Team Software Process (TSP)

- Humphrey; intermediate between PSP and CMM
  - Teams of two to twenty members
  - Multiteams of up to 150 members
- Tradition of statistical process control
- Iterative (four to five month cycles)
- Scripts and forms
Teams (Dyer)

- A team consists of at least two people.
- The members are working toward a common goal.
- Each person has a specific assigned role.
- Completion of the mission requires some form of dependency among the group members.
Effective Teams

• The members are skilled.
• The team’s goal is important, defined, visible, and realistic.
• The team’s resources are adequate for the job.
• The members are motivated and committed to meeting the team’s goal.
• The members cooperate and support each other.
• The members are disciplined in their work.
Team Building

- The team members establish common goals and defined roles.
- The team develops an agreed-upon strategy.
- The team members define a common process for their work.
- All team members participate in producing the plan, and each member knows his or her personal role in that plan.
- The team negotiates the plan with management.
- Management reviews and accepts the negotiated plan.
- The team members do the job in the way that they have planned to do it.
- The team members communicate freely and often.
- The team forms a cohesive group: the members cooperate, and they are all committed to meeting the goal.
- The engineers know their status, get feedback on their work, and have leadership that sustains their motivation.
Launch

Day 1
1. Establish product and business goals
2. Assign roles and define team goals
3. Produce development strategy

Day 2
4. Build top-down and next-phase plans
5. Develop the quality plan
6. Build bottom-up and balanced plans

Day 3
7. Conduct risk assessment
8. Prepare management briefing and launch report

Day 4
9. Hold management review
Perform the launch postmortem
New teams: TSP process review
Strategy

• Create a conceptual design for the product
• Decide what will be produced in each cycle
• Make initial size and effort estimates
• Establish a configuration management plan
Selecting Roles

• Team Leader
• Development Manager
• Planning Manager
• Quality/Process Manager
• Support Manager

• Customer interface manager
• Design manager
• Test manager
• Safety manager
• Security manager
• Performance manager
Team Leader Responsibilities

• Motivating team members
• Handling customer issues
• Interaction with management
• Day-to-day direction of the work
• Protecting team resources
• Resolving team issues
• Conducting team meetings
• Reporting on the work status
Development Manager

• Leads and guides the team in designing and developing the product
  – Lead the team in producing the development strategy and the product conceptual design
  – Lead the team in producing the design specification (SDS)
    • If there is no separate Design Manager or Software Architect
  – Lead the team in implementing the product
Planning Manager

- Supports and guides the team in planning and tracking their work
  - Lead the team in producing the task plan and schedule for each development cycle
  - Lead the team in producing the balanced team development plan
  - Track the team's progress against their plan
Quality / Process Manager

• Supports the team in defining their process needs, in making the quality plan and in tracking process and product quality
  – Lead the team in producing and tracking their quality plan
  – Identify where quality performance falls short of objectives.
  – Lead the team in defining, documenting, and maintaining their processes and development standards
  – Act as moderator and lead all team reviews and inspections
Support Manager

- Supports the team in determining, obtaining, and managing the tools needed to meet its technology and administrative support needs
  - Lead the team in determining their support needs and obtaining the needed tools and facilities
  - Lead the development and management of Change/Configuration Management System
  - Handle the team's issue and risk tracking system
  - Act as the team's reuse advocate
Task Planning

• Generate a default task list
• Modify the default list as appropriate and estimate sizes and times for each task
• Assign portions of tasks to individual engineers
• Determine total time required for the project cycle
Schedule Planning

• Use LOC estimates and LOC/hour rates for time estimation

• Generate TASK and SCHEDULE plans
  – Estimate times based upon LOC and LOC/hour estimates
  – Estimate time available for the team
Produce Size Estimates

• Produce the conceptual design
  – Objects for all cycles
• Select a development strategy
  – Allocate objects to cycles
  – Produce a minimal *working* subset in the first cycle
  – Development Manager leads
• Produce preliminary size estimates
  – Estimate LOC in each class
  – Use size estimates as a basis for allocation of tasks to cycles
  – Enter estimates on the STRAT form
Quality Planning

• Enter default quality criteria into the SUMQ form
  – the Percent Defect Free components in each of the defect detection phases
  – the defect removal yields in various phases (Phase Yields)
  – the rate at which defects are injected in various phases (Defect Injection Rates)
TSP Quality Guidelines

• Percent (of modules) Defect Free (PDF) at entrance to
  – Compile > 10%
  – Unit Test > 50%
  – Integration Test > 70%
  – System Test > 90%

• Defects/KLOC:
  – Total defects injected 75 - 150; If not PSP trained, use 100 to 200.
  – Compile < 10
  – Unit Test < 5
  – Integration Test < 0.5
  – System Test < 0.2

• Defect Ratios
  – Detailed design review defects/unit test defects > 2.0
  – Code review defects/compile defects > 2.0
Development Time Ratios

- Requirements inspection/requirements time > 0.25 Elicitation in requirements time
- High-level design inspection/high-level design time > 0.5  Design work only, not studies
- Detailed design/coding time > 1.00
- Detailed design review/detailed design time > 0.5
- Code review/code time > 0.5
Review and Inspection Rates

- Requirements pages/hour < 2 Single-spaced text pages
- High-level design pages/hour < 5 Formatted design logic
- Detailed design text lines/hour < 100 Pseudocode ~ equal to 3 LOC
- Code LOC/hour < 200 Logical LOC
Defect Injection and Removal Rates

- Requirements defects injected/hour 0.25
- Requirements inspection defects removed/hour 0.5
- High-level design defects injected/hour 0.25
- High-level design inspection defects removed/hour 0.5
- Detailed design defects injected/hour 0.75
- Detailed design review defects removed/hour 1.5
- Detailed design inspection defects removed/hour 0.5
- Code defects injected/hour 2.0
- Code review defects removed/hour 4.0
- Compile defects injected/hour 0.3
- Code inspection defects removed/hour 1.0
- Unit test defects injected/hour 0.067
The Yield Measure

- Phase yield is the percentage of defects entering and injected in a phase that are removed in that phase.
- Process yield is the yield of all phases up to that point in the process.
Phase Yields

- Team requirements inspections ~ 70%
- Design reviews and inspections ~ 70%
- Code reviews and inspections ~ 70%
- Compiling ~ 50% (90+ % of syntax defects)
- Unit test - at 5 or less defects/KLOC ~ 90%
  - For high defects/KLOC - 50-75%
- Integration and system test - at < 1.0 defects/KLOC ~ 80%
  - For high defects/KLOC - 30-65%
- Before compile >75%
- Before unit test > 85%
- Before integration test > 97.5%
- Before system test > 99%
Quality Measures

• Percent (modules) defect free—PDF
• Defect-removal profile
  – Defects/KLOC vs. phase
• Quality profile
  – Design review time, design/code ratio, code review time, compile defects/KLOC, unit test defects/KLOC
• Process quality index—PQI
  – Product of quality profile factors
Produce the Quality Plan

• Estimate defect injection rates for each phase
• Estimate yield for each phase
• Generate a trial quality plan
• Compare the quality plan with team goals
  – Examine produce quality at each phase of the project
  – Modify time planned for defect removal if quality goals are not satisfied
• Continue generating trial plans until quality goals are satisfied
Component Quality Profile

• The PSP/TSP criteria for a quality process are that
  – Detailed design (DLD) time >= coding time
  – Detailed design review time >= 50% of DLD time
  – Code review time >= 50% of coding time
  – Compile defects <= 10 per KLOC
  – Unit test defects <= 5 per KLOC

• Many defect-free components do not meet these criteria

• All components that have met these criteria have been defect free
Project Tracking

- *Earned value* [Humphrey 95]
- Each task is assigned a value based on the percentage of the total project estimate that is required for that task
- If a project was planned to take 1,000 task hours, a 32-hour task would have 3.2 planned value, or $100 \times \frac{32}{1000} = 3.2\%$.
- Then, when the team has completed that task, the engineers would have accumulated 3.2 earned value points, no matter how long the task actually took.
Experiences

• Teradyne improvement from 20 defects per KLOC to 1 defect per KLOC. The savings in defect repair costs were about 4.5 times the cost of producing the programs in the first place.

• Hill Air Force Base productivity improved 123% and test time was reduced from 22% to 2.7% of the project schedule

• Boeing, on a large avionics project, had a 94% reduction in system test time