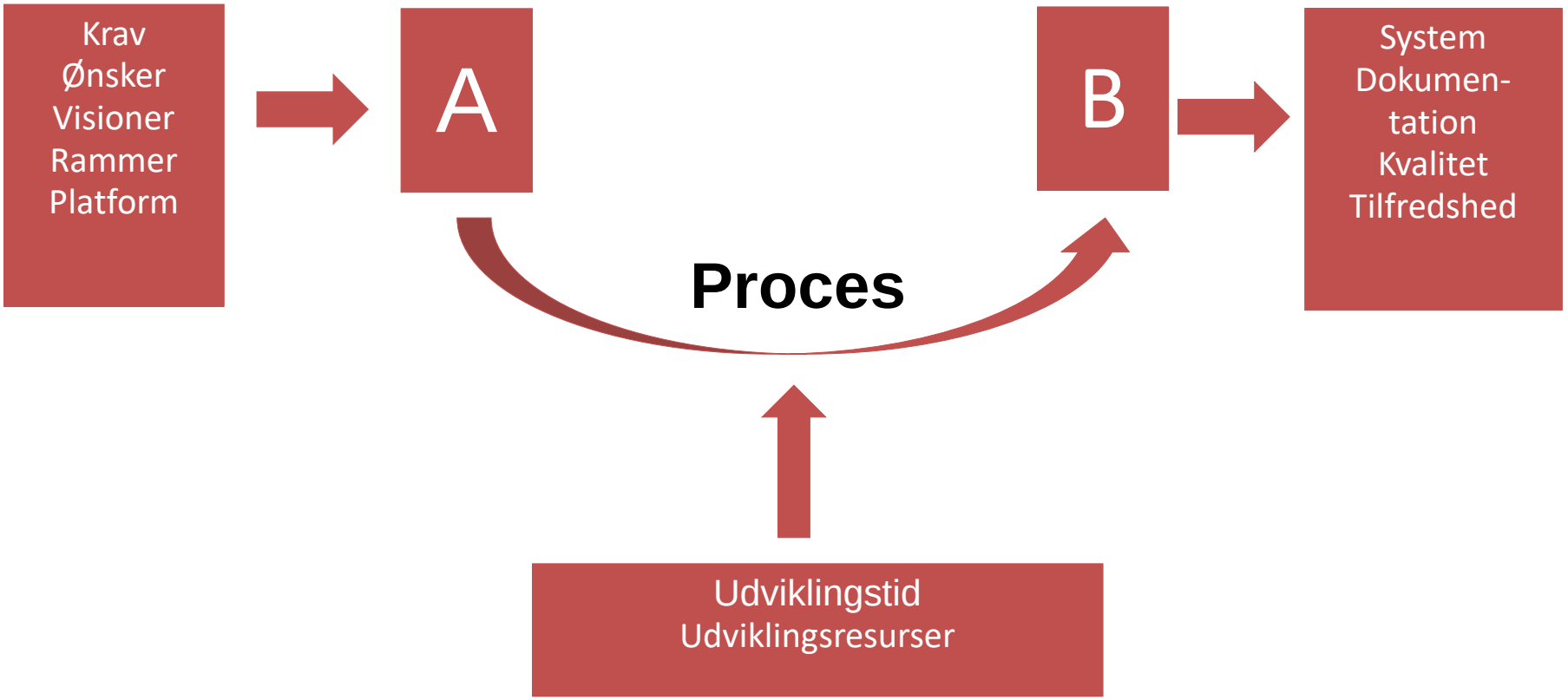
Development Processes

Introduction to Systems Engineering
I2ISE

Introduction

- What is a (development) process?
- Why do we need a development process?
- Some examples
  - Traditional, iterative, agile and the ASE processes

Systems engineering – skematisk set



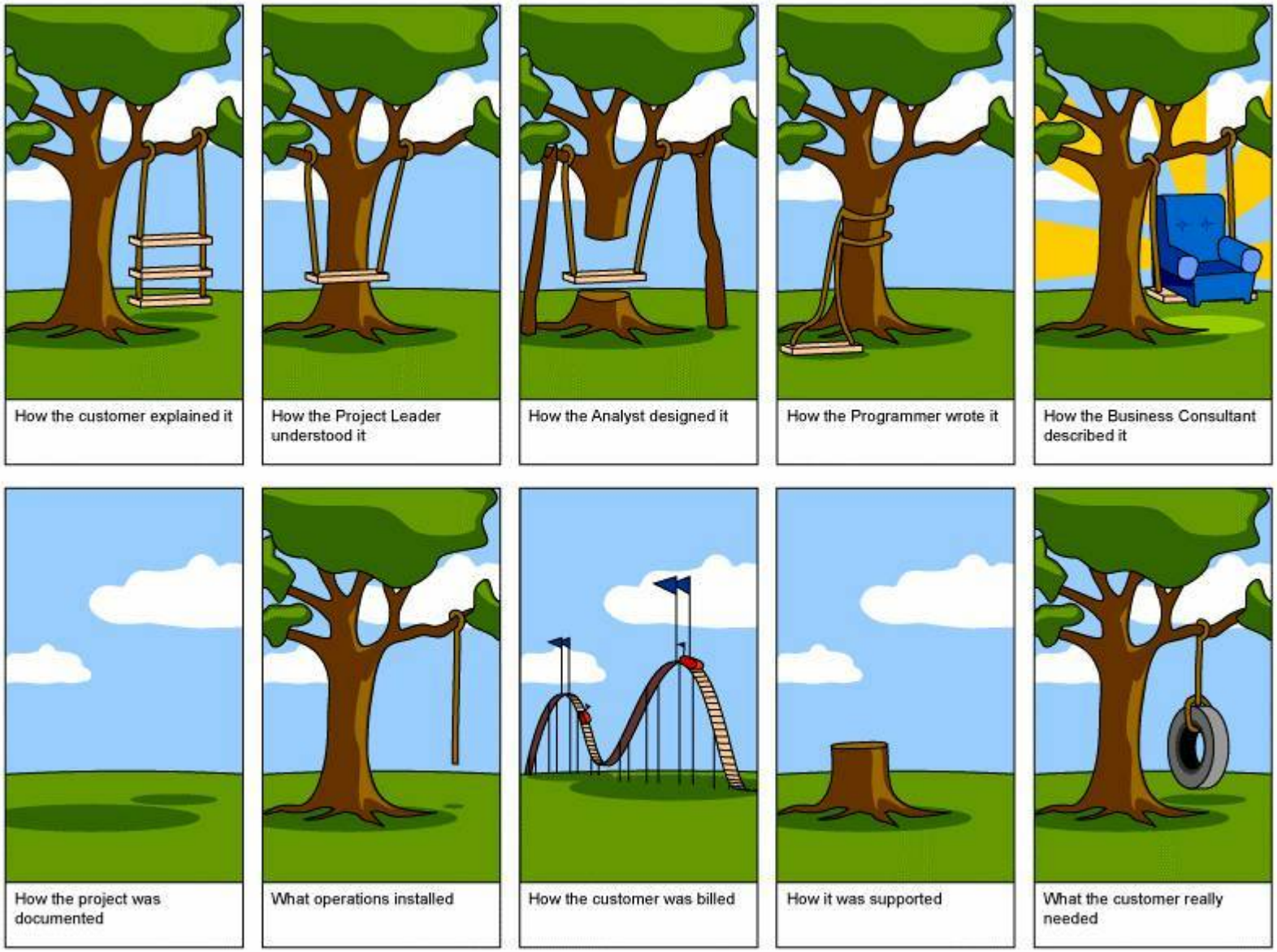
What is a development process?

- A *process* is the action of taking something through a defined set of steps to transform something into something else
  - Milk → cheese, metal → car, thoughts → products, etc.
- A *development process* is a process defined to support development (of HW, SW, …)
- A development process may define…
  - How to arrive at a product
  - What input is needed at what times
  - What (secondary) output there should be
  - …

Why use a development process?

- Using a development process may seem to incur an overhead
  - E.g., you may not actually ”produce” anything before ”late” in the process
- So…why do we use it?
- Because we are engineers, so we are *concerned*
  - …that we are producing the right thing
  - …with the right capabilities
  - …at the right time
  - …at the right cost
  - …

Why use a development process?



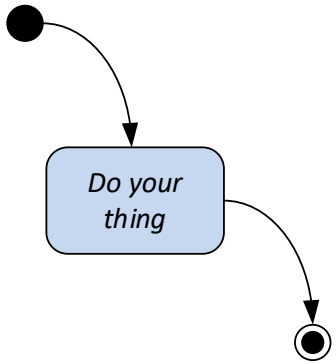
Why use a development process?

- Development processes answers some important questions:
  - What are you going to *produce*?
  - When will you be *done*?
  - What will it *cost*?
  - How will you handle *changes*?
- Answers to these questions are important to the customer
- Are the answers important to you? To your business? Why?

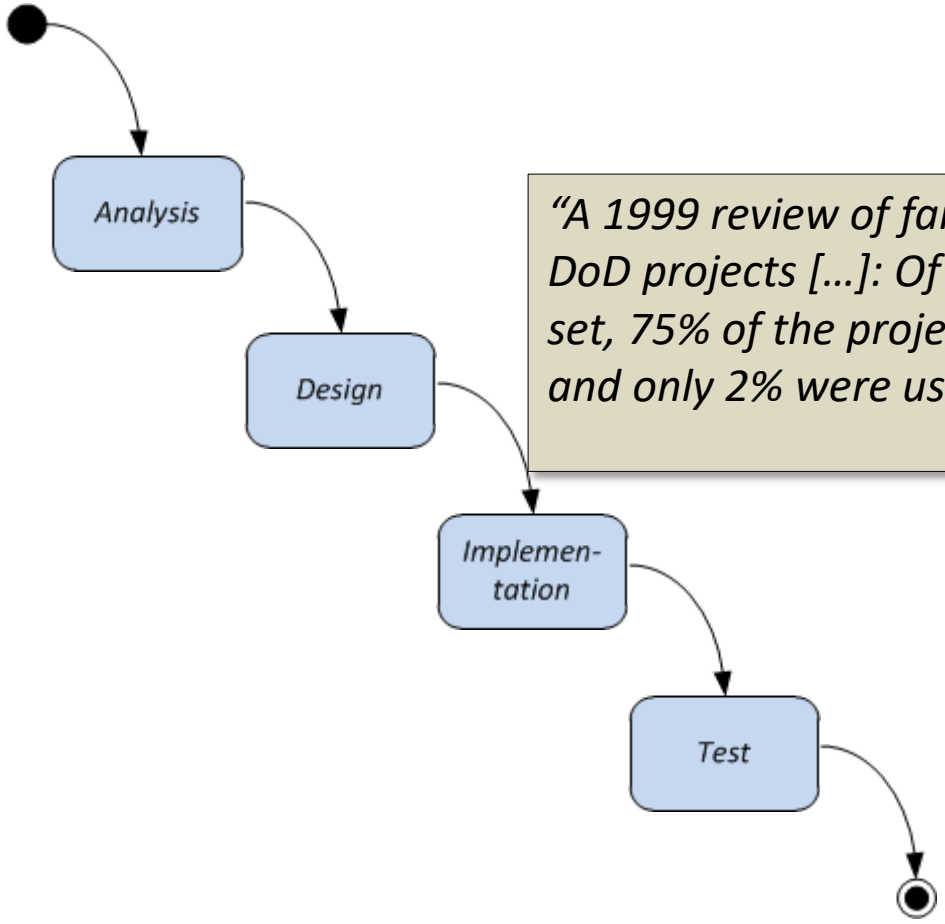
Examples: *Traditional* development processes

- The ”null” process
- The waterfall process
- The V-model

The "null" process



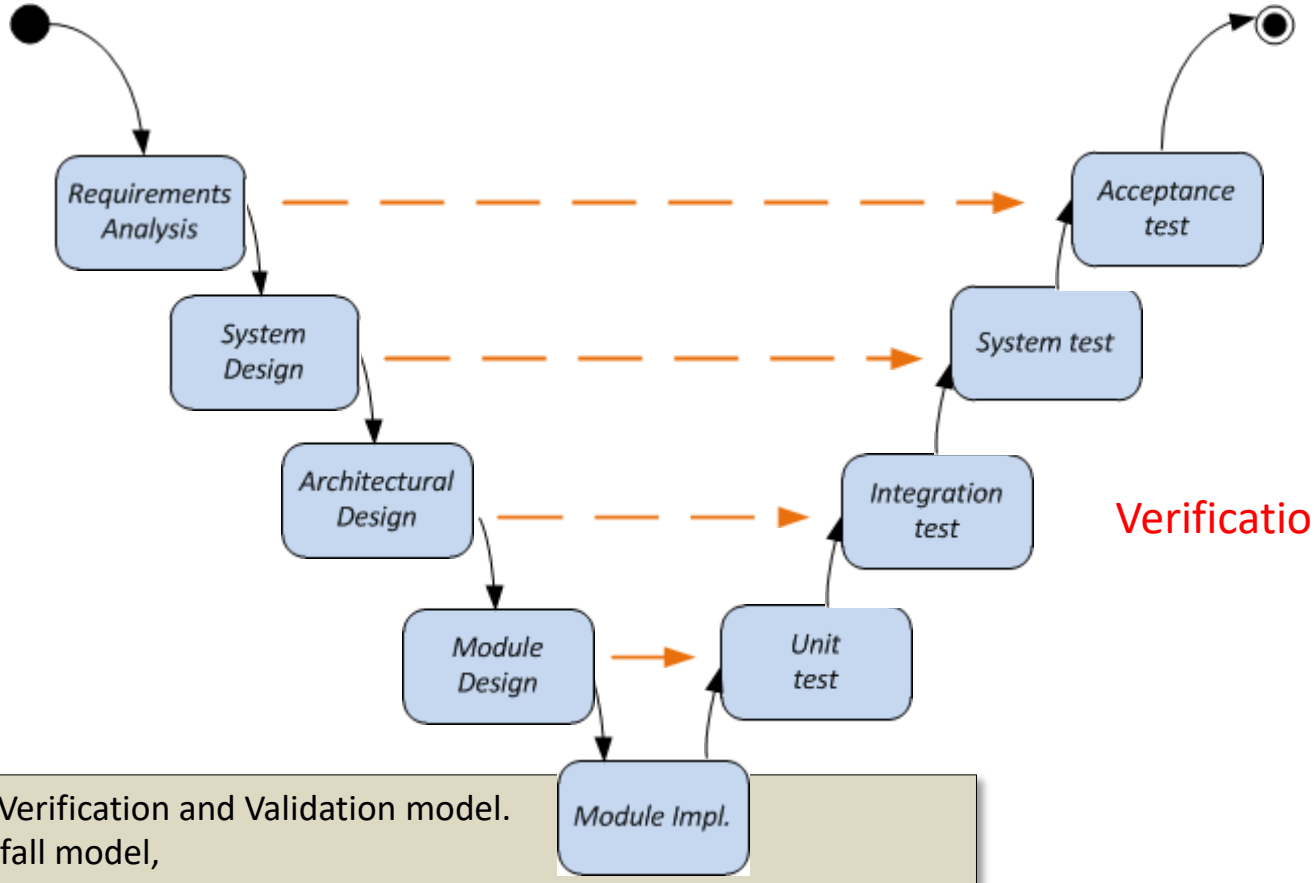
The waterfall process



"…a flawed, non-working model"
-Winston R. Royce, 1970

"A 1999 review of failure rates in a sample of earlier DoD projects […]: Of a total $37 billion for the sample set, 75% of the projects failed or were never used, and only 2% were used without extensive modification."
- S. Jarzombek, 1999

The V-model



"V- model means Verification and Validation model.
Just like the waterfall model,
the V-Shaped life cycle is a sequential path of execution of processes.
Each phase must be completed before the next phase begins.
Testing of the product is planned in parallel
with a corresponding phase of development" .. *Try to improve quality*

- ISTQB Certification

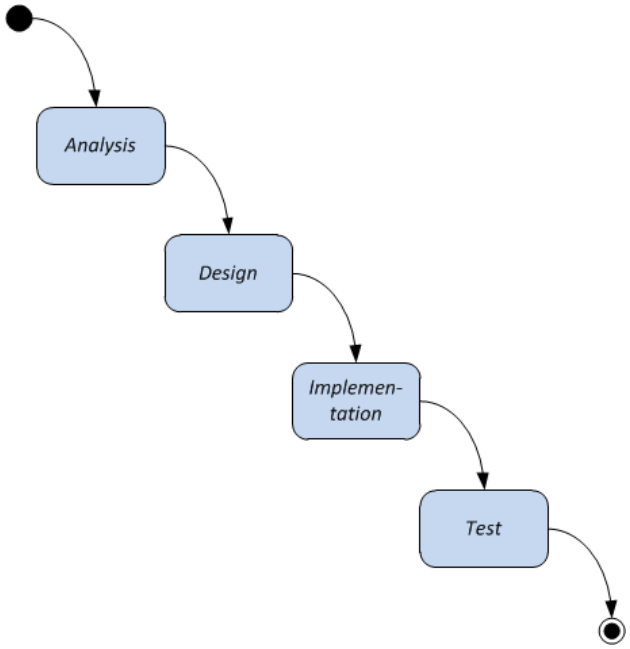
When to use the V-model?

- The V-shaped model should be used for small to medium sized projects where requirements are clearly defined and fixed.
- The V-Shaped model should be chosen when ample technical resources are available with needed technical expertise.
- High confidence of customer is required for choosing the V-Shaped model approach. Since, no prototypes are produced, there is a very high risk involved in meeting customer expectations.

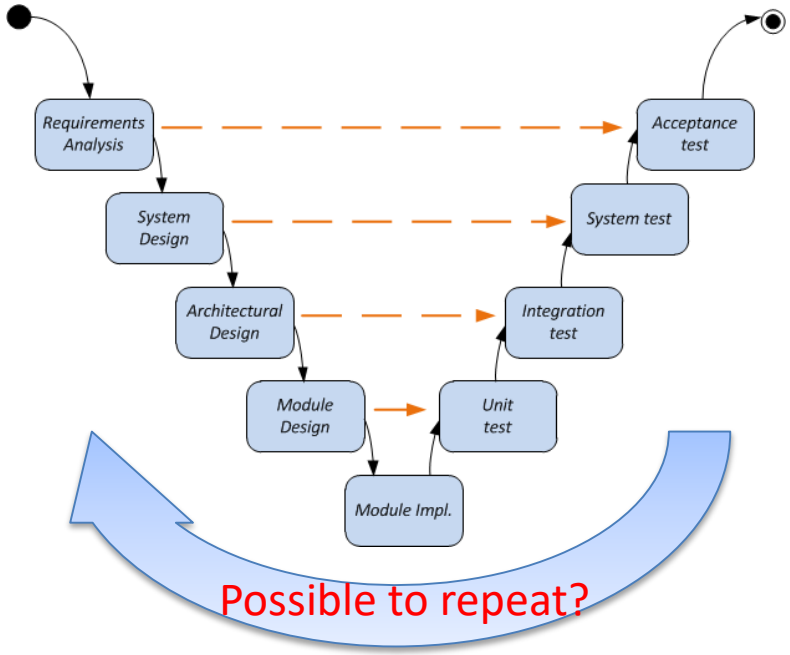
http://istqbexamcertification.com/what-is-v-model-advantages-disadvantages-and-when-to-use-it/

Discussion

- What is the difference?



Improves quality!



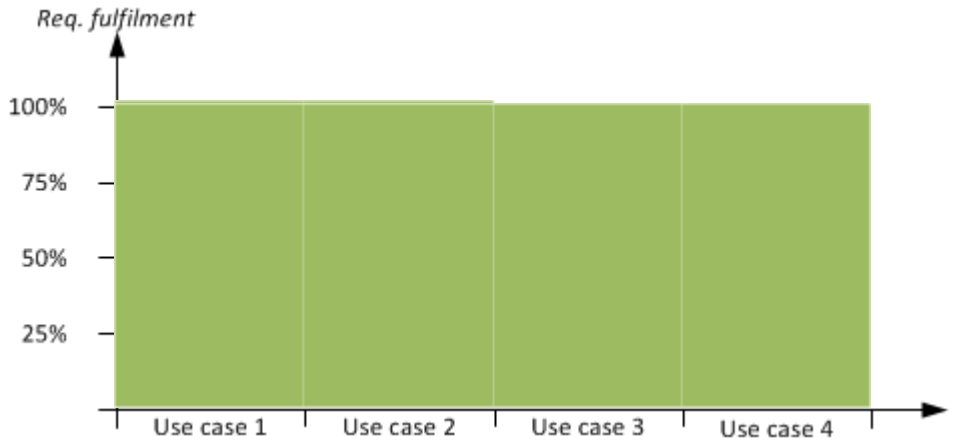
Iterative and incremental development processes

- *Iterative* refers to the repetitive nature of the process
  - An *iteration* is a single repetition of the same sub-process.
  - The sub-process result is a partial working system of *production-quality*

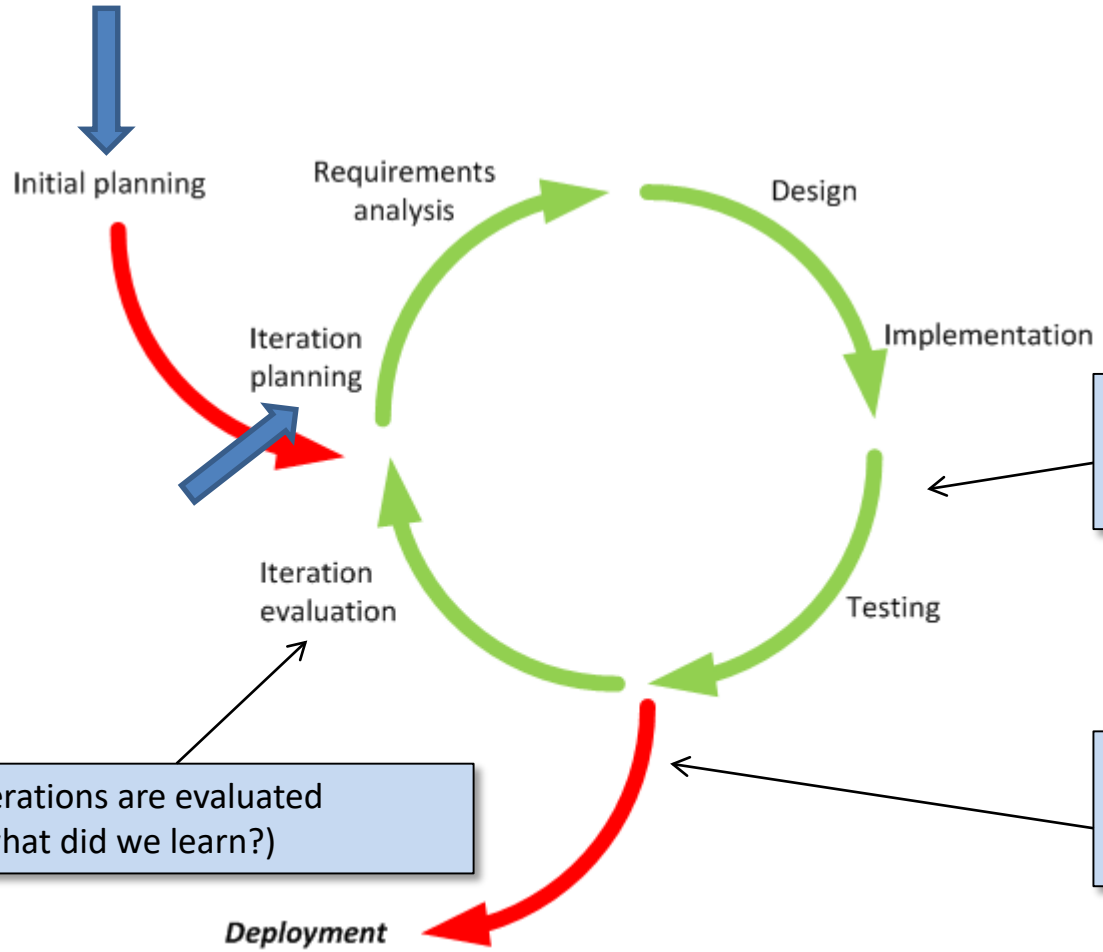
- *Incremental* refers to the *continued expansion* of system capabilities.

Iterative vs. *incremental*

- Iterative *and* incremental



Iterations

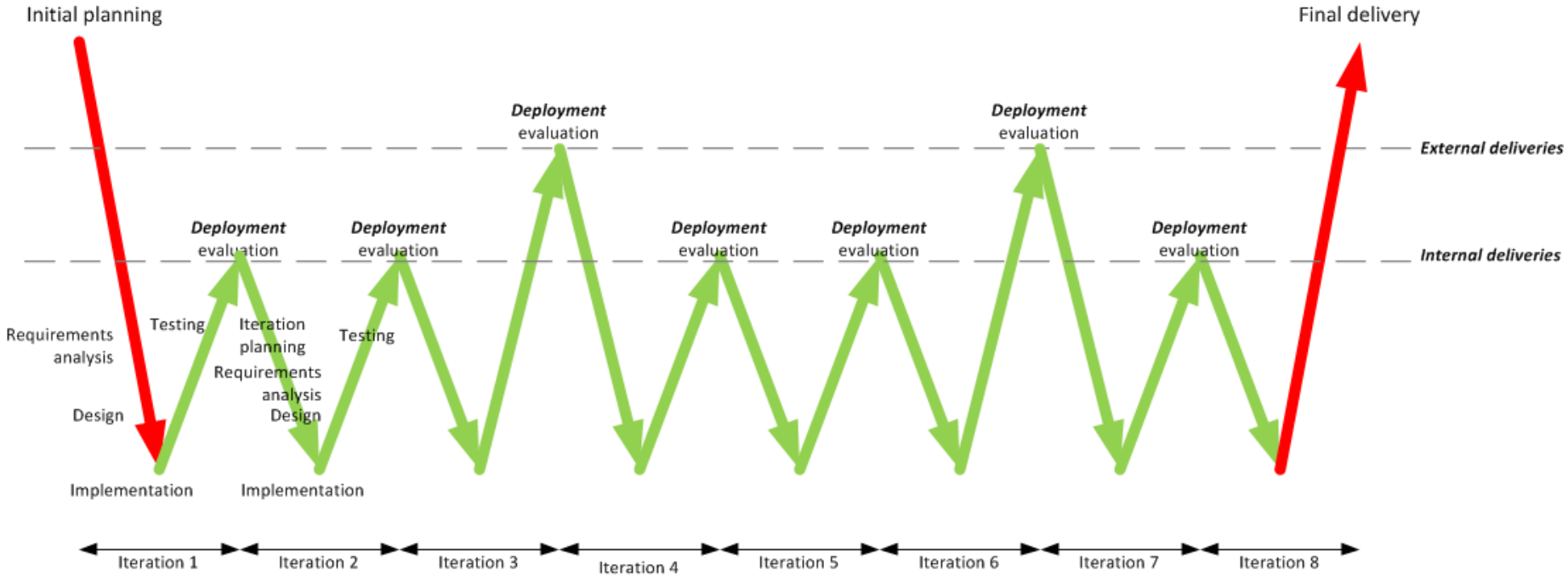


Iterations are *short* and *timeboxed* – reduce requirements, do not extend deadline

Each iteration produces an internal or external *production-grade system*

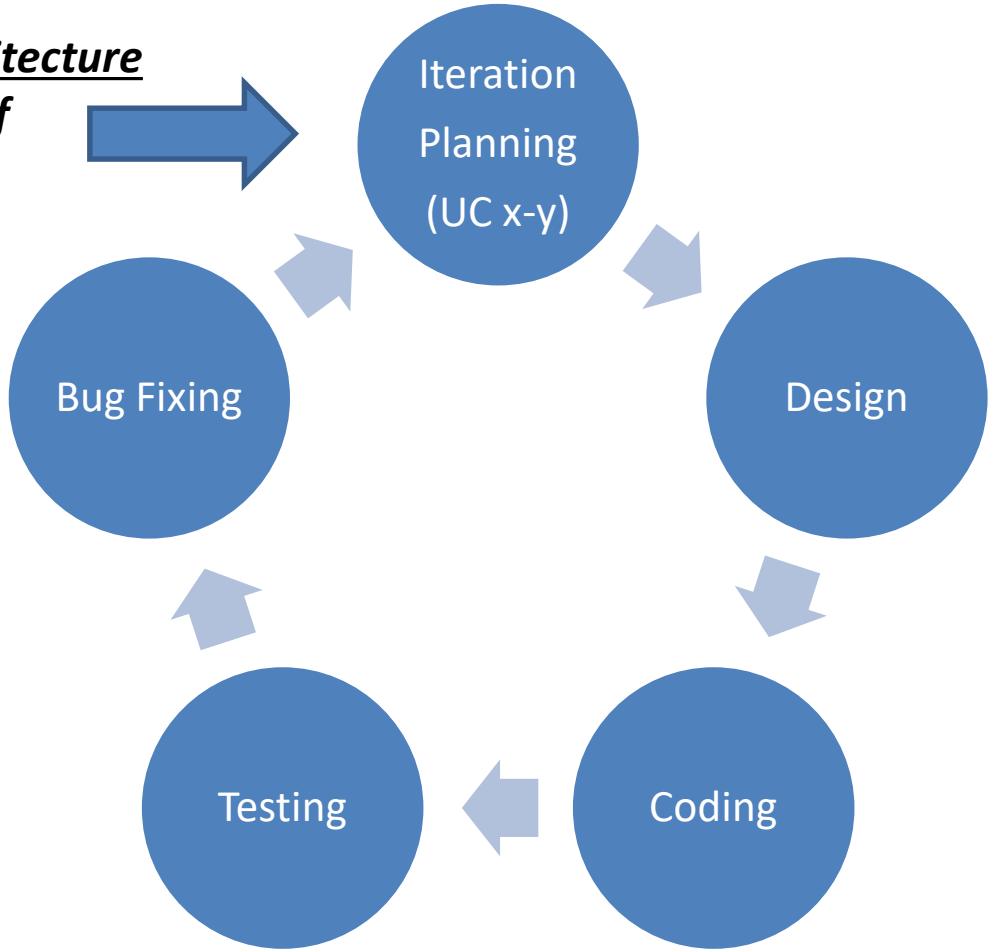
Iterations are evaluated (what did we learn?)

Iterations – another view



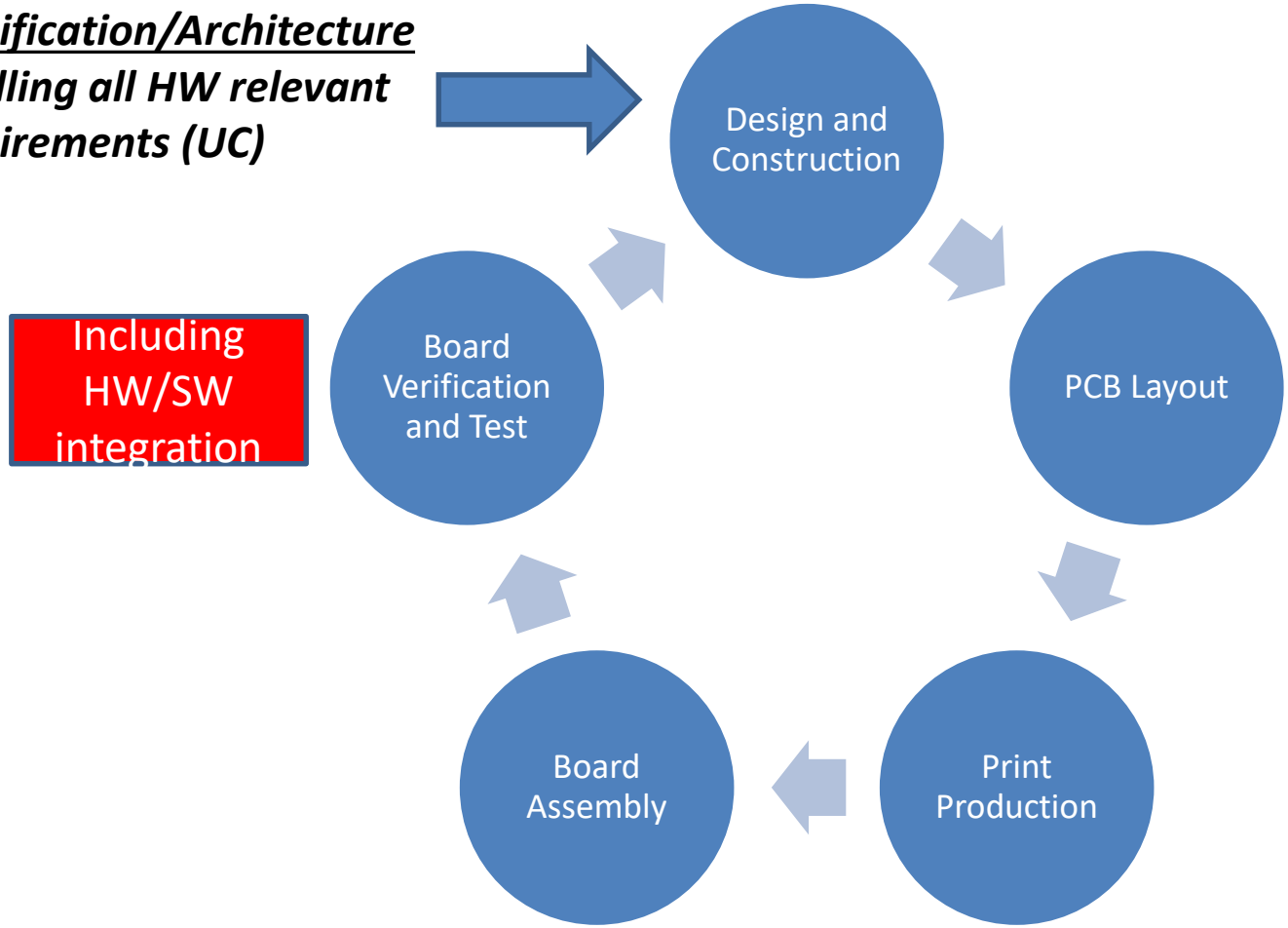
Typical SW Iterations

Specification/Architecture
Selected number of Use Cases (UC)

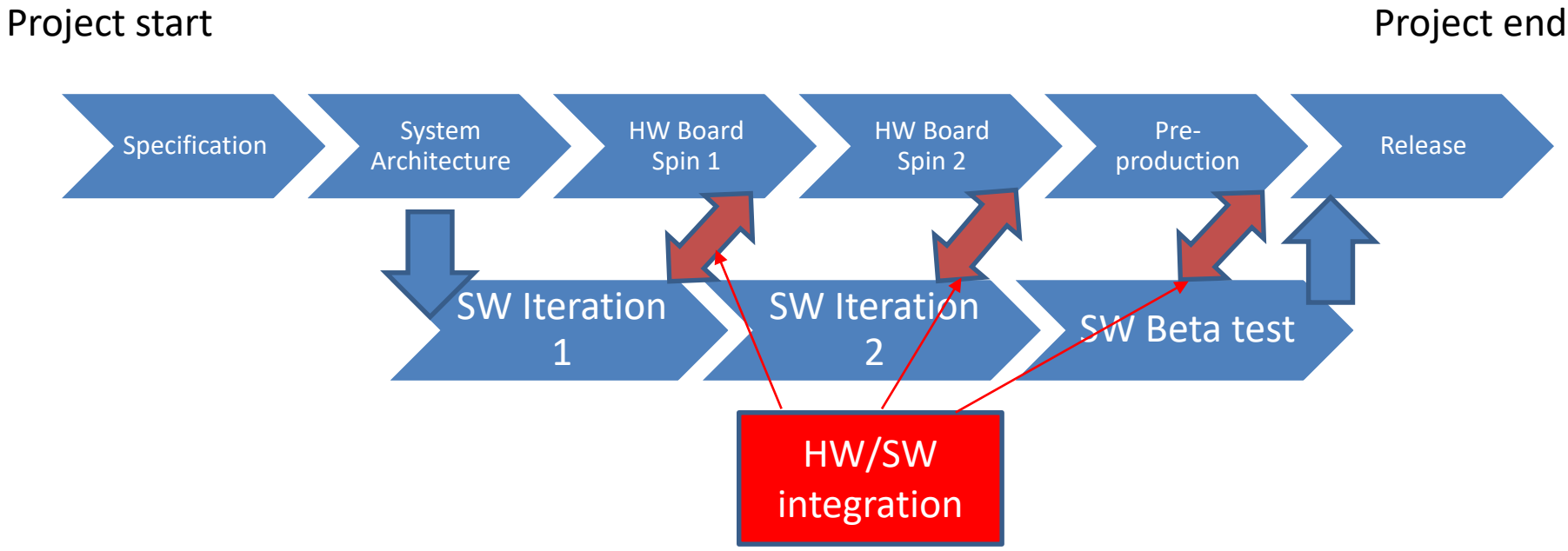


Typical HW Board Spins (Iterations)

Specification/Architecture
Fulfilling all HW relevant requirements (UC)

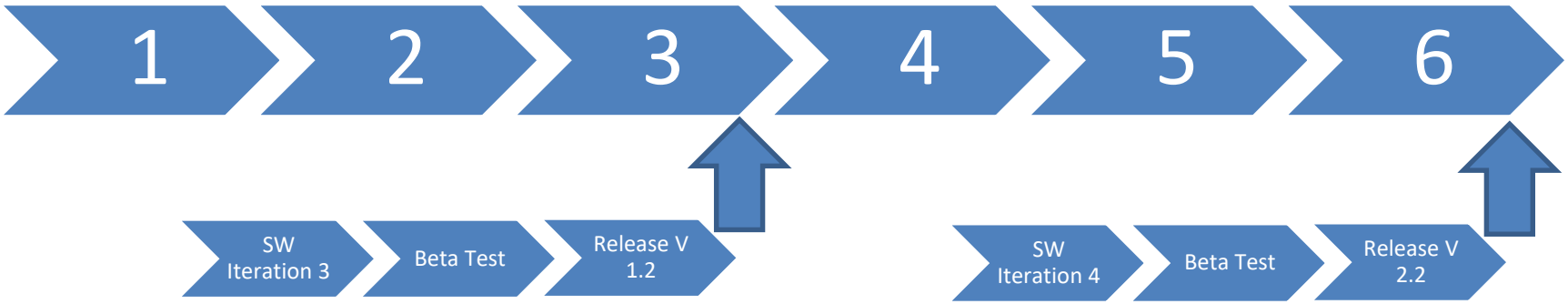


Embedded (HW/SW) Development Overall Project Plan



Embedded (SW) Development Product Life-time

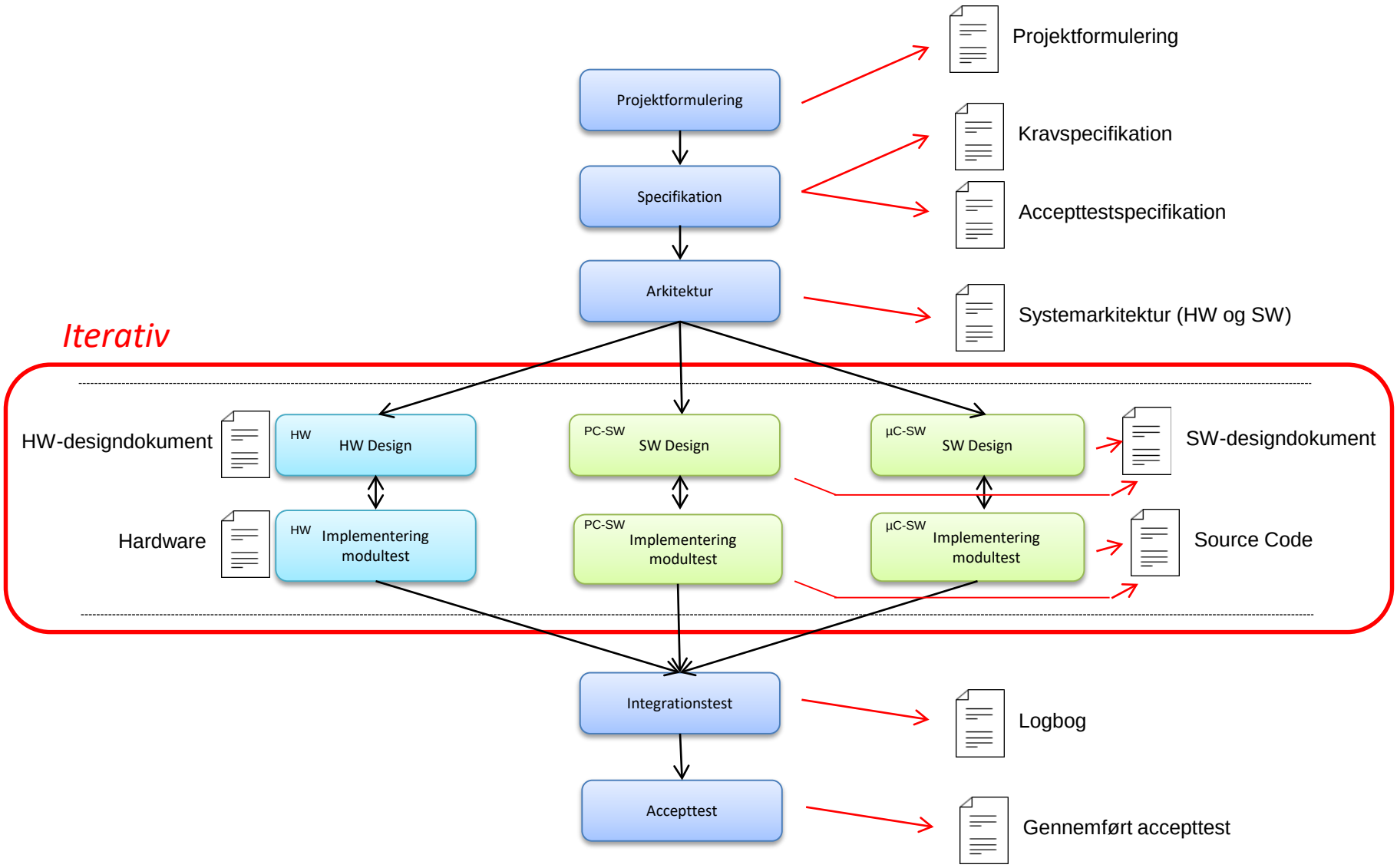
Product life (months)



Semesterprojektmodellen

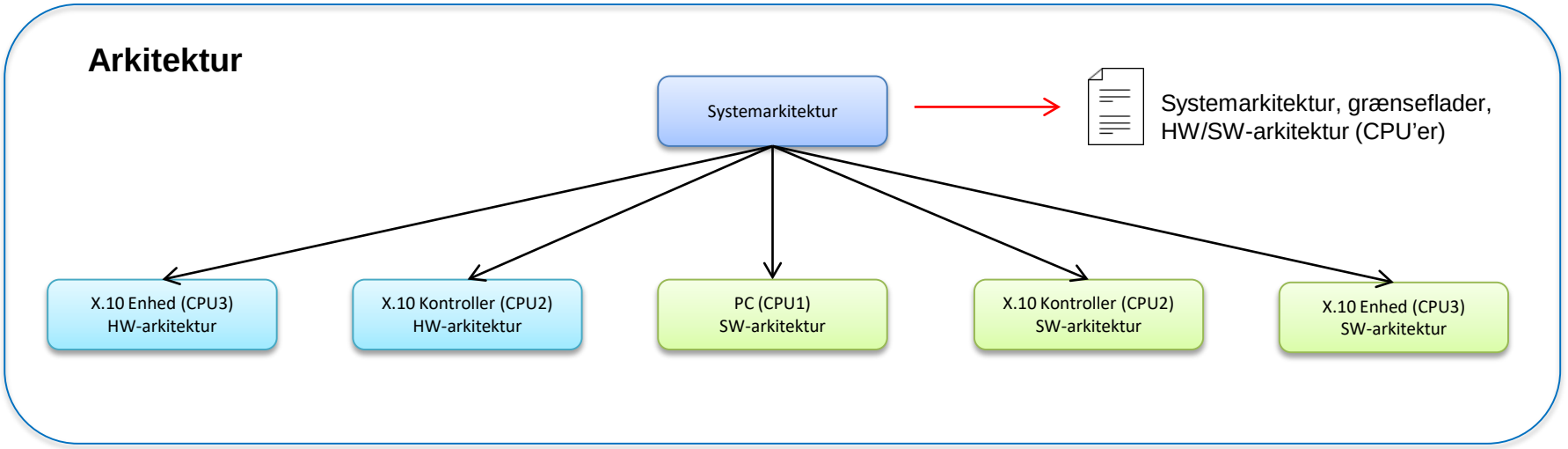
- This is the process you are going to use in your semester project
- A *use case*-driven, ”middleweight” *semi-iterative* development process
- Accounts for both *hardware* and *software* development
  - Here the essential architecture needs to be fixed early in the project

Semesterprojektmodellen



Analyse og Design

- Fastlæggelse af systemarkitekturen



Refleksion

- Læs s. 4 – 10 i “Vejledning til udviklingsprocessen for projekt 2” og især arkitektur s. 9 - 10
- Sammenlign semesterprojektmodellen og vandfaldsmodel?
- Hvilke elementer fra V-modellen er også med?
- Hvordan er der indbygget kvalitet i semesterprojektet modellen?
- Hvad målet med arkitekturfasen?
- Hvad skal beskrivelsen af systemarkitekturen indeholde?

Example: Rational Unified Process

- Rational Unified Process (RUP)
  - Developed by *Rational Software (*now IBM*)*
  - Developed from the *Unified Process*
    Jacobson, Booch, Rumbaugh

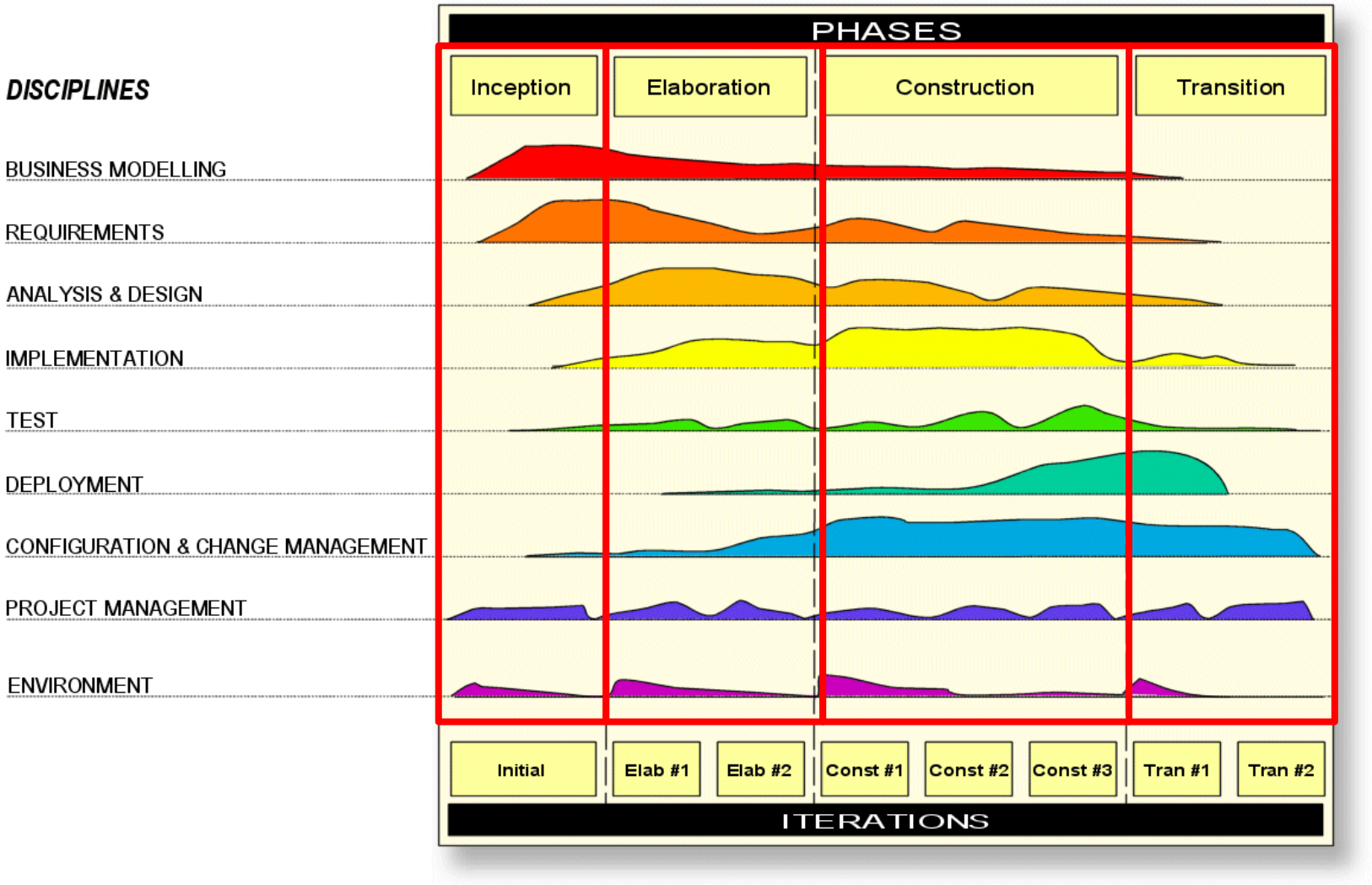
- Actually a process *framework* from which processes can be *instantiated*

RUP: Phases and disciplines

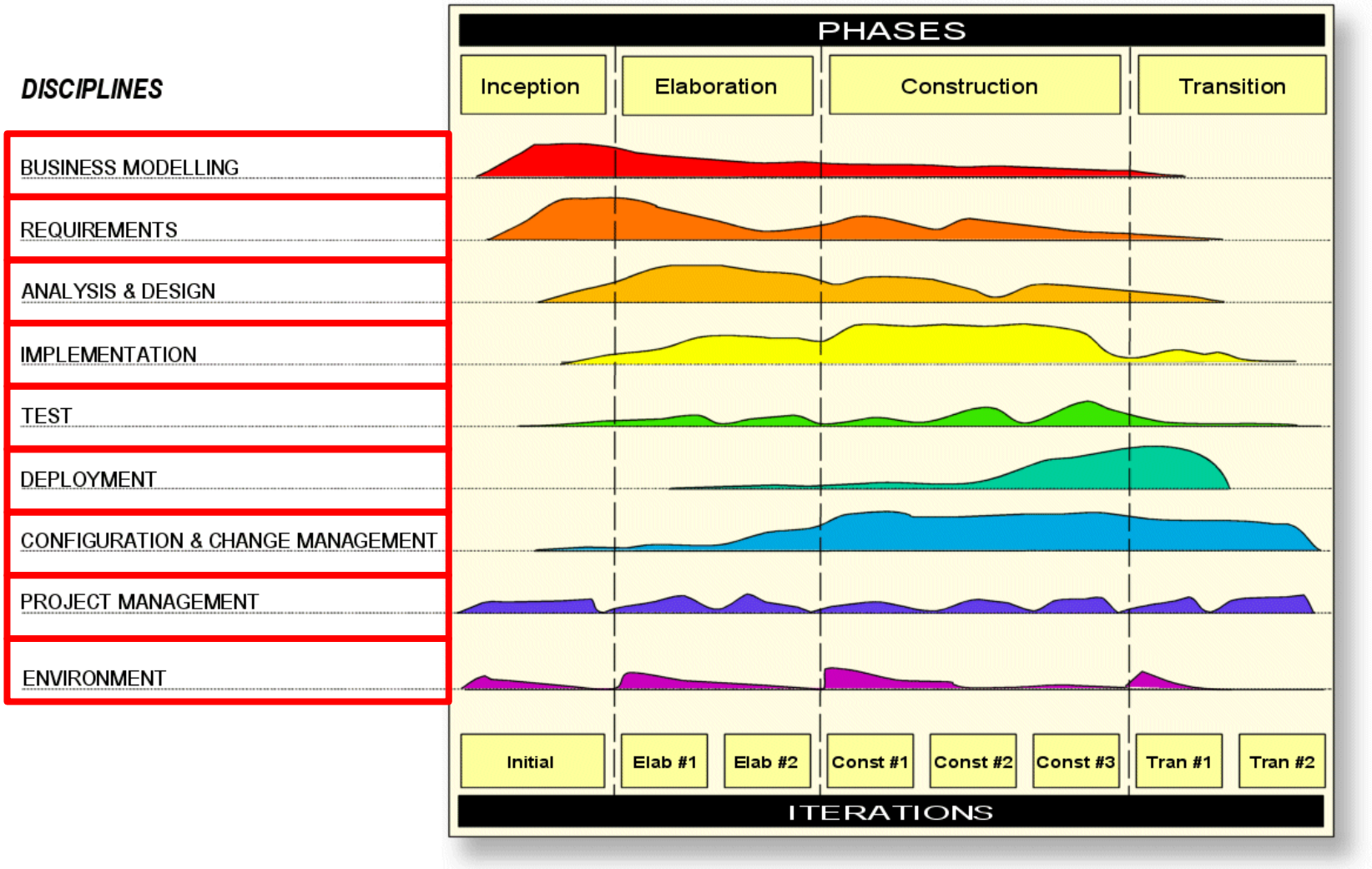
- RUP defines 4 (sequential) *phases*
  - Inception — Understand *what* to build
  - Elaboration — Understand *how* to build it
  - Construction — Build it
  - Transition — Use/sell/ship it

- RUP defines 9 (concurrent) *disciplines*

RUP: Phases


PHASES
DISCIPLINES
Inception
Elaboration
Construction
Transition
BUSINESS MODELLING
REQUIREMENTS
ANALYSIS & DESIGN
IMPLEMENTATION
TEST
DEPLOYMENT
CONFIGURATION & CHANGE MANAGEMENT
PROJECT MANAGEMENT
ENVIRONMENT
Initial
Elab #1
Elab #2
Const #1
Const #2
Const #3
Tran #1
Tran #2
ITERATIONS

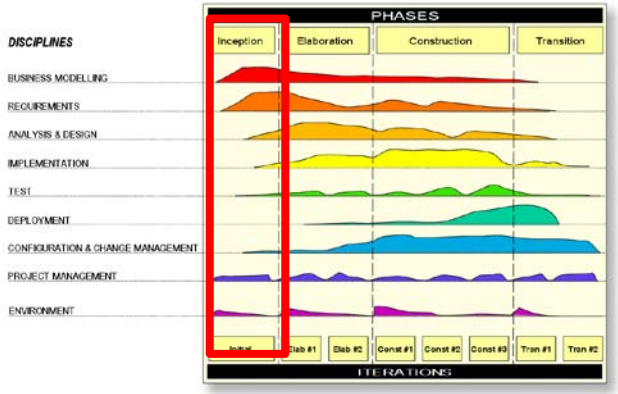
RUP: Disciplines



RUP: Inception phase

- Life-cycle objectives of the project are stated, so that the needs of every stakeholder are considered.
- Scope and boundary conditions, acceptance criteria and some requirements are established.

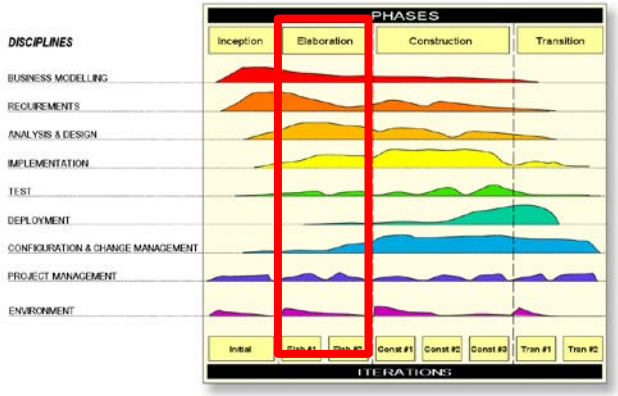
- Activities:
  - Problem description
  - Product limitations
  - Requirements definition (use cases)
  - Acceptance test plan
  - Risk analysis
  - High-level architectural considerations



RUP: Elaboration phase

- Determine risks, stability of vision of what the product is to become
- Determine stability of architecture and expenditure of resources

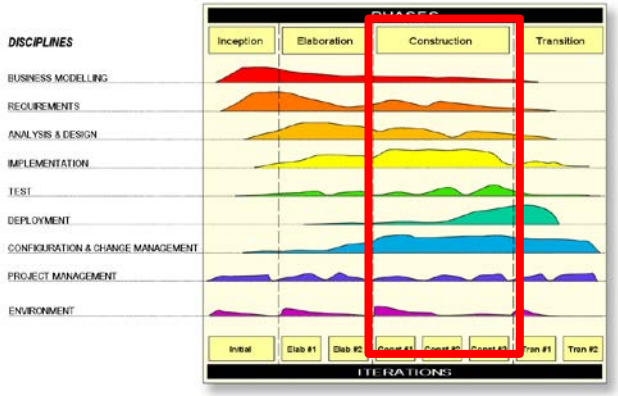
- Activities:
  - Requirements elaboration, prioritization and allocation to Construction iterations
  - Risk mitigation
  - Domain analysis and design
  - HW/SW architectural considerations
  - Interface specifications



RUP: Construction phase

- Manufacture produce
- Manage risk, resources, etc. to optimize cost, schedule and quality
- Detailed iteration planning and tracking

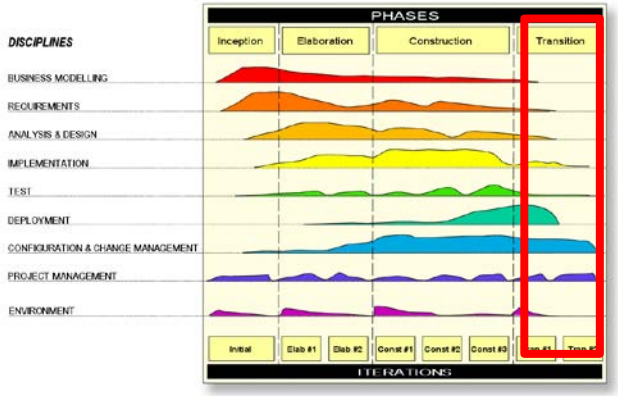
- Activities:
  - Construction, unit/integration/system tests
  - Per-iteration working system prototype
  - Continuous focus on risk mitigation, planning etc.



RUP: Transition phase

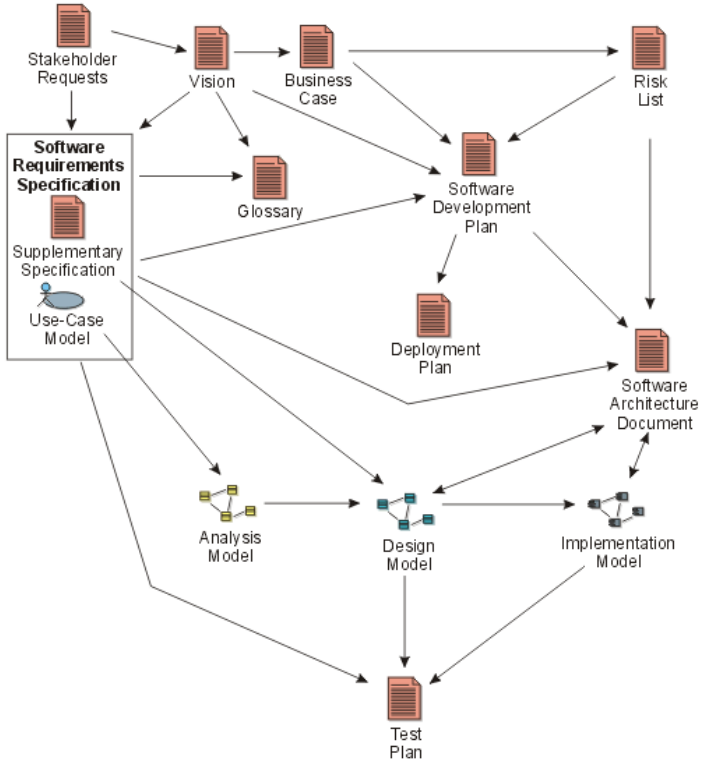
- Marketing, packaging, installing, configuring
- Supporting user community, making corrections, updates, etc.

- Activities:
  - Acceptance test (alpha/beta test if planned)
  - Corrections, configuration control
  - User education
  - Production tests and documentation
  - Marketing
  - Market implementation



RUP: Artifacts

- RUP defines a lot of *artifacts* associated to the disciplines
  - *Documents*
  - *Models* (or *model elements*) with associated *reports*



- Is RUP a ”light” or ”heavy” process?

What's the problem?

Disciplined execution
kills innovation

Innovation requires
"no discipline"

Disciplined execution ⟷ *Continuous innovation*

Plans, deadlines, documents

Open environment, no "management"

Agile methods

- Agile: *adræt, rapfodet, fleksibel, agil*
- Claiming that the traditional processes are fundamentally flawed and that many iterative processes are heavy, *agile* processes emerged in the 1990's.

- Defined in the *agile manifesto* in 2001 by 17 signatories.

- The agile "bottom line": Faith in *people* rather than *paper*

- ***Mostly used for pure software development***

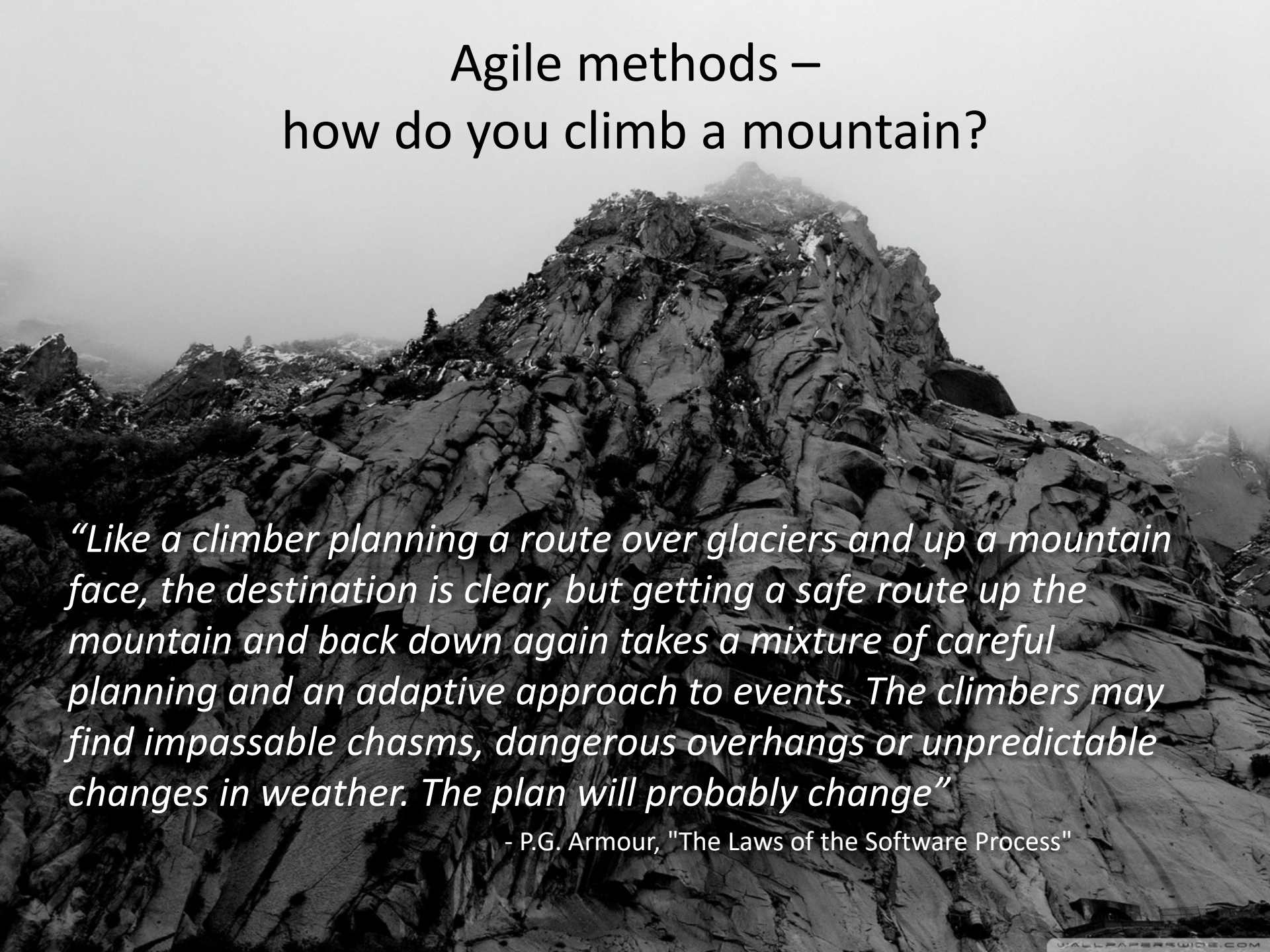
Agile methods: The agile manifesto

- **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.

The danger of Agile methods

Agile methods – how do you climb a mountain?



“Like a climber planning a route over glaciers and up a mountain face, the destination is clear, but getting a safe route up the mountain and back down again takes a mixture of careful planning and an adaptive approach to events. The climbers may find impassable chasms, dangerous overhangs or unpredictable changes in weather. The plan will probably change”

- P.G. Armour, "The Laws of the Software Process"

Agile methods: Some of the 12 agile principles

- Satisfy the customer through early and continuous delivery of valuable software
- Welcome changing requirements, even late in development
- Business people and developers must work together daily throughout the project
- Working software is the primary measure of progress
- Simplicity – the art of maximizing the amount of work not done – is essential

Example: eXtreme Programming (XP) (Software)

- Developed by Beck, Cunningham and others
  - First coined in 1996

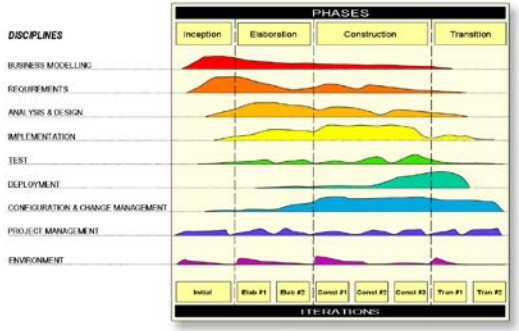
- Some characteristics:
  - Focus on *customer satisfaction*
  - Permanent on-site *customer presence*
  - Short development cycles
  - Incremental planning
  - Continuous feedback
  - Evolutionary design
  - Pair programming

Discussion

- Imagine you are the *developer* in a team. What would make you feel more comfortable – RUP or an agile process? Why?

- Now imagine you are the *customer*. What would make you feel more comfortable – RUP or an agile process? Why?

- Do you think it is *easier* to work in an agile project than in a RUP project?



The state of things

- The days of the standard process are over…
- The most commonly seen process today is tailored to meet the business needs
- Usually the process will be highly iterative with selected agile elements (team, iterations, customer involvment, etc.)
- Usually, it will be managed by Scrum (which we'll learn about later)