

CS3213: Foundations of Software Engineering

In-class Lecture and Exercises

Bioblitz

- 147 observations
- 82 species
- 5 observers
- 53 identifiers



Mid-term Survey

Mid-term Feedback

Started: 8 Feb at 15:39

Quiz instructions

We have revised major parts of the course for this offering:

- We completely revised the project component and format
- We re-created the lab tutorial contents and slides to better align the contents and the course project
- We made the lecture contents more visual and went more in-depth compared to previous years
- We restructured the course to a blended-learning format with more in-person interactive activities

Submit by the end of this week!

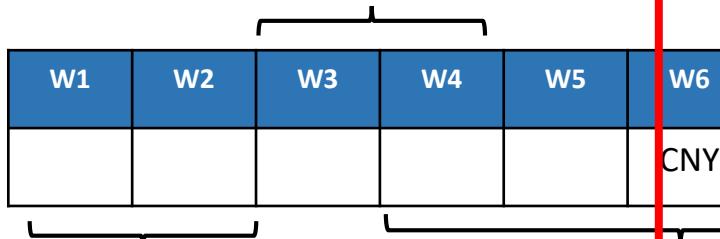
We would thus be grateful if you could spend some minutes to give us feedback on how these changes support your learning, hinder your learning, or any other feedback that you have that could help us to improve the class. We can try to address common feedback for the second part of the semester, or in next year's offering. Last year's feedback was already useful for us in identifying those components that required improvement, and we tried to address this feedback exhaustively.

The mid-term survey is anonymous.

(Planned) Project Assignments

Assignment 2: Requirements Specification

Mon, 26 Jan to Mo, 10 Feb



Assignment 4: Intermediate Artifact

Mon,

By now, you (mostly) finished eliciting and documenting the key requirements, and should have already started with the architectural design (and implementation)

Assignment 1: Requirements Elicitation Preparation

Mon, 12 Jan to Fri, 23 Jan

Assignment 3: Design Document

Mon, 2 Feb to Fri, 20 Feb

Assignment 6: Final report and presentation

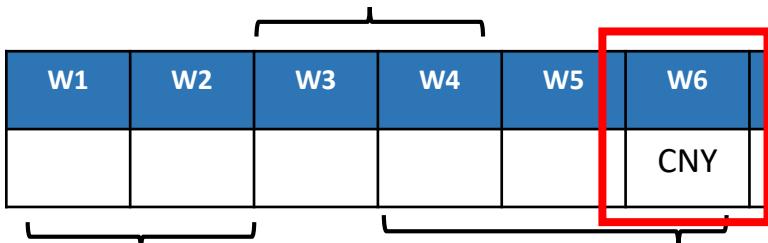
Mon, 16 Mar to Fri, 27 Mar

(Planned) Project Assignments

Assignment 2: Requirements Specification
Mon, 26 Jan to Mo, 10 Feb

Assignment 4: Intermediate Artifact
Mon, 2 Mar to Fri, 13 Mar

Assignment 6: Final report and presentation
Mon, 30 Mar to Fri, 17 Apr



Any questions regarding the lecture or project? Drop by my office (COM3-02-42) between 2pm and 4pm on February 16

Assignment 1: Requirements Elicitation Preparation
Mon, 12 Jan to Fri, 23 Jan

Assignment 3: Design Document
Mon, 2 Feb to Fri, 20 Feb

Assignment 5: Testing
Mon, 16 Mar to Fri, 27 Mar

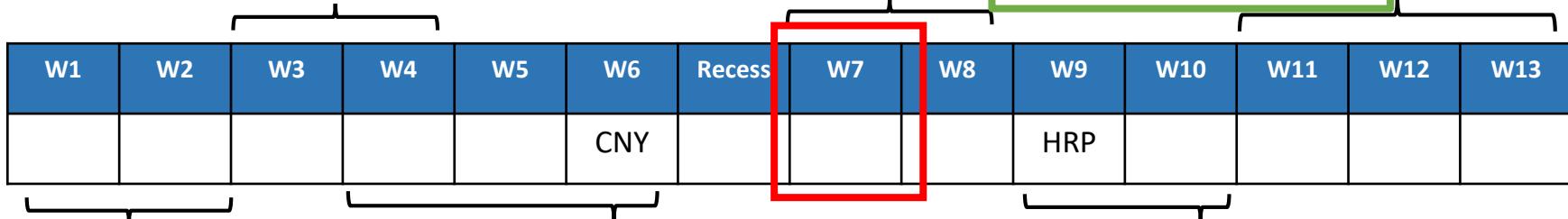
(Planned) Project Assignments

Assignment 2: Requirements Specification
Mon, 26 Jan to Mo, 10 Feb

Assignment 4: Intermediate Artifact
Mon, 2 Mar to Fri, 13 Mar

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Mon, 30 Mar to Fri, 17 Apr

Mid-term Exam!



Assignment 1: Requirements Elicitation Preparation
Mon, 12 Jan to Fri, 23 Jan

Assignment 3: Design Document
Mon, 2 Feb to Fri, 20 Feb

Assignment 5: Testing
Mon, 16 Mar to Fri, 27 Mar

Mid-term Exam (Main Venue)

- Date: Monday, March 2, 2026
- **Location: MPSH 1A**
- Hall Entry Time: 14:00
- **Start Time: 14:30**
- **End Time: 15:30**
- Hall Exit Time: 16:00
- Pen-and-paper and a double-sided A4 help sheet

Last Year's Mid-term Exam

CS3213 Mid-term Exam

6. (1 points) Which of these characteristics are typical of agile methods? Select all that apply.

- Trust in individuals and empowering teams
- Optimizing the development process
- Following a pre-defined plan
- Elaborate documentation

Previous mid-term exams are online

7. (1 points) Determine which of the following are true or false about *Extreme Programming (XP)*.

Specifies concrete development practices such as Pair Programming and Collective Code Ownership. True False

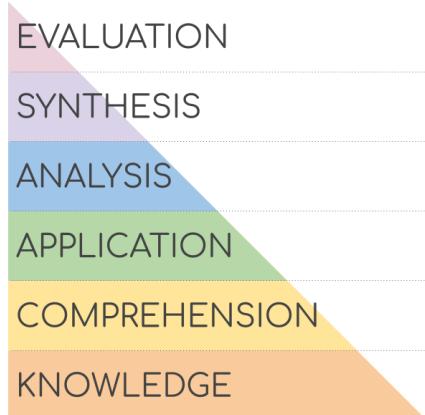
Various of its practices have become mainstream in both plan-driven as well as agile development. True False

Extreme Programming was pioneered by the team working on Windows XP, hence the name. True False

XP has parallels with DevOps, for example, the focus on Continuous Integration/Continuous Deployment (CI/CD). True False

This Year's Mid-term Exam

- More open-ended questions, few(er) multiple-choice questions
- Focus on the higher layers of Bloom's taxonomy
 - Fewer comprehension/knowledge questions



FAQ

- In-class contents? Yes
- Project-specific? No
- Diagraming? Yes
- Questionnaire design? No
- Optional videos? No

(Planned) Project Assignments

Assignment 2: Requirements Specification
Mon, 26 Jan to Mo, 10 Feb

Assignment 4: Intermediate Artifact
Mon, 2 Mar to Fri, 13 Mar

Assignment 6: Final report and presentation
Mon, 30 Mar to Fri, 17 Apr

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
					CNY				HRP				

Assignment 1:
Elicitation P
Mon, 12 Jan

We strongly encourage you to work on the implementation **already now** (finish Assignment 3 asap!), since the submission deadline will be preceded by CNY, recess week, and the mid-term exam

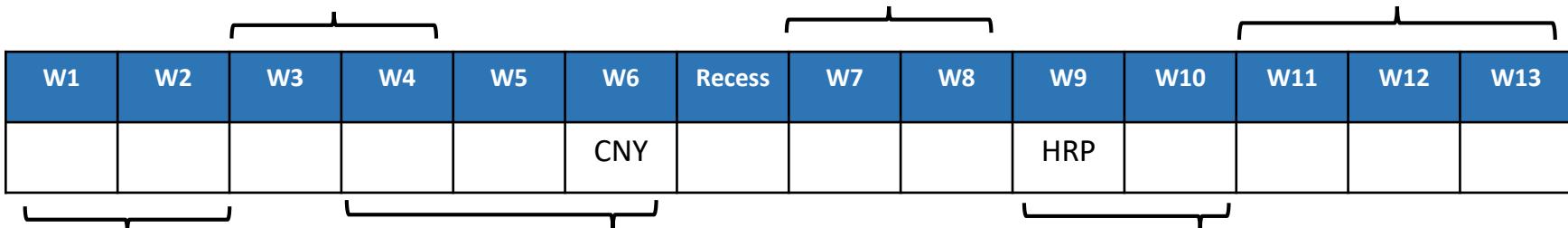
5: Testing
o Fri, 27 Mar

(Planned) Project Assignments

Assignment 2: Requirements Specification
Mon, 26 Jan to Mo, 10 Feb

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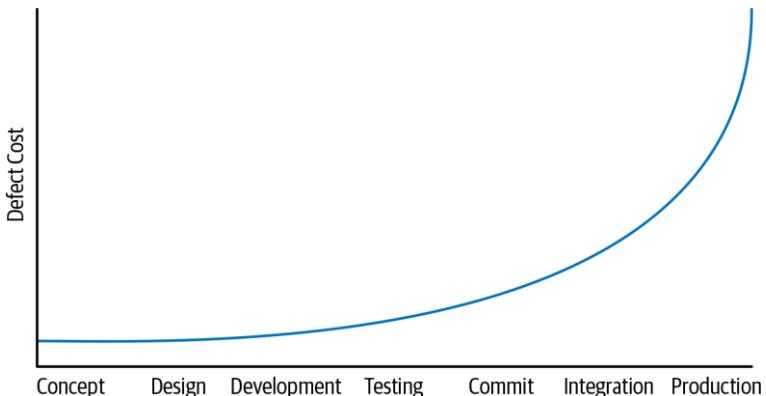
Week 1: Course Introduction

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

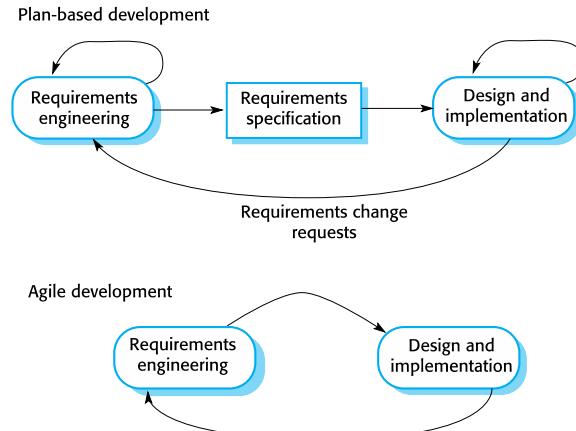
- Course overview
- What is software engineering?
 - Engineering discipline: messy real-world tradeoffs and decision making vs. elegant and clean principles
- “*No Silver Bullet*” essay

Week 1: Course Introduction

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	



“Shifting Left”



“Plan-driven vs. agile development”

Week 2: Requirements Engineering (RE)

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- Requirements elicitation and analysis
- Requirements specification
- Requirements validation
- Process models

Week 3: Project Overview and RE

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	



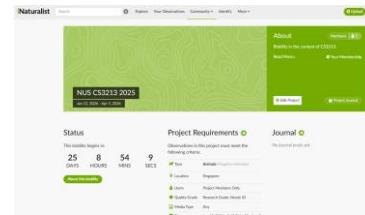
Citizen Science Program for Critically Endangered Primates: A Case Study from Singapore

Andie Ang¹, Sabrina Iabbat², Vilma D'Rozeno² and Jayanti Lakshminarayanan³

¹Raffles' Banded Langur Working Group, Wildlife Reserves Singapore Conservation Fund, Singapore
²Sone Goodwill Institute, Singapore
³National Parks Board, Singapore

Abstract: Raffles' banded langur (*Presbytis rubicunda*) is one of three species of non-human primates in Singapore. With only 67 individuals left, it is listed as locally Critically Endangered. Due to its elusive nature, arboreality, and small population

No questions about the project for
the mid-term and final exam



Date	Signatory	Location (GPS)	Notes	No. of observations	Indicate no. of observations made if possible	Description (What were they doing?)	Any notes on activities etc. (e.g. long delay, unexpected things were observed...)	Any pictures of targets (please share with stakeholders/engaging partners)
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Week 4: Modeling and Software Architecture

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- UML and C4
- Attribute-driven Design (ADD)
- Architectural tactics and strategies

Week 5: (Agile) Software Frameworks

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- Scrum
- Kanban
- Extreme Programming
- DevOps

Week 8: Software Testing

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- Unit tests, integration tests, system tests
- Test-driven development
- Specification-based testing
- Structural testing

Week 9: Q/A with CHANG Sau Sheong

W:
L1

Shaping a digital nation: GovTech's Chang Sau Sheong on leading Singapore's tech evolution

Written by KrASIA Writers
Published on 5 Sep 2024 · 6 mins read

Share    



Photo of Chang Sau Sheong, CTO and deputy chief executive (products) of GovTech.

GovTech's CTO discusses Singapore's digital trajectory, highlighting innovation, resilience, and the importance of events like the STACK Developer Conference.

W7	W8	W9	W10	W11	W12	W13
	L6	L7	L8	L9	L10	

Week 10: Debugging

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- “The Scientific Method” to Debugging
- Program slicing
- Statistical fault localization
- Test-case reduction
- Isolating failure-inducing changes

Week 11: Advanced Testing

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- Property-based testing
- Differential testing
- Metamorphic testing
- Fuzzing

Week 12: Software Evolution and Course Summary

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

- Software versioning
- Hyrum's Law
- Dependency management
- Deprecation

Week 13: Project Presentations

W1	W2	W3	W4	W5	W6	Recess	W7	W8	W9	W10	W11	W12	W13
L1	L2	L3	L4	L5				L6	L7	L8	L9	L10	

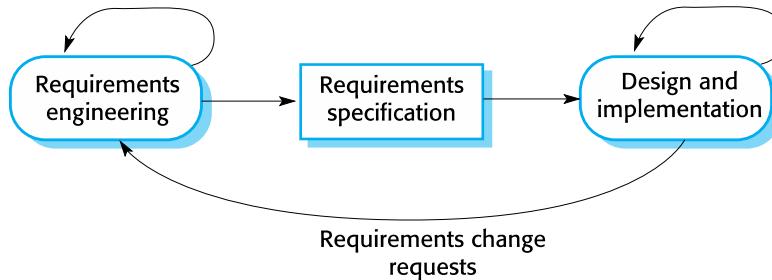
- Dr. Andie will join!



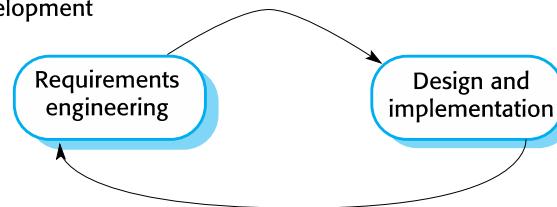
Recap

Plan-driven vs. Agile

Plan-based development



Agile development



Two general approaches to develop software: plan-driven and agile

Agile Manifesto (2001)

Manifesto for Agile Software Development

We are uncovering better ways of developing software by doing it and helping others do it.

Through this work we have come to value:

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.

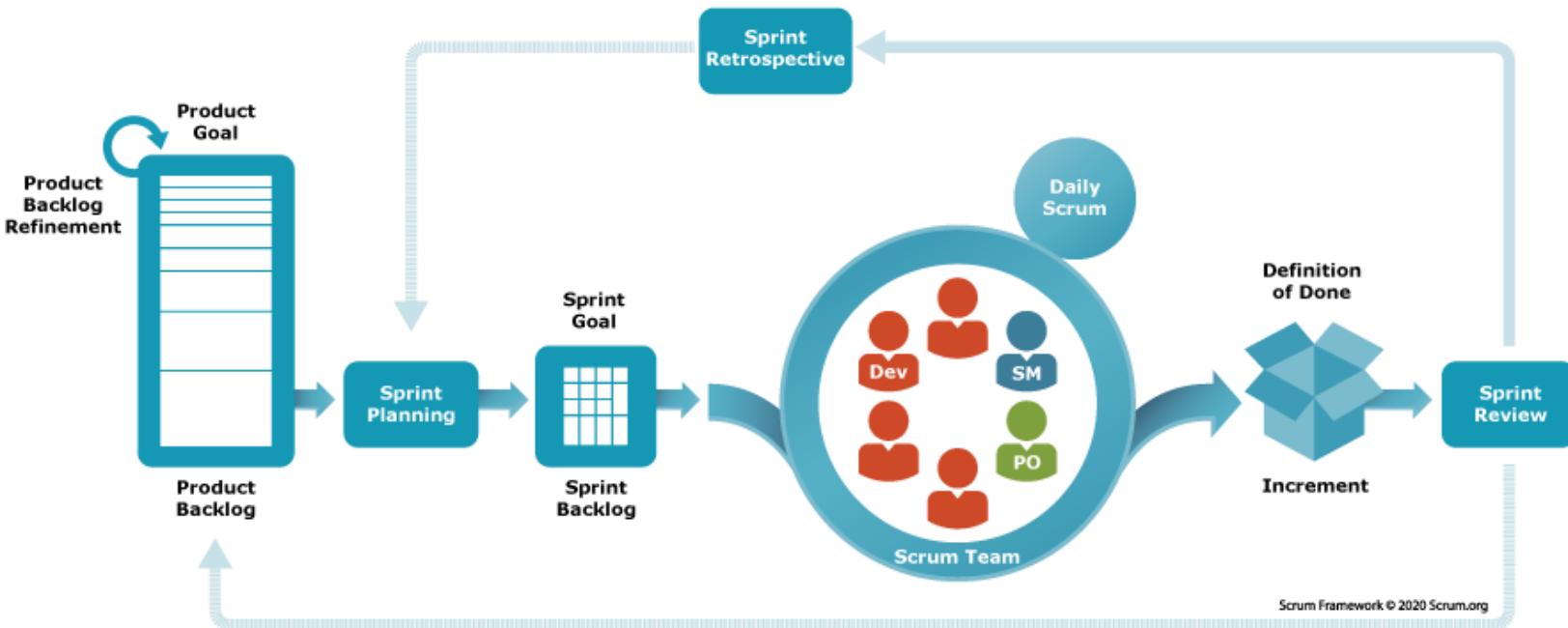
The New New Product Development Game (1986)

- New approach: fast and flexible, an “integrated” approach
 - “Scrum”



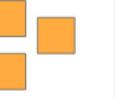
By PierreSelim - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=17336884>

Scrum



Flow

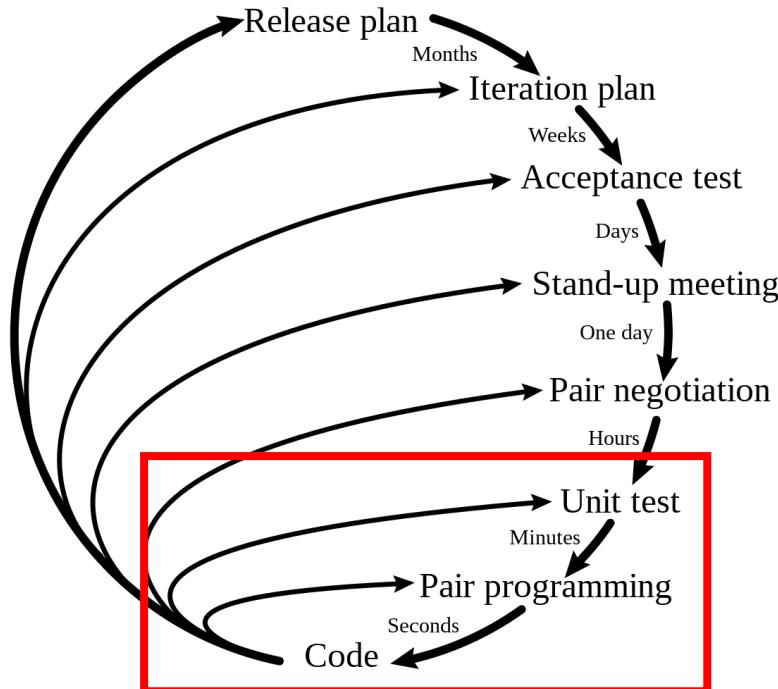
- **Flow:** movement of potential value through a system
- Kanban optimizes *flow*
- Enforces a *work in progress (WIP) limit*

Backlog	Creating (WIP: 3)	Review (WIP: 2)	Publishing (WIP: 1)	Done
				

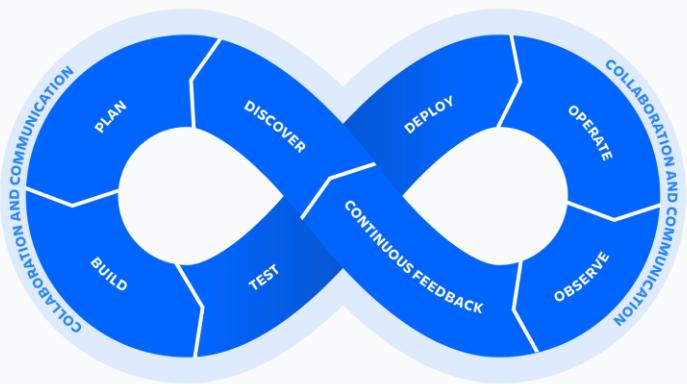


Extreme Programming

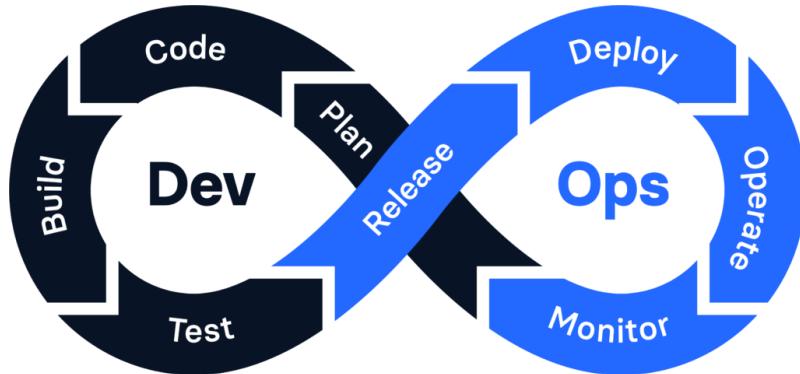
Planning/feedback loops



DevOps



<https://www.atlassian.com/devops>

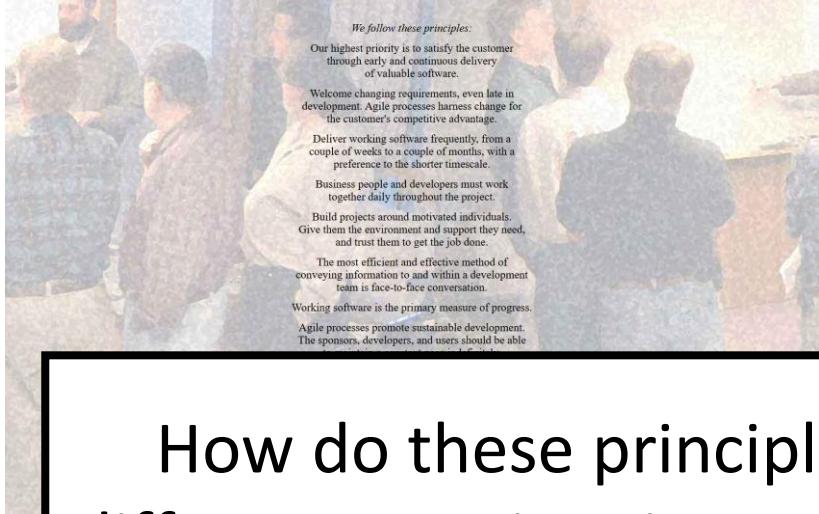


<https://ubiqware.net/en/our-approach-to-devops/>

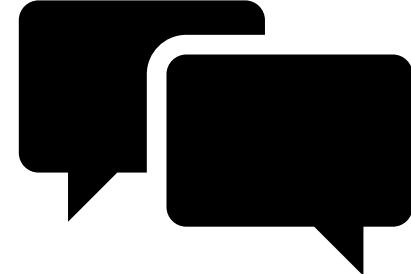


Agile Exercises

Course Exercise



How do these principles map to the different practices in Scrum, Kanban, and DevOps?





Business people and developers must work together daily throughout the project.

Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.



Business people and developers must work together daily throughout the project.

- Scrum: Product Owner role
- Extreme Programming: on-site customer
- DevOps: shared responsibility and breaking down silos



Agile processes promote sustainable development.
The sponsors, developers, and users should be able
to maintain a constant pace indefinitely.

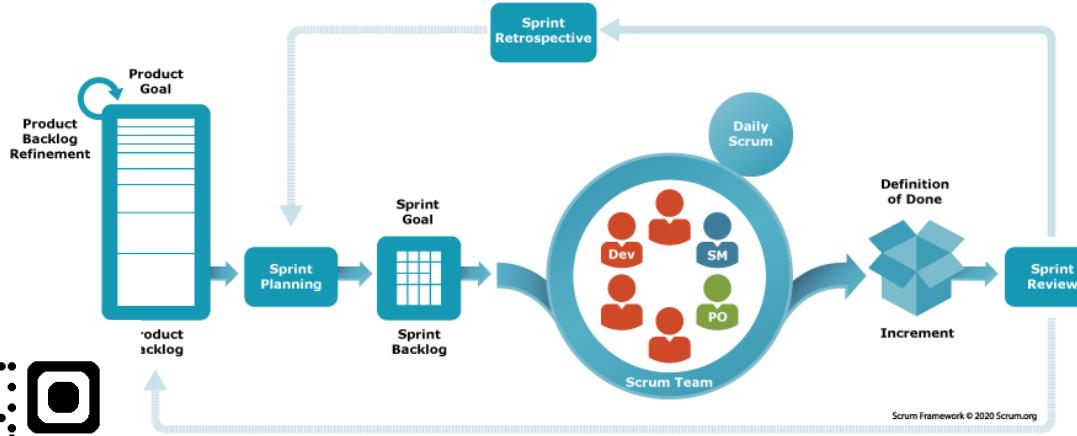
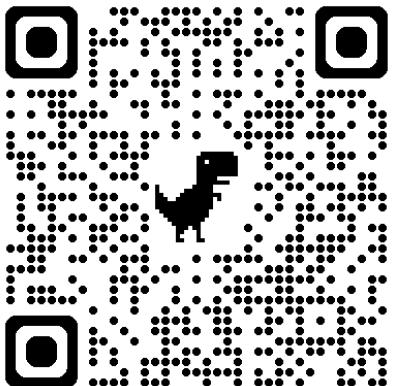
- Scrum: Sprints
- Kanban: Flow
- DevOps: continuous deployment, Value Stream Mapping



At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

- Scrum: Sprint Retrospective
- Kanban: continuous improvement (Kaizen)
- DevOps: blameless postmortems, monitoring and continuous improvement

Course Exercise



Do you think that agile approaches are a silver bullet? Why/why not?

Agile: Challenges with Adoption and Drawbacks



Have Agile Techniques been the Silver Bullet for Software Development at Microsoft?

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Abstract—Background. The pressure to release high-quality, valuable software products at an increasingly faster rate is forcing software development organizations to adapt their development practices. Agile techniques began emerging in the mid-1990s in response to this pressure and to increased volatility of customer requirements and technical change. Theoretically, agile techniques seem to be the silver bullet for responding to these pressures on the software industry.

Aims. This paper tracks the changing attitudes to agile adoption and techniques, within Microsoft, in one of the largest longitudinal surveys of its kind (2006-2012).

dology was used to develop these large software products. In reality, many large software companies did not religiously follow any specific development methodology and adapted methods and tools to suit the products they were producing.

Over time, consumers of software and software-intensive products increasingly welcomed more frequent software releases. Simultaneously, software began to be distributed electronically, and software-as-a-service (SaaS) increased in popularity. Traditional methodologies were viewed as too slow, not customer focused, not adaptable and too bureaucratic to handle the new software reality. In response, agile methods emerged in

Agile: a Silver Bullet?

[...] some proponents of agile (both at Microsoft and elsewhere) appear to become **almost religious** about its use. These proponents **emphasize the potential benefits of using agile** while often **downplaying the cost or the learning curve**. We observed in some the attitude of “if agile doesn’t work for you, then you’re doing it wrong.” Whether this is true or not (we do not claim either) is immaterial. In either case, **teams have attempted to adopt an agile practice and have run into problems**. Portraying agile as a nearly universal solution, downplaying its difficulties, or blaming the team when they do not reap the expected benefits, all serve to drive potential adopters away from agile practices.”



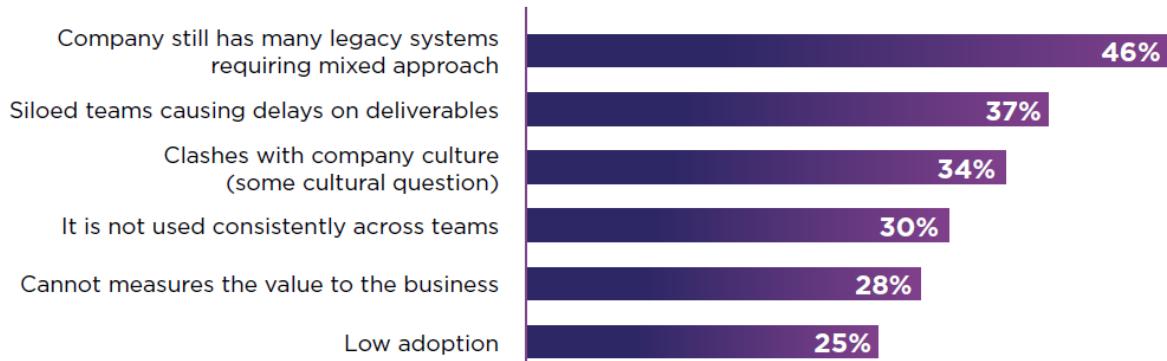
Agile: Problems with Adoption



- Almost half of the survey takers perceive a general resistance to adopting agile practices
- Business teams do not understand what agile is and what it can do for them
- Only 6% of survey takers said they have no barriers to Agile adoption



Agile: Problem After Adoption



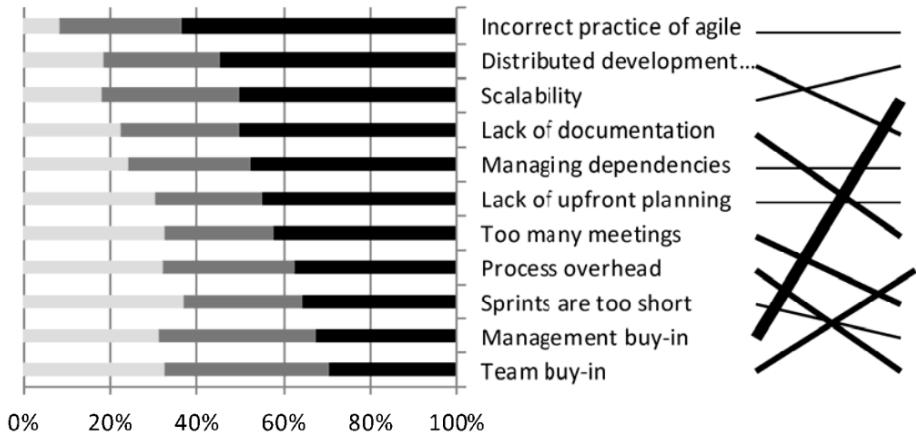
- “Too many mixed systems”, forcing practitioners to adopt hybrid approaches
- Siloed teams causing delays

Agile: a Silver Bullet?

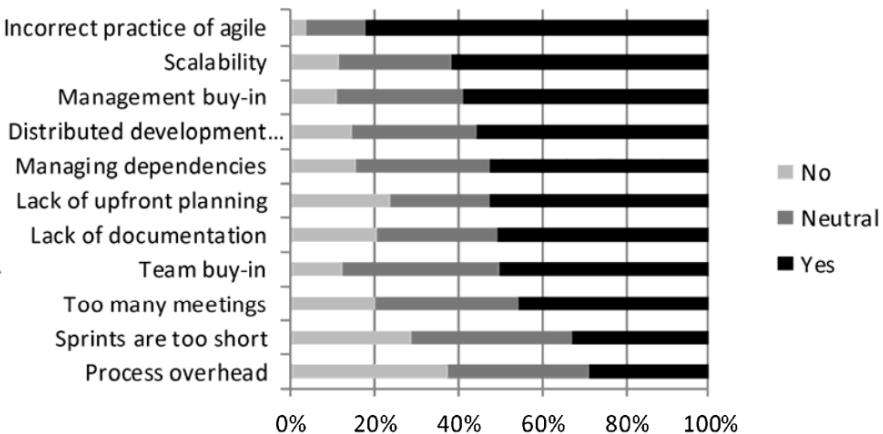
Above-Background. The pressure is *below* generic, valuable software products at an increasingly faster rate in the market. This is where the real value of the software development practice, Agile techniques begin emerging in the mid-1990's in response to this pressure and to increase velocity of delivery and quality of delivered software. Theoretical Agile techniques were to be the silver bullet for responding to these pressures on the software industry.

adoption and techniques, within Microsoft, in use of the largest implementation success of its kind (2006a:2812).

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



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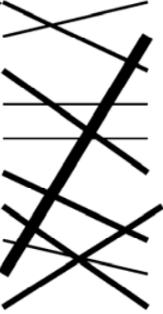
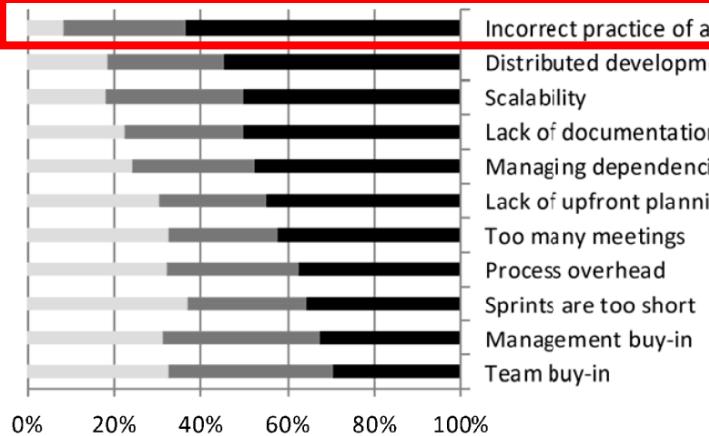
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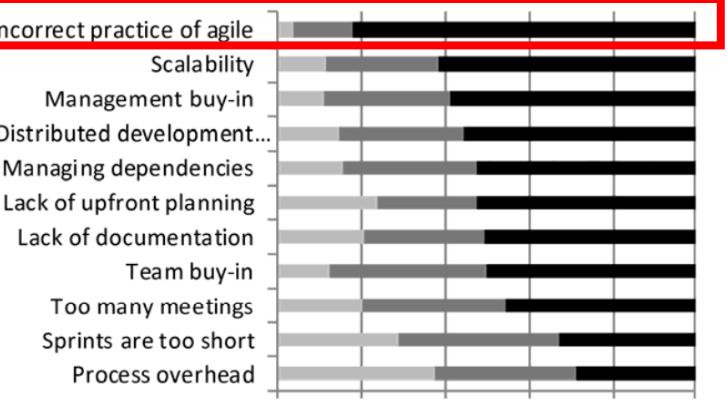
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Agile: a Silver Bullet?

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



Legend:
■ No
■ Neutral
■ Yes

- Some organizations might claim to use an agile approach, but actually use a hybrid or traditional model

Author Background: The authors have conducted research on the use of agile methods in large-scale software development organizations to adapt their processes to changing requirements. In 2008, they found that 100% of respondents to this survey had increased relatedness between requirements and code, and 90% had increased relatedness between requirements and design. This was interpreted as a sign of improved quality of requirements and better practices for responding to changes in the software market.

Also, this paper tracks the changing attitudes of agile developers over time. It shows that the use of the term "agile" has increased over time, especially among younger respondents.

Over time, concern of software and software-related risks has increased, while concern of other risks has decreased. Similarly, software began to be distributed electronically, and the number of distributed electronic devices increased.

Finally, traditional methodologies were viewed as no longer being appropriate for modern software development, and the new software reality, in response, agile methods emerged in

Agile: a Silver Bullet?



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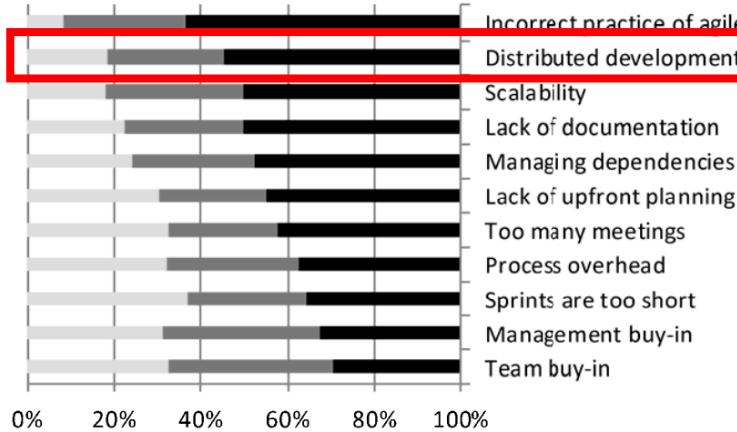
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Abstract - Background: The promise to reduce high-risk/high-reward software development projects by applying agile methods has been widely adopted. However, many large-scale distributed software development organizations have adopted agile methods without fully understanding the pros and cons. This paper explores the reasons why increased adoption of agile methods has led to increased risk in some cases and decreased risk in others. It also highlights the challenges of scaling agile methods to distributed teams.

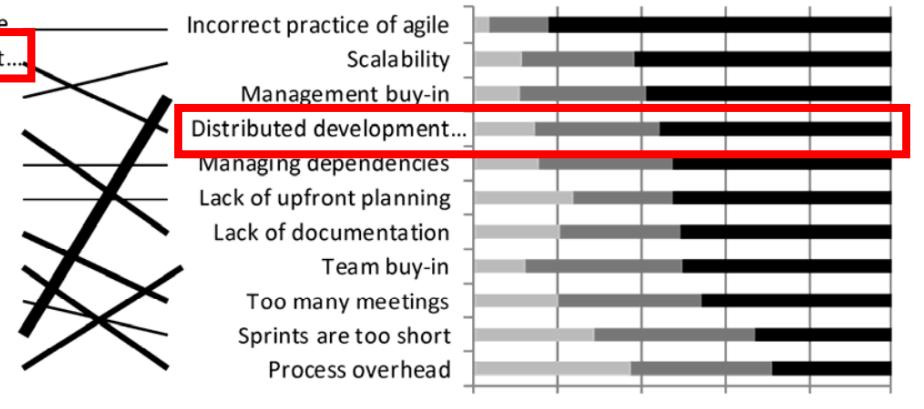
Aims: This paper tracks the changing attitudes of agile developers over time, comparing the views of two sets of individual surveyors in the field (2006-2012).

Agile: a Silver Bullet?

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



- Microsoft has many geographically distributed teams

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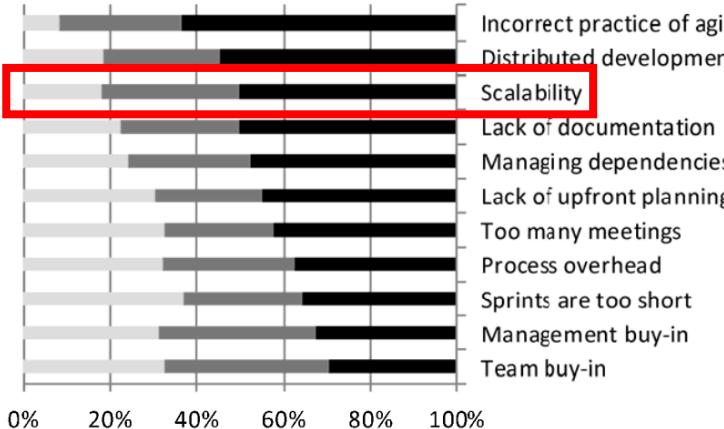
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Abstract - Background: The promise to reduce high-risk/high-reward software development projects by applying agile software development techniques has been a major draw for many large organizations. In this paper, we report on a study of how large organizations are adapting their software development processes to incorporate agile methods. We find that while 100% of respondents believe that agile techniques are effective, only 10% believe that they are appropriate for their organization's needs. This suggests that there is a significant gap between the promise of agile and its actual presence in the software industry.

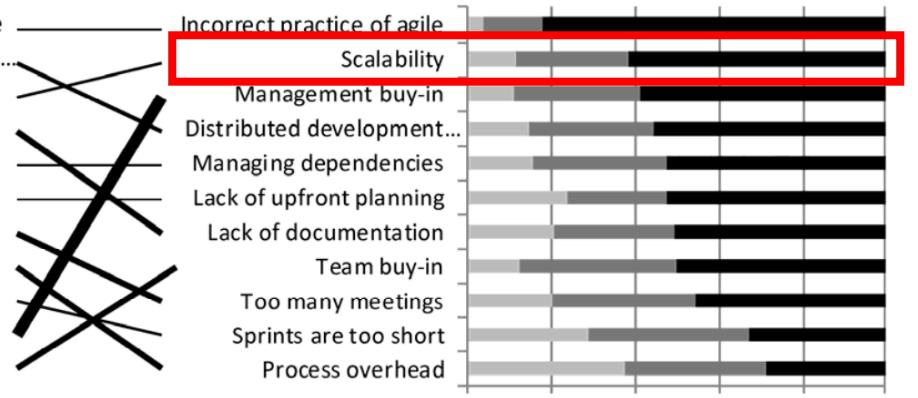
Aims: This paper tracks the changing attitudes of agile practitioners over time, and provides a new set of insights regarding the challenges of scaling agile methods across individual servers in the cloud (2008-2012).

Agile: a Silver Bullet?

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



No
Neutral
Yes

- Products like Microsoft Windows or Office have thousands of developers
- Multiple Product Owners, but causes some problems

Scaling Scrum

- Various approaches have been proposed to scale Scrum
- Scaled Agile Framework (SAFe)
- Scrum@Scale (S@S)
- Nexus
- Large Scale Scrum (LeSS)
- Disciplined agile delivery (DAD)
- The “Spotify model”
- ...

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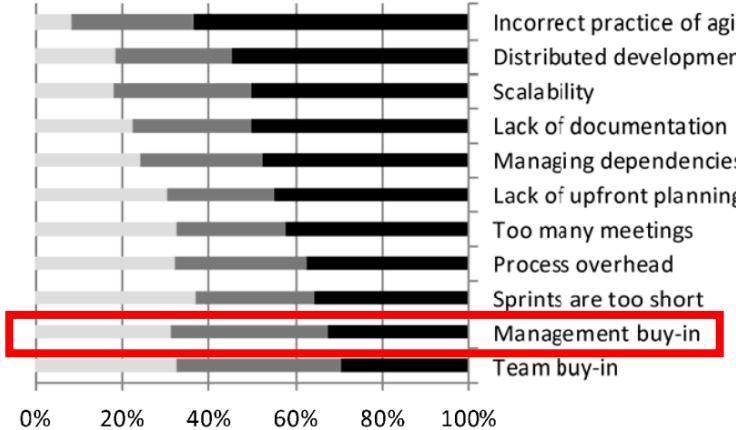
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Author Background: The decision to release high-quality software products on time is critical for success. Many leading software development organizations have adopted agile methods to increase their speed of delivery and efficiency in response to this pressure and to increased volatility in the market. This paper explores the challenges of scaling agile methods to large teams and the attitudes of managers towards adopting these processes in the software industry.

Also, this paper tracks the changing attitudes of agile practitioners over time, comparing the views of the original individual surveyors in 2006 (2006-2012).

Agile: a Silver Bullet?

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



- For agile practitioners, buy-in already exists
- Non-agile developers might have seen resistant to agile techniques

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Agile: a Silver Bullet?

Agile Devs: Perceived Problems



Non Agile Devs: Perceived Problems



- Agile developers might have “felt the pain” of not having documentation when they would have required it

Author's background: The desire to reduce high-maturity, slow-moving software development organizations to adopt their own processes and practices has been around since the late 1990s and 2000s. In response to this pressure and to increased volatility in the software market, Microsoft began to build a culture of experimentation and innovation, leading to the development of new processes for the software industry.

Also, This paper tracks the changing attitudes of agile developers over time, comparing the views of a set of the largest longitudinal surveys in the field (2006-2012).

ability was used to develop three large software products. In addition, large-scale experiments were conducted to test how any specific developer methodology and adopted technologies could be used to improve the quality of the software.

Over time, concern of software and software-engineering researchers about the need for better software development processes led to the development of various methodologies. Simultaneously, software began to be developed electronically, and the Internet became a major source of information. Traditional methodologies were viewed as no longer appropriate. Agile methodologies were viewed as no alternative, and the new software reality, in response, agile methods emerged in

Planning in Agile

Numbers: 0, 1, 2, 3, 5, 8, 13

1

Changing the background color of the page to blue

3

Add an export button that downloads the data from database

5

Adding an admin dashboard

13

Train and integrate a ML-based classifier to distinguish different kinds of animals

Planning in Agile

Numbers: 0, 1, 2, 3, 5, 8, 13

1
Changing the background color of the page to blue

3
Add an export button that downloads the data from database

5
Adding an admin dashboard

13
Train and integrate a ML-based classifier to distinguish different kinds of animals

???
Automatically resolve conflicts when multiple volunteers submit a report

Planning Poker

- Improves planning accuracy
- Estimating tasks relative to completed ones, rather than in absolute time
- Avoid bias and give equal voice to everyone

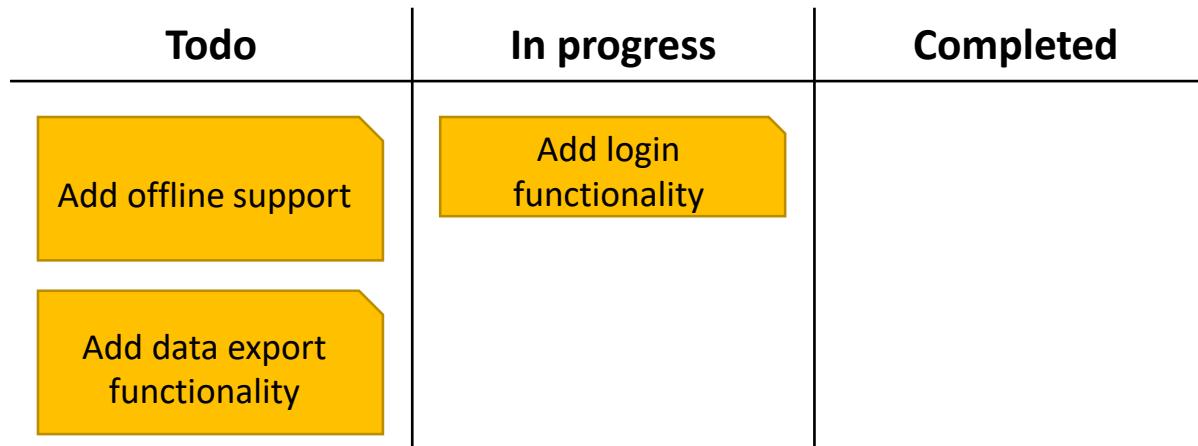
Local-First Software

The video player interface includes:

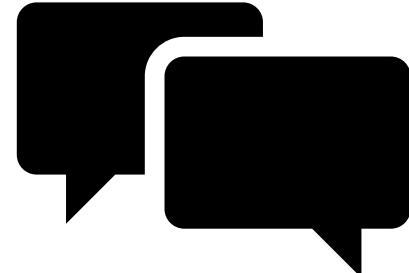
- Top left: LOCAL-FIRST CONF logo.
- Top center: BERLIN, GERMANY 30TH MAY 2024.
- Video frame: A man with long hair tied back, wearing a blue t-shirt and jeans, speaking on stage.
- Slide content:
 - TECHNOLOGY FOR LOCAL-FIRST** (underlined in blue)
 - My bet is on *Automerge*, but there are many other libraries/systems/products/protocols
- Bottom right: YouTube video controls (play/pause, volume, progress bar at 27:52 / 29:45).
- Bottom left: Channel info: Local-First Conf 3.57K subscribers.
- Bottom right: Interaction stats: 508 likes, Share, Ask, Save, more options.

[The past, present, and future of local-first - Martin Kleppmann \(Local-First Conf\)](https://www.youtube.com/watch?v=NMq0vncHJvU)

Kanban: Definition of Workflow



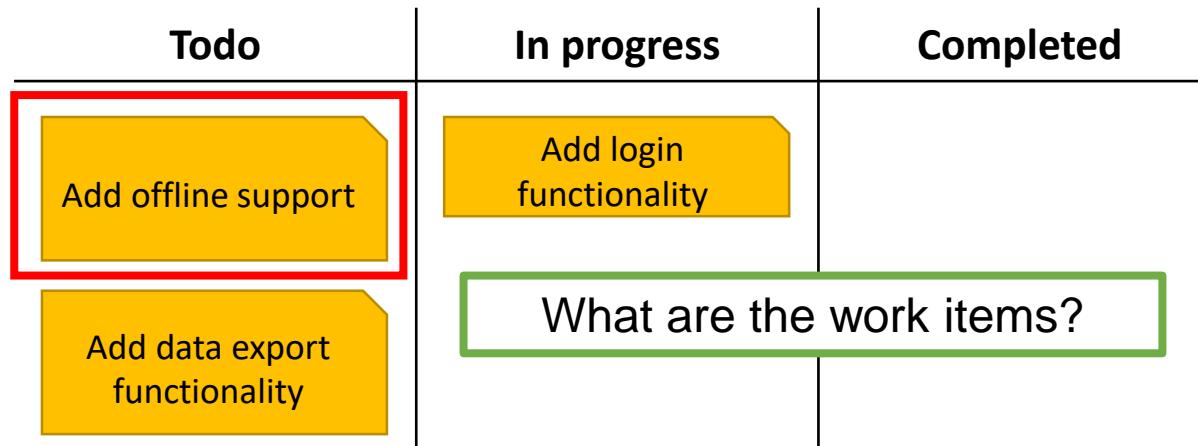
Definition of Workflow



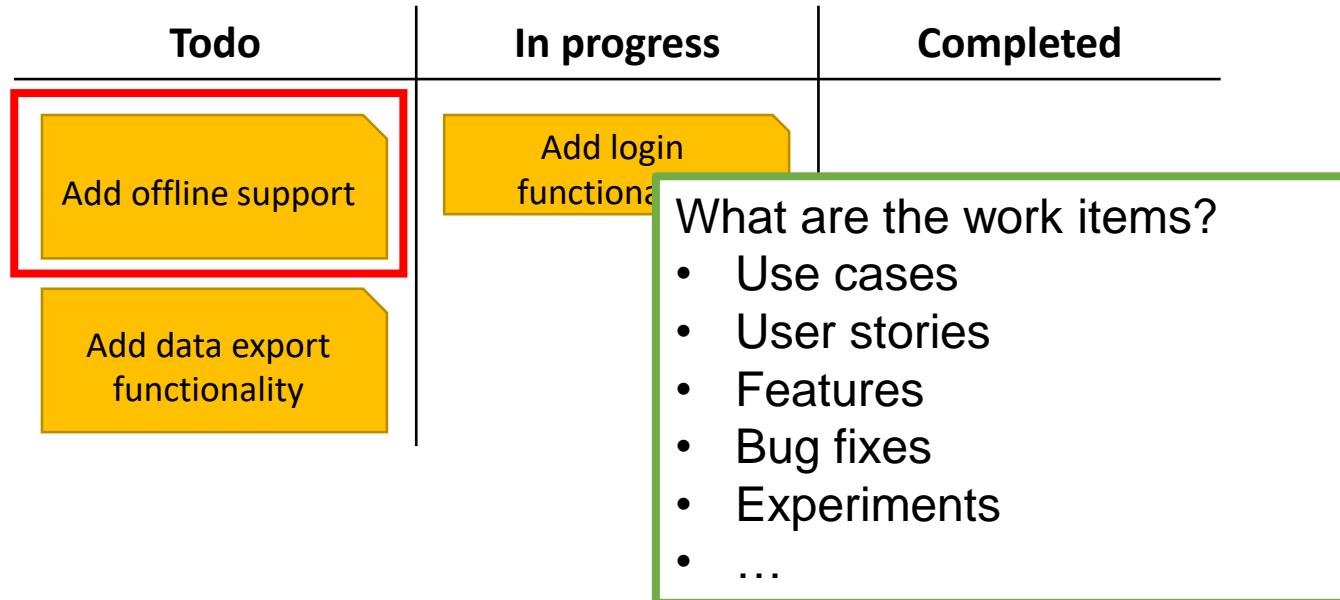
What concepts do we need to define for the Kanban
Definition of Workflow?



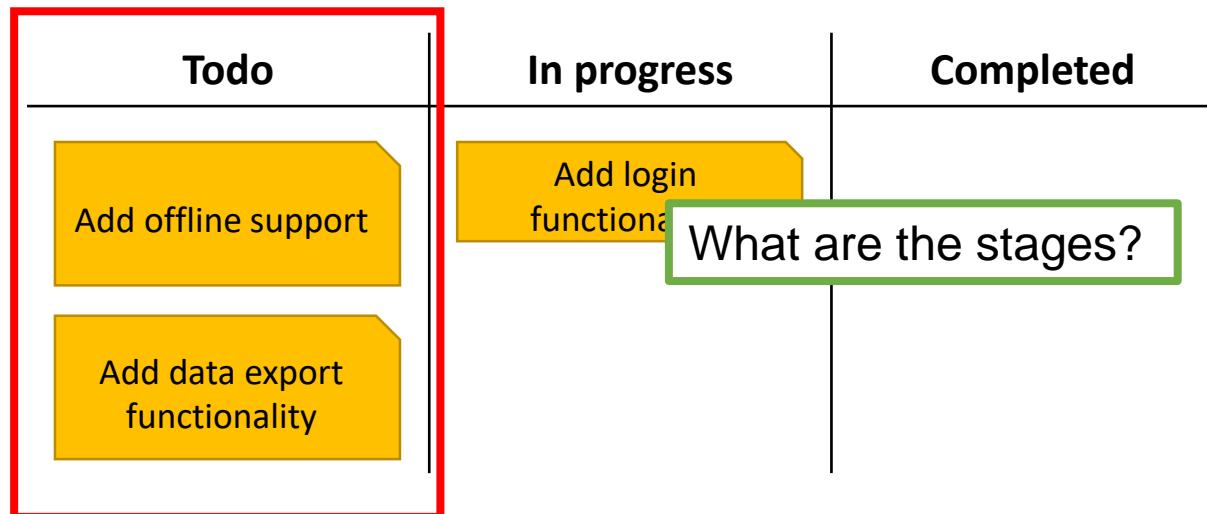
Definition of Workflow



Definition of Workflow



Definition of Workflow



Definition of Workflow

Use Case	Before Next TA Meeting	In progress	Completed
Add offline support		Add login functionality	
Add data export functionality			

Definition of Workflow

Use Case	Before Next TA Meeting	In progress	Completed
<p>Add offline support</p> <p>Add data export functionality</p>	<p>What are the policies that you apply to items and stages?</p>	<p>Add login functionality</p>	

Definition of Workflow

Use Case	Before Next TA Meeting	In progress	Completed
Add offline support		Add login	
Add data export functionality	<ul style="list-style-type: none">• Start and end points• When an item can move from one to another stage or entry/exit criteria• WIP limit. How enforced?• Sorting/prioritization		