

Software Architecture and Techniques

Why Agile Architecture and Design?

Every Company is now a software company.

– *Forbes Magazine*

Software is eating the world, in all sectors.

In the future every company will become a software company.

– *Marc Andreessen, Wall Street Magazine*

The future is already here. It is just not evenly distributed.

– *William Gibson*

Form follows function.

– *Louis Sullivan*

SWAT Course Description

Teaches the **basics** of systematic **agile design** of an adequate software architecture for a selected application.

Methods of **agile quality assurance** and **software craftsmanship** are explored using predefined or self-selected projects provided by students.

Organization (1/4)

Lecturer	Marcel Baumann
Lectures	3 hours per week, and 14 weeks
Room/Time	<i>see technical university course site</i>
Description	Software Architecture and Techniques
Acronym	SWAT

Organization (2/4)

- SWAT weights 3 ECTS – *90 hours*
 - Lectures → $14 * 2.5$ **35 hours**
including 1/3 practice time
 - Examination preparation **15 hours**
 - Learning and exercises **40 hours**
- All documents are available on the lecture platform
- Questions and Answers in SWAT lecture forum (Microsoft Teams)

Organization (3/4)

- Slides are in English and provide hints on the theory
 - *Attend the lecture and read the literature, slides are not enough*
- Assumes you know Java 21 and higher, OOP, Scrum
- 2/3 theory and paper exercises and 1/3 computer exercises (*source code is written in Java 21 or higher, actual regular JDK is preferred*)
- Literature
 - References articles *must be read*
 - Historical articles *could be read*
 - References books *could be read*

Organization (4/4)

- Lecture attestation
 - Refactoring project and presentation to your peers (history in git)
 - Architecture examples and participation in exercise coaching
 - Test automation (TDD, ATDD, CI/CD/CD) concepts and examples
 - Presentation of code during the practical part of the lecture
 - Proficiency with GitLab or GitHub
- Examination (after successfully completing lecture)
 - **Oral** examination with questions about the course slides, mandatory articles, and exercises

Student Portfolio

- Refactoring project and presentation (history in git) based on your source code
- Architecture examples based on your source code
 - with diagrams e.g. [PlantUML](#), [C4](#)
- Test automation (TDD, ATDD, CI/CD) concepts and examples based on your source code

Reference Books

Clean Architecture: A Craftsmanship Guide to Software Structure and Design

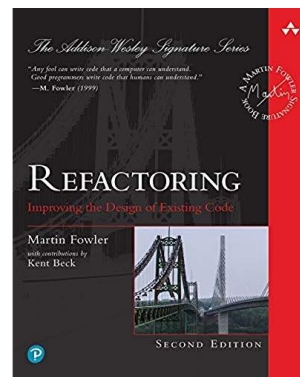
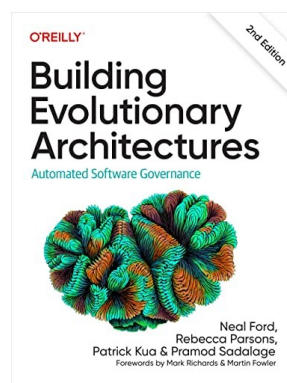
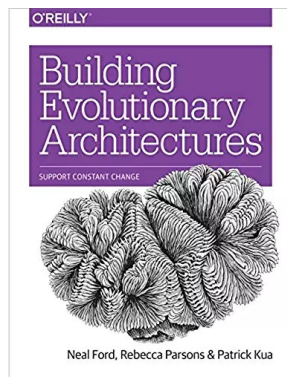
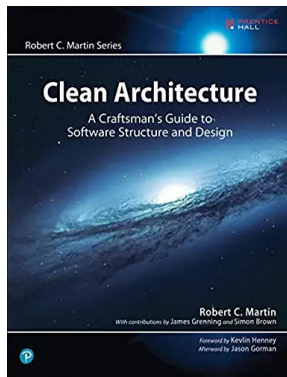
Robert Martin, Prentice Hall, 2018

Building Evolutionary Architectures

Rebecca Parsons, O'Reilly, 1st Edition 2017, 2nd Edition 2023

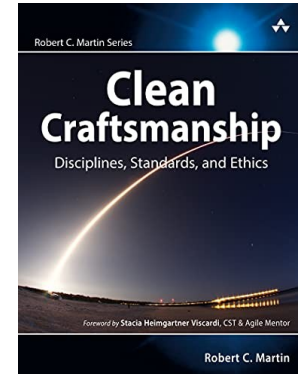
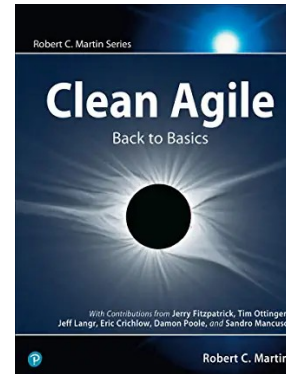
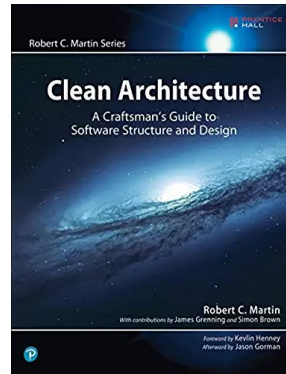
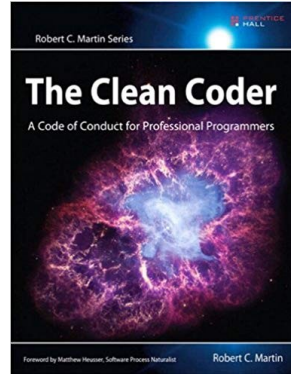
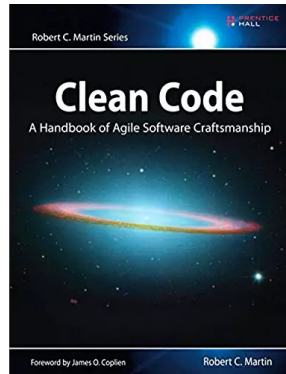
Refactoring: Improving the Design of Existing Code

Martin Fowler, Addison Wesley, 1999-2015



Historical Famous Books

- *Clean Code: A Handbook of Agile Software Craftsmanship*, 2008
- *Clean Coder: A Code of Conduct for Professional Programmers*, 2011
- *Clean Architecture: A Craftsmanship Guide to Software Structure and Design*, 2017
- *Clean Agile: Back to the Basics*, 2019
- *Clean Craftsmanship: Disciplines, Standards, and Ethics*, 2021



Goals

- Understand architecture as a **compromise** to fulfill functional and non-functional requirements
→ *design engineering*
- Have a **toolbox** to define an emergent and evolving architecture
- **Understand** the advantages and consequences of agile and lean approaches
- Be able to **work** on an agile product development initiative

Principles

- Science and its practical application “**engineering**” are vital tools in making effective progress in technical disciplines.
- Our discipline is fundamentally one of **learning** and **discovery**, so we need to become **experts at learning** to succeed, and **science and engineering** are how we learn most effectively.
- Finally, the systems that we build are often **complex** and are increasingly so. Meaning, to cope with their development, we need to become **experts at managing that complexity**.

Farley, David. Modern Software Engineering (p. xxiii)

Designers are Experts of Learning

- Iteration
 - Testability, Deployability, Speed, Variability Control, Continuous delivery
- Feedback and *Transparency*
- Experimentation and *Inspection*
- Empiricism and *Adaptation*

Designers are Experts of Complexity

- Modularity
- Cohesion
- Separation of Concerns
- Abstraction
- Loose Coupling

Lecture Content

- Why Agile Architecture and Design?
- Evolution of Software Architecture over the last Decades
- What is Agile Architecture?
- Agile Approaches with Scrum, XP, LeSS
- Refactoring
- Errors, Vulnerabilities, Smells in Source Code
- Architecture of Components and Subsystems
- Verify Functional Features
- Validate Quality Attributes of Software Architecture
- Architecture Documentation
- Architecture Trends I
- Architecture Trends II
- Domain-Driven Design Workshop
- Team and Technical Excellence for Architects

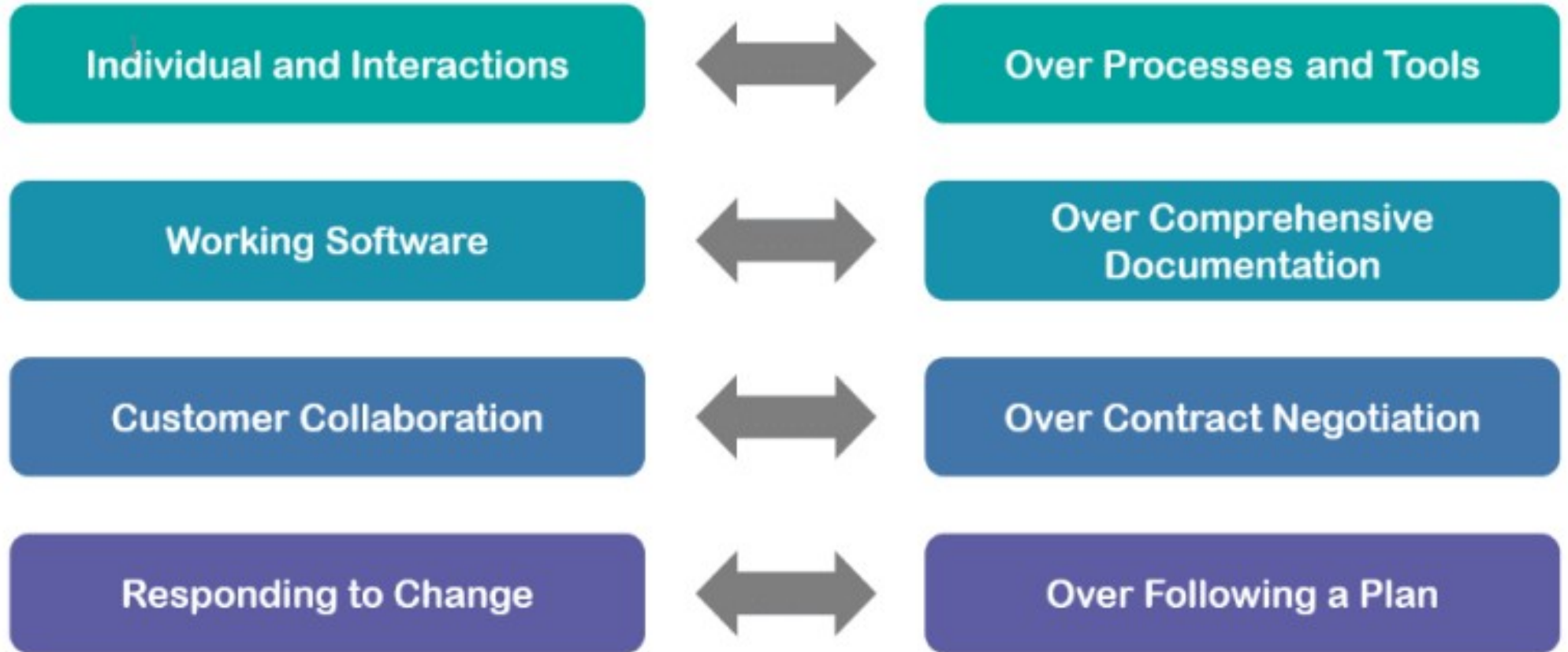
Why Agile Architecture and Design?

- Most of digital product development uses **agile** approaches
- As an architect, designer, developer you must:
 - Implement **functional** requirements
→ *Build the correct product*
 - Fulfill **non-functional** requirements
→ *Build the product correctly*
 - Respect **legal** and **governance** rules
→ *legal, social, and ethical responsibility*






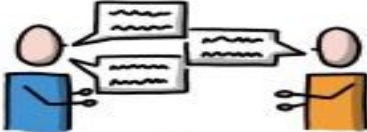






Agile Architecture

- 1) The sum of all the **source code** is the true **design blueprint** or software architecture.
- 2) The real software architecture **evolves** (better or worse) every day of the product, as people do **programming**.
- 3) The real living architecture needs **to be grown every day through acts of programming** by **master** programmers.
- 4) A software architect who is not in touch with the evolving source code of the product is out of touch with reality.
- 5) **Every programmer is some kind of architect** - whether wanted or not. Every act of programming is some kind of architectural act - good or bad, small or large, intended or not.

Agile Manifesto



Agile Manifesto Principles

<p>Satisfy the customer through early and continuous delivery of valuable software.</p> 	<h1>12 Agile Principles</h1> <p>@OlgaHeismann</p> <div><p>Welcome changing requirements, even late in development.</p></div> <div><p>Deliver working software frequently.</p></div>		<p>Business people and developers must work together.</p> 
<p>Build projects around motivated individuals. Give them the support they need. Trust them.</p> 	 <p>The most efficient and effective method of conveying information is face-to-face conversation.</p>	<p>Working software is the primary measure of progress.</p> 	 <p>The sponsors, developers, and users should be able to maintain a constant pace indefinitely.</p>
<p>Continuous attention to technical excellence and good design.</p> 	 <p>Simplicity — the art of maximizing the amount of work not done — is essential.</p>	<p>The best architectures, requirements, and designs emerge from self-organizing teams.</p> 	<p>The team reflects on how to become more effective and adjusts its behavior accordingly.</p> 

Some Agile Manifesto Principles

- Our highest priority is **to satisfy the customer** through early and continuous delivery of **valuable software**.
- Business people and developers must work together **daily** throughout the project.
- Build projects around **motivated individuals**. Give them the **environment** and support they need, and **trust them** to get the job done.
- **Working software** is the primary measure of progress.
- **Continuous** attention to **technical excellence** and **good design** enhances agility.
- **Simplicity** - the art of maximizing the amount of work not done - is essential.
- The **best** architectures, requirements, and designs **emerge** from **self-organizing teams**.

The source code is the architecture

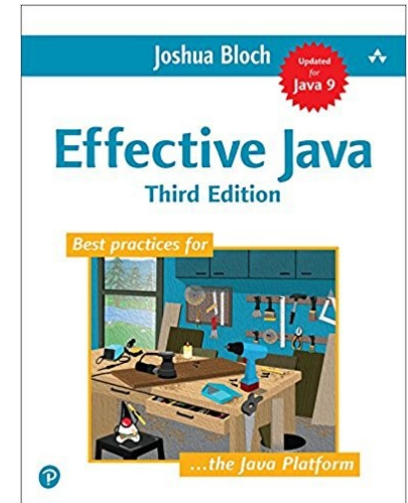
- Difference between to *architect* (process) and an *architecture* (result)
- If you think good architecture is *expensive*, try bad architecture
- ***Waste*** in architecture and design
- Good architects should be ***good developers***

Amazon Service Architecture

- 1) All teams will henceforth expose their data and functionality through **service interfaces**.
- 2) Teams **must** communicate with each other through these interfaces.
- 3) There will be **no other form of interprocess communication allowed**: no direct linking, no direct reads of another team's data store, no shared-memory model, no back-doors whatsoever. The only communication allowed is via service interface calls over the network.
- 4) **It doesn't matter what technology they use**. HTTP, CORBA, Pub/Sub, custom protocols -- doesn't matter. Bezos doesn't care.
- 5) All service interfaces, without exception, must be designed from the ground up to be externalizable. That is to say, the team must plan and design to be able **to expose the interface to developers in the outside world**. No exceptions.
- 6) Anyone who doesn't do this will be **fired**.
- 7) Thank you; have a nice day! (By **Jeff Bezos**, CEO Amazon, 2002)

Anti pattern: Cowboy Programmer

- *“From the brain to the terminal”*
- Spaghetti code, huge classes, huge methods
- No automatic tests
- No automatic build and delivery
- Has **never** read “Effective Java”



Anti pattern: Gold Plated Architecture

- No running code after weeks of work
 - *Architects are incapable or refuse to write code*
- Tons of UML diagrams
 - *You have a kickback from the UML tool or the printer company*
- Software Architecture Document SAD with hundreds of pages
 - *Can be often found in Swiss companies*
- Proof of concept on paper
 - *Value is zero!*
- All the patterns of the Gang of Four
 - *Wow, the architect can read*
- Copy Amazon or Netflix architecture for an internal product
 - *Incredible, you have 2'000'000'000 customers, congratulations*

Doing Agile instead of Being Agile

- Measuring velocity is odd because you should measure **outcome**
 - *means value - instead of output*
- **Undone Department** - *Can You **really** ship?*
 - You build it, You deploy it, You run it, *and you document it!*
- **Doing** Scrum **damns** you to deliver mediocre software every two weeks
- Being Agile means Scrum, eXtreme Programming, Lean → TDD, ATDD, DevOps, Agile Architecture, Refactoring, etc.
 - Learning and improving daily
 - Simple Test: How effective is your retrospective?
 - Simple Test: Is your CI/CD always green?

Good Principles (1/2)

- KISS – *Keep It Simple Stupid*
- DRY – *Don't Repeat Yourself*
- YAGNI – *You Aren't Gonna Need It*
- Architecture is like gardening
 - Clean Architecture
 - Legacy solutions → Violation of clean approaches
 - Geriatric solutions → Time to leave

Good Principles (2/2)

- **SOLID** - Five Design Principles
 - **Single responsibility Principle**
 - Open/Close Principle
 - Liskov Substitution Principle
 - **Interface Segregation Principle**
 - **Dependency Inversion Principle**

Architecture Styles: Old (technical)

Various architecture styles exist. Here some examples

- Batch – [Java Batch Module JSR-352](#)
- Pipe and Filter – Streams in Java
- [Blackboard](#)
- [Client Server](#) – JEE servers
- [Layered Systems](#) (3-tier, N-tier, multi-tier architecture)

Architecture Styles: New (business)

- Micro-architecture
 - Bounded Domains – parallel development
 - Build on Docker and Kubernetes
- Hexagon and Onion Design
 - Business Domain Model
- Reactive and Event Based – JavaRX
 - Java Future, FutureCompletion, ...

Architecture Styles: Other (DevOps)

- Server Architecture
 - Barebone servers, virtual machines, docker images, Serverless
- Resilience
 - Redundancy, P2P, Serverless
- Security
 - Trusted, Secure and Untrusted Approaches

Architecture Concepts

- Modularity
- Cohesion
- Separation of Concerns
- Information Hiding and Abstraction
- Managing Coupling

Links

- Git Introduction - [Switch Tube HSLU Video](#) -
- [What Software Architecture Should Look Like?](#), David Farley, GOTO 2022
- Wikipedia [Agile Architecture](#)
- What should a [Scrum Developer](#) know?

Exercises (1/2)

- Read article “Who Needs Architects?” written by [Martin Fowler](#)
- Short [YouTube video](#) and long [YouTube video](#) by Martin Fowler
- Study [Agile Manifesto](#) and [12 Principles](#)
- Explore [LeSS architecture page](#)
- How are **you** doing design and architecture?
*(team discussion and identify **your improvements** based on Manifesto principles)*

Exercises (2/2)

- Install [IntelliJ](#) IDEA IDE and GitHub Copilot
- Use Analyze Code of IntelliJ and install [SonarLint](#) Plugin
- [PlantUML](#) – optionally plugin for IntelliJ IDEA
- [AsciiDoc](#) – optionally plugin for IntelliJ IDEA
- You could also use [SonarQube](#) cloud account
- You should also use official school Gitlab to host your project
- Import your code and do *Analyze Code* with *IDE* and *SonarLint*.
Your project must be under git (use university gitlab).