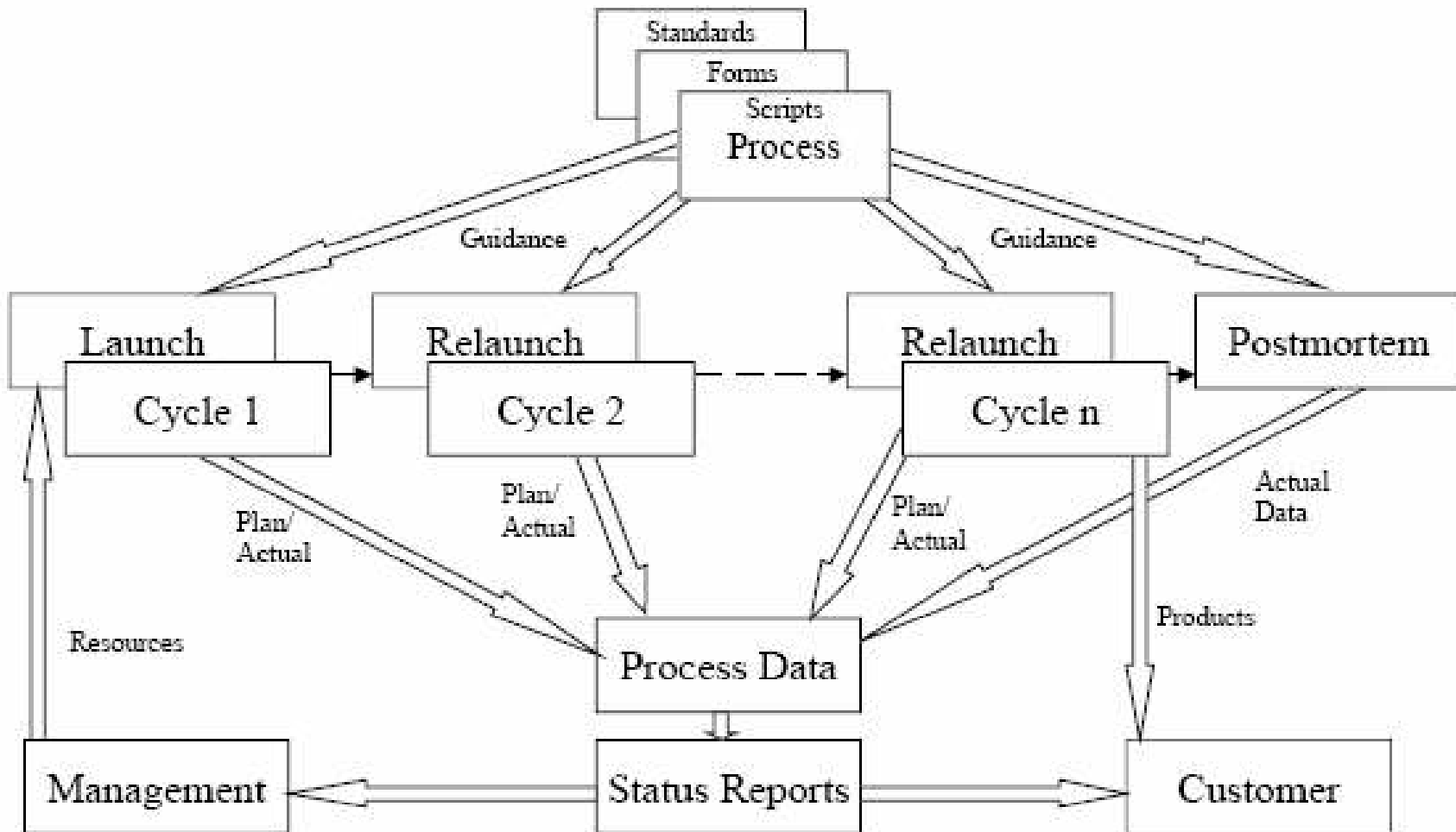# Team Software Process (TSP)

- 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

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Process Flow

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.
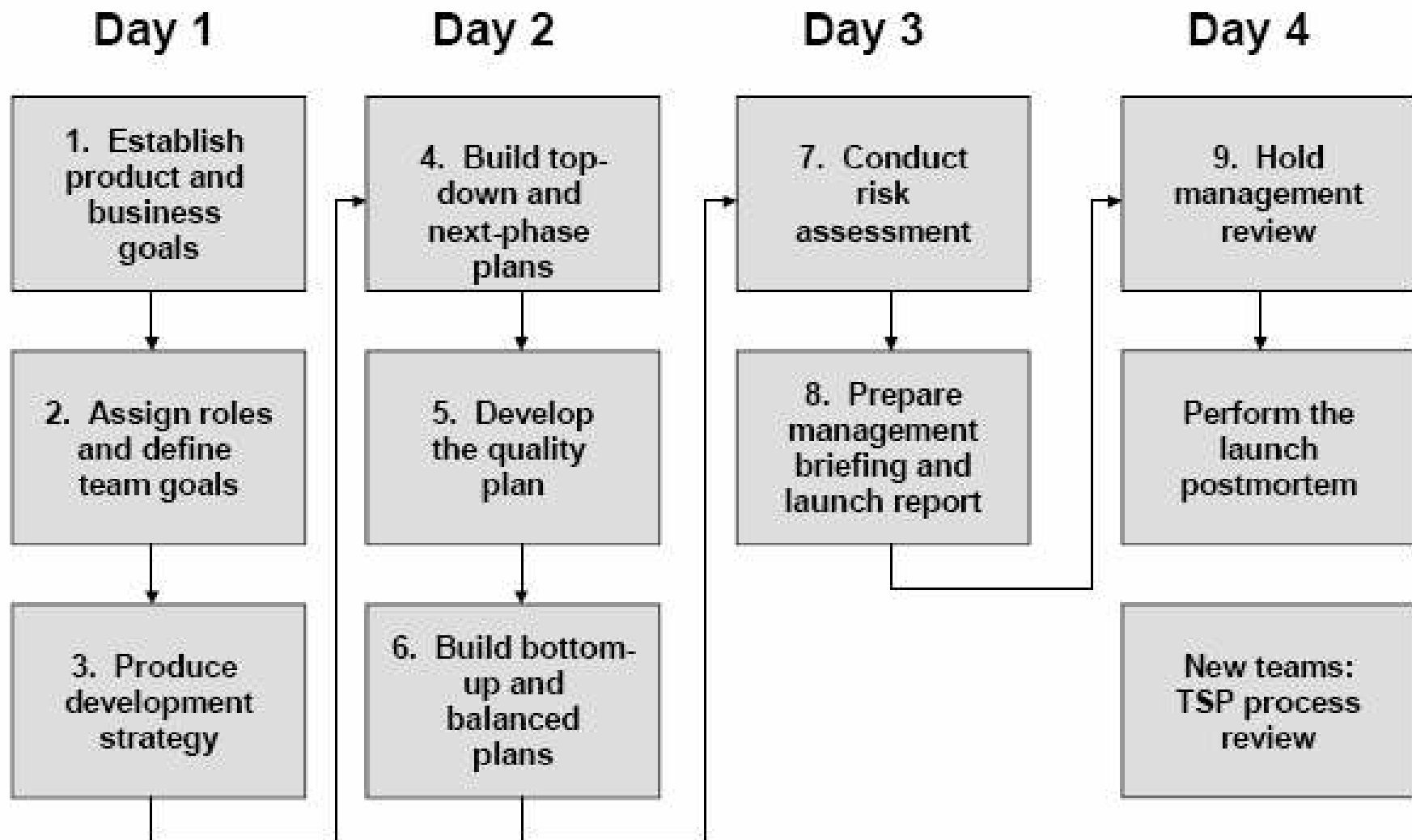
Effective Teams

- 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	Day 2	Day 3	Day 4
1. Establish product and business goals	4. Build top-down and next-phase plans	7. Conduct risk assessment	9. Hold management review
2. Assign roles and define team goals	5. Develop the quality plan	8. Prepare management briefing and launch report	Perform the launch postmortem
3. Produce development strategy	6. Build bottom-up and balanced plans		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

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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

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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

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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

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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

Development Injects defects

Defect injection phase

Phase yield → %

Development Injects defects

% Defect removal phase

Phase yield → %

Development Injects defects

Process yield ←

Phase yield → %

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*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

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