Process Examples: TSP & XP

15-313: Foundations of Software Engineering

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Announcements: Project

- You will make an enhancement to some open source project
- Goal: insight into open source processes and practices

This week
- Form teams of 2
- by Saturday: pick a project, look for a task, email both to donna@cs
- Bring up your proposal with project members
- by Tuesday
  - build the project
  - draw an architectural diagram relevant to your task
  - describe the task

- No more homeworks (after this week)
- By April 29 / May 1
  - Make your enhancement
  - Submit it to the project
    - include tests that fit into project’s testing strategy
    - package fix as a patch
    - appropriate documentation
    - “sell” your enhancement to the project
  - Write a report
    - task, design, interaction with community, lessons learned, code
  - Present in class

- Scope
  - 2 people, 2 weeks = pretty small
  - bug fixes are OK
Outline

- Team Software Process
- Extreme Programming
- Comparison
Team Software Process (TSP)

- Developed by Watts Humphrey of the CMU SEI
- Process is completely defined
  - Even up to individual reporting forms
- Scales well to medium/large projects
- Moderate overhead, but still adoptable
- Substantial use in industry
Process Challenges & TSP Response

- Unclear goals that differ among team
  - TSP: Up-front process to set goals with all team members
- Unclear division of responsibility
  - TSP: Set of predefined roles are assigned up front
- Unclear or poorly thought through plan
  - TSP: Up-front planning: estimate work, divide into cycles, ordering within cycle, who does what
- Bad communication
  - TSP: Weekly meetings with defined content
- Poor quality
  - TSP: Defined quality management practices in process
TSP Development Strategy

- Iterative development
  - Minimum functionality at end of cycle 1
- Produce conceptual design
  - Only for planning purposes
- Allocate functions to development cycles
- Size and time estimates for products
  - Detailed for current cycle, high-level for others
- Assess risks
  - Rate by impact, likelihood, and assign to team members
- Develop configuration management plan
  - Copies of each version
  - Record of who/what/when/why for each change
- Document all of the above on standard forms
TSP Development Cycle Plan

- List of tasks
  - Size estimate: <10 hours per engineer
    - e.g. for 4 engineers, <40 hours
  - Includes coding but also non-coding tasks like design, tests, meetings, etc.
  - Assign effort by week and by engineer

- Unplanned tasks
  - Major: produce a new plan
  - Minor: allocate 5-10% of time to unplanned tasks
    - Important to account for earned value
TSP Tracking

- Tasks
  - Date task completed
  - Time spent on each task
    - Spend more time in design than coding
    - Spend 50% of design time in reviews
  - Earned value by task, week, total to date

- Defects
  - Phase injected
    - Do we need to improve a particular phase?
  - Phase removed
    - Do we need to catch errors earlier?
  - Yields
    - 75% removed before first compile
    - 85% removed before first unit tests
    - 97% removed before integration test
    - 99% removed before system test
  - Broken down by module
    - Enables finding problem code
TSP Requirements

- Review system “need statement” for necessary clarifications
- Divide requirements among team by area
- Document requirements
  - a use case for each function
  - source of the requirement
- Inspect requirements document within team
  - 30 minutes per page
- Review requirements document with customer
- Check in requirements
  - Further changes require change control documentation
TSP Design

- Define components
  - Allocate use cases to each
- Set up design standards
  - naming conventions
  - how to document interfaces, error messages
  - how to represent design
- Develop detailed designs for each component
  - Produced and reviewed by team member
- Inspect design
  - Every use case covered
  - Design is complete and correct
- Check in design document
TSP Implementation

- Standards-based
  - naming, interface, coding standards
  - measurement standards for sizes, defects
  - defect prevention

- Development
  - Detailed design, personal design review
  - Develop unit test
  - Detailed design inspection
  - Code
  - Engineer reviews code personally, then compiles

- Team inspection
- Unit test
- Review quality
TSP Postmortem

- Analyze project data
  - Identify problem areas
  - Suggested resolutions
- Peer reviews / constructive criticism
- Summary report
Outline

- Team Software Process
- **Extreme Programming**
- Comparison
Extreme Programming (XP)

- Developed by Kent Beck and Ward Cunningham
  - Chrysler benefits organization project
- An iterative/spiral process
  - Divides development into short iterations delivering functionality
- Lightweight practices
- Increasingly popular in industry
  - But primarily for small teams/projects
  - Scale-up is widely questioned
- Seen as “fun,” but requires great discipline
XP Requirements

- User stories on 3x5 cards
  - Scenario / use case for system
  - Requirements
    - Testable with automation
    - Progress toward customer’s goal
    - Doable in <1 two-week iteration
    - Estimatable
**XP “Planning Game”**

- **Input:** stories
  - Customer assigns priority
  - Development assigns cost in “ideal time”

- **Set release date**
  - Customer picks date
    - developers compute total cost of stories available
  - Customer picks functionality
    - developers compute release date

- **Set order**
  - Respect dependencies
  - Working system first
  - Value first
  - Risk first

- **Change control**
  - Development may change order due to dependencies
  - Customer adds stories
    - either push back release, or reject other stories
XP Tracking

Load factor = total time in last iteration / ideal time of stories completed

Divide available time by load factor to determine “ideal time” available for each iteration
XP Design

- System metaphor
  - Lightweight architecture
- CRC card design
- Do the simplest thing that could possibly work
XP Implementation

- Pair programming
  - Two developers coding at one workstation
  - Lightweight reviewing process
    - Spreads expertise around – switch frequently
  - Empirical data on success
    - 15% slower than 2 independent programmers
    - 50% fewer bugs!

- Refactoring
  - Once and only once
    - Immediately refactor code to eliminate duplication
  - Fix design problems immediately (“code smells”)
XP Testing

Test first
- Write tests before code
- Implement only enough code to pass the test
  - Don’t write code if you don’t need it right now—you may never need it!

Automation
- All unit tests should be automated

Quality standards
- Add a unit test whenever a bug is discovered
- Only check in code when 100% of test cases pass
XP Process Improvement

- Meet at the end of each iteration
- Discuss issues, tweak process
Outline

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## Comparison

<table>
<thead>
<tr>
<th>TSP</th>
<th>XP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lots of documents</td>
<td>Just the code &amp; personal knowledge</td>
</tr>
<tr>
<td>Requirements document</td>
<td>User stories, frequent customer interaction</td>
</tr>
<tr>
<td>Formal design</td>
<td>Informal CRC design, constant refactoring</td>
</tr>
<tr>
<td>Reviews</td>
<td>Pair programming</td>
</tr>
<tr>
<td>Write tests first</td>
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</tr>
<tr>
<td>Earned value</td>
<td>Load factor</td>
</tr>
</tbody>
</table>
Agile Manifesto

**Individuals and interactions** over processes and tools

**Working software** over comprehensive documentation

**Customer collaboration** over contract negotiation

**Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more.
Continuous improvement loop

Say what you do
(documentation)

Act on the difference
(frequently means changing
documentation or training)

Do what you say
(training and expecting
documentation to be followed)

Record what you did

Identify/analyze the difference

[source: Larry Maccherone]
Say what you do

Act on the difference

Do what you say

Identify/analyze the difference

Record what you did

• Standards
• Procedures/work instructions
• Training manuals
• Checklists
• Measurement information model
• Key metrics and target values

Specifying desired outcomes in standards, checklists and key measures is better than trying to spell out every step in scripts, procedures or work instructions.

[source: Larry Maccherone]
Do what you say

Say what you do

Act on the difference

Do what you say

Identify/analyze the difference

Record what you did

- A function of process design
- Training not just on process steps but on underlying reasons
- Internal and external audits
- Driven by conviction and understanding

[source: Larry Maccherone]

You can’t impose discipline from the top down. The process and training program must be designed to enable it to emerge from the bottom up.
Record what you did

Say what you do

Act on the difference

Do what you say

Identify/analyze the difference

• Measurements captured in process
• Samples gathered post-process

Passive data capture is preferred over requiring manual input. If manual input is required, user must believe in value of data and should get immediate pay-back if possible. [source: Larry Maccherone]
April 8, 2008

Analysis of Software Artifacts

Identify/analyze the difference

Say what you do

Do what you say

Record what you did

Act on the difference

Identify/analyze the difference

Report output of “Record what…” retrospectively by looking at non-conformance reports and...

Identified in-process (defects, where statistical process control is often misapplied.

Difference between “Say what…” and “Do what…”

In software, this is where statistical process control is often misapplied. [source: Larry Maccherone]

Source: Larry Maccherone
Act on the difference

- How to prevent future deviations
- Change documentation, metrics, etc.
- Training – best when it’s passive “training” like IDE feedback

When you find a defect:
1. Fix it
2. Find/fix others like it
3. Catch similar again in future
4. Prevent injection in future

Valid for process defects