Changing Behavior:

The key to adoption of complex process technology

Dr. Gene Miluk
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

November, 2009

My goals for this presentation

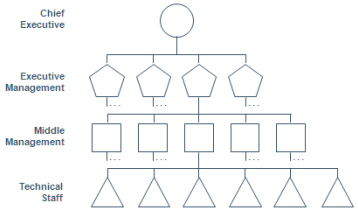
1) Present new or different approaches to technology transition
2) Challenge your current thinking (changing change agents is hard)
3) Describe what I see is working in the field (and my thoughts on why)
4) Focus on the potential benefits to you and your organization inherent in these approaches to change
5) Describe my reactions and internalization of the approaches

Topics

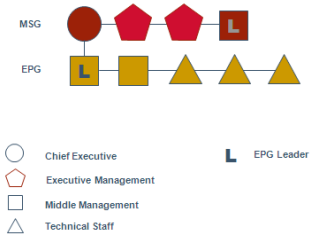
- Current SEI Change Management Approach
- What's Needed
- A New Approach
- Bandura Social Learning
- Bayesian Belief Networks

Comprehensive System Change Model (IDEAL)

Typical Organization Structure



Staffing the Process Infrastructure

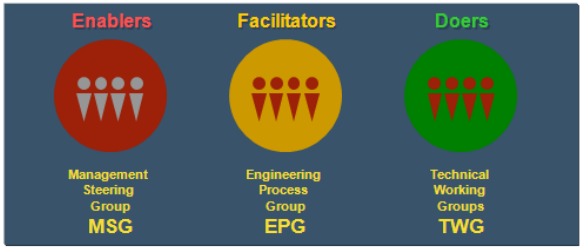


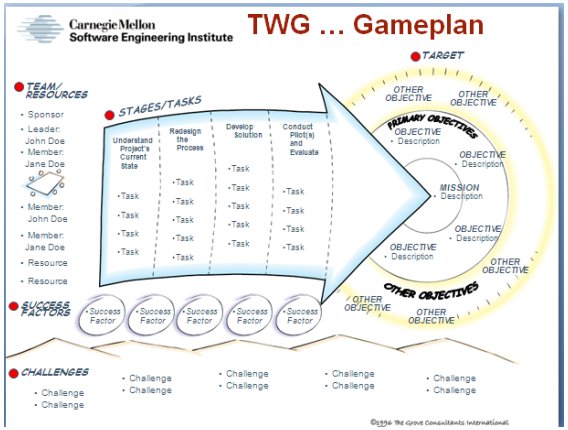
The Process Change Method

1. Organize and Prepare
2. Conduct Organizational Scan
3. Establish Technical Working Groups
4. Understand Project's Current State
5. Redesign the Process
6. Develop Solution
7. Conduct Pilot(s) and Evaluate
8. Facilitate Organizational Learning

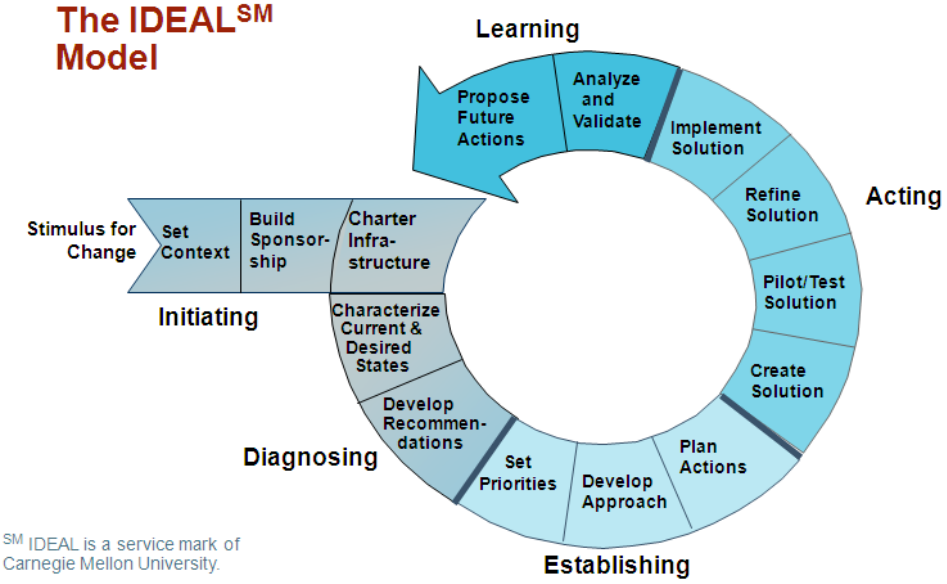
A Process Improvement Infrastructure

Core Teams are typically formed and given responsibilities and roles for managing, facilitating, and implementing a change effort from start to finish.





SEI IDEAL™ Model



Based on Org Change Principles:

Action Research

Socio-tech Systems

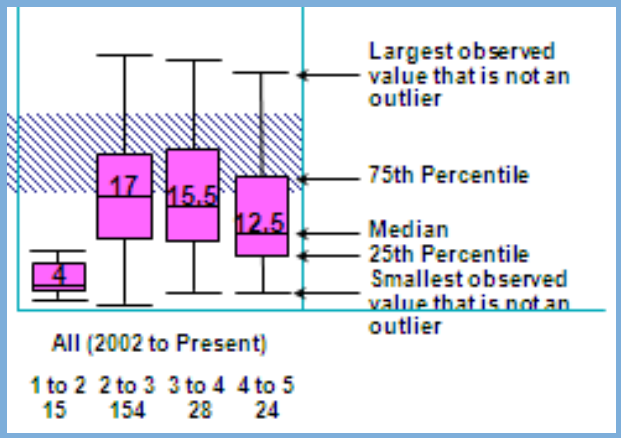
Plan Do Check Act

Cascading Sponsorship

Parallel learning Structures (SEPG)

My experience with using IDEAL:

- Takes too long (SEI time to move up)
- Costs too much
- Engineers don't embrace it
- Hard to sell Management Value Proposition



The assimilation gap is the gap between the objective and the deployment

Assimilation Gap

1) Implementation gap

2) Performance gap

Robert G. Fichman, Chris F. Kemerer, ***"The Illusory Diffusion of Innovation : An Examination Of Assimilation Gaps"****, Working Paper Series No.746, Katz Graduate School of Business, University of Pittsburgh, November 1995.*

Interested In ?

A streamlined transition approach that provides:

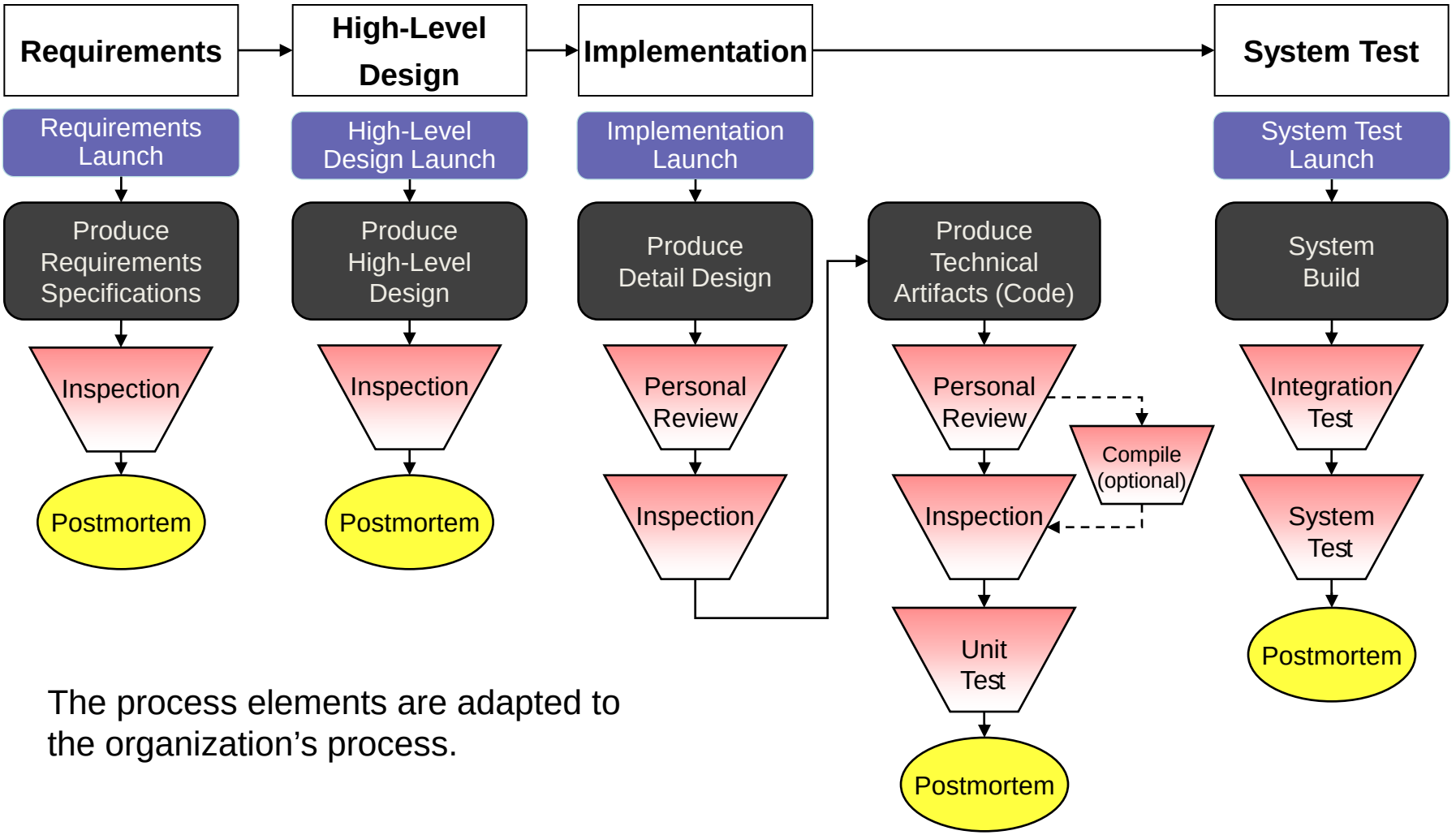
- Compelling Management Value Proposition
  - Predictable Costs
  - Creeping Commitment
  - Quick results with measurable ROI
- Concentrated and Focused process investments
- Accelerated Learning Environment
  - New Processes, New Experiences, New Data, New Beliefs, New Behaviors
- Rapid Predictable Organizational Adoption
- Continually Measurable Results

Major Differences in Approach to Transition

- Concentrated Process
  - Comprehensive Packaged Operational System of Integrated Processes
  - Proven Performance
  - Integrated Operational Measurement System (Individual level)

- Focused Implementation Strategy
  - Unit oriented (Project/Team)
  - JIT Concentrated 3 level Training
  - Accelerated Learning Laboratory
  - Effective Project/Team Launch Process
  - Coaching and continued support

Comprehensive HP Development Process



The process elements are adapted to the organization's process.

Effective Project/Team Launch Process

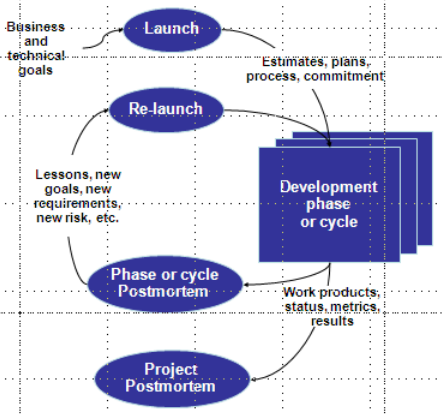
TSP Process Structure

The TSP process elements can be organized into whatever process structure makes the most business and technical sense.

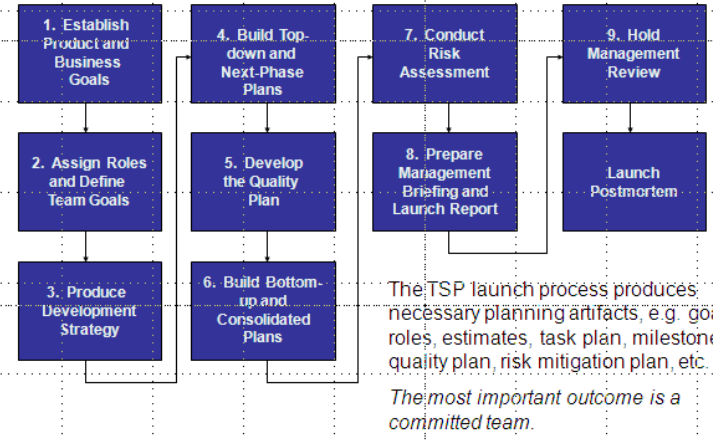
The phases can be implemented iteratively in small cycles, in a spiral with increasing cycle content, or sequentially as in a waterfall.

TSP projects can start on any phase or any cycle.

Each cycle starts with a launch or re-launch and ends with a postmortem.



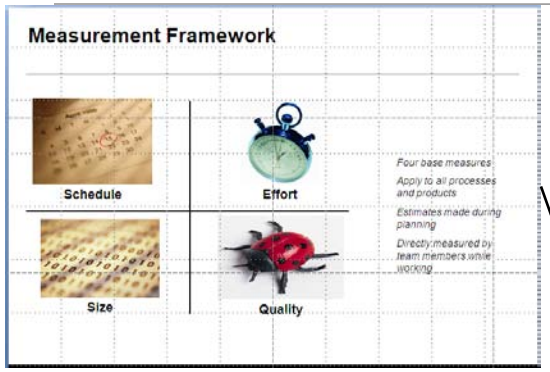
The TSP Launch Process

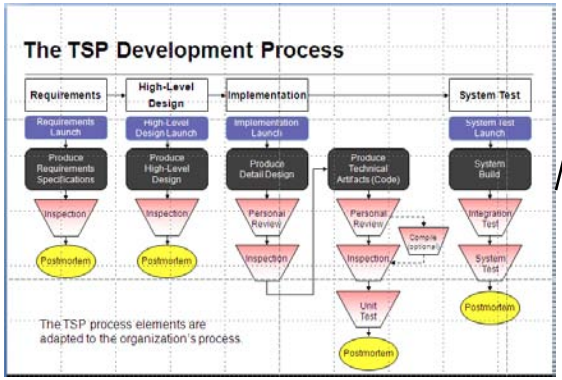


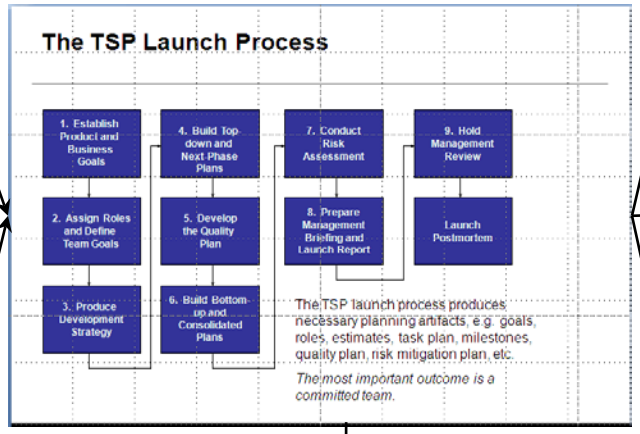
The TSP launch process produces necessary planning artifacts, e.g. goals, roles, estimates, task plan, milestones, quality plan, risk mitigation plan, etc.

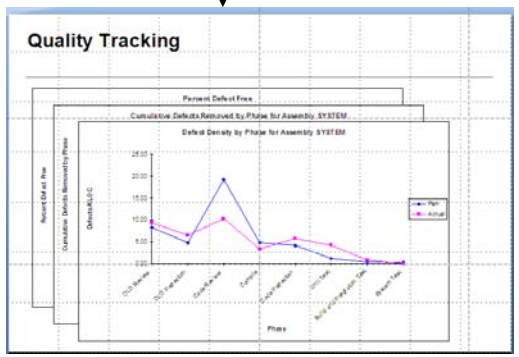
The most important outcome is a committed team.

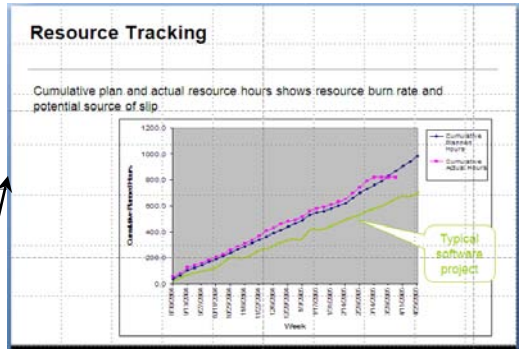
Operational Plans
Implemented Processes

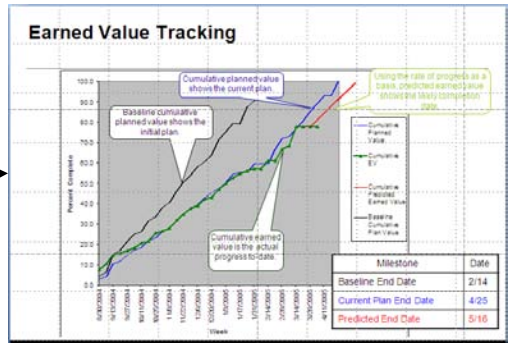


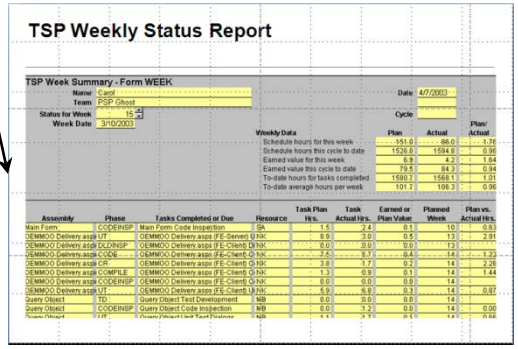




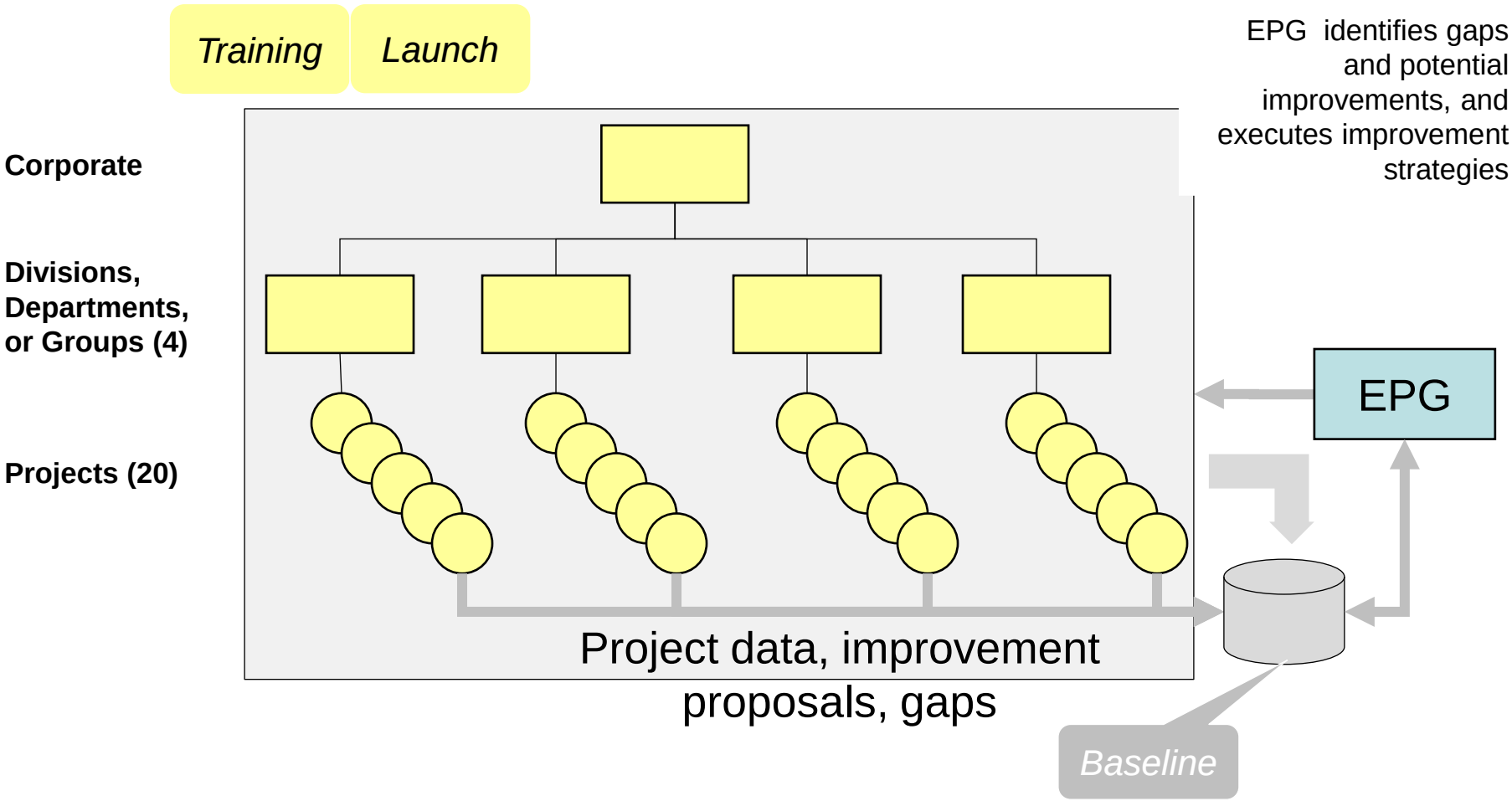








Focused Implementation: Building Organizational Capability Project-by-Project, Team-by-Team

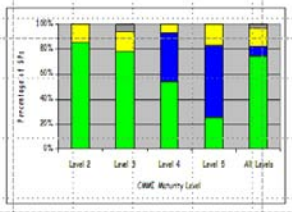


Does it work for Organizations?

TSP Implements CMMI -2

An organization using TSP has directly addressed or implemented most specific practices (SP).

- 85% of SPs at ML2
- 78% of SPs at ML3
- 54% of SPs at ML4
- 25% of SPs at ML5
- 80% of ML2 and ML3 SPs
- 75% of SPs through ML5



Most generic practices are also addressed.

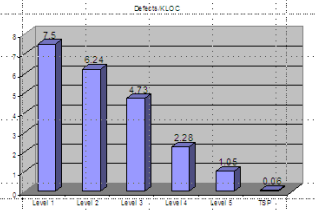
Based on a SCAMPI C of the latest version of TSP.

Reliable Products

An analysis of 20 projects in 13 organizations showed TSP teams averaged 0.06 defects per thousand lines of new or modified code.

Approximately 1/3 of these projects were defect-free.

These results are substantially better than those achieved in high maturity organizations.



Source: CMU/SEI-2003-TR-014

Organizations Using TSP

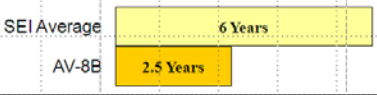
Microsoft, Softtek, Intuit, EDS, Vicarious Visions, Oracle, Toshiba, Fujifilm, Adobe, IBM, Sun

NAVAIR AV-8B TSP/CMMI Experience

AV-8B is a NAVAIR System Support Activity.

They integrate new features into the Marine Harrier aircraft.

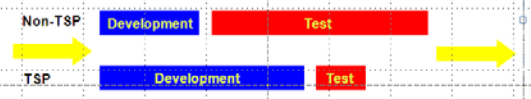
They used TSP to reduce the time to go from CMMI Level 1 to CMMI Level 4.



Productivity Improvement

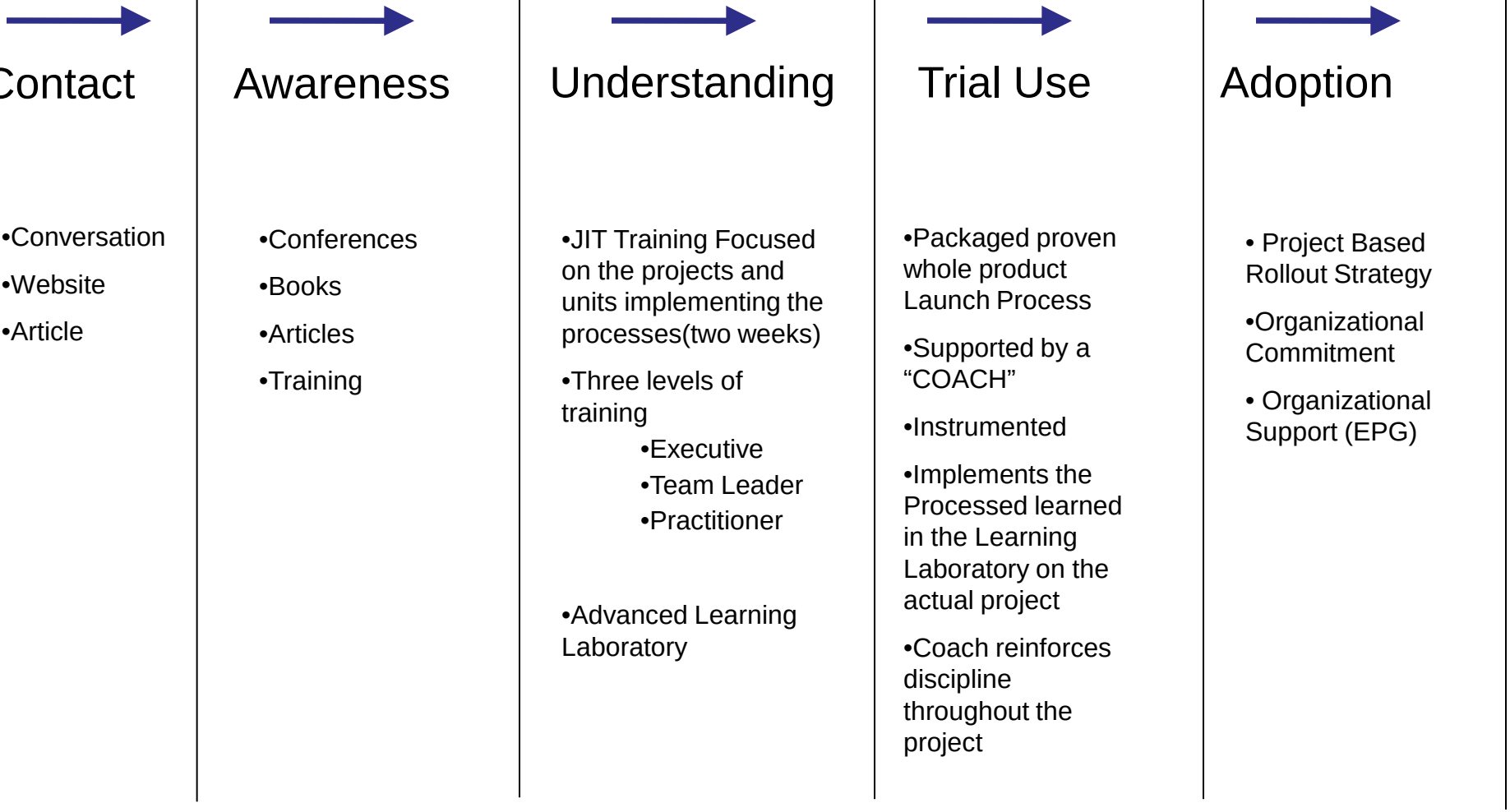
From data on over 40 TSP teams, Intuit has found that

- post code-complete effort is 8% instead of 33% of the project
- for TSP projects, standard test times are cut from 4 months to 1 month or less.

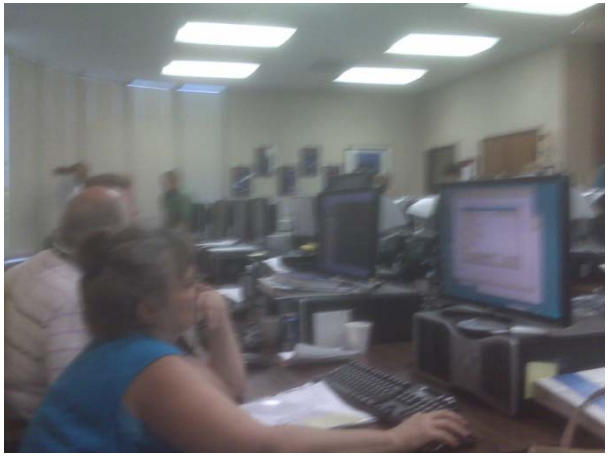


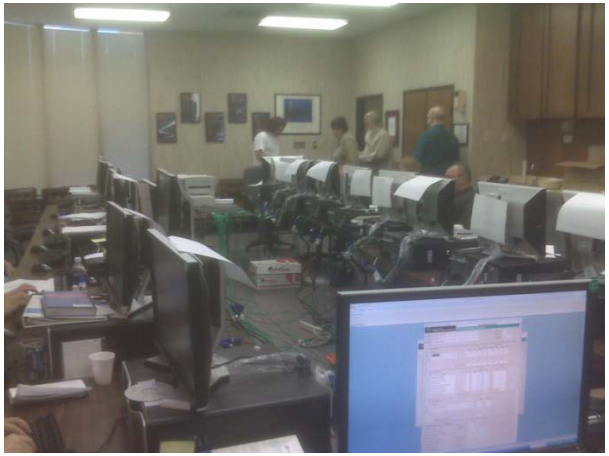
Organizations using TSP report productivity gains of 30% to 80% resulting in lower costs or more functionality in delivered software.

Individual Transition:



Advanced Learning Laboratory





Training ++

Process Simulation

Individual Instrumentation

Immersion Therapy

Self Discovery

Behavioral modification

Challenge current beliefs

Change Behavior

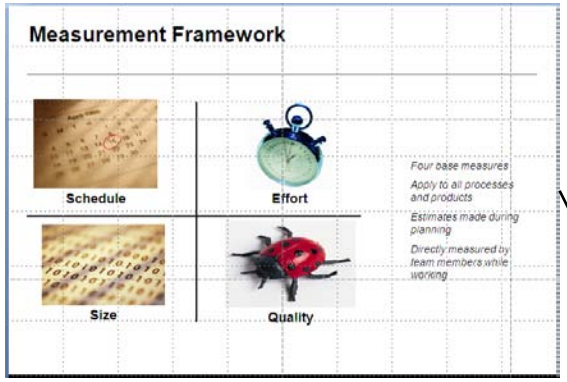
Change Behavior generates new results

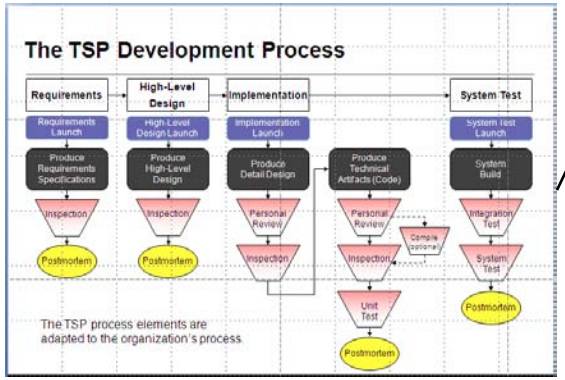
Process Simulation

Executing the Processes

Results from executing the Process

Product-Process-Planning Data





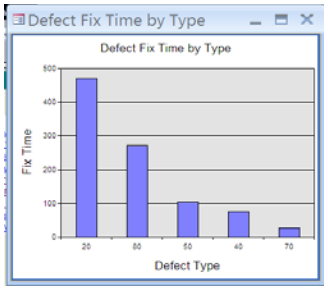
Process Simulation

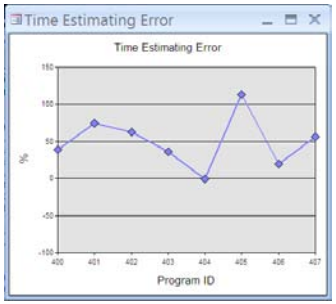
Program 1

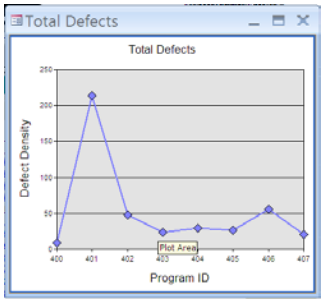
Program 2

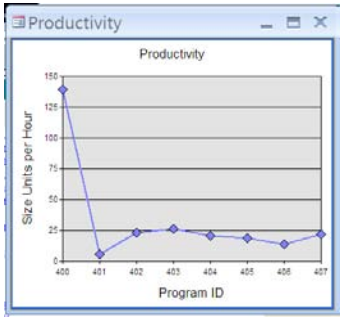
Program 3

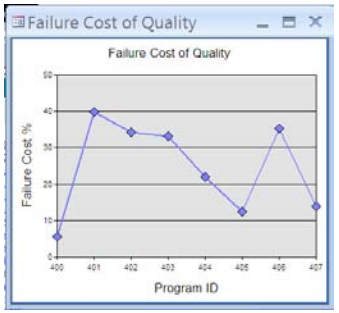
Program 4





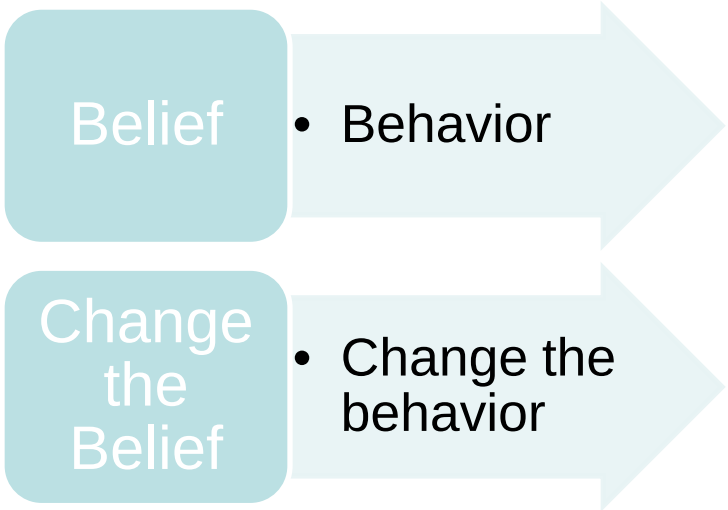






Belief Systems and Behavior

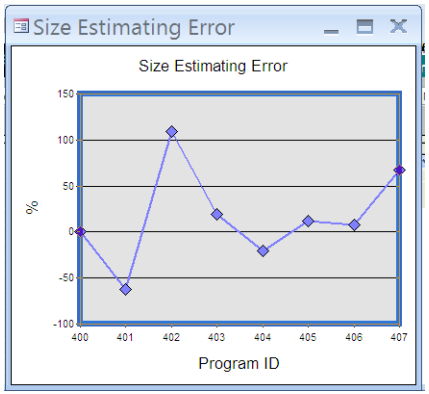
Belief drives behavior

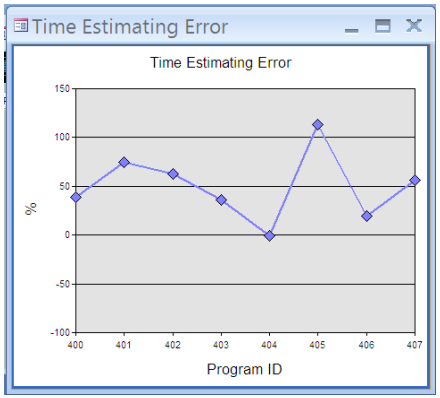


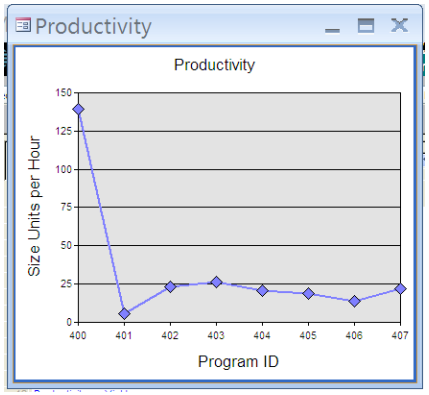
How to change a belief?

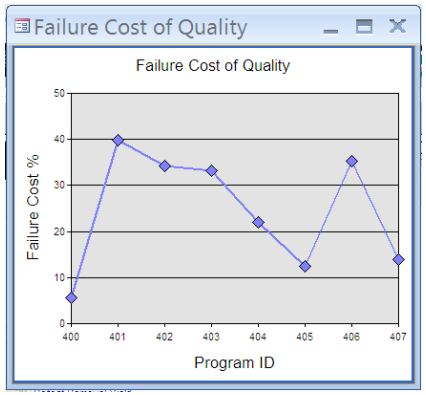
Show results inconsistent with the belief

My Beliefs-My Data-- My Journey





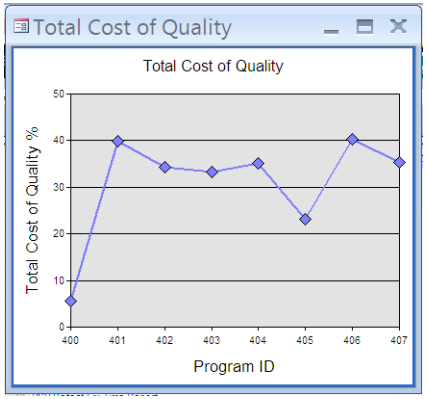




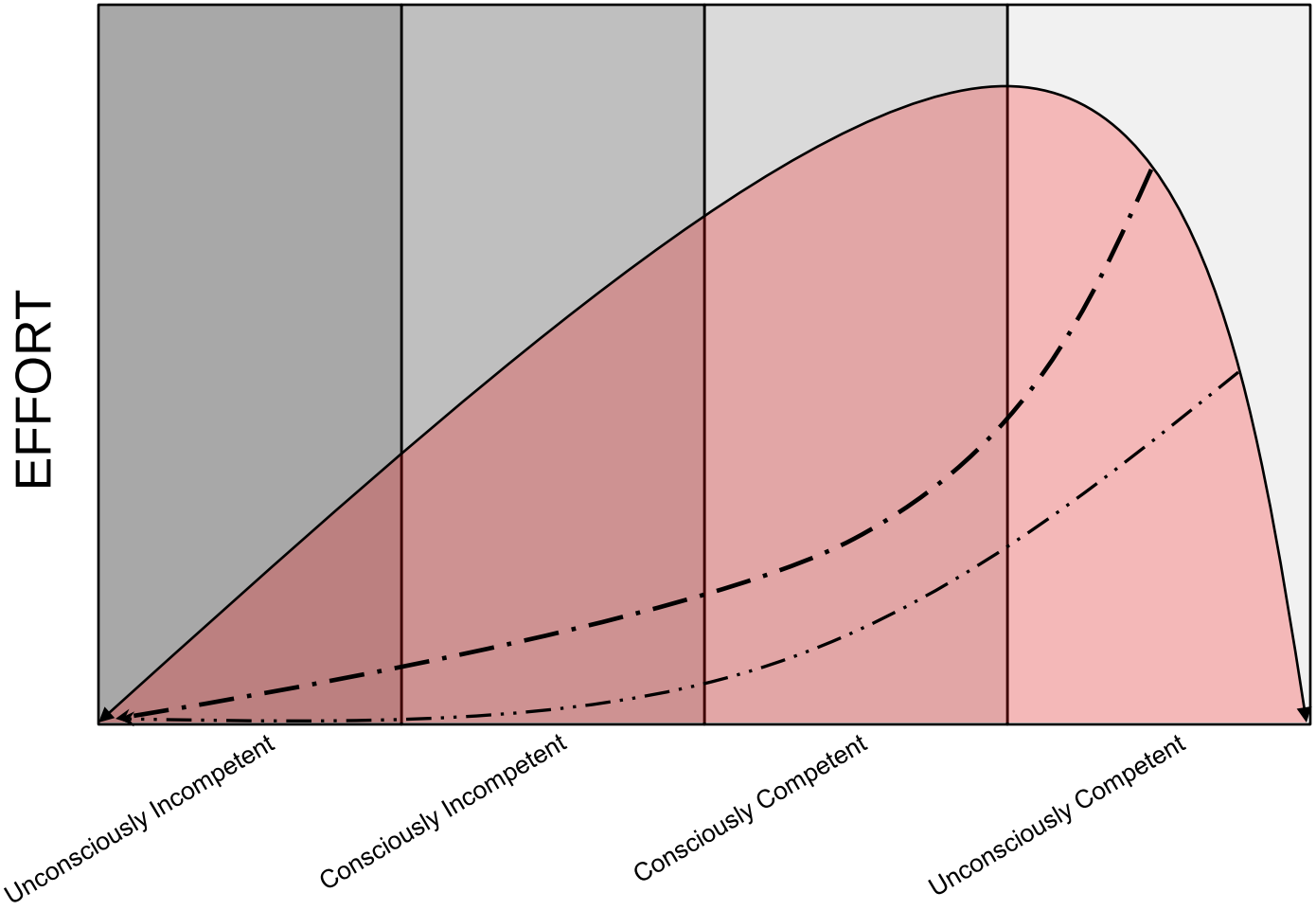
Think

Change

Improve



Consciousness Model and Bandura Social Learning



Bayesian Belief networks

Bayesian Inference Model: Allow the use of prior knowledge.

Let $P(h|\xi)$ be a degree of belief in h given current state of information ξ.

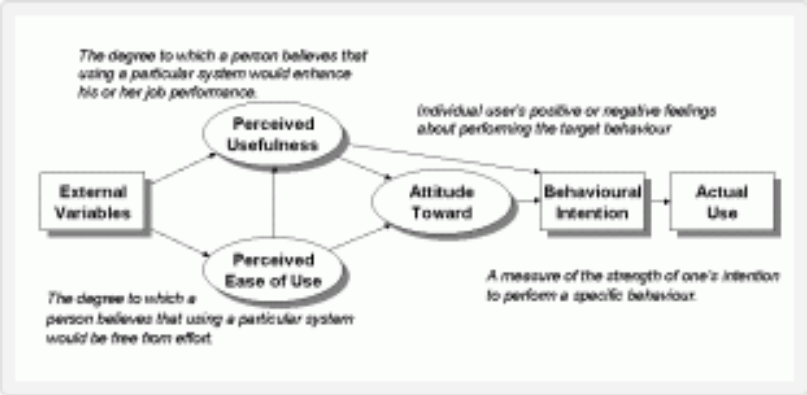
New evidence $\tilde{e}$ is presented.

Update using Bayes's Theorem:

$$P(h \mid \tilde{e}, \xi) = \frac{P(h \mid \xi) P(\tilde{e} \mid h, \xi)}{P(\tilde{e} \mid \xi)}$$

Predicting Behavior based on Beliefs

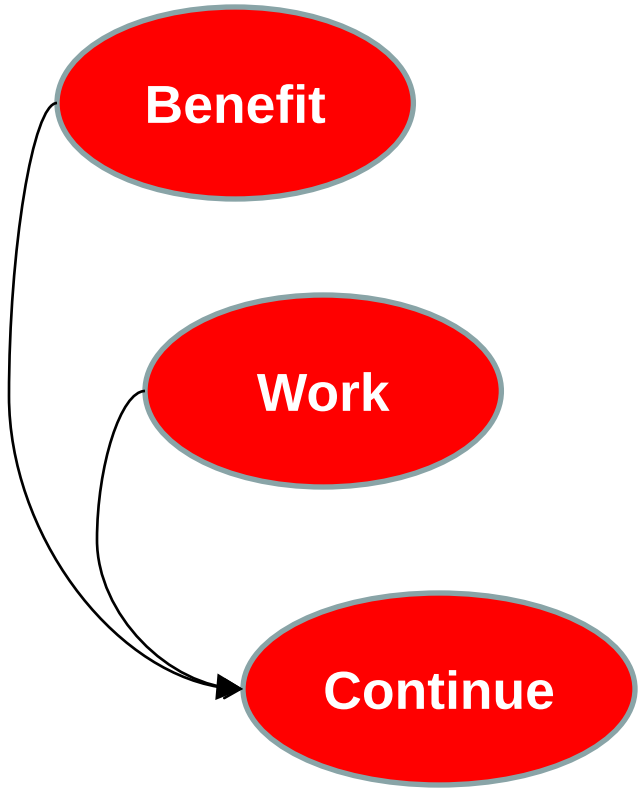
The Technology Acceptance Model is an information systems theory that models how users come to accept and use a technology



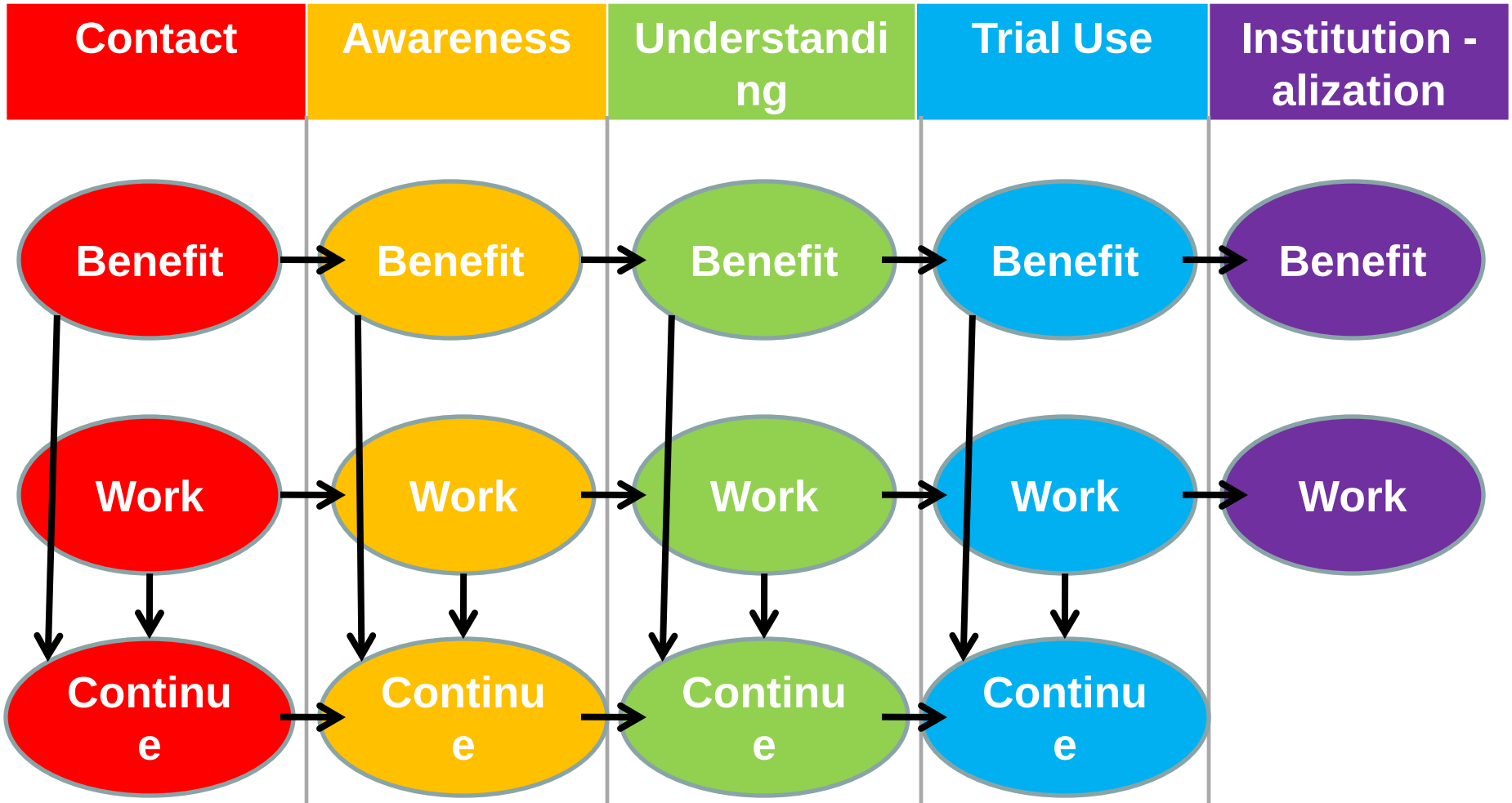
Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). ***Development and test of a theory of technological learning and usage. Human Relations****, 45(7), 660-686.*

Simplified Acceptance Model based on Beliefs

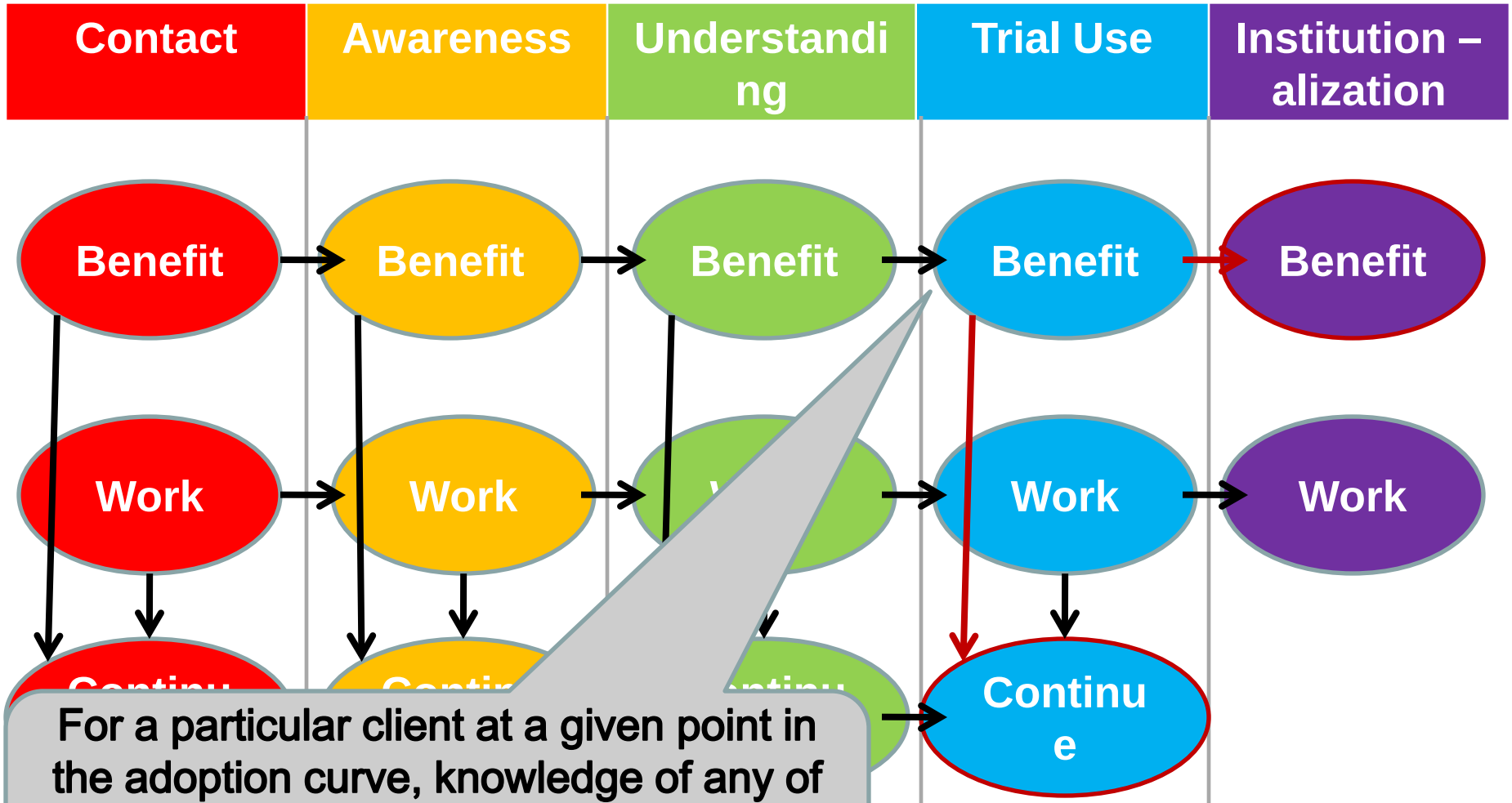
Repeated for Contact, Awareness, Understanding, Trial use and Institutionalization



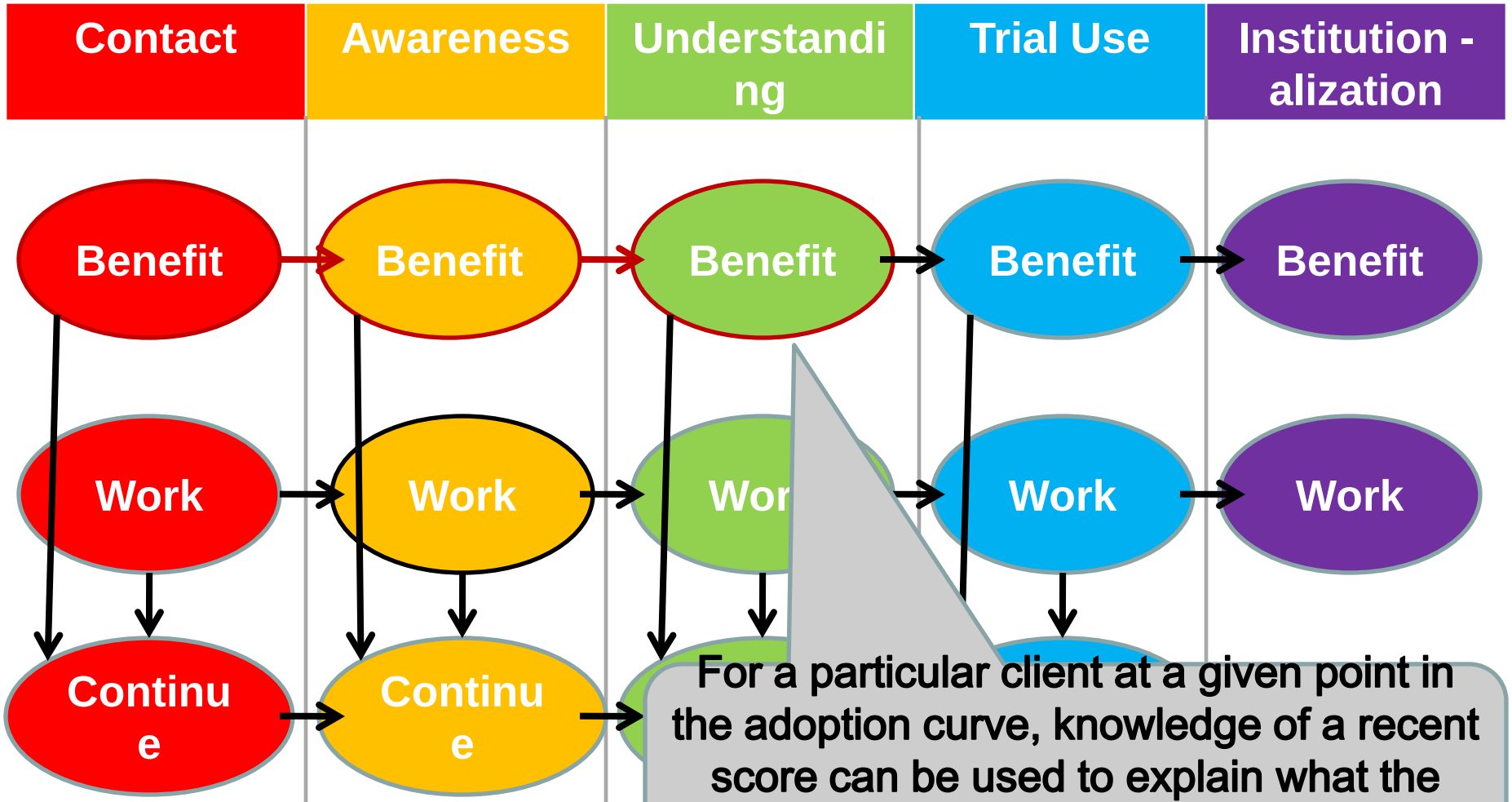
Concept of a BBN Model



Using BBN Model to Predict Future



Using BBN Model to Explain Past



Transition Survey

Awareness:

Activity: Executive Seminar/ Team lead training

PSP will benefit me/my organization:

No Yes

0%.....25.....50.....75.....100%

PSP/TSP will work for me/ my organization

No Yes

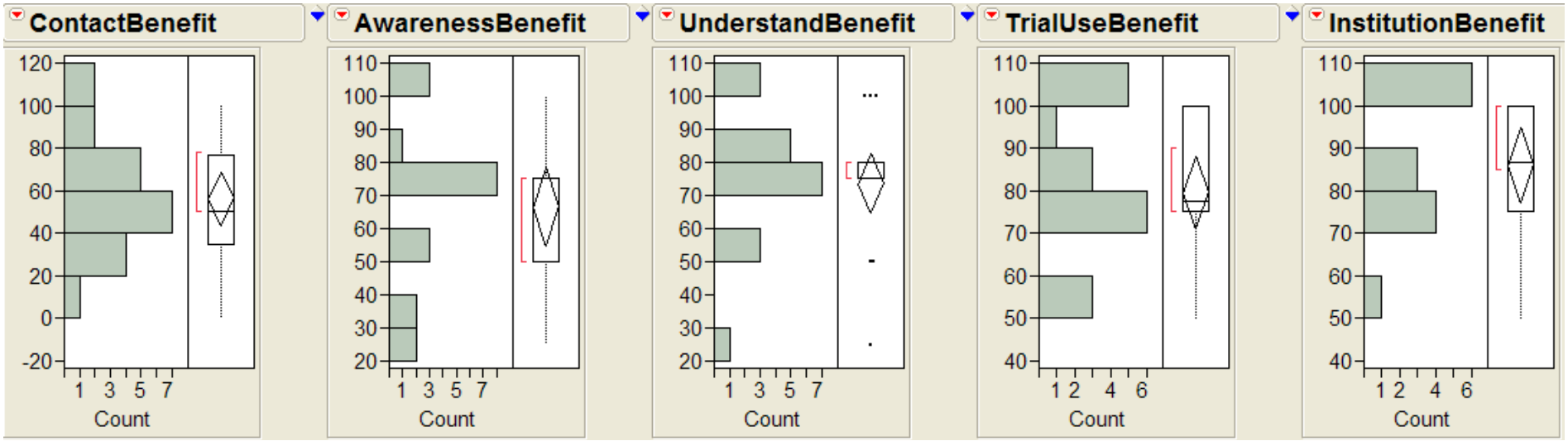
0%.....25.....50.....75.....100%

(For Partners) What percentage of clients continue on to understanding

0%.....25.....50.....75.....100%

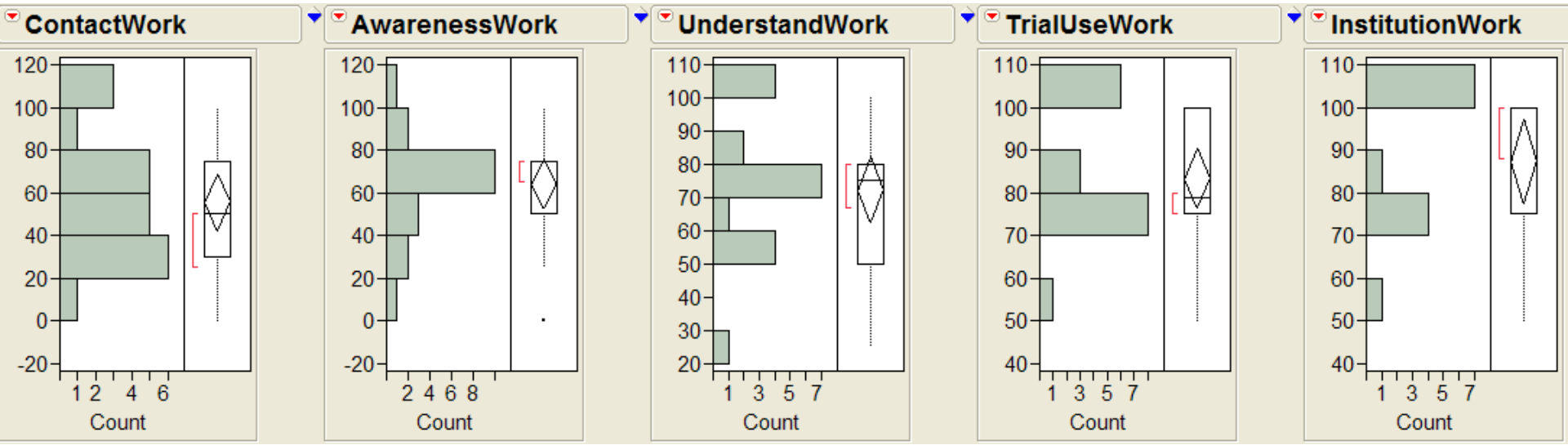
Comments:

Changing Benefit Profile



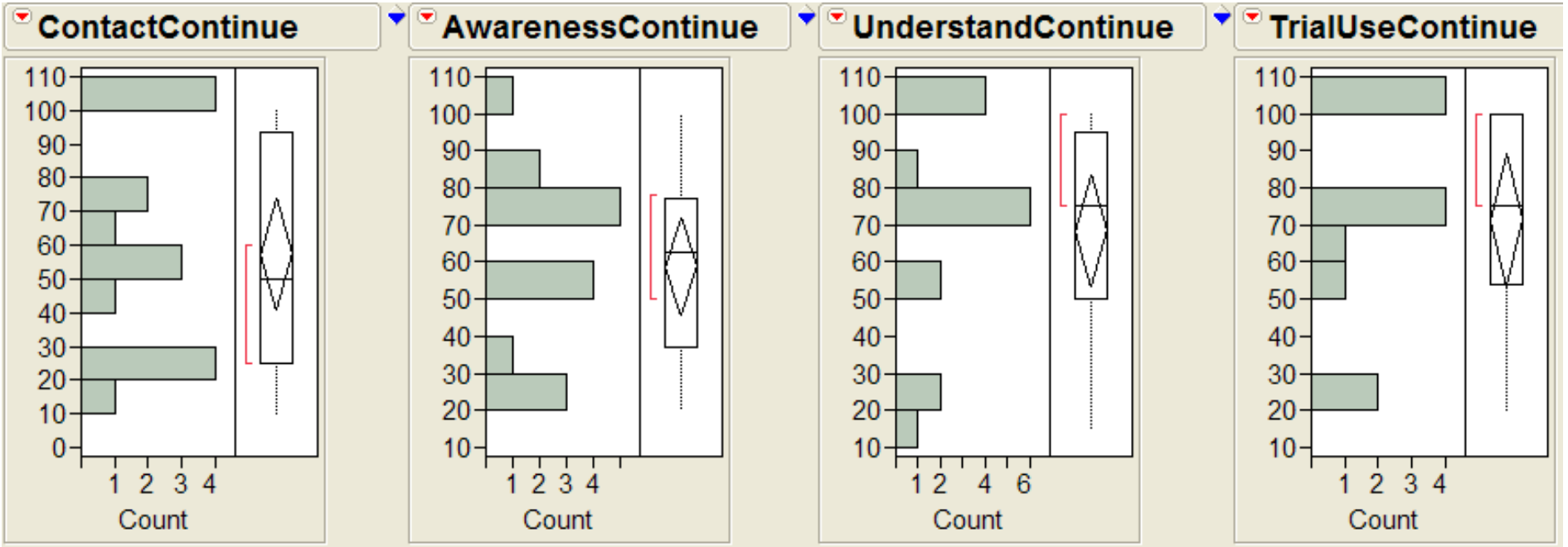
This distribution of the Benefit score is noticeably moving up across the adoption phases

Changing Work Profile



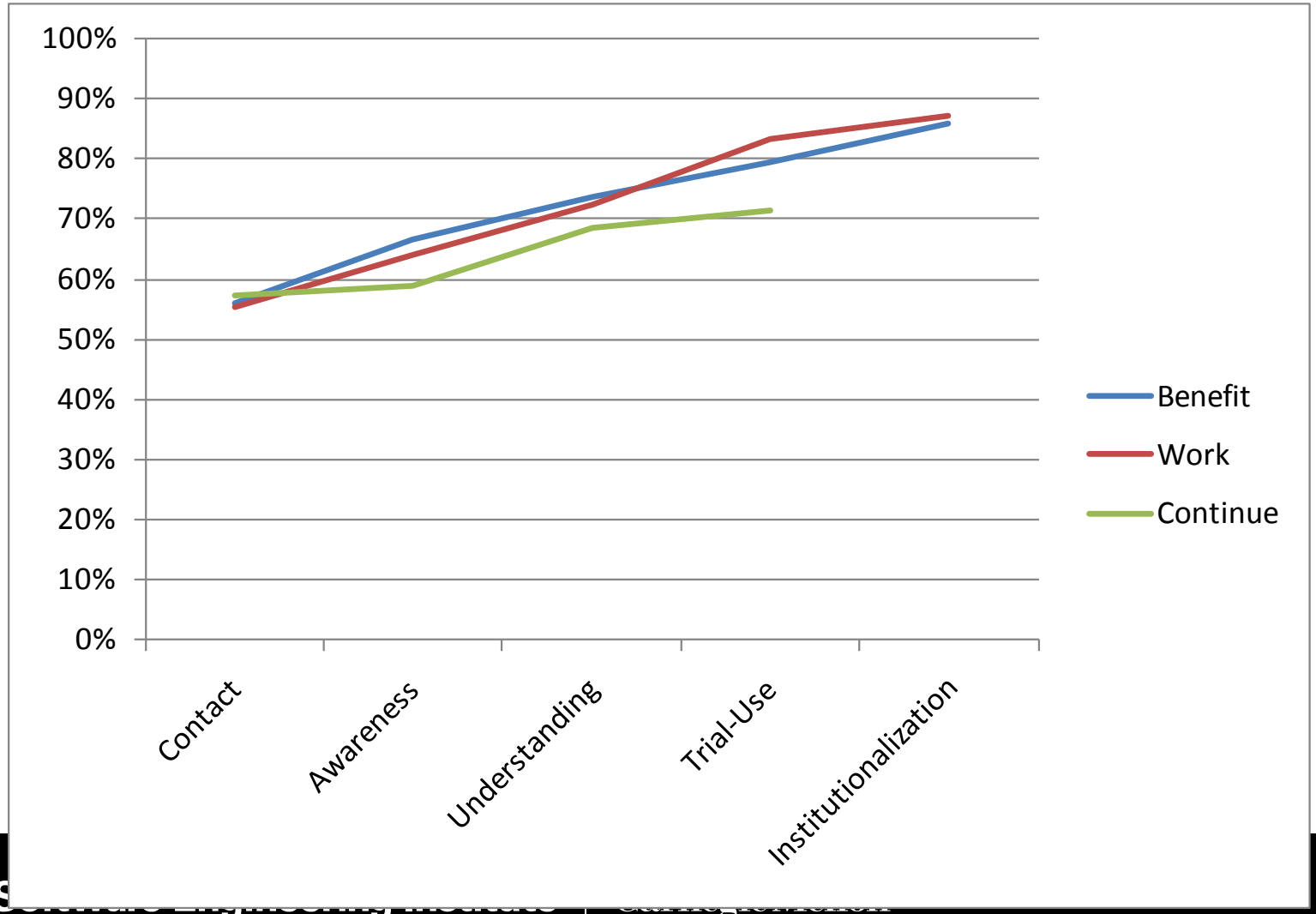
This distribution of the Work score is noticeably moving up across the adoption phases

Changing Continue Profile



This distribution of the Continue score is noticeably moving up across the adoption phases

Overall Trend of Average Responses



Some Initial Linear Models

Contact-Continue-Score = 4.3 + 0.85 * Contact-Work-Score

(Adj-Rsquare = 48%)

Understand-Be
Aware

(Adj

Although we prefer adjusted Rsquare values in the 80%+ range, these single factor prediction models show promise.

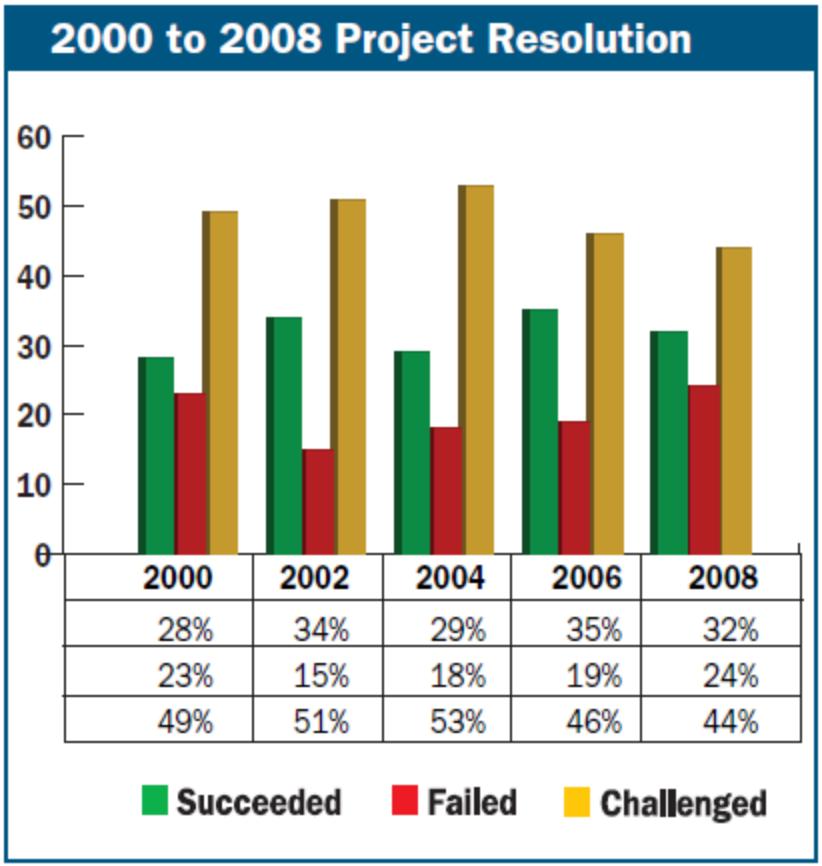
Remember, Adj-Rsquare is the amount of behavior of the outcome explained by the modeling factor

Questions?

Software Engineering Institute | Carnegie Mellon

Backup and Reference slides follow

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 Quality Performance

The software industry is the only modern high-tech industry that ignores quality until test.

Most software defects are found in or after test when defect removal costs are the highest and the methods are the least effective.

This strategy results in defective products and unnecessary rework that inflates development costs by 30% to 40% or more.

This strategy is also a principal cause of unexpected delays, system failures, and software security vulnerabilities.

Linux crash on Airbus Entertainment System

Competitive Advantage

As competition in the software industry increases, organizations seek:

- lower development cost
- shorter schedules
- more features per release
- predictable plans
- improved product quality
- fewer customer reported defects
- reduced staff turnover

Team Software Process supports these objectives.

Reliable Estimates

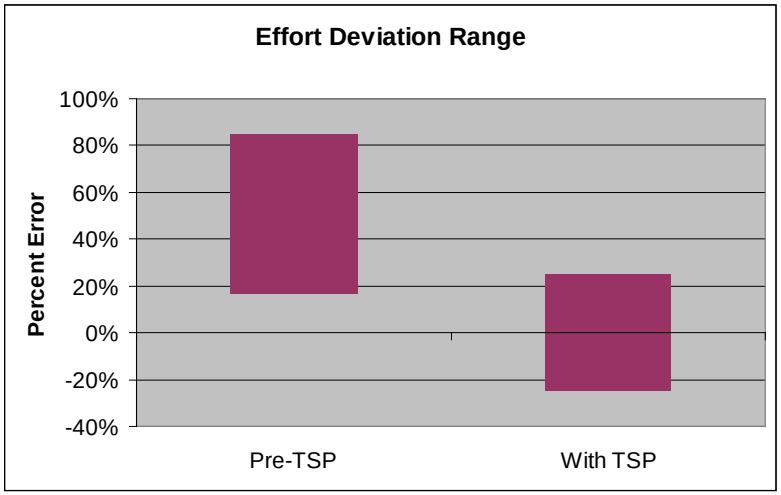
From a study published in 2000

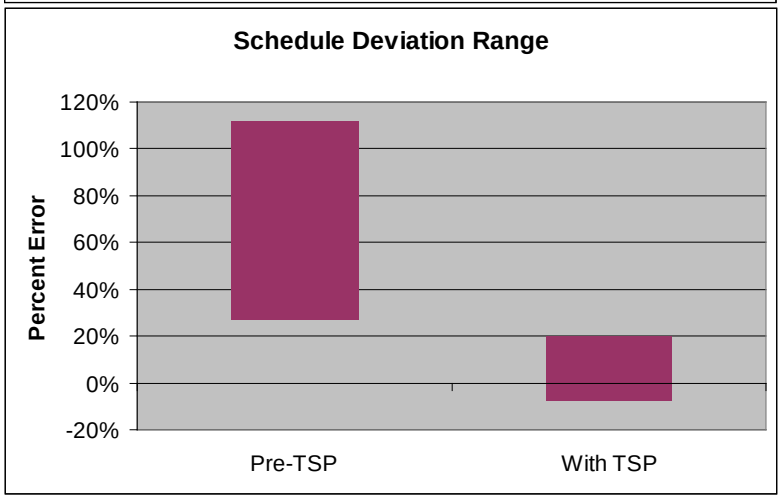
- fifteen projects in four organizations
- CMM ML1, ML2, ML3, and ML5
- TSP improved effort and schedule predictability at all maturity levels

Effort (Cost) Performance	
Study baseline	+17% to +85%
TSP	-25% to +25%

Schedule Performance	
Study baseline	+27% to +112%
TSP	-8% to +20%

Source: CMU/SEI-TR-2000-015



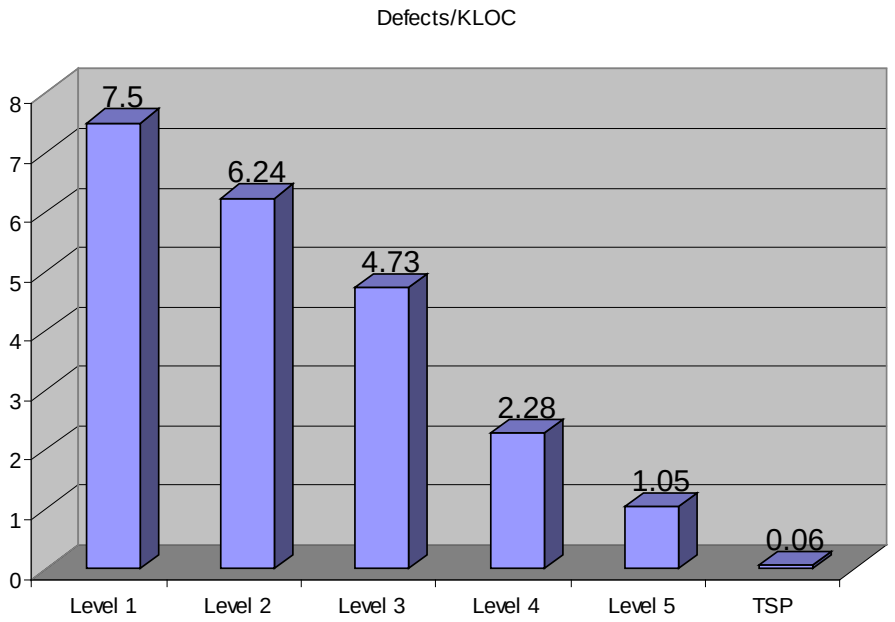


Reliable Products

An analysis of 20 projects in 13 organizations showed TSP teams averaged 0.06 defects per thousand lines of new or modified code.

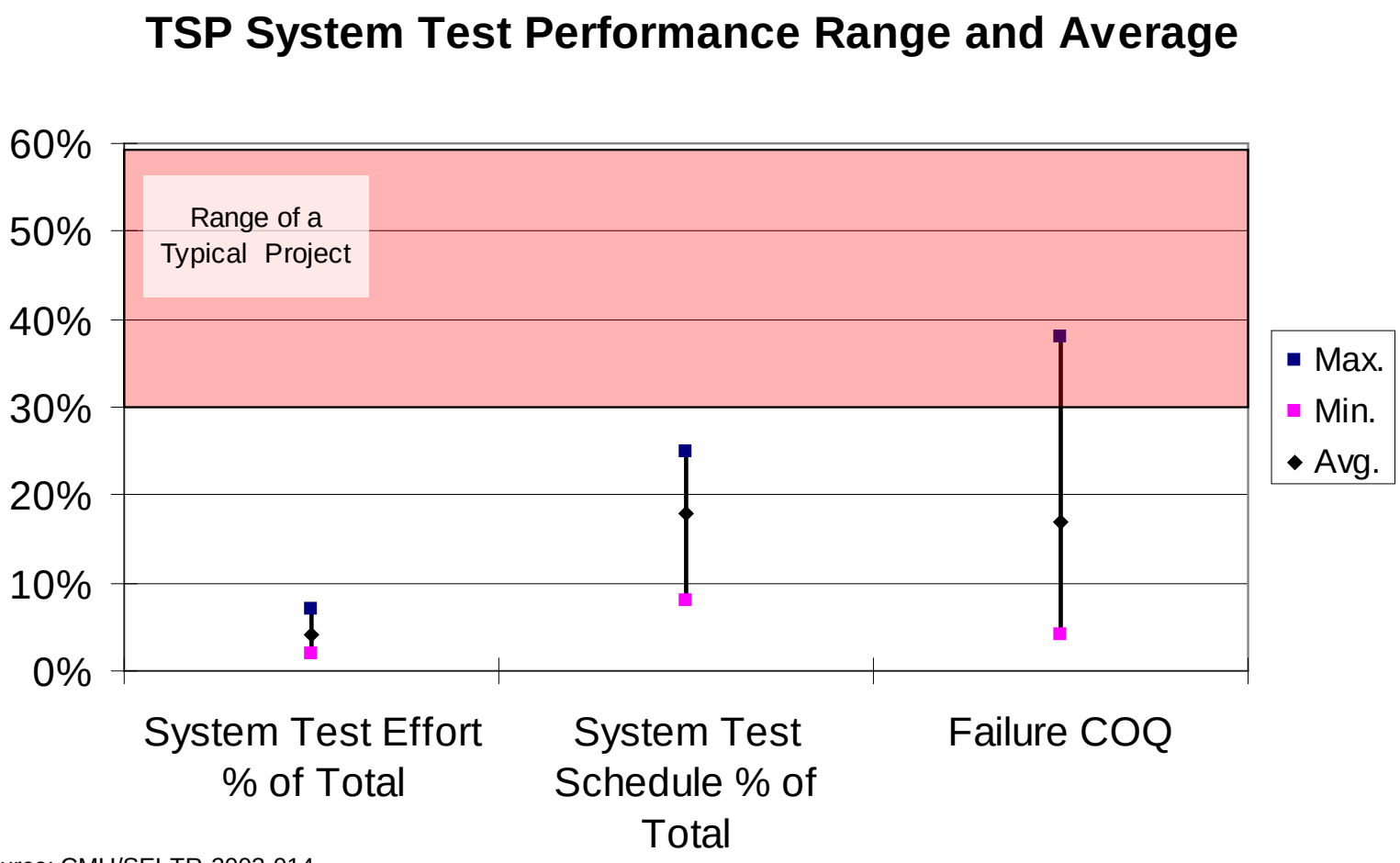
Approximately 1/3 of these projects were defect-free.

These results are substantially better than those achieved in high maturity organizations.



Source: CMU/SEI-2003-TR-014

Reduced Rework



Source: CMU/SEI-TR-2003-014

Productivity Improvement

From data on over 40 TSP teams, Intuit has found that

- post code-complete effort is 8% instead of 33% of the project
- for TSP projects, standard test times are cut from 4 months to 1 month or less.

Organizations using TSP report productivity gains of 30% to 80% resulting in lower costs or more functionality in delivered software.

A Process for Managers and Developers

"It was nice to be associated with a project that had few defects."

"The system test engineers became convinced that TSP was worthwhile when they realized that they were going from tracking down software bugs in the lab to just confirming functionality. Our first project: certified with ten times increase in quality with significant drop in cost to develop. Follow-on project: certified with NO software defects delivered to system test or customer."

"One of my first projects as an embedded systems programmer finished on the day we planned to finish six months earlier. I attribute the success to planning at a better granularity and making full use of the earned value tracking. The day we got 100% earned value was the day we planned to get 100% value, and we as a team celebrated like we had won a basketball game."

"My first TSP-based team recently finished their system test. They had three system test defects in 7400 lines of code. No defects were code- or design-related; they were either install or documentation—each of which took about five minutes to fix. System test took less than five percent of the overall project effort."

"Multiple projects in our organization have been able to keep within their time schedules (+/- three weeks) over a six-month span. This is something we [had] not been able to accomplish in the past. This is one of the reasons that management is very happy with the TSP process."

"Our schedule reliability is now +/- ten percent from –50/+200 percent and our defect density at the team level has been reduced by over 50 percent."

"Measuring progress helps generate progress."

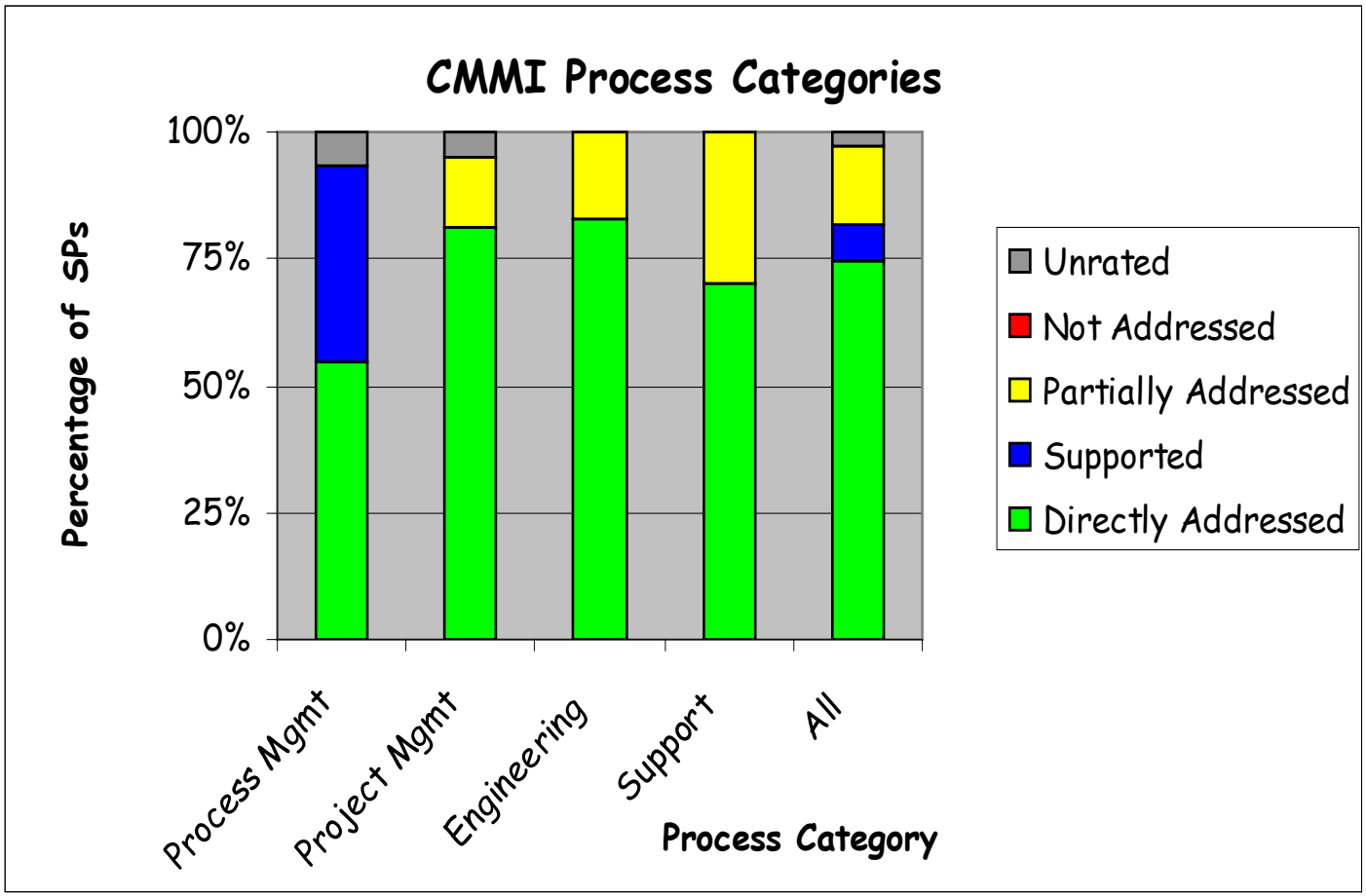
"...[TSP is a] transparent project management paradigm—everybody has a common understanding of the plan and everyone knows what is going on in the project and where we are in the project at any time."

"Our plans are much more detailed and all the involved developers understand them. As a consequence, we deliver what we planned, on time."

"PSP really sells you on the idea about finding defects early in the process. It really does make a difference at the end. We thought it wasn't going to work. But we all became converts. In doing the work, you are producing valuable data along the way. We improved productivity...improved it greatly. I worried because I have seen too many people more interested in the process than in the product. You are finishing smaller products at more regular intervals."

Source: CMU/SEI-TR-2003-014

TSP Implements CMMI -1



Unrated - out of scope for TSP.

Not addressed - project practice that TSP does not cover.

Partially addressed - project practices that TSP addresses with some weakness of omission

Supported - organizational practices that TSP supports.

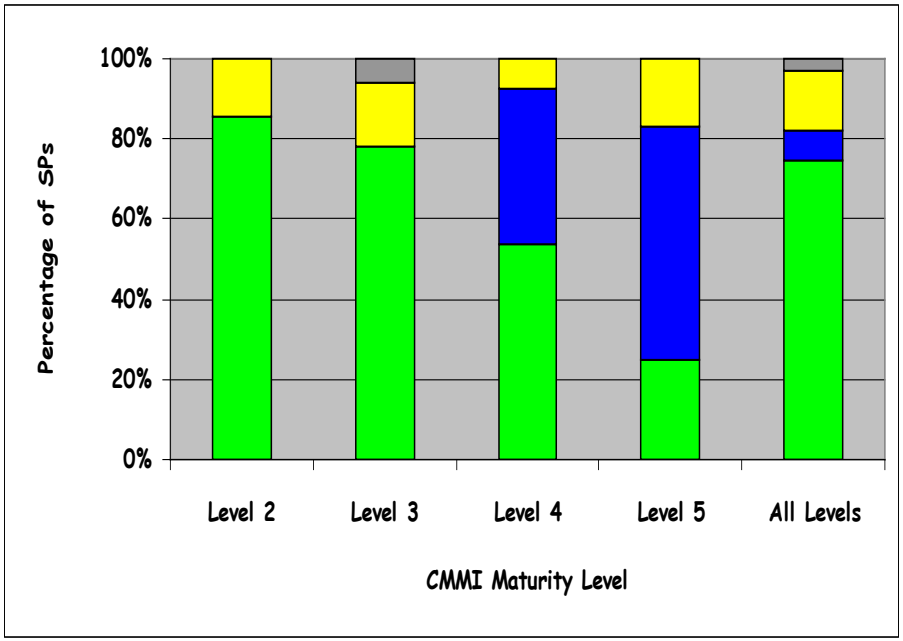
Directly Addressed - TSP practices meet the intent of the CMMI specific practice (SP) without significant reservations.

Based on a SCAMPI C of the latest version of TSP

TSP Implements CMMI -2

An organization using TSP has directly addressed or implemented most specific practices (SP).

- 85% of SPs at ML2
- 78% of SPs at ML3
- 54% of SPs at ML4
- 25% of SPs at ML5
- 80% of ML2 and ML3 SPs
- 75% of SPs through ML5



Most generic practices are also addressed.

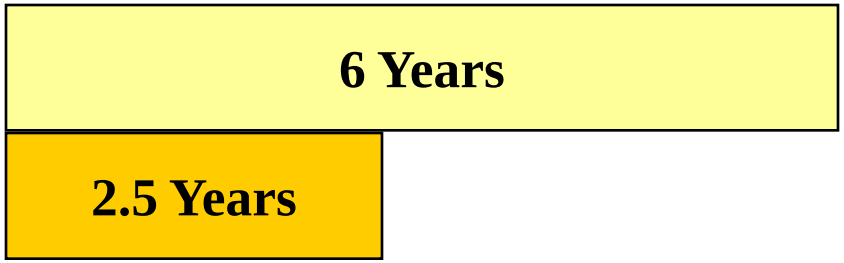
Based on a SCAMPI C of the latest version of TSP

NAVAIR AV-8B TSP/CMMI Experience

AV-8B is a NAVAIR System Support Activity.

They integrate new features into the Marine Harrier aircraft.

They used TSP to reduce the time to go from CMMI Level 1 to CMMI Level 4.



Organizations Using TSP

Advanced Information Services, Inc.
Centro De Investigacion En Matamaticas
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

Knowldege 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)

Topics

Introduction

TSP concepts

- Self-directed teams and coaching
- Personal Software Process
- Process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

Key Features -1

Unlike many other software development methods TSP a uses self-directed team management style…the team owns the plan.

TSP has an operationally defined process that is also owned by the team.

The process is supported by an integrated measurement framework to help the team track their work and improve their estimating abilities.

TSP emphasizes quality with comprehensive quality management practices.

- build the right product the right way to avoid rework
- put quality product into test instead of trying to test-in quality

Key Features -2

Complete engineering process – system requirements through acceptance test.

Scalable – small to large organizational settings and projects.

Tailorable – TSP is tailored or is adapted to support existing processes.

Provides immediate and measurable benefits on first use.

Role specific training, documented process, and tools.

Topics

Introduction

TSP Concepts

- Self-directed teams and coaching
- Personal Software Process
- Process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

Management Styles

The principal management styles have been:

Body Management

People as oxen that must be driven, directed, and motivated through fear.

Frederick Taylor

Task Management

People as machines. Management knows the best way to get the work done. The workers follow.

Peter Drucker

Knowledge management

People as individuals. The knowledge worker knows the best way to get the work done. Management motivates, leads, and coaches.

Knowledge Work

"The key rule in managing knowledge work is this: managers can't manage it, the workers must manage themselves."

Software development is knowledge work.

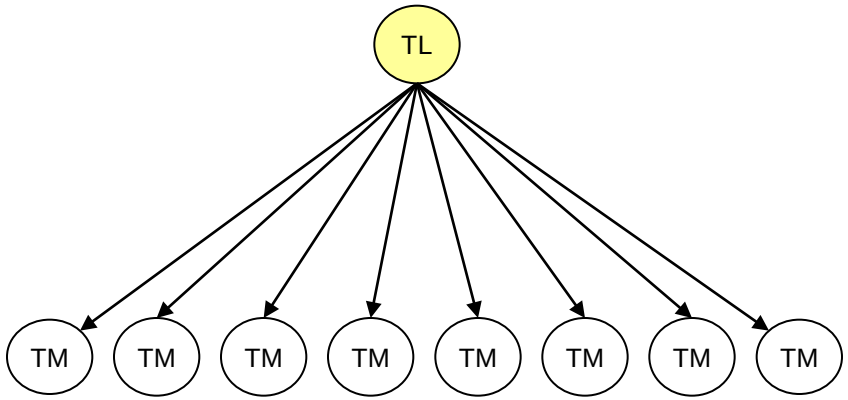
To manage software work, developers must

- be motivated
- make accurate plans
- negotiate commitments
- track their plans
- manage quality

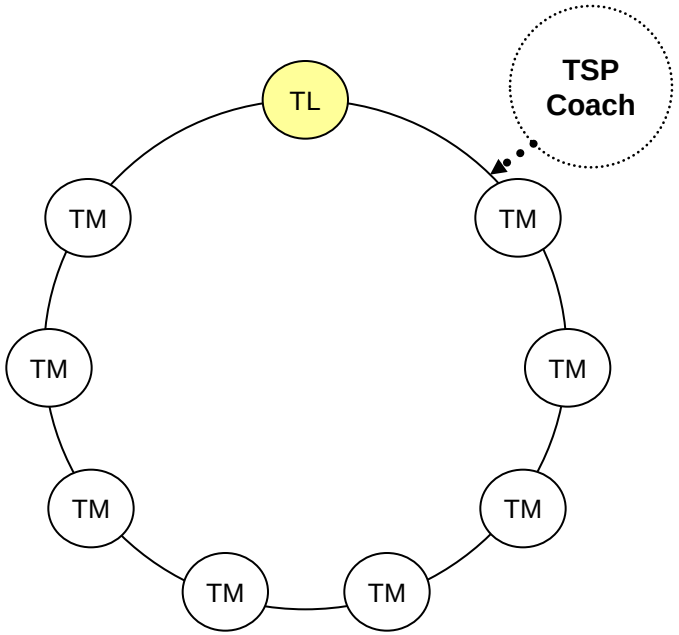
How is this accomplished?

Watts Humphrey, creator of TSP

TSP Self-directed Team Management Style

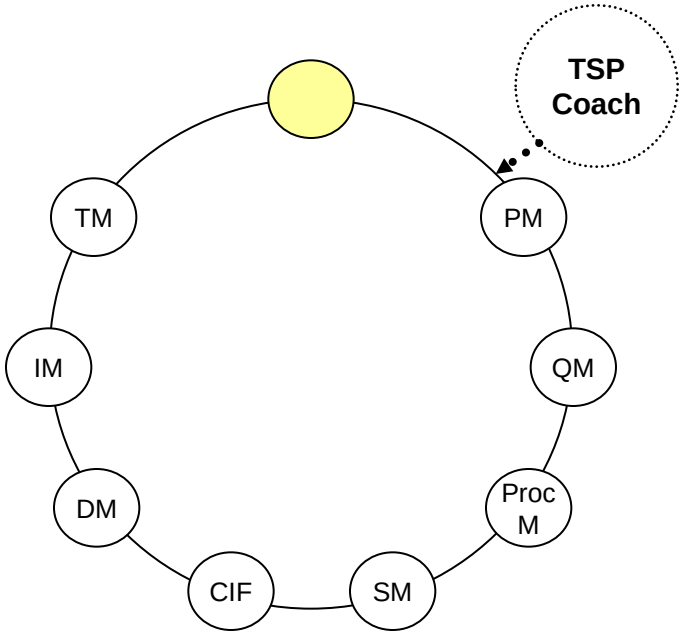


Traditional team
The leader plans, directs, and tracks the team's work.



Self-directed team
The team members participate in planning, managing, and tracking their own work.

Sharing the Team Management Responsibilities



Self-directed team roles

Eight pre-defined roles distribute traditional project management responsibilities across the team.

All team members have traditional roles, e.g. developer, tester, etc.

Project Management Roles
Planning manager – responsible for tracking the plan.
Quality manager – responsible for tracking the quality plan.
Process manager – responsible for ensuring process discipline and for process improvement.
Support manager – responsible for ensuring that support needs are met and for configuration management.
Technical Roles
Customer interface manager – responsible for the interface to the customer or customer representative.
Design manager – responsible for the design practices and quality.
Implementation manager – responsible for implementation practices and quality.
Test manager – responsible for test practices and quality.

The Team Leader's Role

The team leader does not typically take one of the eight team member roles.

The team leader's job on a TSP team is to

- guide and motivate the team in doing its work
- take the time to reach full consensus on all important issues
- ensure that the team establishes high standards for the work
- provide management support to the team
- support the team with management
- protect the team so that it can concentrate on the project

The TSP Coaching Role

The coach

- trains and facilitates the adoption of TSP
- works with the team leader to build the team
- observer that guides the team

Tiger Woods and his coach Hank Haney.

Team Leader vs. Coach

The team leader's job is to use the team to build the product.

The coaches job is to use the project to build the team.

The Impact of Self-Directed Teams

A self-directed team

- builds its own plans, negotiating trade-offs with management.
- owns its process and is committed to following it.
- measures and tracks its own work.
- knows precisely where it stands.

Because of this the team members are highly motivated to help each other meet their commitments and achieve their best performance.

Topics

Introduction

TSP Concepts

- Self-directed teams and coaching
- Personal Software Process
- Integrated process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

Learning to Develop Software

In universities,

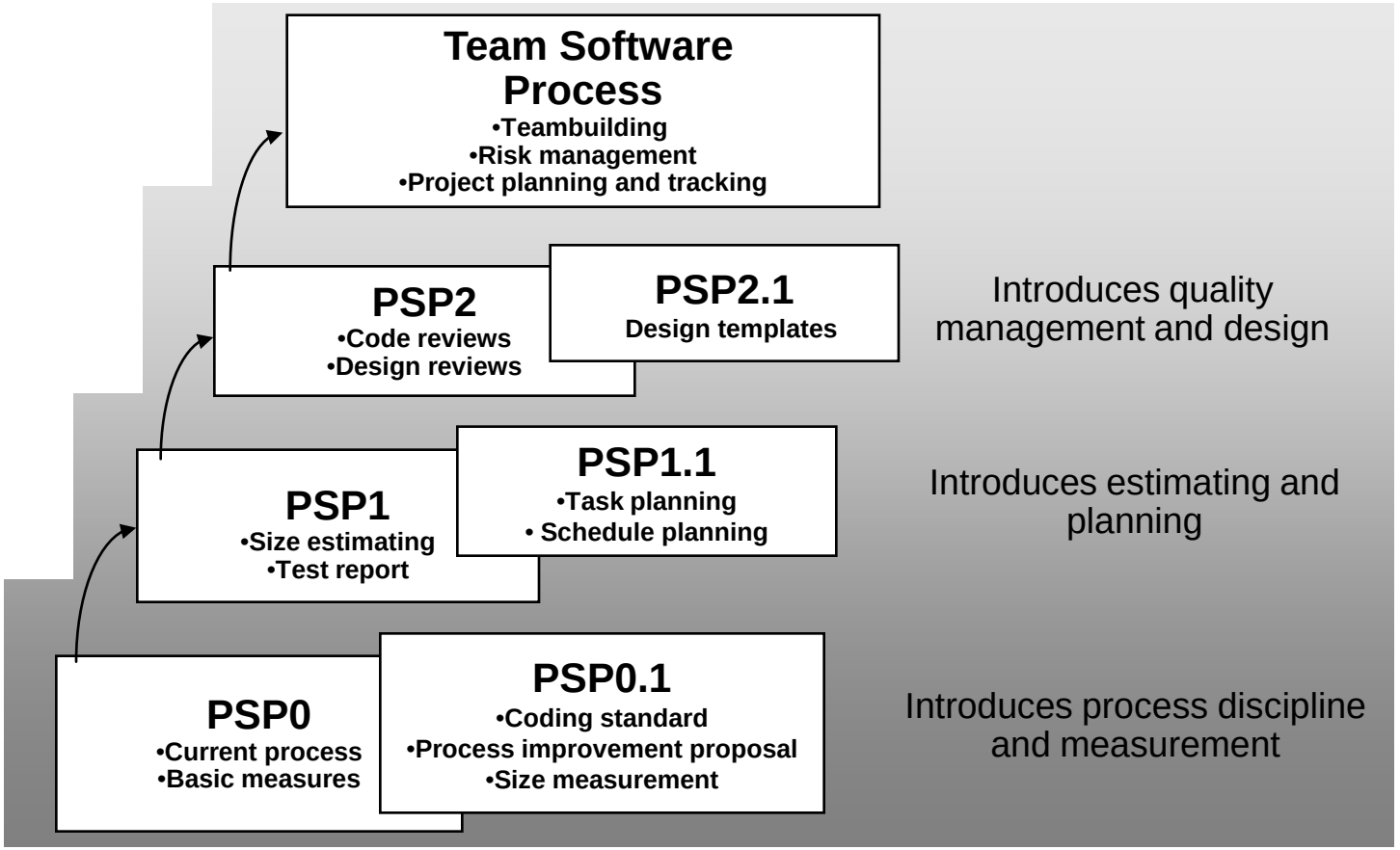
- the emphasis is on technical knowledge and individual performance.
- evaluation emphasizes code that runs, not how the student got there.
- the prevailing ethic is to code as quickly and fix the problems in test.

In industry, team-working skills are also needed.

TSP uses the Personal Software Process to build these skills.

- planning and tracking the work
- measuring and managing quality
- anticipating and correcting problems

PSP Learning Stages



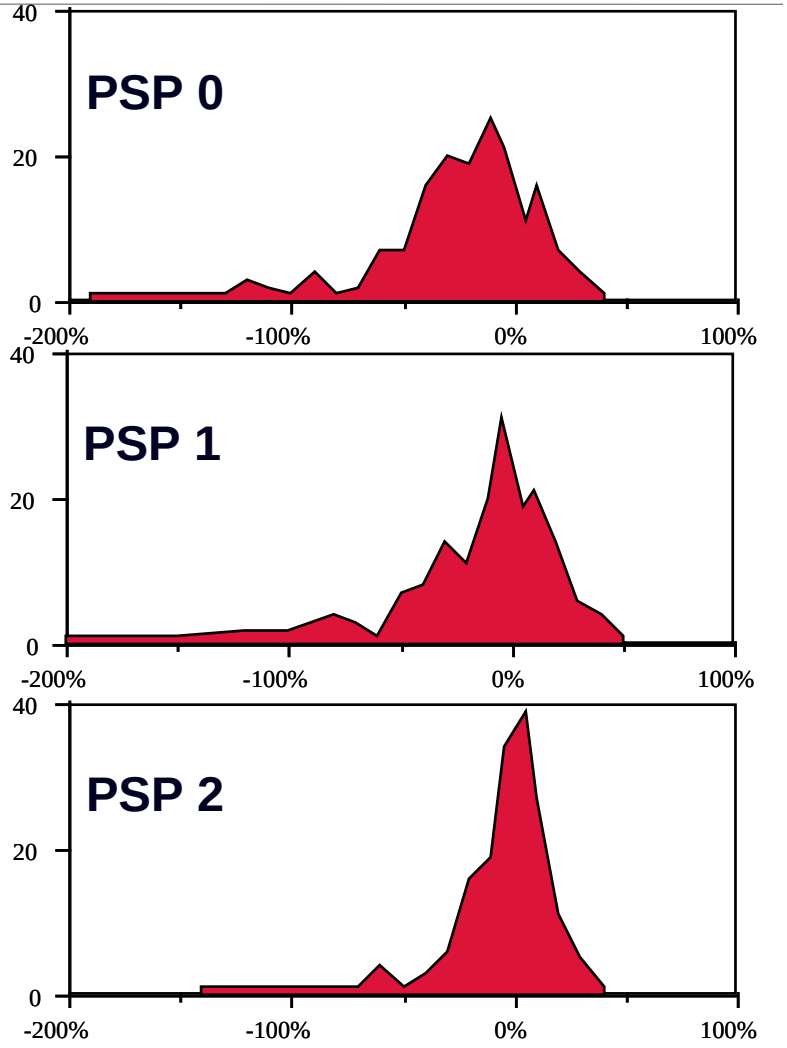
Developers write one or more programs at each PSP level

PSP Estimating Accuracy

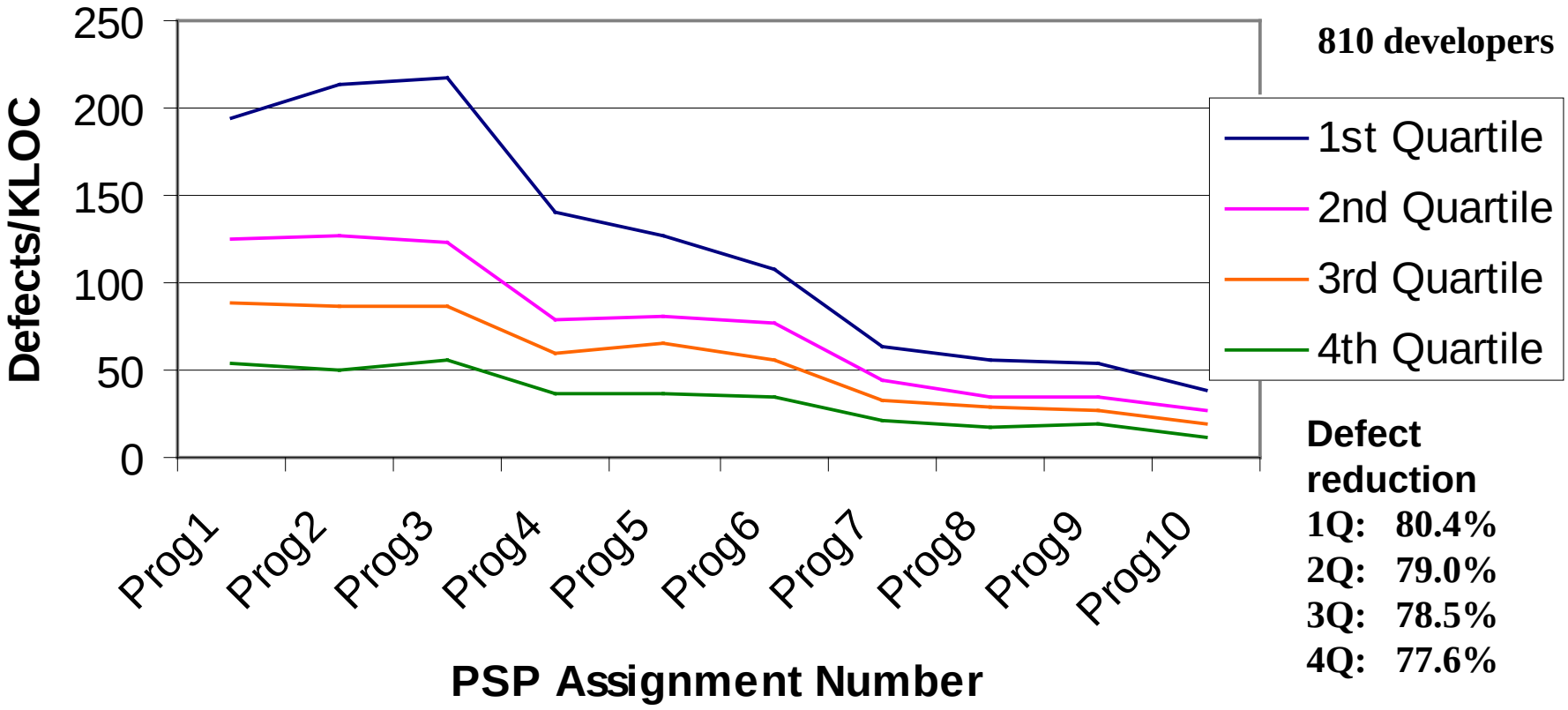
Majority are under-estimating

Balance of over-estimates and under-estimates

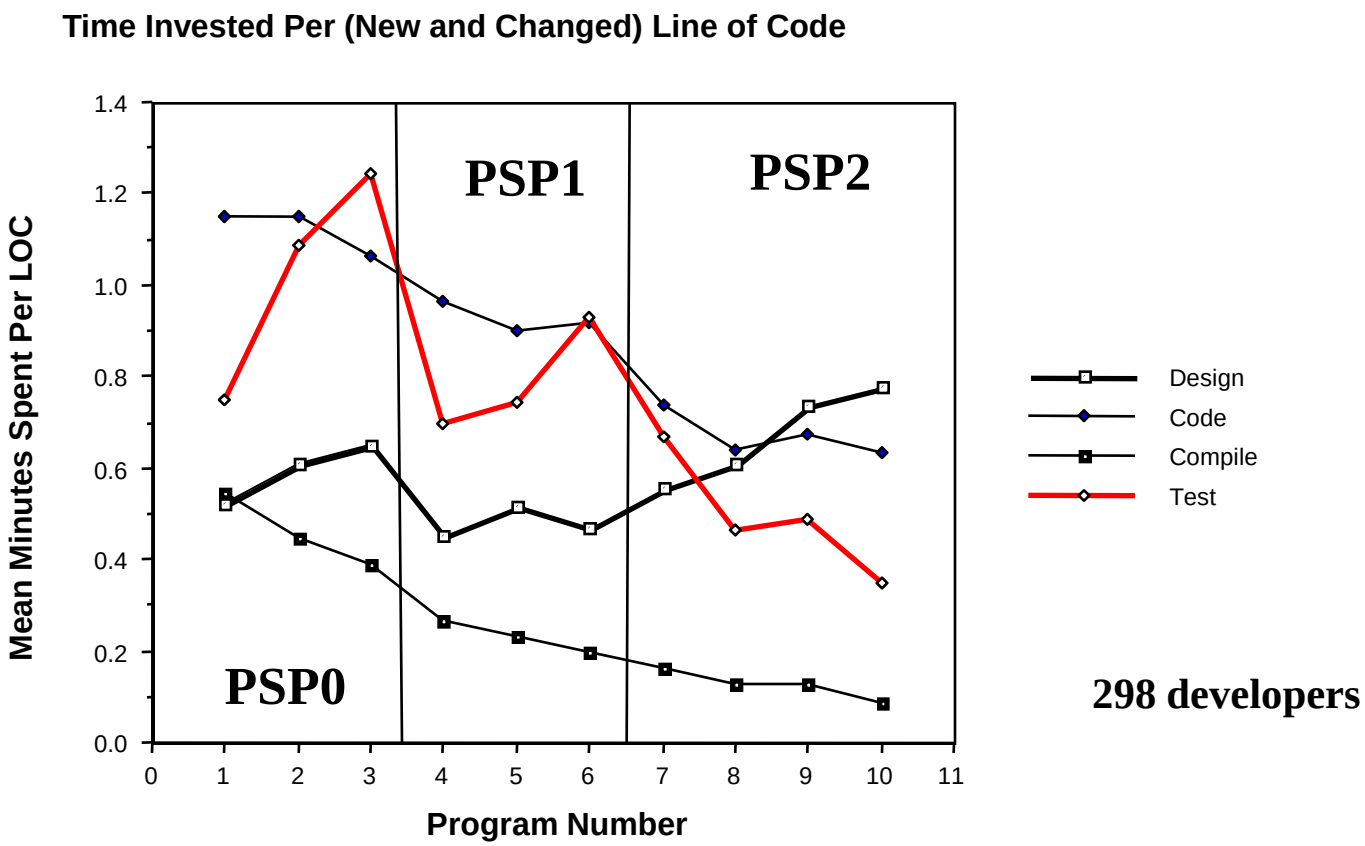
Much tighter balance around zero



Compile and Test Defects - from PSP Training



PSP Design Time Results



Topics

Introduction

TSP Concepts

- Self-directed teams and coaching
- Personal Software Process
- Process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

TSP Operational Processes and Measures

TSP is defined operationally.

- The processes provide guidance without being too detailed or inflexible.
- They are easily tailored to fit existing organizational processes.
- The measurement definitions are precise but also extensible.

Benefits

- Allows self-directed teams to own their processes.
- Instills *process discipline* rather than enforcing *process institutionalization* with auditing methods.

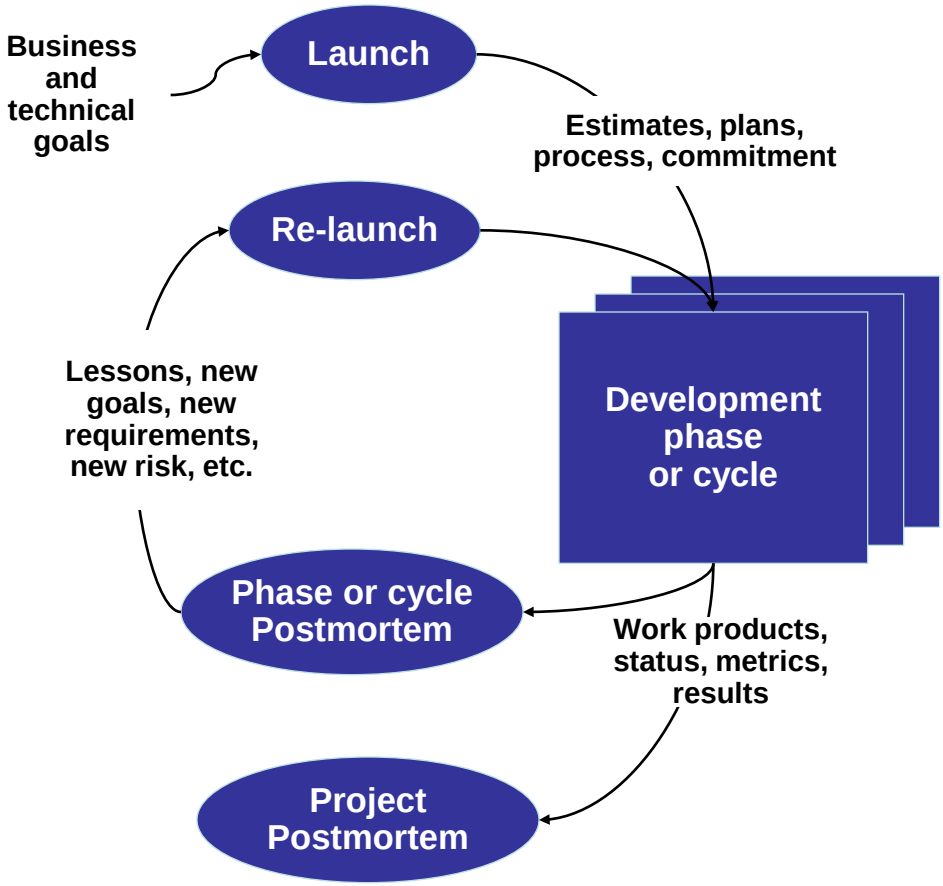
TSP Process Structure

The TSP process elements can be organized into whatever process structure makes the most business and technical sense.

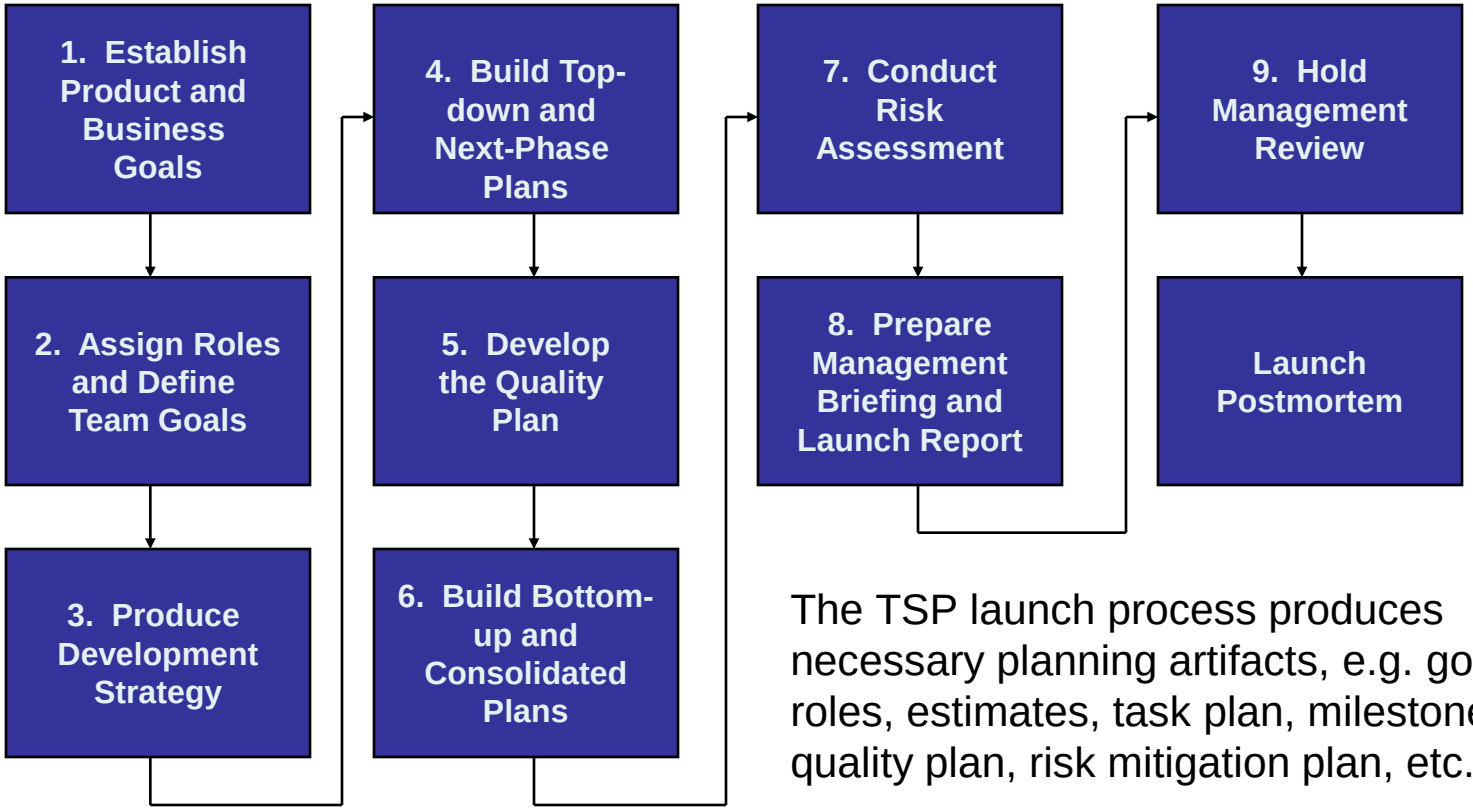
The phases can be implemented iteratively in small cycles, in a spiral with increasing cycle content, or sequentially as in a waterfall,

TSP projects can start on any phase or any cycle.

Each cycle starts with a launch or re-launch and ends with a postmortem.



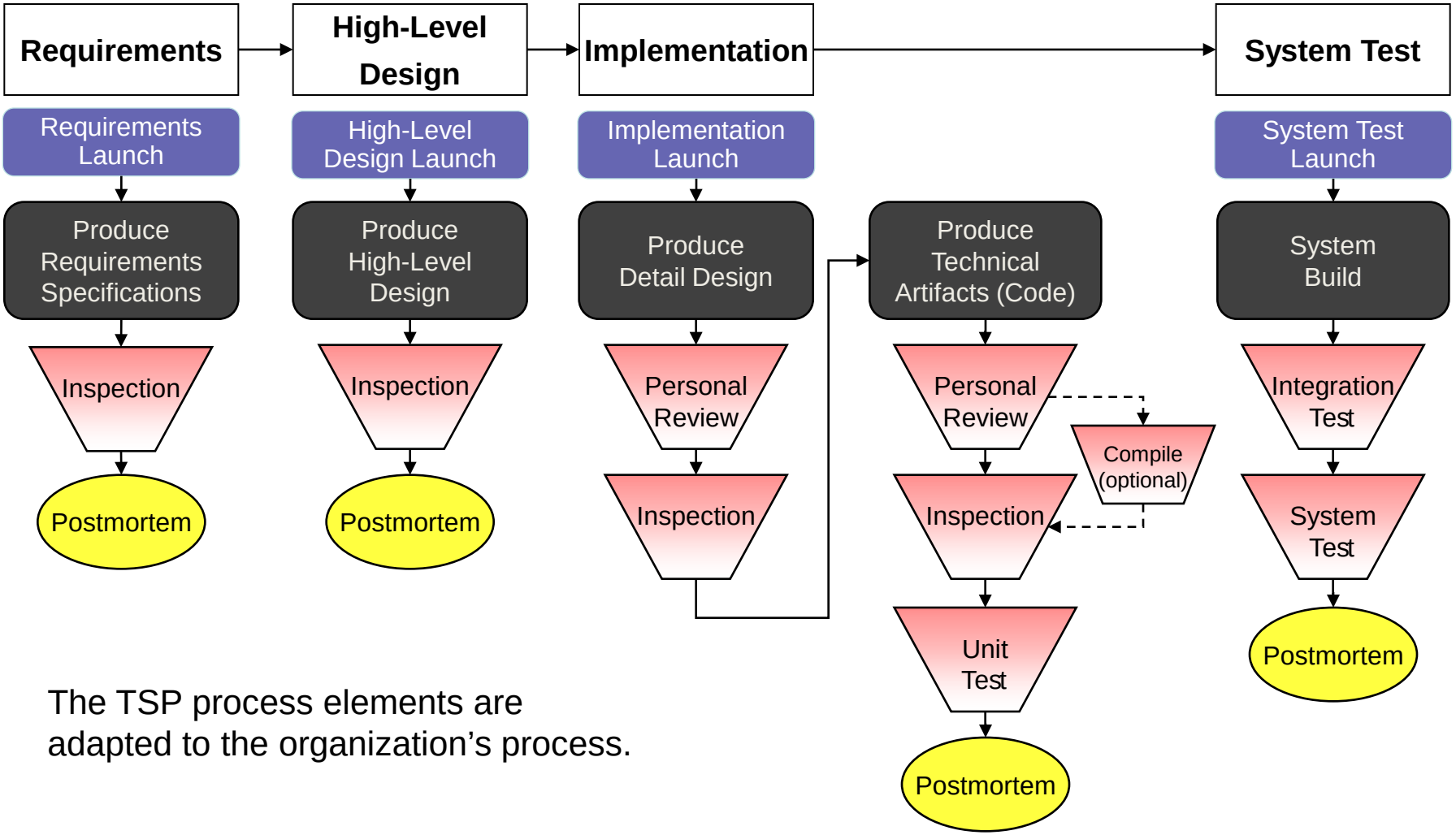
The TSP Launch Process



The TSP launch process produces necessary planning artifacts, e.g. goals, roles, estimates, task plan, milestones, quality plan, risk mitigation plan, etc.

The most important outcome is a committed team.

The TSP Development Process



The TSP process elements are adapted to the organization's process.

Measurement Framework

Schedule

Effort

Size

Quality

Four base measures

Apply to all processes and products

Estimates made during planning

Directly measured by team members while working

Schedule

Schedule is the most commonly used project measure.

Schedule accuracy depends on granularity.

TSP schedule granularity is in hours, not days, weeks, or months.

TSP Task Planning Template - Form TASK

Name: Prasad Perini
Team: PSP Ghost
Date: 2/3/2004
Cycle:

Total Plan Hours: 318.9

Reminder:
Estimated Hours can be entered manually - OR - calculated based on Estimated Si
If Size and Rate are present, this field will be recalculated when you Update Task

Generate Task List | Update Task and Schedule

Assembly	Phase	Task	Resources	Estimated Size	Size Measure	Rate (per Hr.)	Estimated Hours	Engrs	Plan Hours	Plan Date	Plan Week	Actual Hours	Actual Date
Main Form	DLDINSP	Main Form DLD Inspection	SA, PP	300	LOC	200.0	1.5	1.0	1.5	3/10/2003	15	5.0	3/7/2003
Main Form	CODEINSP	Main Form Code Inspection	SA, PP	300	LOC	200.0	1.5	1.0	1.5	3/10/2003	15	4.8	3/10/2003
Filter Object	CODEINSP	Filter Object Code Inspection	SA, PP	300	LOC	200.0	1.5	1.0	1.5	3/10/2003	15	3.2	1/22/2003
Task Panel Control	DLDINSP	Task Panel Control DLD Inspection	NK, PP	250	LOC	200.0	1.3	1.0	1.3	3/10/2003	15	0.0	3/7/2003
Task Panel Control	CODEINSP	Task Panel Control Code Inspection	NK, PP	250	LOC	200.0	1.3	1.0	1.3	3/10/2003	15	0.0	3/10/2003
ProfileUserList.aspx	DLDINSP	ProfileUserList.aspx DLD Inspection	PP, VY	1010	LOC	200.0	5.1	1.0	5.1	3/17/2003	16	2.0	2/4/2003
ProfileUserList.aspx	CODEINSP	ProfileUserList.aspx Code Inspection	PP, VY	1010	LOC	200.0	5.1	1.0	5.1	3/17/2003	16	4.4	2/27/2003

Time

Time is a measure of time on task.

The TSP time measure is task hours, i.e. the time spent on a project task, minus interruption time.

TSP team members record their time as they work, not at the end of the day, week, or month.

TSP Time Recording Log - Form LOGT

Name Prasad Perini **Date** 2/3/2004
Team PSP Ghost **Cycle**
Hours 321.2

Assembly	Phase	Task	Date	Start	Int.	Stop	Delta
OEM-ChangeR	PLAN	OEM-ChangeRequest-7 PLAN	03/13/03	15:45:10		16:22:43	37.6
OEM-ChangeR	HLD	OEM-ChangeRequest-7 HLD	03/13/03	16:53:08		17:30:40	37.5
OEM-ChangeR	DLD	OEM-ChangeRequest-7 DLD	03/13/03	17:30:49		18:02:59	32.2
OEM-ChangeR	DLD	OEM-ChangeRequest-7 DLD	03/13/03	18:55:20		19:54:35	59.3
OEM-ChangeR	DLDR	OEM-ChangeRequest-7 DLDR	03/14/03	10:00:43		10:31:59	31.3
OEM-ChangeR	DLDINSP	OEM-ChangeRequest-7 DLDINSP	03/17/03	14:37:36		15:13:56	36.3
OEM-ChangeR	DLD	OEM-ChangeRequest-7 DLD	03/17/03	15:46:18		16:00:51	14.6
OEM-ChangeR	DLD	OEM-ChangeRequest-7 DLD	03/17/03	16:11:56		16:33:34	21.6
OEM-ChangeR	DLDR	OEM-ChangeRequest-7 DLDR	03/17/03	16:46:49		17:04:20	17.5
OEM-ChangeR	CODE	OEM-ChangeRequest-7 CODE	03/17/03	17:45:47		18:47:23	61.6
OEM-ChangeR	CODE	OEM-ChangeRequest-7 CODE	03/17/03	18:50:51		19:01:18	10.5
OEM-ChangeR	CODE	OEM-ChangeRequest-7 CODE	03/18/03	09:38:54		10:10:35	31.7
OEM-ChangeR	CR	OEM-ChangeRequest-7 CR	03/18/03	11:50:46		12:04:33	13.8
OEM-ChangeR	CR	OEM-ChangeRequest-7 CR	03/18/03	12:53:56		13:29:14	35.3

Size

Size is a measure of the magnitude of the deliverable, e.g. lines of code or function points, pages.

TSP size measures are selected based on their correlation with time.

TSP also uses size data to

- normalize other measures
- track progress

TSP Size Summary - Form SUMS

Name: Prasad Perini
Team: PSP Ghost
Date: 2/3/2004
Cycle:

						Actual Size						
ID	Assembly, Sub-Assembly, or Part Name	(A)ssembly or (P)art	Parent Assembly Name	Owner	Size Measure	Base	Deleted	Modified	Added	Reused	New and Changed	Total
25	DeliveryOEMPartValidate-Files	A	OEM MOO Integration RSM	PP	LOC	0	0	0	489	0	489	489
26	DeliveryOEMPartList(SQL)	A	OEM MOO Integration RSM	PP	LOC	0	0	0	613	0	613	613
27	AppDataExchangeCreate(SQL	A	OEM MOO Integration RSM	PP	LOC	0	0	0	178	0	178	178
28	AppDataExchangeGet(SQL)	A	OEM MOO Integration RSM	PP	LOC	0	0	0	153	0	153	153
29	OEM MOO Integration RSM	A	SYSTEM	NK	Text Pages	0	0	0	4	0	4	4
30	Build Doc for OEM MOO Team	A	OEM MOO Integration RSM	NK	Text Pages	0	0	0	0	0	0	0

Defects

Defects are the measure of quality in the TSP.

Any change to an interim or final work product, made to ensure proper design, implementation, test, use, or maintenance, is a defect in the TSP.

Defects are logged as they are found and fixed.

Defect tracking takes place throughout the process.

TSP Defect Recording Log - Form LOGD

Name Prasad Perini **Date** 2/3/2004
Team PSP Ghost **Cycle**

Date	Num	Type	Assembly	Injected	Removed	Fix Time	Fix Ref.	Description
1/16/2003	66	20	OEM User Groups	CODE	CR	5.0		Missing ',' between parameters
1/16/2003	67	70	OEM User Groups	CODE	CR	5.0		Permissions don't match for objects and its attribut
1/23/2003	68	70	OEM User Groups	DLD	CODEINSP	5.0		SRFile, SRProperty objects need create permissio
1/23/2003	69	70	OEM User Groups	DLD	CODEINSP	10.0		Permissions don't match for objects and its attribut
1/23/2003	70	70	OEM User Groups	CODE	CODEINSP	2.0		211-212 Wrong Sproc (iGrpApp should be iCode)
1/24/2003	71	70	OEM User Groups	CODE	UT	25.0		Wrong Database Name for UserAccount Object
1/24/2003	72	70	OEM User Groups	DLD	UT	3.0		Extra Attribute name in UserAccount ObjectAttribu
1/24/2003	73	90	AppDataExchangeG	DLD	DLDR	1.0		Granted permissions to OEMUsers instead of Phoe
1/24/2003	74	40	AppDataExchangeG	DLD	DLDR	5.0		Step names in Logic don't match with error table
1/24/2003	75	40	AppDataExchangeG	DLD	DLDR	1.0		Change record to IsActive in step 2
1/24/2003	76	70	AppDataExchangeG	DLD	DLDR	1.0		Column names were not specified in step 4

What the Base Measures Provide

Management measures derived from the base measures are used by the team to manage the project and manage quality.

Project management measures: earned value, productivity , estimation accuracy, estimation size and effort prediction intervals, cost performance index, time in phase distributions, …

Quality management measures: defects injected and removed in each process phase, defect density, defect injection and removal rates, process yield, phase yield, review and inspection rates, cost of quality, percent defect free, quality profiles, quality profile index, …

Topics

Introduction

TSP Concepts

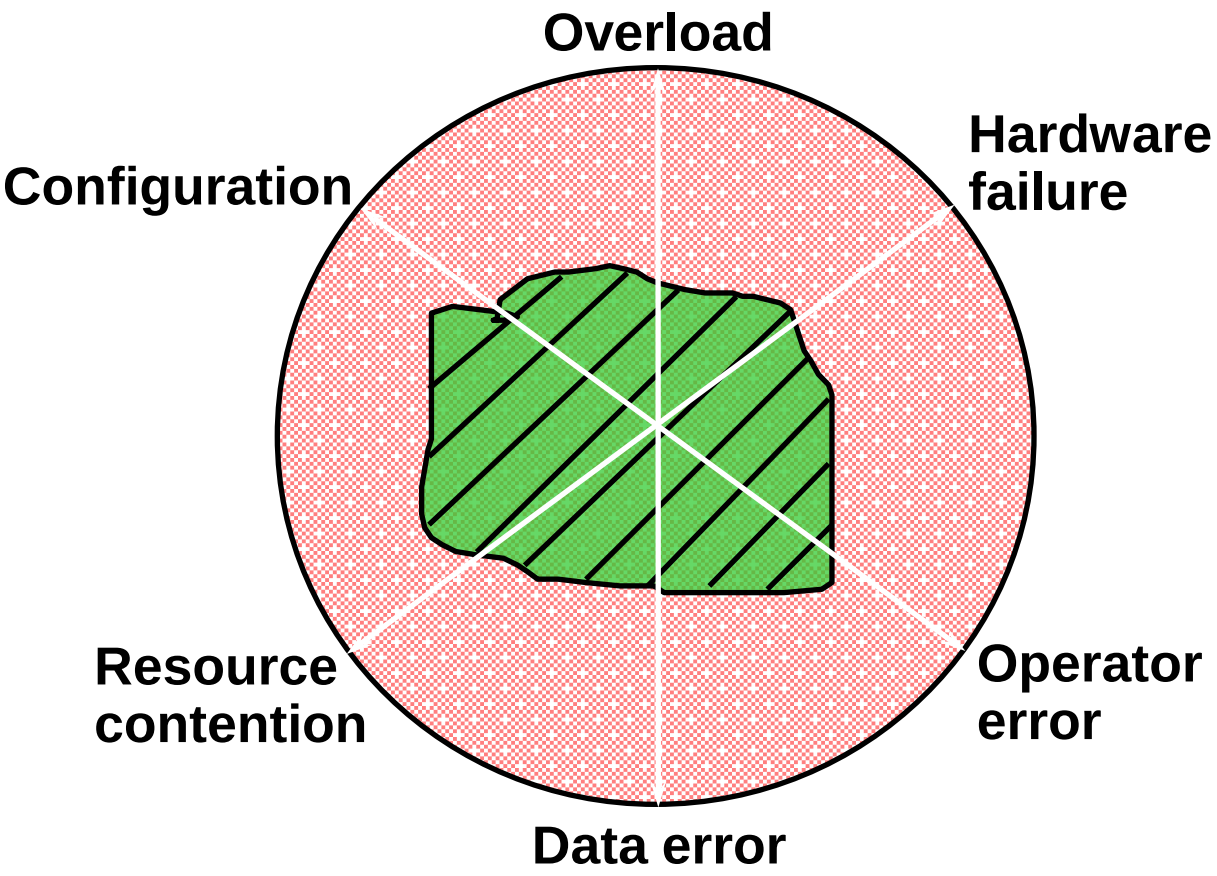
- Self-directed teams and coaching
- Personal Software Process
- Process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

Testing Coverage



Safe and secure region = tested (shaded green)

Unsafe and insecure region = untested (shaded red)

Put a Quality Product into Test

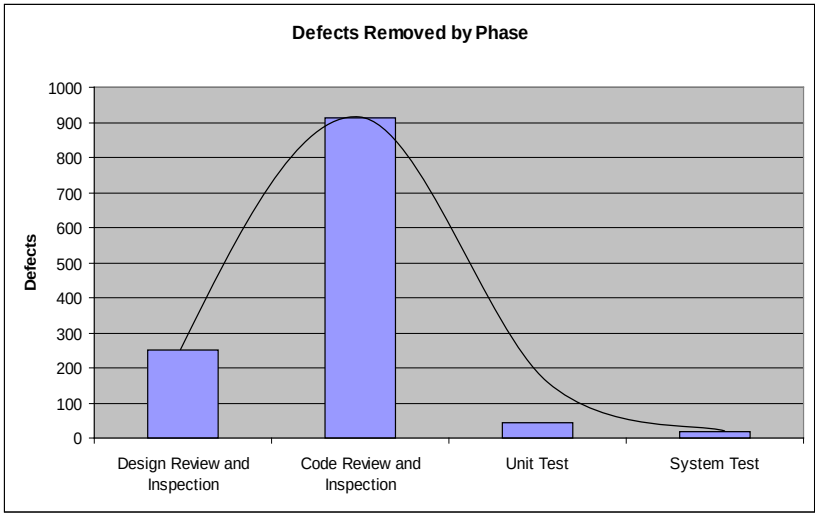
IBM's Dr. Harlan Mills asked: "*How do you know that you've found the last defect in system test?*"

"You never find the first one."

If you want a quality product out of test, you must put a quality product into test.

How do you put a quality product into test?

Quality Management!



TSP Quality Management Practices -1

Planning for quality

- TSP quality planning estimates the number of defects injected and removed at each phase based on historical injection rates and phase yields.
- Removal rates, review rates, phase time ratios, defect densities, and other quality indicators are then calculated by the tools.

Measuring and tracking quality

- Developers track every defect found and fixed.
- Quality is reviewed weekly by the quality manager and the team.

TSP Quality Management Practices -2

Defect removal filters

- Every activity that finds and removes defects can be thought of as a defect removal filter, e.g. reviews, inspections, compilers, static analyzers, etc.
- TSP has many such filters.

Capture/Recapture

- TSP uses capture/recapture to estimate the defects missed in inspections.

Defect prevention

- Every defect found in system test or later is analyzed to prevent future escapes.
- Every defective module is re-inspected.

Quality and the Team

High quality can only be achieved by the development team.

To manage quality they must

- have control of their process
- have the proper data to track quality
- be properly trained and motivated

The self-directed team management style empowers the team to manage quality.

The integrated measurement framework provides the data.

PSP provides the training, motivation, and commitment.

Topics

Introduction

TSP Concepts

- Self-directed teams and coaching
- Personal Software Process
- Process and measurement framework
- Comprehensive quality management

Team management with TSP

User experience

Getting Started

Team Management with TSP

With the TSP measurement framework, teams know exactly where they stand in several dimensions.

- Schedule
- Resources
- Product quality

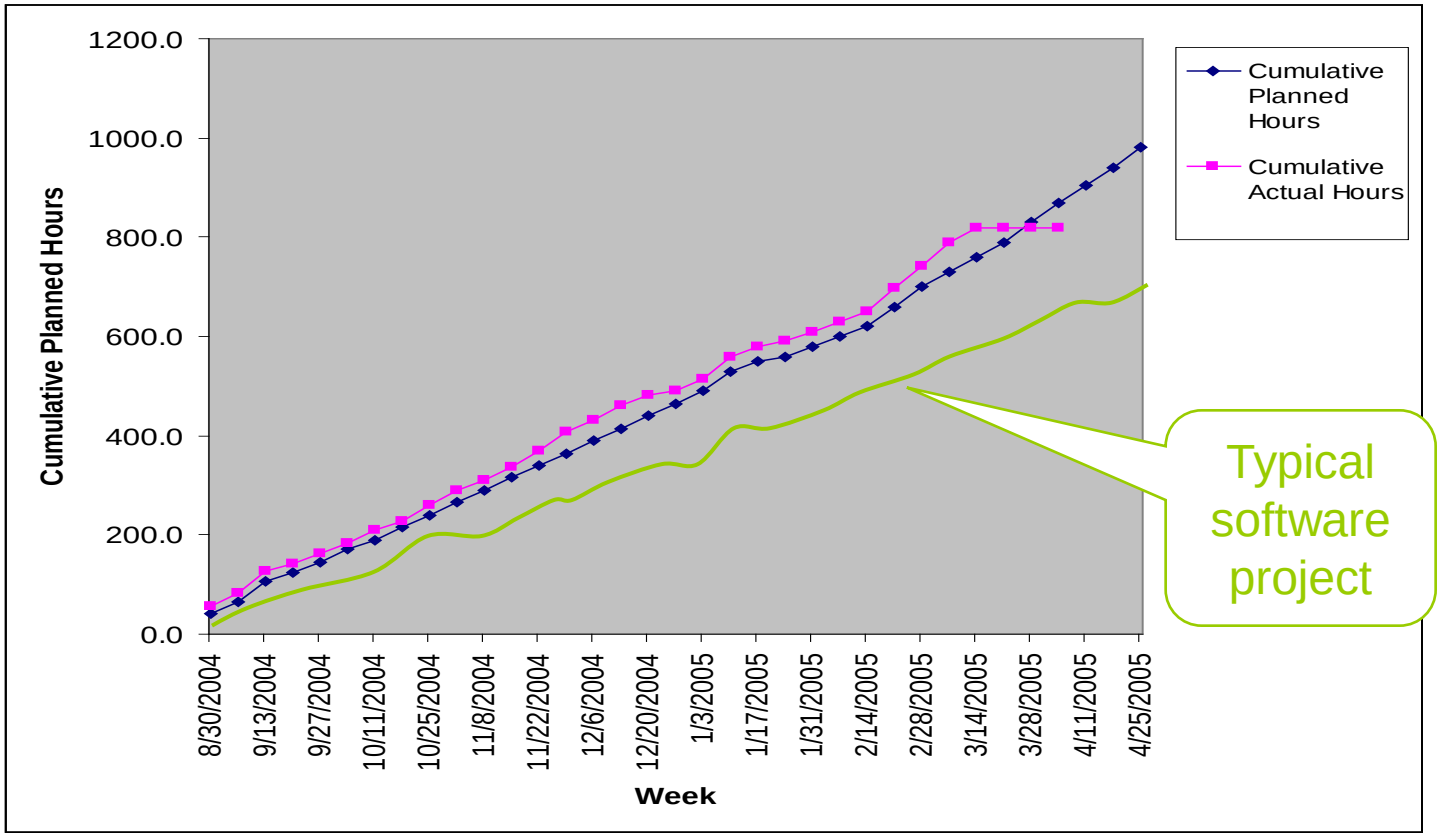
Teams use the data to

- manage their work
- anticipate and address problems early
- improve cost, schedule, and quality

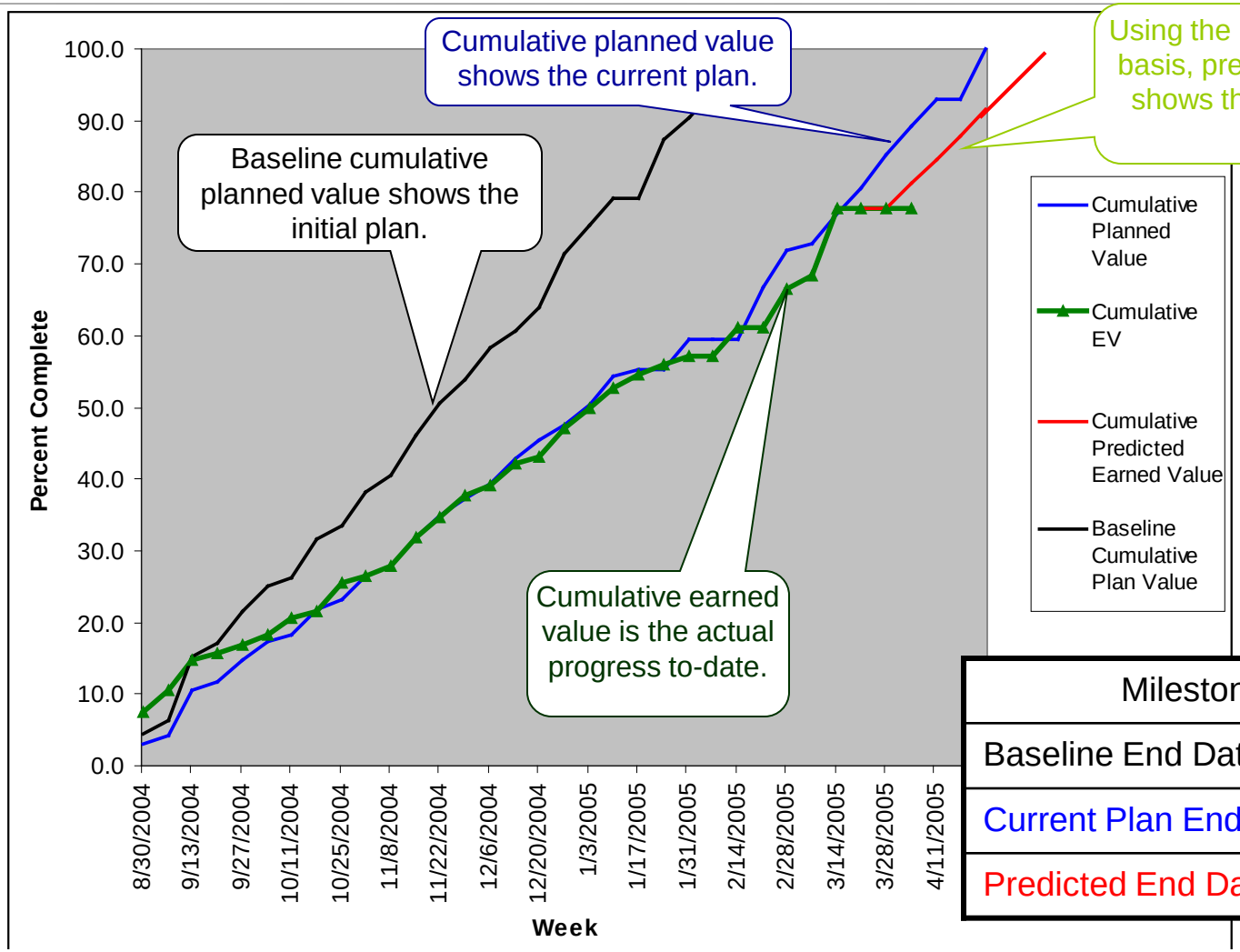
The teams and their managers use the same data to manage the project as illustrated in the following sample of TSP charts and forms.

Resource Tracking

Cumulative plan and actual resource hours shows resource burn rate and potential source of slip



Earned Value Tracking



Milestone	Date
Baseline End Date	2/14
Current Plan End Date	4/25
Predicted End Date	5/16

TSP Weekly Status Report

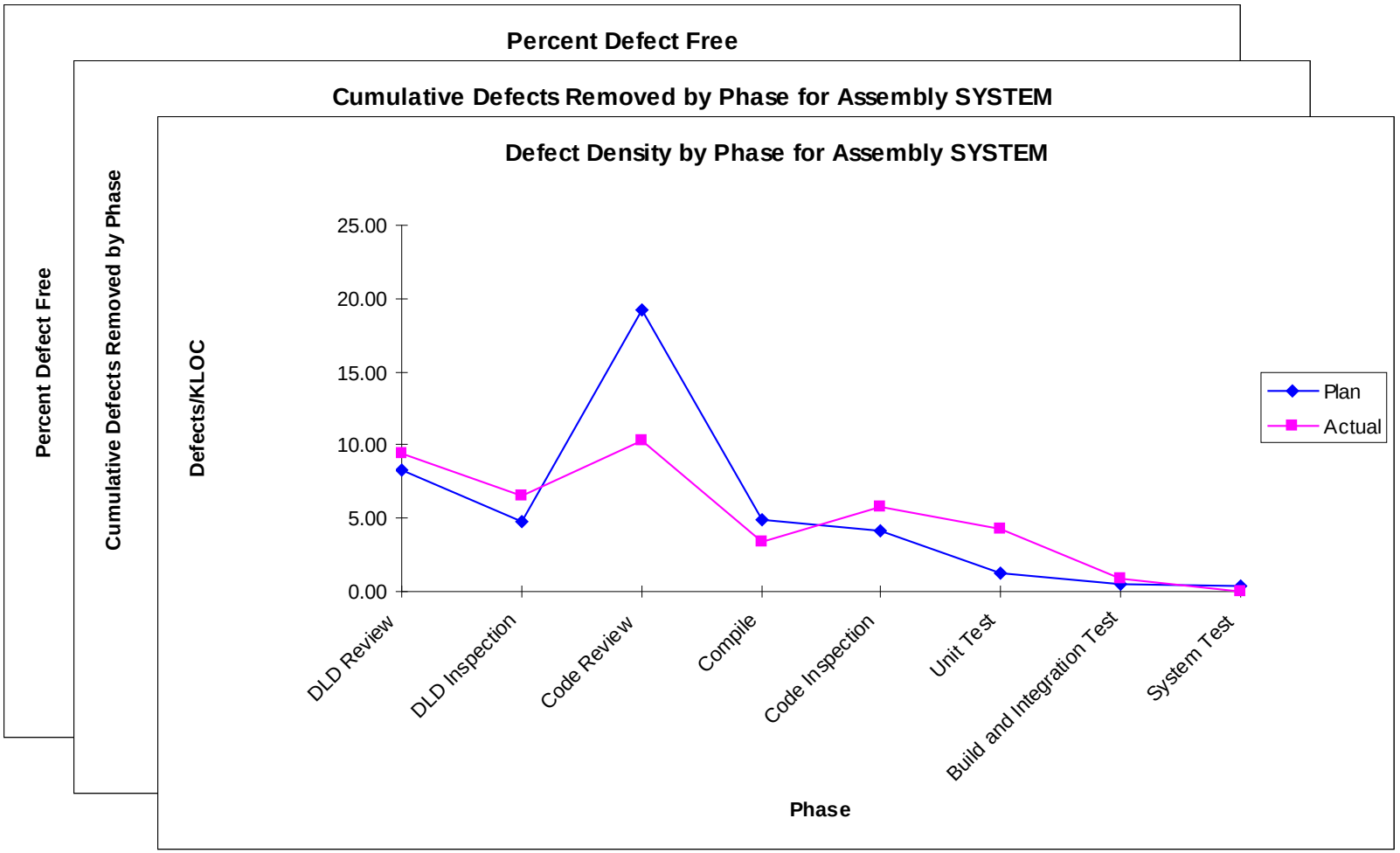
TSP Week Summary - Form WEEK

Name	Carol
Team	PSP Ghost
Status for Week	15
Week Date	3/10/2003
Date	4/7/2003
Cycle	

Weekly Data	Plan	Actual	Plan/ Actual
Schedule hours for this week	151.0	86.0	1.76
Schedule hours this cycle to date	1526.0	1594.8	0.96
Earned value for this week	6.9	4.2	1.64
Earned value this cycle to date	79.5	84.3	0.94
To-date hours for tasks completed	1580.7	1568.1	1.01
To-date average hours per week	101.7	106.3	0.96

Assembly	Phase	Tasks Completed or Due	Resource	Task Plan Hrs.	Task Actual Hrs.	Earned or Plan Value	Planned Week	Plan vs. Actual Hrs.
Main Form	CODEINSP	Main Form Code Inspection	SA	1.5	2.4	0.1	10	0.63
OEMMOO Delivery.aspx	UT	OEMMOO Delivery.aspx (FE-Server) U	NK	8.9	3.0	0.5	13	2.91
OEMMOO Delivery.aspx	DLDINSP	OEMMOO Delivery.aspx (FE-Client) DI	NK	0.0	0.0	0.0	13	
OEMMOO Delivery.aspx	CODE	OEMMOO Delivery.aspx (FE-Client) C	NK	7.5	5.7	0.4	14	1.32
OEMMOO Delivery.aspx	CR	OEMMOO Delivery.aspx (FE-Client) C	NK	3.8	1.7	0.2	14	2.26
OEMMOO Delivery.aspx	COMPILE	OEMMOO Delivery.aspx (FE-Client) C	NK	1.3	0.9	0.1	14	1.44
OEMMOO Delivery.aspx	CODEINSP	OEMMOO Delivery.aspx (FE-Client) C	NK	0.0	0.0	0.0	14	
OEMMOO Delivery.aspx	UT	OEMMOO Delivery.aspx (FE-Client) U	NK	5.9	6.8	0.3	14	0.87
Query Object	TD	Query Object Test Development	MB	0.0	0.0	0.0	14	
Query Object	CODEINSP	Query Object Code Inspection	MB	0.0	1.2	0.0	14	0.00
Query Object	UT	Query Object Unit Test Dialogs	MB	1.1	1.7	0.1	14	0.66

Quality Tracking



Quality Profile

The TSP Quality Profile is a quality early warning indicator.

It examines criteria that are effective predictors of system test and post-release quality, and produces a graph of the result.

It supports drill down to any level for further analysis, e.g. in software:

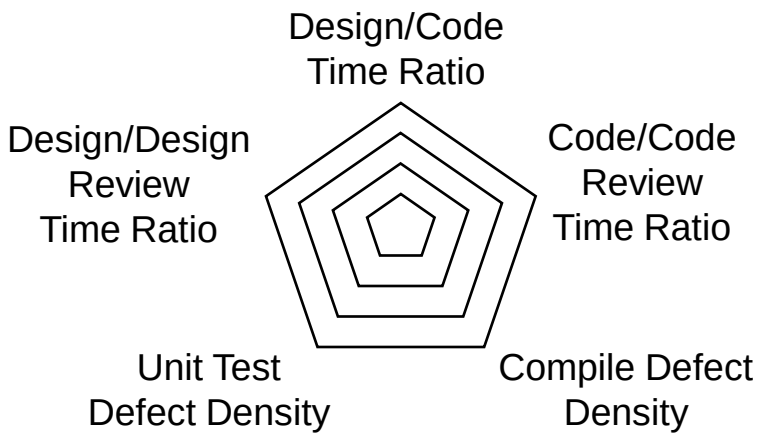
system → component → module → class.

Quality Profile Criteria

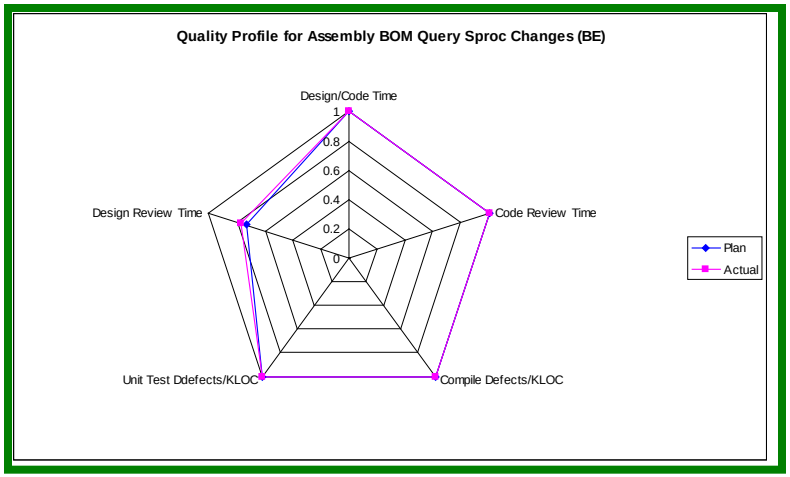
1. Design time = coding time
2. Design review time = ½ design time
3. Code review time = ½ coding time
4. Compile defects < 10 per KLOC
5. Unit test defects < 5 per KLOC

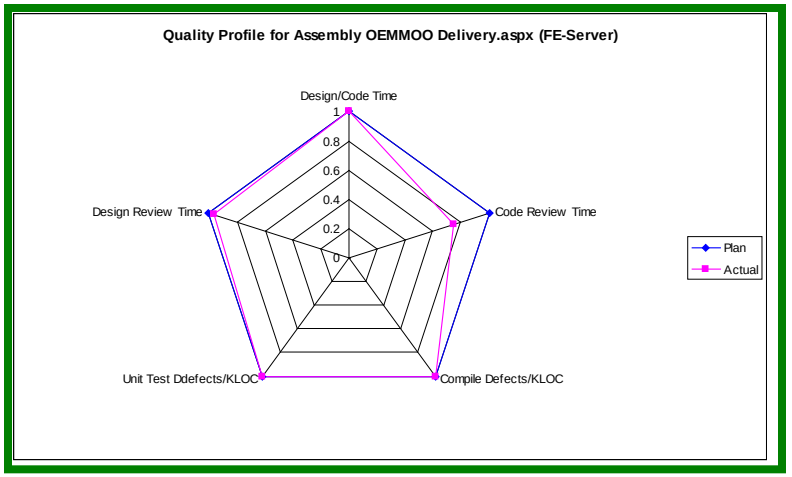
If satisfied, a criterion has a value of 1, and is drawn along the outer edge of the chart.

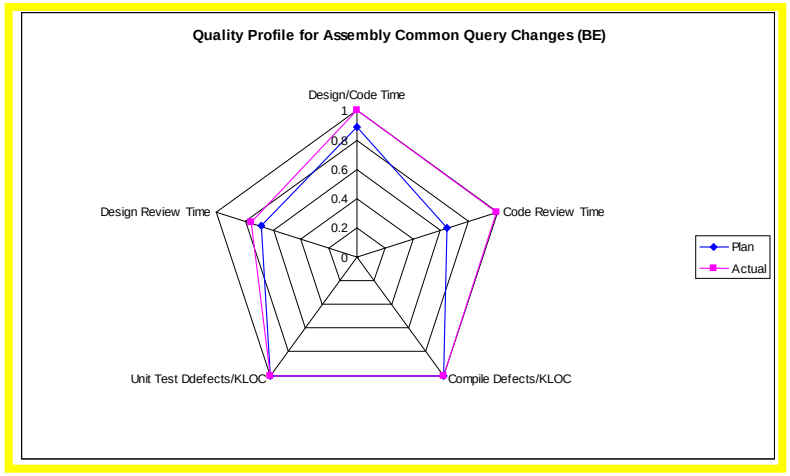
Quality Profile

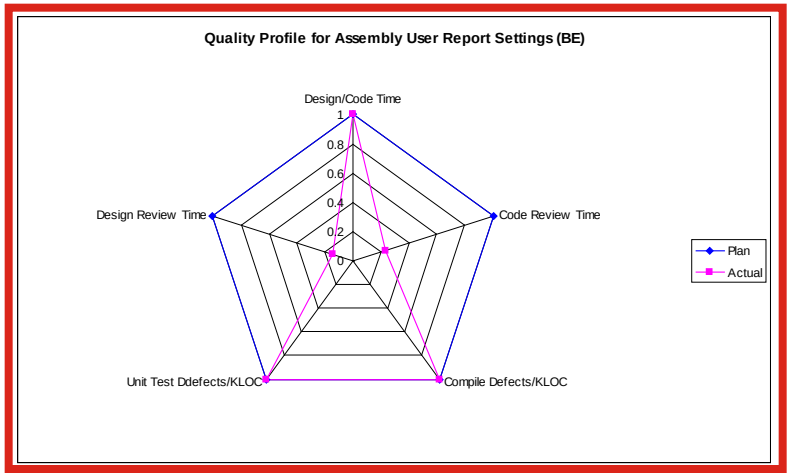


Using the Quality Profile









Topics

Introduction

TSP Concepts

Team management with TSP

User experience

Getting Started

The Business Case for TSP

The principal cost of introducing TSP are training costs and lost opportunity cost resulting from time spent in training.

The principal benefits are

- lower development costs and shorter schedules
- more functionality per release and improved productivity
- lower defect density in both system test and in the delivered product
- improved work-life balance for the developers
- improved customer satisfaction

Schedule Management

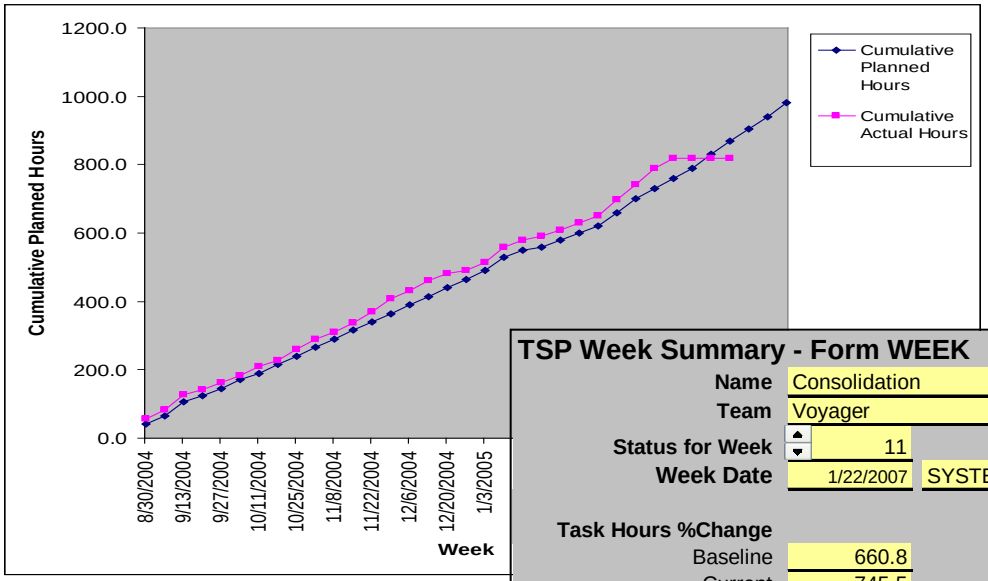
First-time TSP projects at Microsoft had a 10 times better mean schedule error than non-TSP projects at Microsoft as reflected in the following table.

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

Managing Task Hours

Task hours are the hours that teams spend on planned tasks and do not include unplanned but necessary tasks like meetings, courses, coordination, handling mail, etc.

When measured, tracked, and managed, the team can usually improve task hours, but management can't. ***Why?***



Teams monitor actual vs. plan hours per week and for the cycle

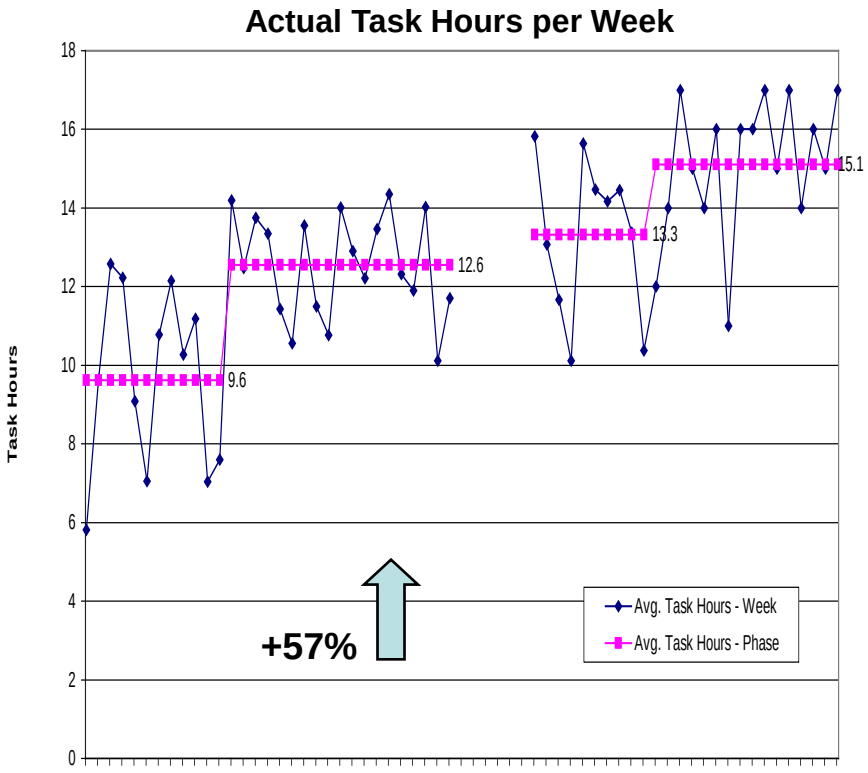
TSP Week Summary - Form WEEK

Name	Consolidation						**Date**
Team	Voyager						
Status for Week	11	**Selected Assembly**					**Cycle**
Week Date	1/22/2007	SYSTEM					
Task Hours %Change			**Weekly Data**	**Plan**	**Actual**	**Plan / Actual**	**Plan - Actual**
Baseline	660.8		Schedule hours for this week	51.0	48.1	1.06	2.9
Current	745.5		Schedule hours this cycle to date	344.0	395.0	0.87	-51.0

Improving Task Hours

At Allied Signal average task hours per developer per week were improved from 9.6 hours to 15.1 hours through quiet time, process documentation, more efficient meetings, etc.

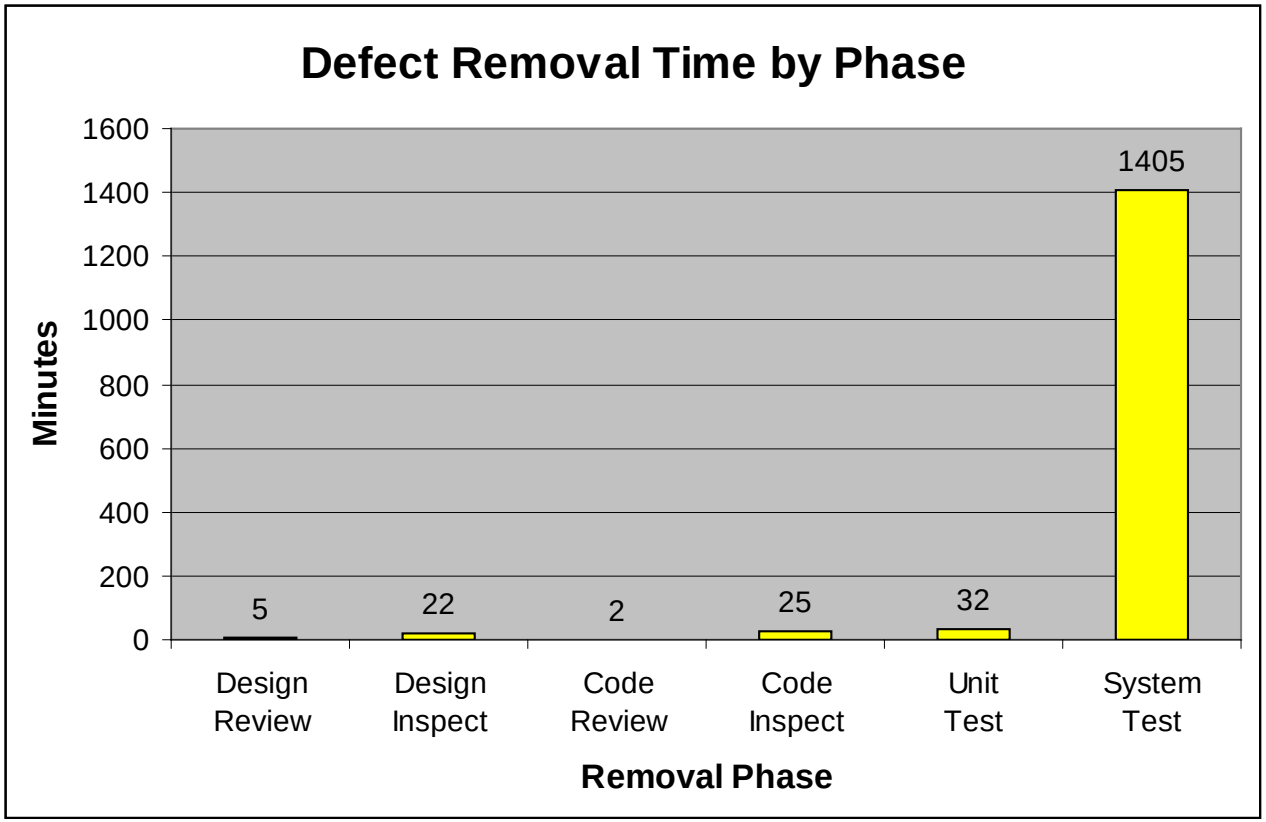
This is equivalent to a 57% increase in productivity.



Source: Allied Signal

Reviews and Inspections Save Time

Xerox found that TSP quality management practices reduced the cost of poor quality by finding and removing defects earlier when costs are lower.



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

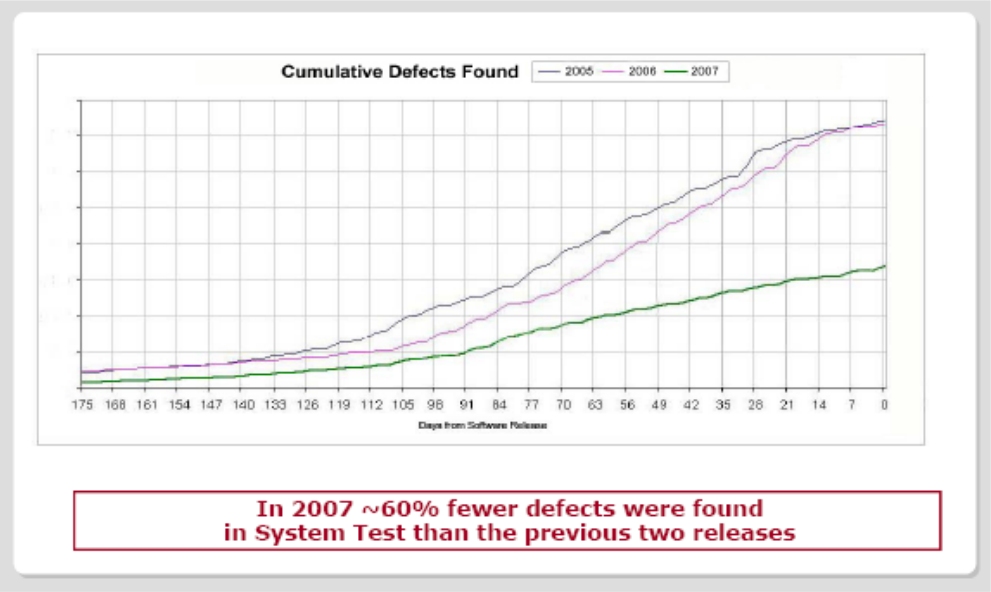
Source: Intuit

Intuit Quality Improvement

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

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

Results at Intuit: Improved Quality



Source: Intuit

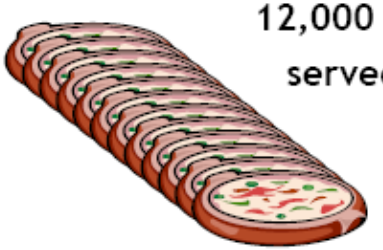
Work-Life Balance

Finding and retaining good people is critical to long-term success.

Intuit found that TSP improved work-life balance, a key factor in job satisfaction.

Results at Intuit: Improved Work-Life Balance

- Half as many weekend source check-ins (<3%)
- Reduced $ on dinners as measured by PSS - "Pizza Slices Served"



12,000 pizza slices served last year

vs

~30 pizza slices this year

TSP helped improved employee work life balance

Source: Intuit

Topics

Introduction

TSP Concepts

Team management with TSP

User experience

Getting Started

TSP Product Suite: Process, Training, Tools

Process Notebook

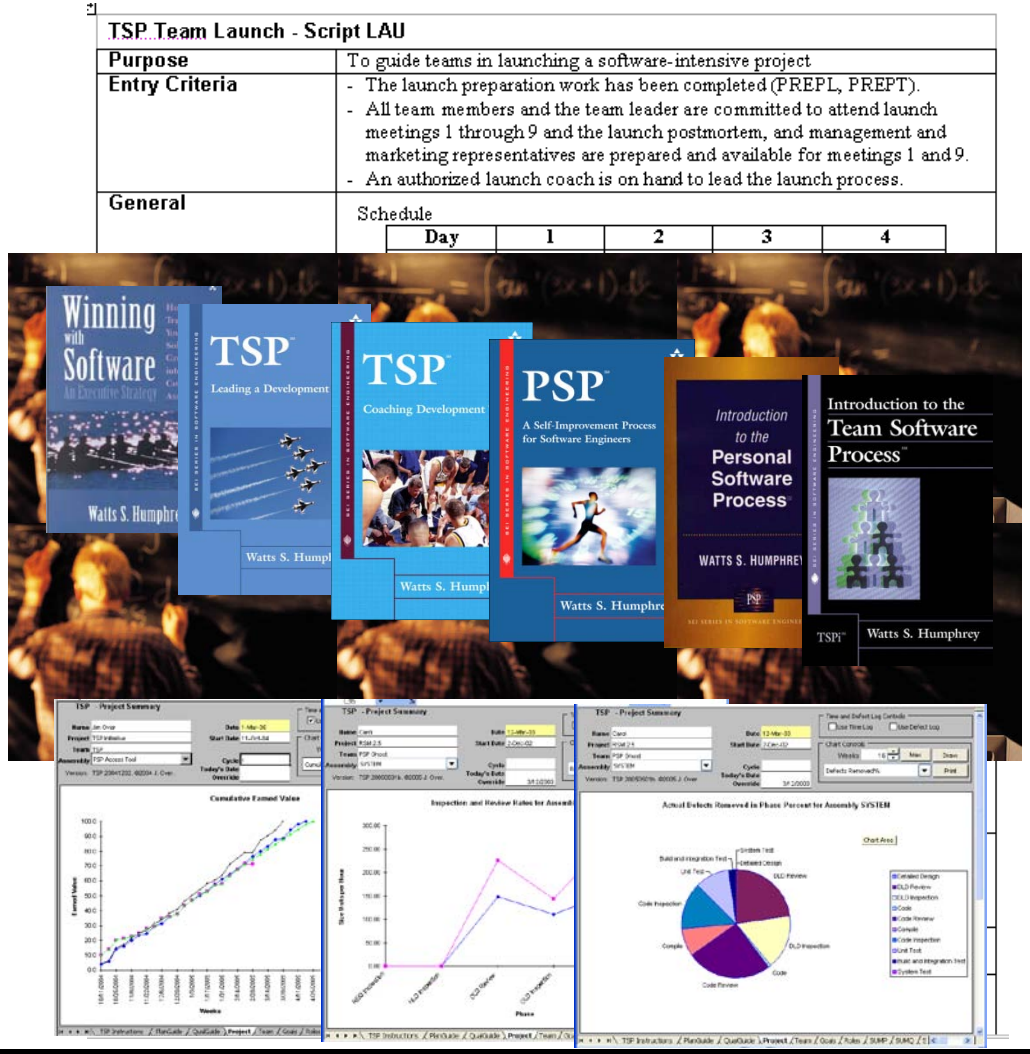
- Process scripts
- Forms
- Guidelines and standards
- Role descriptions

Training and Textbooks

- Executives
- Project Managers
- Engineering
- TSP Coach
- TSP Trainer

Tools

- TSP Workbook
- PSP Workbook
- Coach/Trainer Workbook



TSP Team Launch - Script LAU	
Purpose	To guide teams in launching a software-intensive project
Entry Criteria	- The launch preparation work has been completed (PREPL, PREPT). - All team members and the team leader are committed to attend launch meetings 1 through 9 and the launch postmortem, and management and marketing representatives are prepared and available for meetings 1 and 9. - An authorized launch coach is on hand to lead the launch process.
General	Schedule

Day	1	2	3	4

TSP Implementation Strategy

TSP is implemented on a project-by-project or team-by-team basis

Start with two or three teams.

- train the team members and their managers
- launch these teams with TSP
- evaluate and fine tune the approach

This cycle is then repeated, increasing scope at a sustainable pace.

Deployment Timeline

Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TSP Executive Strategy Seminar	♦											
Leading Development Teams	♦											
PSP Fundamentals		♦										
Launch Initial Teams		♦										
Cycle Postmortem for Initial Teams				♦								
Re-launch Initial Teams				♦								
Train instructors and coaches		→	→									
Project Postmortem for Initial Teams						♦						
Train and launch remaining projects and teams at a sustainable pace.				→	→	→	→	→	→	→	→	→

The training schedule can be compressed to as short as one month for a faster start.

The gating factor for most organizations is the availability of projects.

SEI recommends training internal coaches as soon as possible.

Selecting Pilot Projects

Pick 2 to 3 pilot projects.

- 3 to 15 team members
- 4 to 18 month schedule
- software-intensive new development or enhancement
- representative of the organization's work
- important projects

Select teams with members and managers who are willing to participate.

Consider the group relationships.

- contractors
- organizational boundaries
- internal conflicts

Build Internal Capability

Organizations should develop internal capability to support TSP.

- SEI-certified TSP coaches are essential
- SEI-authorized trainers are optional as training can be outsourced

The initial pilot projects provide the “hands-on” experience.

- first SEI leads the effort and internal staff observe
- then internal staff lead and SEI mentors

Training and authorization requirements

- Coach – one week training course, exam, and a launch observation
- Instructor – one week training course and an exam

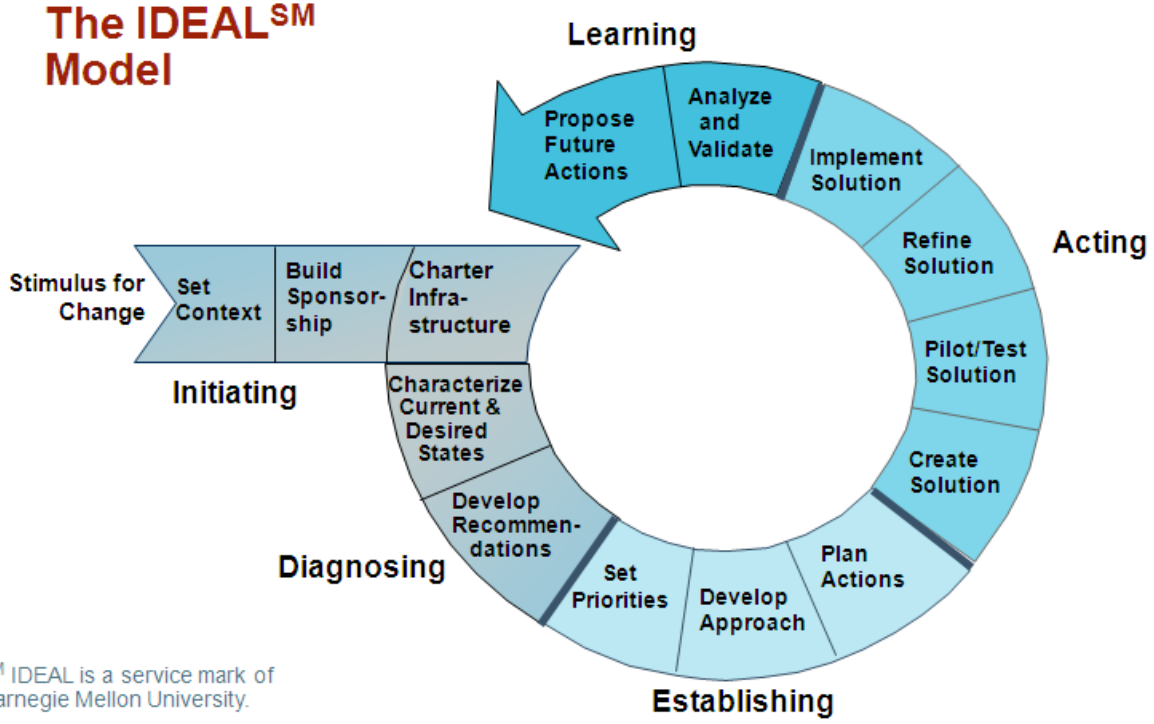
Training for Participants

Participant	CBT Option	Course	Notes
Executives and senior management	No	*TSP Executive Strategy Seminar*	1 day + optional ½ day strategic planning session.
Middle and first-line managers	No	*Leading Development Teams*	3 days
Software developers	Yes	*PSP Fundamentals* *PSP Advanced*	5 days 5 days (optional)
Team members other than software developers		*TSP Team Member Training*	2.5 days (will replace *Introduction to Personal Process in 2009)*
Instructors	No	*PSP Instructor Training*	5 days Pre-requisite training: *PSP Fundamentals and PSP Advanced or PSP I and PSP II*
Coaches	No	*TSP Coach Training*	5 days Pre-requisite training: *PSP Fundamentals and PSP Advanced or PSP I and PSP II*

Questions?

Software Engineering Institute | Carnegie Mellon

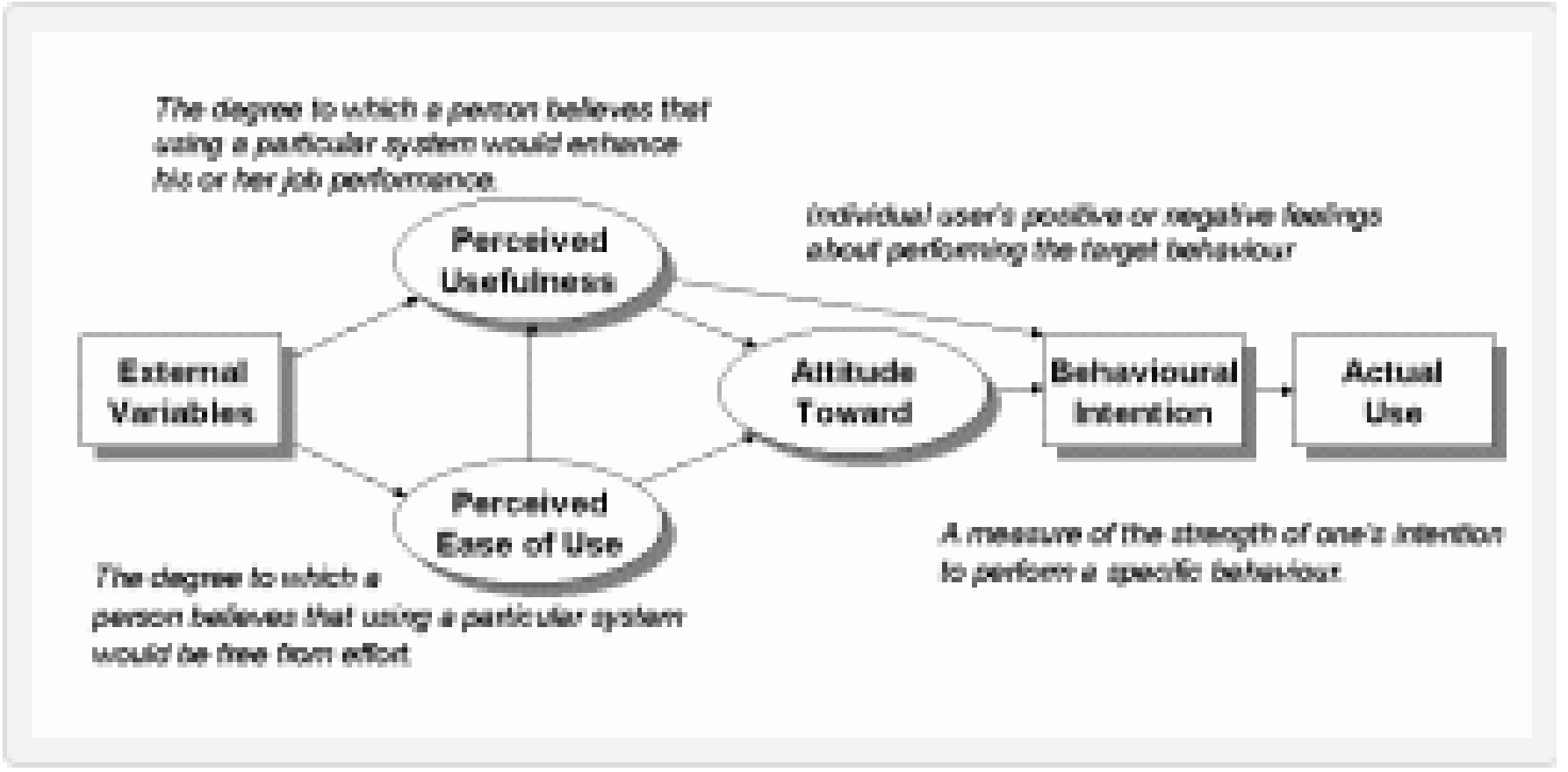
The IDEAL℠ Model



℠ IDEAL is a service mark of Carnegie Mellon University.

Contact	Awareness	Understanding	Trial Use	Adoption
•Conversation •Website •Article	•Conferences •Books •Articles •Training	•Books •Classes •Conferences •Consultants	•Org Sponsorship (MSG) •Change Agency (EPG) •Action Teams (PATS) •New Organizational Processes/Innovation •Pilot Projects	•Rollout Strategy •Training •Support

The Technology Acceptance Model is an information systems theory that models how users come to accept and use a technology.



Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). ***Development and test of a theory of technological learning and usage. Human Relations****, 45(7), 660-686.*