Software Process Improvement

Overview

Marcello Visconti
Departamento de Informática
Universidad Técnica Federico Santa María
Valparaíso, Chile

Motivation

- Immaturity of software engineering - state of the practice
- 3 critical factors: people, technology, and process - main drivers of costs, schedules, productivity and software quality
- Basic principle: improve software product quality by improving software process quality
- Capability - maturity measurement - predictor of software process quality - can be improved
Motivation

- Important: differentiate change and process improvement
- Important question: what is the return on software process improvement?
- Need for metrics and methods
- Difficulty of measuring certain aspects: lower risks, productivity, quality increase, client satisfaction, and of associating return on investment to software engineering process and technology

Definitions

- Process: sequence of steps executed with a specific purpose
- Software process: set of activities, methods, practices, and transformations used to develop and maintain software and its associated products, i.e. plans, design documents, code, test cases, manuals
Definitions

- Software process improvement: deliberate and planned methodology that follows standardized documentation practices to capture in paper (and practice) each element of software process, and determine its added value; useful tool: ETVX diagram

ETVX diagram

- Process is composed of activities
- Each activity is controlled using a defined model: Entry-Task-Verification-eXit
- The structure of the model requires: entry criteria, task, verification and exit criteria for each activity
ETVX diagram

**ENTRY**
- Policies
- Procedures
- Resources
- Funding
- Training
- Orientation
- Processes
- Sponsorships
- Responsibilities / Roles
- Databases
- Tools / Methods

**TASK**
- Plans
- Actions
- Metrics
- Information

**VERIFICATION**
- Reviews / Audits
- Measurements
- Analysis

**EXIT**
- Goal Satisfaction
- Assets
- Complete Products

**Goals**

- Understand the present state of software engineering practice and management in an organization
- Select improvement areas where the changes may mean the highest long-term benefits
- Focus on adding value to business, not on achieving a process utopia
- Prosper combining effective process with prepared, motivated and creative people
Requisites

- Intelligent, trained, creative engineers and managers
- Effective team work
- Shared culture focused towards quality
- Clear improvement goals
- Metrics to control progress
- Honest evaluation of problem areas
- Time to select, pilot, and implement improved process
- Consistent high level leaderships and expectations
- Everyone involved in improvement efforts
- Common sense, combined with a commitment to improve

Change possible
Commitment to change

Adoption continuum

"The Chasm"
10 traps to avoid

- Lack of high level commitment
- Unreal expectations from high level management
- Leaders who don’t assign the resources
- Inadequate training
- Achieving a given model level is the goal
- Ill-applied at the micro level
- Ineffective evaluations
- Action plan implementation delay
- Process improvement becomes a game
- Hope that process will replace people

Enemies of improvement

- Re-structuring, fusion, downsizing
- Middle manager sabotage
- Lack of strategic plan linking software process improvement to business
- Lack of high level buy-in
- Insufficient resources
- Software process improvement not managed as a project
- Demands for immediate results
- Insufficient training for software engineering process group
Acronyms

- SPI - Software Process Improvement
- CMU/SEI -- Carnegie Mellon University / Software Engineering Institute
- CMM/CMMI -- Capability Maturity Model / Capability Maturity Model Integration
- SEPG - Software Engineering Process Group
- CBA/IPI -- CMM-Based Appraisal for Internal Software Improvement
- KPA -- Key Process Areas
- PSP/TSP -- Personal / Team Software Process
- ISO -- International Organization for Standardization
- SPICE -- Software Process Improvement and Capability dEtermination
- S:PRIME(R) -- Software Process Risk Identification, Mapping and Evaluation (Resolver)

SEI’s most popular models

- 5 level software process maturity model (framework presented in 1987)
  - initial (ad hoc/chaotic)
  - repeatable (intuitive)
  - defined (qualitative)
  - managed (quantitative)
  - optimizing (feedback)
- Each level establishes an intermediate set of goals to achieve the next higher level of process maturity
- Development of SW-CMM, CMM family, CMMI, IDEAL
- http://www.sei.cmu.edu
IDEAL model

CBA/IPI

- Developed by SEI, supports the Diagnosis phase in the IDEAL model
- Objectives: to establish a precise situation of software process strengths and weaknesses according to CMM, and generate internal commitment to SPI
- 3 steps: negotiation and preparation (2 to 6 months), collection and data analysis (2 weeks), and recommendations report (4 to 6 weeks)
- Developed by lead assessors certified by SEI, involves a high cost in man hours from the organization under evaluation
PSP/TSP

- Developed by the SEI since 1994
- Represents an elegant synthesis of proved concepts (CMM, experience factory, inspections, cause analysis) customized at the team and individual levels
- Incorporates quality principles to defined processes that teams and engineers can follow
- CMM - builds organizational capability
- TSP - builds quality products on cost and schedule
- PSP - builds individual skill and discipline

ISO 9000

- From 1987, very important for certification requirements (mainly, Europe)
- ISO 9001/9000-3, relevant for software (standard 1994)
- Emphasis in minimum requirements for quality systems, little explicit support for continuous improvement
- Developed by certified auditors
- New version ISO 9001:2000
SPICE

- ISO 15504
- Still a (never-ending) project (ISO/IEC JTC1/SC7 WG10)
- Objective: develop an international standard for software process assessments
- Origins: CMM, ISO, and other products
- Relates process, process assessment, capability determination, and process improvement
- Made of 9 products in the form of guidelines and questionnaires
- Since 1995 a number of trial phases ...... unknown whether it will ever be a working product ......

S:PRIME

- Developed by ASEC (CGLA), CRIM, Canada; based on CMM, focus to small and medium size organizations
- Handles 2 questionnaires: one for managers (7 risk categories), and the other for practitioners (15 practice areas), to determine the levels of perceived and probable risks, for a given practice satisfaction
- Method steps: questionnaire adaption, selection of project sample, questionnaire responses, analysis and compilation of responses, presentation and discussion of results
- Developed by lead assessors certified by CRIM, S:PRIME requires significatively fewer man hours, compared to CBA/IPI
- http://www.grafp.com
Other products

- Bootstrap (Esprit, Europe)
- Trillium (Canada)
- SAM, HealthCheck, TickIT (United Kingdom)
- STD (Compita)
- SQPA (Hewlett-Packard)
- Specific process models - documentation, SQA, SCM, testing
- Process meta-models/frameworks

Other considerations

- SPI: ¿Top-down or bottom-up?
- ¿Immaturity levels?: 0, -1, -2, -3, ....
- Process v/s plan
  - process: framework for a family of tasks, typical structure, intermediate guideline from where to start
  - plan: is unique and for a specific task, facilitated by a defined process
Return on investment

- "The return comes later, the investment is now"
- Conflicting issues
  - motivation for more immediate returns
  - competing alternatives seeking funding
  - technical people have a hard time justifying investment
- To build business case - need to deploy SPI so returns are observed sooner than later, they are huge and obvious, and ROI tools and models are simple
- Still a long way ..... dialog between technical, management and business people

Some early results

- Study of costs and benefits, 13 organizations (mid 90s)

<table>
<thead>
<tr>
<th>Category</th>
<th>Range</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of SPI per software engineer per year</td>
<td>US$490 - 2004</td>
<td>US$1375</td>
</tr>
<tr>
<td>Productivity gain per year</td>
<td>9% - 67%</td>
<td>35%</td>
</tr>
<tr>
<td>Reduction in time to market per year</td>
<td>15% - 23%</td>
<td>---</td>
</tr>
<tr>
<td>Reduction in post-release defects per year</td>
<td>10% - 94%</td>
<td>39%</td>
</tr>
<tr>
<td>Return on investment</td>
<td>4.0 - 8.8:1</td>
<td>5.0:1</td>
</tr>
</tbody>
</table>
Same early results (cont)

- Summary of additional benefits
  - higher motivation and lower turnover
  - lower risk and better image
  - less overtime hours
  - professionals after improvement opportunities
  - better communication at all levels
  - pride and ownership of SPI makes it sustainable and continuous