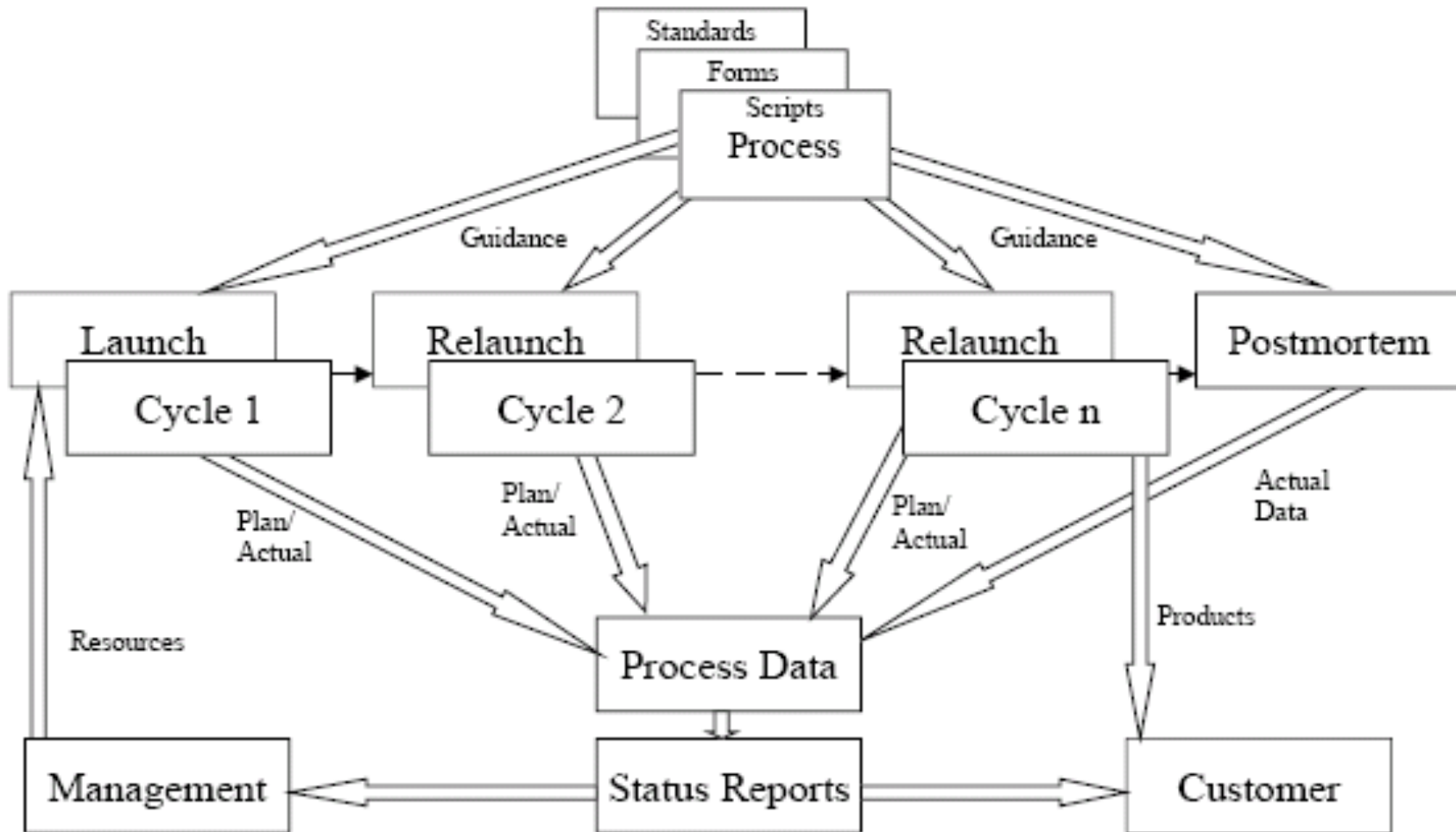


TSP

- 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

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

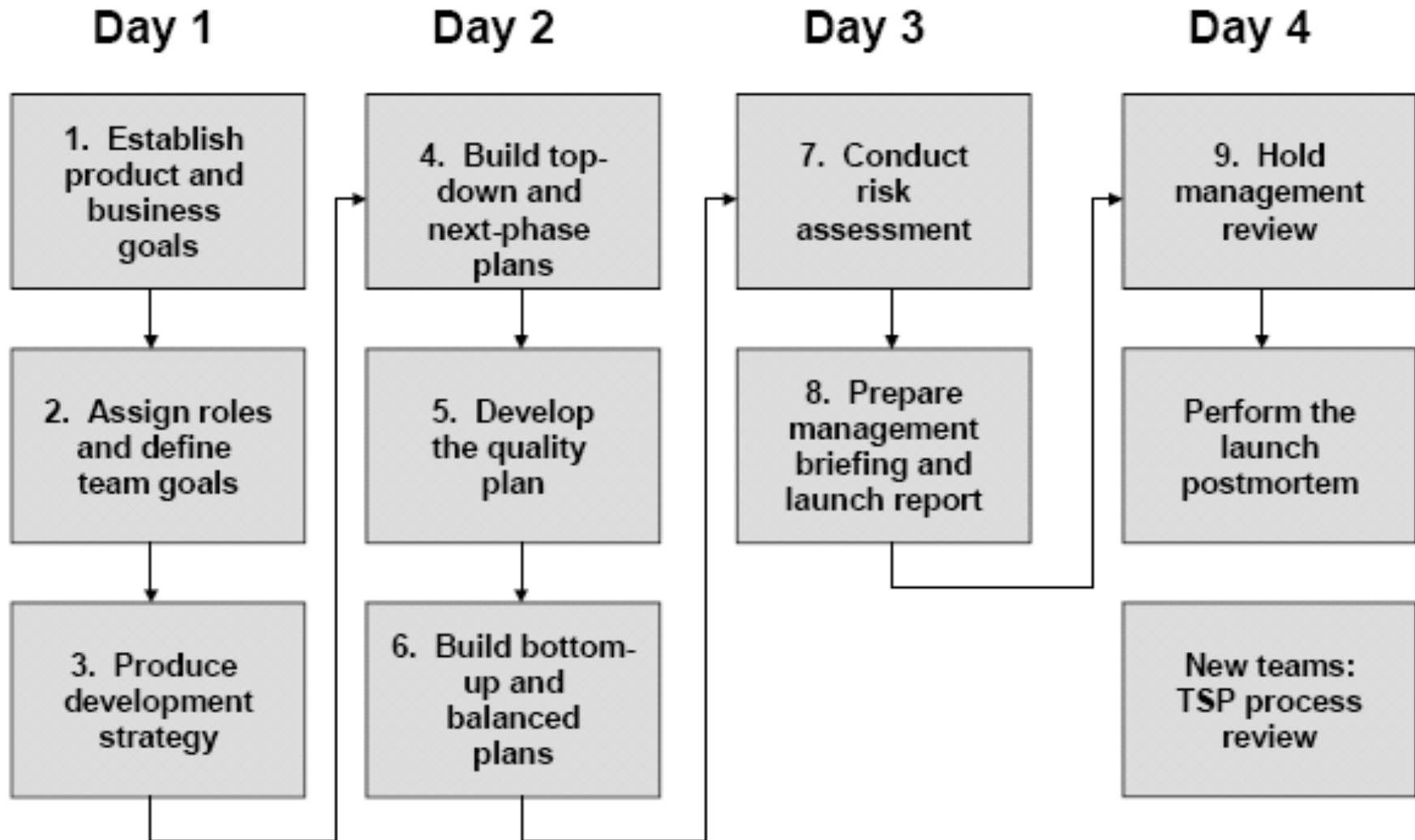
Team Building

- 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

Team Building - 2

- 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 Process



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 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%

Quality Guidelines - 2

- 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

Quality Guidelines - 3

- 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 included 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
 - A line of pseudo code ~ 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

Defect Rates - 2

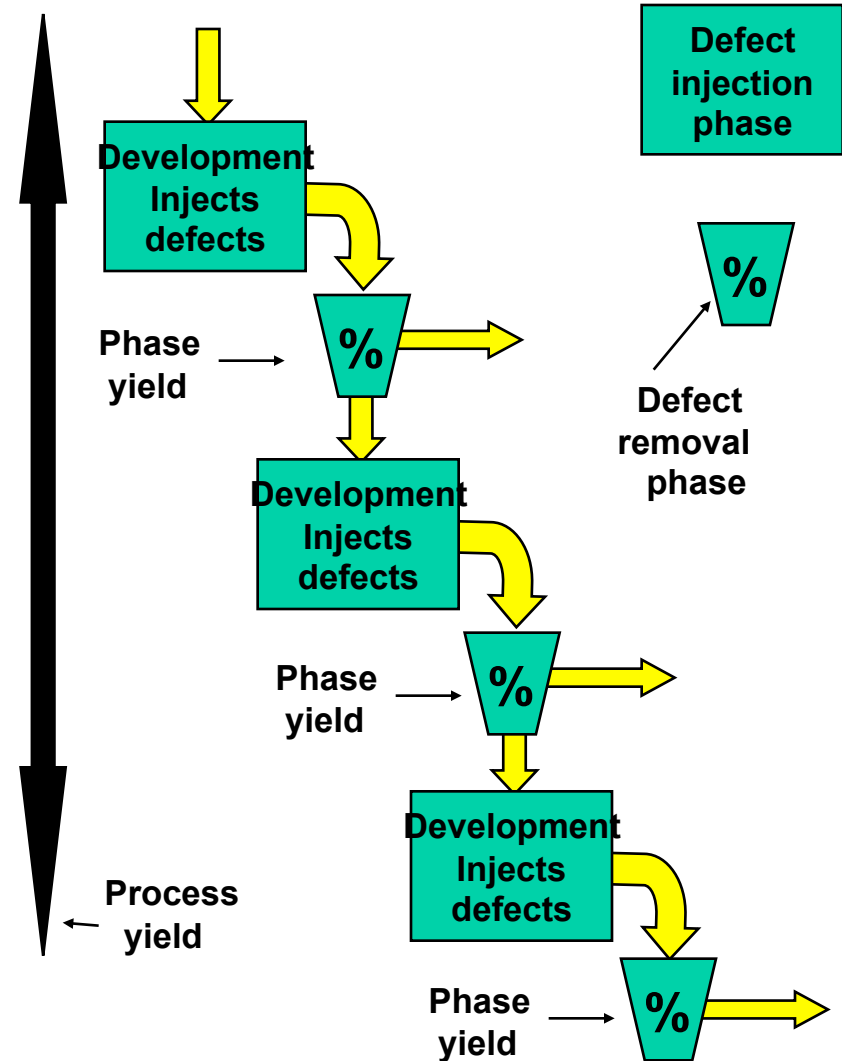
- Detailed design defects injected/hour 0.75
- Detailed design review defects removed/hour 1.5
- Detailed design inspection defects removed /hour 0.5
- Code defects injected/hour 2.0

Defect Rates - 3

- 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%

Phase Yields - 2

- Integration and system test < 1.0 defects /KLOC ~ 80%
- 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 \geq coding time
 - Detailed design review time \geq 50% of DLD time
 - Code review time \geq 50% of coding time
 - Compile defects \leq 10 per KLOC
 - Unit test defects \leq 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 $100 \times 32 / 1000 = 3.2\%$.
- 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