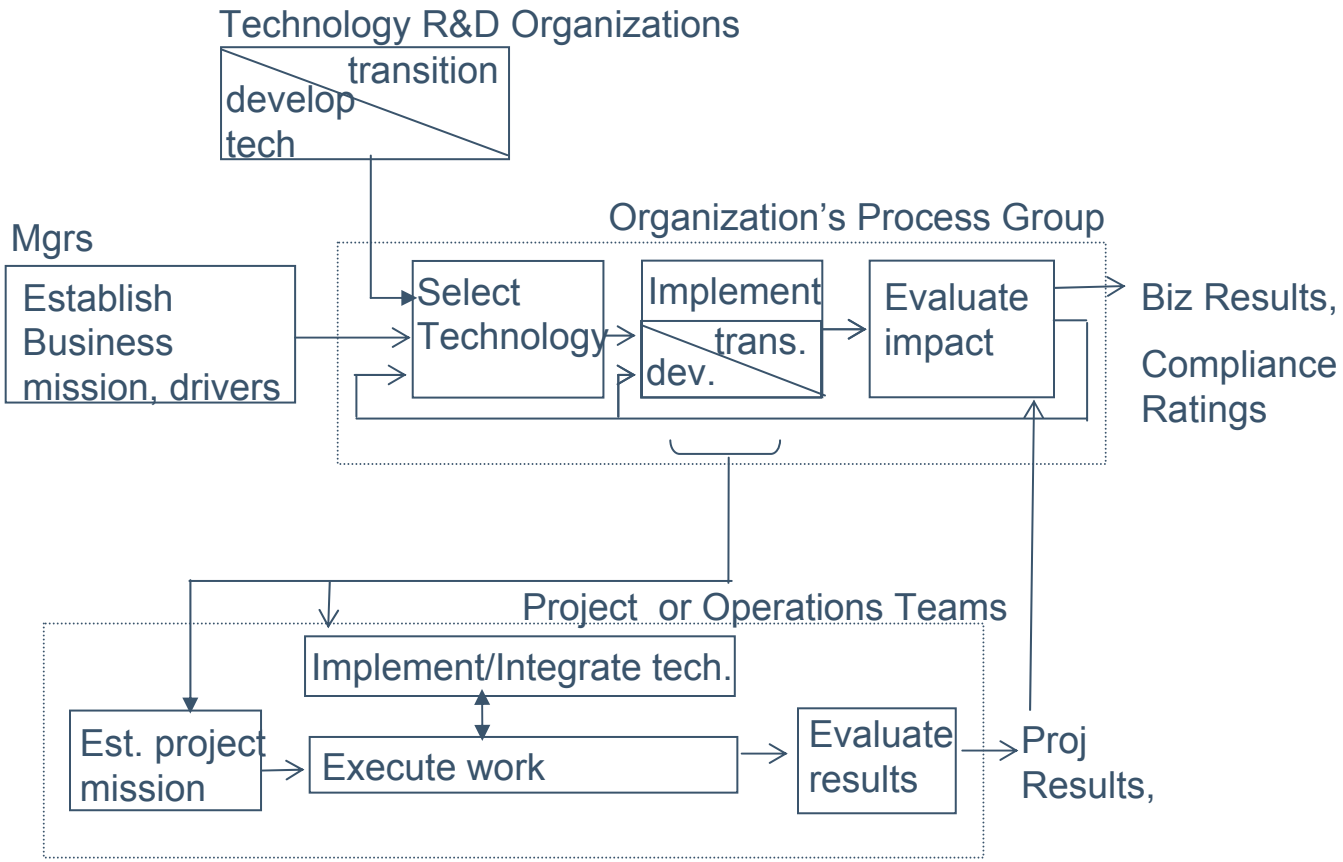
Considerations & Success Factors

- Process architecture & process architects
- Technology and organization readiness
- Technology adoption scenarios and strategy patterns
- Measurement as integrating platform

[Siviy 05-2]

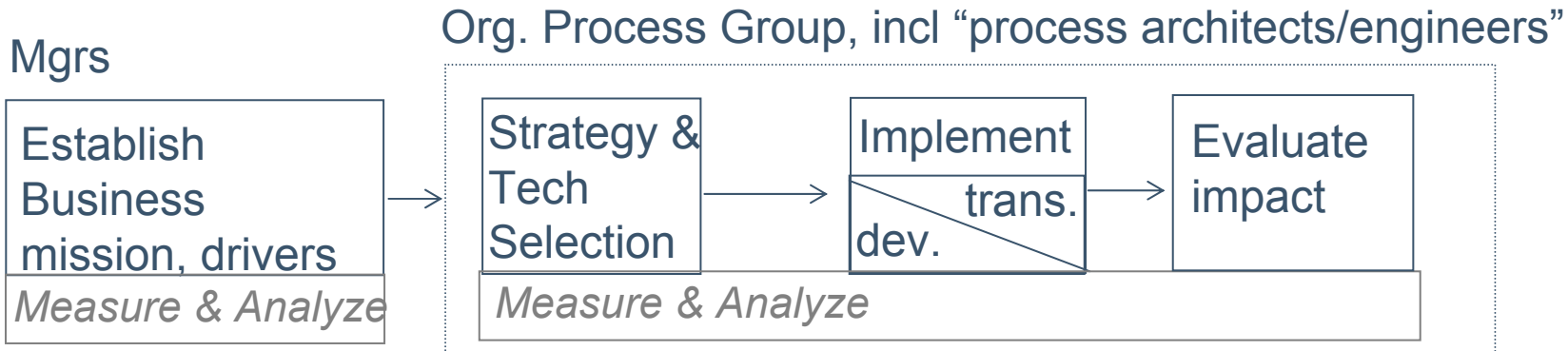
Determining YOUR Approach

First Remember: Everything is a Process!



[Siviy 04]

Emerging Research: An Initial Reasoning Framework



- Mission/strategy planning
- "Mission Translation" via GDM and 6S techniques
- Project portfolio management

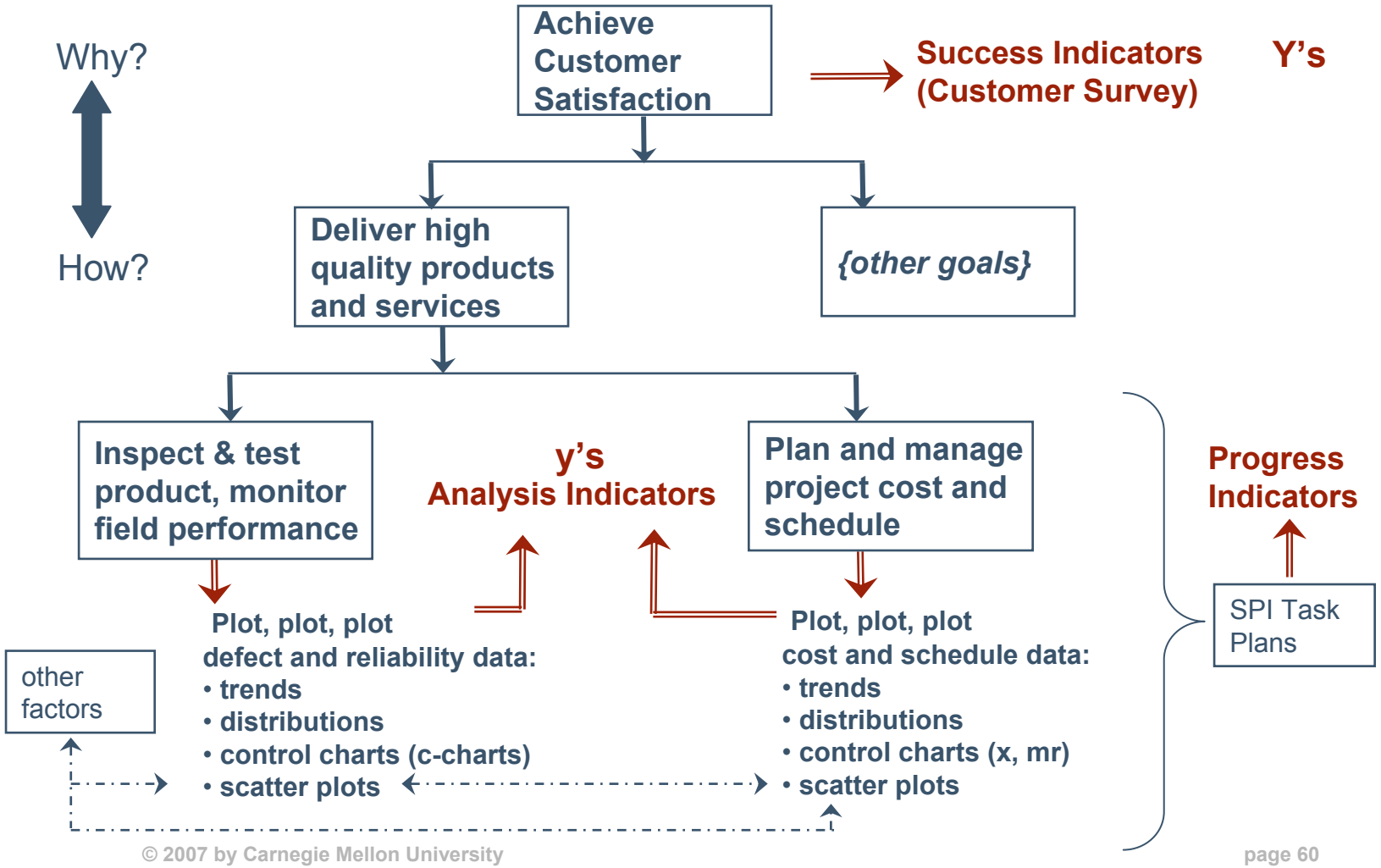
- Strategy/design patterns for model integration
- Decision science

- Process design/arch and validation methods,
- Transition science

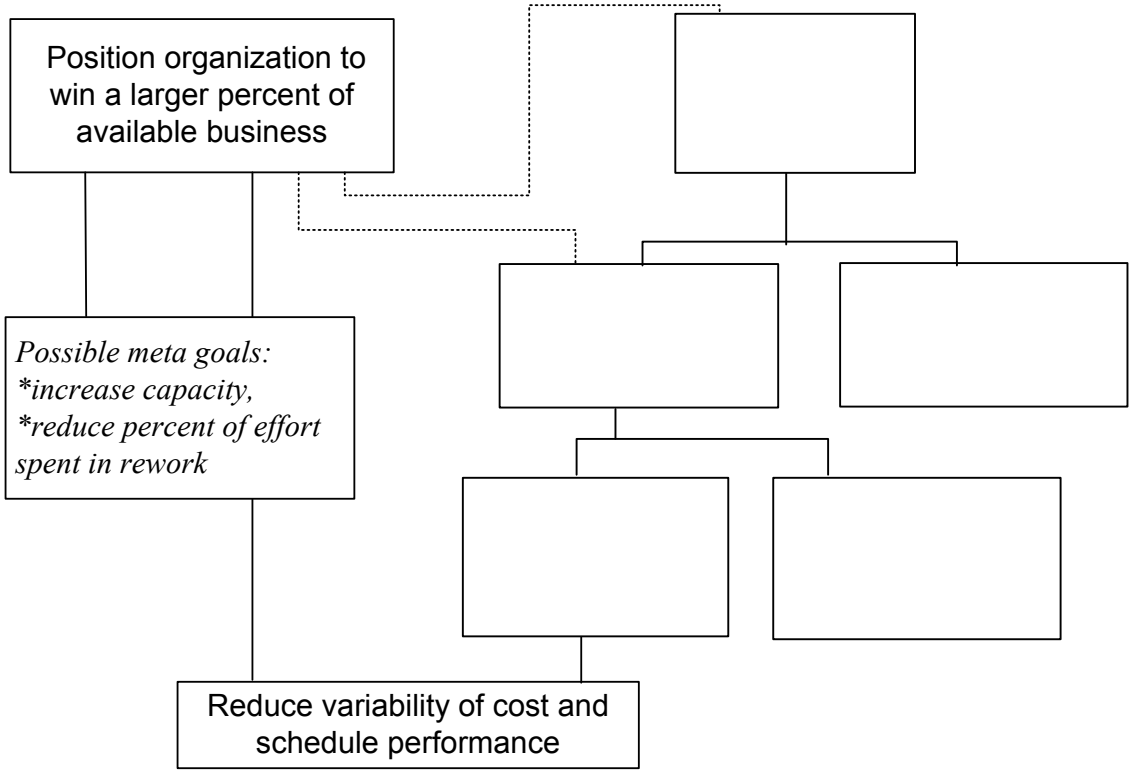
Cross-process practices

- Organizational Change Mgmt, including communications in all directions
- Measurement and Analysis methods – both for "strategic integration" and tactical value

Mission Translation



Mission Translation: Goal Realignment



While the re-alignment may not change the specific improvement activities, it will positively affect "change management" efforts.

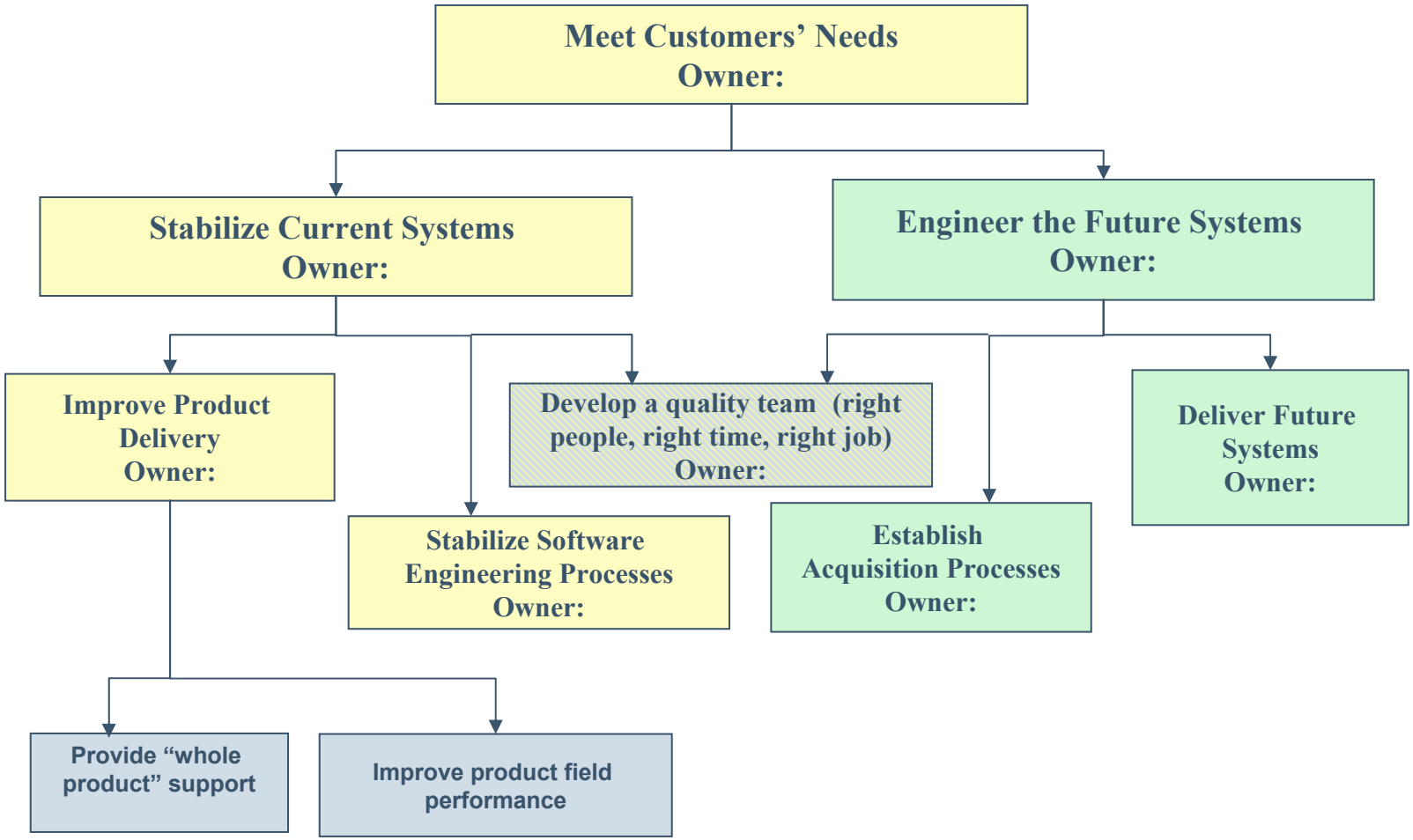
Project Portfolio Management

Different project types

- Enabling, for example
  - Establish measurement infrastructure
- Problem solving, for example
  - variance reduction, cycle time reduction, and so forth
  - *Reduce the total variance by decreasing the variance of the top 3 internal causes by 50% in 1 year.*
  - *Reduce the impact of external causes by 50%.*
- Design, including
  - Product design
  - Process design

Alignment, prioritization guided by “mission translation”

Project Portfolio Management Example



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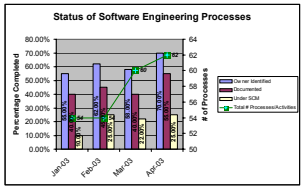
Sr. Mgmt scorecard ;
Middle Mgmt dashboard

Goal:
Establish Acquisition Processes

Success Criteria



Success Indicators
process owners, training, CM, and documentation
(future: procedural adherence)

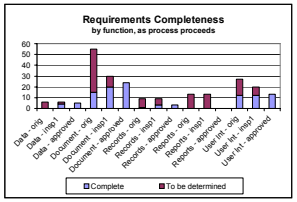
Strategy to accomplish goal

- Reference models: CMMI, SA CMM, IEEE/ISO 12207
- Leverage CMMI capabilities built in engineering: MA, REQM, RD, CAR
- Aim for CMMI capability in selected PAs: SAM, DAR, RSK, PP/PMC, CM, PPQA
- Reference all SA-CMM Level 2 kPAs, noting overlaps with CMMI

Sr. Mgmt dashboard
- quality trends
- selected project EV data

Middle Mgmt dashboard
- system documentation and testing

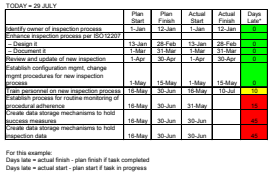
Middle Mgmt Dashboard
- selected SPI plan EV data



Analysis Indicators
Reqts completeness – original, at inspection, approved (for contract 1)

Tasks to Accomplish goal

- Implement requirements management process
- Tailor existing project monitoring processes for acquisition managers
- …..



Progress Indicators
start, finish dates with progress noted
(move toward EV)

Lockheed Martin IS&S Proj. Selection

Process Improvement Recommendation (PIR)

- Process Owner evaluates, determines feasibility, level of institutionalization and need for pilot

E-Transformation

- all business processes that affect overhead are applicable
- select based on ROI and relevance to business
  - Requires firm understanding of the “before” state
  - “Just do it” Projects
  - Kaizen event with rollout plan
- required use of Six Sigma methods/tools for optimization

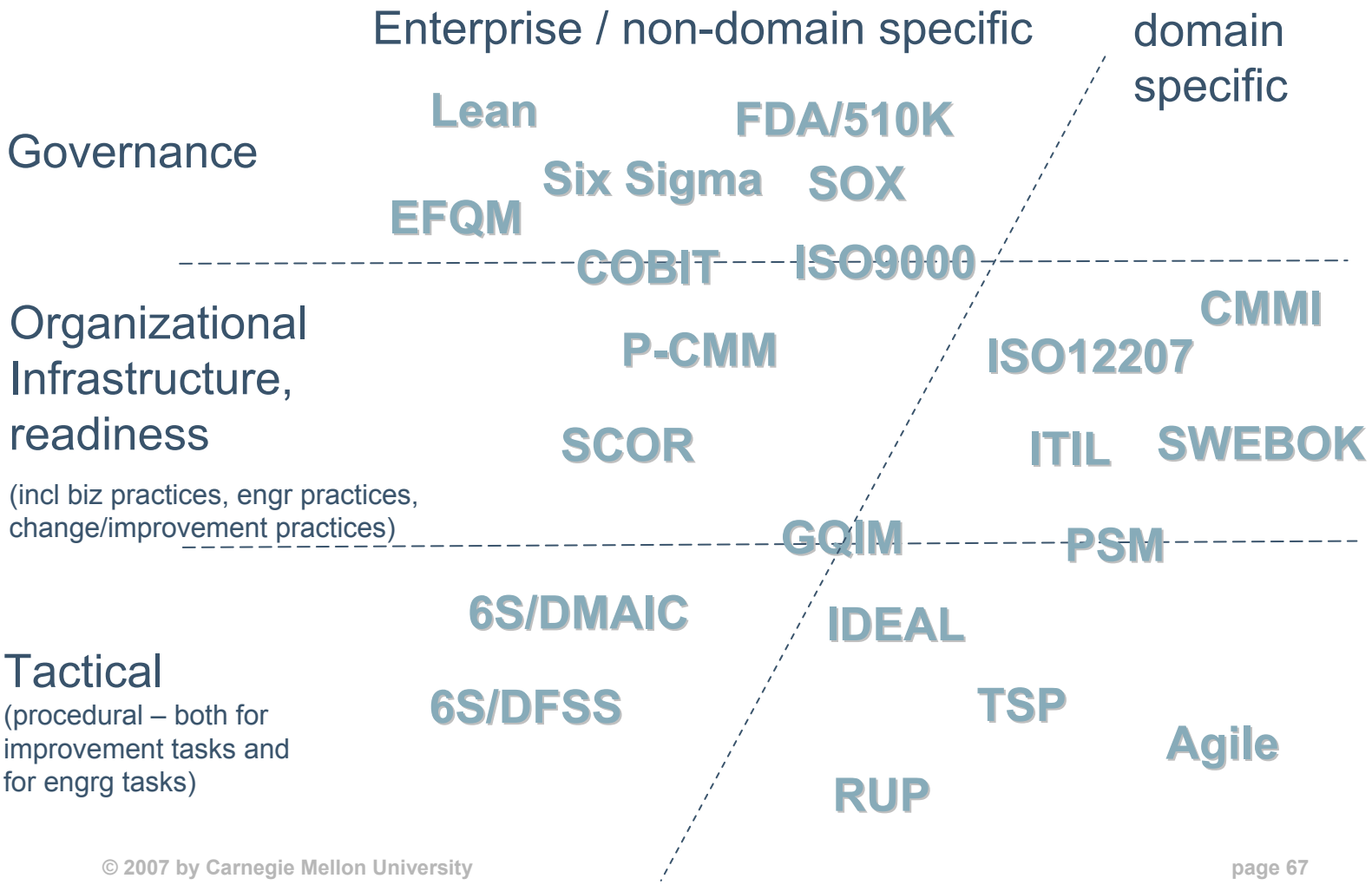
Technology Change Management Working Group (TCMWG)

- once a year call for ideas, incl PIR pilots
- “before state” used to measure impact of the “after” state
- required use of Six Sigma methods, modeling for optimization

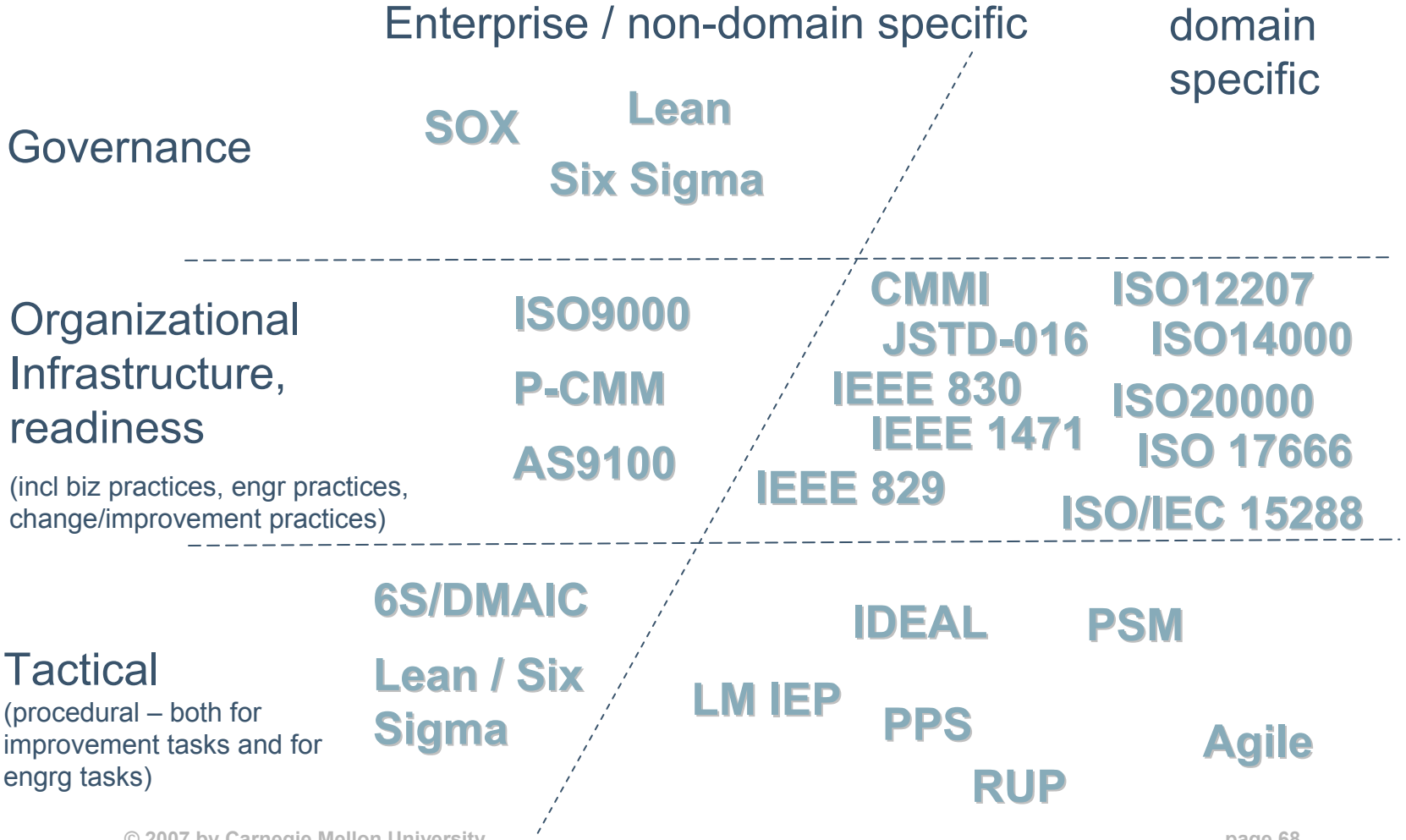
Motorola Project Selection

- Big Y to Vital x project trees ensured systems thinking of improvement needs driven by business goals
- Significantly reduced sub-optimization within individual disciplines and shifted focus to the overall business
- Improvement projects received proper management sponsorship and resources because of Vital x nature
- Performance highlighted to entire organization thereby motivating and enhancing team achievements!

Strategy/Design Patterns



LMCO IS&S Strategy/Design Pattern



Process Architecture

"Architecting" software processes is an area of emerging research

Best Practices to leverage

- Process mapping
- DFSS / LDFSS
- ETVX
- CMMI Generic Practices
- CMMI, ISO 12207 and other model content
- EPIC's "validated architecture"
- UML

EPIC = Evolutionary Process for Integrating COTS-Based Systems

Effective Transition Planning

"Transition" is indicated by each of the following:

- maturation, introduction, adoption, implementation, dissemination, rollout, deployment, or fielding

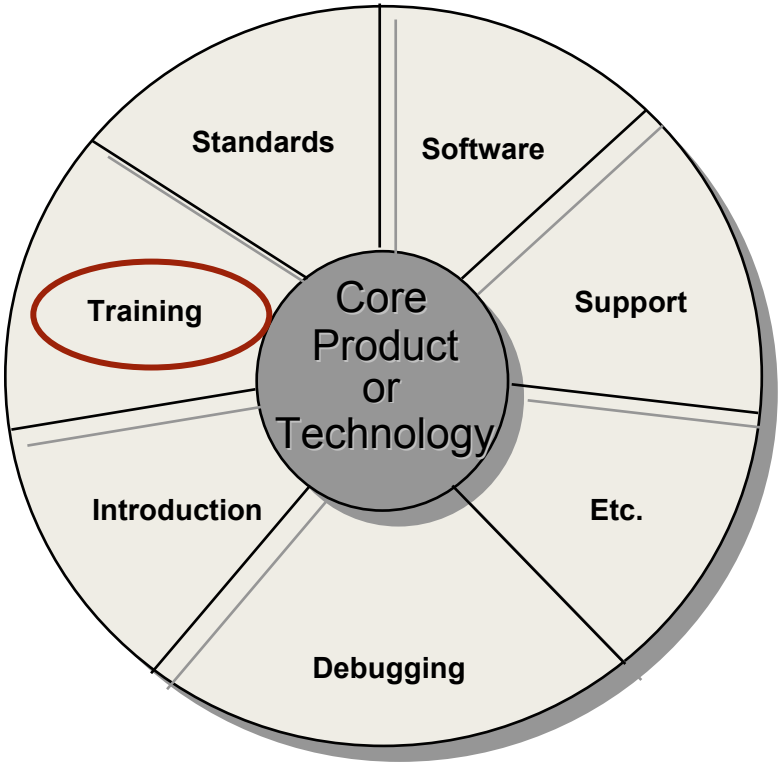
Features of effective transition planning include:

- precision about the problem, clarity about the solution
- transition goals and a strategy to achieve them
- definition of all adopters and stakeholders and deliberate design of interactions among them
- complete set of transition mechanisms: a whole product
- risk management
- either a documented plan or extraordinary leadership throughout the transition

[Forrester], [Schon], [Gruber]

"Whole Product"

A Feature of Effective Transition Planning



Economies of scale are needed in training.

A holistic, "connected" approach is needed in training.

Leaving students to their own devices to make connections can be risky and/or time-consuming.

[Moore]

Integrated Training Solutions

Integrated training solutions underway:

- DFSS training that includes awareness sessions of relevant technologies
  - SEI's Product Line Practices, ATAM, CMMI engineering PAs
- DFSS training that leverages ATAM
- DMAIC training that references PSP-based instrumented processes

Strategic Emphasis

Tactical Emphasis

SEI's approach uses *measurement & analysis* as an *integrator*.

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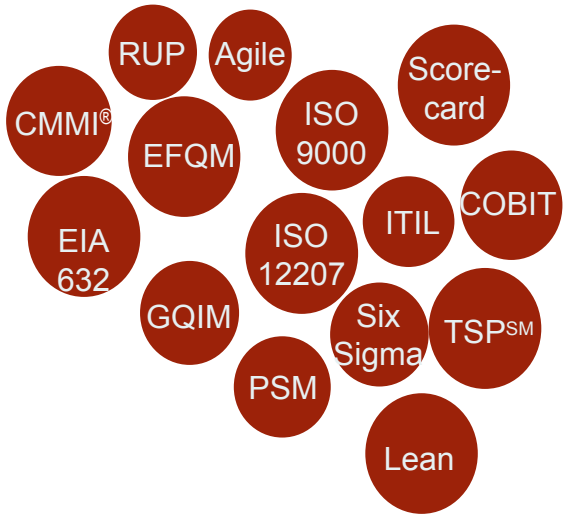
Summary

Value Proposition



SEI special project
- Six Sigma as an enabler of domain-specific initiatives

Primary conclusions, *supported by data*
- Enabler
- Accelerator
- Synergistic and complementary
- Effective at all CMMI maturity levels

Key supporting findings
- Mission focus
- “Seamless” model integration
- Engineering process architecture & design
- Robustness to organizational change
- High comfort with measurement & analysis
- Culture Change

Strategies & Tactics

Focus on mission success

- Supported by performance driven improvement

Process improvement itself is a process

- Leverage best practices and emerging research for design, transition and measurement

Implementation Strategies

- CMMI process areas as “Lean / Six Sigma projects”
- Lean/Six Sigma as tactical engine for high maturity
- Integrated process standard

Design an integrated, ***yet simple***, process architecture

Everything should be made as simple as possible, but not one bit simpler

- Albert Einstein

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Contact Information

Jeannine Siviy
412.268.7994
jmsiviy@sei.cmu.edu

M. Lynn Penn
610.354.1188
mary.lynn.penn@lmco.com

Robert Stoddard
412.268.1121
rws@sei.cmu.edu

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[Hefner 03] Hefner, Rick and Ron Ulrich, *Minimizing SCAMPI Costs via Quantitative Methods* , Northrop Grumman Mission Systems, CMMI Users Group Conference 2003

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Online Resources

Online Statistical Textbooks

Computer-Assisted Statistics Teaching - http://cast.massey.ac.nz

DAU Stat Refresher- http://www.cne.gmu.edu/modules/dau/stat/dau2_frm.html

Electronic Statistics Textbook - http://davidmlane.com/hyperstat/index.html

Statistics Every Writer Should Know - http://nilesonline.com/stats/

Six Sigma Resources

isixsigma software channel – http://software.isixsigma.com

SEI Measurement & Analysis Initiative – http://www.sei.cmu.edu/sema

- See presentations page and publications page

International Society of Six Sigma Professionals, http://www.isssp.org

Six Sigma in Software & Systems Engineering Yahoo Group – http://groups.yahoo.com/group/6S_SWSE