

The SEI: A Focus on Process

TSP Symposium
Software Engineering Institute
Carnegie Mellon University

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Paul Nielsen



Software Engineering Institute

Carnegie Mellon

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Outline

- Introduction to the Software Engineering Institute (SEI)
- Is Process Improvement Still Needed?
- SEI Process Focus
- TSP Highlights
- TSP User Feedback



Introduction to the Software Engineering Institute (SEI)



SEI Background

Funded by the U.S. government as a research & development lab; (FFRDC)

Created in 1984 and administered by Carnegie Mellon University

Headquartered in Pittsburgh, Pennsylvania; offices and support worldwide

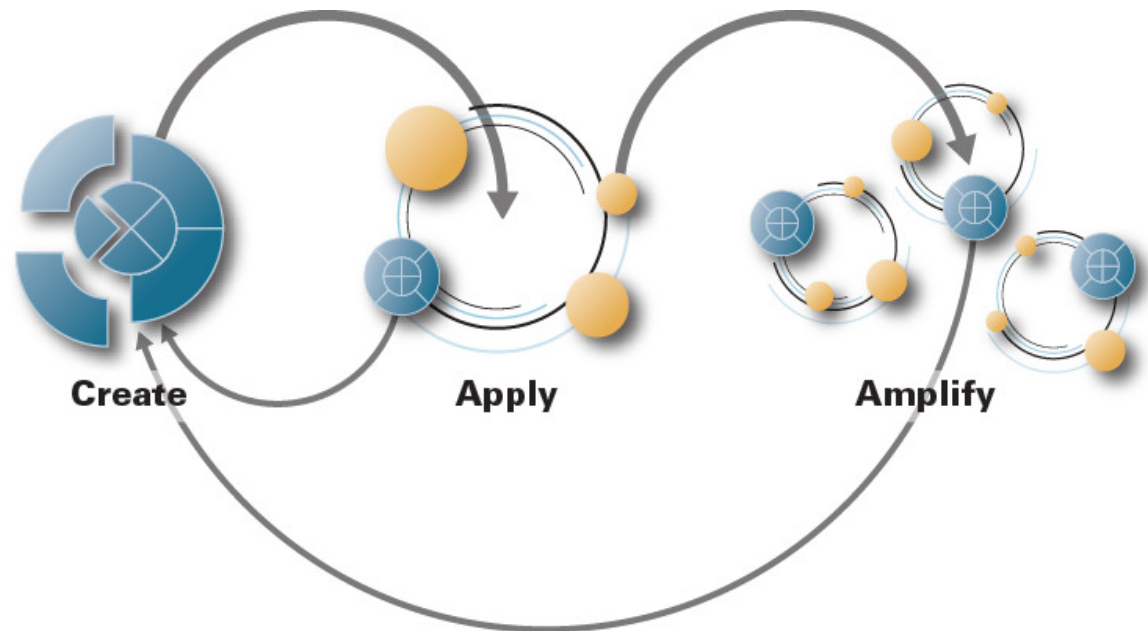


SEI Mission and Strategy

Mission

The SEI advances software engineering and related disciplines to ensure systems with predictable and improved quality, cost, and schedule.

Strategy



Organizations Must Understand Architecture, Process, Security, Risk, and Teamwork

Software Architecture

Gives an abstract view of a software system different from the details of implementation, algorithms, and data representation

Process Improvement

Guides the management and development of software and systems through quantitatively managed processes that are repeatable, predictable, and continuously improving

Cyber Security

Helps organizations protect against, detect, and respond to attacks on networked systems

Operational Risk

Allows an understanding of current conditions that may lead to a loss and negatively affect mission outcome

Team Performance

Guides organizations in building high-performance teams that plan, manage, and achieve goals



SEI Research – Important Areas

Architecture

Cyber Security

Integration & Interoperability

Predictable Assembly

Process Improvement

Risk Management & Cost
Estimating

Software Assurance

Ultra-Large-Scale Systems



SEI publications



SEI Work in Cyber Security

Vision: a securely connected world

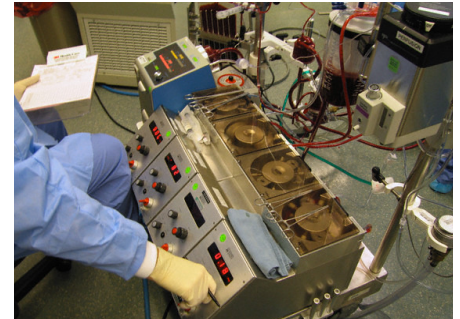
- Cyber forensics
- Secure coding
- Incident response teams
- Safe networking
- Workforce training



SEI Work in Architecture-Centric Engineering

Architecture-Centric Engineering (ACE) is the discipline of using architecture as the focal point for performing ongoing analyses to gain increasing levels of confidence that systems will support their missions.

- The **ACE Initiative** develops principles, methods, foundations, techniques, tools, and materials in support of creating, fostering, and stimulating widespread transition of the ACE discipline.



SEI – New Books

CMMI for Services: Guidelines for Superior Service

CMMI-ACQ: Guidelines for Improving the Acquisition of Products and Services

Secure Coding in C and C++

People CMM: A Framework for Human Capital Management (Second Edition)

The Method Framework for Engineering System Architectures

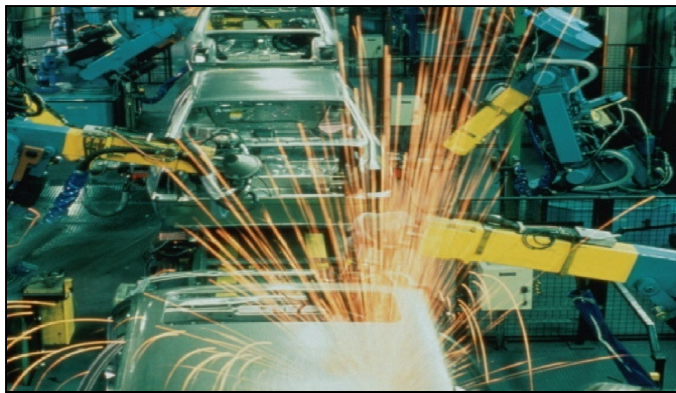




Is Process Improvement Still Needed?



Software is Essential to Organizations



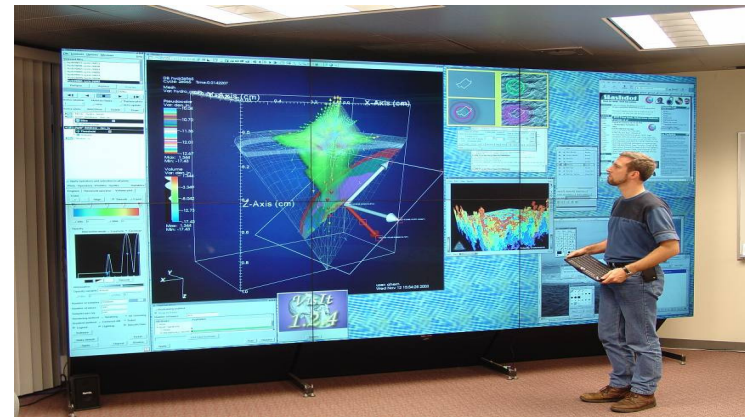
Manufacturing



Finance



Space

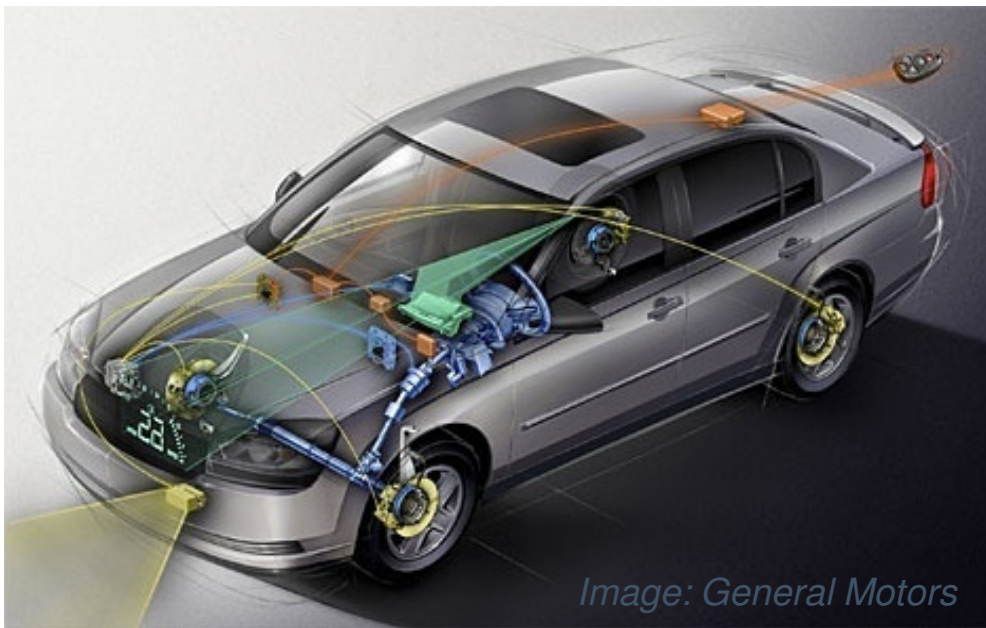


Engineering



Software Complexity is Growing

- Boeing Dreamliner 2010: 6.5 million lines of code for avionics & onboard support
- Premium automobile 2009: approximately *100 million* lines of code
- Software is used in 70 to 100 microprocessor-based electronic control units (ECUs) networked throughout the body of a current, high-end car



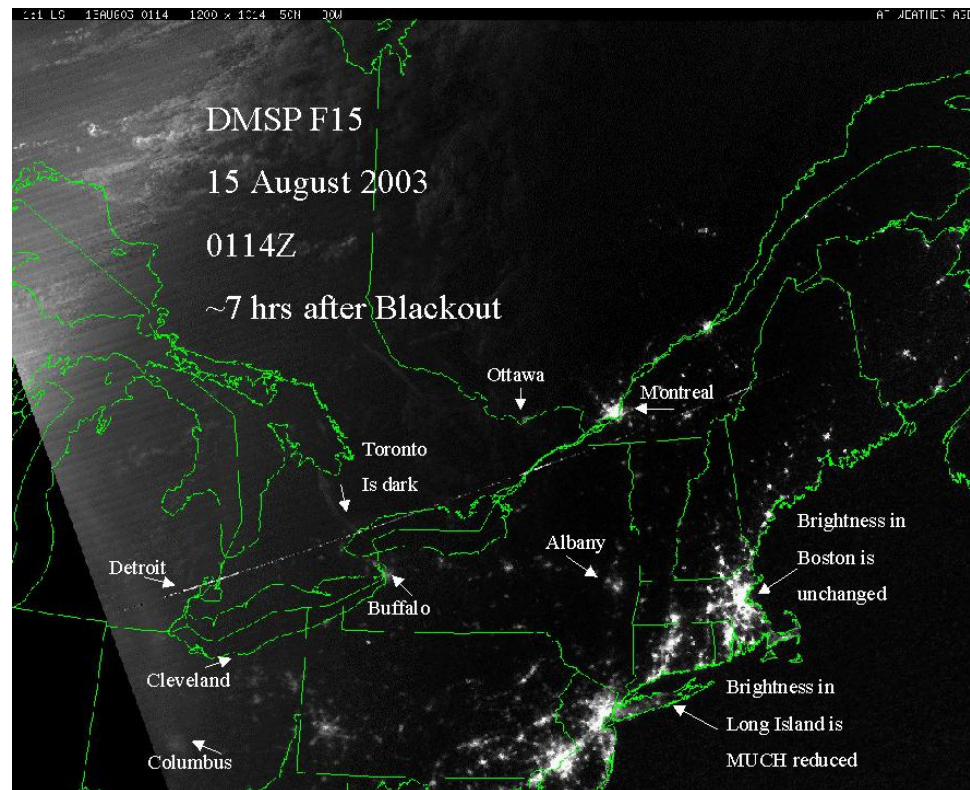
Air-bag system	Antilock brakes	Automatic transmission
Alarm system	Climate control	Collision-avoidance system
Cruise control	Communication system	Dashboard instrumentation
Electronic stability control	Engine ignition	Engine control
Electronic-seat control	Entertainment system	Navigation system
Power steering	Tire-pressure monitoring	Windshield-wiper control



Software is Critical to our Survival!

2003 North America blackout

- Affected 40 million people in eight U.S. states
- One-third of the population of Canada lost power
- Largest blackout in North American history
- Outage-related financial costs estimated at US\$6 billion

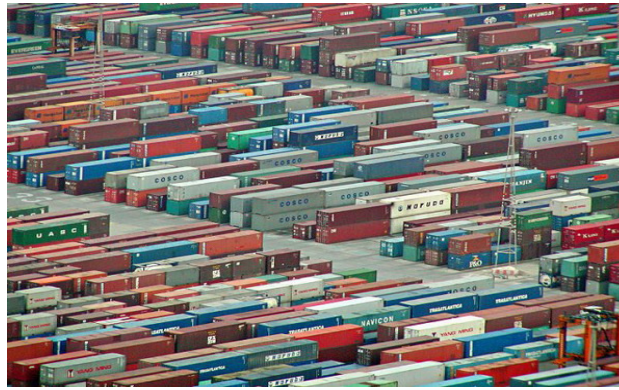


*Satellite image of August 2003 power outage
(Image: NOAA)*



Software Links Global Business

- Business today is multi-layered, interconnected, and global
- To remain competitive, all organizations need excellent business and software processes, from market research and product design to delivery and customer service (example: shipping)



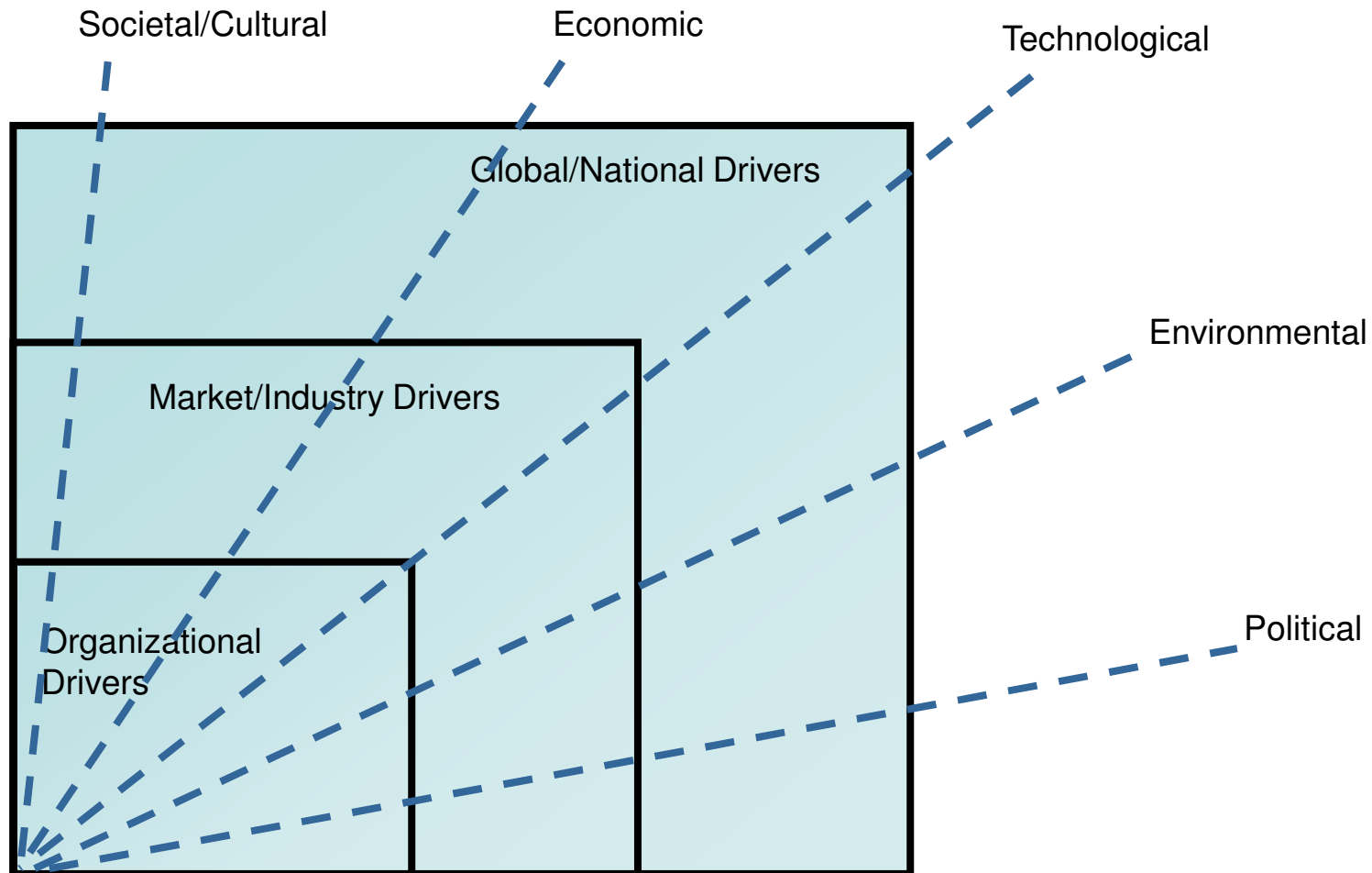
Organizations Developing Software Need Models, Maps, & Metrics

For any software-intensive operation, progress on the path to improvement and organizational resilience requires

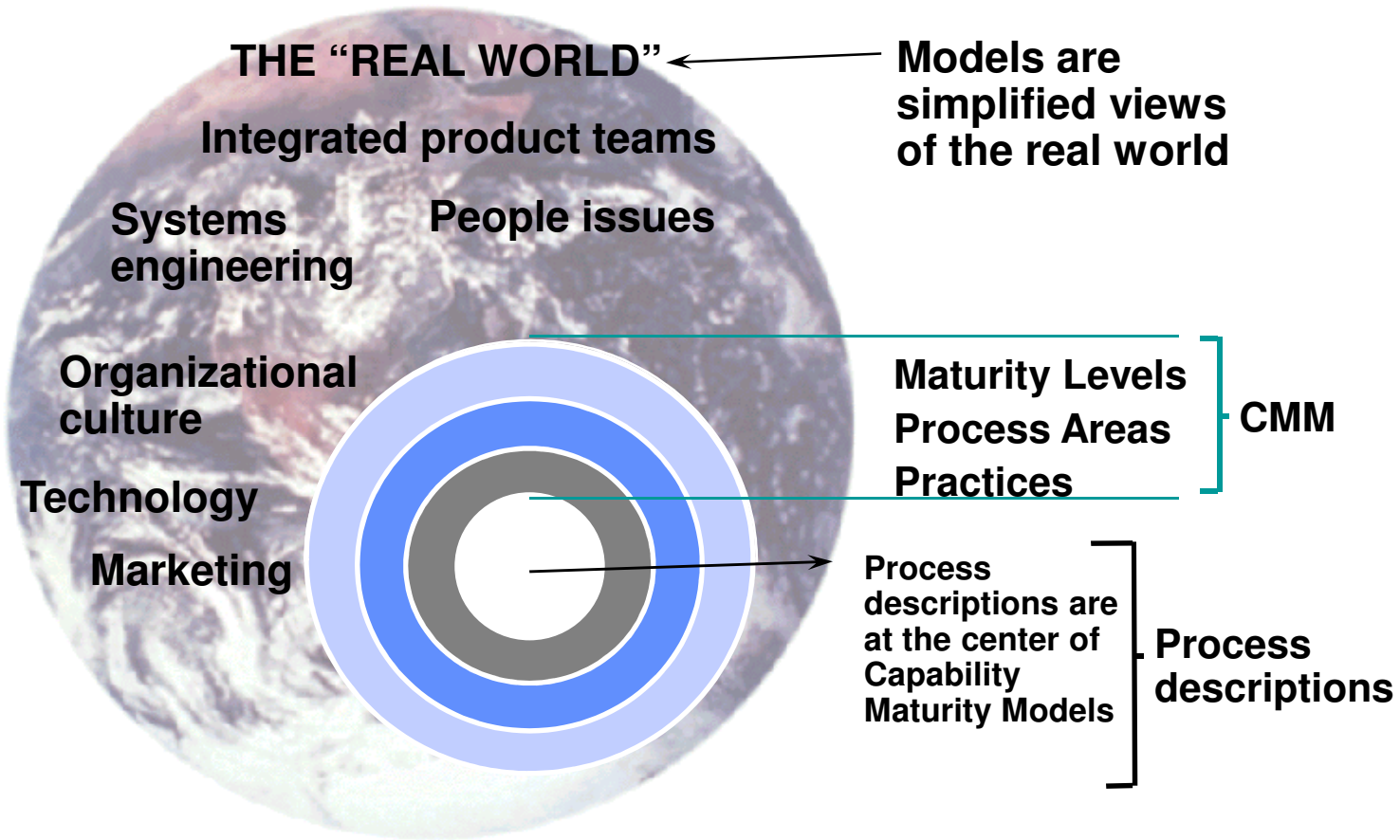
- a detailed model
- an accurate map
- careful metrics



Process Helps us Manage Complexity Across Business Cycles



“M” is for Model



“All models are wrong; some models are useful.” - George Box



When are Better Processes Needed?

Commitments consistently missed

- Late delivery
- Last minute crunches
- Spiraling costs

Little/no management visibility

- You're always being surprised

Quality problems

- Too much rework
- Functions do not work correctly
- Customer dissatisfaction post-delivery; continuing high costs

Poor morale

- Frustration
- Is anyone in charge?



Petrobras oil platform (March 2001)

- Significant construction cost savings from bypassing rigid engineering processes
- Sank before commissioning



How Can Process Improvement Help?

Process improvement supports multiple organizational goals and it enables

- Repeatability
- Insight and oversight
- Control and tracking
- Measurement
- Improvement
- Training
- Transformation (via consistency, integration, coordination)



Critical Success Factors for Process Improvement

Commitment to improve must start at the top

Understand the current process

Structured change must become a way of life

Improvement requires investment

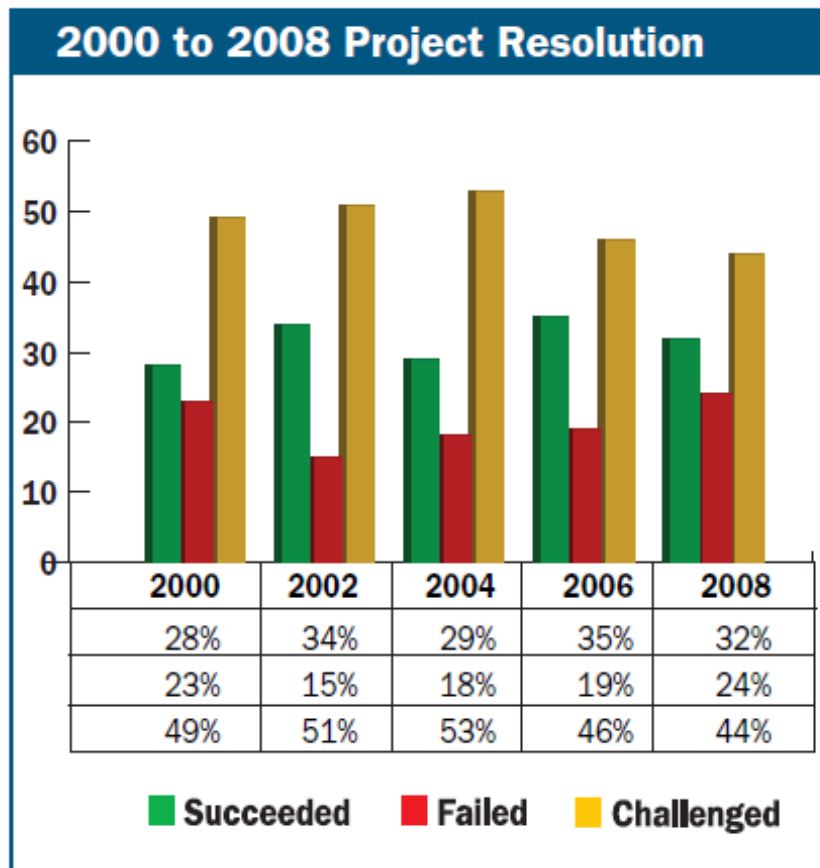
If failure occurs, focus on the process, not the people

Institutionalizing improvements requires vigilance and periodic reinforcement

Ongoing individual and team performance improvement is key



Dismal Software Industry Project Performance



Successful projects delivered on time, on budget, with required features and functions

Challenged projects were late, over budget, and/or failed to deliver all of the required features and functions

Failed projects were cancelled prior to completion or delivered and never used

Source: Standish group 2009 Chaos report



Software Industry Lags in Quality Performance

The software industry is the only modern high-tech industry that relies on testing to remove defects

Many important software products have 1 to 2 defects per thousand lines of code, or higher

- operating systems
- communications systems
- database systems

Application software is usually worse



Depicted above is a Linux system crash screen on an Airbus Entertainment System



Getting Better Results through Team Performance

Software products are developed, integrated, and tested by a team

Individual and team skill, discipline, and commitment govern the result

Organizational success depends on the performance of these teams

To improve performance, improve the practices of

- individual software developers
- software development teams



SEI Process Focus



SEI Leads the Evolution of Process

- Expanding the Team Software Process
- Initiating CMMI V1.3, which integrates performance improvement, measurement, and analysis
- Refining the Smart Grid Maturity Model
- Launching CMMI for Services
- Introducing the Resiliency Maturity Model



Bill Peterson – Director SEPM
(retired)



Anita Carleton – Acting Director;
Software Engineering Process
Management (SEPM)



Team Software Process (TSP)

TSP was originally designed for software teams; now being expanded to other types of teams

It's purpose is to build high-performance teams that

- plan, manage, and own their commitments
- produce quality products at lower cost
- achieve their best performance



TSP improves competitive advantage by improving the performance of project teams and their team members



Continuous Improvement, Integrated across Teams and Organizations

Elements

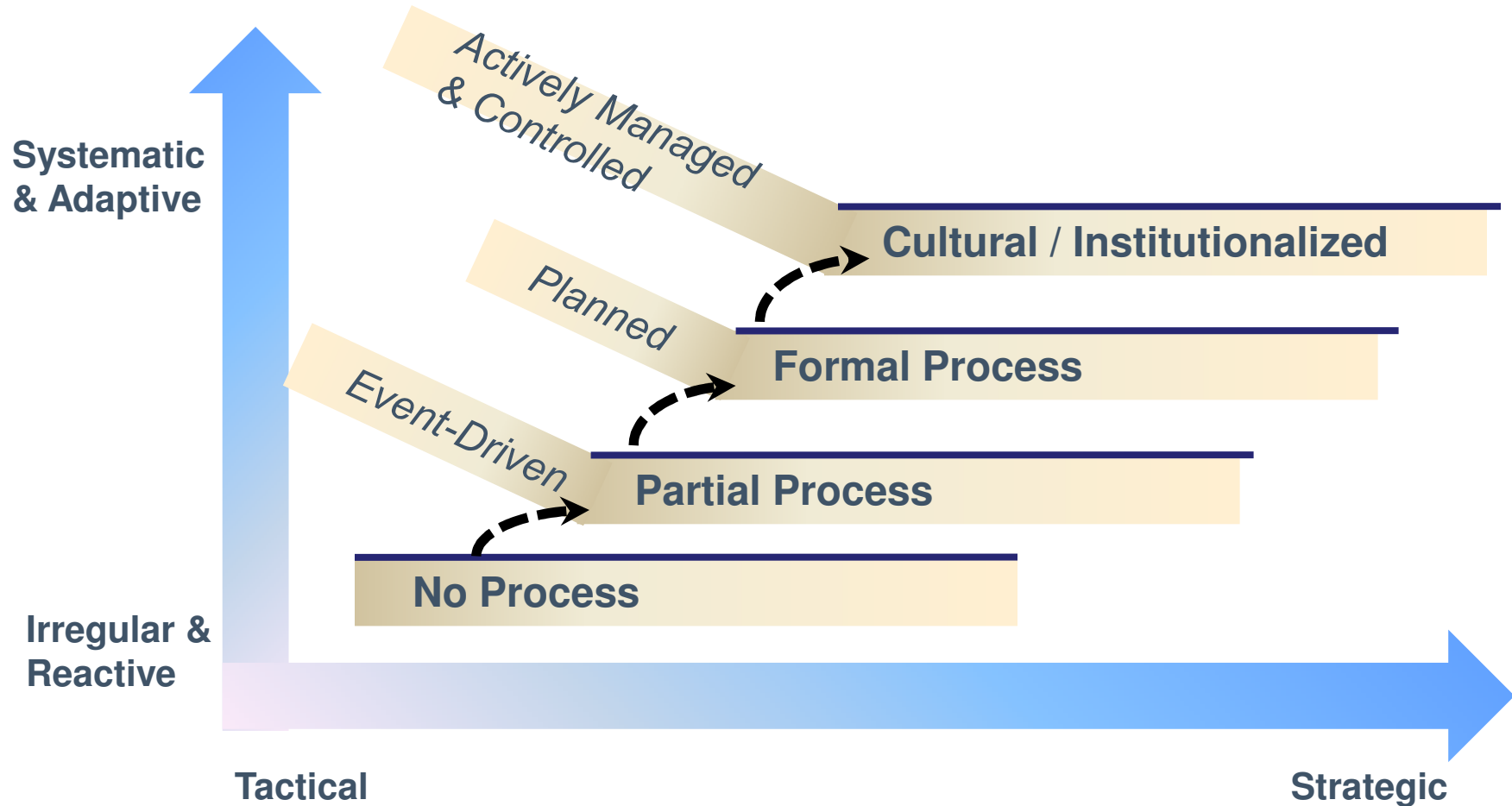
- Understanding tools for improvement
- Nurturing a business culture of teamwork & continuous improvement
- Providing strong leadership
- Linking improvement to business strategy and results
- Focusing on customer needs
- Making quality as important as cost and schedule

Benefits

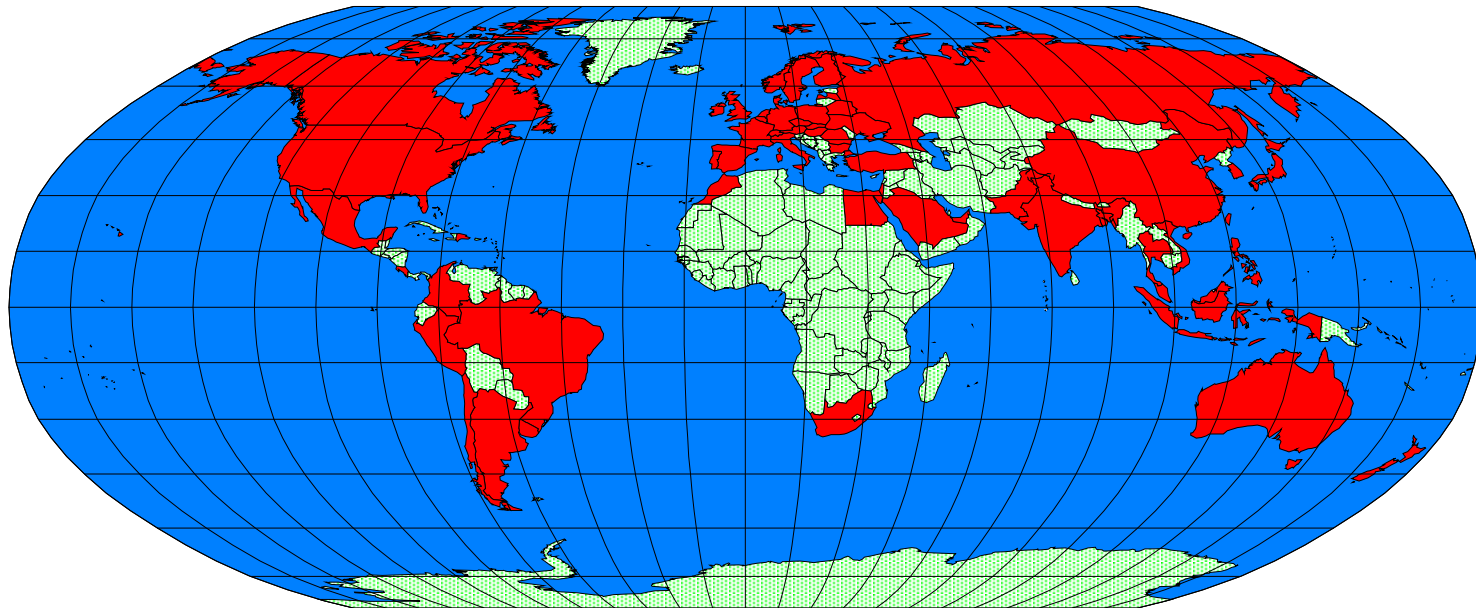
- Cost benefits
- Clarity of focus
- Eliminates process repetition (“Lean”)
- Agility – organization can quickly adapt to change



Process Maturity Accelerates Capability



Countries Reporting CMMI Appraisals



Argentina	Australia	Austria	Bahrain	Bangladesh	Belarus	Belgium	Brazil
Bulgaria	Canada	Chile	China	Colombia	Costa Rica	Czech Republic	Denmark
Dominican Republic	Egypt	Finland	France	Germany	Hong Kong	Hungary	India
Indonesia	Ireland	Israel	Italy	Japan	Korea, Republic Of	Latvia	Malaysia
Mauritius	Mexico	Morocco	Netherlands	New Zealand	Norway	Pakistan	Peru
Philippines	Poland	Portugal	Romania	Russia	Saudi Arabia	Singapore	Slovakia
South Africa	Spain	Sweden	Switzerland	Taiwan	Thailand	Turkey	Ukraine
United Arab Emirates	United Kingdom	United States	Uruguay	Viet Nam			

Red country name: New additions with this reporting



TSP is Also Widely Used...



Advanced Information Services, Inc.
 Centro De Investigacion En Matematicas
 Chinasoft International, Inc.
 COmputing TechnologIeS, Inc.
 Davis Systems
 DEK International GmbH
 Delaware Software, S.A. de C.V.
 Delivery Excellence
 Grupo Empresarial Eisei, S.A. de C.V.
 Herbert Consulting
 Hitachi Software Engineering Co., Ltd.
 Idea Entity Corp.
 InnerWorkings, Inc.
 Instituto Tecnologico y de Estudios Superiores de Monterrey
 It Era S,A, de C,.V.
 Kernel Technologies Group, S.A. de CV

Knowledge Partner QR Pvt. Ltd.
 Kyushu Institute of Technology
 L. G. Electronics
 LogiCare
 Motiva, LLC
 National Aeronautics & Space Administration
 Next Process Institute Ltd.
 Praxis High Integrity Systems
 Process & Project Health Services
 Procesix
 PS&J Consulting - Software Six Sigma
 QuarkSoft
 Sandia National Laboratories
 Science Applications International Corporation (SAIC)
 Siemens AG

SILAC Ingenieria de Software S.A. de C.V.
 SKIZCorp Technology
 Software Engineering Competence Center (SECC)
 Software Park Thailand
 STPP, Inc.
 TOWA INTEGRADADORA S.A. de C.V.
 TRX
 Universidad Autonoma De Zacatecas
 Universidad de Monterrey
 Universidad Regiomotana A.C.
 University of Aizu
 U.S. Air Force (CRSIP/STSC)
 U.S. Census Bureau
 U.S. Navy Air Systems Command (NAVAIR)
 U.S. Naval Oceanographic Office (NAVO)



...And it's Not Just for Software Anymore

Systems engineering—extending application of TSP to support systems engineering teams on AV-8B and E-2C



Nuclear engineering (DOE Naval Reactor Programs)—applying TSP to nuclear/thermal engineering applications



Vicarious Visions—applying TSP to development of gaming systems



NAVOCEANO recently launched an IT Services team that is using TSP



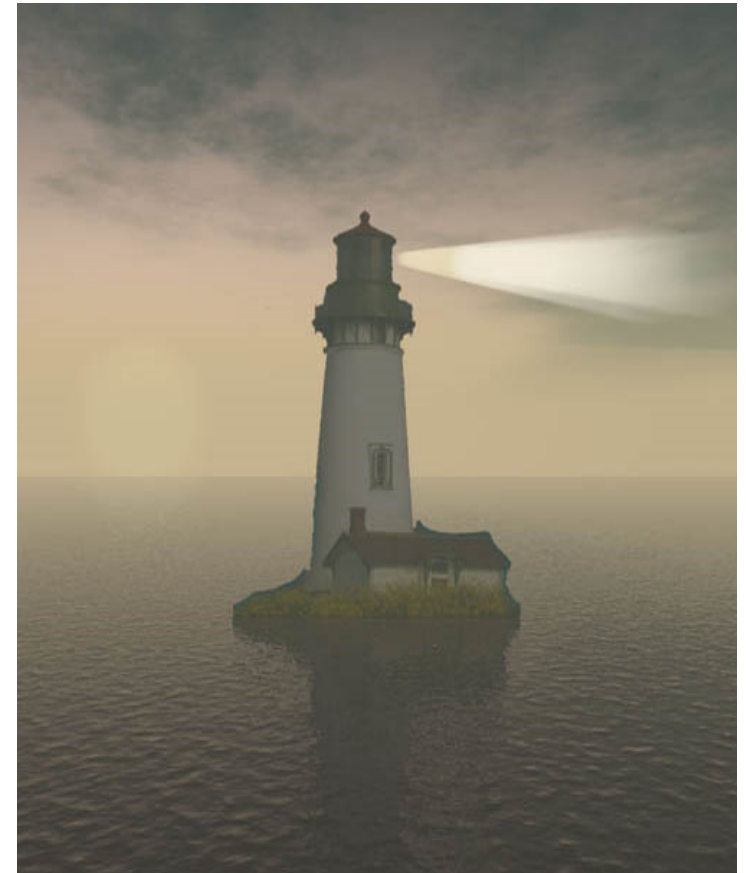
TSP Highlights



TSP: New Directions

TSP is expanding its focus

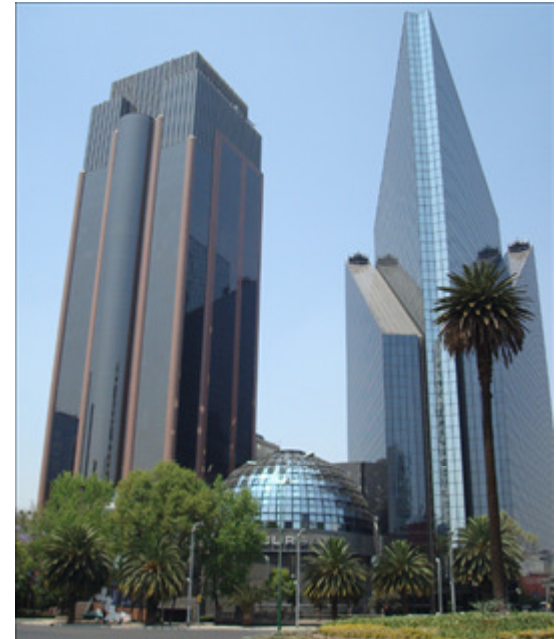
- Introducing TSP coach mentoring program
- Blending architecture-centric engineering with TSP to enhance design process
- Exploring TSP for secure development to reduce software vulnerabilities
- Implementing CMMI-DEV for both high performance and high maturity
 - Integrates TSP, SEMA measurement techniques, and a project-focused improvement strategy



TSP and Architecture-Centric Engineering

The SEI is integrating architecture-centric engineering knowledge about the requirements and design phase with the team building and process discipline strengths of TSP

- A pilot project is now underway with Bursatec to create a new software trading engine for the Mexican stock exchange
- Objective is to build the build the fastest, highest-quality trading engine in the world



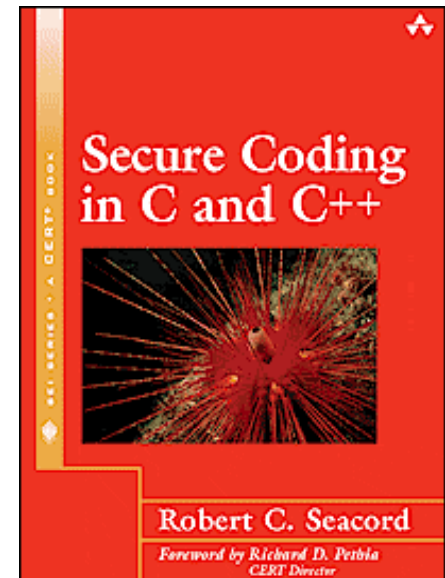
TSP and Cyber Security

Defective Software is NOT Secure

- Current practices produce defective software; typically 1-7 defects per thousand lines of code in delivered software
- Software defects can cause critical vulnerabilities

Software vulnerabilities can be reduced through secure code *with* disciplined team engineering

- SEI's Secure Coding training shows developers how to avoid common causes of vulnerabilities through secure coding practices
- SEI's TSP-Secure development process integrates these practices with its measured, disciplined engineering practices

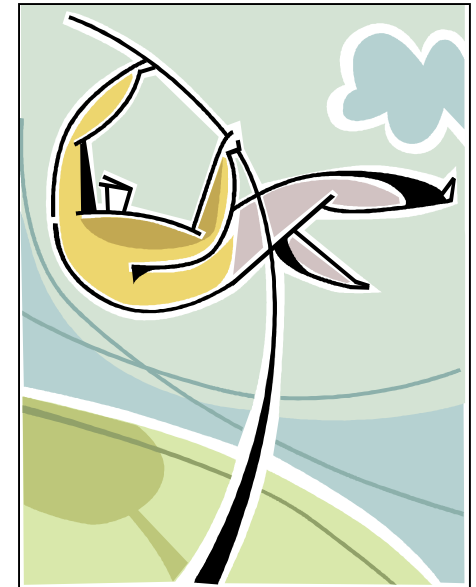


Implementing CMMI for Performance

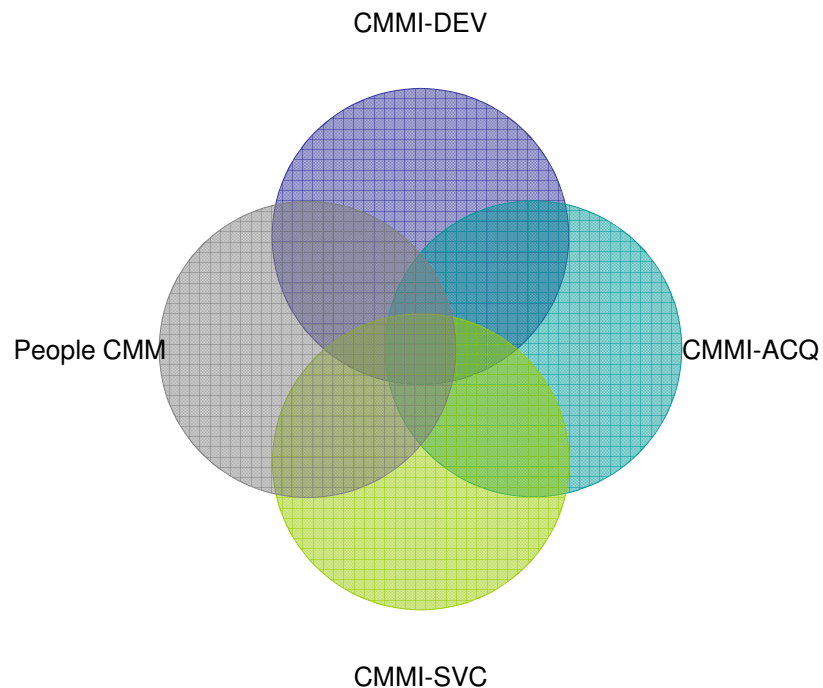
Many people believe that when you achieve a higher CMMI maturity rating that higher performance follows

Achieving a higher CMMI maturity rating doesn't guarantee higher performance

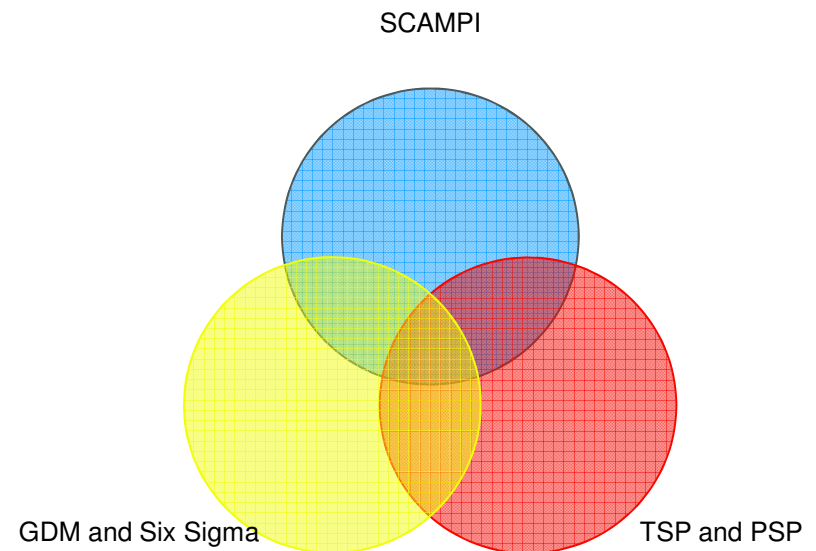
Performance achievement depends on *how* CMMI is ***implemented***



TSP is Central to Improving Performance



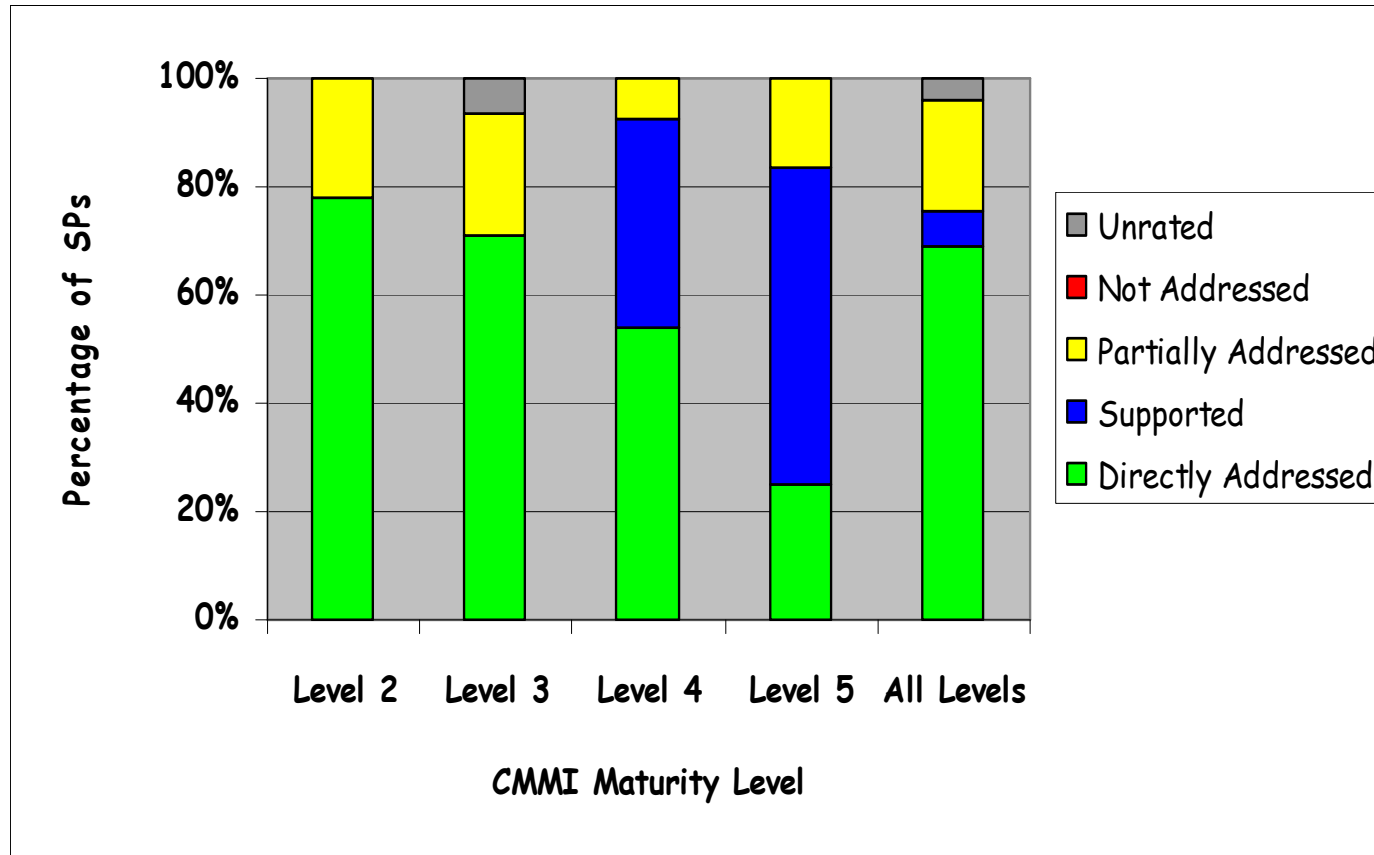
The “What” – Quality Principles



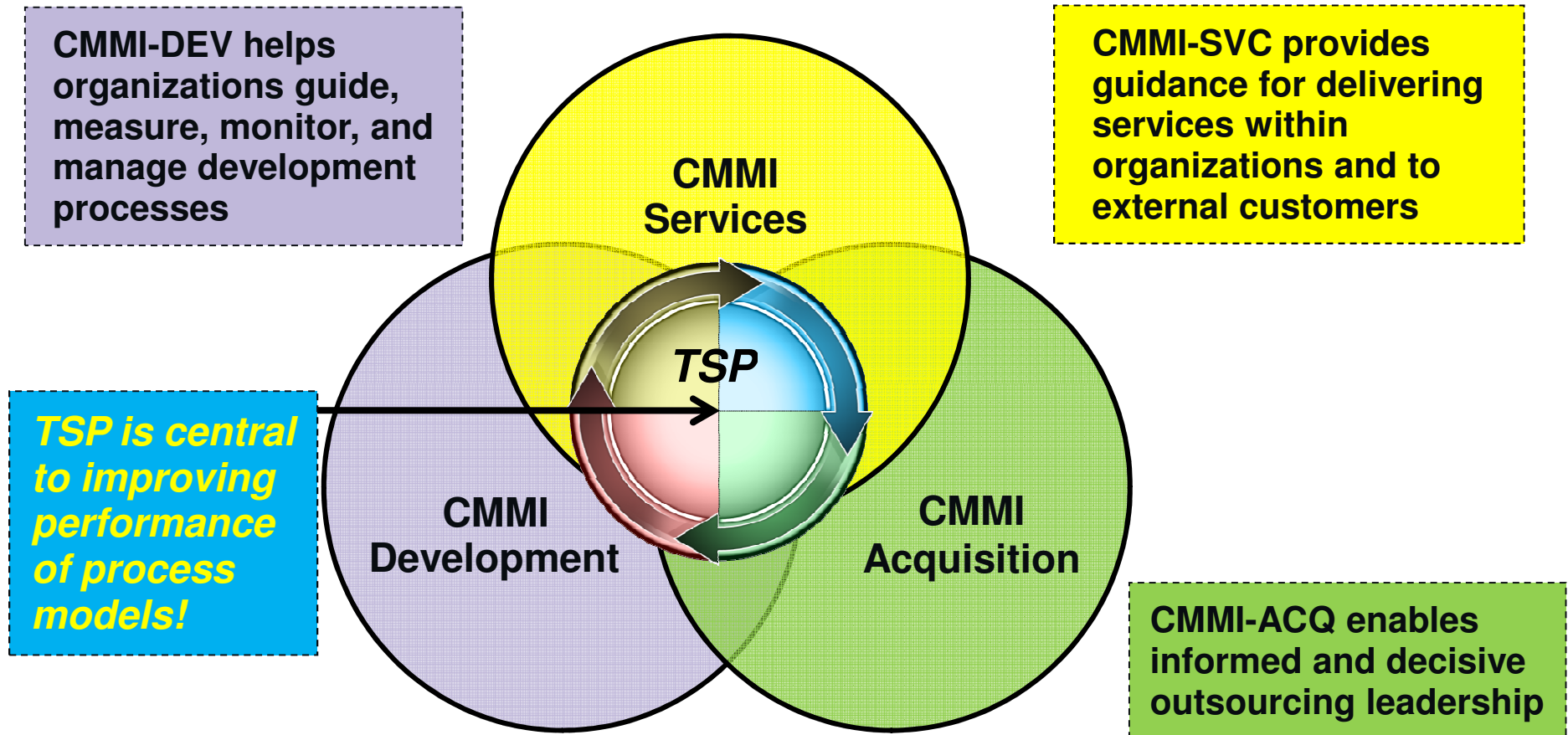
The “How to” – Appraisal methods, operational practices, improvement techniques, M&A Tools,



TSP Now Addresses most CMMI-DEV Practices



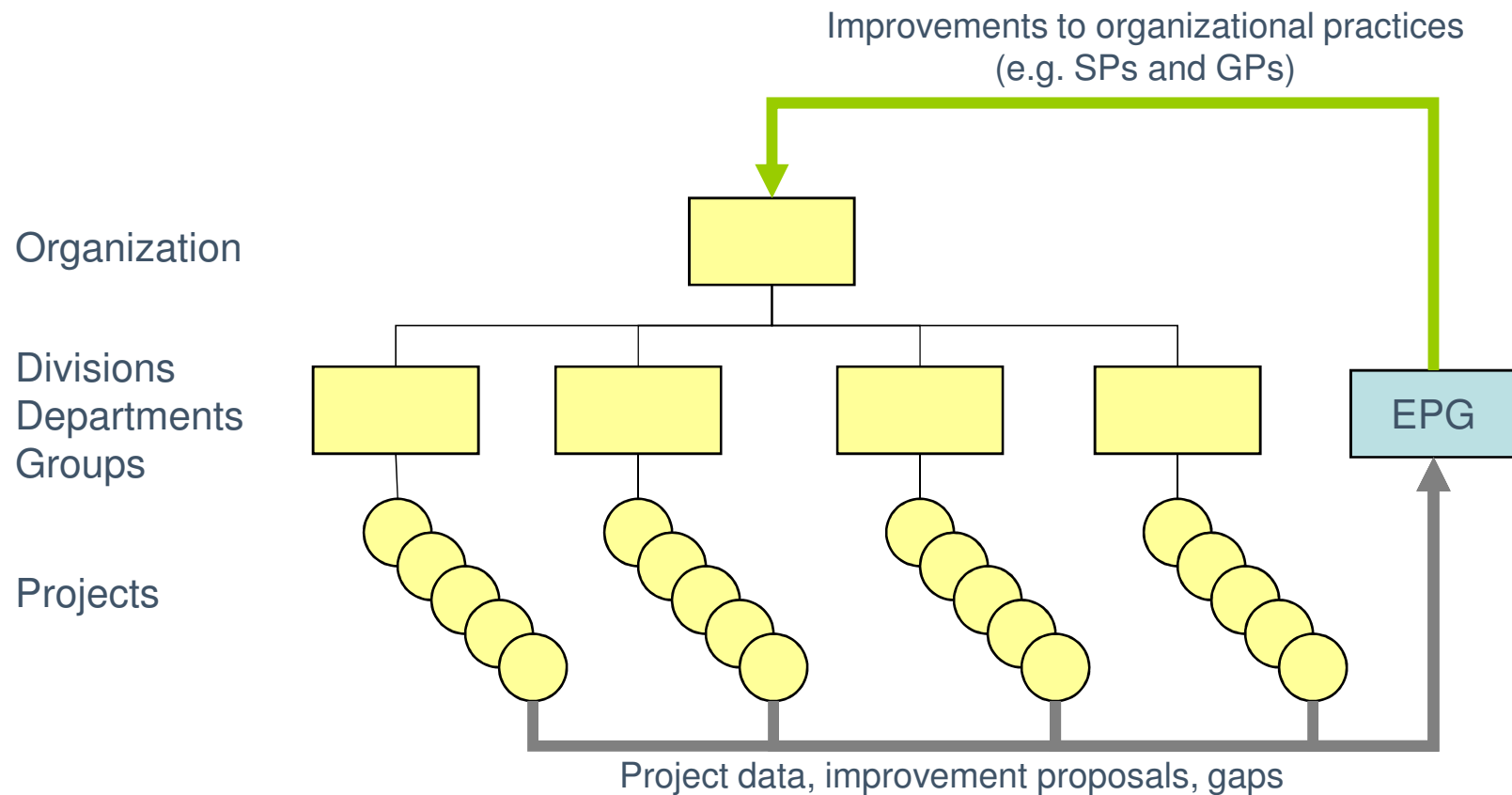
TSP Improves Performance of CMMI Constellations



16 foundational process areas shared by all



Building Capability Project-by-Project



Benefits of the Integrated Strategy

Organization Benefits

- Faster, lower cost, repeatable approach to implementing CMMI
- Includes 80% of the practices through ML3 and 75% through ML5
- Measurable and trackable improvement strategy
- Local ownership and responsibility
- Direct route to higher maturity and high performance
- Scalable from large to small organizations
- Changes the culture by changing the behavior

Project Benefits

- Immediate business value and results on each project
- Organization sets the pace; which projects; how many projects
- Each project pays for itself within first year
- Improves performance from the bottom up



TSP User Feedback



Schedule Management

First-time TSP projects at Microsoft had a 10 times better mean schedule error than non-TSP projects at Microsoft as reflected in the following table.

Microsoft Schedule Results	Non-TSP Projects	TSP Projects
Released on Time	42%	66%
Average Days Late	25	6
Mean Schedule Error	10%	1%
Sample Size	80	15



NAVAIR TSP Experience – Cost Savings

NAVAIR used TSP to advance from ML1 to ML4 in only 2.5 years, less than half the average reported time and substantial cost, schedule, and quality improvements.

	Size KSLOC	Defects per KSLOC	Number of defects	Cost to fix a defect	Cost of fixing all defects
Warp (before TSP)	~450	1.13	501	\$8,330	\$4,169,831
AVJMPS (after TSP)	~450	0.59	261	\$8,330	\$2,177,169
Savings from reduced defects					\$1,992,663
Cost of TSP support					\$225,300
Total cost savings					\$1,767,363

This represents a savings of \$3.90 per LOC

Source: NAVAIR nomination for the 2005 IEEE Computer Society Award for Software Process Improvement



Intuit Productivity Improvement

By putting a quality product into system test Intuit improved productivity and reduced cost while delivering 33% more functionality than planned

Results at Intuit: Productivity

- During 2007 over 60% of Intuit's Small Business Division used TSP
- TSP was a major contributor to the QuickBooks 2007 release
- It was the smoothest release anyone can remember:
 - On time delivery of all planned scope
 - 13 new features were added during the cycle(33% of initial scope)
 - Saved \$700K in temporary testing staff expenses
 - Level of automated testing coverage was doubled compared to previous year

Focused improvements helped deliver a great release

Source: Intuit

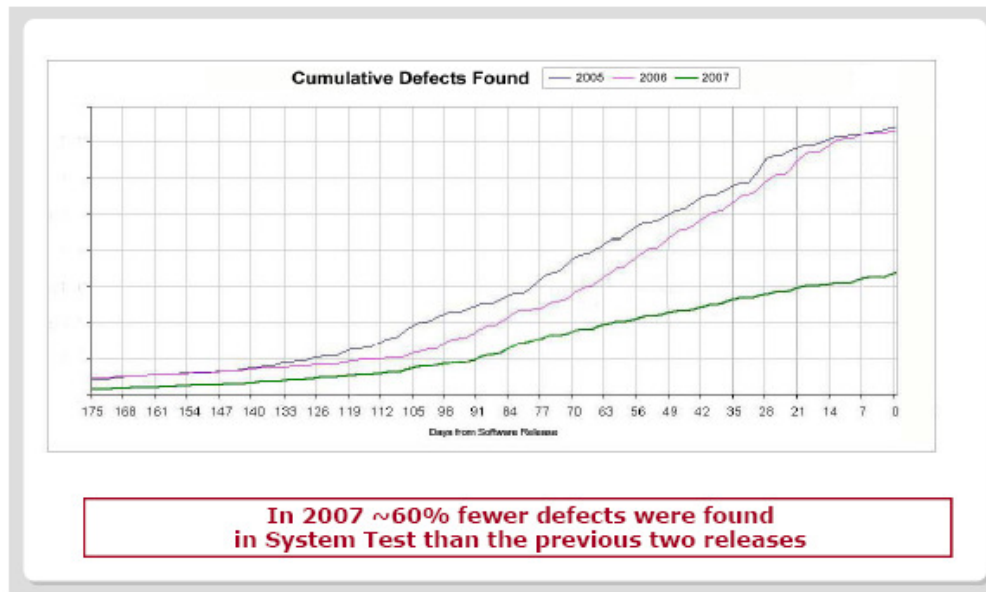


Intuit Quality Improvement

TSP reduced defects found in system test by 60% over the previous two releases of QuickBooks 2007 release

Intuit also reported a savings of \$20M from a reduction in customer support calls on QuickBooks 2007

Results at Intuit: Improved Quality



Source: Intuit



Summary

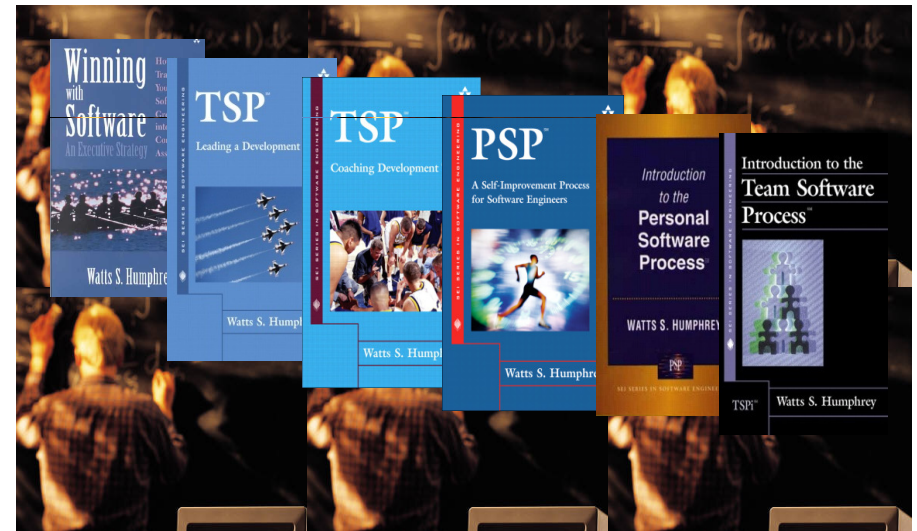
SEI models and operational methods are being adopted around the world, helping teams, organizations, and governments improve their process work

TSP is a solution to the competitive challenges that face software organizations

TSP teams achieve top performance

- Predictable schedules
- Productivity gains of 30% to 50%
- Industry best quality management

The TSP introduction strategy ensures that the investment in improvement is demonstrated and recovered on a project-by-project basis



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