Course "Spezielle Themen der Softwaretechnik"

**Agile Methods**

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- Goals and priorities in SW development
- Principles of agile approaches
  - Misunderstandings about them
- Assumptions of agile methods
- Balancing risk:
  - Too much vs. too little planning
    - The XP planning game
  - Other
- CMMI process areas in agile methods
Learning objectives

- Understand the basic ideas of agile methods
- Contrast them to "conventional" approaches
- Understand the best-fit regions for application of agile methods
- Understand risk as a driver for agility decisions
SW processes and value generation

- As we saw in the lecture on SW engineering economics, optimizing value-generation is quite difficult.
- Therefore, conventional (plan-driven) SW processes run a high risk of producing:
  - at least high overhead (\(\Rightarrow\) increased cost),
  - at worst low value.

- Worse, requirements (and hence the value proposition) change much faster and wider today than they did in the past.
- Plan-driven processes cannot cope well with significant changes of a project's value proposition:
  - due to their high initial investments in requirements and design.
Purpose of software processes

One possible view (but more facets exist):

- **Plan-driven:**
  1. Anticipate development as much as possible in order to eliminate the cost of changes
  2. Generate high quality at low cost

- **Agile:**
  1. Find ways to reduce the cost of change because eliminating change is impossible
  2. Generate high value at low cost and high speed

  - Very good introduction into the agile way of thinking
Agile is about priorities

Highsmith and Coburn:
• "Processes, tools, documentation, contracts, and plans are useful. But when push comes to shove — and it usually does — something must give, and we need to be clear about what stays and what gives."
  • Agile methods were initially called "lightweight" methods, because they attempt to get rid of superfluous process elements

• These priorities were spelled out in the oft-misunderstood Agile Manifesto
  • published by a group of 17 high-profile members of the agile process community
  • all of them are practitioners who know perfectly well what they are talking about
Manifesto for Agile Software Development (2001)

- "We are uncovering better ways of developing software by doing it and helping others do it.

Through this work we have come to value:
- 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."
Agile Manifesto: Principles

We follow these principles:

1. Our highest priority is to satisfy the customer.
   • through early and continuous delivery of valuable software.
   • (Value focus, not quality focus!)

2. Working software is the primary measure of progress.
   • Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.

3. Welcome changing requirements, even late in development.
   • Agile processes harness change for the customer's competitive advantage.

4. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
   • In particular, business people and developers must work together daily throughout the project.
5. Agile processes promote sustainable development.
   - The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

6. Build projects around motivated individuals.
   - Give them the environment and support they need, and trust them to get the job done.
   - Continuous attention to technical excellence and good design enhances agility.
   - The best architectures, requirements, and designs emerge from self-organizing teams.
   - At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

7. Simplicity is essential.
   - Simplicity is the art of maximizing the amount of work not done.
The common misunderstanding

Source: http://www.agilemanifesto.org/history.html

• "The Agile movement is not anti-methodology,
  • in fact, many of us want to restore credibility to the word methodology.

• We want to restore a balance.
  • We embrace modeling, but not in order to file some diagram in a dusty corporate repository.
  • We embrace documentation, but not hundreds of pages of never-maintained and rarely-used tomes.
  • We plan, but recognize the limits of planning in a turbulent environment."

• Agile Methods is about clear positions in really hard trade-offs
  • NOT about letting all discipline and process go and just hack.
Assumptions of Agile Methods

1. You cannot foresee the development of a whole project
2. Developers are motivated, technically competent, and capable of good judgement
   - if they do not have to work in Dilbert-like work environments
3. A project can adjust to unforeseen changes
   - In particular, changes to the design are not ruinously expensive
4. Adjustment is easier if everything that need not be in writing, is not done in writing
   - Code must be in writing
   - User documentation may, too (Depends!)
   - Most other information does not.

- Agile methods are useful if these assumptions are met,
  - they are problematic if even one of them is not.
  - The most risky assumption that of cheap design changes
When are the assumptions true?

1. You cannot foresee the development of a whole project
   - Almost always true

2. Developers are motivated, technically competent, and capable of good judgement
   - Depends critically on available staff and organizational culture

3. Changes to the design are not ruinously expensive
   - True only if modern technology (such as reusable components, middleware, modules, object-orientation, development tools etc.) is used in a highly competent fashion
   - False if an "architecture breaker" occurs
     - almost sure if you do not have a good architecture to begin with

4. Adjustment is easier if everything that need not be in writing, is not done in writing
   - Possible only if there is a tightly coupled, fairly stable, and preferably co-located team
The planning spectrum


- The defining difference between agile and conventional methods is the amount of planning
  - There can be too much planning ("inch-pebble") as well as too little ("just hacking")
The planning spectrum (2)

- Risk exposure is the product of
  - $P(L)$ (probability of loss) and
  - $S(L)$ (size of loss)
- High exposure can come from too much planning or from too little

![Graph showing the planning spectrum with sweet spot and execution-related exposure and planning-related exposure labels.](Image)
The planning spectrum (3)

- The most relevant factors are dependability requirements and project size
  - More planning is useful if they are high
  - Less if they are low
The "home ground" of agile vs. plan-driven methods

Agile methods:
- Developers:
  - agile, knowledgeable, co-located, collaborative
- Requirements:
  - Largely emergent, rapid change
- Architecture:
  - Designed for current req'mts
- Refactoring:
  - Inexpensive
- Size:
  - Smaller teams and products
- Primary objective:
  - Rapid value

Plan-driven methods:
- Developers:
  - plan-oriented, adequate skills, access to external knowledge
- Requirements:
  - Knowable early, largely stable
- Architecture:
  - Designed for current and foreseeable requirements
- Refactoring:
  - Expensive
- Size:
  - Larger teams and products
- Primary objective:
  - High assurance
Too much planning
Too much planning (2)
"Just enough" planning: The XP Planning Game

• Extreme Programming (XP) is one of several concrete agile development methods
  • It consists of a number of specific practices (see next lecture)
  • One of these is called "Planning Game" and describes the project planning method

• XP project planning occurs on three granularity levels
  • Release  ~2-4 project months
  • Iteration ~1-2 project weeks
  • Task  ~0.5-3 person days

• Only the current Release, Iteration, and set of Tasks are planned in some detail
  • all future Releases and Iterations-within-release are at most sketched, perhaps not even that
XP Planning Game: Release planning

- Customer enumerates (rough) requirements
  - Each is written on a Story Card
  - Cards are collected
- Customer prioritizes stories into E (essential), V (valuable), and N (nice-to-have)
- Developers query Customer to obtain sufficient detail about stories to understand their content and purpose
  - "conversation"
- Developers estimate development cost for each story
  - and categorize their estimates into R (reliable), A (approximate), and U (unknown)
- Customer selects stories for next release, preferring E and V
  - Remaining stories are to be realized in subsequent releases
XP Planning Game: Iteration and task planning

• Before each iteration, the customer can select stories for it
  • Priorities may have shifted
  • Estimation may now be more precise
  • Customer is even allowed to bring in new requirements
    • but must drop (for this release) others of the same weight
• Customer defines acceptance tests for selected stories
  • "confirmation"
• and clarifies remaining details about the stories
  • "conversation"

• Developers turn the set of stories (requirements) into a set of tasks (design and implementation work)
  • A developer adopts a task and then must personally estimate its size
XP Planning Game: Plan tracking and replanning

- Tracking the release-level plan
  - after each iteration, compare expected and actual progress
    → possibly modify release content

- Tracking the iteration-level plan
  - informally ask developers for progress every ~2 days or so
    → possibly modify iteration content

- Estimation is always done in terms of "ideal development time"
  - i.e., programming only, without interruptions or additional tasks.
  - After each iteration, a "load factor" is computed for each developer, relating ideal time to elapsed time
  - and is used during the next iteration planning

- Planning focus is always on stories
  - because they represent customer value
Other elements of agile processes

Besides lean planning, there are other typical behaviors that help with agility:

• **Documentation:**
  - Whenever you can, rely on oral communication instead of written information
    - Rationale: Talking is so much cheaper than writing that you can even tolerate some redundance; in the presence of change, writing costs can probably never pay off
    - Rationale: Oral communication is more flexible, understanding is easier to obtain
  - If you have to use writing for clarity, consider throwing it away as soon as understanding has been achieved
    - Rationale: In the presence of change, it is too costly to keep the documentation up-to-date.

• **Automation:**
  - Use automation wherever possible to remove barriers against change (in particular: build process; testing)
Other elements of agile processes (2)

- **Meetings and communication:**
  - Keep meetings with multiple participants as short as possible
    - Rationale: Long meetings are inefficient
  - Rely a lot on one-to-one discussions with changing partners
    - Rationale: Can replace many meetings; avoids meetings' tendency to get lengthy; improves motivation and initiative
  - Maximize the opportunity for informal communication
    - Rationale: Reduces the need for formal meetings as risk-reduction mechanisms

- **Early and intensive feedback:**
  - Reduce the uncertainty about the quality of requirements (and implementation) by frequent releases
  - Reduce the uncertainty about the consistency of design and implementation by automated builds and tests

- **Simplicity:**
  - Avoid all complexity that is not very clearly warranted
Using Risk for Balancing Agile vs. Plan-Driven


Basic idea:
• Agile methods are susceptible to different risks than plan-driven methods
• Analyzing risk types and strengths helps deciding which method (or balance of methods) to use

Approach:
• Classify risks into
  • environmental risks
  • agility-oriented risks
  • plan-driven risks
Using Risk for Balancing...: Examples

- Characteristics of 3 imaginary example projects/systems:

<table>
<thead>
<tr>
<th>Application</th>
<th>Team size</th>
<th>Team type</th>
<th>Failure risks</th>
<th>Clients</th>
<th>Requirements</th>
<th>Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event planning</td>
<td>5</td>
<td>In-house venture startup,</td>
<td>Venture capital, manual</td>
<td>Single, colocated, representative</td>
<td>Goals generally known, details</td>
<td>Provided by single COTS package</td>
</tr>
<tr>
<td></td>
<td></td>
<td>colocated</td>
<td>effort</td>
<td></td>
<td>emergent</td>
<td></td>
</tr>
<tr>
<td>Supply-chain management</td>
<td>50</td>
<td>Distributed, often multiorganization</td>
<td>Major business losses</td>
<td>Multiple success-critical stakeholders</td>
<td>Some parts relatively stable, others volatile, emergent</td>
<td>Provided by small number of COTS packages</td>
</tr>
<tr>
<td>National crisis management</td>
<td>500</td>
<td>Highly distributed, multiorganization</td>
<td>Large loss of life</td>
<td>Many success-critical stakeholders</td>
<td>Some parts relatively stable, others volatile, emergent</td>
<td>System of systems, many COTS packages</td>
</tr>
</tbody>
</table>
Using Risk for Balancing...: Examples risk assessment

<table>
<thead>
<tr>
<th>Risk items</th>
<th>Event Managers</th>
<th>SupplyChain.com</th>
<th>NISCM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E-Tech</strong>: Technology uncertainties.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td><strong>E-Coord</strong>: Many stakeholders.</td>
<td>□</td>
<td></td>
<td>□</td>
</tr>
<tr>
<td><strong>E-Cmplx</strong>: Complex system of systems.</td>
<td>□</td>
<td></td>
<td>□</td>
</tr>
<tr>
<td><strong>A-Scale</strong>: Scalability.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td><strong>A-Yagni</strong>: Use of simple design.</td>
<td>□</td>
<td></td>
<td>□</td>
</tr>
<tr>
<td><strong>A-Churn</strong>: Personnel turnover.</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A-Skill</strong>: Not enough people skilled in</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>agile methods.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P-Change</strong>: Rapid change.</td>
<td>□□□□□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>P-Speed</strong>: Need for rapid results.</td>
<td>□□□□□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>P-Emerge</strong>: Emergent requirements.</td>
<td>□□□□□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>P-Skill</strong>: Not enough people skilled in</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>plan-driven methods.</td>
<td></td>
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</tbody>
</table>
Using Risk for Balancing...: Decision schema

- High risk uncertainty → "buy" information

Step 1. Risk analysis
Rate the project's environmental, agility-oriented, and plan-driven risks

Step 2. Risk comparison
Compare the agile and plan-driven risks
- Plan-driven risks dominate
  - Go risk-based plan-driven
- Agility risks dominate
  - Go risk-based agile
- Neither dominate
  - Architect application to encapsulate agile parts
  - If uncertain, buy information via prototyping, data collection, and analysis

Step 3. Architecture analysis
- Go risk-based agile for agile parts; go risk-based plan-driven elsewhere

now tailor, execute, and monitor
Using Risk for Balancing...: Levels of development staff

Table C. Levels of software method understanding and use.

<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Able to revise a method, breaking its rules to fit an unprecedented new situation.</td>
</tr>
<tr>
<td>2</td>
<td>Able to tailor a method to fit a precedent new situation.</td>
</tr>
<tr>
<td>1A</td>
<td>With training, able to perform discretionary method steps such as sizing stories to fit increments, composing patterns, compound refactoring, or complex COTS integration. With experience, can become Level 2.</td>
</tr>
<tr>
<td>1B</td>
<td>With training, able to perform procedural method steps such as coding a simple method, simple refactoring, following coding standards and CM procedures, or running tests. With experience, can master some Level 1A skills.</td>
</tr>
<tr>
<td>-1</td>
<td>May have technical skills, but unable or unwilling to collaborate or follow shared methods.</td>
</tr>
</tbody>
</table>

A 5:1 ratio of Level 1A to Level 2 staff can be OK for agile methods, but 1B get in the way.

Plan-driven can function with many 1B.

-1 are always a problem.
Using Risk for Balancing...:
Risks and risk levels
CMMI process areas in agile methods

- Level 2: Managed
  - + Requirements Mgmt
  - o Project Planning
  - + Project Monitoring&Control
  - - Supplier Agreement Mgmt
  - o Measurement and Analysis
  - o Process and Product Quality Assurance
  - + Configuration Management

- Level 3: Defined
  - + Req's. Development
  - + Technical Solution
  - o Product Integration
  - o Verification
  - + Validation
  - - Organizational Process Focus
  - - Organ'l Process Definition

- Level 4: Quantitatively Manag'd
  - - Organizational Training
  - o Integrated Project Mgmt.
  - o Risk Management
  - o Decision Analysis and Resolution

- Level 5: Optimizing
  - - Organizational Process Performance
  - o Quantitative Project Mgmt
  - o Causal Analysis and Resolution

+ usually available
o avail. in reduced form
- usually mostly absent
Further resources

- http://www.agilealliance.com
  - A community portal around the agile approach. Has pointers to most everything about it.
- http://alistair.cockburn.us/
  - Alistair Cockburn (one of the best writers-of-agile), Crystal
- http://www.controlchaos.com/
  - Ken Schwaber, SCRUM
- http://www.adaptivesd.com/
  - Jim Hightsmith, Adaptive SW Development
- http://www.xprogramming.com
  - Ron Jeffries, XP

- IEEE Computer, June 2003
  - Issue topic "Agile Methods" (7 articles about when and how)
  - http://www.computer.org
Believe nothing, no matter where you read it or who said it, not even if I have said it, unless it agrees with your own reason and your own common sense.

Gautama Siddharta Buddha
Summary

- Agile approaches expect change and attempt to accommodate it as much as possible
- They attempt to avoid process elements that make change expensive
  - and replace them by something cheaper

- Agile approaches are most suitable when
  - team sizes are small,
  - dependability requirements are modest, and
  - requirements change is common

- A disciplined agile process can cover many of the CMMI process areas up to level 5
  - however in rather unconventional ways
Thank you!