Software Project Management – IS212

Software Development Processes

Software Development Processes

Objectives

On completing this module, you will be able to:

- Summarise the key traditional and agile software development processes
- Identify the pros and cons of each

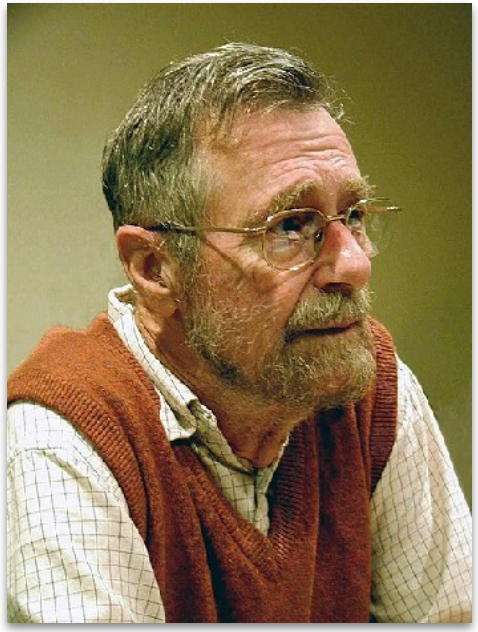
Traditional

- Waterfall
- RUP

Agile

- Extreme Programming
- Kanban
- Scrum

1960/70s – Software Crisis



The major cause of the software crisis is that the machines have become several orders of magnitude more powerful!

To put it quite bluntly: as long as there were no machines, programming was no problem at all; when we had a few weak computers, programming became a mild problem, and now we have gigantic computers, programming has become an equally gigantic problem.

– Edsger Dijkstra

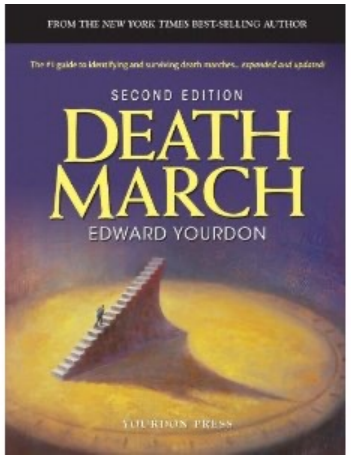
low quality ***difficult to maintain***

over budget

Computing power was outpacing the ability of software developers to effectively use it

inefficient

often didn't meet requirements



Software requirements rarely 'frozen' before development

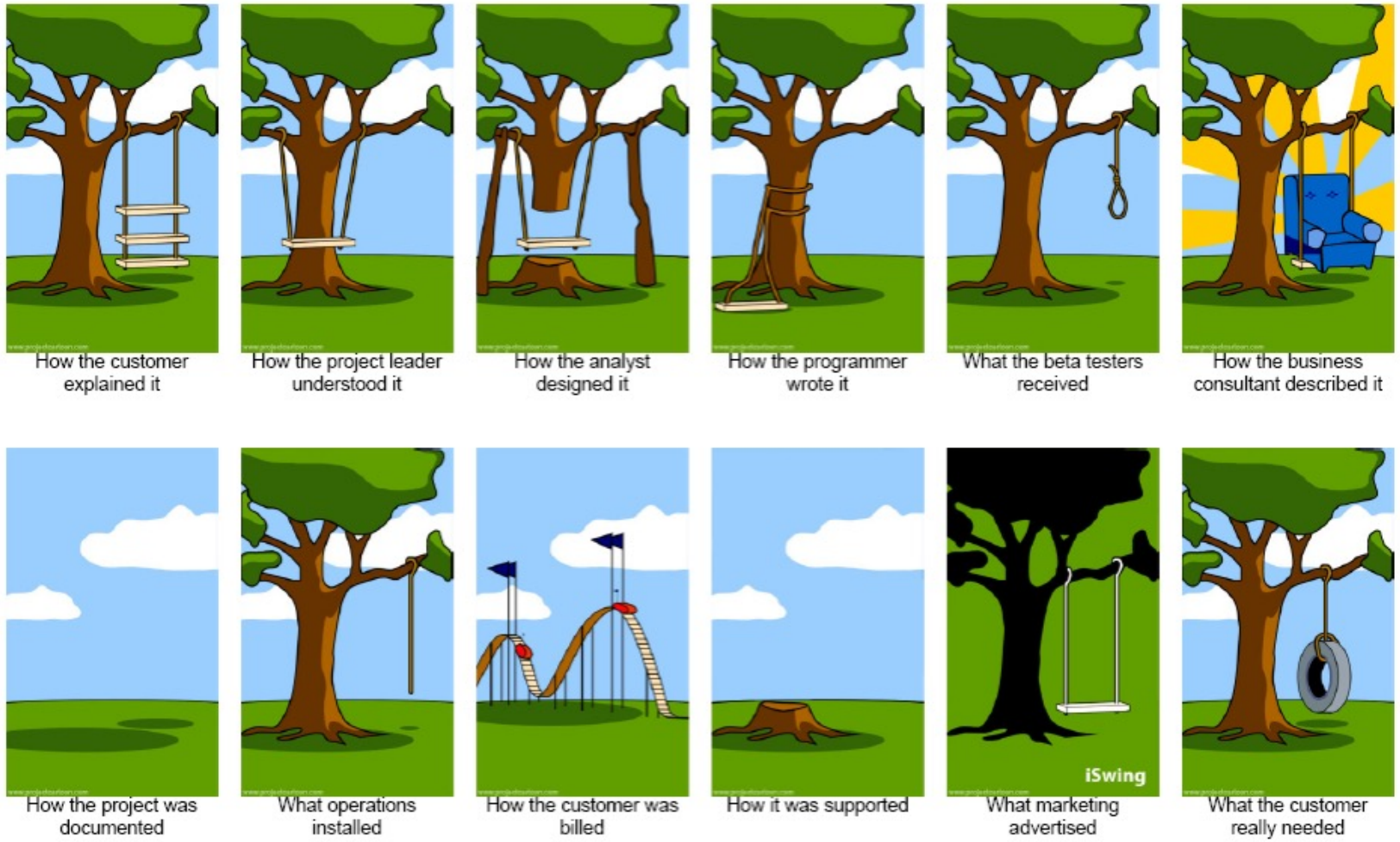
Software is subject to (frequent) change

Engineering **software** vs. engineering, say, a **bridge**

Software and Work In Progress (WIP) are "invisible"

Maintenance & technical debt are major challenges

A classic comic…



Software Development Processes

Traditional

- Waterfall
- RUP

Agile

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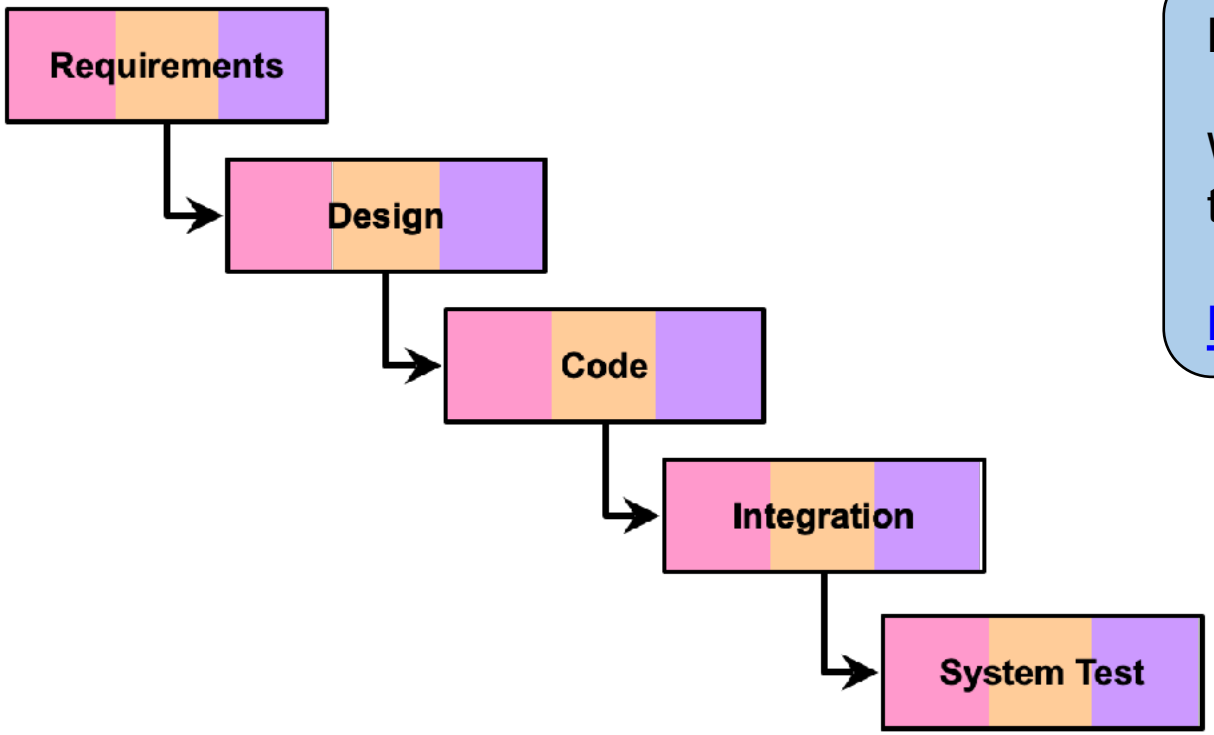
Waterfall

Idea: break software development into linear, sequential phases



Padlet Exercise

What are some **pros** and **cons** of this process?

https://padlet.com/XXX/YYY

Waterfall – Discussion

- Don't knock it! Waterfall often works well –
  - If the project is small and simple
  - If requirements are contractually agreed before development (e.g. when outsourcing to vendors)
  - If customers are not heavily involved during development
  - If the level of formality is high (e.g. safety critical systems; need to "freeze" requirements document)
- But waterfall's inflexible partitioning of phases makes it less appropriate for projects that involve a lot of uncertainty
- Harder to respond to changing customer requirements
- Difficult to experiment, which may stifle the team's innovation
- Testing at the end of the process invites failure *(when it's too late!)*

Waterfall – Discussion

Many software projects are iterative

Software Development Methods

Traditional

Agile

iterative traditional method —>

- Waterfall
- RUP

- Extreme Programming
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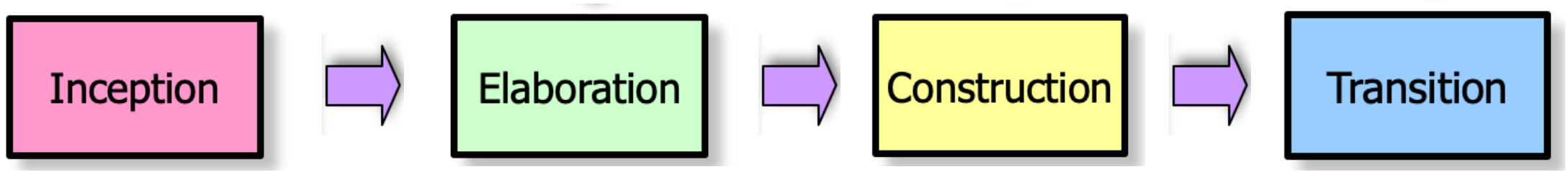
Rational Unified Process (RUP)

- The Rational Unified Process (RUP) consists of four phases
  - i.e. key 'milestones' for the project, similar to waterfall



understand ***what*** product to build

understand ***how*** to build the product

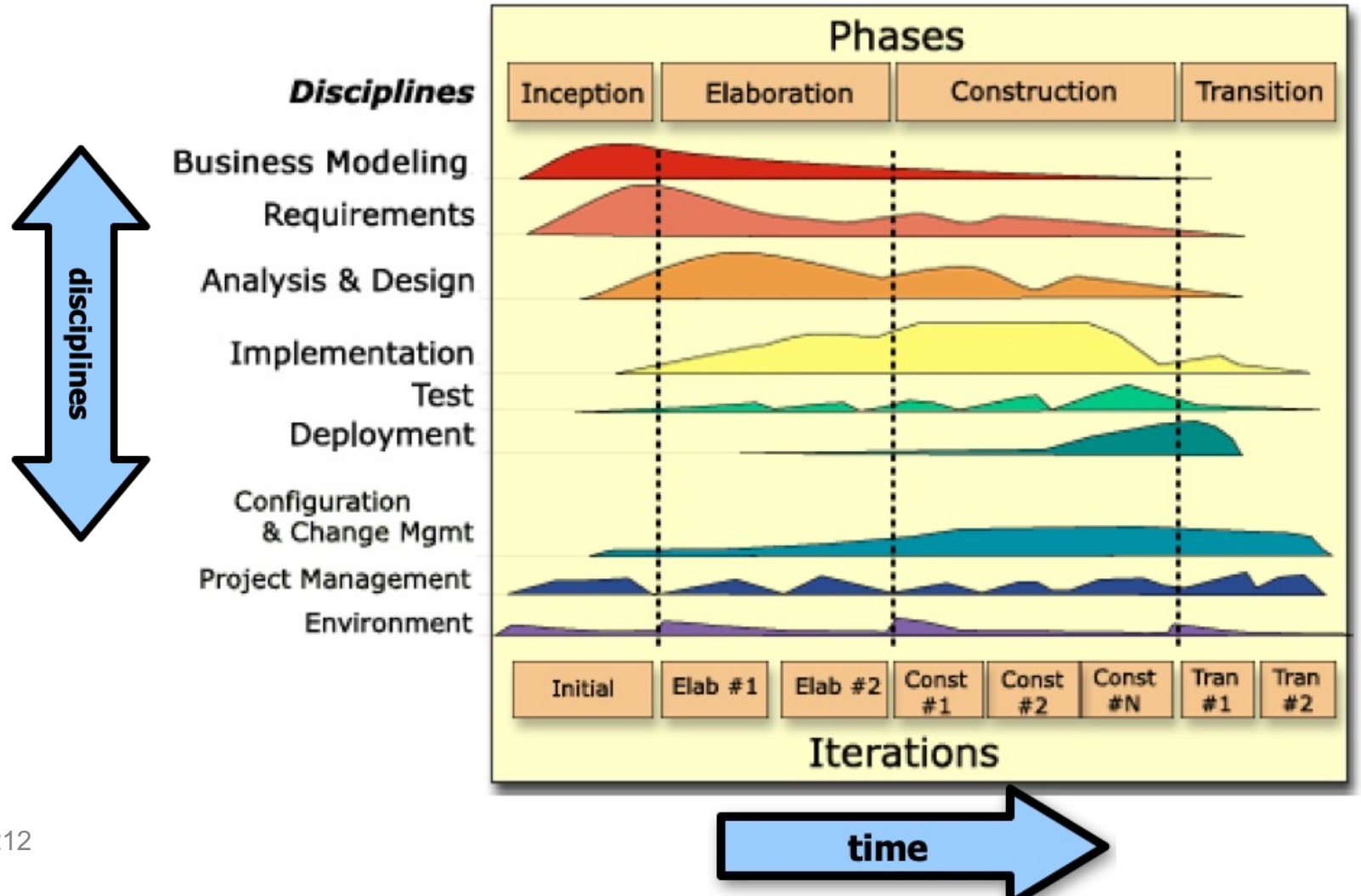
actually ***build*** the product

validate and ***deploy*** the product

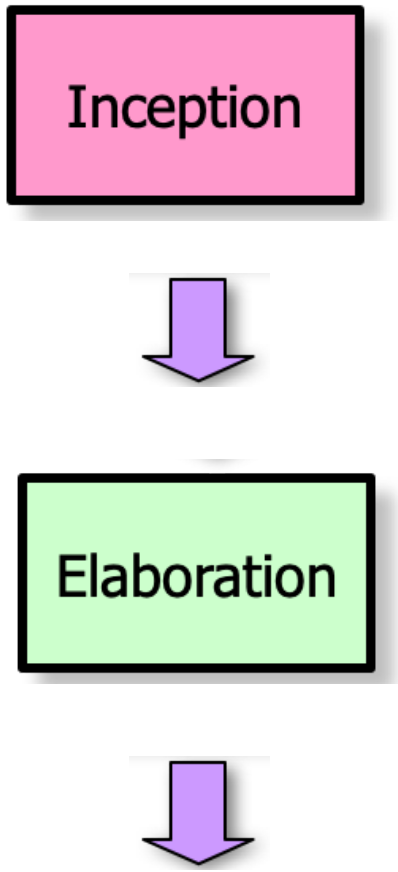
- Various 'engineering disciplines' then cut across all four phases
  - *e.g. business modelling, requirements, implementation, testing*

Rational Unified Process (RUP)

- Unlike waterfall – it explicitly encourages iterations within phases



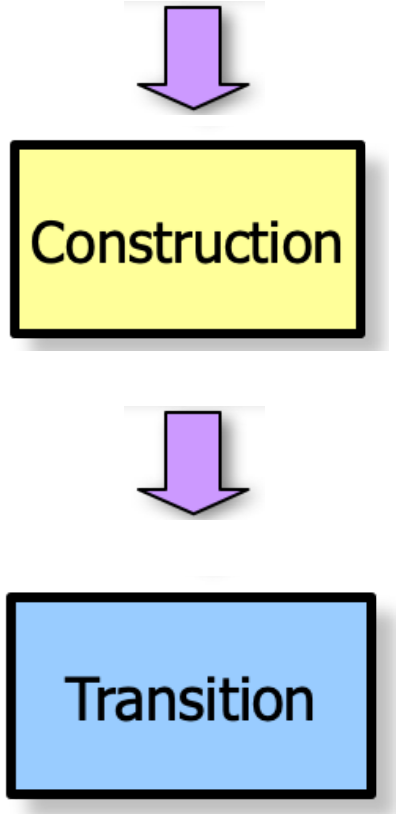
RUP phases – cross-discipline outcomes



- Vision document / business case
- Develop high-level requirements / use cases
- Stakeholder concurrence; identify risks

- “80% complete” use case models
- Prototypes for exploring key risks
- Development plan; architecture description

RUP phases – cross-discipline outcomes

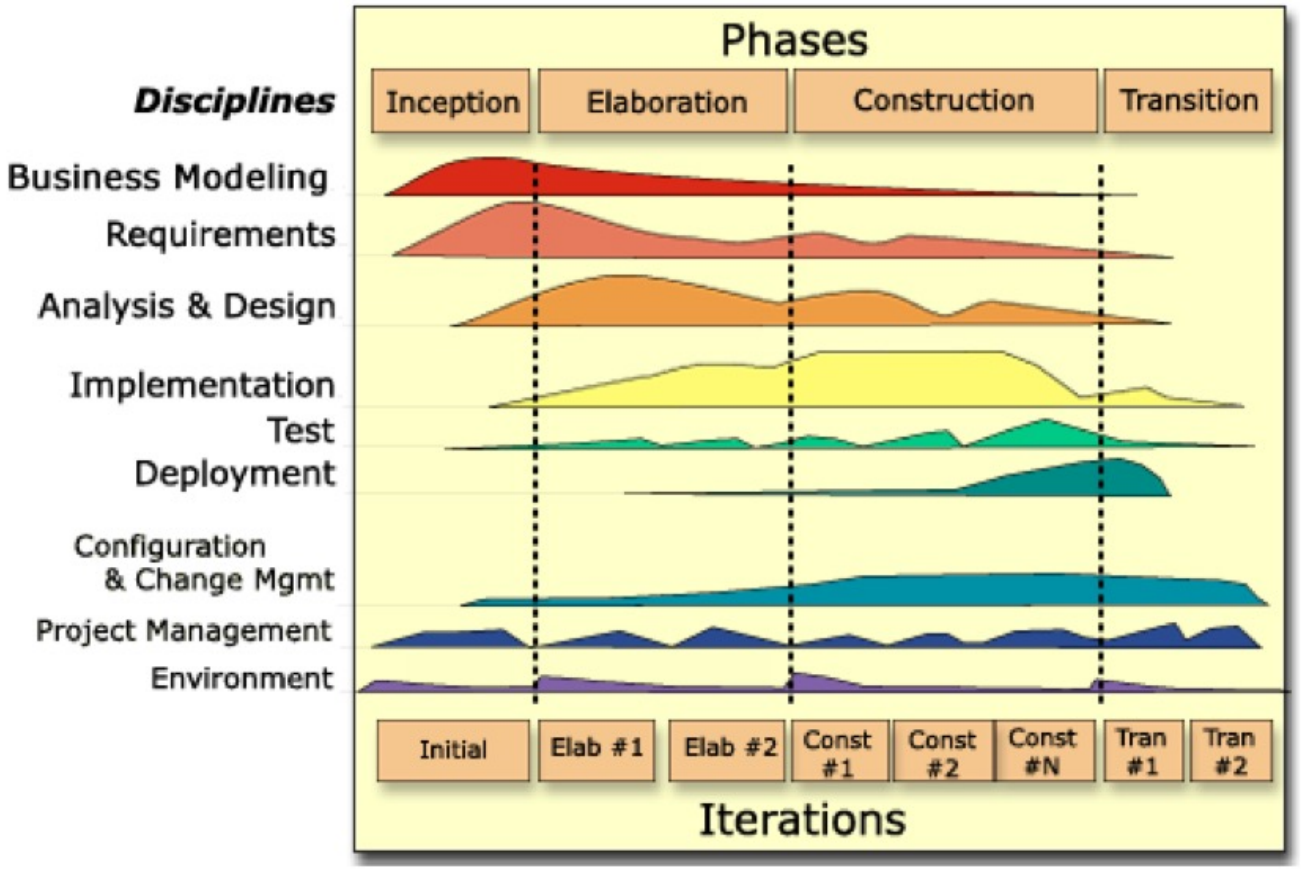


- Demonstrable prototypes
- Working software components
- Bulk of coding

- Training end users / maintainers
- Evaluate against ‘Inception’ requirements
- ‘Post-mortem’ project analysis

Discussion: what's your assessment of the RUP method?

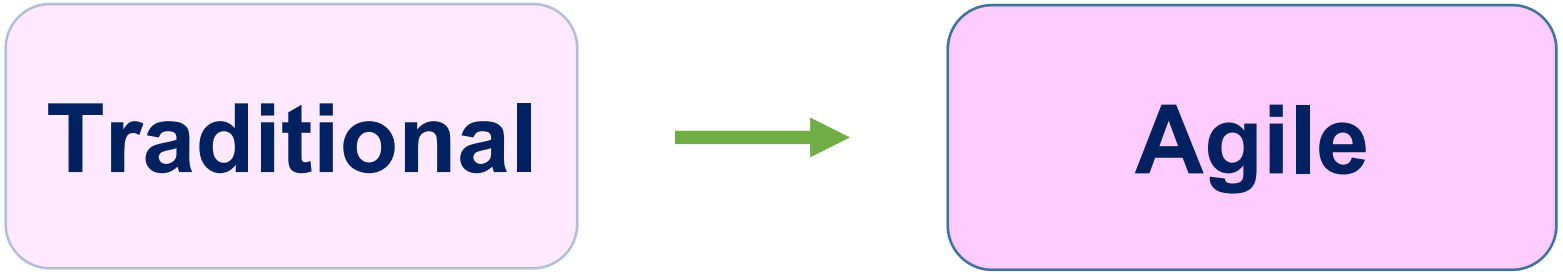
– *advantages over waterfall?*
– *any possible drawbacks?*



RUP – Discussion

- Support for iteration a big advantage over classic waterfall
- Forces integration to happen throughout the software development
- Testing can happen as early as 'inception' – not left until the end!
- RUP is quite complex; a lot of process 'overhead'
  - Less flexible than agile / scrum methods *(see later!)*

Software Development Methods



- Waterfall
- RUP

- Extreme Programming
- Kanban
- Scrum

Agile – Motivation

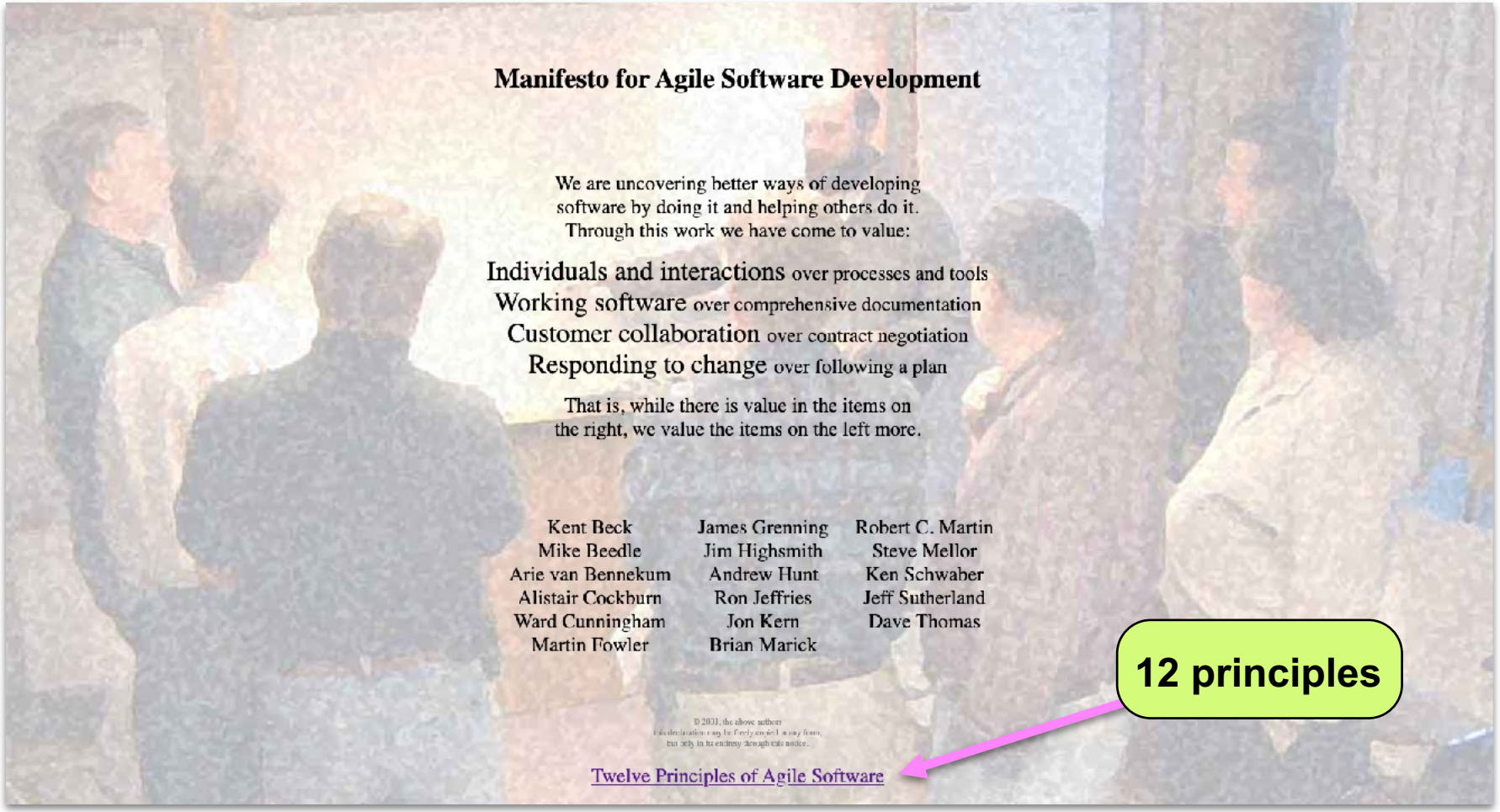
- Traditional heavyweight methods can be overly regulated, planned, and micromanaged, i.e. bureaucratic

- In reaction, a number of lightweight methods started evolving that collectively became known as "agile", emphasising:

Individuals and interactions	**over**	processes and tools
Working software		comprehensive documentation
Customer collaboration		contract negotiation
Responding to change		following a plan

"while there is value in the items on the right, we value the items on the left more"

Agile Manifesto (2001)



https://agilemanifesto.org/

Agile Principles *(re-organised; Meyer '14)*

Agile principles

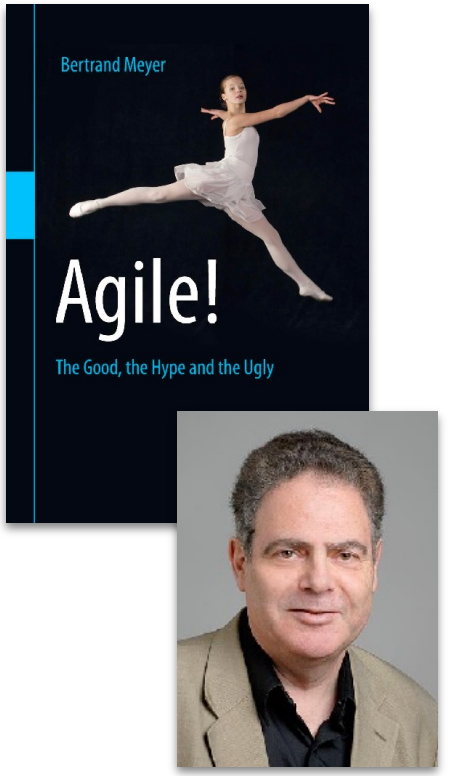
Organizational

1 Put the customer at the center.
2 Let the team self-organize.
3 Work at a sustainable pace.
4 Develop minimal software:
  4.1 Produce minimal functionality.
  4.2 Produce only the product requested.
  4.3 Develop only code and tests.
5 Accept change.

Technical

6 Develop iteratively:
  6.1 Produce frequent working iterations.
  6.2 Freeze requirements during iterations.
7 Treat tests as a key resource:
  7.1 Do not start any new development until all tests pass.
  7.2 Test first.
8 Express requirements through scenarios.

key insight



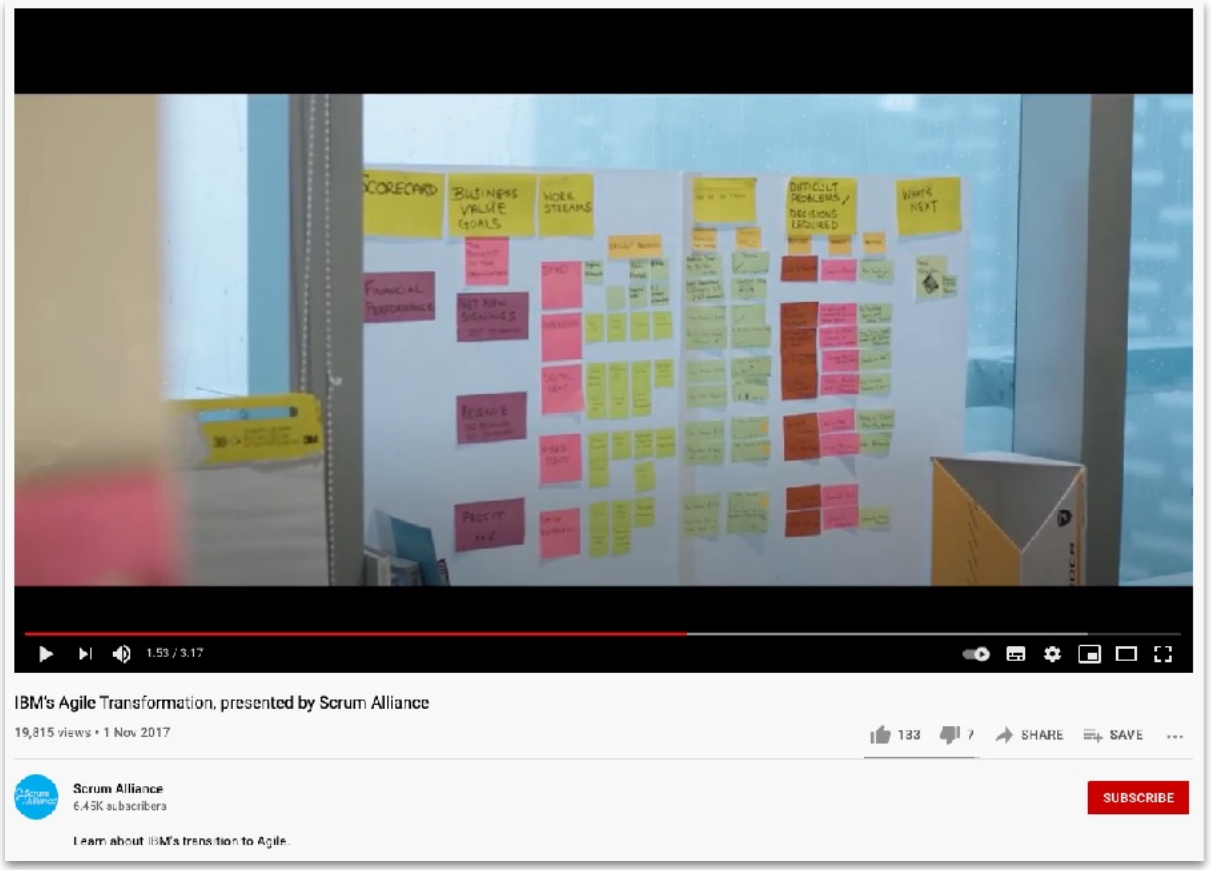
Bertrand Meyer

Agile – IBM Video

Padlet Exercise

What agile tools and methods do you see IBM using?

https://padlet.com/XXX/YYY



https://www.youtube.com/watch?v=Xu0nxyebc6g

Highly iterative and flexible

Working software delivered frequently

Working software (not "WIP") is the measure of progress

Agile – Key Characteristics

Late changes in requirements – no problem

Close, daily co-operation

Visualise activities and "WIP" to manage team's capacity

Software Development Methods

Traditional

- Waterfall
- RUP

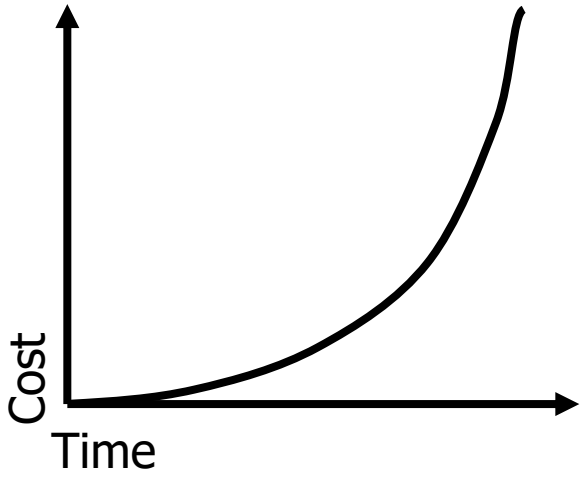
Agile

- Extreme Programming
- Kanban
- Scrum

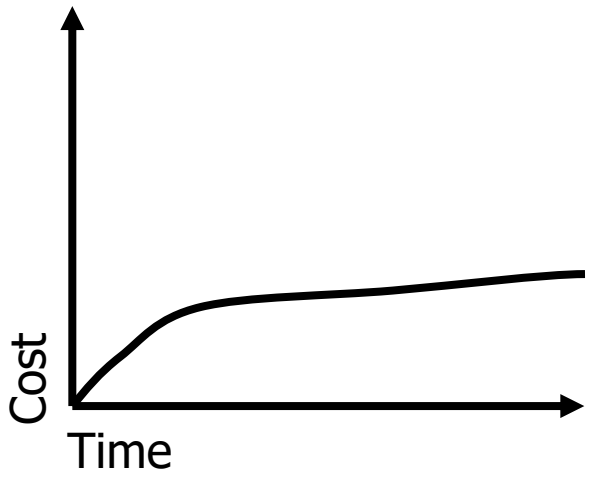
Extreme Programming (XP)

- Premise of extreme programming (XP)

Traditional
- upfront design
- code late
- release when ‘done’



XP
- code early
- release early
- continuous design



Extreme Programming (XP)

- Focus – customer satisfaction

- XP Principles –

Coding is the core activity	Code doesn't only deliver the solution – use it to explore / explain problems too!
LOTS of testing during dev	Design unit tests or software contracts first – *then* code! (aka **Test-Driven Development**)
Developers and customers communicate directly	Programmer must understand the business requirements to design a technical solution
Regular refactoring	Overall system design is considered during regular **refactoring** exercises

12 XP Practices

Fine-scale feedback

- Pair programming
- Planning game
- Test-Driven Development
- Whole team

Shared understanding

- Coding standard
- Collective code ownership
- Simple design
- System metaphor

Continuous process

- Continuous integration
- Design refactoring
- Small releases

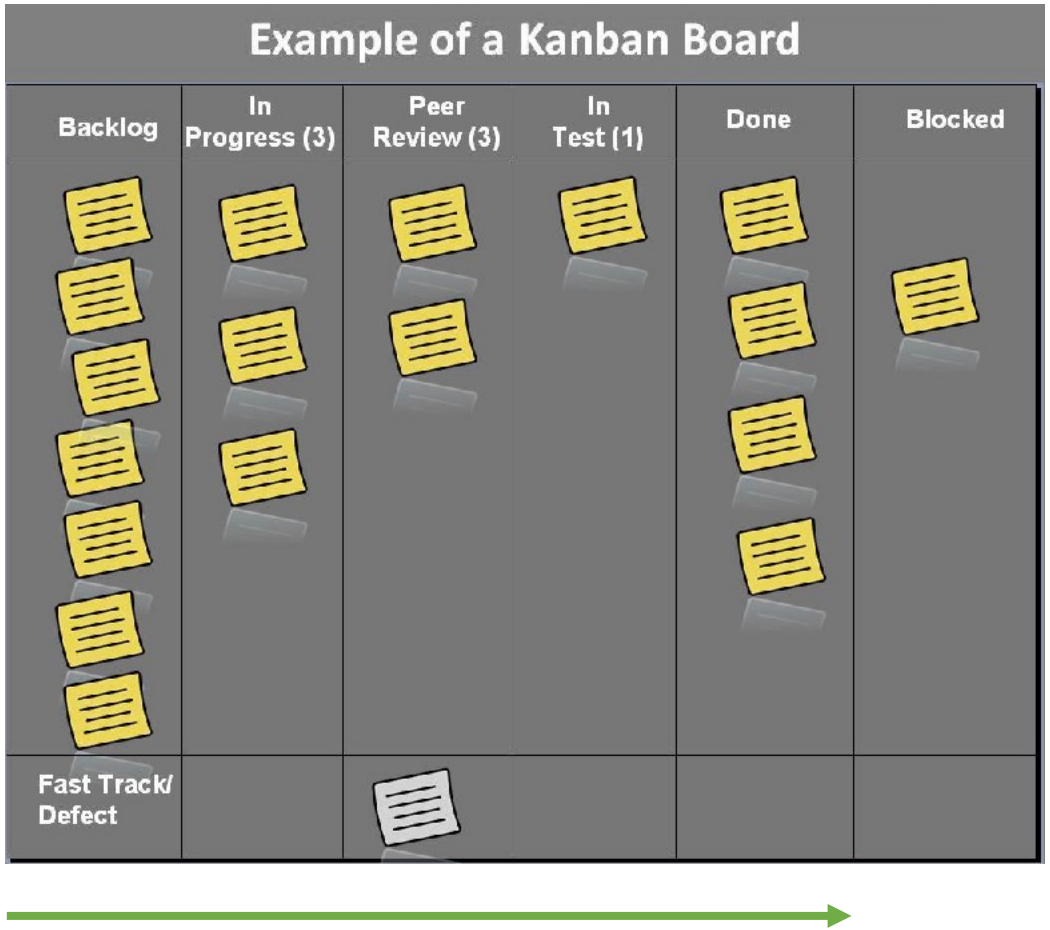
Programmer welfare

- Sustainable pace

XP – Impact

- XP provided a ‘jolt’ that brought attention to agile methods.
- Some see XP as ‘dogmatic’; others see it as a consistent, strong view of how programming should be practiced.
- Many of the individual practices promoted by XP have left their mark on industry, especially that:
  - Projects should integrate code all the time
  - Tests are a key resource, and should be run against code often

Kanban



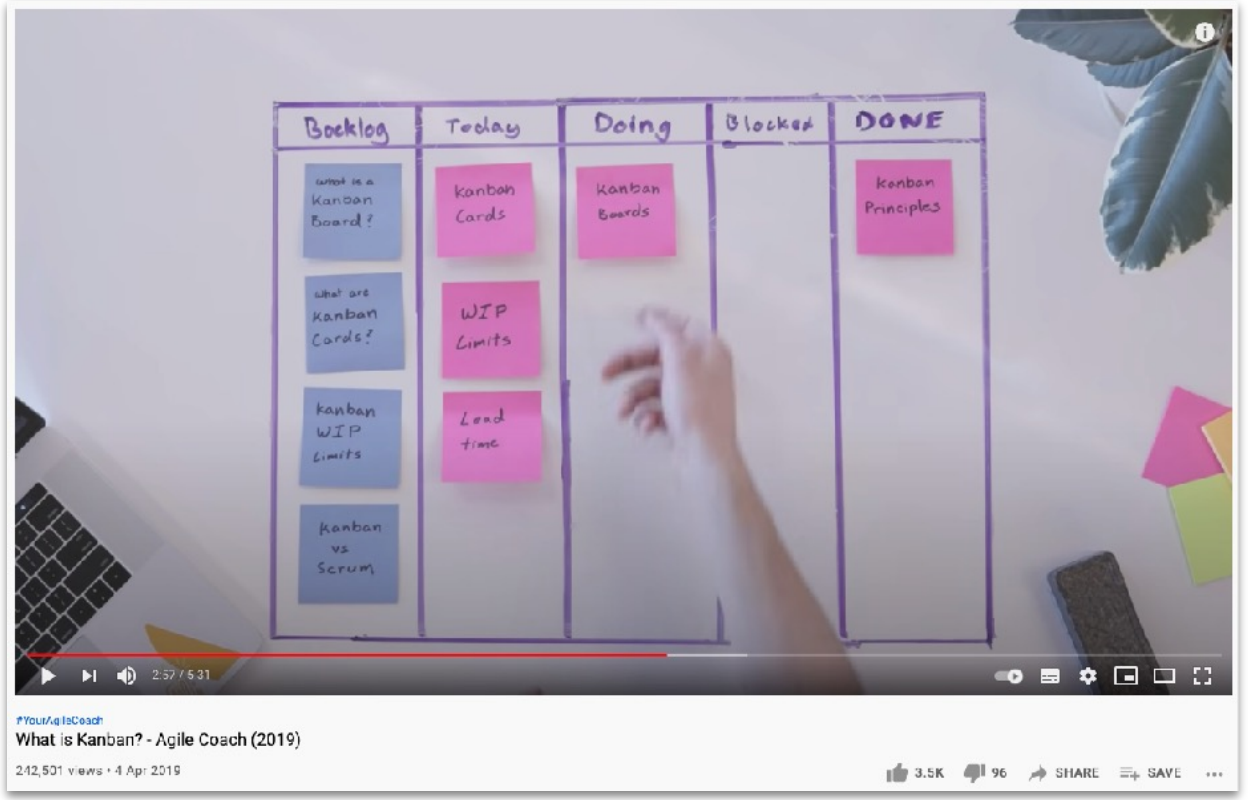
*"**kanban**"*

- Japanese word meaning (roughly) "large visual board"

- *idea: visualising a team's workflow helps identify potential waste / constraints*

- *NB: a single 'kanban board' is used throughout the whole project*

Kanban

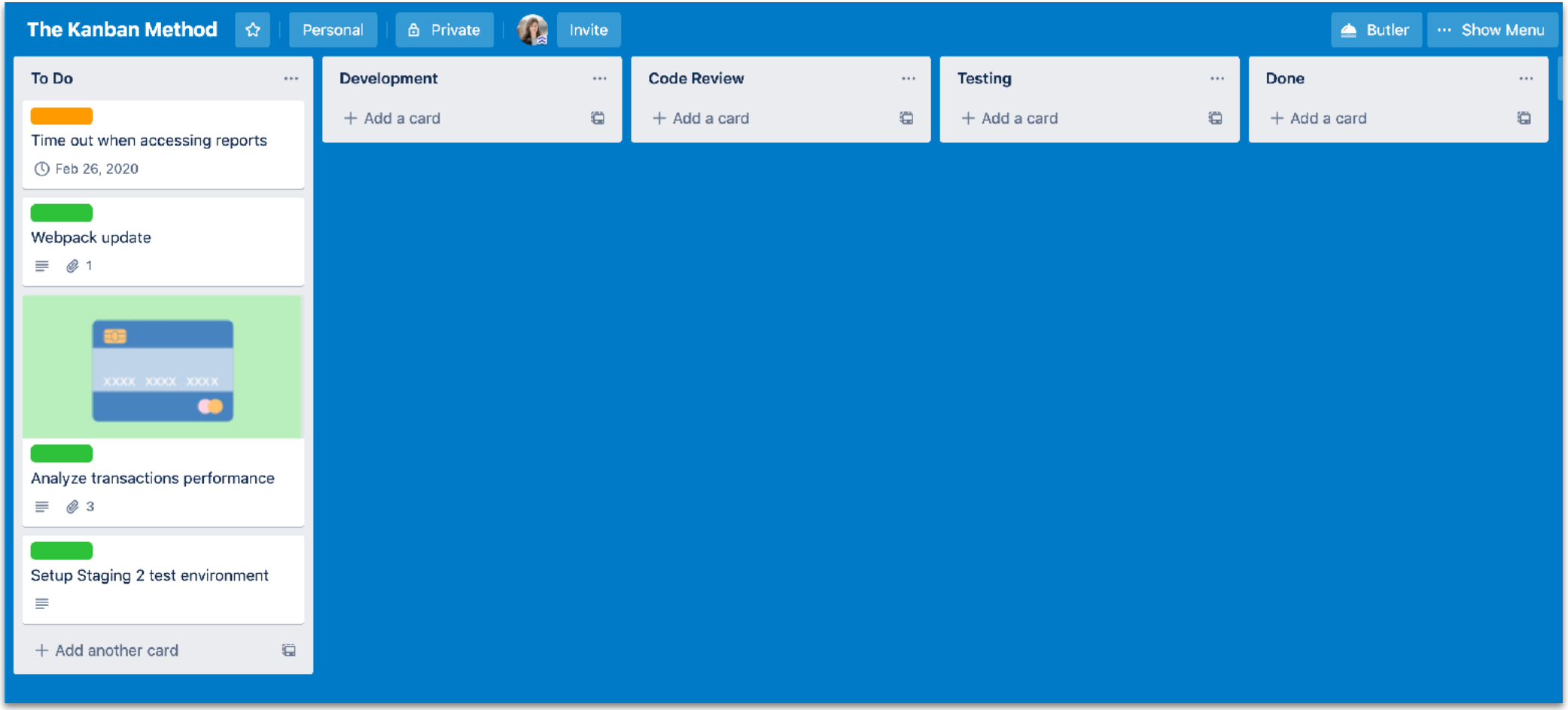


https://www.youtube.com/watch?v=iVaFVa7HYj4&t=116s

Kanban

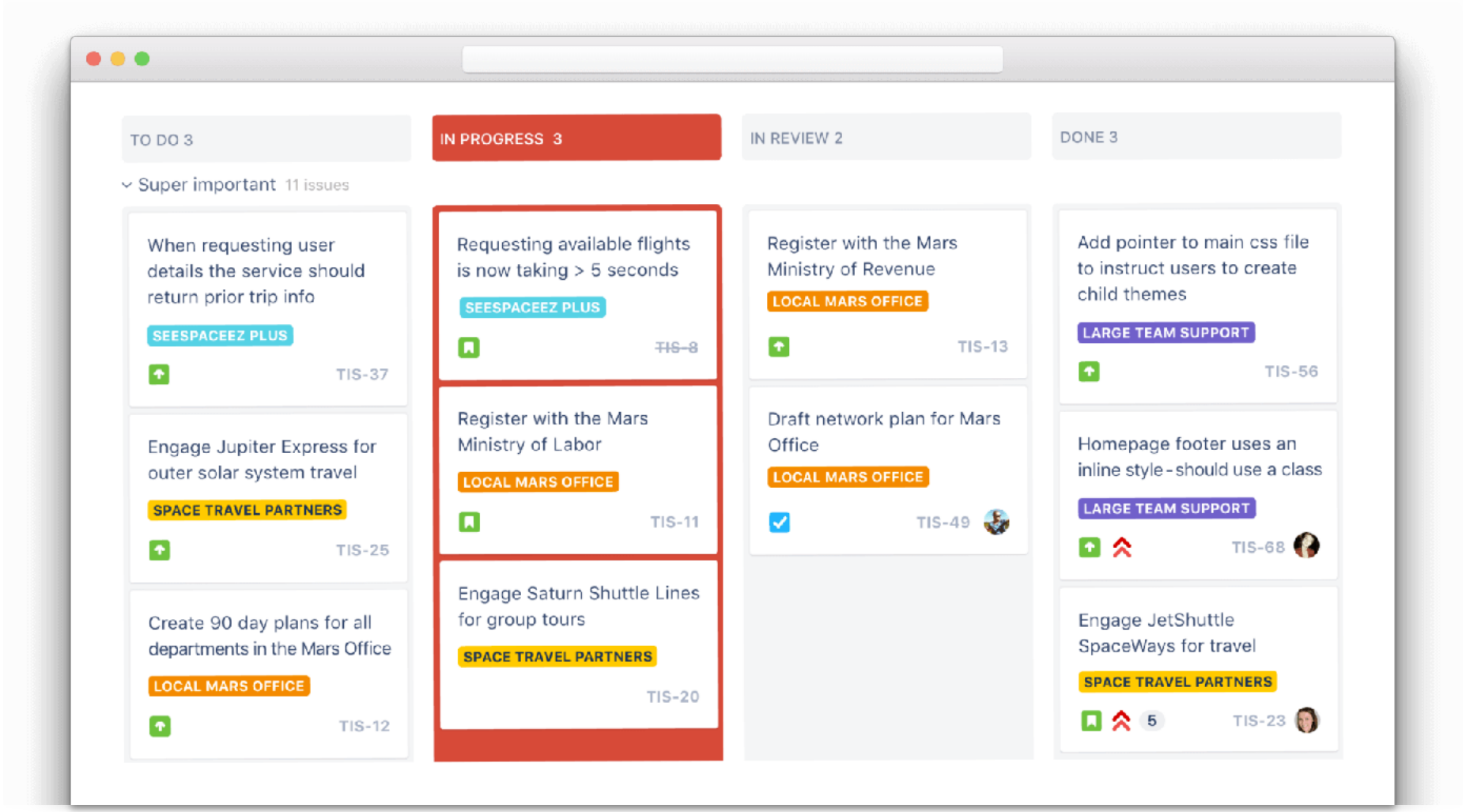
- Work-in-progress (WIP) doesn't deliver value until deployed
- Limiting / minimising WIP makes it easier to identify inefficiencies and constraints in a team's workflow
- Kanban: clearly visualise WIP and match to team's capacity
- Simple, but effective approach to help teams coordinate

Kanban – Virtual Boards



https://trello.com/en

Kanban – Virtual Boards



https://www.atlassian.com/software/jira

Scrum

*"**scrum**"*

- borrowed from rugby (formation of players)

- term introduced to emphasise teamwork

We will follow the **scrum process** for the IS212 project

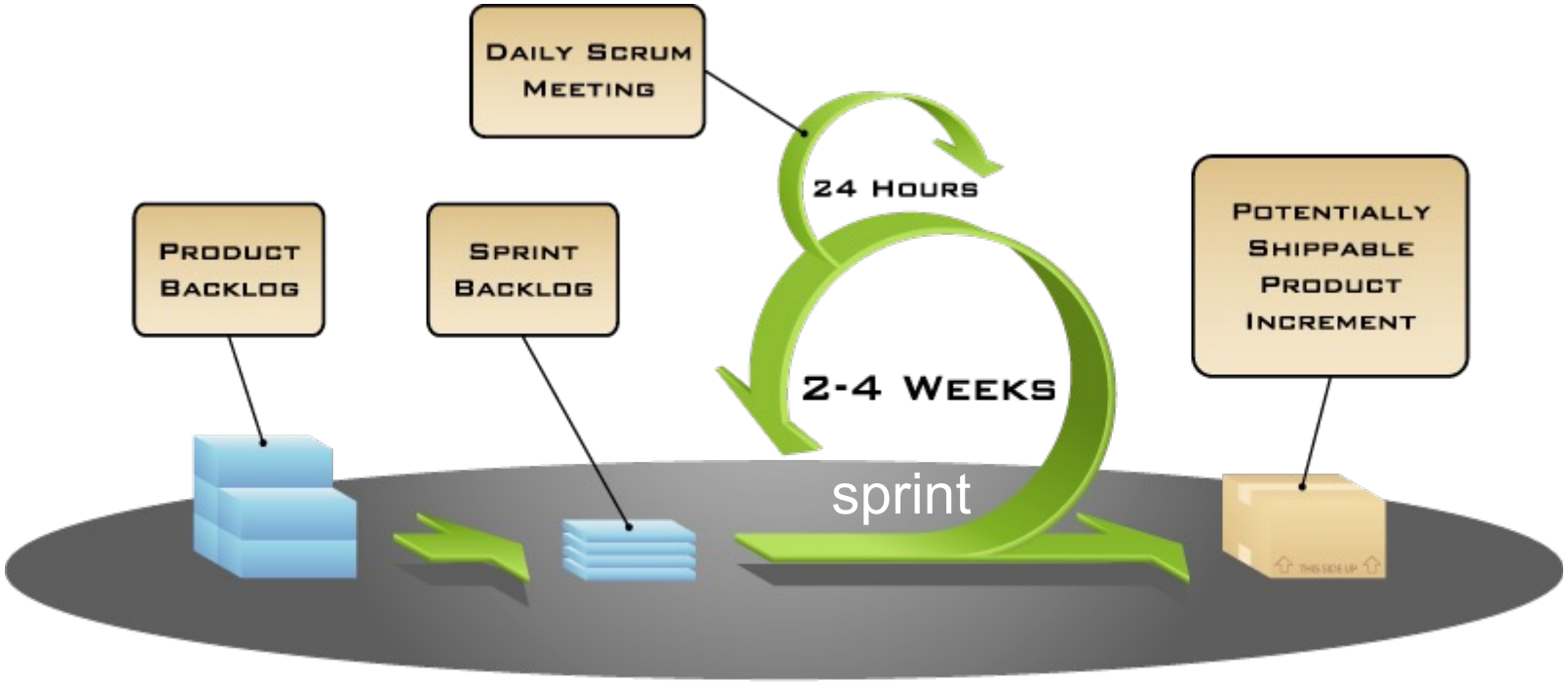
Scrum

https://www.youtube.com/watch?v=TRcReyRYIMg

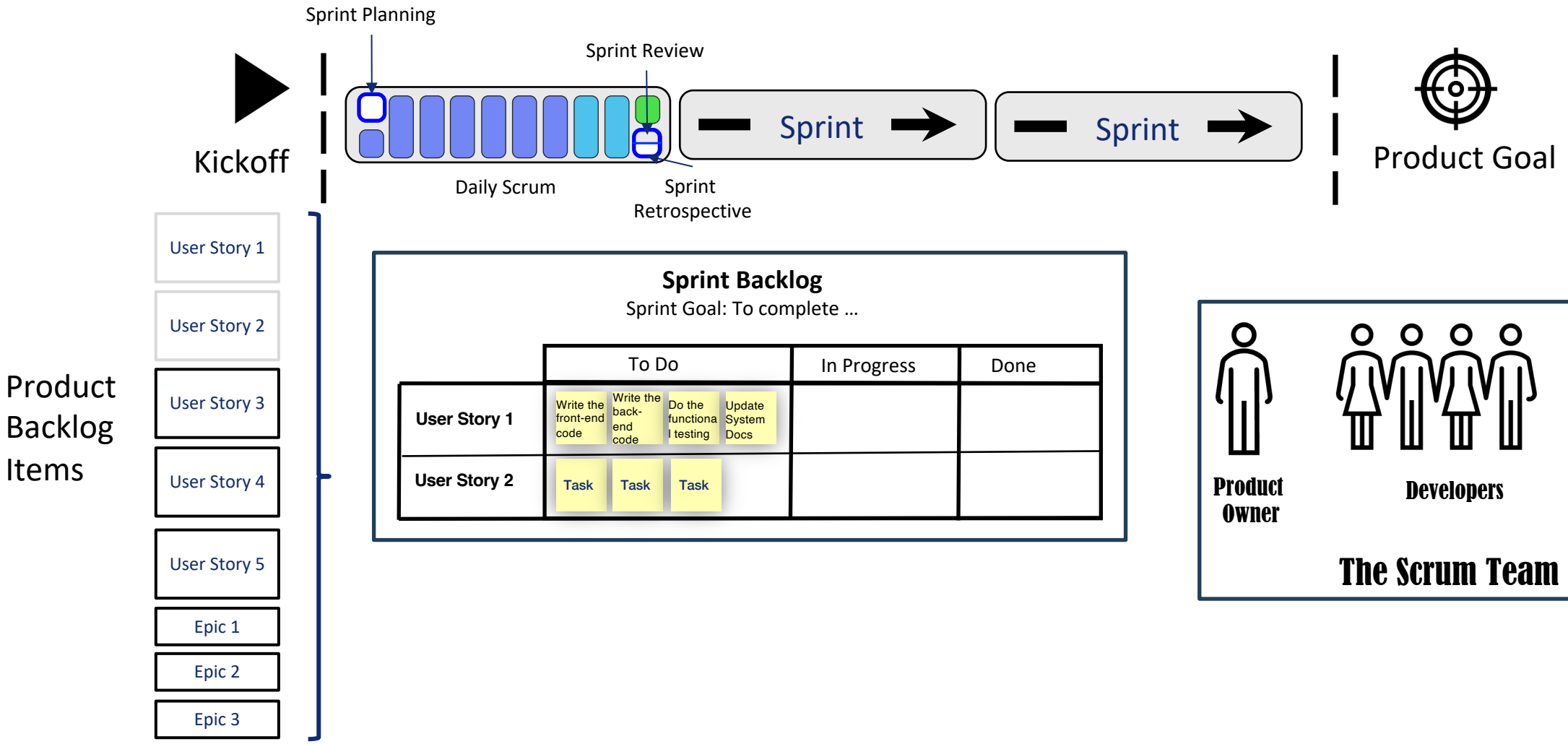
Scrum

- Scrum is a lightweight, iterative method for managing software development in a complex and changing environment

- It has a cyclical nature – the "sprint", and processes within it, repeat over and over



Scrum – A Closer Look **(More in Weeks 2–4)**



Scrum – Accountabilities

Scrum Master

- Facilitates scrum events (standups, reviews, retros)
- Removes impediments
- Facilitates mentorship and conflict resolution
- Ensures that team embraces agile values to achieve the business goals

Developers

- Design, Code, Test and Integrate the software product
- Deliver High-Quality Shippable Product
- Are Self Organised and Cross functional
- Pace the development in a Sustainable manner

Scrum Teams: 5 to 8 developers

Product Owner

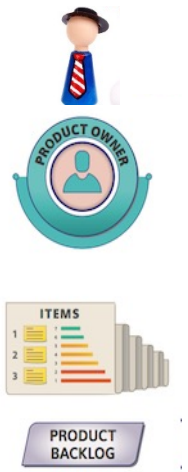
- Identifies and prioritises/re-prioritises product features
- Writes user stories and grooms the product backlog
- Collaborates with stakeholders (e.g. the customer)
- Validates product increments after each sprint

What is a Product Backlog? **(More In Week 2)**

- It is a **prioritised list** of features that
  - *Will deliver an overall **Product Goal***
  - *Adds **Value** to the customer*
  - *Is **Estimated** (i.e., amount of effort required)*
- A Product Backlog principally contains items that bring direct value to customers
  - *Features expressed as User Stories **(see Weeks 2–3)***
- It can also contain items that bring indirect value to customers
  - *Enhancements and Fixes*
  - *Infrastructure set up (e.g. Git repository, CI/CD pipeline)*
  - *Exploratory research work*
- It is created and groomed by the Product Owner as the Product evolves
- It is a living document that continuously evolves as the Sprints are executed
- It does not contain **low-level tasks**
  - *e.g. sending emails ✗, implement PersonDAO class ✗*

Product Backlog Example **(More in Week 2)**

Priority	User Story	Estimate	More Details (Wiki Page)	Status
1	As a shopper, I want to browse the catalog of products, so that I know what to buy	3	http://wiki.shopping.com/US010	**Done Sprint 1**
2	As a shopper I want to add a product to my cart, so that I can buy the product	8	http://wiki.shopping.com/US011	**Done Sprint 1**
3	As a shopper, I want to remove a product from my cart so that I don't buy the product	5	http://wiki.shopping.com/US012	**In-Prog Sprint 2**
4	As a shopper, I want to checkout my cart so that I complete my shopping	13	http://wiki.shopping.com/US013	**In-Prog Sprint 2**
7	As a shopper I want to choose payment on delivery, so that can pay after receiving my product	1	http://wiki.shopping.com/US014	Sprint 3

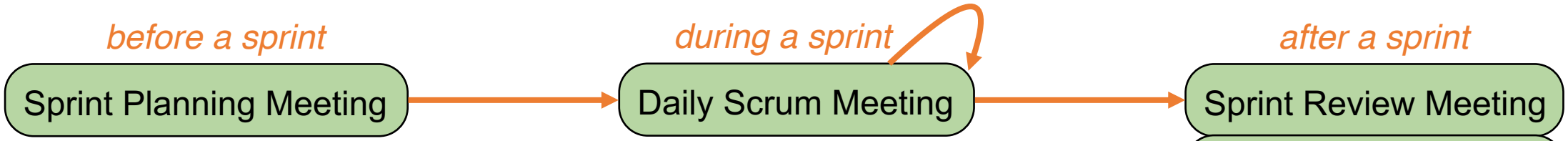


Product Goal: To provide a convenient way for Shoppers to shop online

Scrum – Sprints

- Sprints are fixed-length (e.g. 2, 3, or 4 week) iterations that aim to achieve some agreed-upon outcome, e.g. some tested/integrated software increment
  - For the IS212 project, we recommend a sprint length of **1 or 2 weeks**
  - Requirements are frozen for the length of a sprint

- Sprints are lightly managed using "time-boxed" meetings

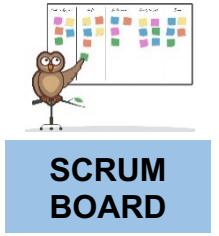


- agree sprint goal based on priorities set by Product Owner
- select product backlog items that contribute to it

- short (~15 mins); facilitated by scrum master
- identify impediments to progress
- **NOT** about finding out who is behind schedule

Details of these scrum meetings coming in **Weeks 2–4** of IS212

The Scrum Taskboard



- Information Radiation
- Each user story associated with one or more implementation tasks
- Monitored by the Scrum master
  - Movement of tasks
  - Stagnant WIP is a warning!
- Updated by Team during standup meetings

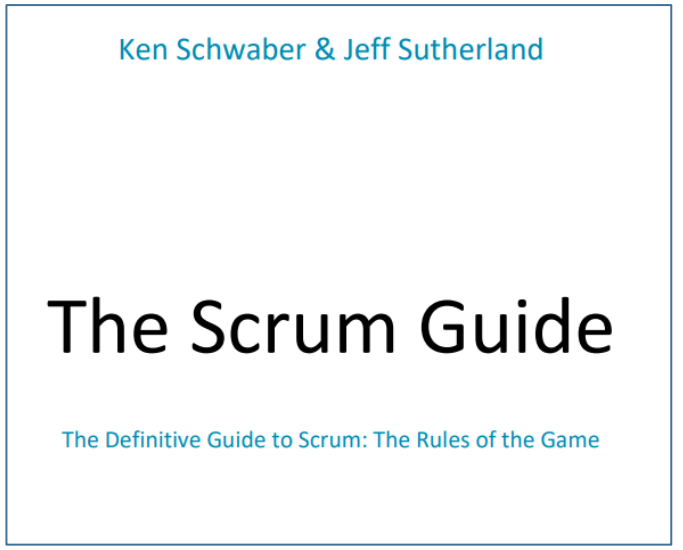
Sprint Backlog

Sprint Goal: To complete …

	To Do	In Progress	Done
User Story 1	Write the front-end code; Write the back-end code; Do the functional testing; Update System Docs		
User Story 2	Task; Task; Task		

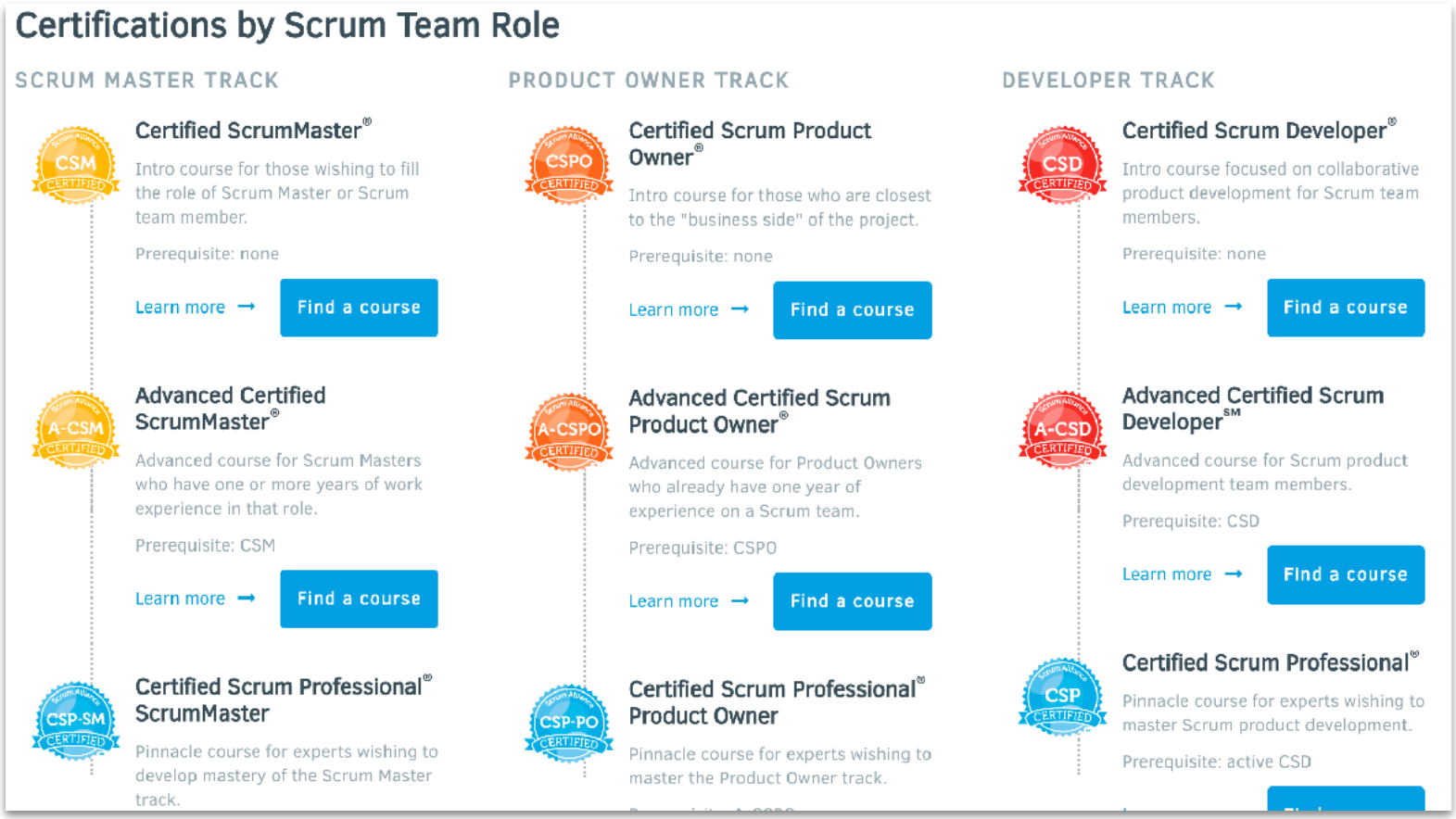
How to get Scrum right

- You will use the scrum process for the IS212 project
- You are encouraged to learn by doing – get your hands dirty, make mistakes in sprint #1, reflect, and then improve
- But we also provide a scrum guide and primer as required reading (see eLearn)
- Read them as we 'deep dive' into user stories, test cases, and agile estimation in **Weeks 2-4**



Scrum – Certification

- The Scrum Alliance provides a number of certification routes for those keen to develop their agile credentials



https://www.scrumalliance.org/

Scrum – Impact

- Scrum has turned the general idea of iterative development into a precise discipline
  - Codified goals, duration, and management of iterations (sprints)
- Savvy marketing operation – certifications turn scrum learners into scrum supporters
- Scrum / sprints have quickly become the industry standard iteration model – even beyond software development

Scrum vs. Kanban

- Scrum is a different process to Kanban, but it shares some similar foundational principles (e.g. minimising WIP)

	Scrum	Kanban
Cadence	Fixed-length sprints	Continuous flow
Release methodology	End of each sprint	Continuous delivery
Accountabilities / Roles	Product owner, scrum master, scrum team	No required roles
Key metrics	Velocity	Lead time, cycle time, WIP
Change philosophy	Requirements frozen during sprints	Requirements can change at any point
Visualisation	Scrum board cleared after every sprint	Kanban board used throughout project

Group Exercise

Google Drive Exercise

In breakout rooms, copy and complete the template at:

http://smu.sg/XXX

Be ready to share and discuss with us!

Traditional

- Waterfall
- RUP

Agile

- Extreme Programming
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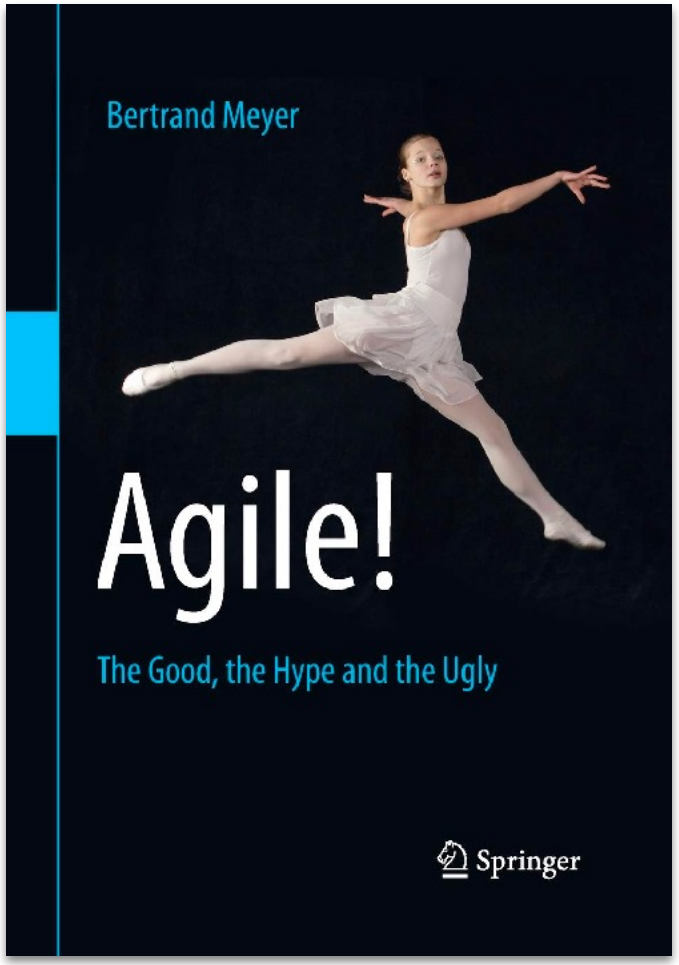
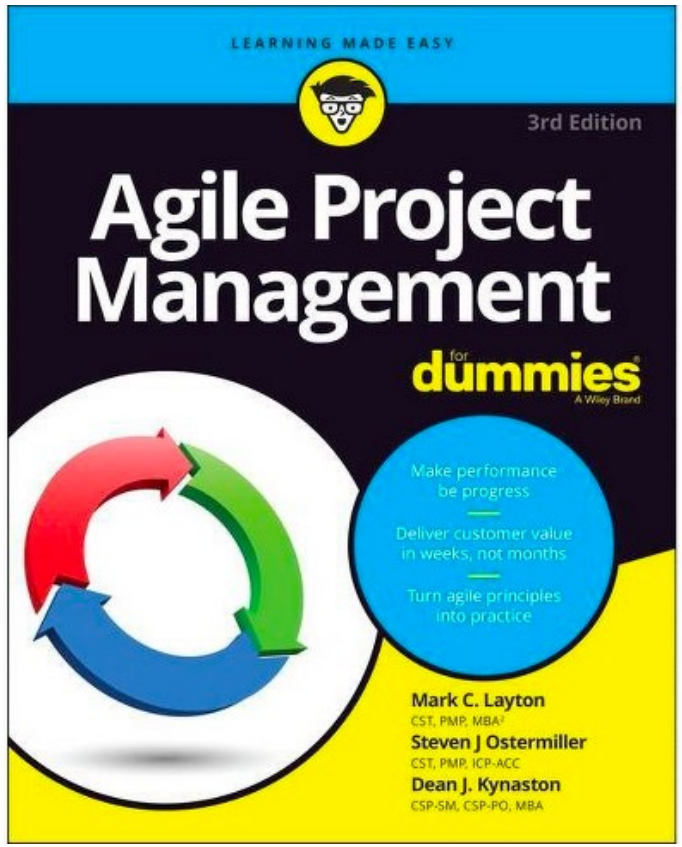
Additional Reading (Optional)





(ignore the title!)