## Extreme programming

- An influential agile method, developed in the late 1990s, that introduced a range of agile development techniques.
- Extreme Programming (XP) takes an 'extreme' approach to iterative development.
  - New versions may be built several times per day;
  - Increments are delivered to customers every 2 weeks;
  - All tests must be run for every build and the build is only accepted if tests run successfully.

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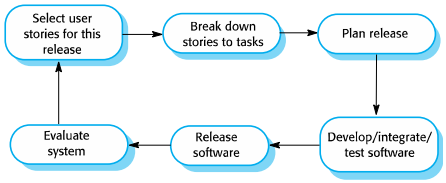
## The extreme programming release cycle

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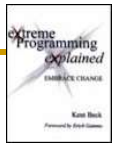
## Extreme programming




- Set of SE practices that produce **high-quality software** with **limited effort**
- Light-weight software development process
  - Replaces documentation with communication
  - Focuses on source code and testing
    **Controversial** – "Hacking"?
  - Strong **productivity** improvements
- Developed by industry practitioners
  - "..proven at cost conscious companies like Bayerische Landesbank, Credit Swiss Life, DaimlerChrysler, First Union National Bank, Ford Motor Company and UBS."
- XP Web Site: http://www.extremeprogramming.org

## XP Challenges Assumptions

- XP says that **analogies** between software engineering and **other engineering domains** are **false**:
  - software customers' requirements change more frequently;
  - our products can be changed more easily;
  - the ratio of **design cost:build cost** is much higher;
  - if we consider coding as "design" and compile-link as "build":
    - the "build" task is so quick and cheap it should be considered instant and free,
    - almost all software development is "design".
- The design meets known existing requirements, not all possible future functionality

## XP Core Values

- Values necessary for an emergent culture and improved productivity
  - **Communication**
  - **Feedback**
  - **Simplicity**
  - **Courage**
- To support and reinforce the core values, XP recommends a whole range of planning, testing and development practices that can be divided into 3 groups:
  1. Programmer practices
  2. Team practices
  3. Project practices

## Fundamentals of XP

- Distinguish between decisions made by business stakeholders and developers
- Simplistic – keep design as simple as possible
  "design for today not for tomorrow"
- Write automated test code before writing production code and keep all tests running
- Pair programming
- Very short iterations with fast delivery

## Why is XP controversial?

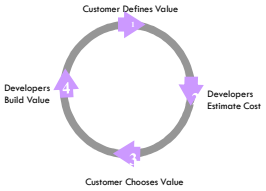
- No specialists
  - Every programmer participates in architecture, design, test, integration
- No up-front detailed analysis and design
- No up-front development of infrastructure
- Not much writing of design & implementation documentation beside tests and code

## When can XP be used?

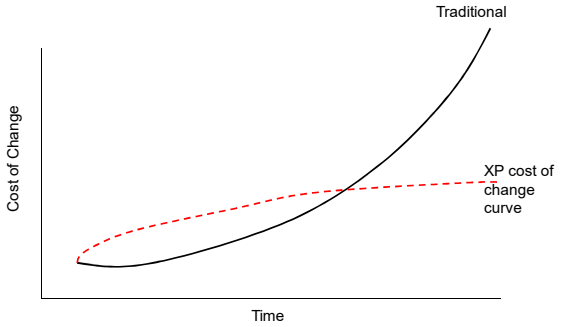
- Small projects:
  - 5-10 developers, maybe 20
- Developer and customer representative are co-located
- Problems:
  - Point-and-go culture
  - Testing takes hours to execute

## XP Definitions

- Kent Beck's idea of turning the knobs on all the best practices up to 10.
- Optimizing the "**Circle of Life**" by hitting the sweet-spot of practices that self-reinforce and become more than the sum of the parts (synergize).




## XP Cost of Change Curve




## The Four XP Values

- **Simplicity**
  - Simplest thing that could possibly work
  - YAGNI
- **Communication**
  - Developers
  - Users
  - Customers
  - Testers
  - Code
- **Feedback**
  - Testing
  - Experimenting
  - Delivering
- **Courage**
  - Trust
  - History

## Twelve XP Practices

1. Planning Game *
2. Short Releases *
3. Simple Design *
4. Testing *
5. Refactoring
6. Pair Programming
7. Collective Ownership
8. Continuous Integration
9. On-site Customer *
10. Sustainable Pace *
11. Metaphor
12. Coding Standards *

- Many of the practices actually existed, in one form or another, prior to the advent of XP (*)

## Influential XP practices

- Extreme programming has a technical focus and is not easy to integrate with management practice in most organizations.
- Consequently, while agile development uses practices from XP, the method as originally defined is not widely used.
- **Key practices**
  - **User stories for specification**
  - **Refactoring**
  - **Test-first development**
  - **Pair programming**
  - **CI**

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## The Planning Game

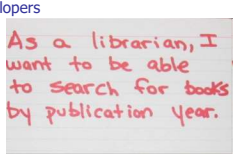
- Recognition
  - You can't know everything when you start
    - What a realization!
  - Customers will learn about what they want by looking at what you've done so far
  - Developers will learn about the domain and technology as the project progresses.
  - Developers will learn what questions to ask once they start
    - Early on, they don't know what they don't know

## 1. Planning Game

- **Release Planning**:
  - Define and estimate higher-level features down to about 5-10 days effort each.
  - Customer lays features in fixed-length iteration schedule.
- **Iteration Planning**
  - Same, but to 3 or less days effort & detailed story cards within next iteration.
- Simple to steer project towards success.

## The Planning Game

- **User Story**
- Written on a card
  - "chunk of functionality that is coherent in some way to the customer"
- Given **priority/value** by the customers based on business value
- Given **estimate** (1, 2, 3 weeks) by the developers
- Given **risk** value by developers
  - Doing risky items first mitigates risk
- The card is a commitment to talk more later.




- Example
  - Employees who are sick more than 3 days go on DAP (Disability Absence Plan). They are paid from their full pay for 190 working days, and then 70% pay up through 270 days. DAP euros paid must be kept separate from regular pay euros, for accounting purposes.

## User Story Examples

A user wants access to the system, so they find a system administrator, who enters in the user's First Name, Last Name, Middle Initial, E-Mail Address, Username (unique), and Phone Number.

**Risk:** Low **Cost:** 2 points

The user must be able to search for a book.

**Risk:** High **Cost:** (too large!)

The user must be able to search for a book by Title, and display the results as a list.

**Risk:** Med. **Cost:** 1 point

The user must be able to search for a book by Category, and display the results as a list.

**Risk:** Med. **Cost:** 2 points

## 2. Short Releases

- **Deliver business value early and often**
- Do not slip iteration release dates
  - adjust scope within an iteration, never time or quality
- Small, stable teams are predictable in short time-frames
- De-scope as opposed to Delay!

## 3. Simple Design

- XP Mantra

  "**The simplest thing that could possibly work**"
- Meet current, minimum business requirements only
- Avoid anticipatory design
- YAGNI – You Aren't Going to Need It

## 4. Testing

- Its all about automation.
- Automated unit tests for every entity.
- Automated acceptance tests for every story / requirement.
- All unit tests pass 100% before checking in a feature.

## Testing

- **Unit Tests**
  - Code Unit Test First (in small increments)
  - When developers go to release new code, they run all the unit tests, not just theirs, on the integration machine.
  - The tests must run at 100% before checking in feature
  - If any test fails, they figure out why and fix the problem.
  - The problem certainly resides in something they did ... since they know the tests ran at 100% the last time anything was released.

## Testing

- **Acceptance Tests**
  - Test cases "extracted from" customer
  - Test system end-to-end
  - Tells the customer and the developers if the system has the features it is supposed to have
  - Don't have to run at 100%
  - Progress used to measure "Project Velocity"
    - What % of the customer's acceptance test cases run?

## Testing

- Automating software testing
  - Manual software testing is time consuming
  - Software testing has to be repeated after every change (regression testing)
  - Write test drivers that can run automatically and produce a test report
- Junit testing
  - A small testing framework written in Java.
  - A series of extensible classes that do much of the testing grunt work for us. (i.e. counting and reporting errors and failed tests, running tests in batch, etc.)
  - Very handy for Extreme Testing…
  - Developed by Kent Beck and Erich Gamma
- Many other unit testing frameworks exist, e.g. pyunit.

## Test automation

- Test automation means that tests are written as executable components before the task is implemented
  - These testing components should be stand-alone, should simulate the submission of input to be tested and should check that the result meets the output specification.
  - An automated test framework (e.g. Junit) is a system that makes it easy to write executable tests and submit a set of tests for execution.
- As testing is automated, there is always a set of tests that can be quickly and easily executed
  - Whenever any functionality is added to the system, the tests can be run and problems that the new code has introduced can be caught immediately.

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## Problems with test-first development

- Programmers prefer programming to testing and sometimes they take short cuts when writing tests.
  - For example, they may write incomplete tests that do not check for all possible exceptions that may occur.
- Some tests can be very difficult to write incrementally. For example, in a complex user interface, it is often difficult to write unit tests for the code that implements the 'display logic' and workflow between screens.
- It difficult to judge the completeness of a set of tests. Although you may have a lot of system tests, your test set may not provide complete coverage.

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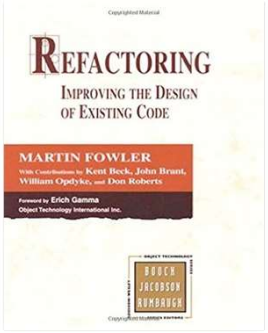
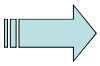
## 5. Refactoring

- Refactoring: changing internal structure without changing external behavior
- When change is hard, refactor to allow change to be easy, testing as you go, then add change.




## Simplicity leads to Refactoring

- Refactoring = Changing the code without changing its functionality
- Remove duplication(s)
- Goal: make code easier to maintain (keep in simplest form)


investment into the future

Refactoring book by Fowler
http://www.refactoring.com

## Simplicity leads to Refactoring

- **Why refactor?**
  - To improve the design of software
  - To make code easier to understand
  - To help find bugs
  - As a result
    - (future) coding becomes faster
    - outside source code documentation less required

## Simplicity leads to Refactoring

- **When do you refactor?**
  - When the code "smells bad"
    - Repeating code
    - Code difficult to understand
    - Long methods / functions
    - …

## Examples of refactoring

- Re-organization of a class hierarchy to remove duplicate code.
- Tidying up and renaming attributes and methods to make them easier to understand.
- The replacement of inline code with calls to methods that have been included in a program library.

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## 6. Pair Programming

- **Two heads are better than one**, especially in an open lab environment (co-location)
- Earliest possible code inspections
- Earliest possible brainstorming
- Peer pressure reinforces discipline

## Pair Programming

- Traditional specialization leads to queues (you will block on the specialist at some point)
- the 'Driver' implements, focusing on the tactical.
- The 'Navigator' is more objective (strategic) – asks 'why' and provides explanations
- Healthy pairings have communications every 45 to 60 seconds.
- Pairs should switch roles often & can break off for low complexity tasks
- Pairing is intense (suggest a break every 2 hours)

## Pair Programming

- Knowledge transfer amongst the team is also a major advantage when using pair programming
  - Both programmers in the pair are familiar with the code and have either written the code or has been actively involved as the programmer watching the code generation.
- Development costs do not double
- Continual training…

## Is Pair Programming Costly?

- **Cost of pair programming**
- Williams, Laurie, Kessler, Robert R., Cunningham, Ward, and Jeffries, Ron, Strengthening the Case for Pair-Programming, IEEE Software, July/Aug 2000 .
  - University study with 41 students
  - Higher quality code
    - Test cases passed individuals: 73.4%-78.1%
    - Test cases passed pairs: 86.4%-94.4%
  - Pairs completed assignments 40-50% faster (average 15% higher costs) Why might this be the case?
  - Pair programming preferred by students (85%)

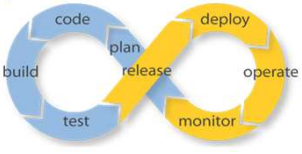
## 7. Collective Ownership

- Interchangeable programmers
- Team can go at full speed
- Can change anything, anytime, without delay

Collective Code Ownership

## 8. Continuous Integration

- Avoids "versionitis" by keeping all the programmers on the same page
- Integration problems smaller, taken one at a time
- Reduces risks associated with the traditional integration phase



## 9. On-site Customer

- Customer/User liaisons are team-members
- Available for priorities, clarifications, to answer detailed questions
- Reduces programmer assumptions about business value
- Shows stakeholders what they pay for, and why
- **On-site customer ensures:**
  - Developers don't have to wait for decisions
  - Face to face communication minimizes the chances of misunderstanding
  - Remember, the original user story was a commitment for a later conversation . . .

## 10. Sustainable Pace

- Tired programmers make more mistakes
- Better to stay fresh, healthy, positive, and effective
- XP is for the average programmer, for the long run

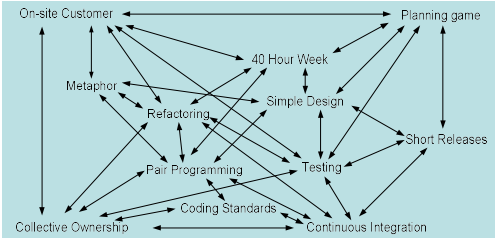
## 11. Metaphor

- Use a "system of names"
- Use a common system description
- Helps communicate with customers, users, stakeholders, and programmers

## 12. Coding Standards

- All programmers write the same way
- Rules for how things communicate with each other
- Guidelines for what and how to document

## XP Practices Support Each Other




Source: Beck, Extreme Programming Explained: Embrace Change, 1999

## Some advantages of XP

- Promotes team cooperation and support (pair programming)
- Strong support for changing / emerging requirements
- Can develop discipline and team ethic for excellence
- Can improve quality (afterall, code inspections are happening as the code is written)
- Recognises that the requirements cannot be fully captured at the beginning and that customers need to continue to be heavily involved throughout the project (co-responsibility)
- Provides for continual training and knowledge transfer
- Avoids over specialisation
- Test-first is cost effective, so is early inspecting

## Some limitations of XP

- Can the customer realistically be on-site?
- Co-location of team members required
- Question marks regarding scalability of the process: Small teams → small projects
- Distributed XP: Can we transfer the productivity benefits of XP to a distributed environment?
  - Communication replaces documentation (KT? Training? Selling company?)
  - Open-source projects
- Virtual teams
  - Software development is more and more distributed
    - Size of projects, Scarce local resources
  - Outsourcing of tasks is often financially beneficial
  - Open source success stories
- Extreme Programming Considered Harmful for Reliable Software Development http://www.agilealliance.org/system/article/file/945/file.pdf
- Is the concept that all people can be equally effective fundamentally flawed? *Premium* people debate…

## Reflections on XP

- Not much evidence to suggest that XP continues to be in widespread use today.
- But as a set of practices, XP has had a profound impact on the software development process.
- Many of the practices used in combination in XP can be seen in active use in practice and in the descriptions of later agile methods.
- XP can therefore be considered to have catalysed a significant change in the approach to the software development process.