OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

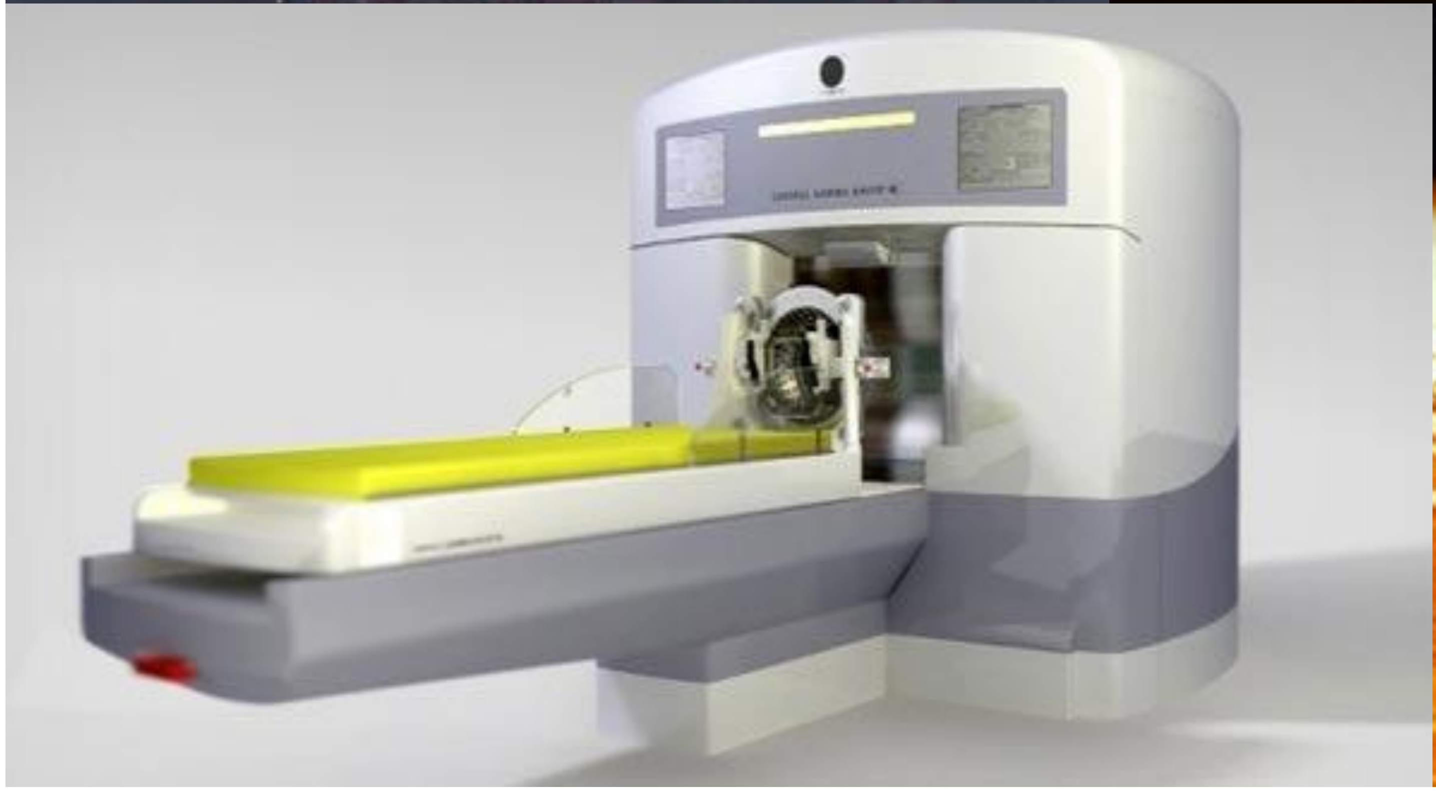
FACULTY OF COMPUTER SCIENCE

SwarmLab

Introduction to Software Engineering for Engineers
Lecture-02: Process Models & SCRUM
Part 1: Introduction to Software Engineering

Dr.-Ing. Christoph Steup

Most Expensive Software Failures



top-10-list.org/2010/05/03/ten-costliest-software-bugs/

What is Software?

Software Systems

Software

computer programs, procedures, rules
and possibly associated documentation and data pertaining to the operation of a computer system.
(IEEE Standard Glossary of Software Engineering)

Software System

A system (or parts thereof), whose components consist of software

Software Systems (2)

Product

A product is a self-contained, usually for a particular customer created, result of a successful accomplished project or manufacturing process. As partial product we denote a completed part of a product.

Software Product

A product, consisting of Software.

Classification of Software

Generic Product
System Software (OS,Compiler,etc…)
Product-integrated
Real-time requirements
Data-intensive
Centralized
Standalone

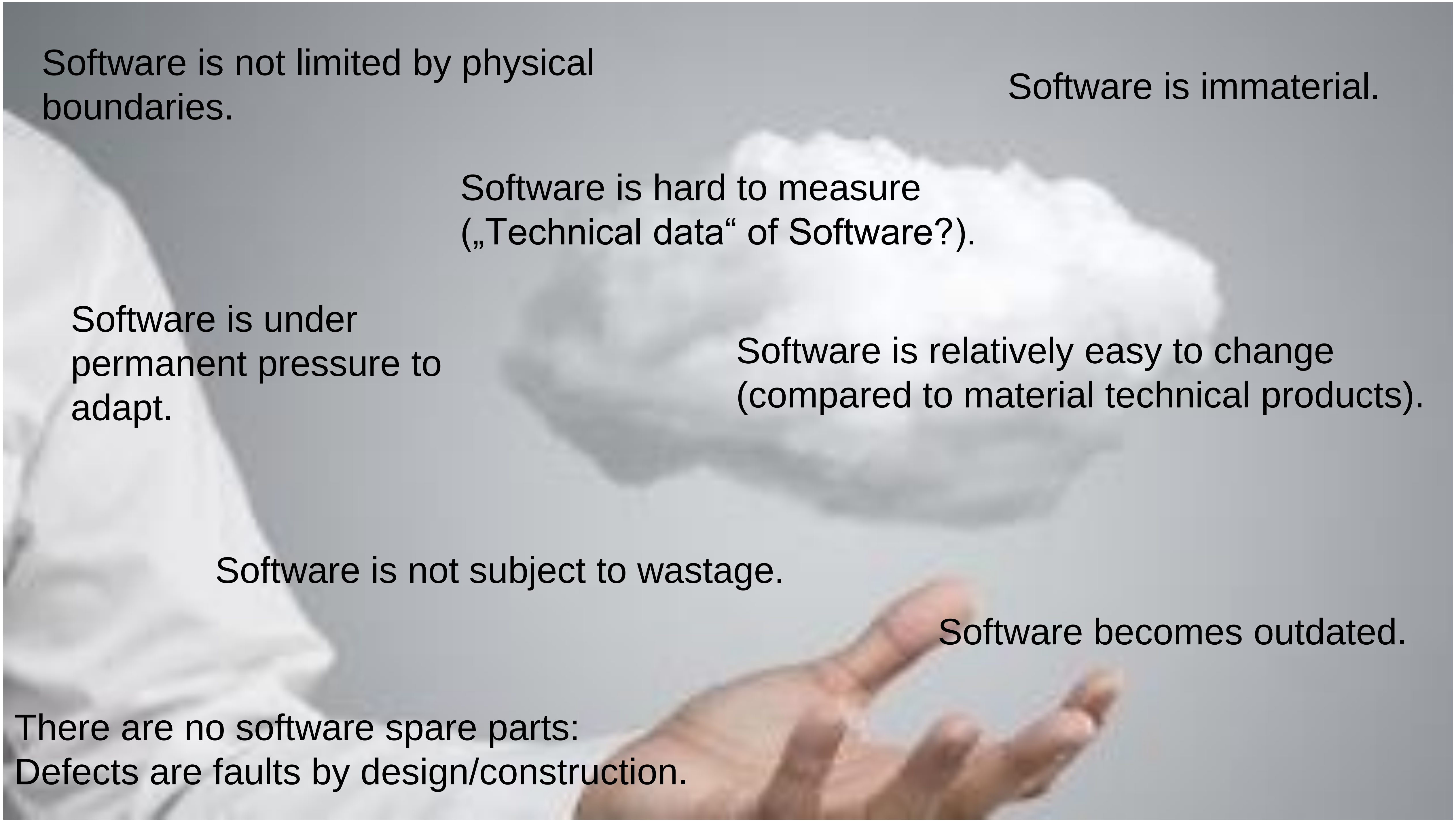
vs.

Tailor-made/Custom-made
Applications Software
Pure computer system
Bandwidth focused
Computation-intensive
Distributed
integrated in applications

No ”eierlegende Wollmilchsau” (Swiss Army Knife)!

Software is characterised by application and domain

Peculiarities of Software



Software is not limited by physical boundaries.

Software is immaterial.

Software is hard to measure („Technical data“ of Software?).

Software is under permanent pressure to adapt.

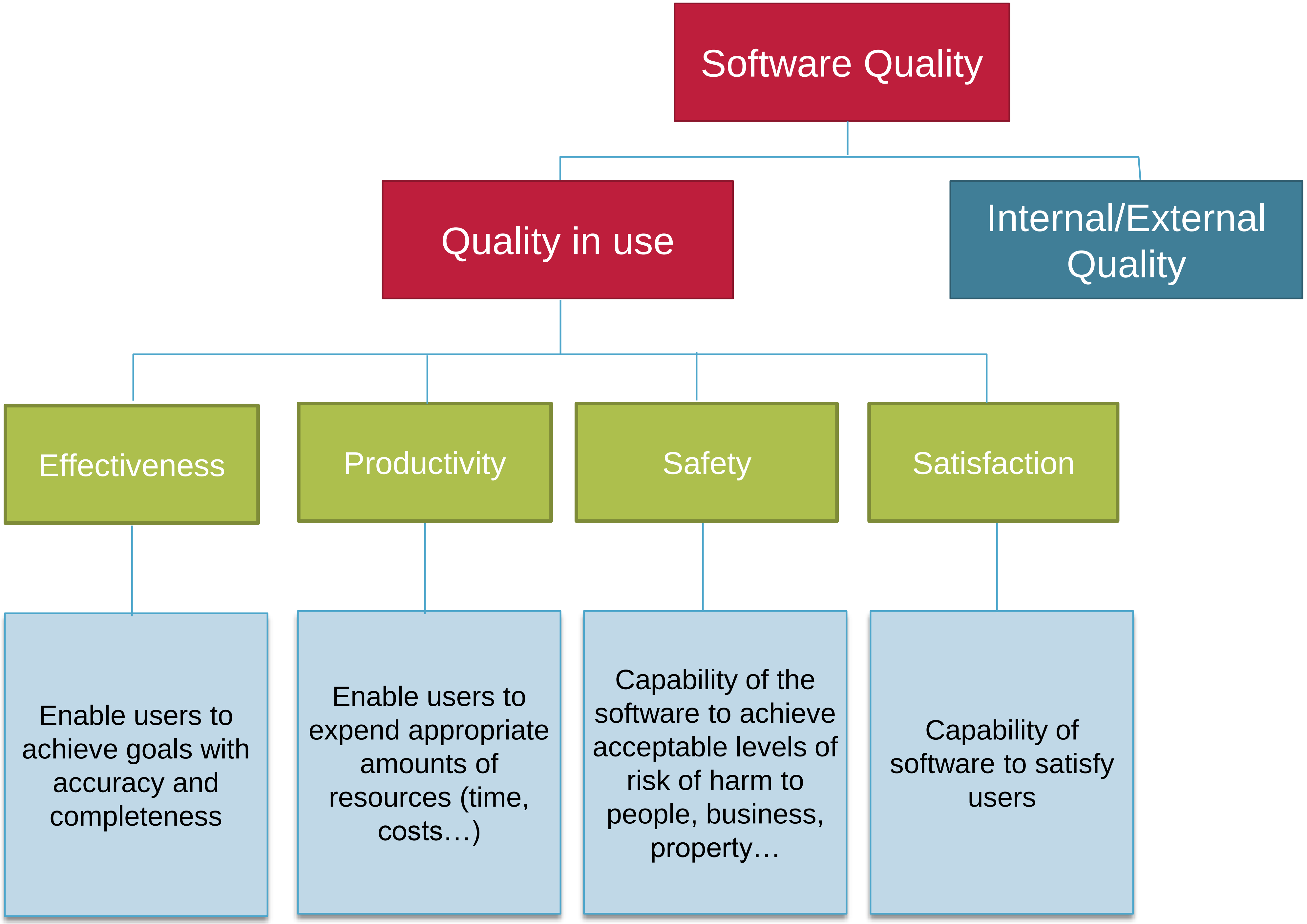
Software is relatively easy to change (compared to material technical products).

Software is not subject to wastage.

Software becomes outdated.

There are no software spare parts:
Defects are faults by design/construction.

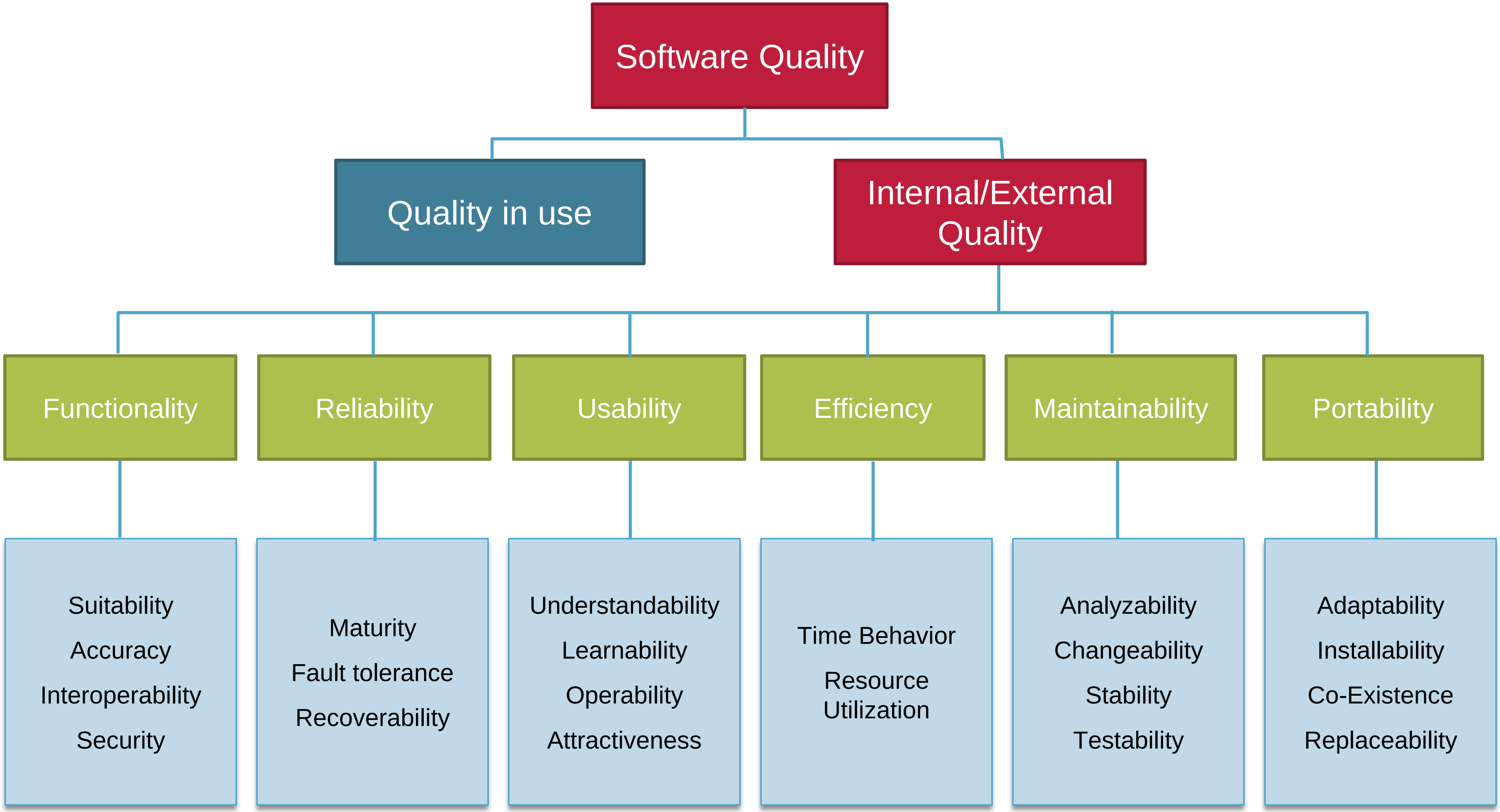
Characteristics of Software Quality



Software Quality
Quality in use
Internal/External Quality
Effectiveness
Productivity
Safety
Satisfaction
Enable users to achieve goals with accuracy and completeness
Enable users to expend appropriate amounts of resources (time, costs…)
Capability of the software to achieve acceptable levels of risk of harm to people, business, property…
Capability of software to satisfy users

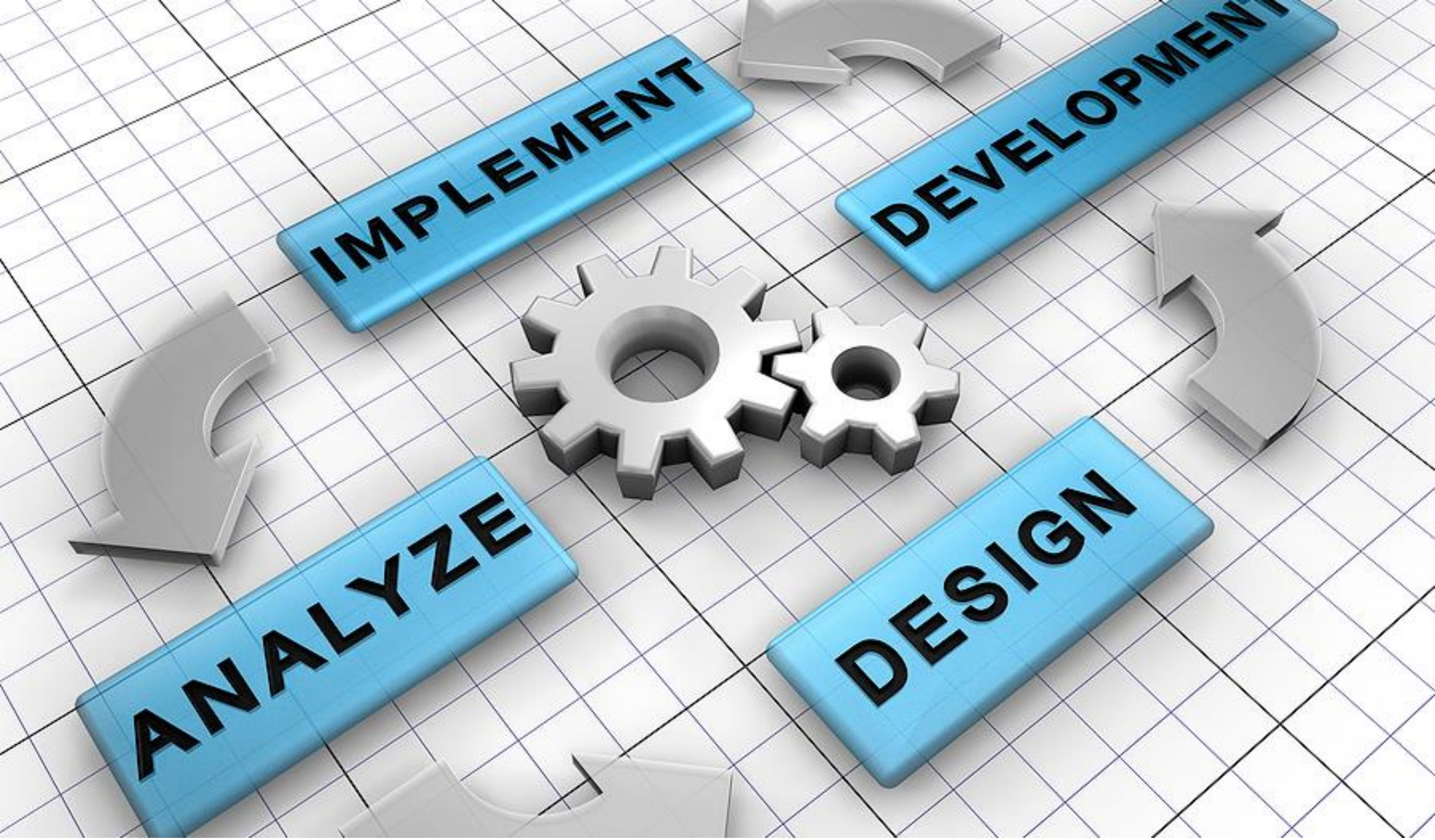
ISO/IEC 9126: Bewerten von Softwareprodukten, Qualitätsmerkmale und Leitfaden zu ihrer Verwendung

Characteristics of Software (2)



- Software Quality
  - Quality in use
  - Internal/External Quality
    - Functionality
      - Suitability
      - Accuracy
      - Interoperability
      - Security
    - Reliability
      - Maturity
      - Fault tolerance
      - Recoverability
    - Usability
      - Understandability
      - Learnability
      - Operability
      - Attractiveness
    - Efficiency
      - Time Behavior
      - Resource Utilization
    - Maintainability
      - Analyzability
      - Changeability
      - Stability
      - Testability
    - Portability
      - Adaptability
      - Installability
      - Co-Existence
      - Replaceability

ISO/IEC 9126: Bewerten von Softwareprodukten, Qualitätsmerkmale und Leitfaden zu ihrer Verwendung



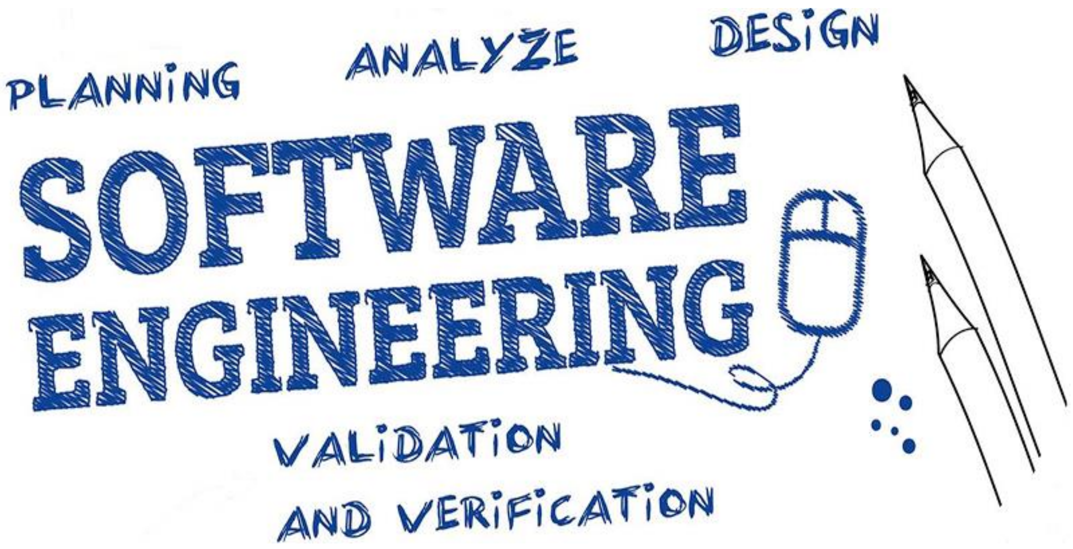
What is Software Engineering?

Software Engineering

Software Engineering

The establishment and use of sound engineering principles in order to obtain economically software that is reliable and runs on real machines.

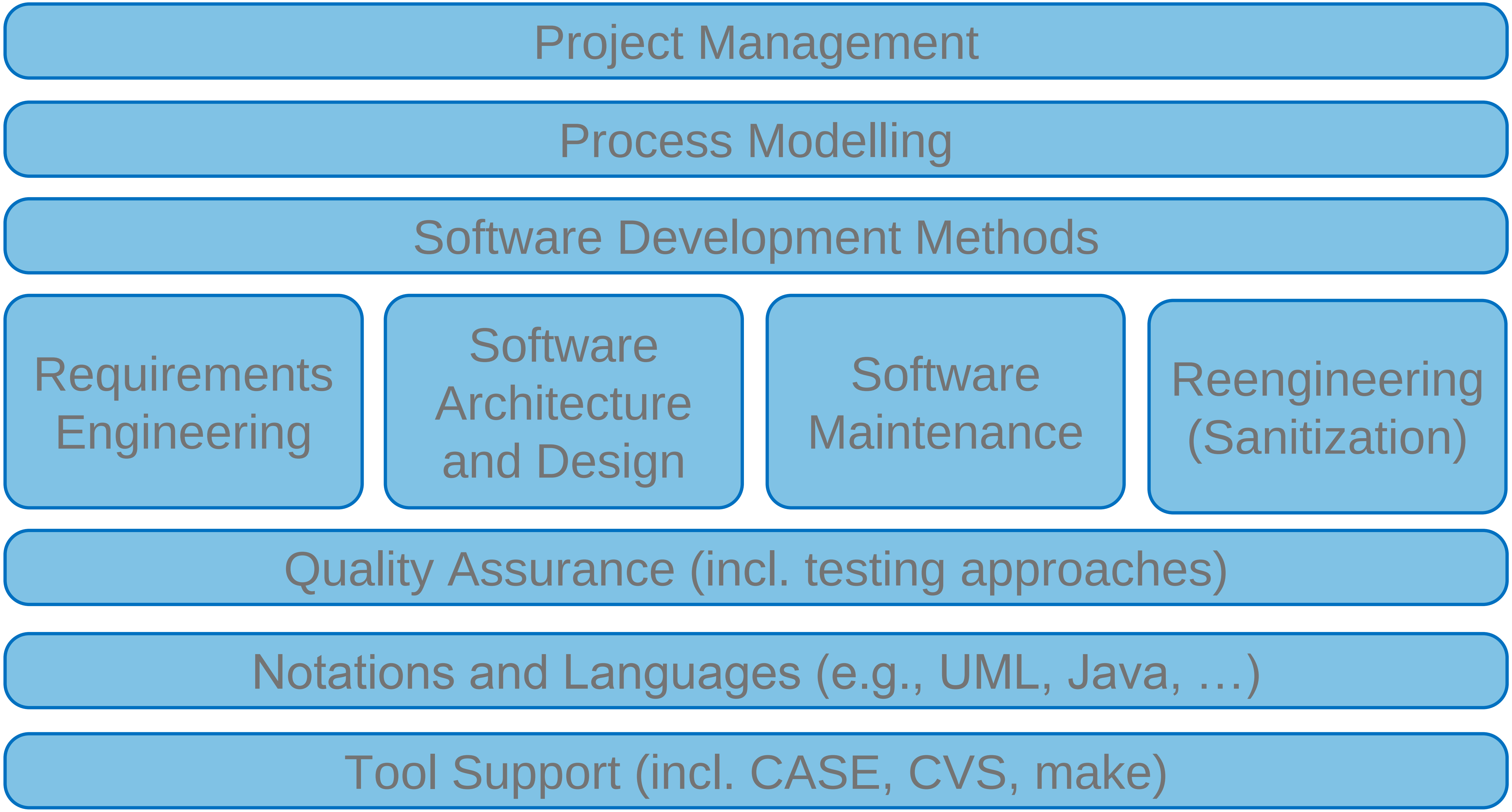
(F.L. Bauer, NATO-Konferenz Software-Engineering 1968)



Manifesto of Software Engineering (2006)

Software Engineering aims at an engineering-like development, maintenance, adaptation, and evolution of large-scale software systems. To this end, systematic processes, principles, methods, and tools should be applied.

Topics in Software Engineering



Project Management

Process Modelling

Software Development Methods

Requirements Engineering

Software Architecture and Design

Software Maintenance

Reengineering (Sanitization)

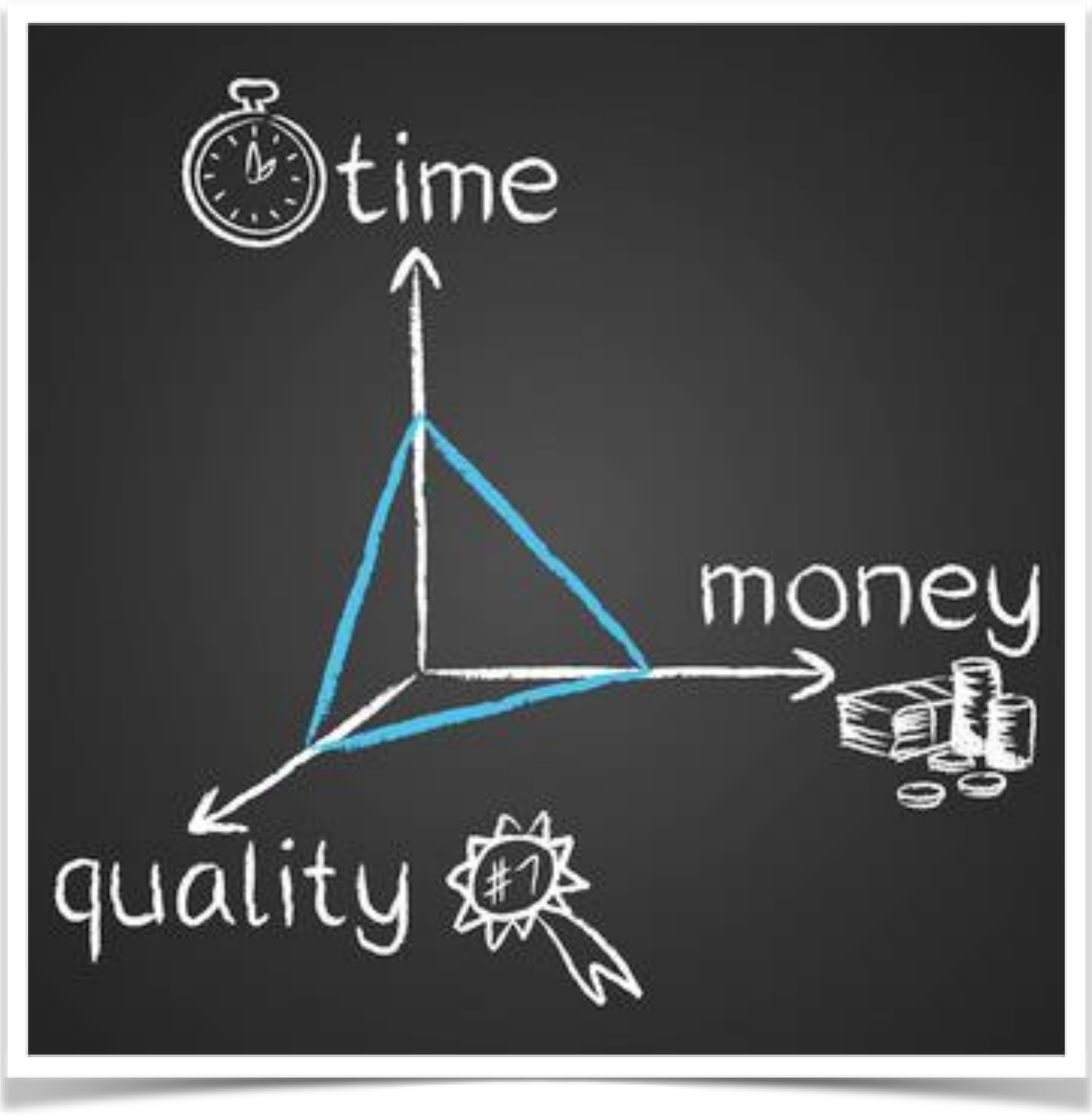
Quality Assurance (incl. testing approaches)

Notations and Languages (e.g., UML, Java, …)

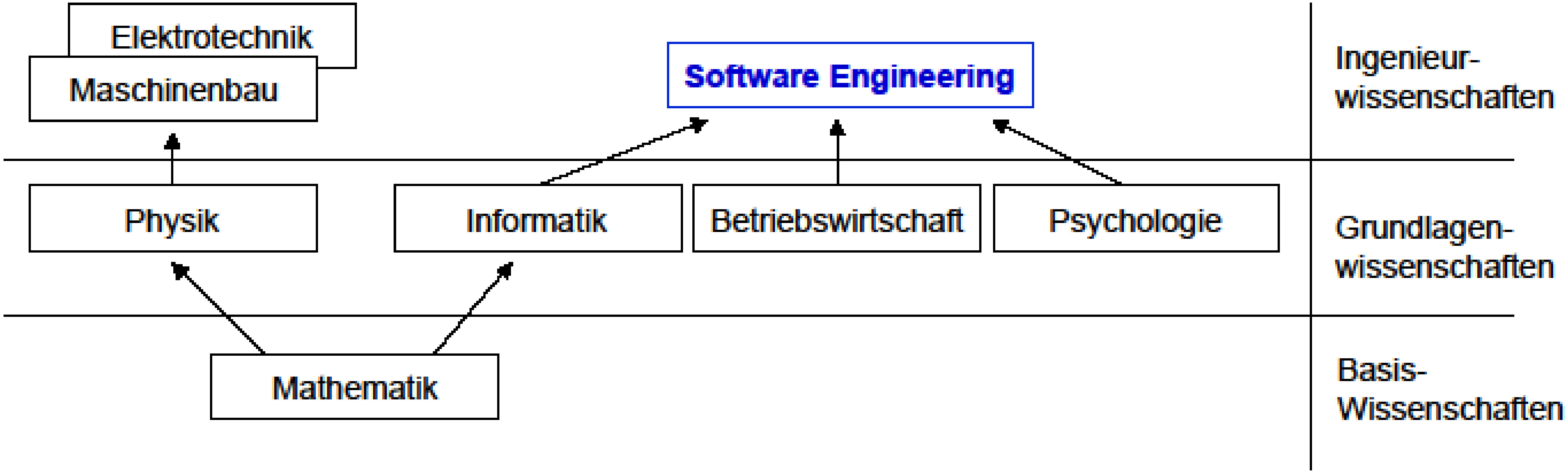
Tool Support (incl. CASE, CVS, make)

Software Engineering is much more than “just” Programming

Constraints/Requirements of Software



Software Engineering vs. Computer Science



Software Engineering is the engineering discipline/science of computer science (similar to the relation between mechanical engineering and physics).

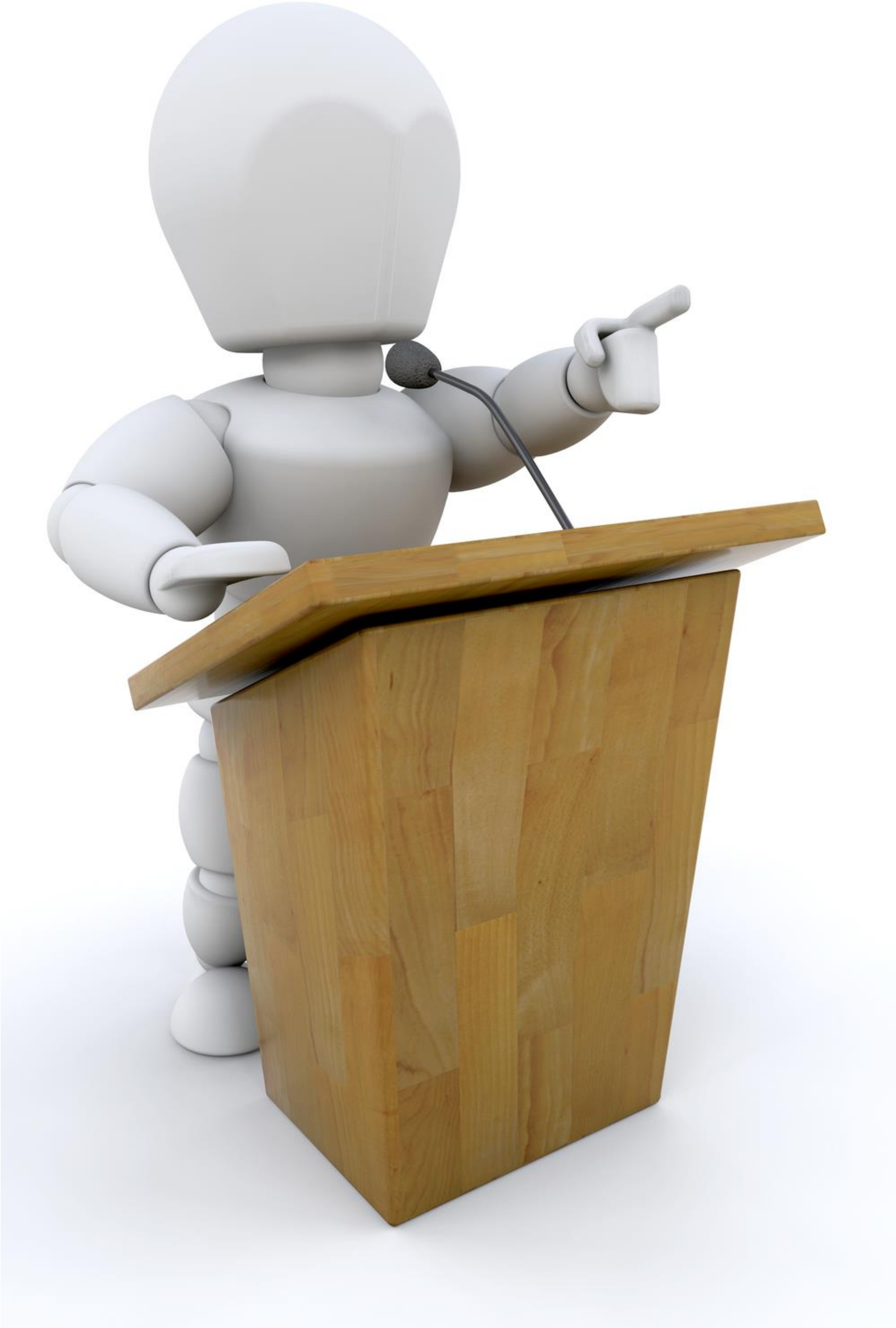
Portfolio of Software Engineering

- For each Problem the appropriate tool at hand of experts, **who can use it.**

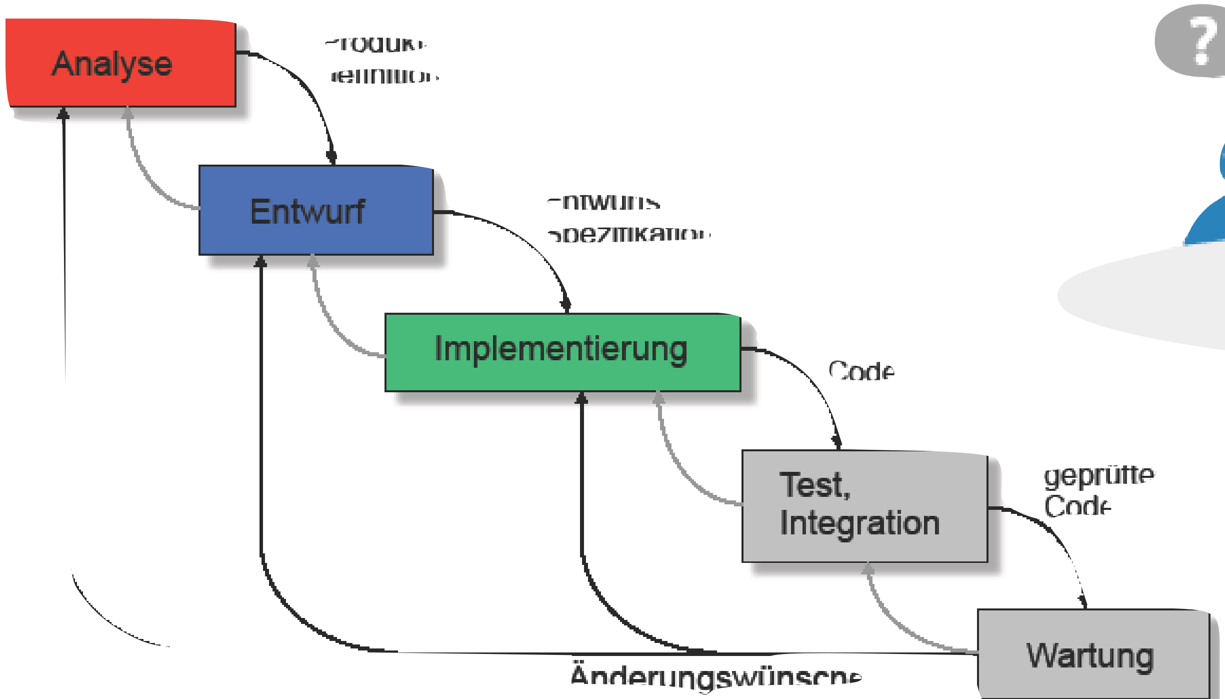
- You don’t need to be able to cope with all tools, but: **the more, the better**

Summary: Software Systems and SE

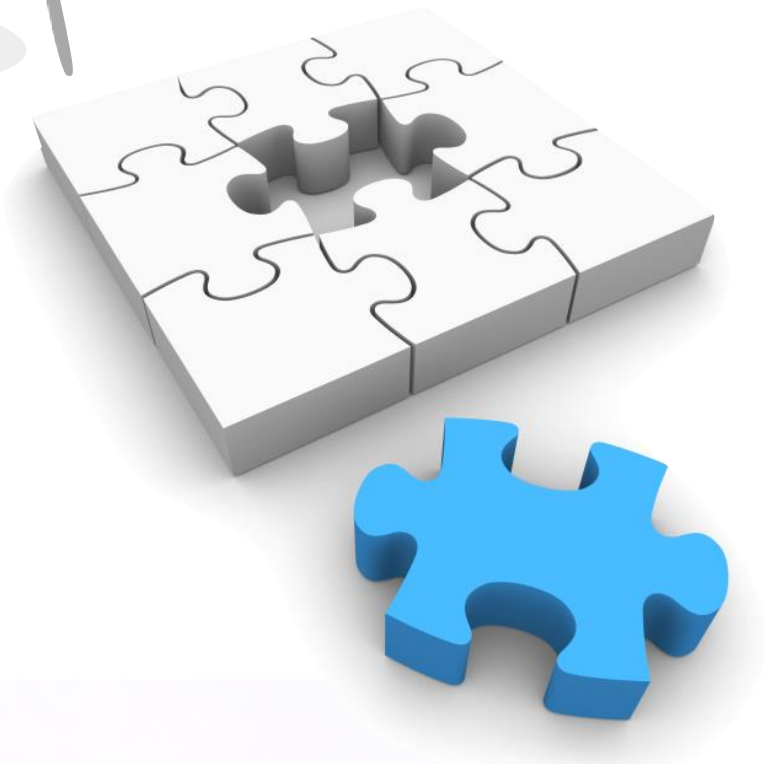
- Software engineering is an engineering discipline that is concerned with all aspects of developing software-intensive systems.
- Diversity of application domains, size, etc. requires a Portfolio of techniques to-be applied.
- Quality is a crucial factor of the developed software.
- Software engineering is application-oriented, and thus, requires that methods and techniques are practiced frequently.



Outlook: Topics of Lecture



nach W. Royce (1970), mit Rückkopplung B. Boehm (1981)



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FACULTY OF COMPUTER SCIENCE

SwarmLab

Introduction to Software Engineering for Engineers
Lecture-02: Process Models & SCRUM
Part 2: Process Models

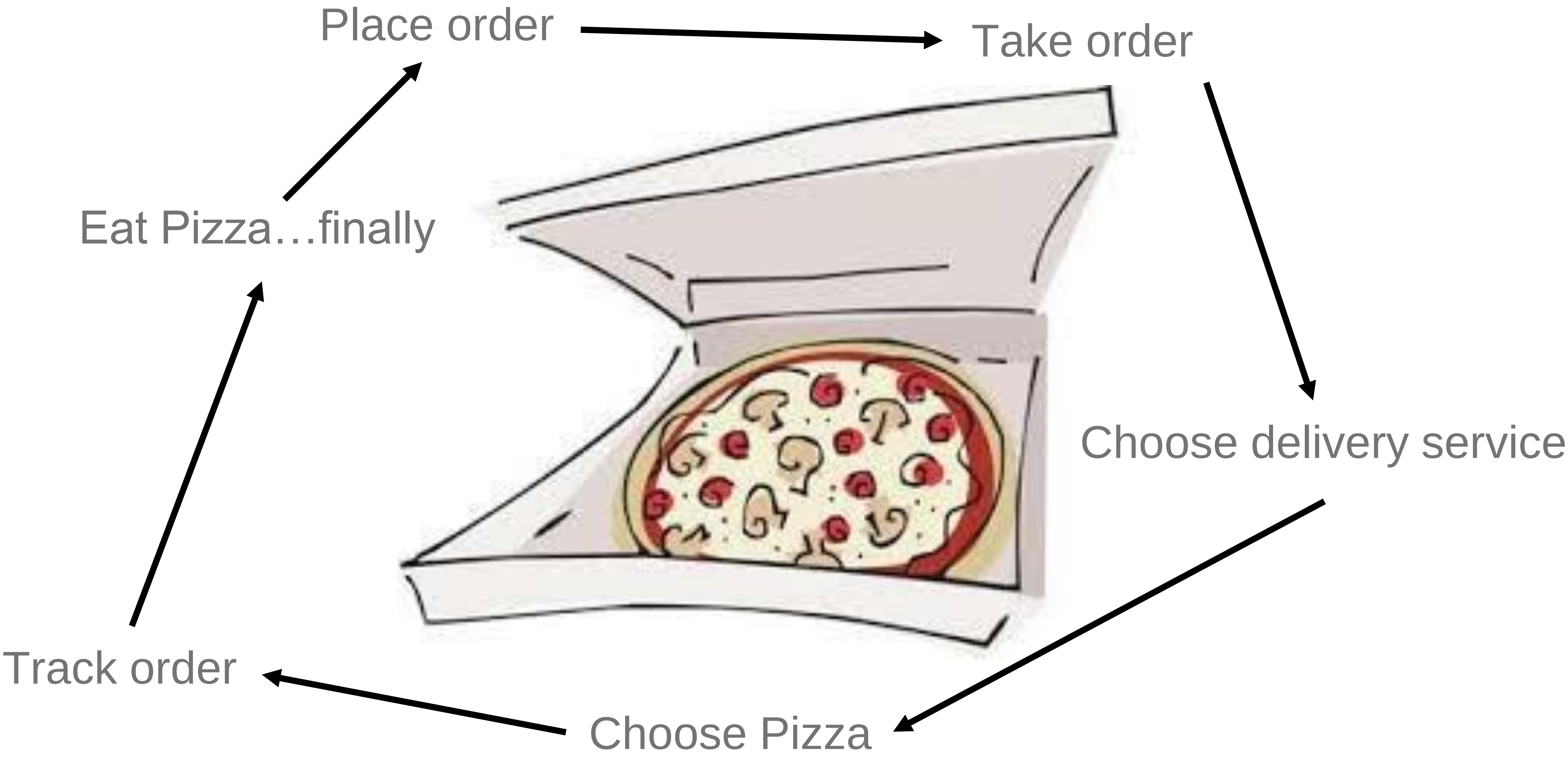
Dr.-Ing. Christoph Steup

Software Process Models

“We try to solve the problem by rushing through the design process so that enough time is left at the end of the project to uncover the errors that were made because we rushed through the design process”

–Glenford Myers

Motivation



Place order

Take order

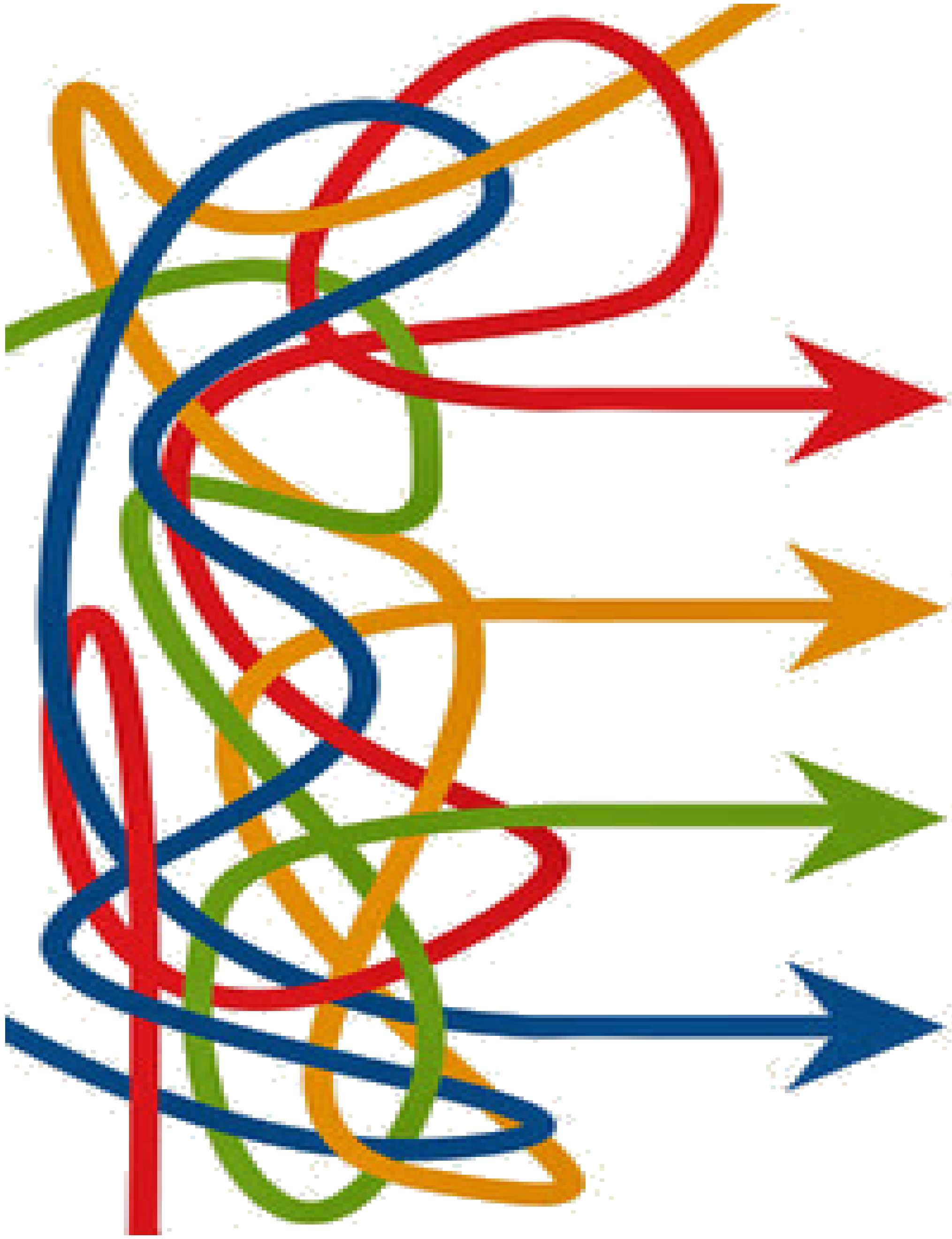
Choose delivery service

Choose Pizza

Track order

Eat Pizza…finally

Benefits of Process Models



- Structuring of a project
- Phases and corresponding activities
- Communication
- Responsibilities
- Completeness
- Prediction of project results
- Monitoring and Analysis of project
- Gaining experience

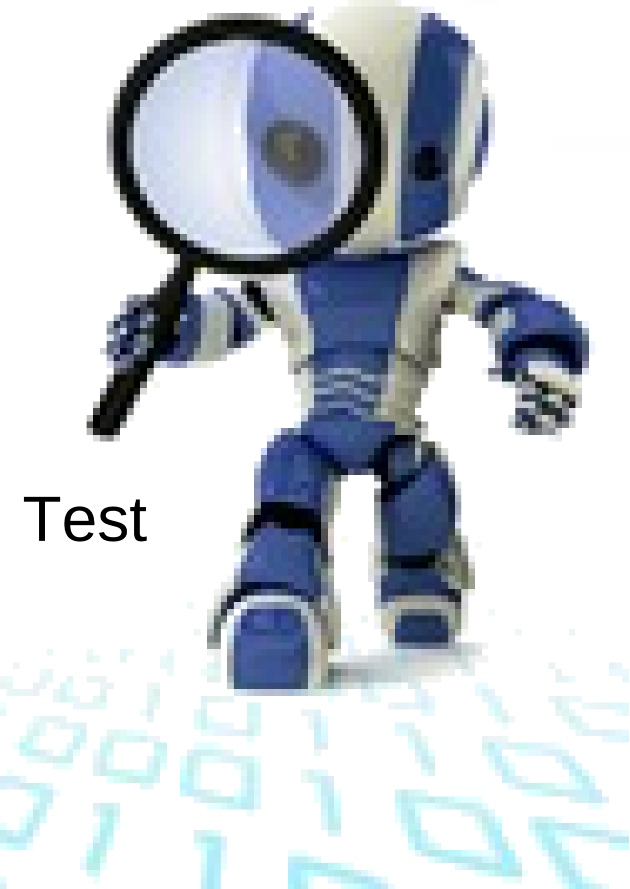
Activities in Software Development

Analysis

Design

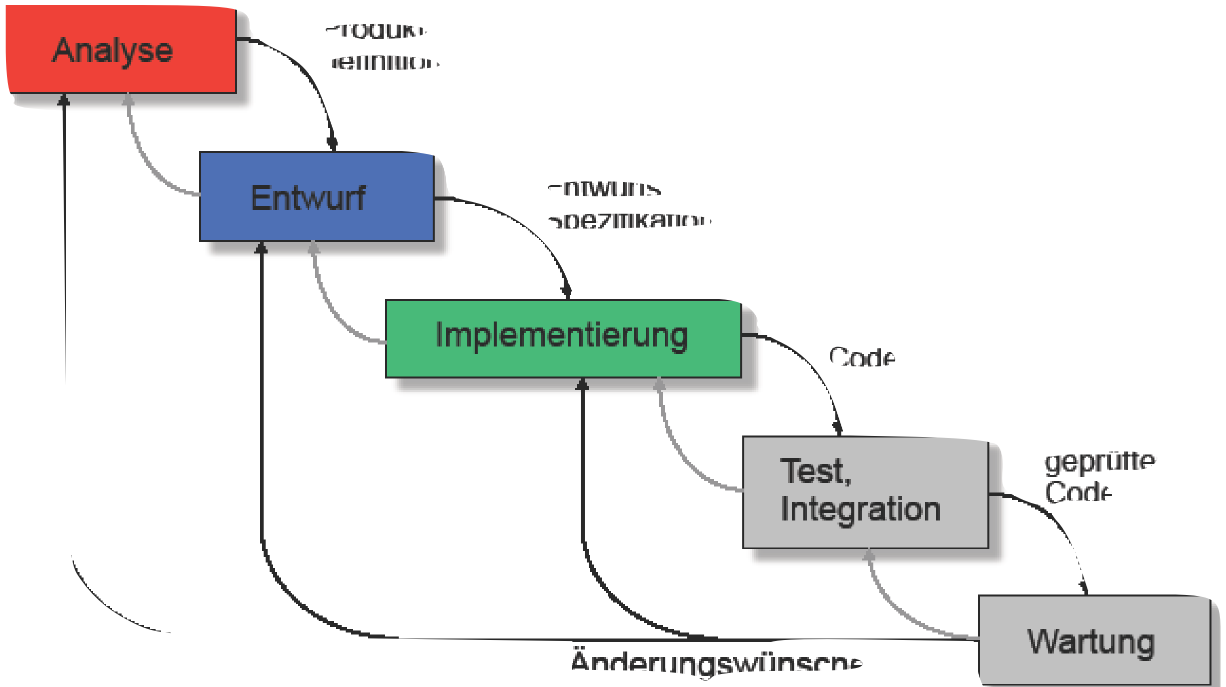
Deployment

Test



Implementation

Popular Process Models



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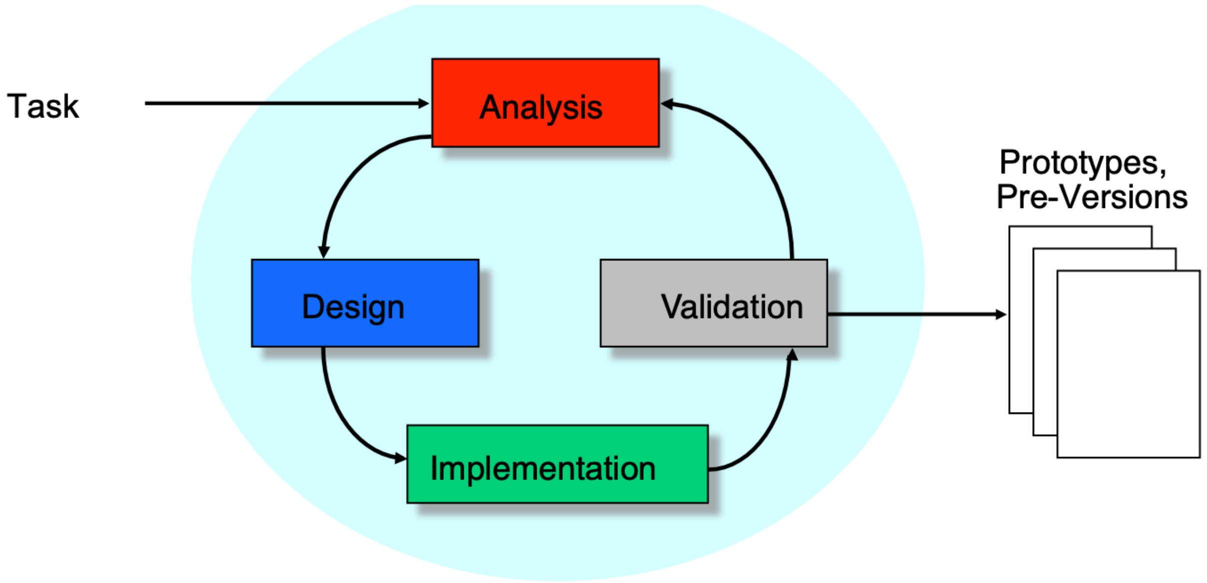
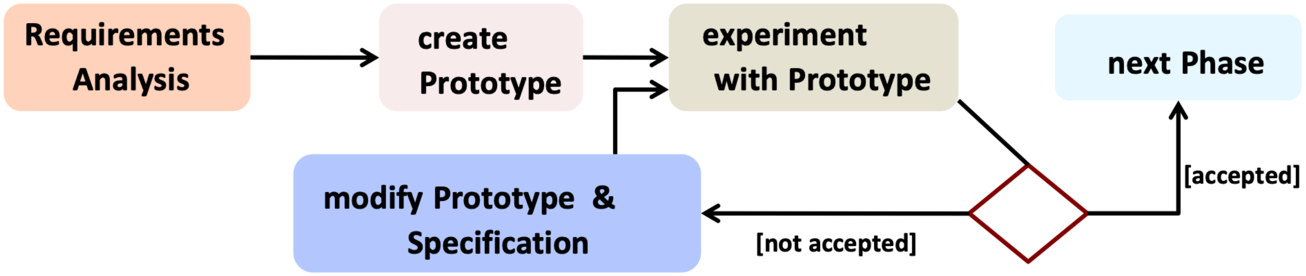
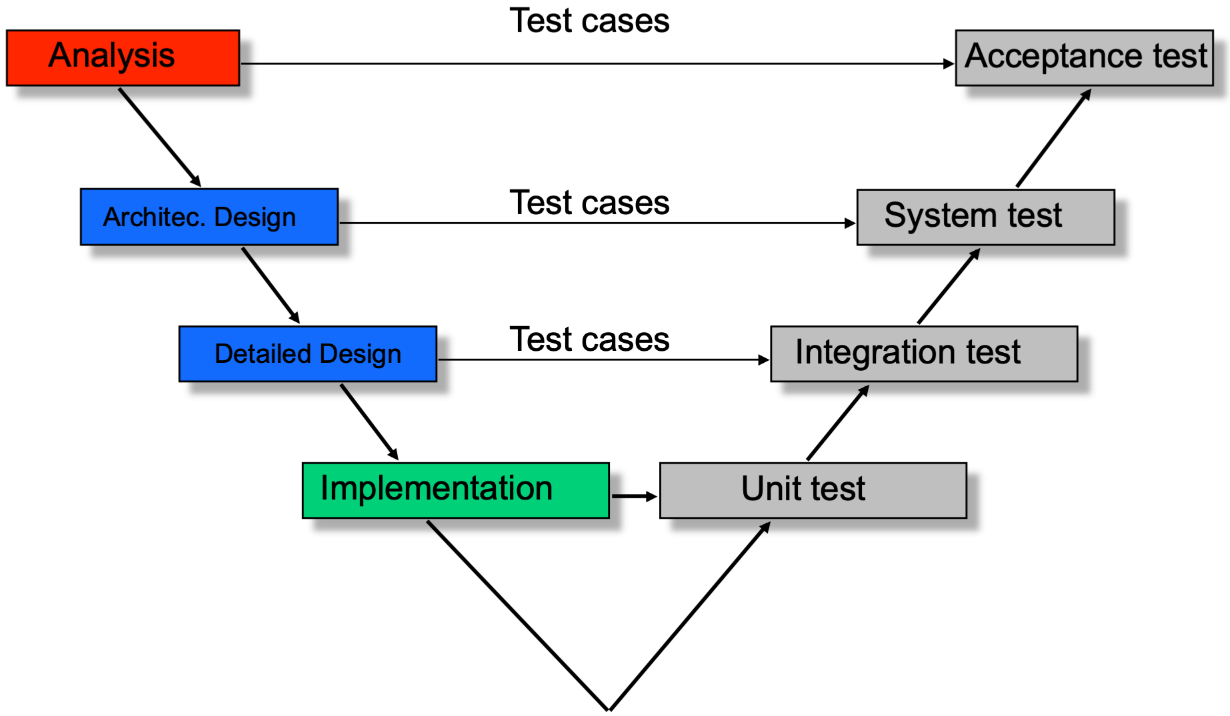
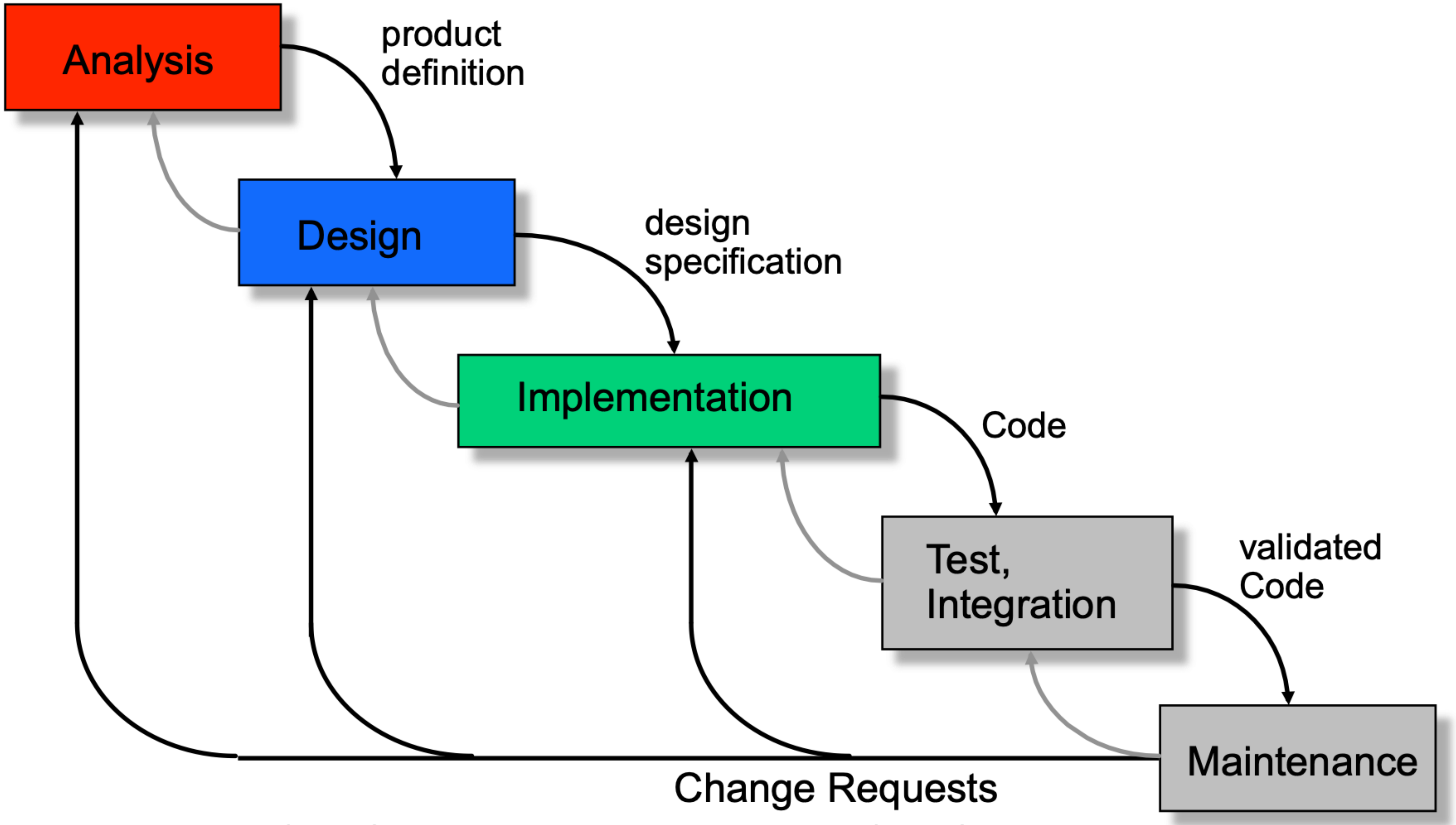






Waterfall Model

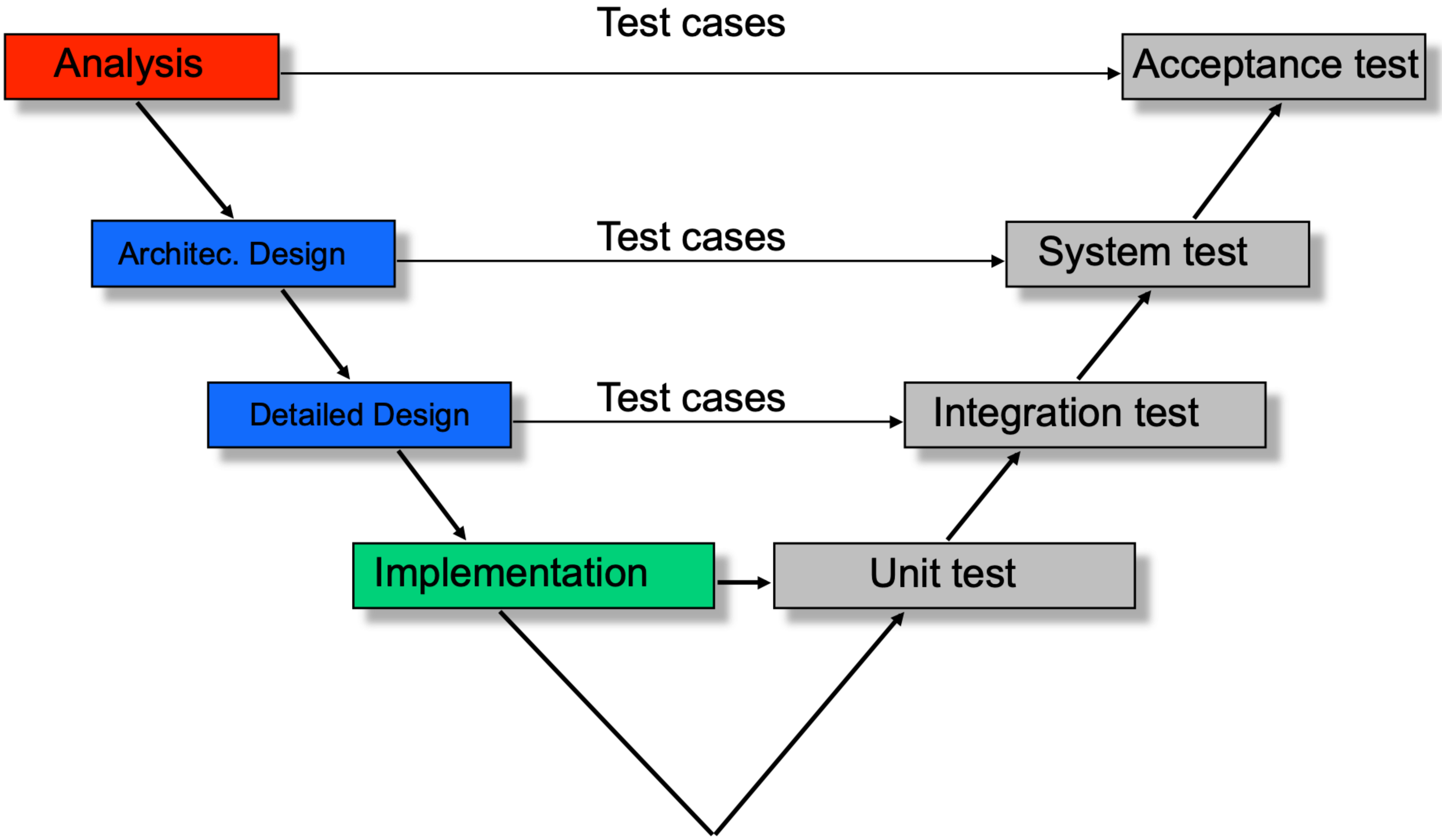


nach W. Royce (1970), mit Rückkopplung B. Boehm (1981)

Characteristics — Waterfall Model

All steps are executed in sequential order
If, anf only if, one step is finished, the next one ist started —> result of the previous phase musst be known
Assessment: ▪ Easy to understand ▪ Easy to manage ▪ Easy to control (defined transitions between phases) ▪ Problem in case of changes and delays of particular phases

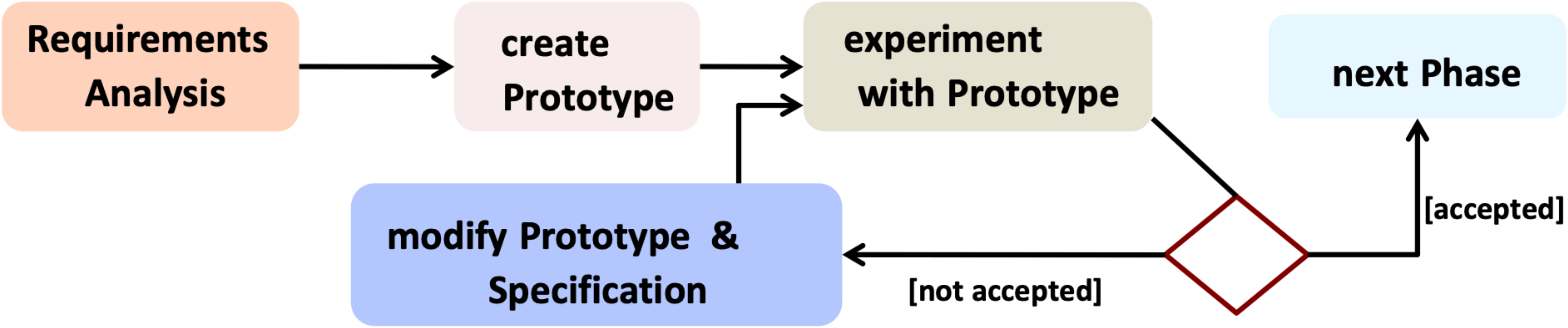
V-Model


Test cases
Analysis
Acceptance test
Architec. Design
Test cases
System test
Detailed Design
Test cases
Integration test
Implementation
Unit test

Characteristics V-Model

Extension of Waterfall Model
Integration of quality assurance (verification and validation)
Mandatory for German Armed Forces and Administration (V-Model XT)
Very comprehensive model; must be tailored for a concrete development task (Tailoring)

Prototype-based Process



Characteristics Prototype-based

Preliminary version (of parts) of the intended system.

Classification of Prototypes:

- One-time (throw-away) Prototype for demonstration purposes;
  only very basic and well-understood features are realized
- Evolutionary Prototype, i.e., development of version 0.1 as a basis for the later developed System;
  first of all the best understood parts/features are realized
- Paper Prototyping (e.g., for GUI development)

Assessment:

- Fast results
- Flexible adaptation
- Longer development process due to inappropriate documentation
- More expensive in the prototype phase

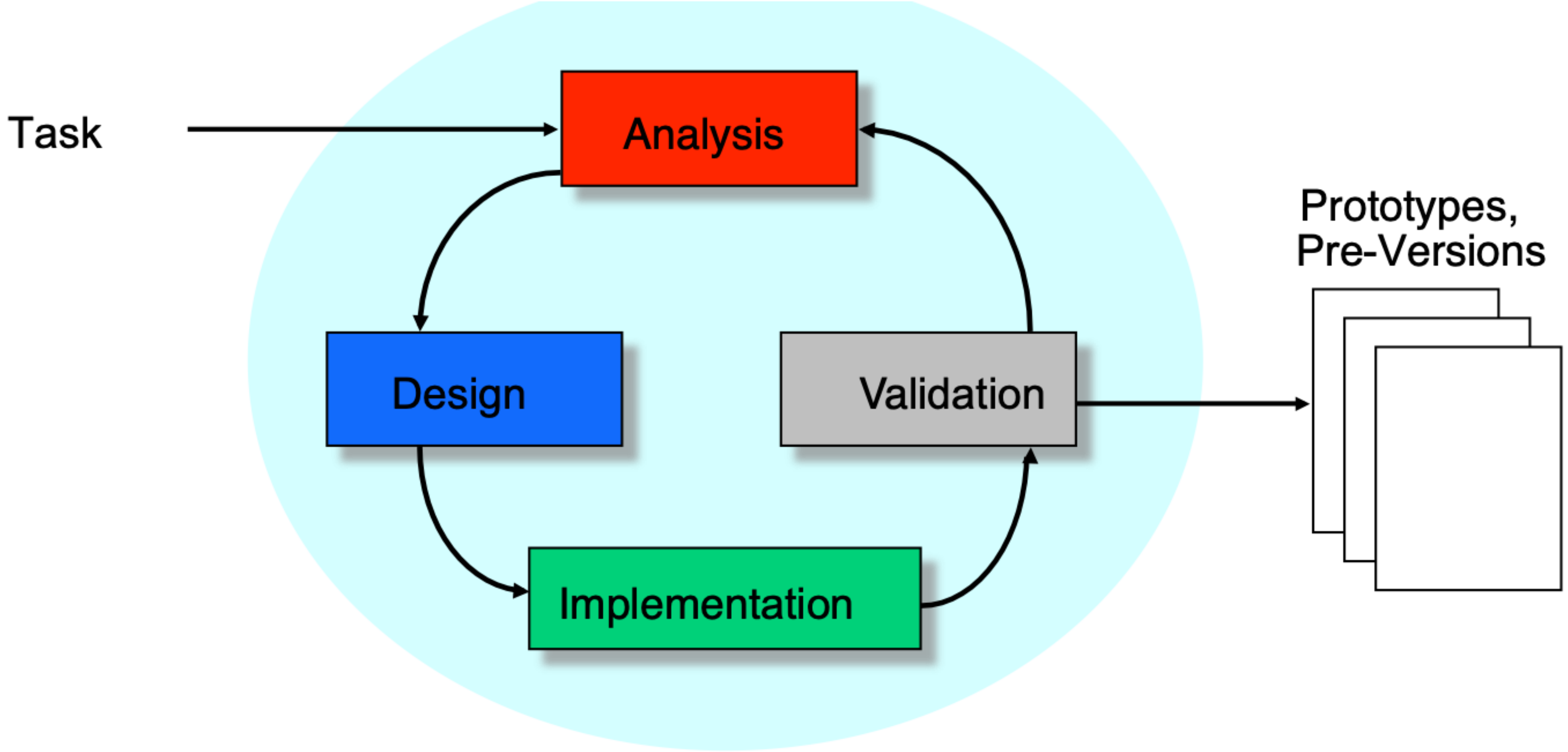
Iterative Models

Development process consists of sequence of cycles *(iterations).*

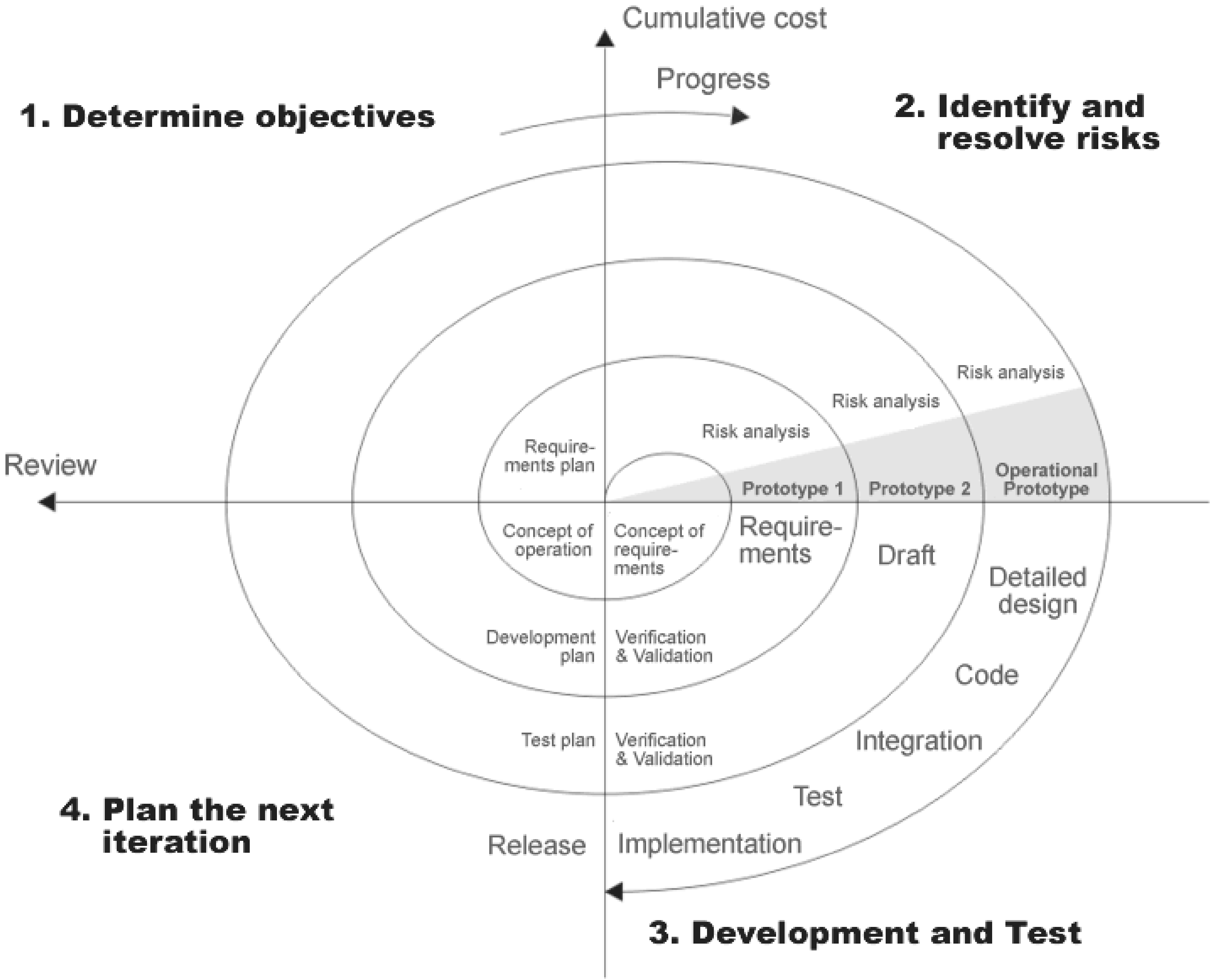
At the end of each cycle a new (executable) version of the SW product is available. Usually, this new version improves and extends the previous version.

Assessment:

- Fast results
- Flexible adaptation



Spiral Model



Characteristics Spiral Model

Iterative Method

Invented by Barry Boehm

Each cycle has the following activities in the respective quadrants:

1. Determining objectives, identifying alternatives, and description of basic conditions
2. Evaluating alternatives; detecting, estimating and reducing risk, e.g., by analysis, simulations, or prototyping
3. Realization and inspection of intermediate product
4. Planning of next cycle (of project continuation)

Process Models — Summary

- Process Models are good for
  - establishing a basic framework for SW projects
  - plan resources and major releases/milestones
  - track progress *in-the-large*
- However, they have been proven to fail due to
  - their static nature —> everything needs to be planned ahead
  - missing flexibility —> what about changing requirements or unforeseen incidents
  - their process-focused view —> technical debt is omitted as well as other aspects that are important in SW projects (humans, tools)
  - flexible models tend to be expensive and come with implementation overhead

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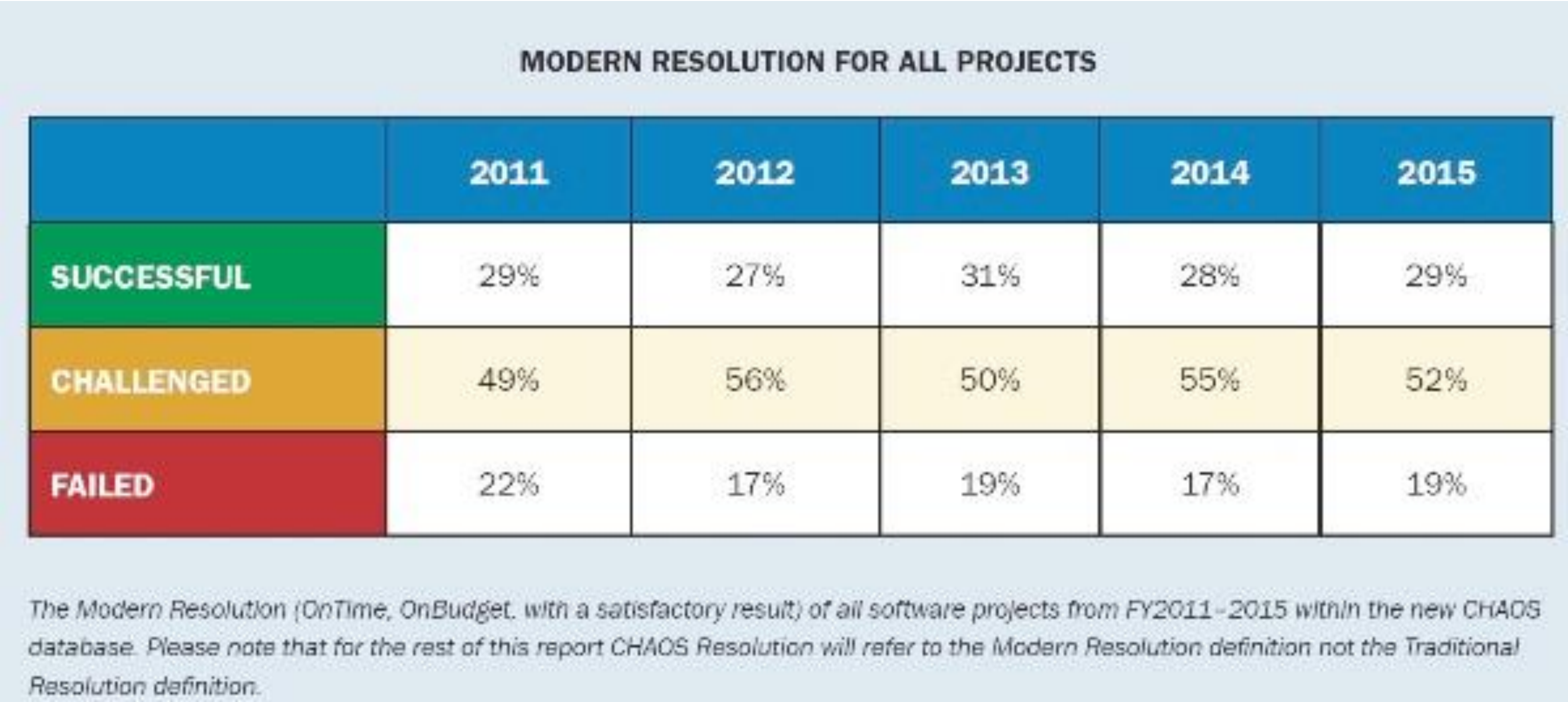
Introduction to Software Engineering for Engineers
Lecture-02: Process Models & SCRUM
Part 3: Agile Software Engineering & SCRUM

Dr.-Ing. Christoph Steup

Standish Group CHAOS Report

- In the U.S.
  - $250 billion per year are spent for IT application development
  - 31.1% of SE projects are cancelled before they ever get completed
  - 52.7% of projects cost 189% of their original estimates



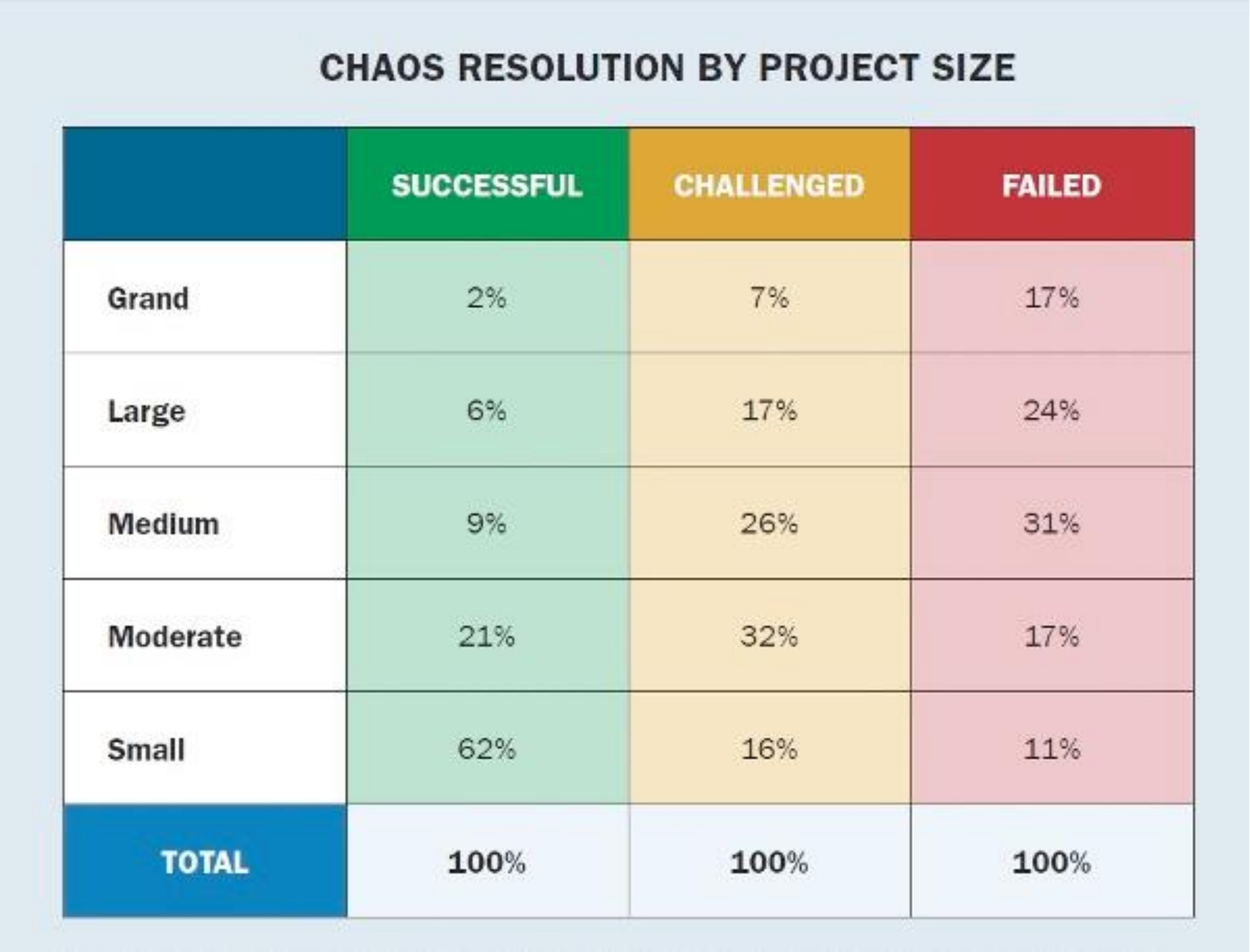
MODERN RESOLUTION FOR ALL PROJECTS

	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011–2015 within the new CHAOS database. Please note that for the rest of this report CHAOS Resolution will refer to the Modern Resolution definition not the Traditional Resolution definition.

Standish Group CHAOS Report (II)

- Obviously, size matters and is hard to manage even with common process models

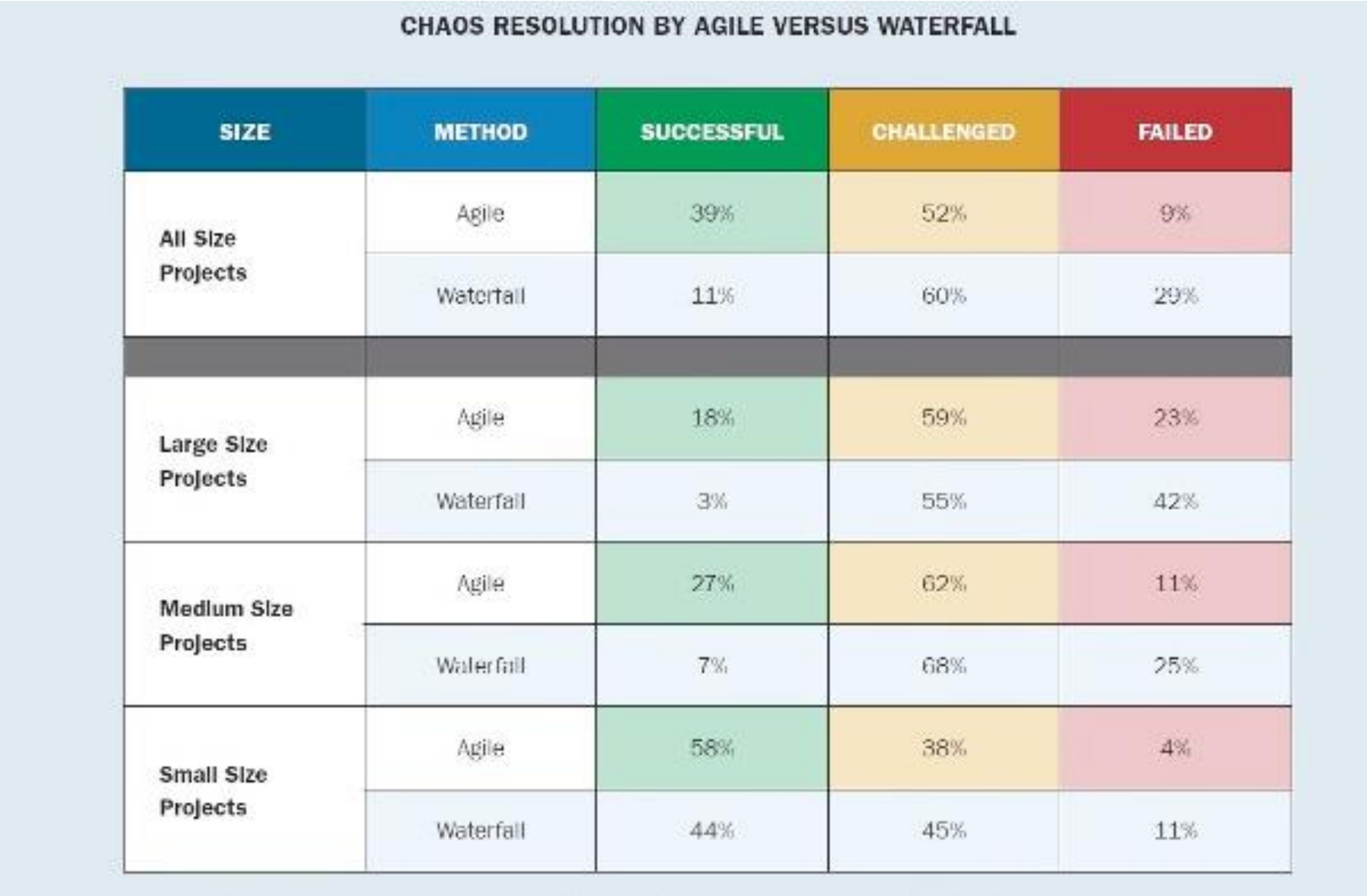


CHAOS RESOLUTION BY PROJECT SIZE

	SUCCESSFUL	CHALLENGED	FAILED
Grand	2%	7%	17%
Large	6%	17%	24%
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%
TOTAL	100%	100%	100%

Standish Group CHAOS Report (III)

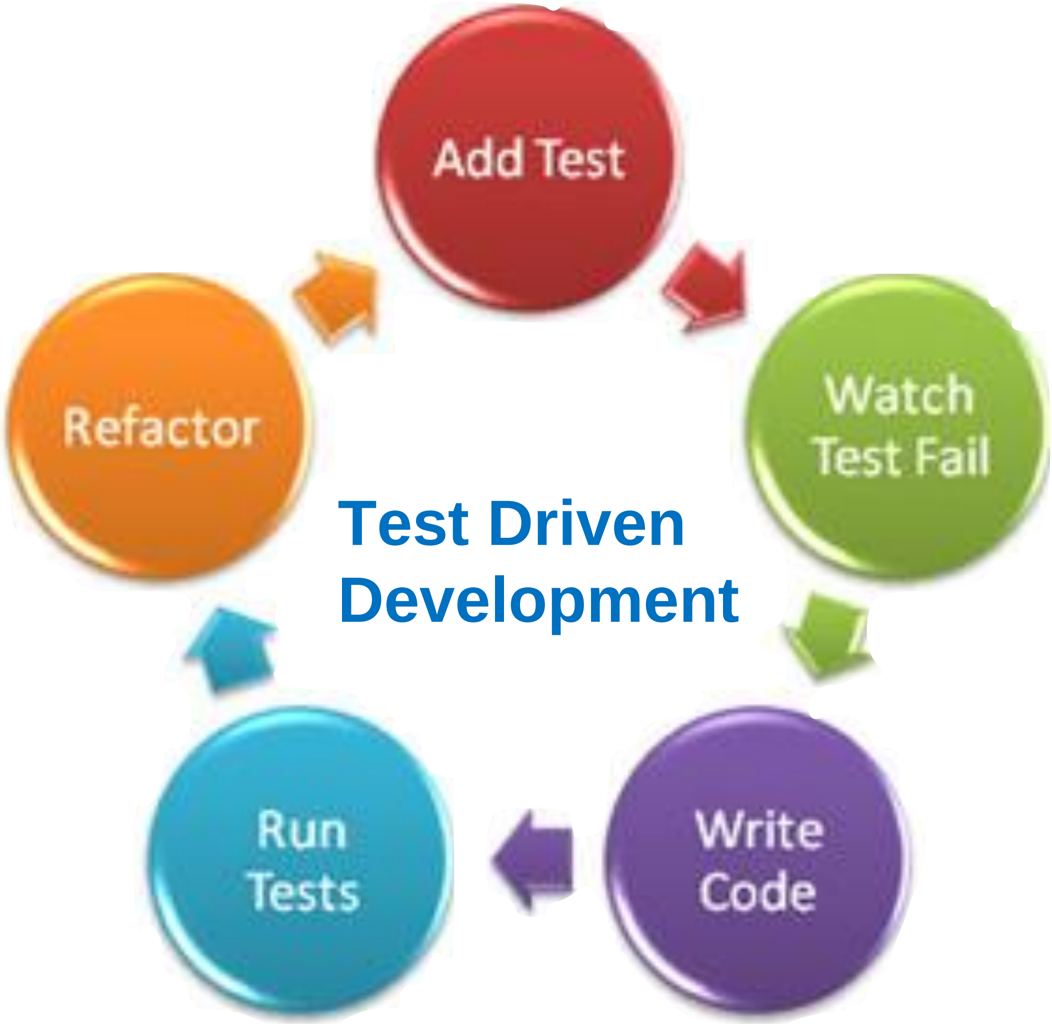
- Alternatives exist that overcome the limitations of common process models



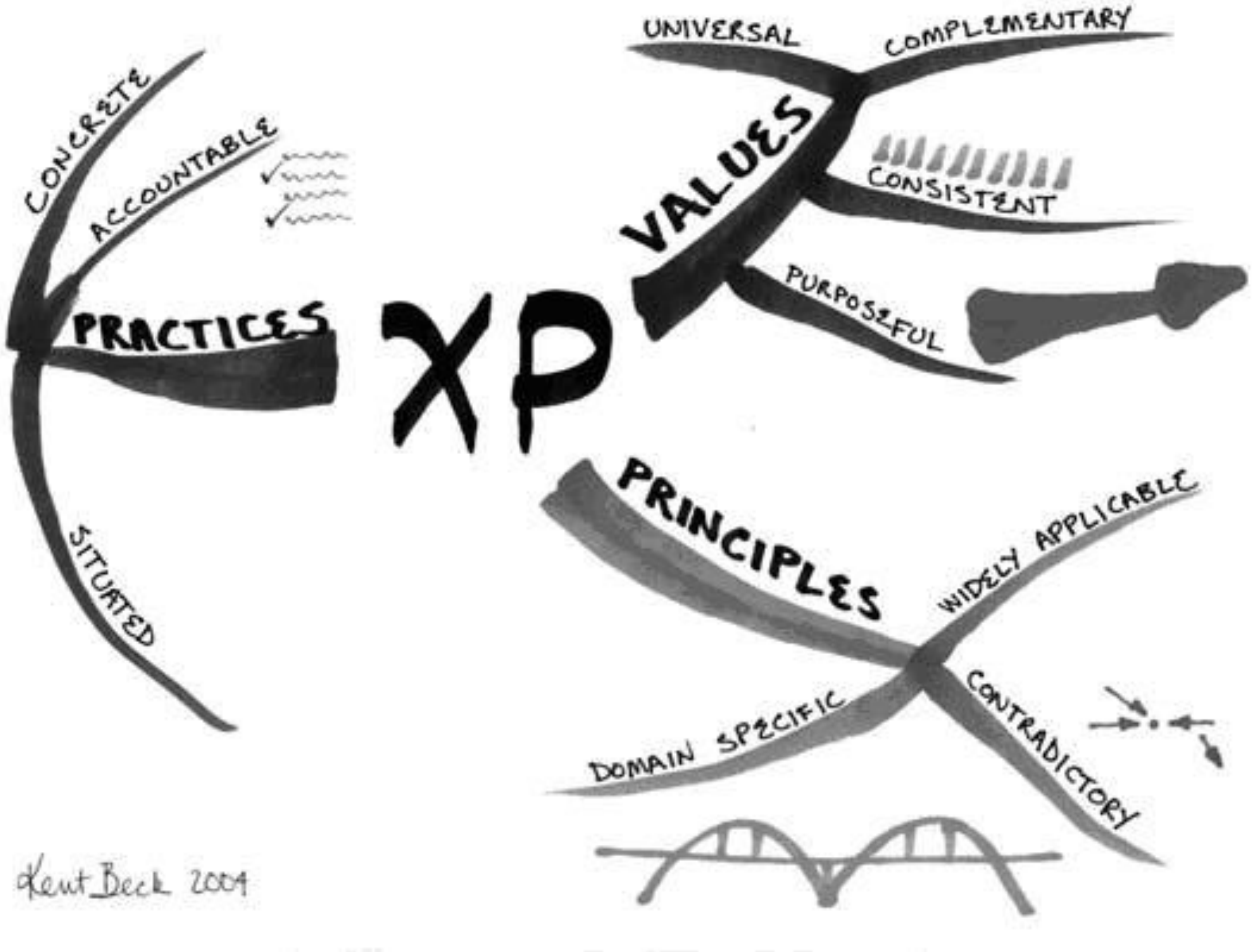
CHAOS RESOLUTION BY AGILE VERSUS WATERFALL

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large Size Projects	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium Size Projects	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small Size Projects	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

Agile Models



Test Driven Development



Characteristics

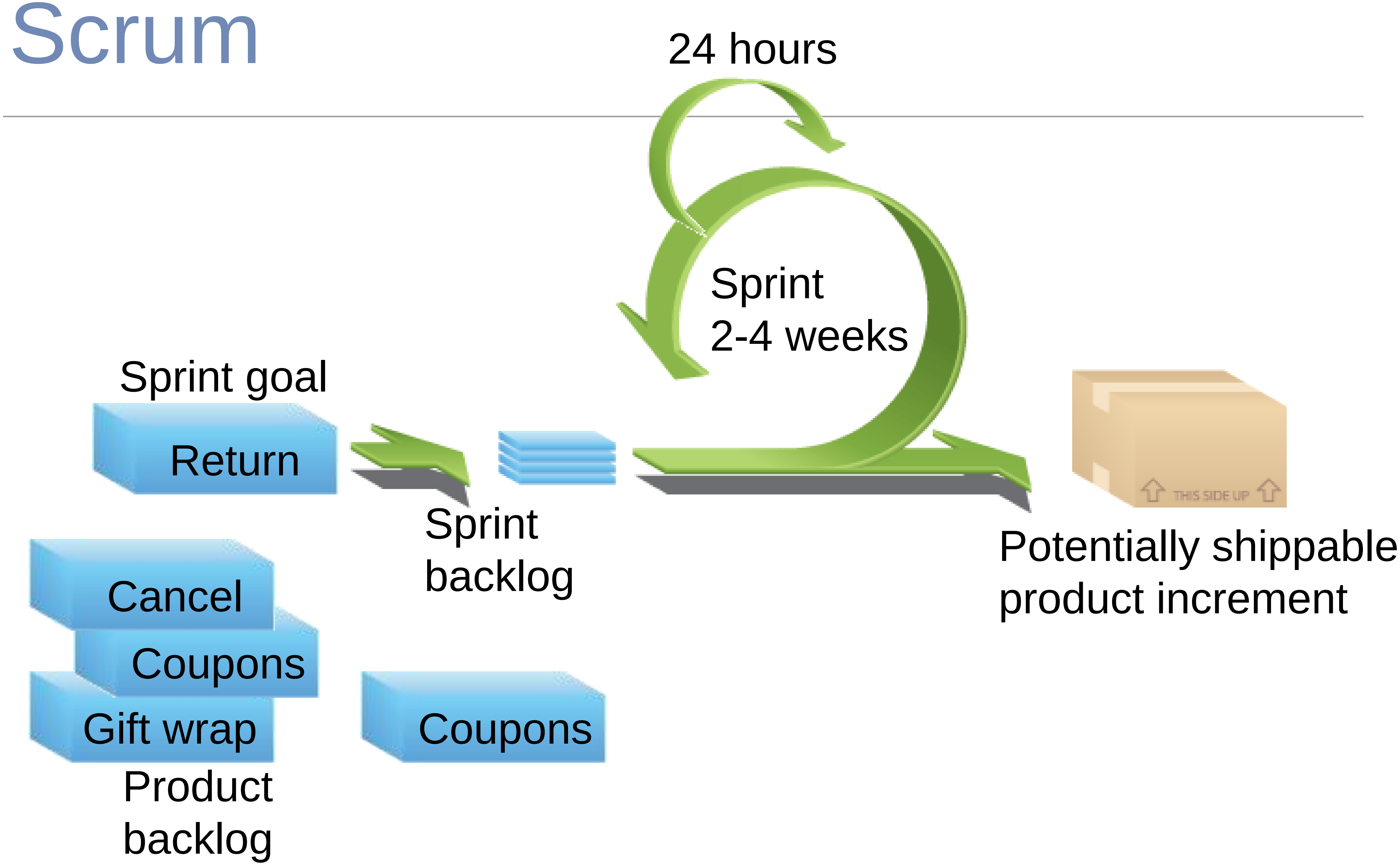
- Self-organizing teams
- Product progresses in a series of month-long “sprints”
- Requirements are captured as items in a list of “product backlog”
- No specific engineering practices prescribed
- Uses generative rules to create an agile environment for delivering projects
- One of the “agile processes”

The Agile Manifesto

Individuals and interactions	over	Process and tools
Working software	over	Comprehensive documentation
Customer collaboration	over	Contract negotiation
Responding to change	over	Following a plan

Source: www.agilemanifesto.org

Scrum



24 hours

Sprint
2-4 weeks

Sprint goal

Return

Sprint
backlog

Potentially shippable
product increment

Cancel

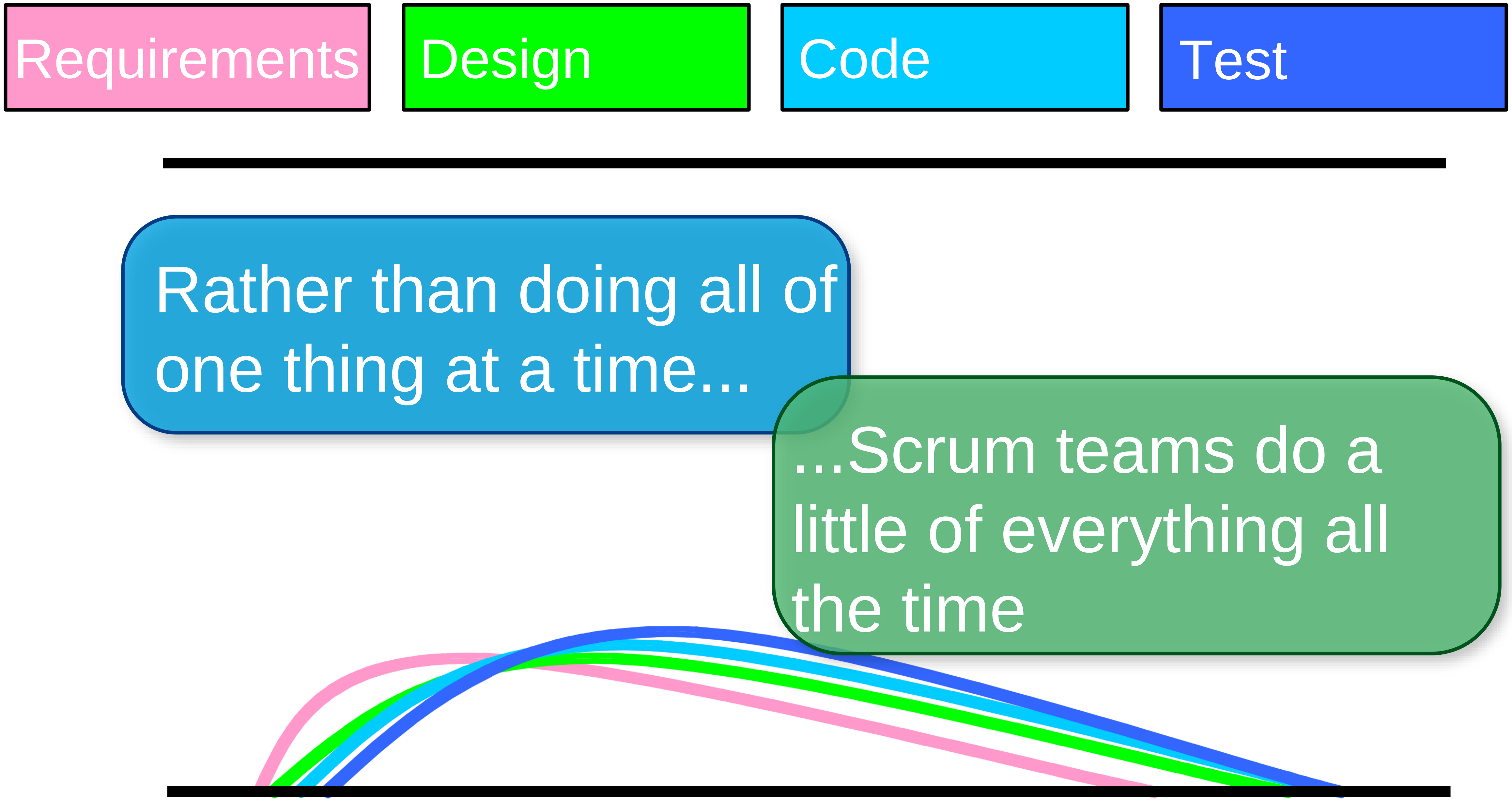
Coupons

Gift wrap

Coupons

Product
backlog

Sequential vs. Overlapping Development



Requirements

Design

Code

Test

Rather than doing all of one thing at a time...

...Scrum teams do a little of everything all the time

Source: “The New New Product Development Game” by Takeuchi and Nonaka. *Harvard Business Review,* January 1986.

SCRUM Framework

Roles

- Product owner
- ScrumMaster
- Team

Ceremonies

- Sprint planning
- Sprint review
- Sprint retrospective
- Daily scrum meeting

Artifacts

- Product backlog
- Sprint backlog
- Burndown charts

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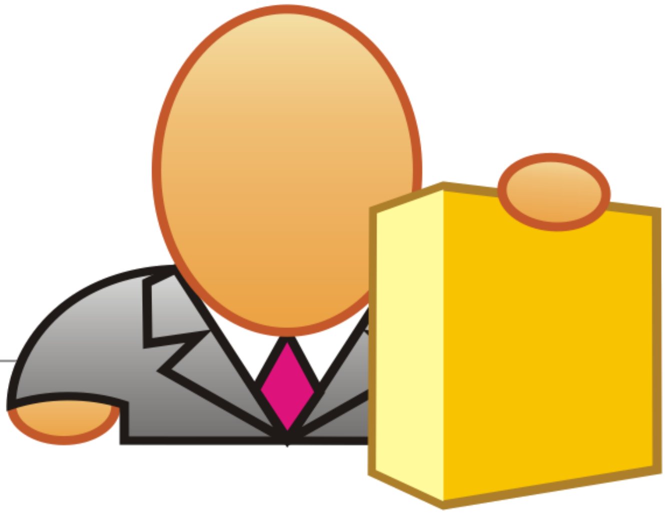
Product Owner

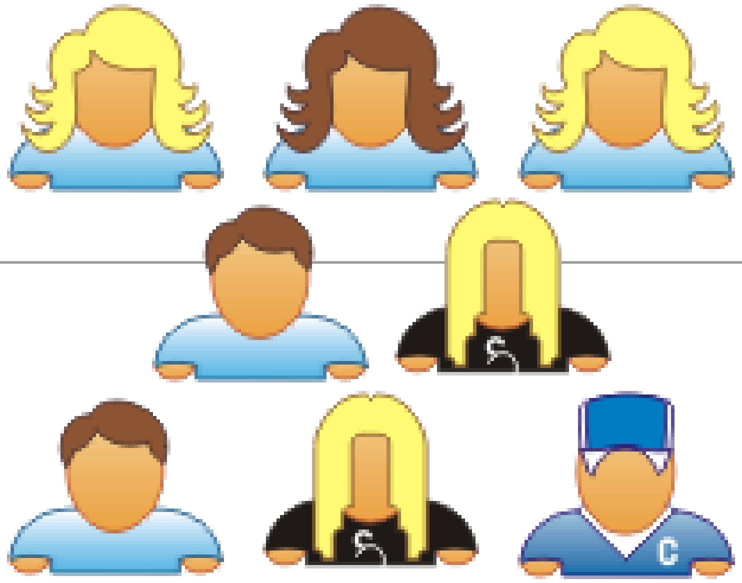


- Define the features of the product
- Decide on release date and content
- Be responsible for the profitability of the product (ROI)
- Prioritize features according to market value
- Adjust features and priority every iteration, as needed
- Accept or reject work results

The SCRUM Master

- Represents management to the project
- Responsible for enacting Scrum values and practices
- Removes impediments
- Ensure that the team is fully functional and productive
- Enable close cooperation across all roles and functions
- Shield the team from external interferences

The Team



- Typically 5-9 people
- Cross-functional:
  - Programmers, Testers, User Interface Designers, etc.
- Members should be full-time
  - Exceptions possible (e.g., database administrator)
- Teams are self-organizing
  - Ideally flat hierarchy, often not possible
- Membership should change only between sprints

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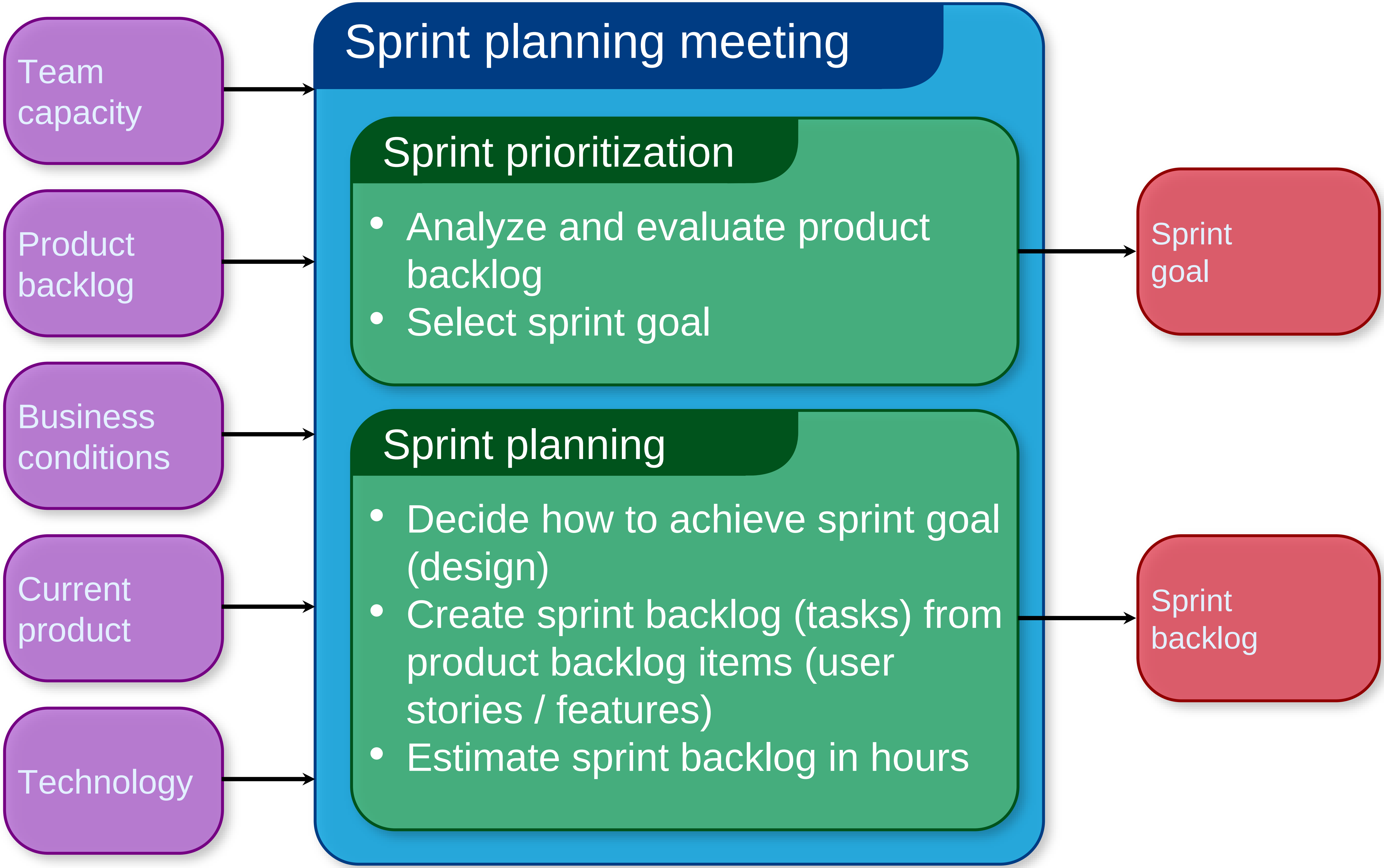


Team capacity

Product backlog

Business conditions

Current product

Technology

Sprint planning meeting

Sprint prioritization

- Analyze and evaluate product backlog
- Select sprint goal

Sprint planning

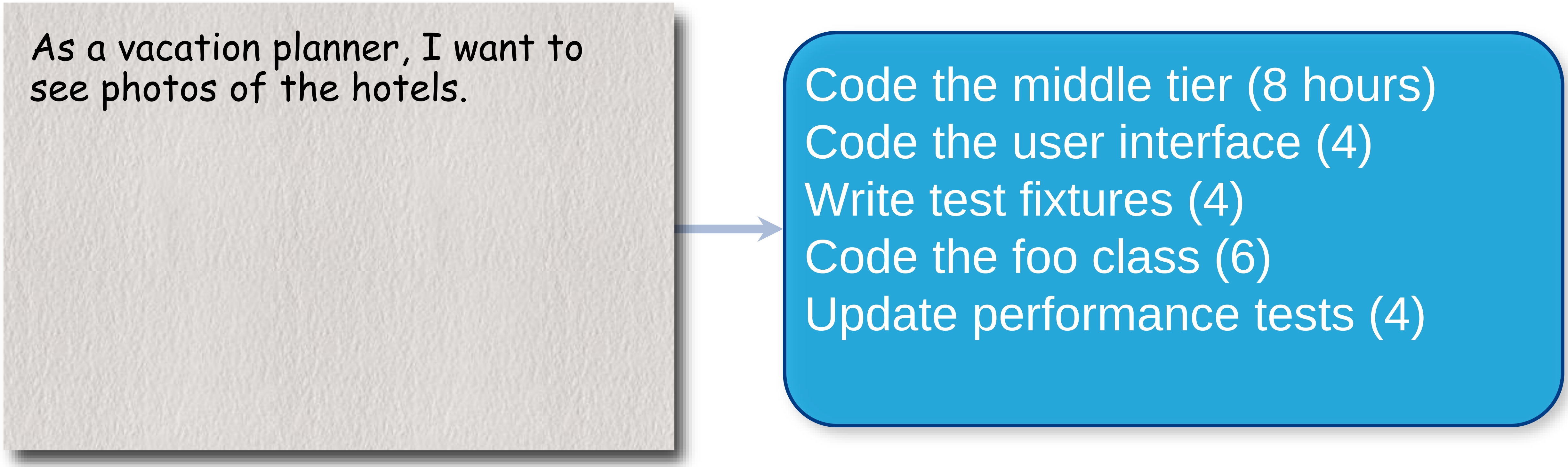
- Decide how to achieve sprint goal (design)
- Create sprint backlog (tasks) from product backlog items (user stories / features)
- Estimate sprint backlog in hours

Sprint goal

Sprint backlog

Sprint Planning

- Team selects items from the product backlog they can commit to completing
- Sprint backlog is created
- Tasks are identified and each is estimated (1-16 hours)
- Collaboratively, not done alone by the ScrumMaster
- High-level design is considered



As a vacation planner, I want to see photos of the hotels.

Code the middle tier (8 hours)
Code the user interface (4)
Write test fixtures (4)
Code the foo class (6)
Update performance tests (4)

The Daily SCRUM

- Parameters
  - Daily
  - 15-minutes
  - Stand-up
- Not for problem solving
  - Whole world is invited
  - Only team members talk; ScrumMaster, product owner, can attend
- Helps avoid other unnecessary meetings

Everyone answers THREE Questions

1. What did you do yesterday?
2. What will you do today?
3. Is anything in your way?

- These are not status for the ScrumMaster
- They are commitments in front of peers (Flat Hierarchy)

The Sprint Review

- Team presents what it accomplished during the sprint
- Typically takes the form of a demo of new features or underlying architecture
- Informal
  - 2-hour preparation time rule
  - No slides
- Whole team participates
- Invite the world

Sprint Retrospective

- Periodically take a look at what is and is not working
- Typically 15–30 minutes
- Done after every sprint
- Whole team participates
  - ScrumMaster
  - (Product owner) —> only if different from stakeholder
  - Team
- Possibly customers and others

SCRUM Framework

Roles

- Product owner
- ScrumMaster
- Team

Ceremonies

- Sprint planning
- Sprint review
- Sprint retrospective
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Artifacts

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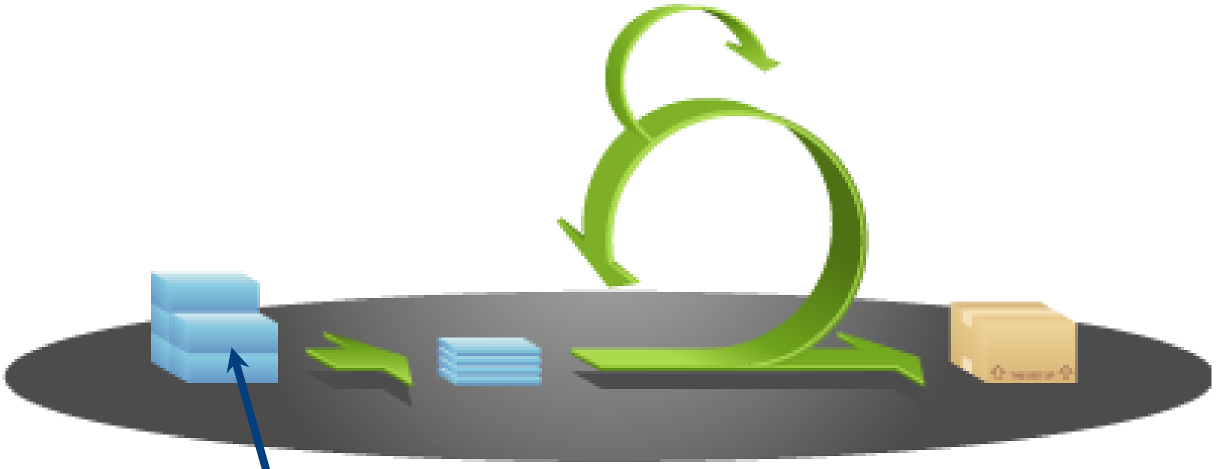
Product Backlog

- The requirements
- A list of all desired work on the project
- Ideally expressed such that each item has value to the users or customers of the product
- Prioritized by the product owner
- Reprioritized at the start of each sprint



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This is the product backlog

A Sample Product Backlog

Backlog item	Estimate
Allow a guest to make a reservation	3
As a guest, I want to cancel a reservation.	5
As a guest, I want to change the dates of a reservation.	3
As a hotel employee, I can run RevPAR reports (revenue-per-available-room)	8
Improve exception handling	8
...	30
...	50

The Sprint Goal

- A short statement of what the work will be focused on during the sprint

Life Sciences

Support features necessary for population genetics studies.

Database Application

Make the application run on SQL Server in addition to Oracle.

Financial services

Support more technical indicators than company ABC with real-time, streaming data.

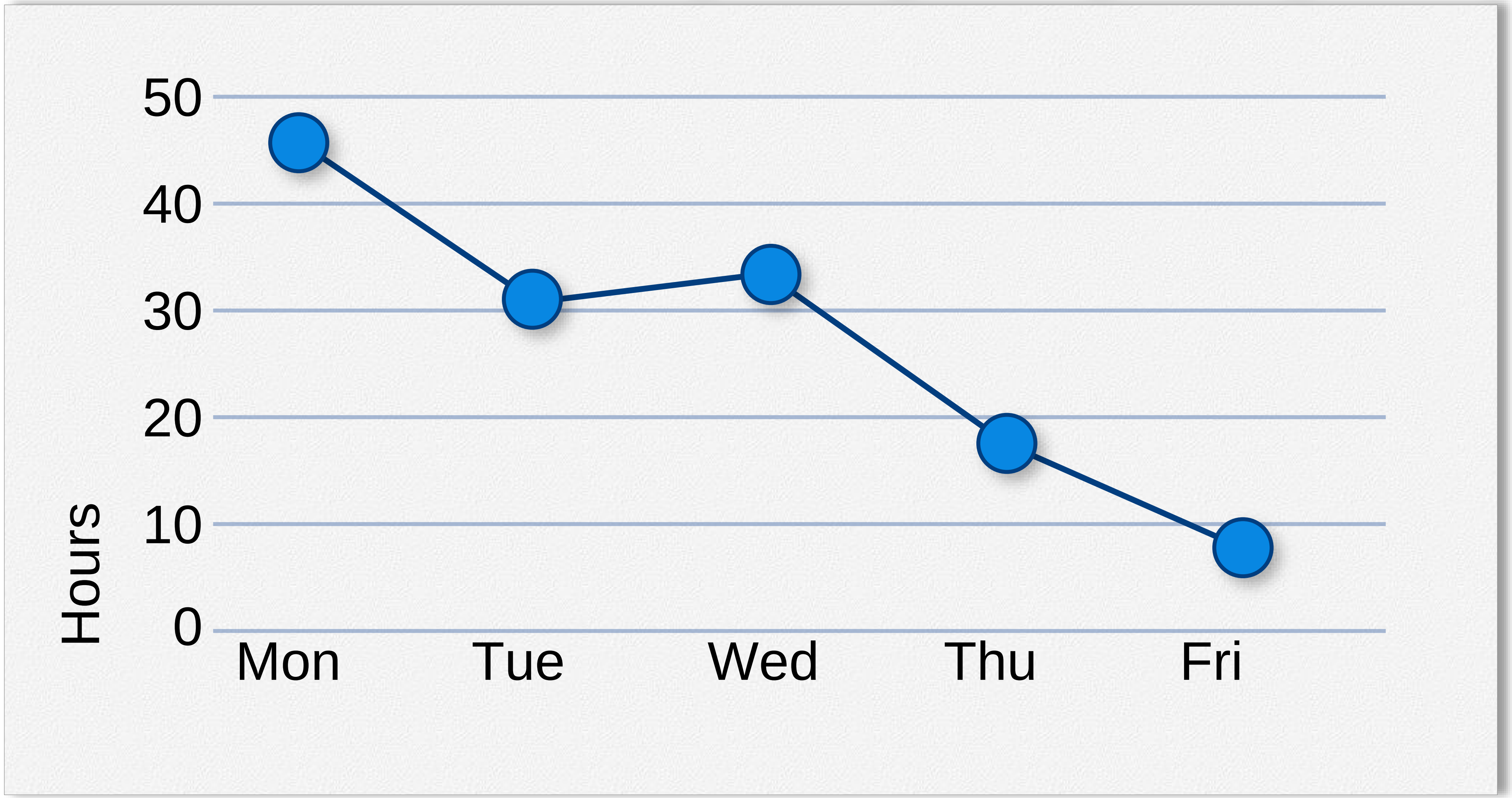
Managing the Sprint Backlog

- Individuals sign up for work of their own choosing
  - Work is never assigned
- Estimated work remaining is updated daily
- Any team member can add, delete or change the sprint backlog
- Work for the sprint emerges
- If work is unclear, define a sprint backlog item with a larger amount of time and break it down later
- Update work remaining as more becomes known

A Sprint Backlog

Tasks	Mon	Tue	Wed	Thu	Fri
Code the user interface	8	4	8		
Code the middle tier	16	12	10	4	
Test the middle tier	8	16	16	11	8
Write online help	12				
Write the foo class	8	8	8	8	8
Add error logging			8	4	

Tasks	Mon	Tues	Wed	Thur	Fri
Code the user interface	8	4	8		
Code the middle tier	16	12	10	7	
Test the middle tier	8	16	16	11	8
Write online help	12				



OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

FACULTY OF COMPUTER SCIENCE

SwarmLab

Introduction to Software Engineering for Engineers
Lecture-02: Process Models & SCRUM
Part 4: User Stories

Dr.-Ing. Christoph Steup

Motivation

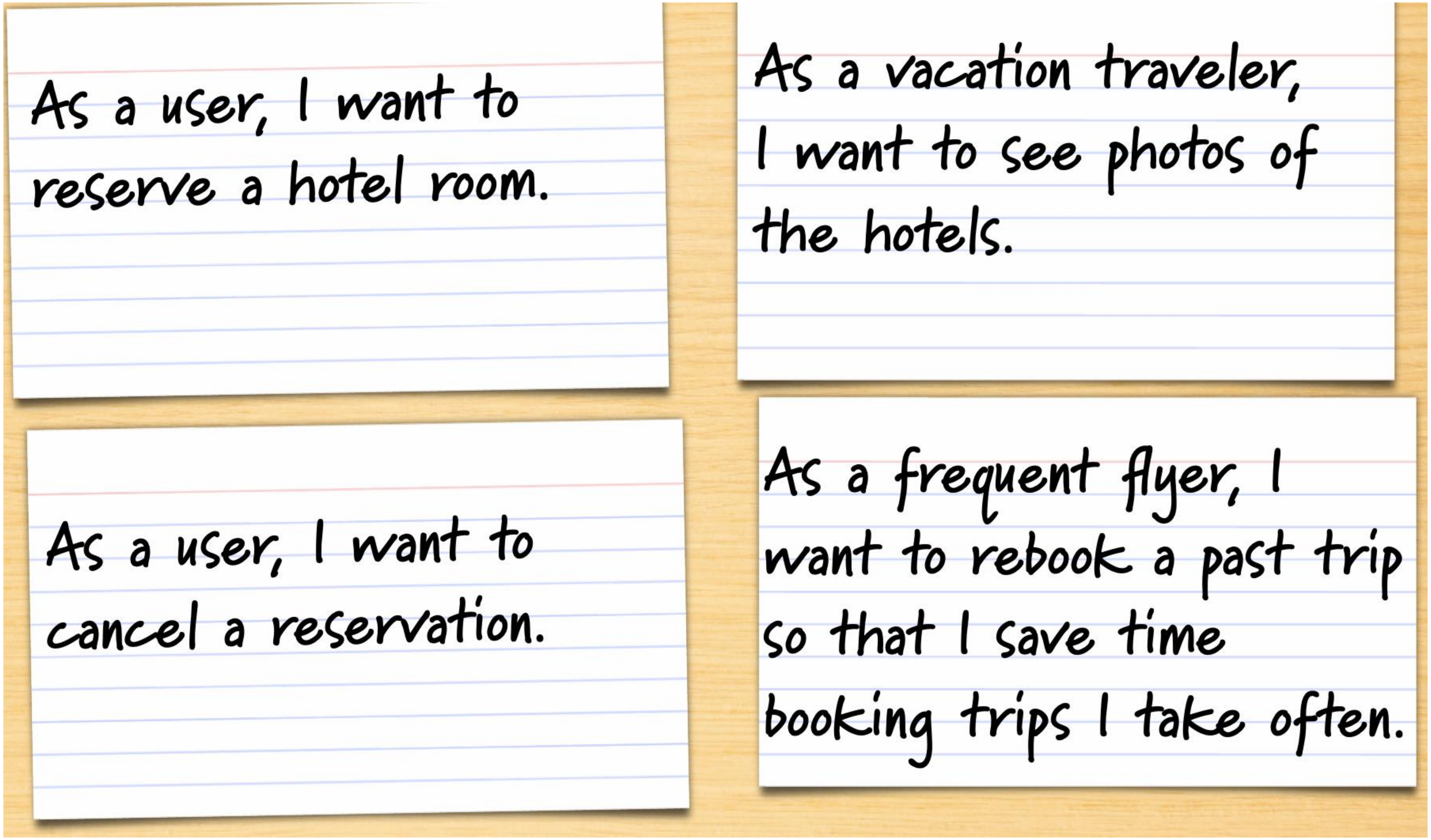
- Predicting a schedule for weeks or even months is impossible

- Thus

  - make decision on information available,
    but do it often

  - Instead of making all-encompassing decisions
    spread decision-making across the project

Samples



As a user, I want to reserve a hotel room.

As a vacation traveler, I want to see photos of the hotels.

As a user, I want to cancel a reservation.

As a frequent flyer, I want to rebook a past trip so that I save time booking trips I take often.

What about Details?

- *As a user, I can cancel a reservation*
  - Does the user get a full or partial refund?
    - Refund to credit card or site credit?
  - How far ahead a reservation must be cancelled?
    - Is it the same for all hotels?
    - For all site visitors? Can frequent travellers cancel later?
- Is a confirmation provided to the user?
  - How?

Details as conditions of satisfaction

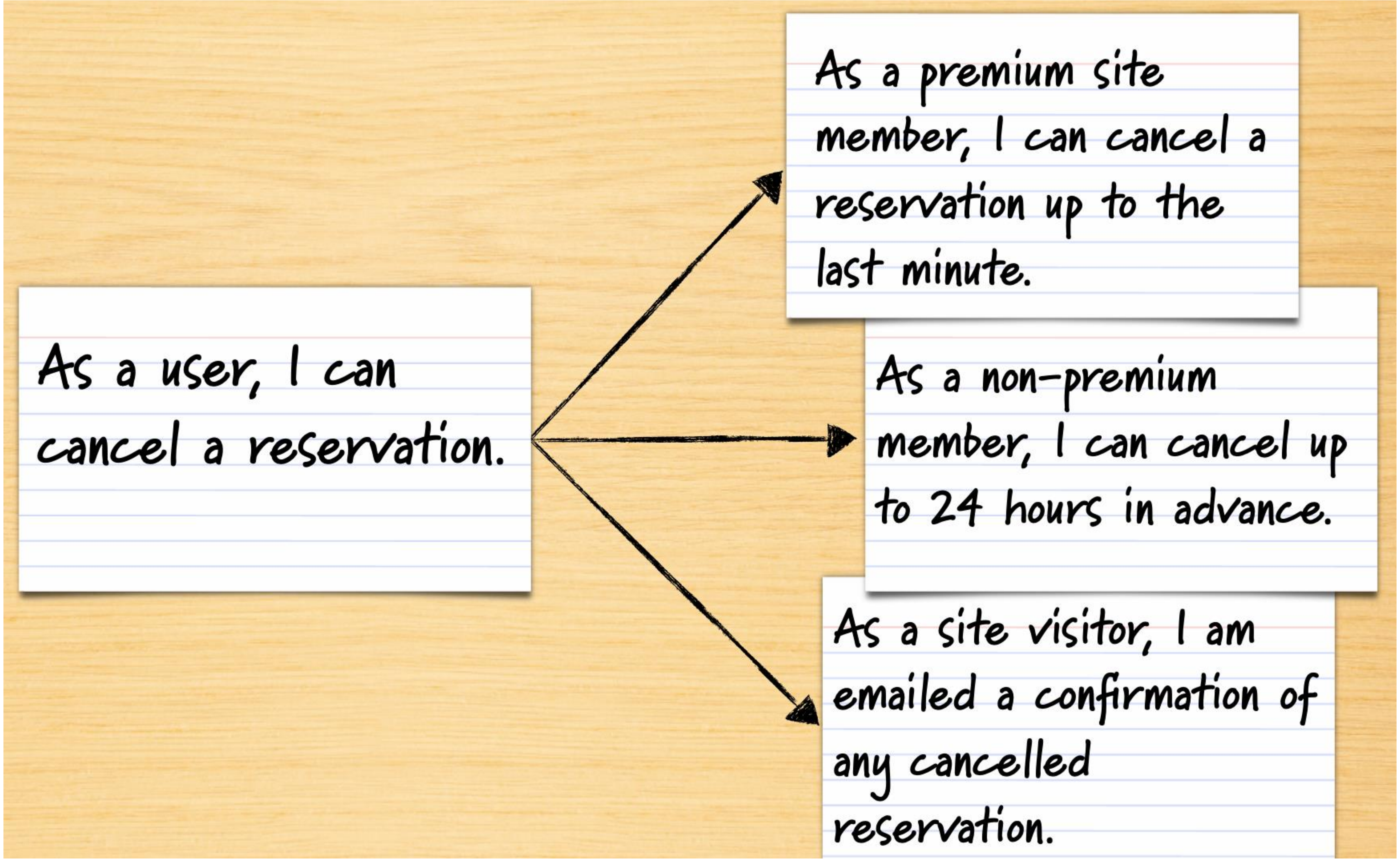
As a user, I can cancel a reservation

- Product owner’s conditions of satisfaction can be added to a story
- These are essentially tests

- Verify that premium member can cancel the same day without a fee
- verify that an email confirmation is sent
- ….

Also called
Acceptance Criteria

Alternative: Details added in smaller sub-stories



As a user, I can cancel a reservation.

As a premium site member, I can cancel a reservation up to the last minute.

As a non-premium member, I can cancel up to 24 hours in advance.

As a site visitor, I am emailed a confirmation of any cancelled reservation.

Techniques can be combined

- Approaches are not mutually exclusive
- Write stories at an appropriate level
- By time of implementation/realization, each story will have conditions pf satisfaction associated with it

Useful Terminology

Theme
A collection of related user stories

Hence, several themes may form an epic

Epic
A large user story (usually to be decomposed)

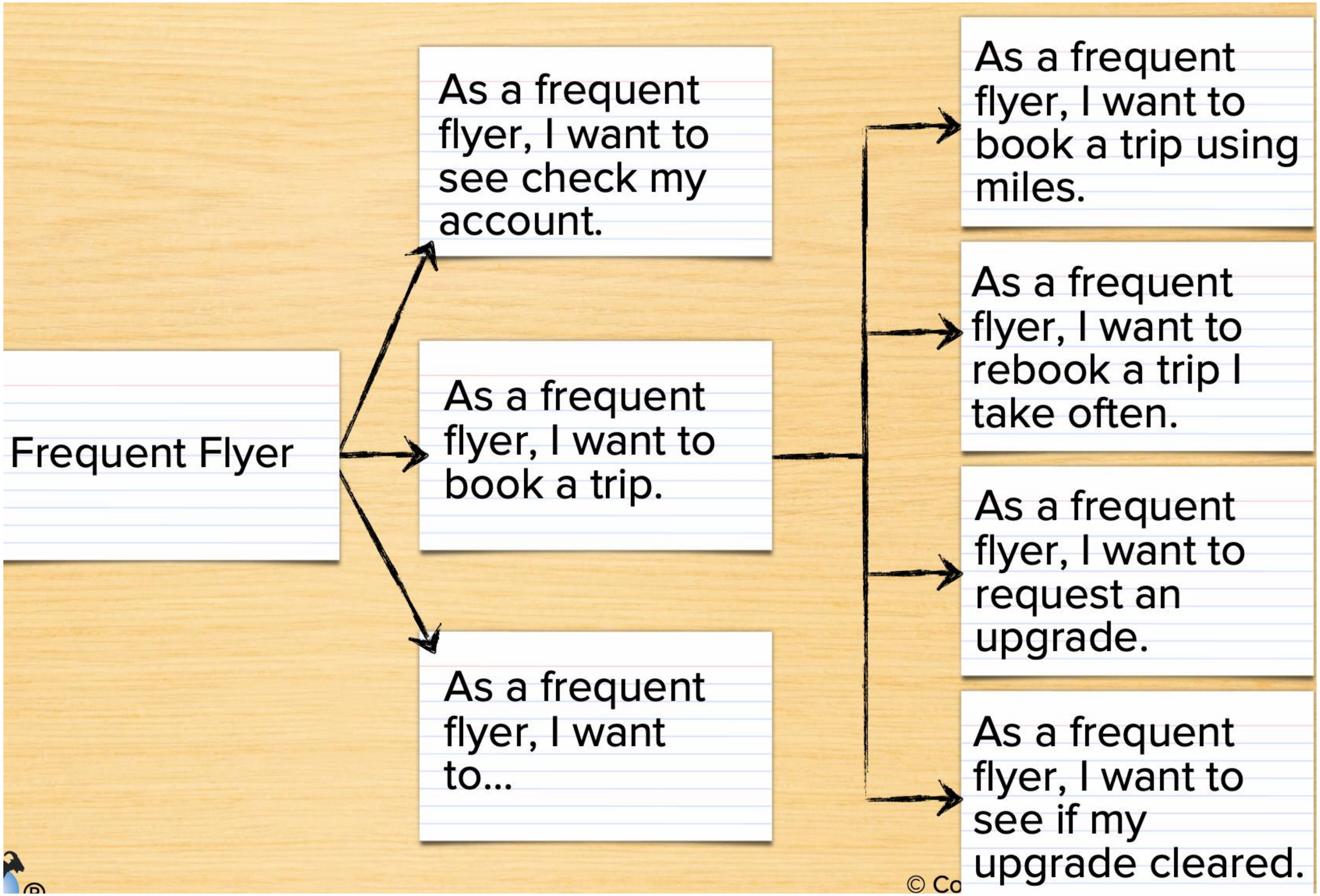
Writing User Stories

“As a <user role>,
I <want/need/can/etc> <goal>
so that <reason>”

Story-Writing Workshops

- Includes the whole team (external stakeholders possible)
- Not done every sprint
- Instead, try to write as many stories as possible at such a workshop
  - some will be “implementation-ready”
  - Others will be epics
- No prioritization at this point

Start with Epics and iterate



Frequent Flyer

As a frequent flyer, I want to see check my account.

As a frequent flyer, I want to book a trip.

As a frequent flyer, I want to…

As a frequent flyer, I want to book a trip using miles.

As a frequent flyer, I want to rebook a trip I take often.

As a frequent flyer, I want to request an upgrade.

As a frequent flyer, I want to see if my upgrade cleared.

© Co

Summary

- Software Engineering
  - Motivation & Terminology
- Process Models
  - Waterfall
  - V-Model
  - Prototype-based
  - Iterative Models
- Agile Models
- Blog Articles
  - Team Presentation