SAND2006-3336P

A family of practices to deliver products on schedule, on budget, and high quality

May 24, 2006

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Science & Engineering Info Systems Group 4510

- Provide high-impact, value-added software and system solutions to Sandia's core mission programs
  - Nuclear Weapons (NW) SMU
  - Defense Systems and Assessments (DS&A) SMU
  - Homeland Security and Defense (HS&D) SMU
  - Integrated Enabling Services (IES) SMU
- Quality emphasis
  - Enterprise Architecture
  - Capability Maturity Model (CMM) Level 3
  - Target of CMMi Level 4
  - High rigor for classified systems as needed

Science & Engineering Info Systems Group 4510

- Core Competencies include:
  - Enterprise Architecture (includes Data & S/W architectures)
  - Production software solutions
    - Used across the Nuclear Weapons Complex
    - Need To Know access component w/API
    - High complexity systems (modeling & simulation, waveform analyses, security, reusable components)
  - Data Services
    - High rigor data warehousing (integration)
    - Data analyses, decision support systems
    - Data mining, pattern recognition, natural language processing

Science & Engineering Info Systems Group 4510

- **Experience with Applications Development**
  - **Currently developing new systems:**
    - **Nuclear Weapons (NW) Stockpile Surveillance**
  - **Releasing new versions**
    - **Classified NW Portal**
    - **NW Record Of Assembly**
    - **Materials Properties Analyses software**
    - **Stockpile Dismantlement software**
    - **Other classified systems**

The Goals of the PSP^{sm} and TSP^{sm}

The principal objective of the PSP and TSP is to make ***quality work*** normal and natural.

To do this, developers must

- Plan and track their personal work
- Measure and manage the quality of their products
- Follow their defined processes

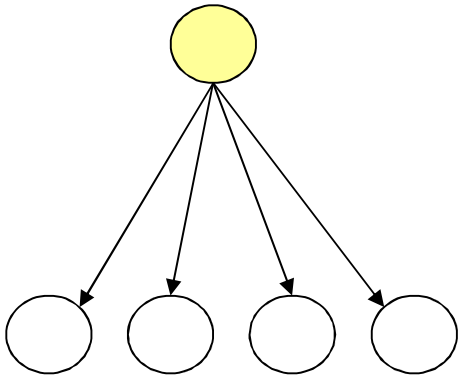
This, in turn, requires that the developers

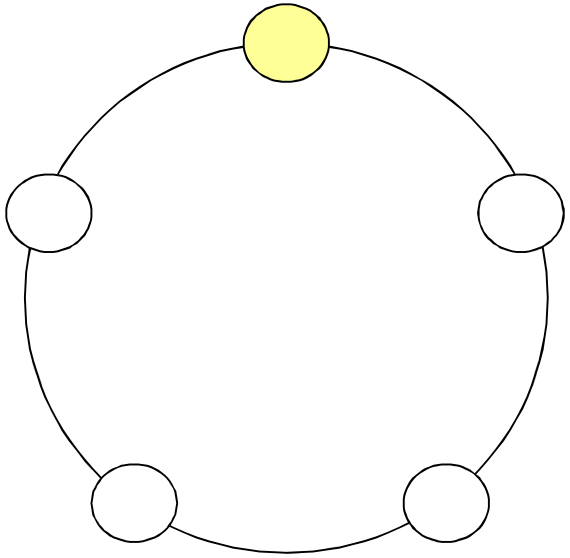
- "own" their own processes
- Believe in and be committed to their plans
- Strive to produce quality products

Successful Team Practices

- **When development teams work well, they generally have successful projects.**
- **To be successful, teams need**
  - clear goals
  - established roles
  - defined processes
  - agreed-upon plans
- **Teams also must be motivated and personally committed.**
- **Without these, teams will rarely be successful.**

Self-directed Teams





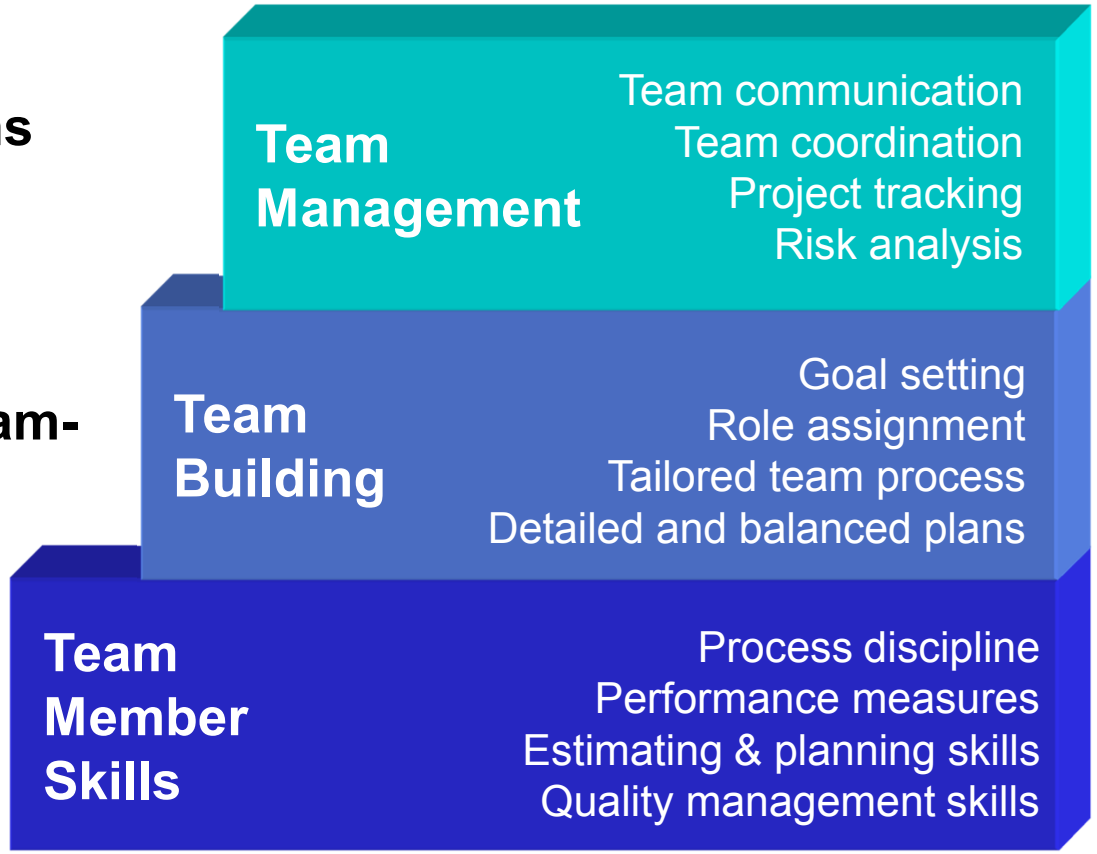
Traditional team
The leader plans, directs, and tracks the team's work.

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

Building Self-directed Teams

Self-directed teams must be built.

This requires a team-building process.



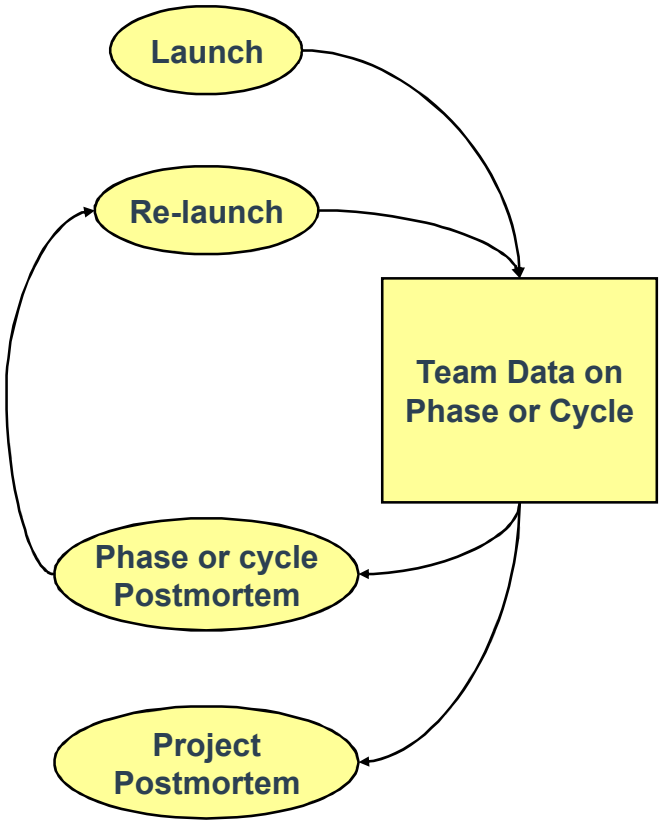
TSP Planning

TSP projects can start on any phase or cycle.

Each phase or cycle starts with a launch or re-launch.

The strategy is to
- develop in increments
- use multiple cycles
- work-ahead

TSP permits whatever process structure makes the most business and technical sense.



The TSP^{sm} Launch/Relaunch

The Launch

- The purpose of the launch is to produce a ***Team*** plan and get management agreement to that plan
- The principal objective of the launch is to build a team that is ready to jell
- The launch builds the team's confidence in their ability to do quality work

The TSP^{sm} Launch/Relaunch

In the four-day TSP team-building process, teams

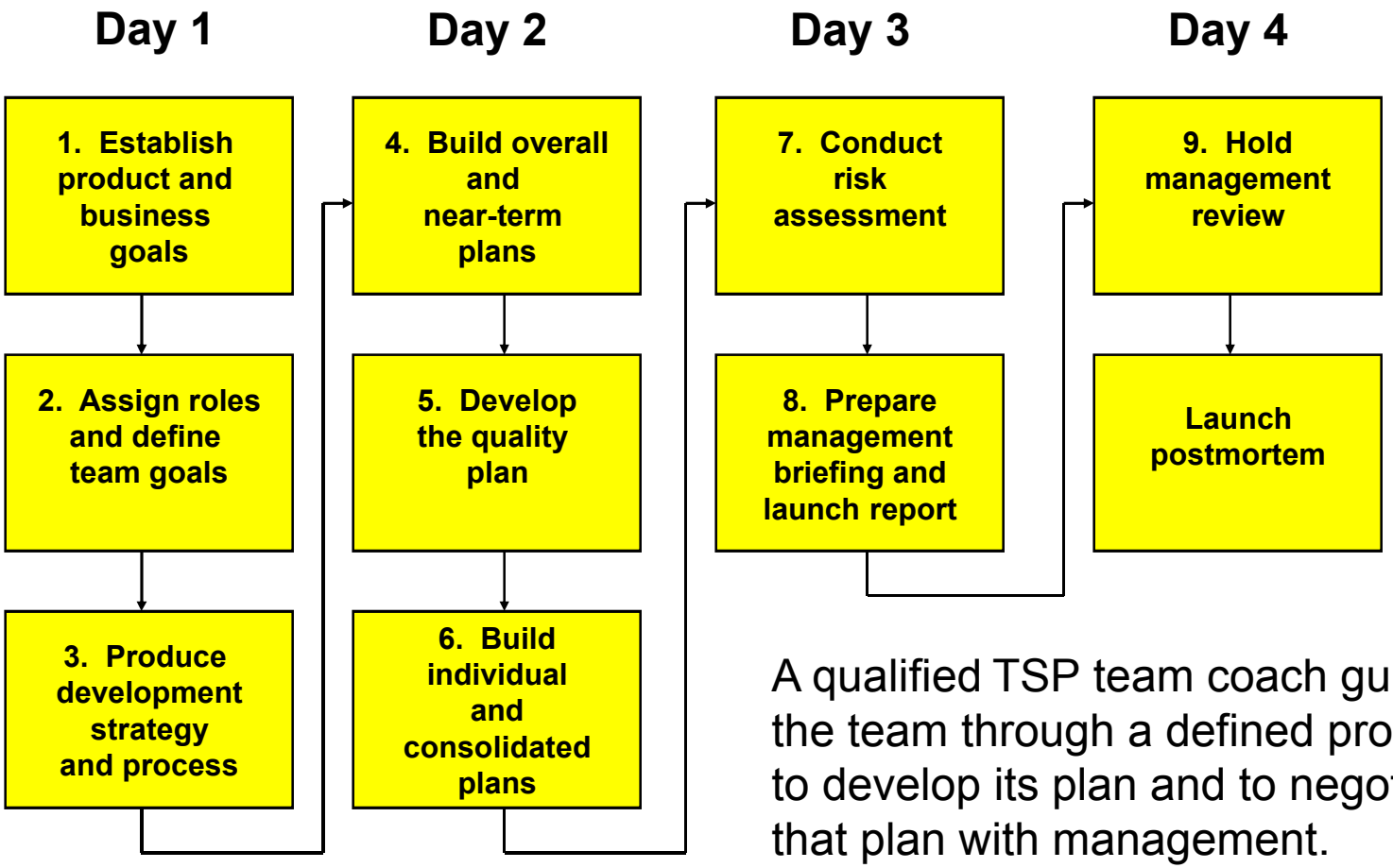
- establish their own goals and roles
- define their own strategies and processes
- produce their product development plans
- defend their plans to management

TSP teams

- own their own processes and plans
- understand why their goals are important
- have voluntarily committed to their goals
- believe that their commitments are achievable

All team members participate in the launch.

The TSP Launch Process



A qualified TSP team coach guides the team through a defined process to develop its plan and to negotiate that plan with management.

TSP^{sm} Metrics: Managing with Data

TSP^{sm} teams **use data** to help manage the project. The four basic metrics:

- Schedule
- Time
- Size
- Defects

From these the team **tracks**:

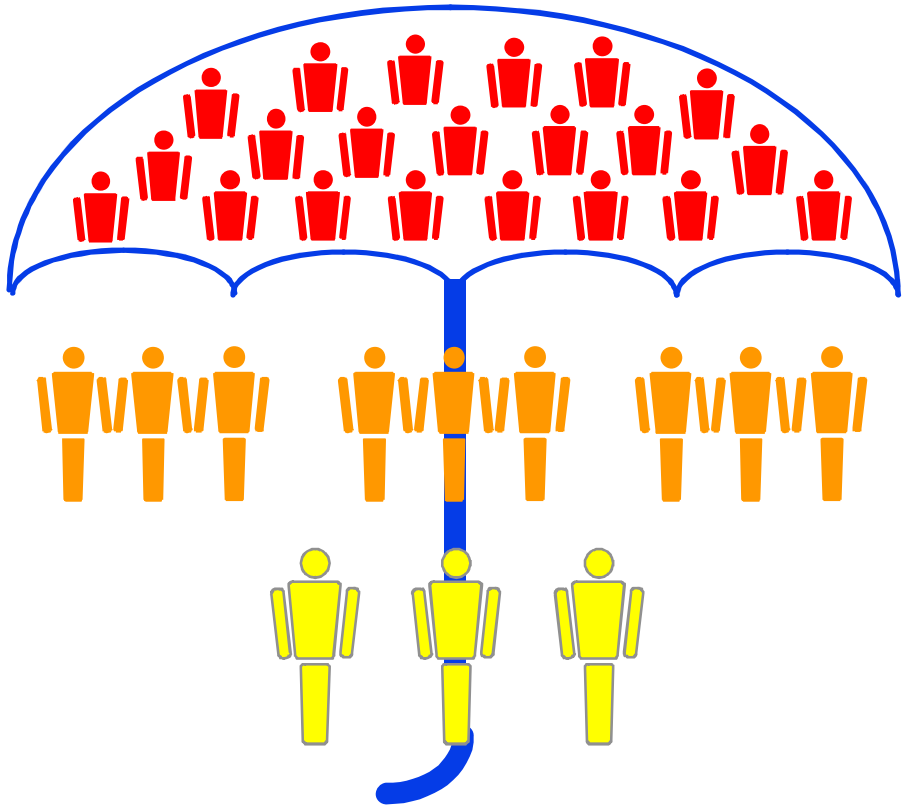
- Earned value
- Defect removal
- Component quality profile.

Vertically Aligned Capabilities: TSP and CMMI

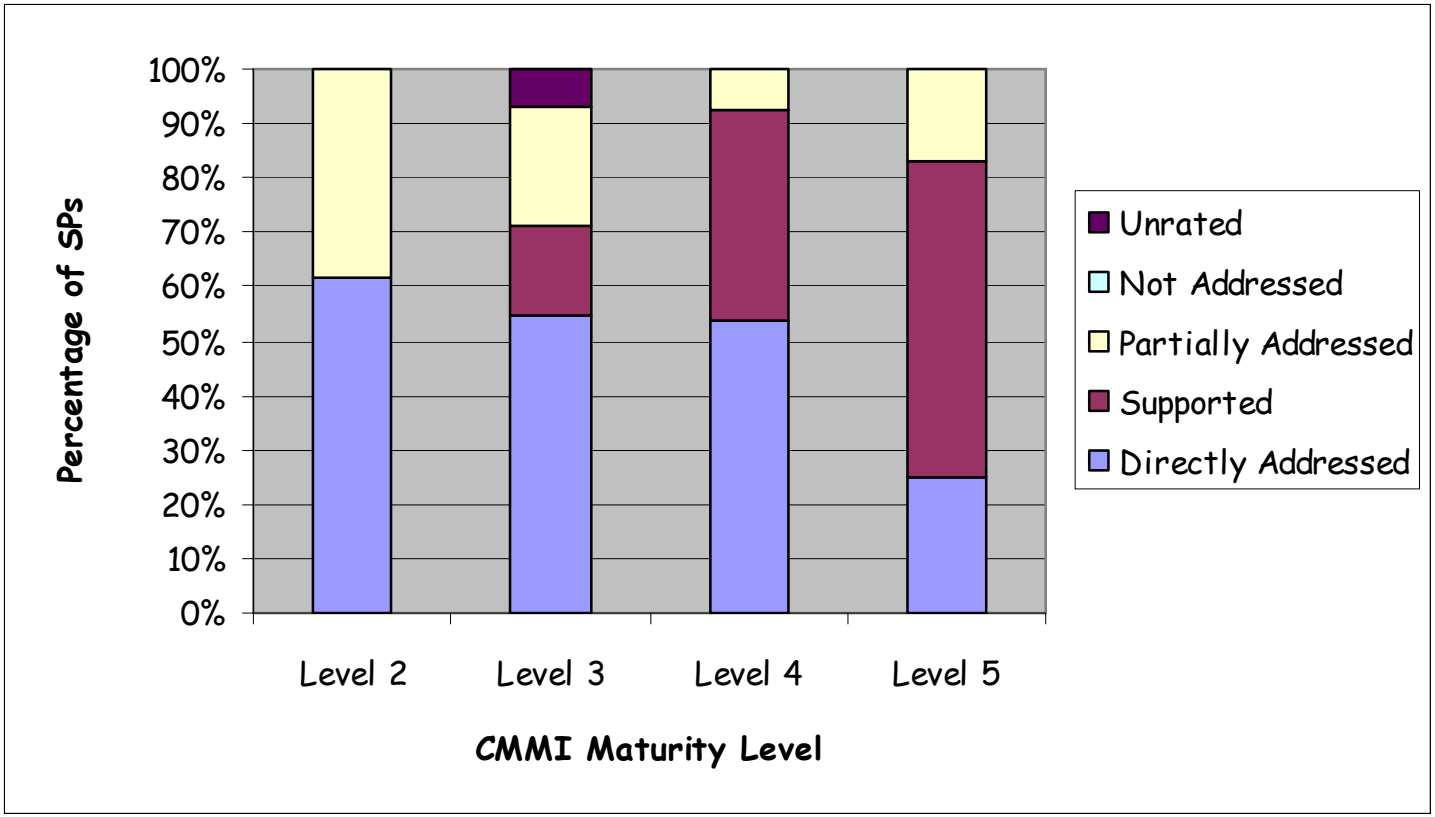
CMM/CMMI: ***for organizational capability***

TSP - ***for quality products on cost and schedule***

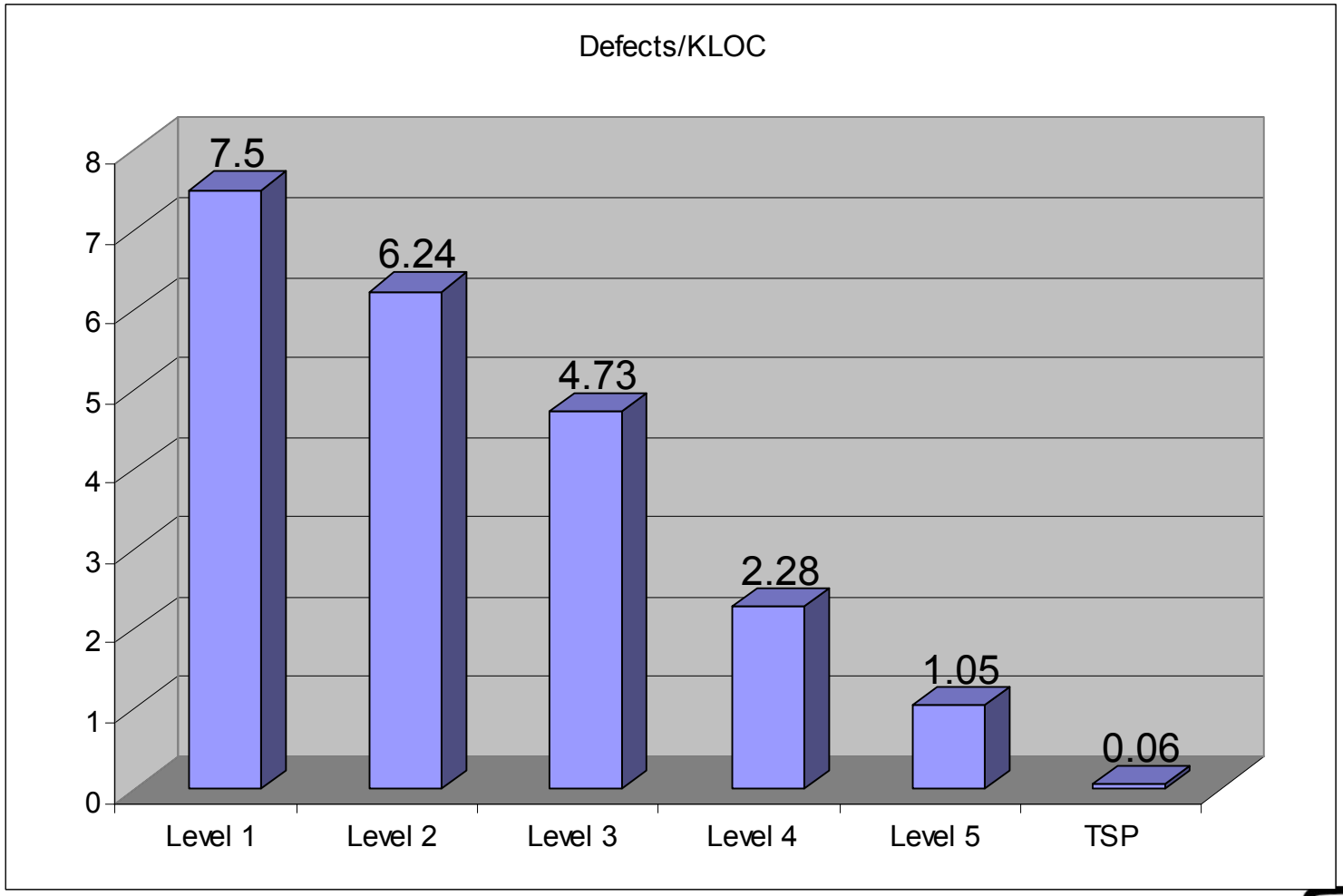
PSP - ***for individual skill and discipline***



TSP-CMMI by Maturity Level



Process Improvement Pays Off

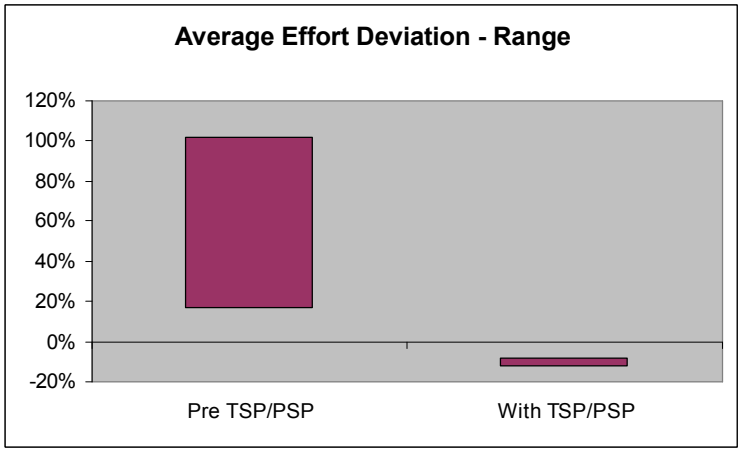


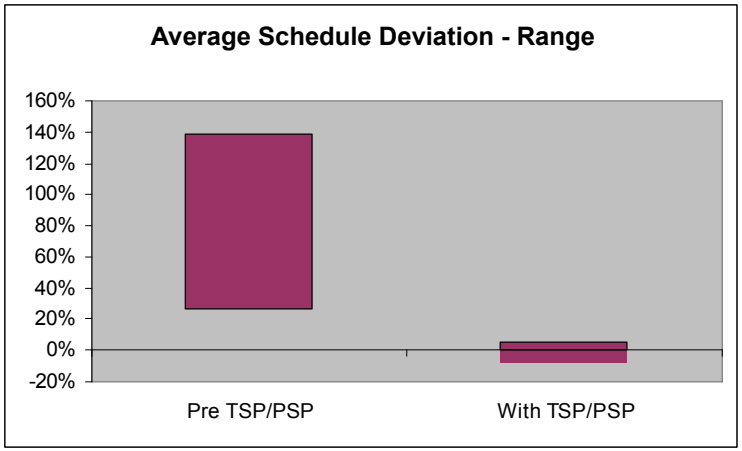
TSP Performance Summary

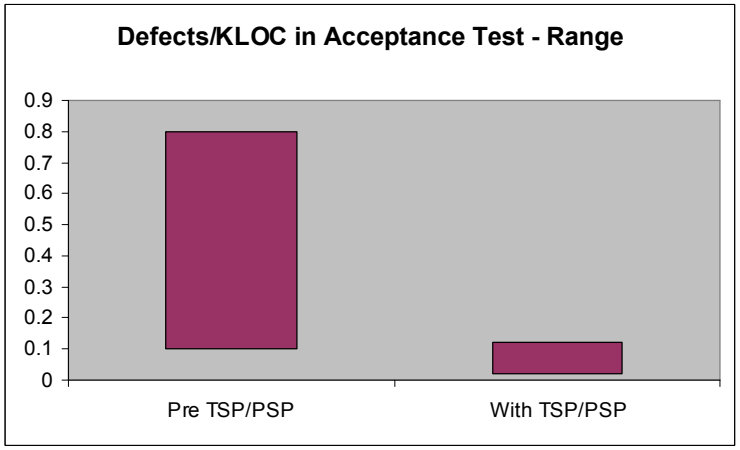
Performance Category	TSP Impact Study (2003)*	Typical Industry Performance
System test defects per thousand instructions	**0.4 avg. 0.0 to 0.9**	**2 to 14**
Released defects per thousand instructions	**0.06 avg. 0.0 to 0.2**	**1 to 7**
System test effort (% of total effort)	**4% avg. 2% to 7%**	**40%**

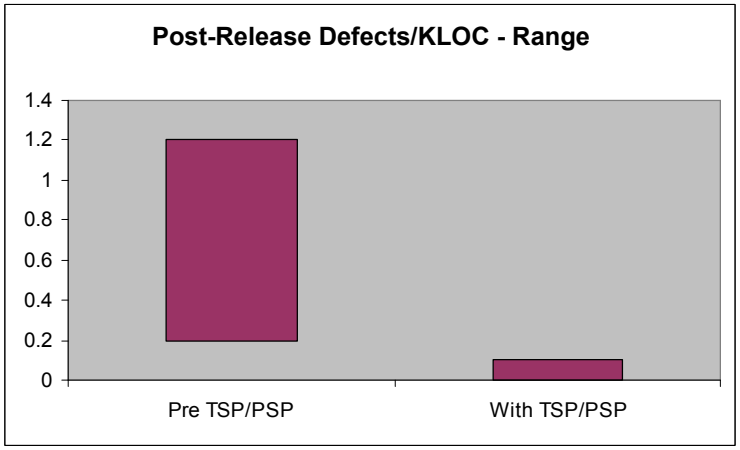
*From a study of 20 projects in 13 organizations

TSP Performance Comparison*









*From a study of 18 projects in 4 organizations

What is Quality Management?

- Most would reply Strong Testing?
- Achieving Quality Goals
  - Gathering data
  - Monitoring process quality
- Quality Management Methods

What is Quality Management?

- With software
  - every team member's work is important
  - any poor-quality module can crash the system
  - only a few defective modules will delay entire programs
- Testing finds only a fraction of a product's defects.
- The number of defects in a delivered product is proportional to the number found in development testing.
- To consistently produce quality products, the defects must be removed before testing

What is Quality Software?

- High-quality products must meet all user requirements.
- Quality software must be essentially free of defects.
- A defect is something in a program that is incorrect and must be fixed.
- Defects result in
  - incorrect, insecure, or unsafe operation
  - installation problems
  - confusing or incorrect documentation
  - error-prone modification and enhancement

Quality Products

- High-quality processes produce high-quality products.
- The cornerstone of a high-quality software process is early defect removal.
- Quality work saves time and money.
- Quality work is not done by accident; it requires discipline, commitment, management, and measurement.
- TSP shows teams how to efficiently remove defects at the earliest possible point in the process.

Importance of High Quality

- To produce high quality systems, every part must be of high quality.
- This is possible only if every engineer consistently follows a quality process.
- To consistently follow a quality process, engineers must
  - be properly trained (with the PSP)
  - work on a disciplined team (with the TSP)
  - have coaching support and guidance

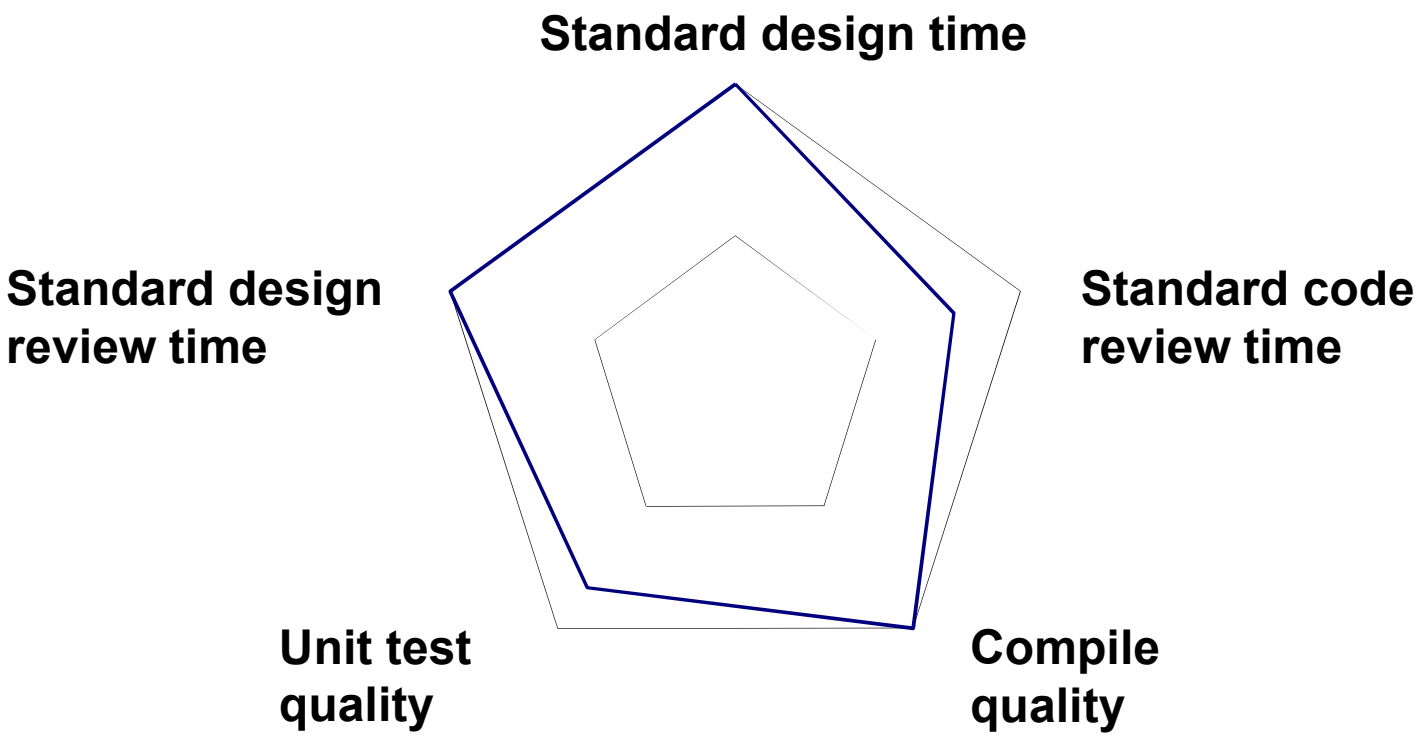
Coaching and Guiding Quality Work

- The first step is to ensure that the planned process is likely to produce a high-quality product.
  - inspections
  - reviews
  - tests
- Next, the team must examine the process data as the work is being done.
  - Adjust the process if it is not adequate.
  - Correct the product elements that were produced with the faulty process.
- Then, continue reassessing and correcting.

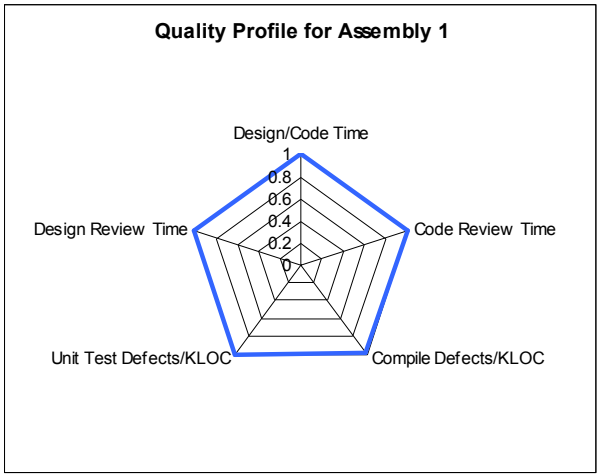
Gathering Data to assess Quality

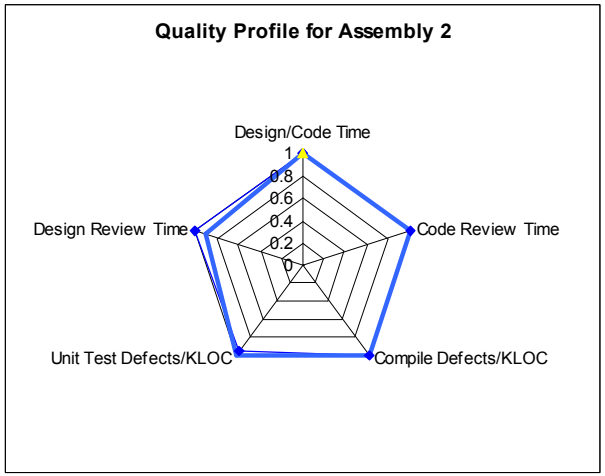
- Size, time and defect data are used to track progress towards team quality goals for
  - individual yield
  - component defect densities
  - defect rate for the system
- Individuals collect their own defect data at the completion of
  - design reviews
  - code reviews
  - compiles
  - unit tests
- Teams collect defect data at the completion of
  - design inspection
  - code inspection
  - integration test
  - system test

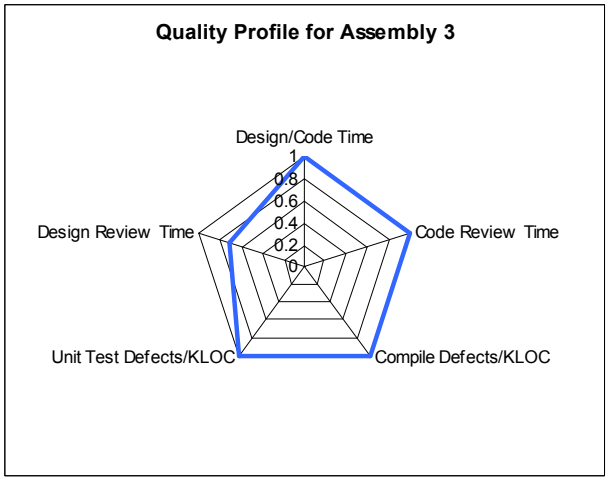
PQI Defined (or Component quality profile)

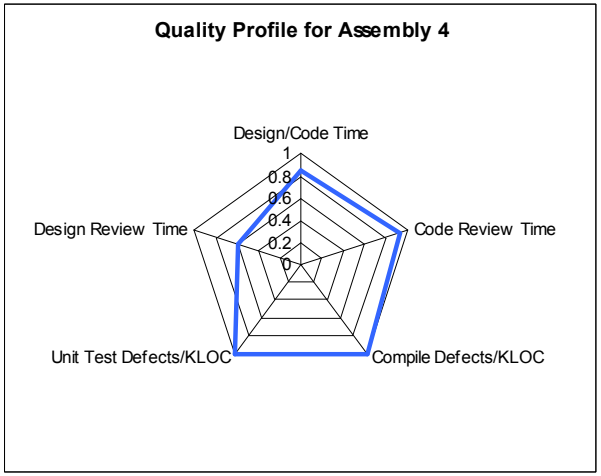


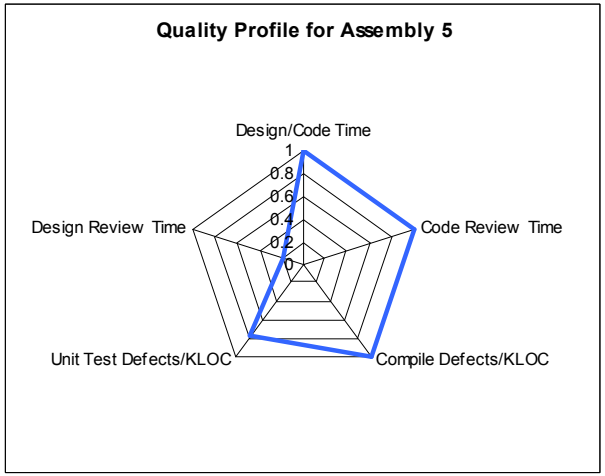
Selected TSP Quality Profiles

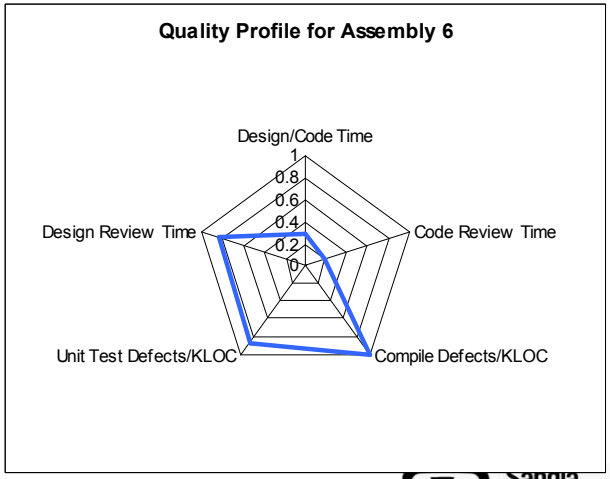












Using Quality Profiles

- The combination of the five profile dimensions provides a reasonably comprehensive view of the development process.
- When the quality profile indicates a high-quality program, that program is unlikely to have remaining defects.
- By examining the quality profiles for many programs, teams can quickly spot programs that are most likely to have quality problems.
- From the quality profile, teams can see which process area was most troublesome and presents an opportunity for improvement.
- The profiles should be used only as guides.

Test Data Analysis

- Test defect should be used to assess upstream processes
- Look at test data and try to identify the most troublesome components.
  - The number of defects found in any test is the best indicator of the number of defects likely to remain after that test.
  - Test yields can be 40-60%, so roughly as many defects remain as were found.
  - If the engineer follows a good process, and defect density in unit test are under 5 def/KLOC, test yields can be 70-90%.

- Have the team reinspect and fix the components that are likely to have remaining defects, as time allows. This will
  - produce higher-quality products
  - reduce integration and test time

Interpreting Quality Data

- To maintain a consistent focus on quality, it is important to regularly analyze and report defect data.
  - need to be looked at in context
  - provide an indication of good and bad quality components
  - provide hints on what may be done to reduce the risk of poor quality products
- Data can be examined for the system or at the individual level.
  - Team-level system data may be reported to management.
  - Team data may indicate troublesome phases or processes.
  - Individual data may indicate components with specific problems.
- Be careful how data are handled.
- As data begin to stabilize, consider statistical analysis.

TSP^{sm} Success Factors

- Clear *Sustained* Management Support
- Focus is on Process and Product Quality improvement
- Manage quality with data and strive to remove defect early in the process (Injected, removed, cause)
- Reduce test time by striving for no test defects
- Manage and make project improvements during the project
- Leverage data to make overall process improvements for the next project

Any Questions?