



Life Cycle Models, CMMI, Lean, Six Sigma – Why use them?

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QuEST Forum Best Practices Conference

Track 3 – What, Where, How & Why

Monday, 24-Sep-07, 4:30 – 5:30

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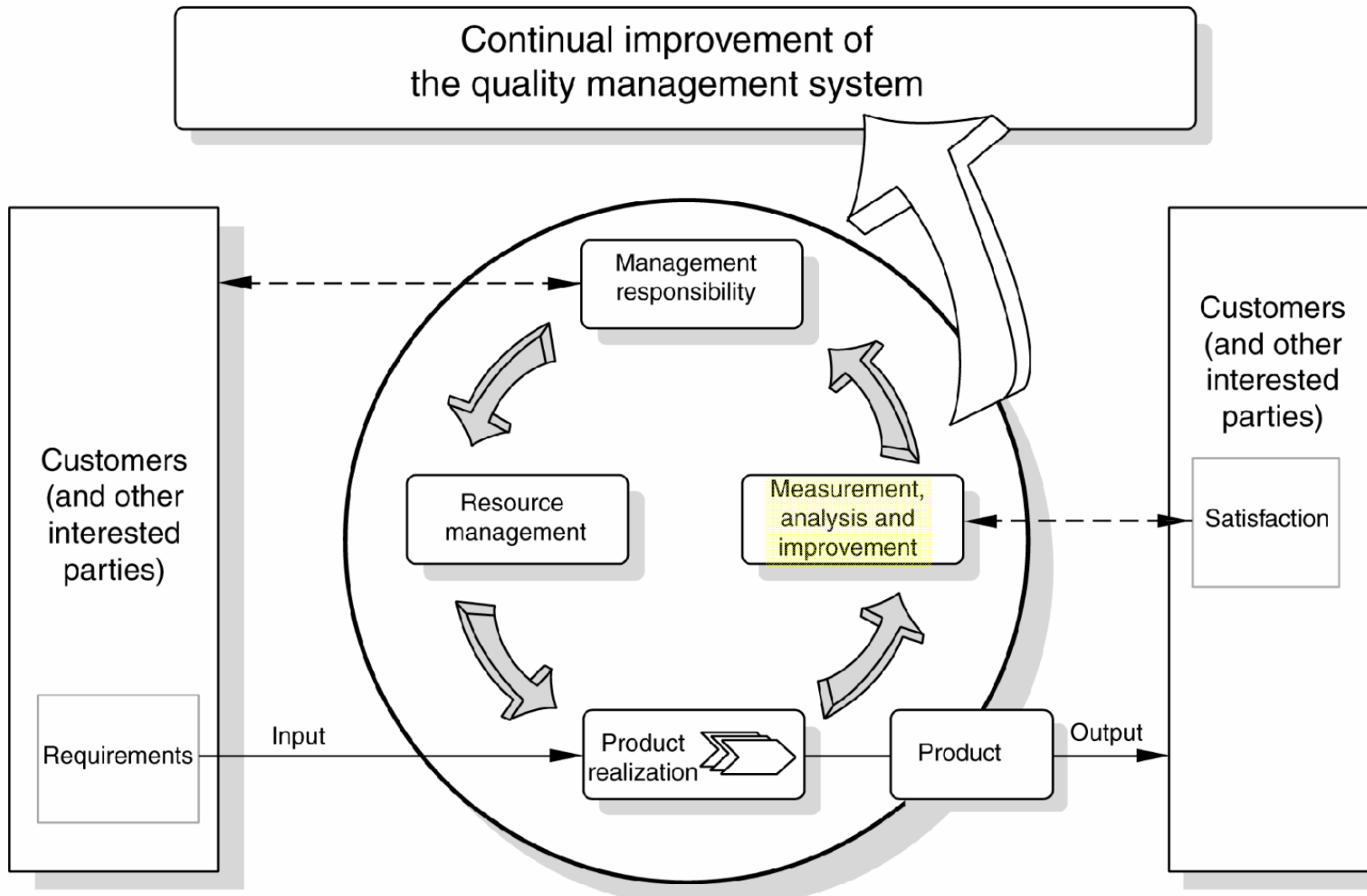


Foundations and layers

- **ISO 9001 Quality Management System Requirements**
- **TL 9000 Quality Management System Requirements**
- **IS 12207 & 15288 Software & System Life Cycle Processes**
- **IEEE 1074 Developing a Software Project Life Cycle Process**
- **Capability Maturity Model Integrated – Development**
- **IEEE 1061 Software Quality Metrics Methodology**
- **TL 9000 Quality Management System Measurements**
- **Lean**
- **Six Sigma**
- **Lean Six Sigma**

Management Systems

ISO 9001 Model of a process-based quality management system



ISO 9001 Quality Management System

- **Quality management principles**
 - Customer focus
 - Leadership
 - Involvement of people
 - Process approach
 - System approach to management
 - Continual improvement
 - Factual approach to decision making
 - Mutually beneficial supplier relationships
- **The organization shall:**
 - Determine the needs and expectations of customers and other interested parties
 - Establish policies, objectives and a work environment necessary to motivate the organization to satisfy these needs
 - Design, resource and manage a system of interconnected processes necessary to implement the policy and attain the objectives
 - Measure and analyze the adequacy, efficiency and effectiveness of each process in fulfilling its purpose and objectives and
 - Pursue the continual improvement of the system from an objective evaluation of its performance.

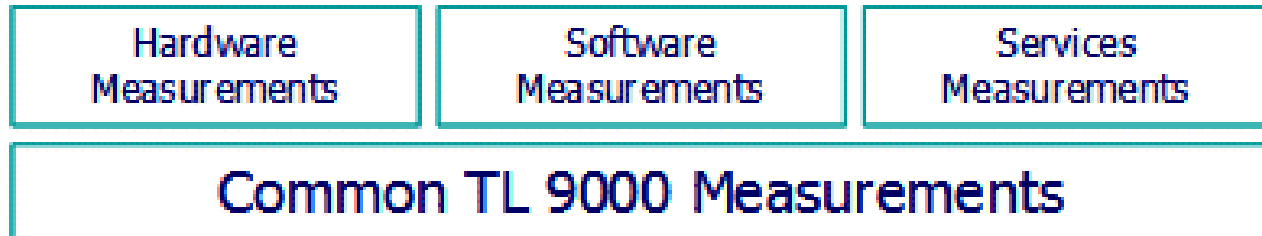
ISO 9001 Quality Management System

- *Foundation of several industry sector standards*
 - Aerospace AS9100,
 - [Telecom TL 9000](#),
 - Automobile ISO/TS 16949,
 - Chemical RC 14001,
 - Medical devices ISO 13485,
 - Petroleum and natural gas ISO/TS 29001

TL 9000

Quality Management System,
QuEST Forum

TL 9000 Model



TL 9000 QMS and Measurements System

- ISO 9001 + best practices + best measures = TL 9000
 - 90 Requirement Adders by engineering domains: H, S, V, C
 - 10 Measurements areas for 100+ Product Categories
- TL 9000 requires
 - Life Cycle Model [7.1.C.1],
 - Effectiveness of each process [8.2.3.C.1], &
 - Error elimination [7.3.5.HS1,2]

Life Cycle Models

TL 9000 Life Cycle Model

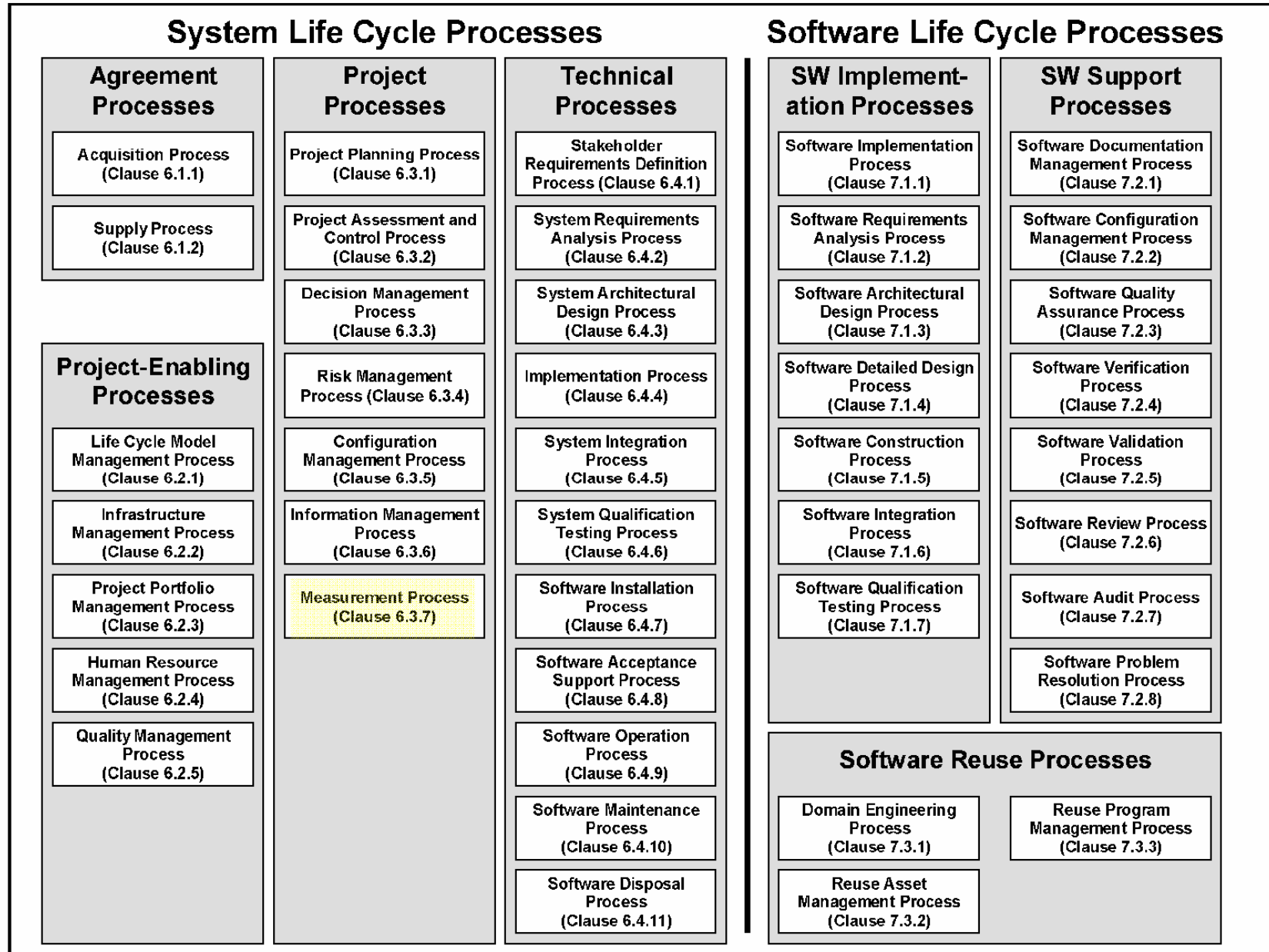
7.1.C.1 Life Cycle Model

- The organization shall establish and maintain an integrated set of method(s) that covers the life cycle of its products. The method(s) shall contain, as appropriate, the processes, activities, and tasks involved in the
 - concept,
 - definition,
 - development,
 - introduction,
 - production,
 - operation,
 - maintenance, and
 - (if required) disposal of products, spanning the life of the products.

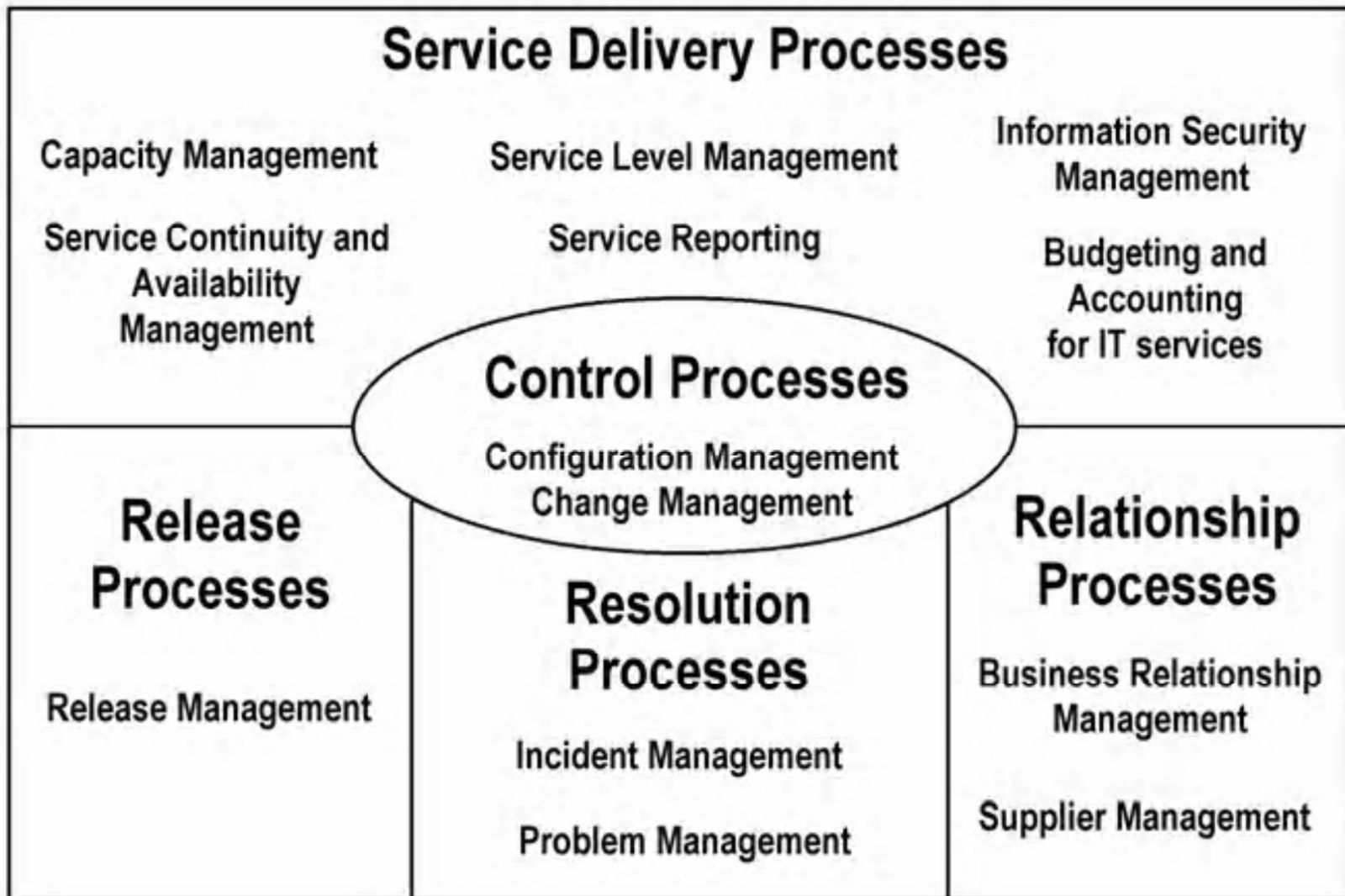
Life Cycle Models

- IS 12207 Software Engineering Life Cycle
 - 18 processes
- IS 15288 System Engineering Life Cycle
 - 25 processes
- IS 2000 Service Management
 - 11 processes
- Control Objectives for Information and related Technology (CobiT)
 - 34 processes
- CMMI-DEV Process Areas (PA)
 - 22 processes

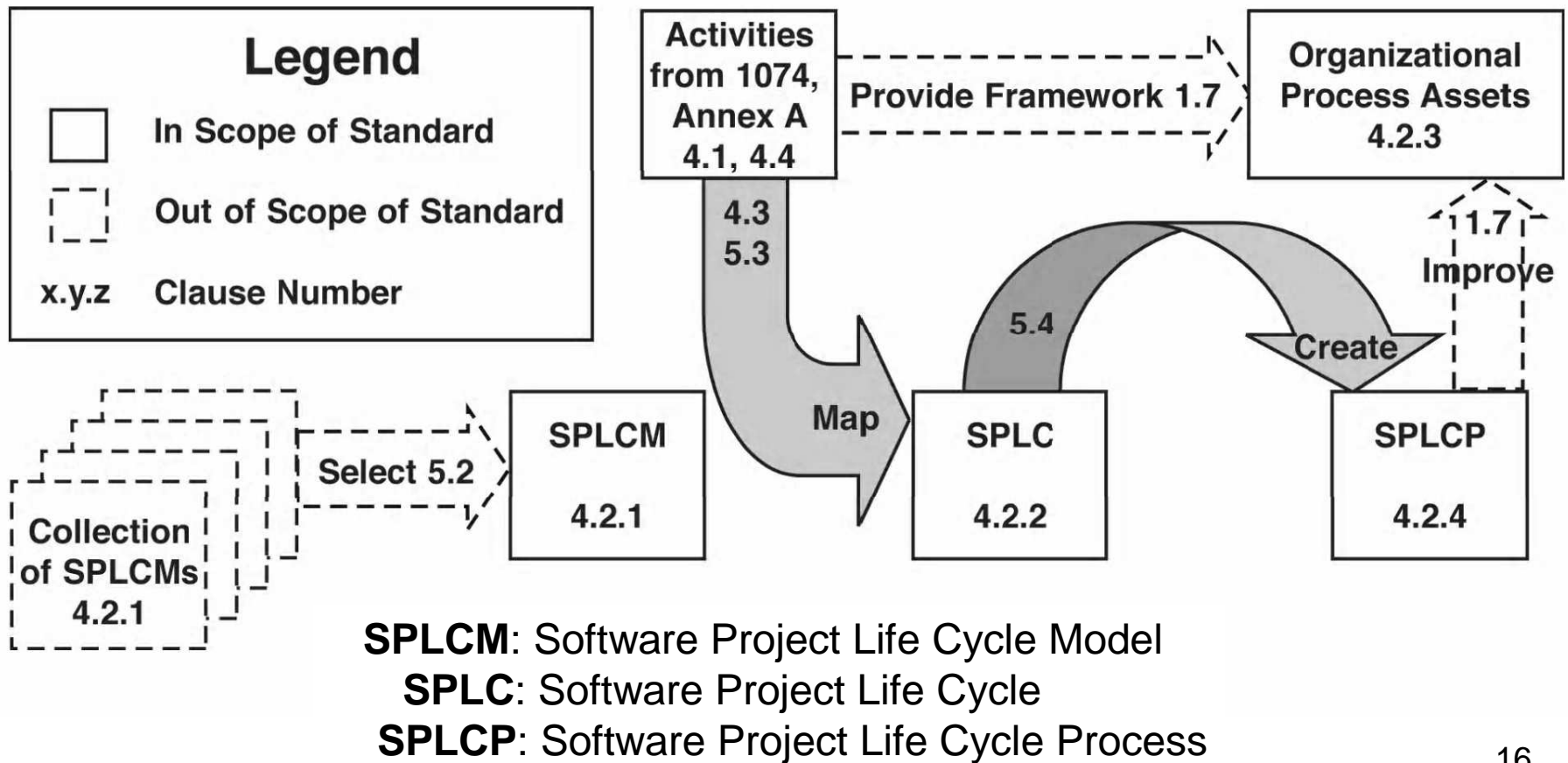
Life Cycle Process Groups, IS12207. IS 15288



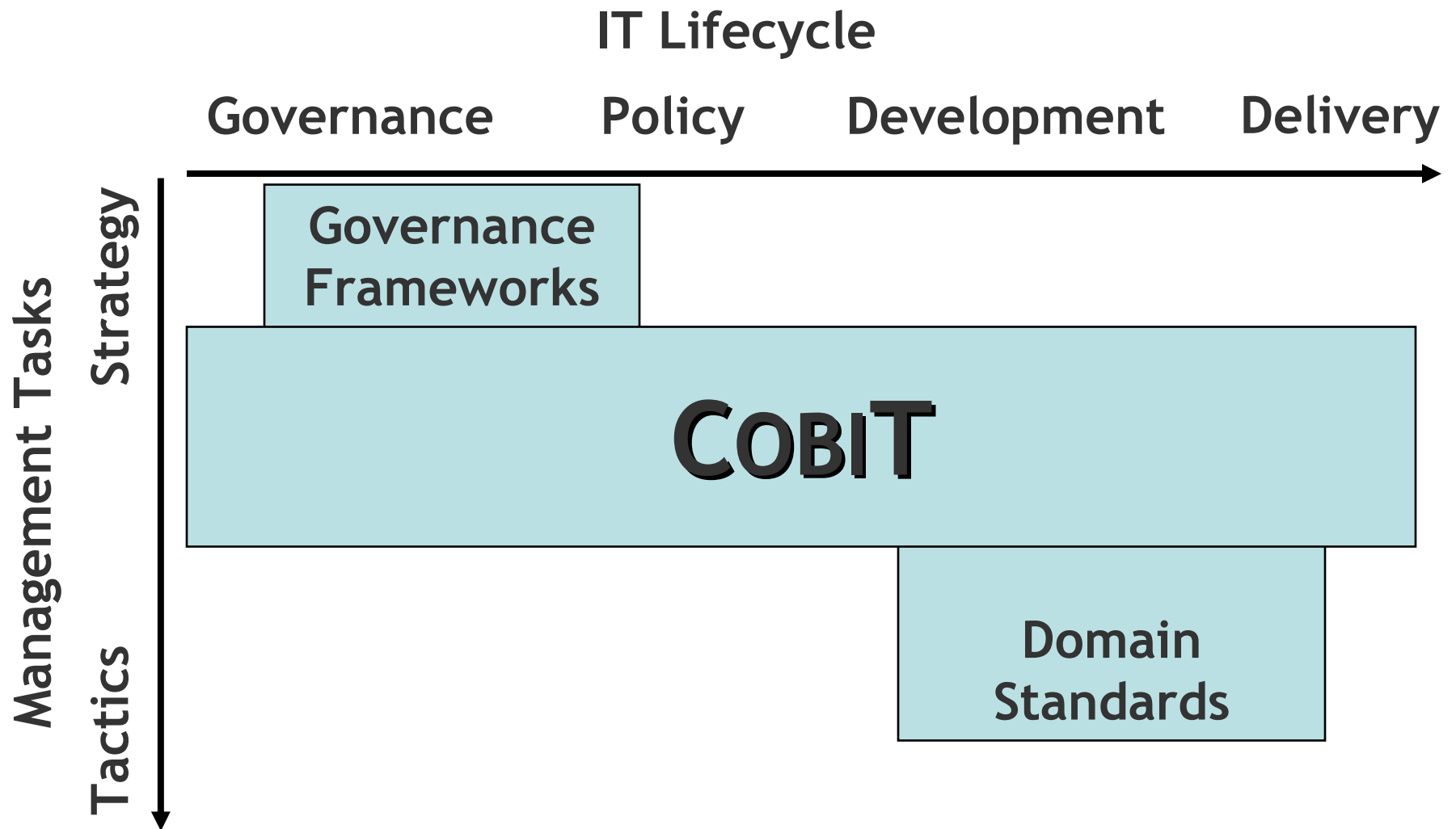
Service Management processes, IS 20000



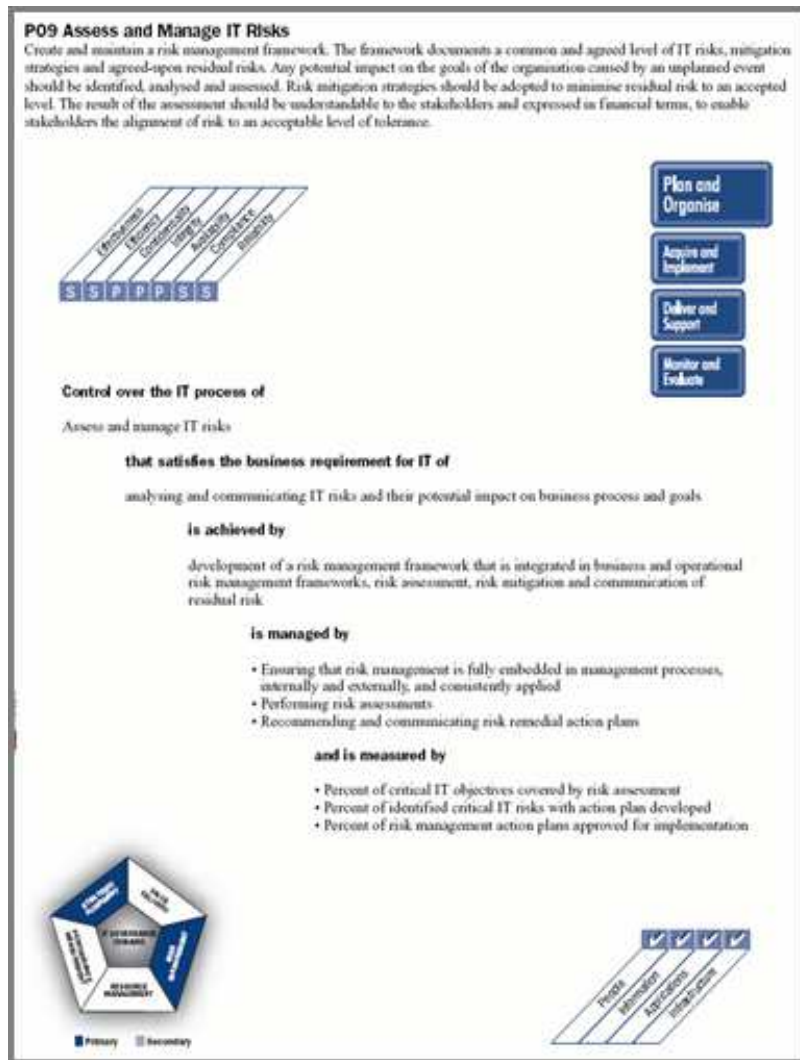
Developing software project life cycle process, IEEE 1074



Where CobiT fits...



For 34 CobiT processes you have ...

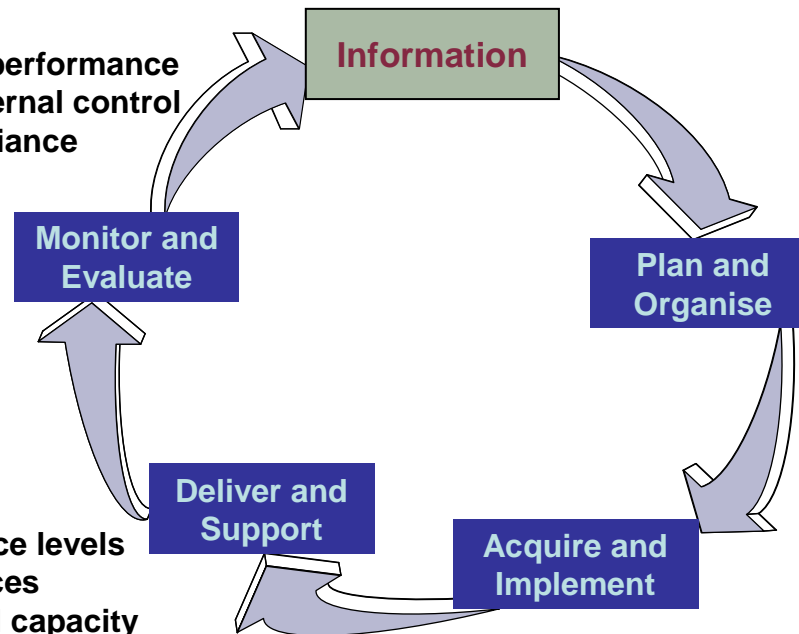


- • Process description
- • IT domains & Information Indicators
- • IT goals
- • Process goals
- • Key practices
- • **Key measurements**
- • IT Governance & IT resource indicators

CobiT IT Processes

- PO1 Define a strategic IT plan
- PO2 Define the information architecture
- PO3 Determine technological direction
- PO4 Define the IT processes, organisation and relationships
- PO5 Manage the IT investment
- PO6 Communicate management aims and direction
- PO7 Manage IT human resources
- PO8 Manage quality
- PO9 Assess and manage IT risks
- PO10 Manage projects

- ME1 Monitor and evaluate IT performance
- ME2 Monitor and evaluate internal control
- ME3 Ensure regulatory compliance
- ME4 Provide IT governance



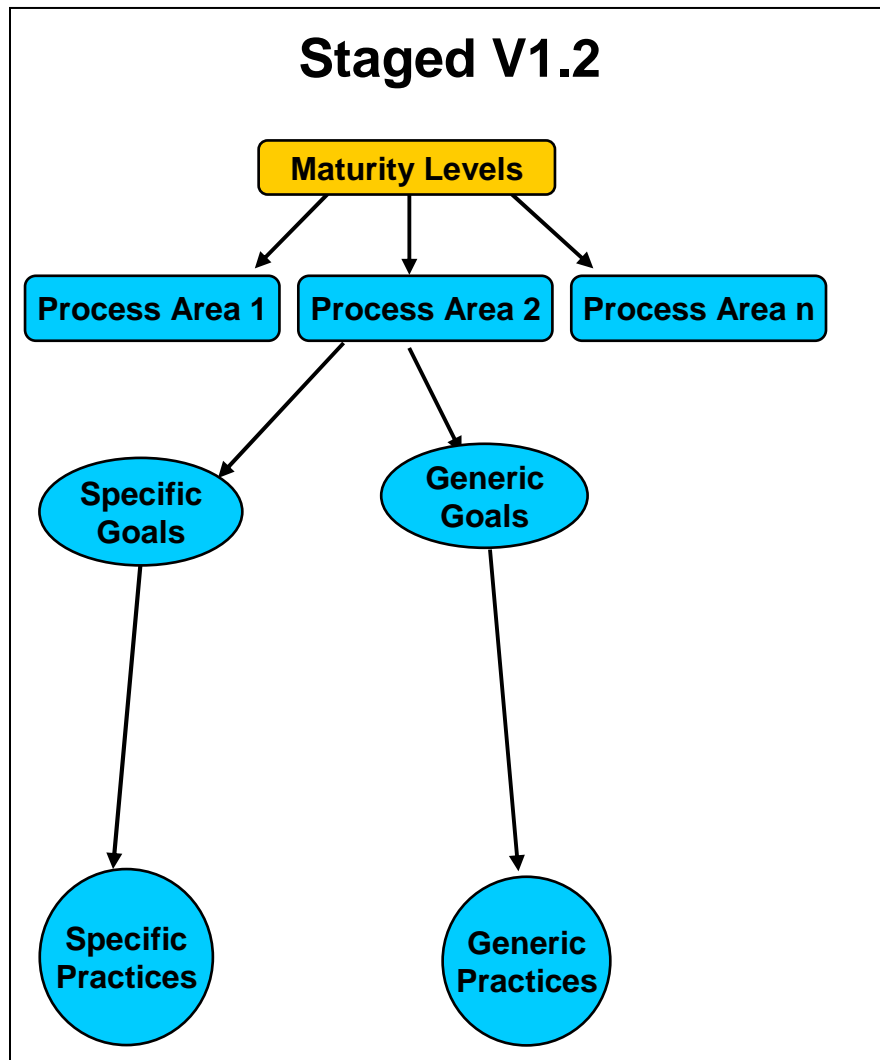
- DS1 Define and manage service levels
- DS2 Manage third-party services
- DS3 Manage performance and capacity
- DS4 Ensure continuous service
- DS5 Ensure systems security
- DS6 Identify and allocate costs
- DS7 Educate and train users
- DS8 Manage service desk and incidents
- DS9 Manage the configuration
- DS10 Manage problems
- DS11 Manage data
- DS12 Manage the physical environment
- DS13 Manage operations

- AI1 Identify automated solutions
- AI2 Acquire and maintain application software
- AI3 Acquire and maintain technology infrastructure
- AI4 Enable operation and use
- AI5 Procure IT resources
- AI6 Manage changes
- AI7 Install and accredit solutions and changes

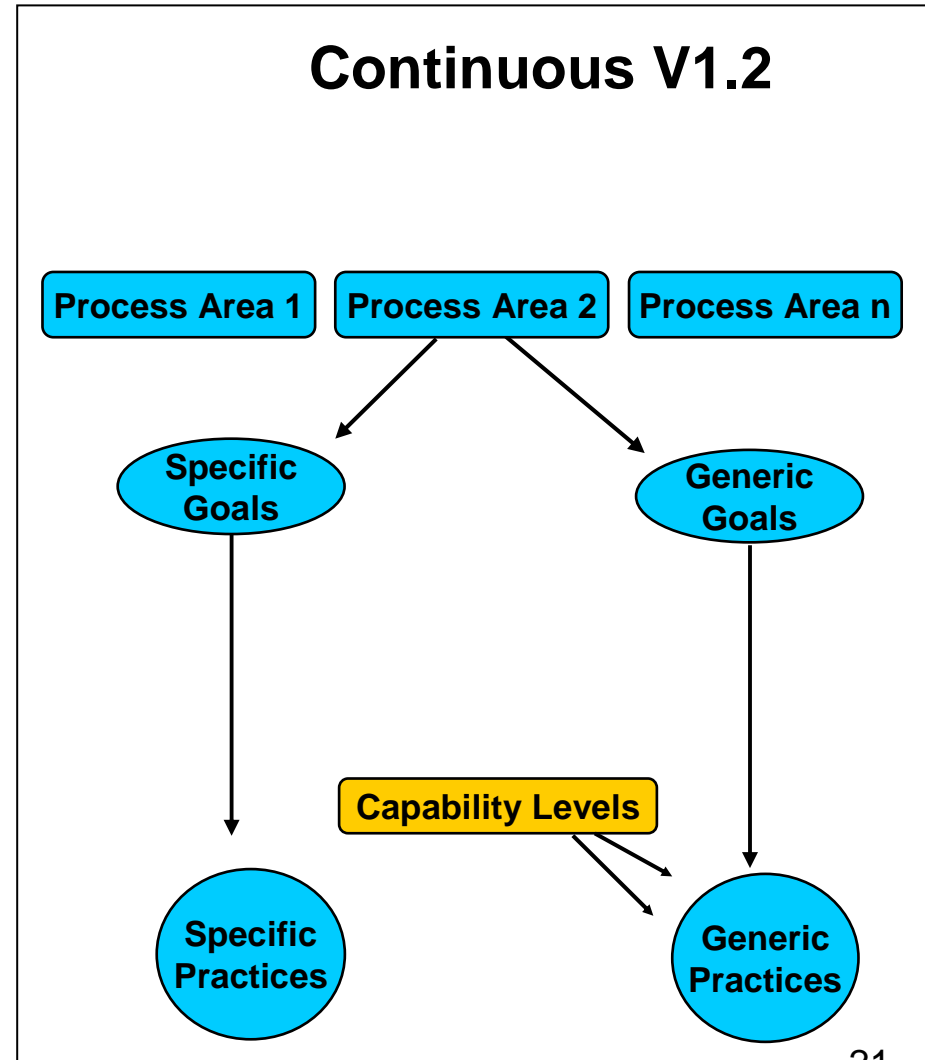
CMMI®

Capability Maturity Model Integrated for
Development, V1.2, SEI

CMMI-DEV Model Structure



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Mike Phillips, SEI -2006

CMMI-DEV Process Areas

	Process Areas
Process Management	Organizational Process Focus Organizational Process Definition (+ IPPD Elements) Organizational Training Organizational Process Performance Organizational Innovation and Deployment
Project Management	Project Planning Project Monitoring and Control Supplier Agreement Management Integrated Project Management (+ IPPD Elements) Risk Management Quantitative Project Management
Engineering	Requirements Management Requirements Development Technical Solution Product Integration Verification Validation
Support	Process and Product Quality Assurance Configuration Management Measurement and Analysis Decision Analysis and Resolution Causal Analysis and Resolution

CMMI-DEV Product Suite

- Provides a set of best practices structured around the concept of a capability maturity model for organizations which produce products
- Set of appraisal methods
- Training courses.
- Provide a framework for organizations striving to improve their product development capabilities.
- Applicable to the development of products which contain one or more of the following elements – hardware, software, firmware and people.

CMMI-DEV

- *Process areas (or PAs)*
 - The primary structural element of a CMMI model
 - Composed of best practices which, when implemented result in satisfaction of associated goals for that process area.
 - Structure is common and includes required, expected and informative components
- *Capability Levels*
 - Each of the six capability levels represents a plateau of capability associated with a particular process area
- *Maturity Levels*
 - Each of the five maturity levels represents a plateau of organizational capability for developing products
- *Institutionalization*
 - Ingrained way of doing business that an organization follows routinely as part of its corporate culture
 - **The process is ingrained in the way the work is performed and there is commitment and consistency to performing the process.**
 - Generic Practices (GP) describe activities that address these aspects of institutionalization.
 - Progression of process institutionalization

CMMI-DEV Appraisal

- Examination of product development processes
- By a trained team of engineering professionals
- Using CMMI-DEV process reference model
- Reviews and/or collects objective evidence
- Determines of extent of practice implementation
- For identifying process strengths and weaknesses

CMMI Appraisals Published

Software Engineering Institute | Carnegie Mellon

Published Appraisal Results

Click the column header to sort by Organization, Organizational Unit, Team Leader, Sponsor, End Date, or Maturity Level.
Click the Maturity Level or Appraisal Year to filter the list.

Filter
Maturity Level: All MLs ML 2 ML 3 ML 4 ML 5 not given
Appraisal Year: All Years 2003 2004 2005 2006 2007

Organization - Organizational Unit	Team Leader - Sponsor	Appraisal End Date	Maturity Level - Representation
WIPRO Corporation - Wipro Infotech: Business Solutions Division	SanthanakrishnanSrinivasan - Rajat Mathur	Aug 14, 2003	ML: 5 - Staged
Wipro Technologies - Wipro Technologies Limited, SJPR Road, Bangalore	KrishnamurthyKothandaraman - Sambuddha Deb	Dec 22, 2006	ML: 5 - Staged
WISCO Engineering Technology Group Auto Co. Ltd. - WISCO Engineering & Technology Group Automation Company, Ltd.	RalphBowden - Bo Huang	May 30, 2006	ML: 3 - Staged
WISCOM SYSTEM CO.,LTD. - Wiscom System CO.,LTD.	WanJuyong - Chao Guo	Dec 15, 2006	ML: 3 - Staged
Wistron Information Technology and Services (Beijing), Inc. - Wuhan Software Development Center	EmanuelBaker - Yu Yang	Jan 28, 2005	ML: 3 - Staged
Wolters Kluwer - Corporate Legal Services - CT Corporation & CCH CORSEARCH	MichaelD'Ambrosa - Chris Jutkiewicz	Sep 30, 2005	ML: 2 - Staged
Wolters Kluwer - Corporate Legal Services - UCC Direct Services	MichaelD'Ambrosa - Chris Jutkiewicz	Nov 14, 2006	ML: 2 - Staged
Woori Finance Information System (WFIS) - Woori Finance Information System (WFIS)	SoowanLee - Jong Shik Kim	Nov 24, 2006	ML: 3 - Staged
World Information Technology -	SeshadriVenkatesan -	May 08, 2007	ML: 2 -

SEI Appraisal Program <http://sas.sei.cmu.edu/pars/pars.aspx>

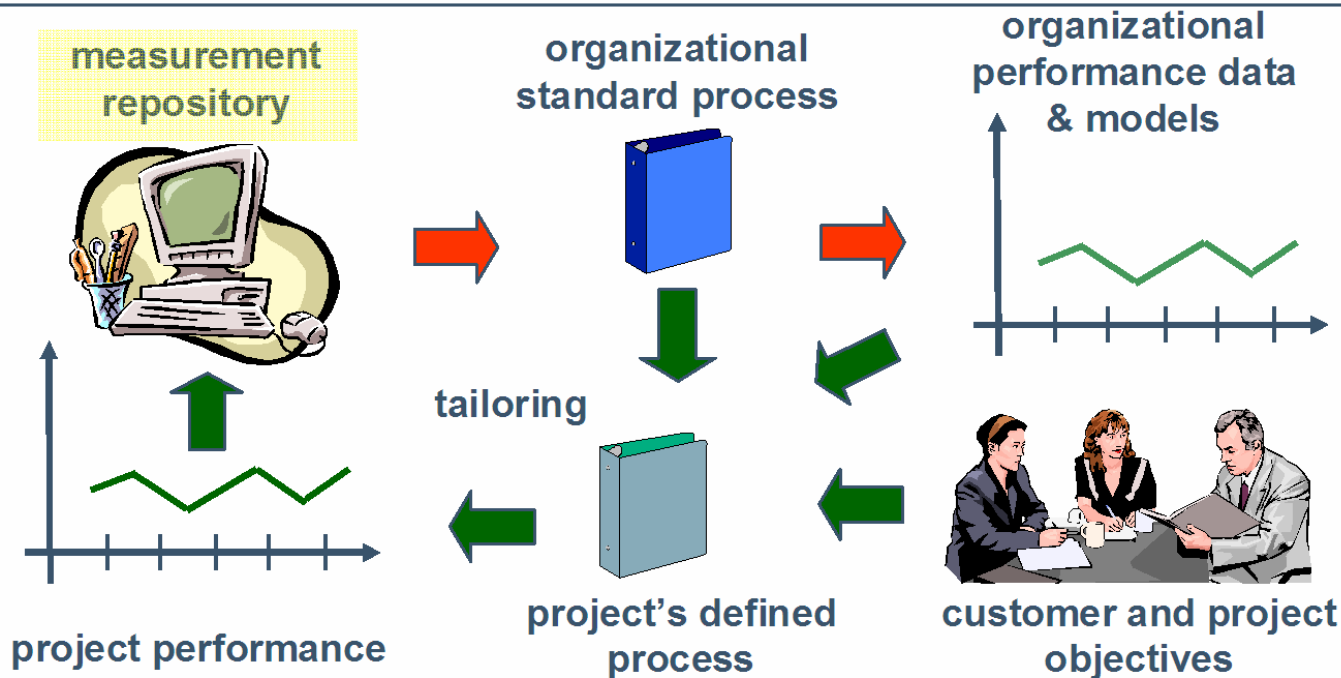
CMMI to TL 9000

- A CMMI Maturity Level 3 Apprised software organization will meet ISO 9001 / TL 9000 requirements with gaps in the following areas:
 - Post deployment support
 - Customer satisfaction surveys
 - Quality partnering
- TL 9000 hardware (H) adders are not addressed in CMMI

Isn't CMMI Level 3 good enough?

Organizational Process Performance

- Establishes a quantitative understanding of the performance of the organization's set of standard processes



Quantitative Project Management

- Quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives.

Measurements

Bottom Line

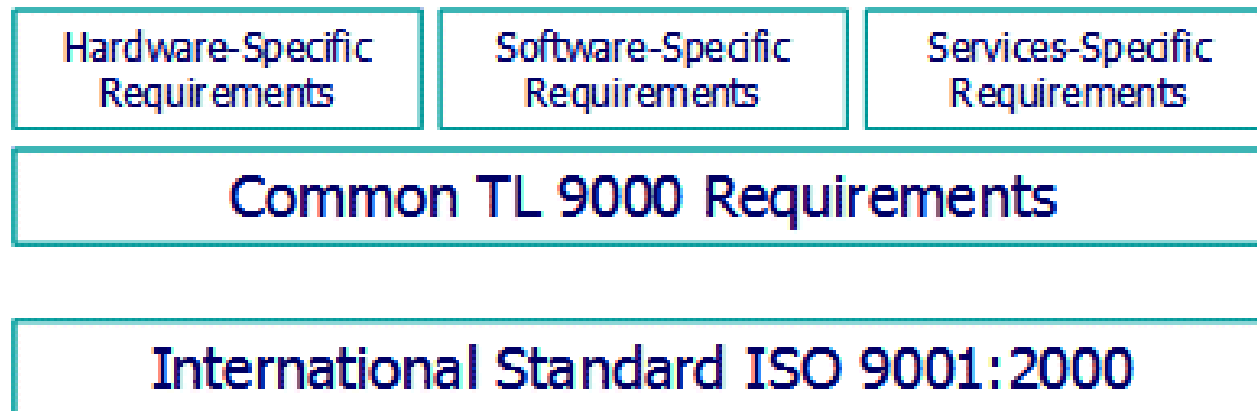
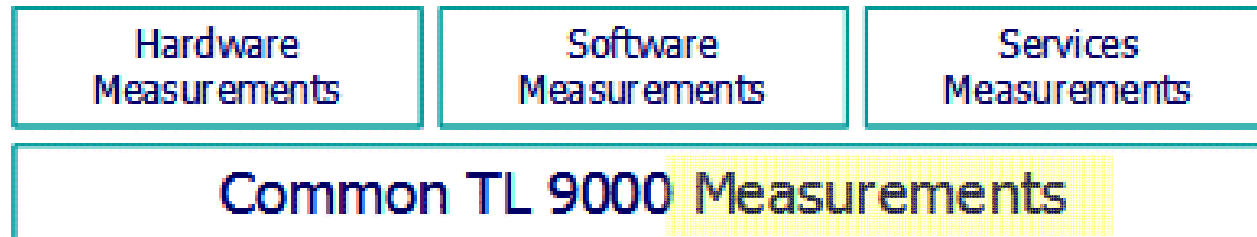
- Process improvement for its own sake will soon die,
- Process improvement should be done to help the business

***“In God we trust,
All others bring data.”***

W. Edwards Deming



TL 9000 Model



Process Measurements

TL 9000 Requirements Release 4.0

- **8.2.3 Monitoring and measurement of processes**

- The organization shall apply suitable methods for monitoring and, where applicable, measurement of the quality management system processes.
- These methods shall demonstrate the ability of the processes to achieve planned results.
- When planned results are not achieved, correction and corrective action shall be taken, as appropriate, to ensure conformity of the product.

- **8.2.3.C.1 Process measurement**

- Expanded: to include appropriate design process measurements and require performance targets or control limits for key process measurements.

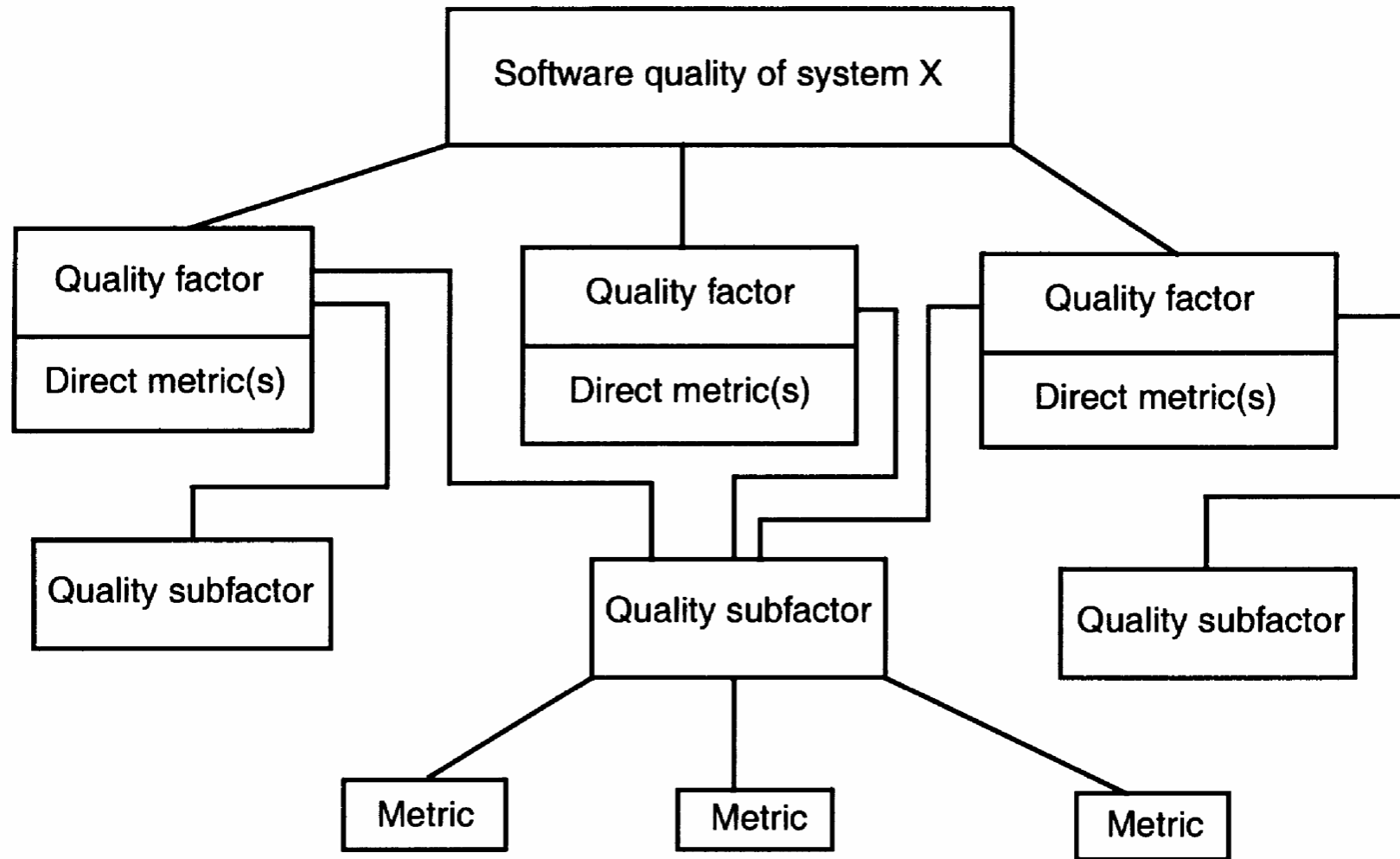
- **7.2.3.HS.2 Design and Development Process Quality Measurements Data Reporting**

- New: Provide design and development process measurements when requested by the customer

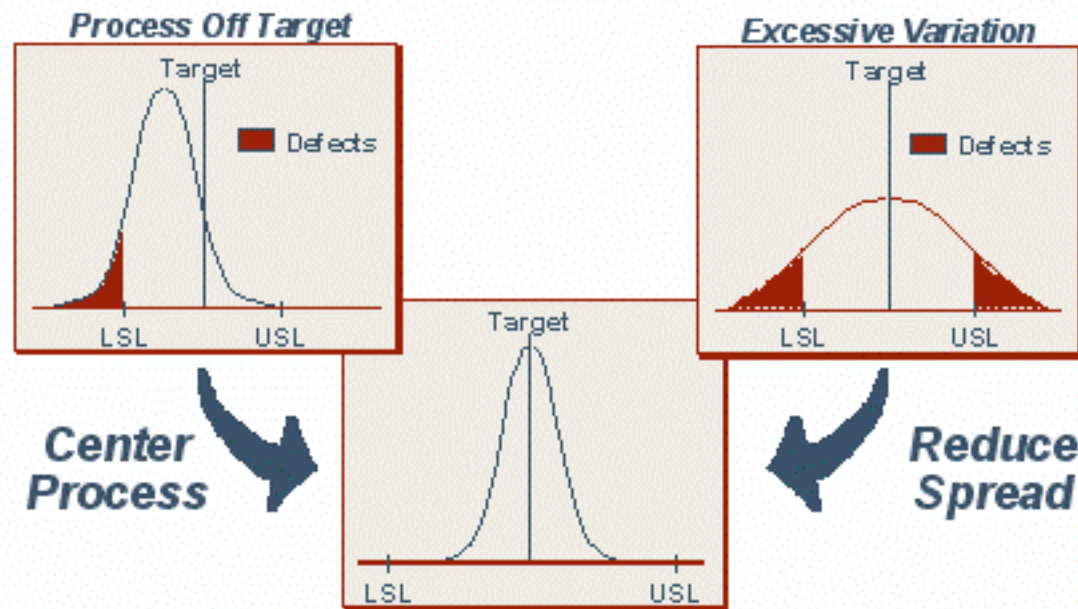
- **7.3.1.HS.2 Design and Development Process Quality Measurement Planning and Implementation**

- New: Planning during the design and development phase to select and report appropriate design and development process quality measures

Software quality metrics framework, IEEE 1061



Statistical Thinking



Software Engineering Institute

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Lean

Lean Principles

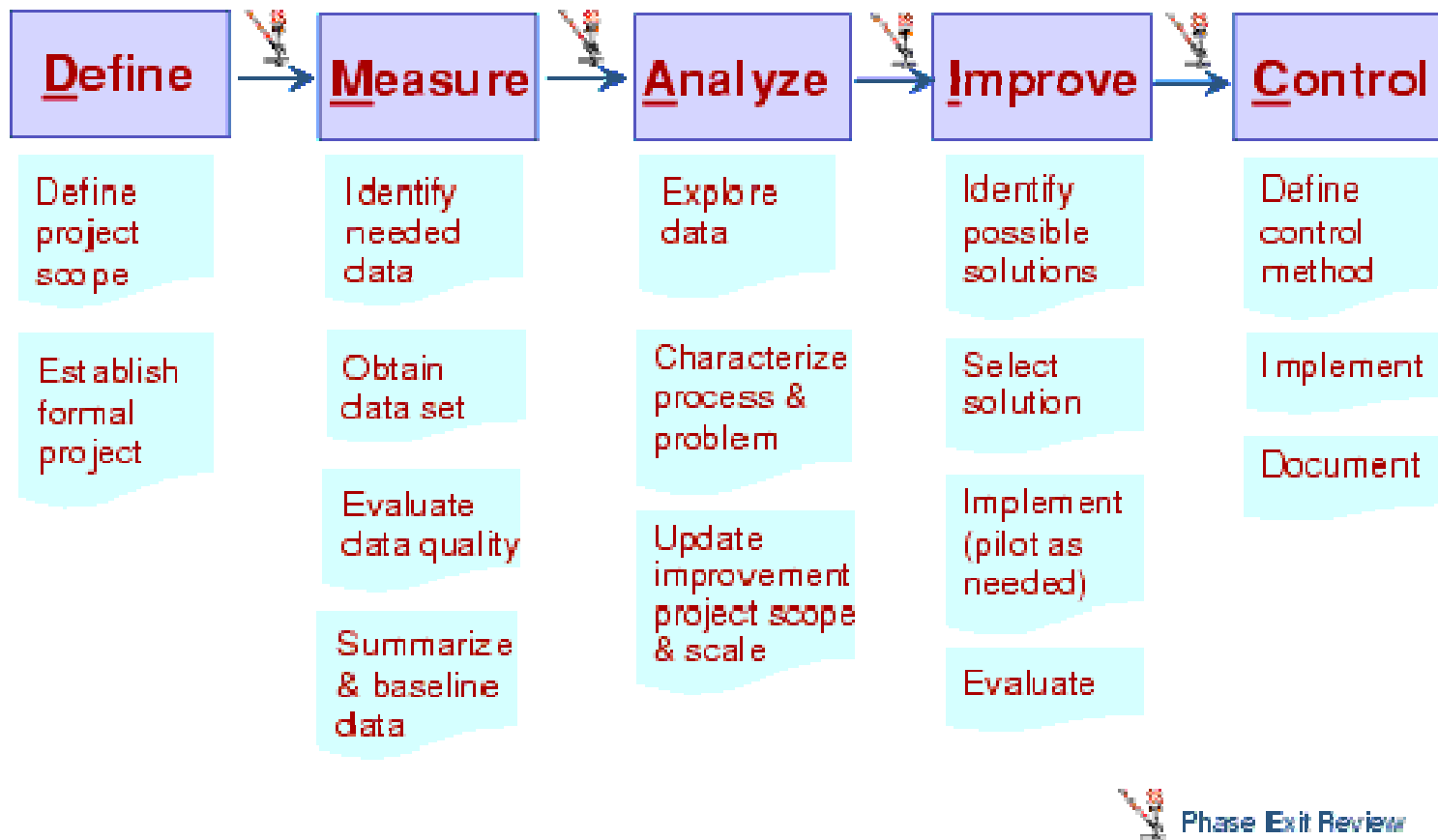
- Lean Manufacturing Processes
 - Helps eliminate production waste, introduce value-added measurements, and push for continuous improvements
- Continuous pursuit of improving the processes
- Philosophy of eliminating all non-value adding activities & reducing waste within the organization
 - Uncover and reduce waste.
 - Engineering defects
 - Wasted time and effort
 - A new way of thinking
 - Whole systems approach
- Lean concept of value flow, or the uninterrupted value flow at the pull of the customer
- Closely associated with "Kaizen", which means "Continuous Improvement"
- Lean implementation **precedes** Six Sigma

Six Sigma

Six Sigma

- **A measurement standard in product variation**
 - A statistical concept measures a process in terms of defects
- **DMAIC method**
 - Define, Measure, Analyze, Improve, and Control
- **Continuous improvement methodology**
 - To improve business processes and products
 - Forces organizations to define their vision of quality in numerical terms.
 - Offers phases, tools, and techniques that help an organization improve their processes
 - Uses data and statistical analysis tools to identify, track and reduce problem areas and defects in products and services
 - Defects are isolated and eliminated and thereby lower the overall costs of rework during production and post production maintenance

DMAIC Roadmap



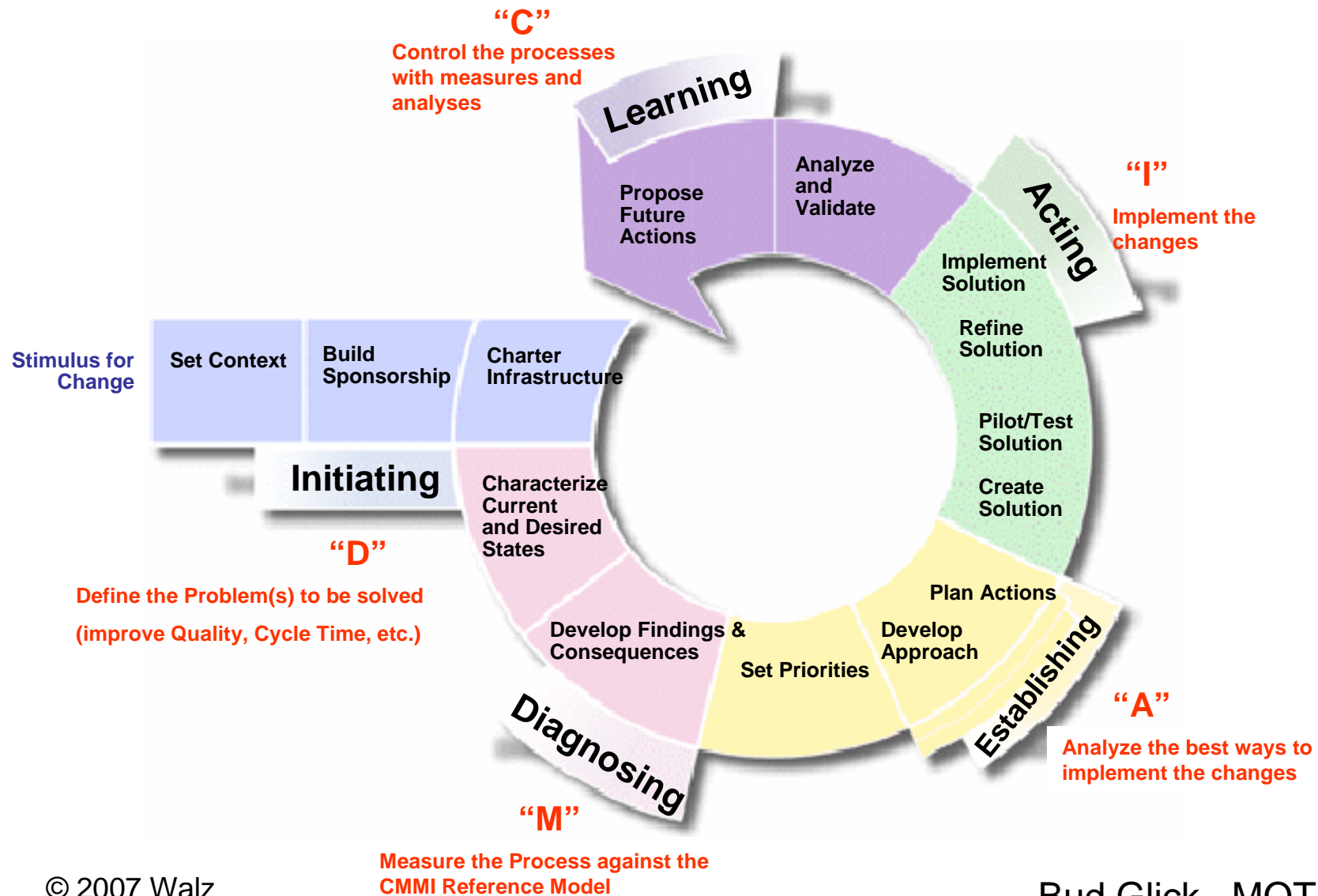
Focus on tools?

- Its not about CMMI or Lean or Six Sigma, its all about Business Improvement. CMMI and Six Sigma are not ends in themselves but are simply important techniques for leveraging more effective Business Performance.
- The successful use of CMMI, Lean, Six Sigma by various industries is challenging the traditional mantra of being able to use one method only
- Lean and Six Sigma, with CMMI can be used as complimentary set of improvement methods to provide a lower risk and faster approach, Otherwise:
 - CMMI can yield behavior changes without benefit
 - Six Sigma improvements based solely on data, may miss innovative improvements (assumes a local optimum)

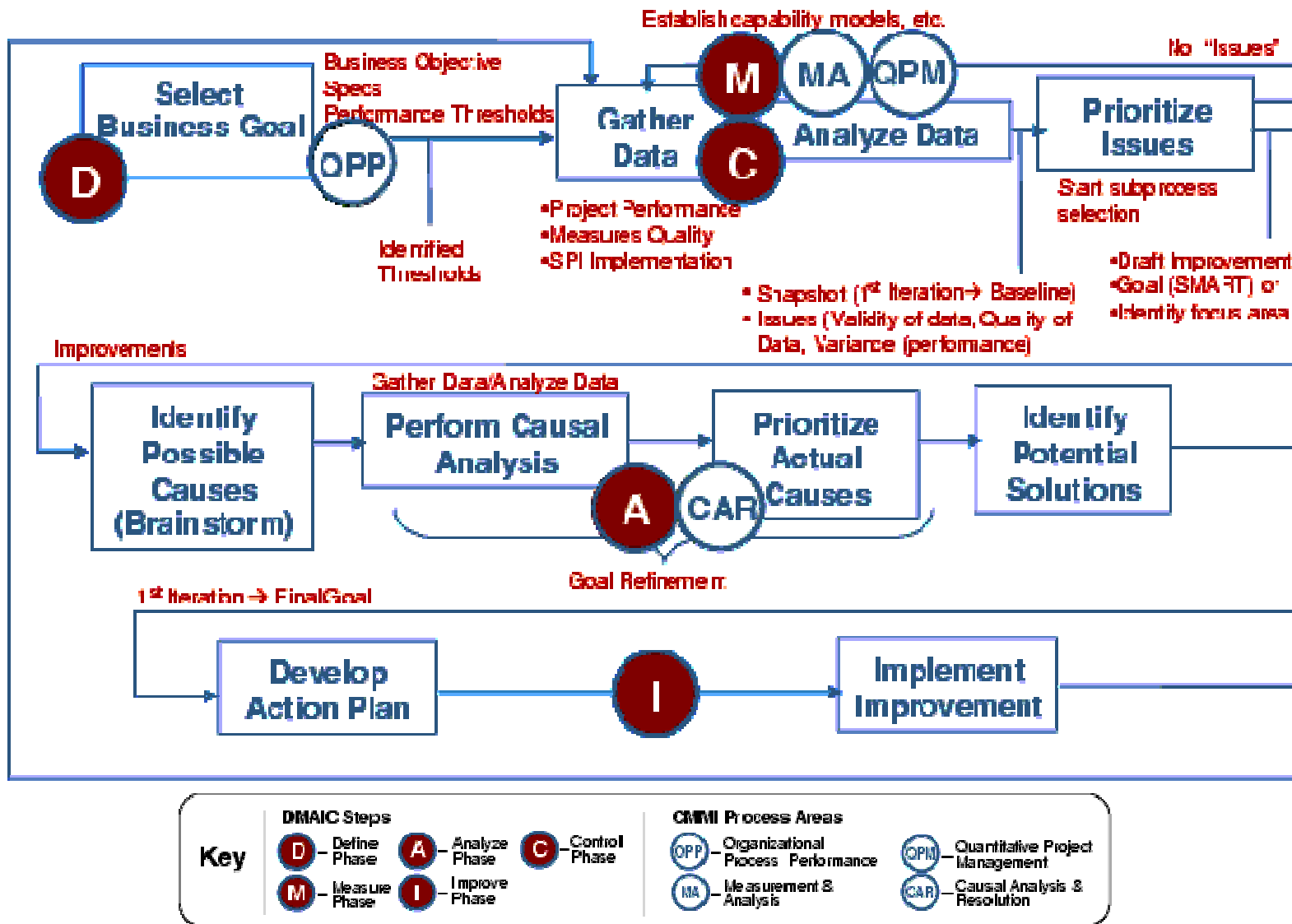
Grant Holdom, 2006 40

Hefner-Northrop Grumman-2005

SEI's IDEALSM Approach (and Six Sigma *DMAIC*)



CMMI Process Areas & DMAIC Steps



Lean Six Sigma

Lean Six Sigma (LSS)

- Lean Six Sigma is the combination of two techniques, Lean and Six Sigma; as they are complementary
 - Lean focuses on increasing the speed of a process, or in the elimination of any non-value added steps or activities within a process
 - Six Sigma focuses more on quality than speed.
 - Lean defines and refines the customer value flow and
 - Six Sigma helps ensure that the value continues to flow smoothly and to improve.
- Fundamentals
 - Delight your Customers
 - Base Decisions on Data & Facts
 - Work Together for Maximum Gain
 - Improve Your Processes

Lean Six Sigma

- Does not provide processes or process descriptions
- Emphasizes that speed is directly related to process excellence
- Combines general quality guidance with a process-based management approach, describing the criteria that the processes should support.
- Uses data to identify and eliminate process problems

LSS Implementation

- The implementation of both Six Sigma and Lean techniques will address and change similar management and technical staff behaviors. The organizational change management approach with both techniques will be quicker and less costly than a sequential approach and provides more benefits than an “Either / Or” approach.

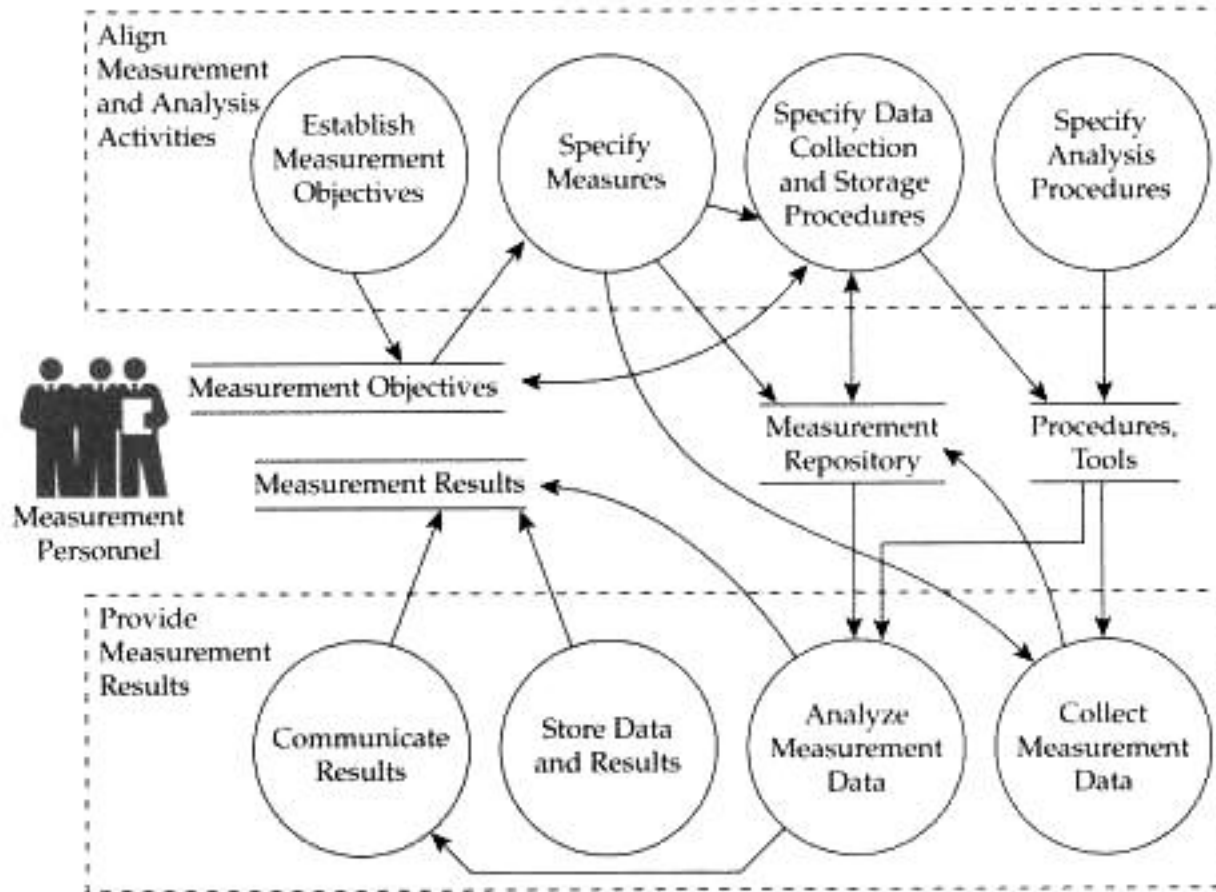
Organizational change management

- Top management has the responsibility of providing overall direction, resources, and the control framework for managing the change process.
- The organizational changes result in changes to participant's skills, their tools, and their work processes and artifacts.

Robust Management System Foundation

- LSS requires a robust management, sound engineering practices, and process measurement system foundation **prior** to the application of its improvement methodologies, like Lean, Six Sigma, or combined Lean Six Sigma
- Organizations, with a robust management system foundation, such as ISO 9001, TL 9000, or CMMI-DEV, are pursuing process improvement by establishing a set of organizationally adopted processes to be applied by all of their projects, and then improving them on the basis of their experience.
- This “experience” is factored by both the Lean principles and the Six Sigma principles; resulting in the use of specific Lean Six Sigma improvement techniques that validate specific process changes to be deployed across the organization.

Measures and Analysis: What & How



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CMMI: **what** should be done, not **how** to do it.

Lean Six Sigma: **how** to do it – a *performance-based* methodology for applying measurement and analysis to problem solving and project management

Resources for Improvements

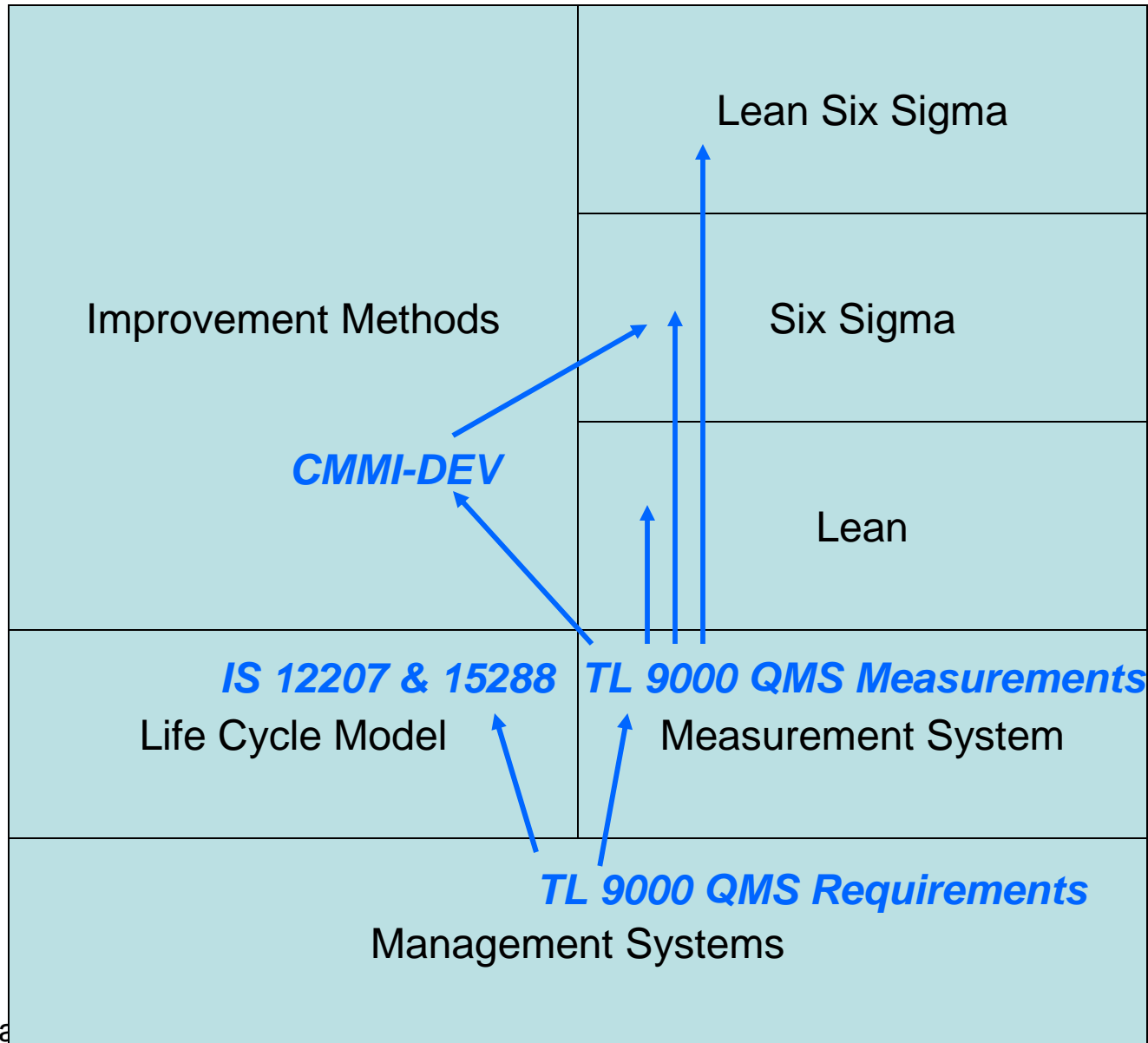
- Whenever objective experiences demonstrate the need for changes to processes and artifacts,
- Then the appropriate IEEE software & system engineering standards can be selected and analyzed for their best practices to be incorporated into
 - processes,
 - internal plans,
 - procedures, and
 - other artifacts,
- to support of Lean Six Sigma implementation.

Conclusions

1st Foundation, 2nd Improvement

- **Foundation**
 - Management System
 - Life cycle models, Software & system engineering, Service, etc.
 - Measurement System
- **Improvement**
 - Only then can organizations move forward to trim the waste and increase their overall production value and product quality.
 - Lean
 - Six Sigma
 - Lean Six Sigma
 - The alternate is improving an undocumented 'fuzzy' process, which means making assumptions about what the process is; Hoping the participants of the next iteration understand and continue the changes.

Building for Business Success



Backup

Development Life Cycle Model steps, IEEE 1074

- Selection of Development Life Cycle Model
- Tailoring of existing software & system engineering processes to create Project Development Life Cycle
- Development of project schedules of major artifacts and project roles
- Project members assigned to roles
- Project members create, review, revise, and transmit project artifacts to other project members or stakeholders. The work products or artifacts can be:
 - Process & product records, as simple as process start and end dates
 - Documents to share or review with team members or the customer
 - Final artifacts are customer deliverables, installations, and / or training
- Project artifacts are stored and managed as part of the project configuration management system
- Engineering processes & associated artifacts can be assessed

IEEE 1220 Systems engineering process

