SEI Approach to Harmonization

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Standard Form 298 (Rev. 8-98)
Prepared by ANSI Std Z39-18
SEI Outline

Value Proposition for Harmonization, including

- ‘Voice of the Customer’ from 2007
- Field reports

Harmonization of Improvement Technologies

- Overview of reasoning framework

The Path Ahead
Value Proposition for Harmonization
What Do We Mean by *Multimodel Environments*?

Multiple improvement technologies

- Concurrently implemented
- At different hierarchical levels
- Across different organizational functions

For example…

- Enterprise governance
- Process infrastructure
- Engineering methods
- Government regulations
- IT operations
- Sector-specific regulations or technologies
- And so on…

---

1 We use the terms *improvement technologies, technologies,* or *models* interchangeably when referring to reference models, standards, best practices, regulatory policies, and other types of practice-based improvement technologies.
Challenges in Multimodel Environments

Competition for implementation resources

- Infrastructure
- Training
- Compliance
- Performance measurement

Independent, non-aligned project portfolios

Unclear relationships between technologies

- Overlaps
- Differentiators

Consequences

- Excess costs
- Erosion of benefits from any single effort

2007 VOC
Top 7 significant challenges

Separate improvement technology ownership
Change management
Technical connections
Senior management understanding
Training and resources
Strategy determination
Senior management sponsorship
Harmonization IS about…

- Mission
- System thinking
- Performance-driven improvement
- Value contribution of technologies
- Technology neutrality
- Process system design and alignment from strategy to implementation

**CMMI & Six Sigma Research Findings, 2004**

Mission-focused, flexible, adaptive to changing org. and tech. situations
Single, seamless solution; meaningful quantitative performance benefits
Six Sigma effective at all CMMI maturity levels; exemplifies high maturity/capability
High-performing IT orgs. realizing similar benefits, with domain-specific technologies
Majority of DFSS implementers progressing with CMMI; a few using ATAM
CMMI offers institutionalization mechanisms
CMMI implementers often well-suited as Six Sigma Black Belts
Harmonization *IS NOT about*…

- Creating a master metamodel
- Developing a
  - new single technology that encompasses all other technologies
  - universal combination to suit every organization
- Promoting any single combination of technologies as the best
- *(Necessarly)* adding more technologies

Harmonization is NOT another process—it relies on an underlying improvement process paradigm
Harmonization Layers and Considerations
An Initial View

Mission
Technology Selection and Composition
• Strategic choices, aligned with mission
• Feature overlaps and differentiators

Organizational Process
• Robust process architecture and standard processes
• Aligned with organizational mission
• Comprises properties of technologies of interest

Implementation
• Improvement infrastructure and resources
• Improvement project portfolios
• Measurement system
• Audit and appraisal
Benefits of Harmonization

Business focus

Cost and cycle-time reduction

• Implementation
• Audit

Robustness

• Process robustness for a dynamic world of models and regulations
• Long-term and robust organizational approach to technology selection

2007 VOC
Top 7 significant benefits

Holistic, more complete views
Efficient
Synergy
Acceleration
Effective
Understanding of the specific connections for specific combinations
Measurement
Integrating Initiatives: *Field Notes* 

*(Public domain literature)*

**Northrop Grumman Mission Systems**

- CMMI, Six Sigma, ISO, KM
- “.. accelerate achievement of Levels 4 and 5 ...”
- “[6S]... an enabler for measuring the value of... improvements”
- “Six Sigma provides a way to connect process improvement and business value”
- “..conducting Level 5 SCAMPI appraisals in 5-6 days...”

**Raytheon**

- CMMI + R6S + IPDS + DFSS
- Escaping defects from 6/KSLOC to 1.16/KSLOC

**University of Pittsburgh Medical Center (UPMC)**

- CMMI, Sarbanes Oxley (SOX), and ITIL.
- First non-profit medical system in U.S. to be certified compliant with the most stringent provisions of SOX

[Facemire 04], [Hefner 04], [Mackertich], [Carmody]
Integrating Initiatives: *Field Notes* 2

*(Public domain literature)*

**Tata Consultancy Services**

- CMMI, ITIL, ISO 9001, P-CMM ➔ “Integrated Quality Mgmt System”
- “…development center…reduce[d]…in-process failure costs…5 to 1%…”

**Wipro**

- ISO 9001, CMM, P-CMM, TL9000, British Standard 7799, Six Sigma ➔ “Enterprise Integrated System”
  - Quantitative understanding, cost savings, performance improvement
  - “customer-centric, data-driven paradigm for … quality”
- “… financial services division … Process … to eliminate non-value adding steps and mistake-proof the system.”
  - Projecting a 30% cycle-time reduction in computer business
  - Estimated short-term [ROI for 6S investment is] six to eight times investment in Six Sigma

**Others**

- Lockheed Martin (profiled on the following slides)
- JP Morgan Chase, Honeywell, and more

[Keeni 03], [Srivastava], [Wipro 04], [Wipro 01]
Profile: *Lockheed Martin Integrated Systems & Solutions*

**STRATEGY**

Establishment of Process Architecture and “Required Dev. Process”

Pursuit of high maturity ➞ Growth & Sustainment

- RDP expansion to Program Process Standard
  - Minimum mandatory set of development processes
  - Updated for industry standards where certifications desired
- 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 business processes outside of CMMI
  - Applied to appraisals
Profile: **LMCO IS&S**

**RESULTS and BENEFITS**

Benefits of Chosen Strategy

- 30% cycle-time reduction; idea to proposal
- Robust; easy to build in new models, practices
- All models working together to achieve performance; distinct contribution of any individual model difficult to extract

Success Factors

- Built the vision while at “low maturity”
- Senior management sponsorship
- Key personnel with needed systems and strategic outlooks as well as breadth of experience
Harmonization: An Initial Reasoning Framework
A Process Paradigm

First Remember:
Everything is a Process!

Technology R&D Organizations

Managers

Organization’s Process Group
Process Improvement Professionals

Project/Operations Teams

Technology
Transition
Develop

Establish business mission/drivers

Select technology

Implement/Integrate technology

Implement
Transition
Develop

Evaluate impact

Evaluate business results

Establish project mission

Execute work

Evaluate results

Business results

Compliance ratings

[Siviy 04]
Key Guidance 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?

Mission Translation
Strategic Technology Selection
Technology Composition
Process Architecture
Process Standard
Implementation Considerations
Mission Translation

Practices to Leverage

- FAST-based Goal Structures ("front end" to Goal-Question-Indicator-Metric)
- Y to X Decomposition
- Quality Function Deployment (QFD)
- Critical Success Factors
- Theory of Constraints: Systems Thinking Diagrams
- Strategy Maps
- Roadmapping

Translating organizational goals and metrics to individuals and teams continues to be one of the most difficult management activities and is often a stumbling block to implementation

- from “How the Learning Organization Manages Change” by Ronald Recardo, Kathleen Molloy, and James Pellegrino
Strategic Classification Taxonomy

- Governance (including external mandates, regulations, and internally chosen governance)
- Organizational infrastructure and readiness (including business, engineering, and change/improvement practices)
- Tactical (procedural, for both improvement and engineering tasks)

Increasing decision authority of process group
Strategy/Selection Guidance

Emerging Research

Methods

• Affinity groups
• QFD
• Pugh’s concept selection
• TRIZ
• Benchmarking, pattern matching and “Positive Deviance”
• Methods from the field of Operations Research

Considerations

• Technology readiness
• Organizational readiness and culture
• Decision authority, regulatory compliance requirements
• Scenarios
• Interoperability
Technology Composition using Element Classification

- What is common among the elements?
- Can we derive a common view of these elements?
- How can we help the different stakeholders in their daily work with the elements?
## Element Classification Taxonomy

<table>
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<th>Good Practice Elements</th>
<th>Improvement Method Elements</th>
<th>Institutionalization Elements</th>
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<td>Change management techniques:</td>
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Process Architecture

Emerging Research

Definitions

- **CMMI**: ordering, interfaces, interdependencies and other relationships among process elements in a standard process
- **Kasser**: function of process architecting is to design, set up and continuously optimize, the process for the development of the specific system being produced
- **Business Analysis BoK**: processes needed to conduct business, how those process interact and how they are managed and modified over time.
  - A process architecture should remain fairly intact even as the details of process execution evolve and change.

Features

- Functional properties, including classes, flow, and attributes
- Outputs, including flow and relationships
- Roles and responsibilities, including users and actors
- Information flow
- Overall interrelationships, dependencies, and constraints

[Kasser], [BABOK]
Process Architecture

Emerging Research

Practices, methods, disciplines to leverage

- DFSS, DFLSS, incl mapping and robust design techniques
- Software and related engineering technologies
  - Technologies/principles: Interoperability; COTS; architecture
  - Diagramming/notations: UML; Little JIL process language
- Business process management architectures and models
  - Architecture of Integrated Information Systems (for BPM)
  - Riva’s process definition technique
  - Goal Oriented Business Process Modeling (BPM)
- Beers Viable Systems Model
- Operations Research

[Osterweil 1], [Osterweil 2], [Avrunin], [Albert et al 02], [Scheer 00], [Davis 01], [BA Insight 06], [Ould 06], [Bider 05], [Beer 85], [Beer 94], [Espeio and Harnden 89]
Harmonization Layers

- MISSION TRANSLATION
- STRATEGIC TECHNOLOGY SELECTION
- TECHNOLOGY COMPOSITION
- PROCESS ARCHITECTURE
- STANDARD PROCESS
- TAILORED/EXECUTED PROCESS
- CROSS TRAINING, IMPROVEMENT PROJECT PORTFOLIO, MEASUREMENT INFRASTRUCTURE
- AUDITS
- PROCESS IMPROVEMENT INFRASTRUCTURE
The Path Ahead
Multimodel Harmonization Builds on Existing Works

Publications generating awareness, ideas, approaches, methods

- Armstrong: Systems Approach to Process Infrastructure
  - Best practices, tools, improvement, measurement
- Kasser: Process Architecting
- Halvorsen et. al.: Taxonomy to compare SPI Frameworks
- Mutafelija: Process Architecture Views and Properties
- Bendell: Structuring Business Process Improvement Methods
  - Problem-solution decision model
- Osterweil: Little JIL process language
- Amescua, Garcia, Sanchez et. al.: Patterns
- Others
Multimodel Harmonization Builds on Existing Works

Guidance, frameworks, metamodels for specific combinations

- SEI research and publications
  - CMMI & Six Sigma sponsored research, book, courses
  - Tech reports: CMMI & ISO, CMMI & Agile, CMMI & TSP…
  - Resiliency Engineering Framework
- Numerous Mappings & Relationship Diagrams
- Integrated Systems Framework (ISF) [Byrnes-Vasques]
- Change Engine [Ghetto-Klar]
- OPEN Process Framework (OPF) [Firesmith]
- eSourcing Capability Model (eSCM) [Hyder et. al.; Hefley et. al]
- Many internal corporate endeavors, mostly proprietary
- Others?
Preliminary Sponsored Work on Harmonization

Sponsored by Lockheed Martin IS&GS

White paper for managers

*Maximizing your Process Improvement ROI through Harmonization*

White paper series for process improvement professionals

1. **The Value of Harmonizing Multiple Improvement Technologies: A Process Improvement Professional’s Viewpoint**
2. **Strategic Classification and Technology Selection in Multimodel Environments**
3. **Improvement Technology Classification and Composition in a Multimodel Environment**
4. **Process Architecture in a Multimodel Environment**
5. **Implementation Challenges in a Multimodel Environment**

May 8 Workshop:
Hard Questions for Process Improvement in Multimodel Environments
But there is much more work to do....

Process Improvement in Multimodel Environments (PrIME)

- an SEI-led project on harmonization
- Common set of principles that all can use
  - base “recipes” from research effort
  - foundation for more “recipes” to be built by the community
- Convergence at the “multimodel” level

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Summary: Multimodel Improvement is Our Reality

Value of Harmonization

• Performance
• Cost and cycle-time reductions
• Robustness

Reasoning Framework for Harmonization

• Mission translation and alignment
• Technology adoption scenarios, selection patterns and decisions, sequencing
• Technology classification and composition
• Process architecture and process architects
• Measurement as integrating platform
• Implementation considerations

Recipes for Specific Technology Combinations
Everything should be made as simple as possible, but not one bit simpler

- Albert Einstein
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[Siviy 05-2] excerpted from working documents from internal SEI research on the joint use of Six Sigma and CMMI; refinement of guidance and subsequent publication is in progress; for more information, contact jmsiviy@sei.cmu.edu

[Siviy-Hefner 06] Siviy, Jeannine and Rick Hefner, Six Sigma Tools for Early Adopters, SEPG 2006


[Stoddard 02] Adapted, with permission, from information provided by Robert Stoddard, Motorola, Inc.

[Vickroy 03] Idea to strategically select MA, OPP, QPM as first PAs in which to achieve capability 5 offered by Robert Vickroy, ABS Group, at CMMI course on 17 January 2003

[wipro1] [www.iqa.org/publication/c4-1-38.shtml](http://www.iqa.org/publication/c4-1-38.shtml)