Agile Software Development

16 - 18 November 2021 | Guido Trensch (JSC, Simulation & Data Lab Neuroscience)

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Motivation

- Scientific software does not end its development cycle on publication of the paper.
- Reproducibility of scientific results requires sustainable software.
- Learn from the industry where rapid software development became the standard methodology for developing sustaining complex software, also known as:

"***Agile Development"*** or "***Agile Methods***"

- Why is Agile Development such a success story?
  - Agile development accelerates the delivery.
    In contrast: plan-driven software development is a lengthy process
  - Agile methods can handle changing requirements.

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Plan-Driven vs Agile Software Development

Plan-driven

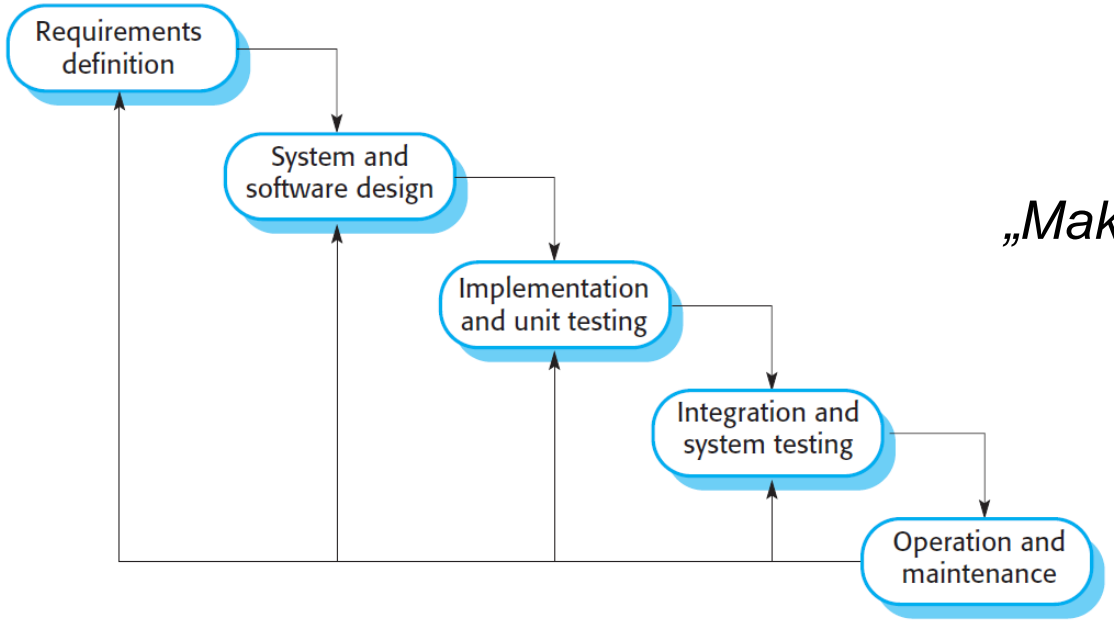
- Also known as “heavy-weight“ or “traditional” methodologies
- Up-front system architecture and detailed plans
- Completely specifies:
  - Requirements
  - Design
  - Build and test environments
- Uses a conventional waterfall or specification-based software development process

Plan-Driven vs Agile Software Development

Plan-driven

- Waterfall model

  One stage must be completed before progress to the next stage is possible!



„Make a plan and do not change it!“

- Plan-driven software development is still applicable for some types of software, e.g. safety-critical systems.

[Ian Sommerville, Software Engineering]

Plan-Driven vs Agile Software Development

Agile Development

- The need for rapid software development and processes has been recognized for many years.
- The idea of "***Agile Methods***" took off in the late 90's.
  - eXtreme Programming (XP) [1999 Kent Beck]

    *The approach was developed by **pushing recognized good practice**, such as iterative development, **to "extreme" levels**.*

    For example: In XP, several new versions of a system may be developed by different programmers, integrated, and tested in a day.
  - Dynamic System Development Method (DSDM)

    *Is a generic approach to **project management and solution delivery** rather than being focused on software development.*

[Ian Sommerville, Software Engineering]

Plan-Driven vs Agile Software Development

What is Agile Software Development?

[Dave Hecker, https://www.youtube.com/watch?v=-zDct5d2smY]

It is ..

- a methodology, a set of methods and practices, a way of executing software development management
- iterative
  - ***Iteration is the main concept in agile**. (All agile methods are iterative!)*
  - *It is the total opposite of the waterfall-model!*
  - *The work is done in tight cycles, so called "**sprints**".*
  - *The "plan" is **constantly revisited**.*
- streamlined
  - *It favors for getting the work done.*
- time-boxed
  - *The work is planed by time instead of by feature.*
- very collaborative

Plan-Driven vs Agile Software Development

Agile Methods and Processes

- eXtreme Programming (XP)
- Scrum
- Large-scale Scrum (LS Scrum)
- Kanban
- …

…. **based on practices like**:

- Test-driven development (TDD)
- User acceptance tests
- Pair-programming
- Refactoring
- Continuous integration and delivery (CI/CD)
- Following coding standards, clean code
- …

Plan-Driven

Make a plan and do not change it!

Agile

Constantly revisit the plan!

Agile methods are designed to

produce useful software quickly!

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Introduction to Scrum

What is Scrum?

- Scrum is an **agile method** offering a **lightweight project management framework** for effective team collaboration.
- The *Scrum methodology* was first public presented in 1995 by *Jeff Sutherland* and *Ken Schwaber* at the OOPSLA conference.
- In the sport of rugby, a *Scrum* is a way of restarting the game, when the ball has gone out of play and 7-8 players work to move the ball forward.

Introduction to Scrum

Scrum Team

- Product Owner
- Scrum Master
- Development Team

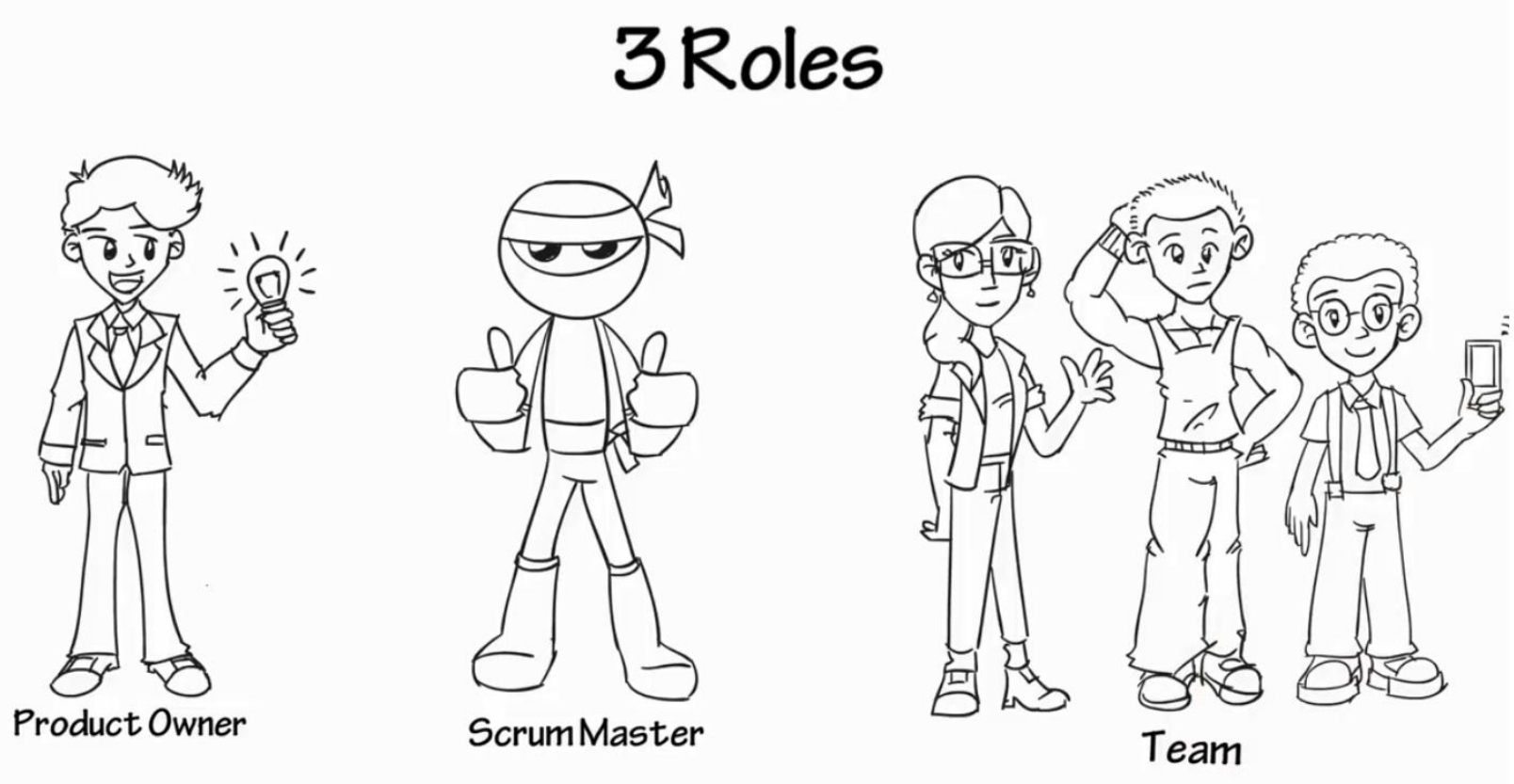
Events

- Sprint Planning
- Daily Scrum (Daily Stand Up)
- Sprint Review
- Sprint Retrospective

Artifacts

- Product Backlog
- Sprint Backlog
- Sprint Progress

Agile Development – Introduction to Scrum



[Steve Stedman, https://www.youtube.com/watch?v=9TycLR0TqFA]

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- **One person**, not a committee!

  He or she is responsible for **managing the backlog** to achieve the desired outcome.

  - Clearly identifies and describes product backlog items
  - Makes decisions regarding the priority of product backlog items
  - Ensures transparency

[Steve Stedman, https://www.youtube.com/watch?v=9TycLR0TqFA]

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- He or she **guides the team** in the effective use of Scrum and **protects the team** from outside interruptions and distractions.
- The Scrum master is responsible for ensuring the team follows the processes and practices that the team agreed they would use.
- The Scrum master **serves** both, the **product owner** and the **development team**, facilitates Scrum events as requested or needed and **moderates the (daily) stand up**.

[Steve Stedman, https://www.youtube.com/watch?v=9TycLR0TqFA]

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- They are a **self-organizing team** and manage their own work.
- No one, not even the Scrum master, tells the development team how to turn the backlog into increments of potentially releasable functionality.
- Development **team size ~ 3 - 9**: Small enough to remain nimble, large enough to complete significant work within a sprint.

[Steve Stedman, https://www.youtube.com/watch?v=9TycLR0TqFA]

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- In this meeting, the entire Scrum **team plans** the work for the **next sprint**.
- The meeting is **time-boxed** to a **maximum of eight hours** for a four-week sprint.
- The work is selected from the backlog.

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- It is **time-boxed** meeting, **max. 15 minutes**, for the development team to synchronize.

  What did I do yesterday?

  What will I do today?

  Do I see any impediment that prevents me or the team from reaching the sprint goal.

- Moderated by the Scrum master.

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- This is an informal **four-hour time-boxed** meeting (for a four-week sprint) at the end of a sprint.
- The Scrum team and the stake holders discuss **what was done in the sprint** and **adjust the product backlog** if necessary.

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- From experience, this is the **most important event** !
- This is a **three-hour time-boxed** meeting which takes place after the sprint review and prior the next sprint planning.
- During the retrospective, the Scrum team inspects how the last sprint went with regards to processes, tools, etc.
- The team creates a **plan for improvements**.
- **Eleminate waste !**

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- The Product Backlog is a list of ToDo items, e.g.:
  - research tasks
  - feature definitions
  - architecture definitions
  - user stories (user requirements)
  - supplementary tasks
  - user documentation tasks
  - .. and more

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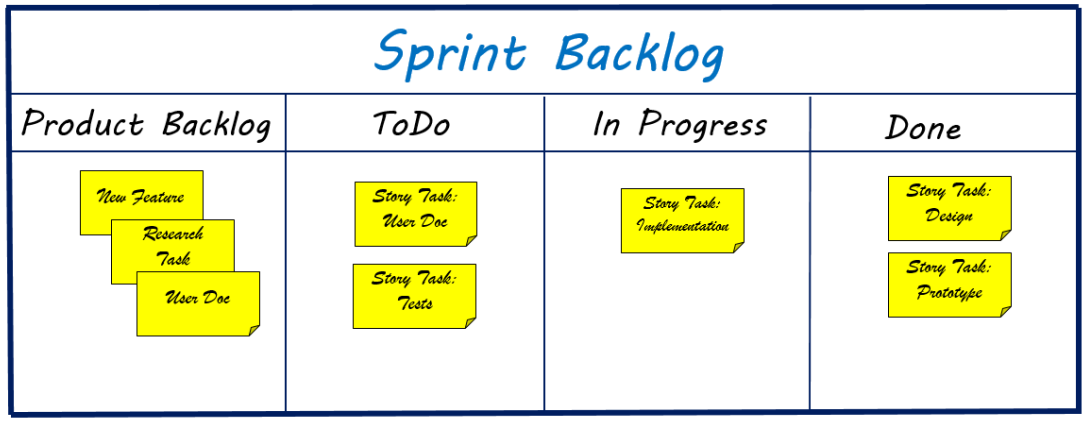
- The Sprint Backlog is a set of backlog items, selected for the sprint.



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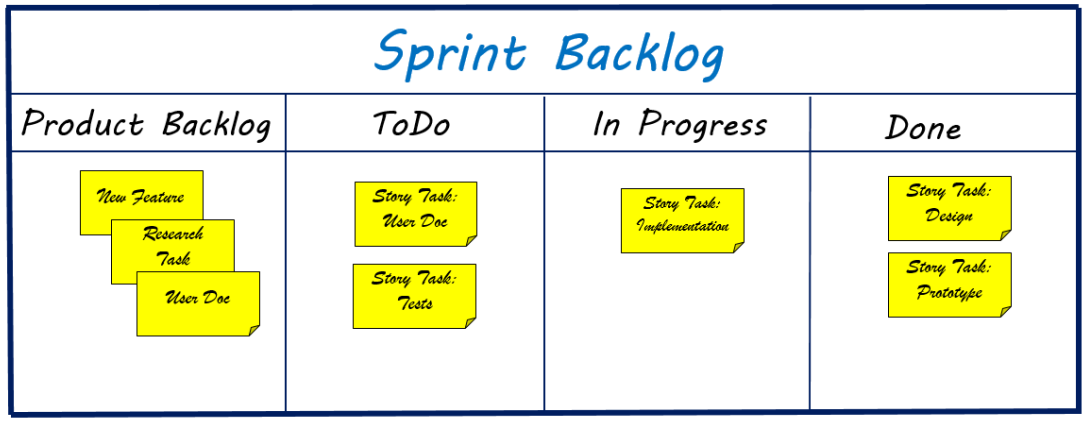
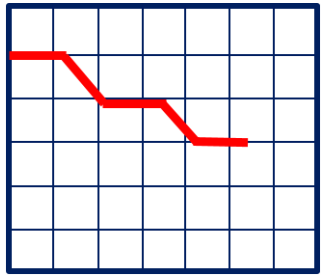


E.g., a burn-down-chart



Definition of Done

- To ensure transparency, Scrum team members must have a **shared understanding of what it means for a task to be completed**, e.g.:
  - source code peer-reviewed
  - documentation adapted
  - test case provided
  - all tests passed successfully
- As Scrum teams mature, the “Definition of Done“ will expand to include **more stringent criteria for higher quality**.
- This guides the team in knowing how many product backlog items can be selected during sprint planning.

Any product should have a “Definition of Done“.

Scrum Myths: There is no planning

- In reality there is a lot of planning in Scrum.
- In Scrum, we emphasize the activity of planning over the plan itself.
- Planning is collaborative.
- Planning is part of every event.
- The people doing the work own the plan.
- The way planning is done is to **eliminate waste** !

[https://www.Scrum.org/resources/blog/Scrum-myths-there-no-planning-Scrum]

Scrum Smells: Signs that something may be amiss on a Scrum project

- Not all Scrum team members attend the Scrum meeting.
- Too much discussion in the Scrum meeting.
- Scrum master assigns work.
- The daily Scrum is for the Scrum master.
- The project team has highly specialized job roles.
- Wild fluctuations shown on a team's initial sprint burndown charts continue to be seen in much later sprints.

[https://www.mountaingoatsoftware.com/articles/toward-a-catalog-of-Scrum-smells]

Conclusions

- Scrum is simple to understand but difficult to master.
- Scrum is not restricted to software development.
- Artifacts defined by Scrum are specifically designed to maximize transparency.
- Scrum functions well as a container for other techniques, methodologies and practices.

Scrum does not solve problems but makes them visible!

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Principles and Practices

Scrum as a method works as container for agile development techniques.

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

[Ian Sommerville, *"Software Engineering"*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- Developers work on all areas of the system
- No islands of expertise develop
- All the developers take responsibility for all of the code
- Anyone can change anything

[Ian Sommerville, *"Software Engineering"*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- As soon as the work on a task is complete, it is integrated into the whole system.
- After any such integration, all the unit tests in the system must pass.

[Ian Sommerville, *"Software Engineering"*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- Requirements are recorded on “story cards”
- The stories to be included in a release are determined by:
  - the time available
  - their relative priority

[Ian Sommerville, *“Software Engineering”*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- Developers work in pairs
- Checking each other's work
- Providing support
- Knowledge transfer

[Ian Sommerville, *"Software Engineering"*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- All developers are expected to refactor the code continuously as soon as potential code improvements are found.
- This keeps the code simple and maintainable.

[Ian Sommerville, *"Software Engineering"*]

Principles and Practices

- Collective ownership
- Continuous integration
- Incremental planning
- Pair programming
- Refactoring
- Test-driven development

- An automated unit test framework is used to write tests for a new piece of functionality before that functionality itself is implemented.

[Ian Sommerville, *"Software Engineering"*]

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Agile Management Tools

- There is a vast market of agile management tools.
- They are usually not free of charge for larger projects.
- The functionality differs in a wide range, from simple tracking or dashboard tools to complex workflow management and reporting for large teams and projects.

GitHub

www.github.com

GitLab

www.gitlab.com

Atlassian Jira

www.atlassian.com/software/jira

asana

www.asana.com

icescrum

www.iceScrum.com

Agile Development Supporting Tools and Platforms

- Modern software development tools and platforms support agile methodologies and workflows:
  - Version control
  - Test-driven development
  - Peer-review
  - Continuous integration, testing and delivery
  - Basic agile managment

GitHub

www.github.com

GitLab

www.gitlab.com

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Agile Management with GitLab

What is GitLab?

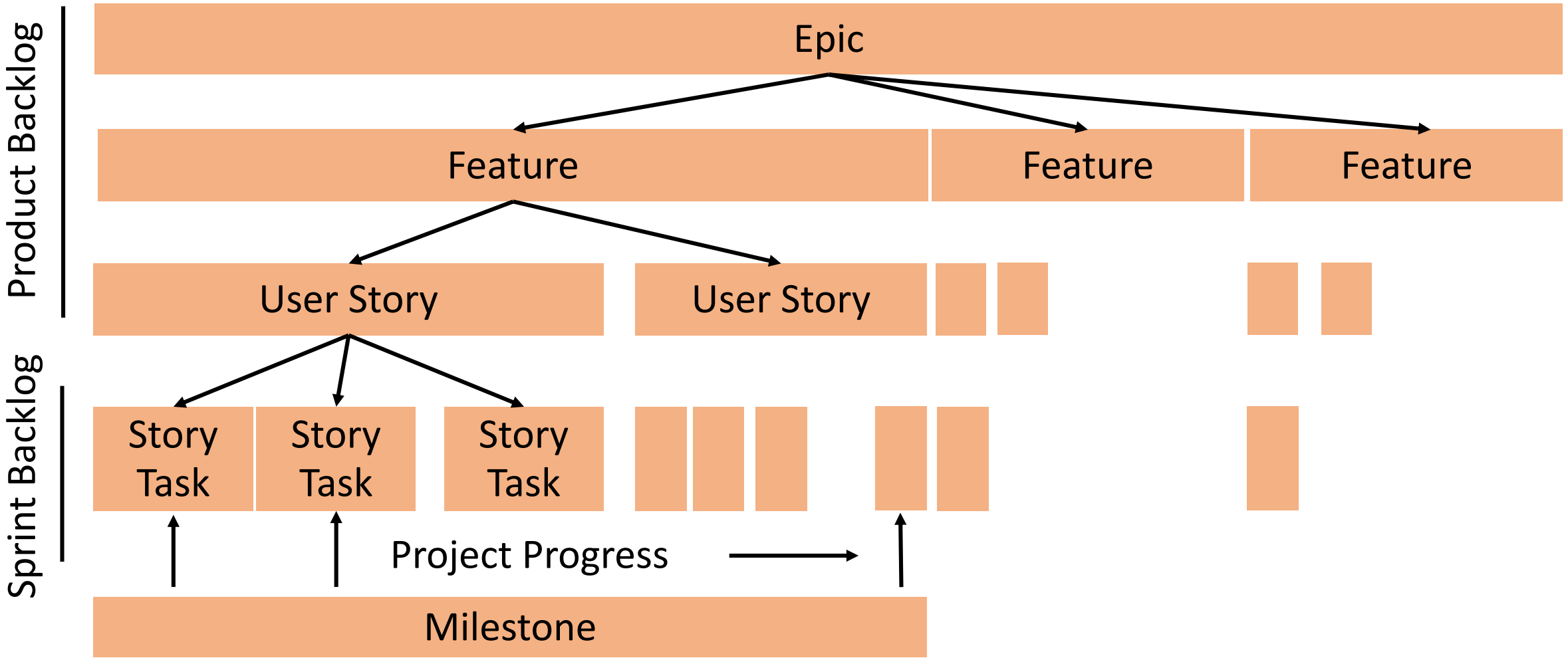
www.gitlab.com

Web-based DevOps (set of software development practices) lifecycle tool:

- Git-repository
- Issue-tracker
- CI/CD pipeline
- Basic agile software development workflow support
- Basic project management functionality
- Milestones
- Configurable issue board
- Wiki
- Simple role management
- Community Edition is free of charge

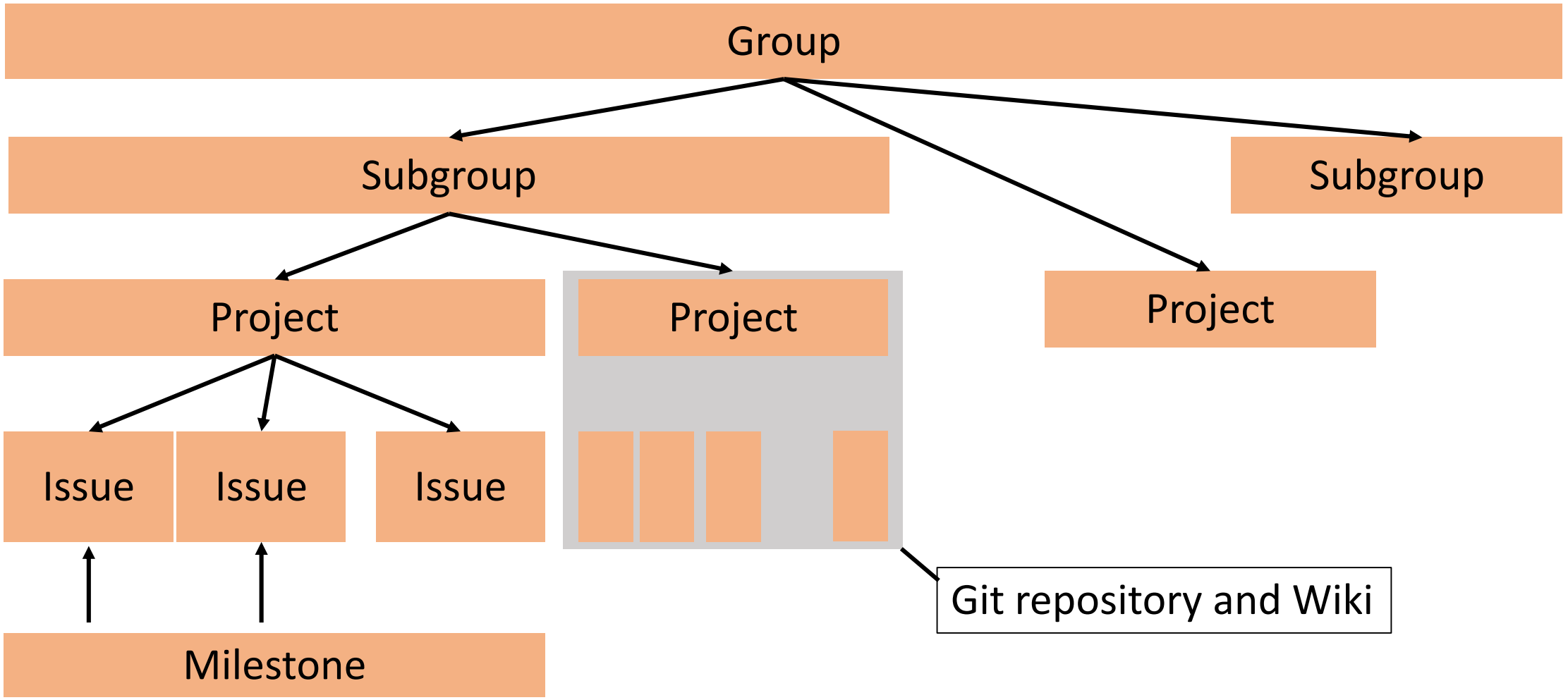
Agile Management with GitLab

Established Terminology and Object Hierarchy

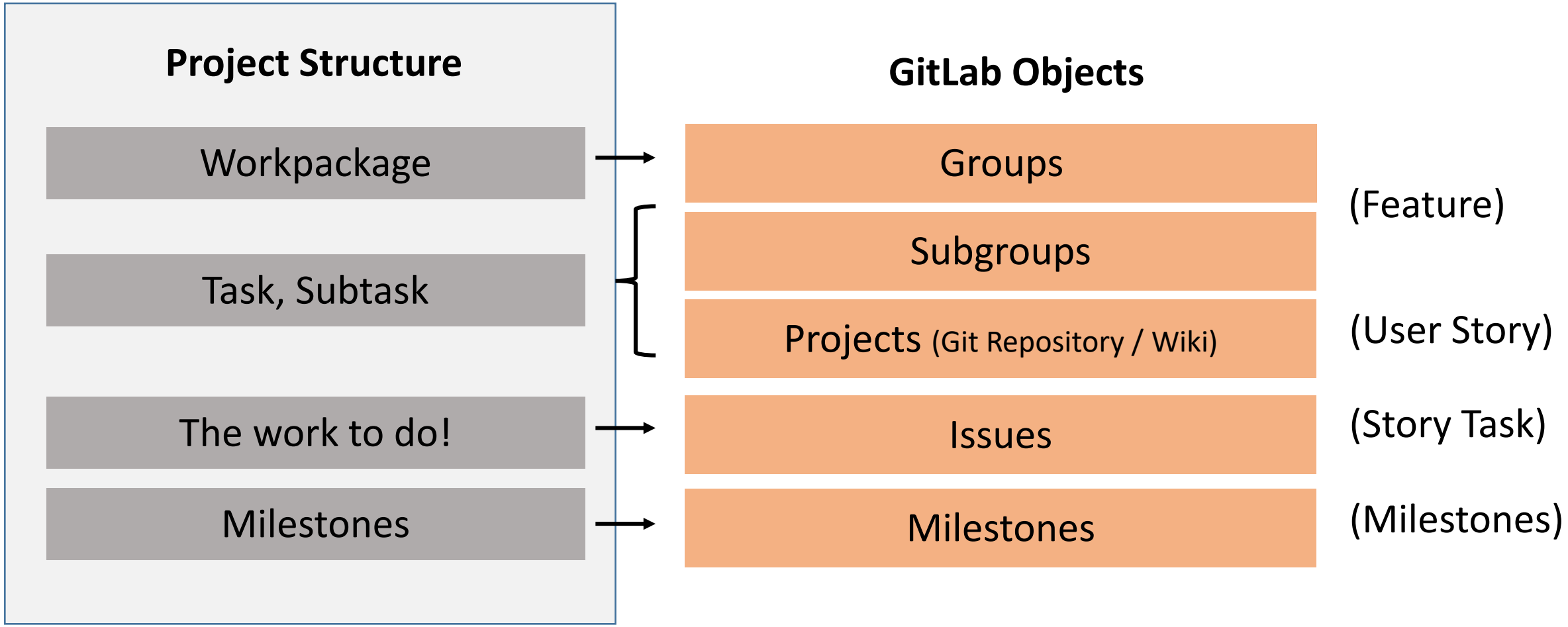


Agile Management with GitLab

GitLab Object Hierarchy



Agile Management with GitLab



Benefits

- Keep all information at one place in common repositories
- Track project (WP) status, milestones
- Simplify the reporting
- Assign work to project members
- Link task dependencies
- Work concurrently in collaboration across teams / organizations
- Maintain the work (software, hardware designs, publications etc.) and their revisions with Git!

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Example Project for Agile Management with GitLab

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Small Projects

- Small project: a few developers
- A common understanding of software engineering methods and best practices is beneficial.
- Use a less complex agile approach such as **Kanban** !

  It works even if:
  - tasks shift on a daily basis, unpredictable, not plannable
  - a fixed Scrum-sprint length planning is not possible

  Kanban briefly explained:
  - visualizes the workflow and uses a **Kanban board** (***ToDo, In Progress, Done***)
  - work is prioritized and pulled from backlog when capacity becomes available
  - limited number of “In Progress” items

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References

- This book provides a state of the art view of most current thinking about using Scrum.
- It is full of practical advices.

References

- This book focuses on the technical aspects of agile development, e.g. continuous integration, test-driven development, refactoring, pair programming and collective ownership.

References

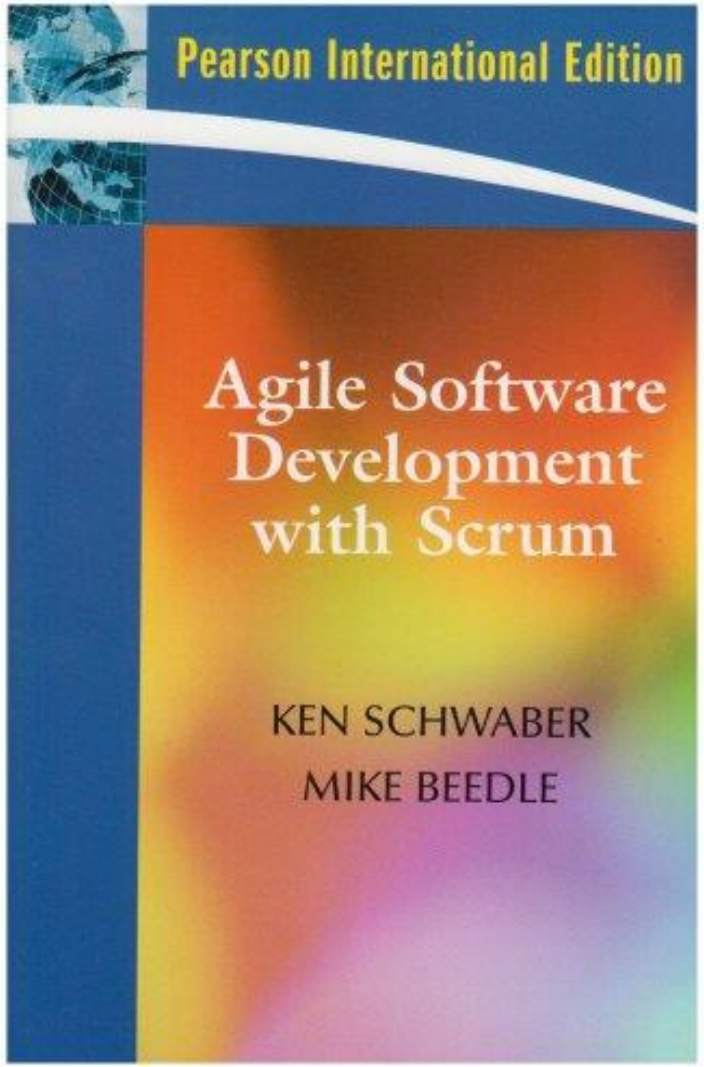
- www.agilealliance.org
- www.Scrum.org

The Scrum Guide™

The Definitive Guide to Scrum:
The Rules of the Game

July 2016

Developed and sustained by Ken Schwaber and Jeff Sutherland



References

The possibly most comprehensive book.

http://iansommerville.com/software-engineering-book/

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