Continuous Stretching of your Software Engineering Capability

A System Thinking for SW Process

Yoshihiro Akiyama (y.akiyama@ieee.org)
Graduate School, Systems & Computer Science, and Center for Information, Communication, and Technology Education
May 23th, 2008
Agenda

Software is technology and enabler

Current Software Practice

“Proper Process” for Software

Stretching Individual Capability by PSP

Stretching Team and Management Capability by TSP

Communicating with others

Establishing Global Project Management

Conclusion
Trademarks and Service Marks

- The following are service marks of Carnegie Mellon University.
  - CMMI\textsuperscript{SM}
  - Team Software Process\textsuperscript{SM}
  - TSP\textsuperscript{SM}
  - Personal Software Process\textsuperscript{SM}
  - PSP\textsuperscript{SM}

- The following are registered trademarks of Carnegie Mellon University.
  - Capability Maturity Model\textsuperscript{®}
  - CMM\textsuperscript{®}
  - Capability Maturity Model\textsuperscript{®} Integration
  - CMMI\textsuperscript{®}
Software is Technology and the enabler
Today ....

- *ICT* is rapidly advancing.
- SOA for more applications is progressing.
- *Global* project management is demanded but thin and short.
- *Software evolution* & maintenance (legacy) are long tail.
- *Software engineers* need to work on many methods, many applications, and many platforms.
- *High quality* is demanded wherever software is used.
Current Software Industry Performance

- Compared to other industries, software performance is sometimes disappointed:
  - Overall architecture is not established in early phase and not clean.
  - Many times of delay must be negotiated.
  - Ship date is rarely met.
  - There are no warranties.
  - Customers must pay significantly for the bugs after shipment.
- Large-scale projects are mostly troubled.
Especially Software Industry wants to say the Quality Objective should be

1 Defect/KLOC $\Rightarrow$ 1 Defect/MLOC!

However current software quality performance is

- *More than 50% of total efforts is sometimes spent for testing.*
- *Neither safe nor secure software is produced.*
- *Unknown Quality of shipped software is usual.*
“Desired” Proper Process for Software

A step by step to follow in order to produce high quality software consistently as planned:

- Framework for self managing individual,
- Framework for self directed team,
- How to Improve estimating and managing project work is included.

**Optimizing**
- Project resources, customer satisfaction, and quality
- Everywhere

**Scalable**
- Works, teams, and locations, users, and resources
Purpose of PSP and TSP: Building High-Performance Teams

Capitalizing on team potential is management's responsibility.

Senior Management
- Team support
- Team discipline
- Program visibility

Team Management
- Team communication
- Team coordination
- Project tracking
- Risk analysis

Team Building
- Goal setting
- Role assignment
- Tailored team process
- Detailed balanced plans

Team Member Skills
- Process discipline
- Performance measures
- Estimating & planning skills
- Quality management skills

Reference: CMU/SEI's course “Managing TSP Teams”
Build High-Performance Individuals

- The TSP strategy is to improve performance from the bottom up.
- This strategy starts with PSP training.

Reference: CMU/SEI's course “Managing TSP Teams”

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The Process Elements

Scripts
Document the process entry criteria, phases/steps, and exit criteria. The purpose is to guide users of the process.

Measures
Measure the process and the product. They provide insight into how the process is working and the status of the work.

Forms
Provide a convenient and consistent framework for gathering and retaining data.

Standards
Provide consistent definitions that guide the work and gathering of data.

Tools
Provide automated accepting, handling, processing, and visualizing process data.

Ref. Don Burton, “Introduction to PSP and TSP, SEPG Conference March 2006"
The PSP Process Training Structure

PSP0
- Current process
- Basic measures

PSP1
- Size estimating
- Test report

PSP1.1
- Task planning
- Schedule planning

PSP2
- Code reviews
- Design reviews

PSP2.1
- Design templates

Ref. SEI's course
"Managing TSP Teams"

Introduces process discipline and measurement

Introduces estimating and planning

Introduces quality management and design

Incremental Extension

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Whenever Improvement is needed, the process statement is modified or deleted and/or a new statement is added,
### Time Log

<table>
<thead>
<tr>
<th>Project</th>
<th>Phase</th>
<th>Date</th>
<th>Start</th>
<th>Stop</th>
<th>Delta</th>
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<table>
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### Defect Log

<table>
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PSP Estimate Accuracy

Size

% Error in Size Estimate

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PSP – Quality Improvement
Test defects found 1/5 of the original defect amount

Defects Found in Test - Range

Defects/KLOC

Program Number

30

6

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Quality is the major control parameter for the variance

About 10% variation identified for 0 < # of defects identified for compile and test < 10.
Large (60%) variation allowed for 0 = zero compile and test defects

Ref.: Yoshihiro Akiyama, Who could be Teacher for High Quality Software in Special Session: Preparing Students for Industry’s Software Engineering needs, organized by Watts Humphrey, CSEE&T 2008
The Launch Process Meetings

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

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

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

Day 4
9. Hold management review
Launch postmortem

Reference: CMU/SEI's course “Managing TSP Teams”
Build and Maintain High-Performance Teams

The TSP strategy is to improve performance from the bottom up.

This strategy starts with PSP training.

Reference: CMU/SEI's course “Managing TSP Teams”
The TSP Launch Products

Business needs
Management goals
Product requirements

What?
- Team goals
- Conceptual design
- Planned products
- Size estimates

How?
- Team strategy
- Team defined process

When?
- Task plan
- Schedule Plan
- Earned-value Plan

Who?
- Team roles
- Task plans
- Earned-value Plan

How well?
- Quality plan

What if?
- Risk evaluation
- Alternate plans

Reference: CMU/SEI's course “Managing TSP Teams”
Progress – Accumulated Earned Value

A team of 6 engineers

Cumulative Earned Value

Week of 7th

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Week Task Hours - Plan vs. Actual

Week of 7th
Team Communication

Plan / estimation accuracy

Week of 7th

- To-date EV is 3.8% below plan (39.4 vs. 35.6).
- Effort has been overestimated by 59%. Is this a trend?
- 57.7 hours (287.2 – 229.5) have been spent on incomplete tasks.

The estimation is not accurate (59% over estimate).
The progress is on track.
Acquisition of Task Hours

Week of 7th

<table>
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<tr>
<th>Date</th>
<th>Week</th>
<th>Plan Hours</th>
<th>Cumulative Plan Hours</th>
<th>Actual Hours</th>
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<td>778.0</td>
<td>7.9</td>
<td>76.2</td>
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</table>

Average 68 hours/week/team ➔ Average 11 hours/week/per.

Average 48 hours/week/team ➔ Average 8 hours/week/per.
Quality Management

- With the TSP, the developers
  - record all of their defects
  - use process data to analyze product quality
  - strive to fix all defects before test

- In managing quality, TSP teams use the
  - process quality profile
  - process quality index (PQI)
Component Quality Profile

Note: LOC is the measure of Modified and Added Code.

A Traditional Quality Profile

- With current typical software practice, PQI is at or near 0.

- With TSP, PQI is measured and can be managed with control charts.

- No defects have been found when PQI is above 0.4.

Reference: SEI Course “Managing TSP Teams”
Selected TSP Quality Profiles – before test

Quality Profile for Assembly 1

PQI = 0.97

Quality Profile for Assembly 2

PQI = 0.88

Quality Profile for Assembly 3

PQI = 0.71

Quality Profile for Assembly 4

PQI = 0.59

Quality Profile for Assembly 5

PQI = 0.15

Quality Profile for Assembly 6

PQI = 0.04

Selected TSP Quality Profiles – after test

Test defects = 0

PQI = 0.97

Test defects = 0

PQI = 0.88

Test defects = 0

PQI = 0.71

Test defects = 0

PQI = 0.59

Test defects = 1

PQI = 0.15

Test defects = 3

PQI = 0.04

PQI vs. Post-development Defects


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Defect Density of Delivered Software

- CMM Level 1: 7.5 defects/KLOC
- CMM Level 2: 6.24 defects/KLOC
- CMM Level 3: 4.73 defects/KLOC
- CMM Level 4: 2.28 defects/KLOC
- CMM Level 5: 1.05 defects/KLOC
- TSP: 0.06 defects/KLOC

Reference: Nooper Davis, Julia Mullany, SEI Technical Report 2003 - 014
Total Cost of Ownership (1/4): Project Performance Study (see Ref.)

Project of
4 members,
About 4.2KLOC size.

Characterized by
Phase Yields (Y),
Phase Rates of Defect (R).

Yes – *TSP value followed*,
No – lower yield, or
higher inject. rate, or
lower removal rate

(*1) One member had a half of the removal rate of the others.
(*2) No yield achieved for Design and Code.

### Project Type

<table>
<thead>
<tr>
<th>Description</th>
<th>Focus on Phase Yields</th>
<th>Focus on Phase Rates</th>
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</thead>
<tbody>
<tr>
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<td>Yes</td>
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<tr>
<td>SYLR</td>
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<td>No</td>
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<tr>
<td>SYLR-1(*1)</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>LYSR</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>LYLRL</td>
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<td>No</td>
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<tr>
<td>LYLRL-zero yield (*2)</td>
<td>Zero yield</td>
<td>No</td>
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</tbody>
</table>

Total Cost Ownership (2/4): Project Management Tradeoff

- **Green segments** show review and inspection.
- **Blue box** show the time duration from the unit test through the system test.

1) If the review & inspection time is longer, the test time becomes shorter.
2) Project length of the SY.. type is almost same or similar to that of LY types.

TSP saves project’s testing time.
Total Cost Ownership (3/4): Project’s Field Support Cost

The grey boxes below show the cost needed to fix field defects.

Field Support Cost

The field support cost of
A) SY* type projects is negligible, i.e., very small.
B) LY* type projects is not negligible, i.e., not small.
Total Cost Ownership (4/4): Field Cost

- **SYxx type project - Solid profit**
  - Almost zero cost needs for the field support.
  - Most of the resources used for the project should be assigned to another project when completed.

- **LYxx type project – Risky or may be Red profit**
  - 20 - 100% of the development cost must be planned for the field support.
  - Long tail maintenance must be expected.
Further Remarks – 1
Communicating with other engineers

Process information is updated with experiences & knowledge:

- Experiences and knowledge on requirement soliciting, design approach, implementation code, etc. are carried over to another project or another engineer.
- Base data used for estimating and planning are continued and consistency is improved.

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Further Remark - 2
Establishing Global Project Management

- *Active users* are living in active markets.
- *Such active markets* are located over the world.
- *Effective process tool support to realize the SOA based development* is necessary.

Here is a simple example by TSP.
TSP/SUMS defines a WBS for project.

SYSTEM

Gui Project

Gui Requirements 5 Pages
Gui HLD 15 Pages
Gui DLD 45 Pages
Gui Software 600LOC

Front_End 300 LOC
Control 300LOC
TSP generates TASK list (below is partial)

<table>
<thead>
<tr>
<th></th>
<th>Assembly</th>
<th>Phase</th>
<th>Task</th>
<th>Resource</th>
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<tbody>
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<td>Front_End</td>
<td>DLD</td>
<td>Front_End Detailed Design</td>
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<td>Front_End DLD Review</td>
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Object (what) | Phase (sequence) | Object Process (how) | Resource (who)

Unique Process
TSP/TASK Global Assignments

TSP Task/Process List

<table>
<thead>
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<th>No.</th>
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</table>
Conclusion - 1

- A desired “proper process” is such as TSP/PSP and provides
  - Framework to manage individual activities,
  - Framework to manage team work.
- The PSP based training enables professional engineers who can show desirable high quality results as industry expects.
- The TSP establishes the effective team and realistic plan to be produced through the launch process.
- TSP process data are used to assess the plan accuracy and the quality of the project product before integration test or system test begins.
- The TSP can supports SOA based development.
Conclusion - 2

- Good Process transforms software engineer to professional who enriches its own process.
- PSP instructors and TSP coaches are effective supports for the transformation.
- Process transfers experiences and knowledge of software activities to other software activities and other engineers for better effectiveness and more efficiency.
- Every engineer uses process to communicate and negotiate on, and standardizes, and produces a new process to meet needs of your project and your organization.
- For SOA era, proper process is mandatory to become professional and to receive key inheritance.
Thank you for your attention,

and

Now for Q&A ….