Lecture 22:

Software Engineering for UIs: How to create high-quality UIs in the context of Agile and other software development processes

05-431/631 Software Structures for User Interfaces (SSUI)

Fall, 2021

Logistics

- HW5 graded
- HW6 due Thursday

- Need final project groups **today**
  - **See the Google Doc link on Canvas**
  - Longer descriptions are on Piazza

How to organize development process

- "Usability is not a quality that can be spread out to cover a poor design like a thick layer of peanut butter." [Nielsen]
  - "It's the careful and user-centered approach to product strategy, features, structure, interactions, content, **and** aesthetics" -- *cite*
- Like Software Engineering, is a process for developing software to help ensure high quality
  - Need process so have structure, planning, management
- Must plan for and support usability considerations throughout design
  - Including right at the beginning
  - Not enough to discover usability problems at the end

Software Engineering

- "Software engineering is the systematic application of engineering approaches to the development of software" -- Wikipedia
- Aspects of development beyond coding
- Aim to achieve *quality metrics,* including:
  - **Reliability (Availability, Dependability, Robustness)**
  - **Usability**
  - **Efficiency**
    - Of the **development process**
    - And of the **resulting system**
      - Both **speed** and **size**
  - **Security**
  - **Maintainability**

"Usability Engineering"

- Parallel with "software engineering"
- Make use of usability more like engineering:
  - "Engineering"
    - Measurable, process-oriented
    - Not just "art"
- Term coined by John Bennett in the 1980's
  - Nielsen book: 1993
- ISO 13407 & 13529 standards discuss UE process

Usability Engineering

Jakob Nielsen

Some Important Components

- Study the users and their tasks
- Study the competition
- Set usability goals
- Participatory Design
- Guidelines and Heuristic Evaluation
  - Evaluate your interface according to the guidelines.
- Make prototypes of the system early and quickly
- Empirical testing
- Iterative design with usability analysis
- Collect feedback from field use

Know the User

- Study the intended users and the use of the product
  - Best if developers go and interview them personally
- Difficult because
  - May want to hide the developers
  - Reluctance of sales people
  - Reluctance of users
- User Characteristics
  - Work experience, education level, age, previous computer experience
  - Time for learning, training
  - Available hardware (monitor size, acceptance of plugins, cell-phones vs. desktop)
  - Social context of use

“Early Focus on Users and Tasks”

- (From Gould & Lewis article)
- Not just “identifying,” “describing,” “stereotyping” users
  - *Direct contact* through interviews, discussions
  - HCI programs teach *Contextual Inquiry* method for this

"Personas"

- Popularized by Alan Cooper
- User archetype you can use to help guide decisions about design decisions
  - "fictional, yet realistic, description of a typical or target user"
- Created after contextual inquiry or equivalent
  - Must be based on user research
- Summarizes properties of a group of users
  - Focus on properties that are relevant to the design

“Personas”, cont.

- Use: helps keep designers & implementers focused on user needs.
  - “personas support user-centered design throughout a project’s lifecycle by making characteristics of key user segments more salient” cite: https://www.nngroup.com/articles/persona/
- Include: behavior patterns, goals, skills, attitudes, and environment, with a few fictional personal details to bring the persona to life
- Have a small number for each product
  - One for each important group of users
- Special *new* version for identifying gender issues: http://gendermag.org/

Persona Example

From: http://www.steptwo.com.au/papers/kmc_personas/

Bob is 52 years old and works as a mechanic with an organisation offering road service to customers when their car breaks down. He has worked in the job for the past 12 years and knows it well. Many of the younger mechanics ask Bob for advice when they meet up in the depot as he always knows the answer to tricky mechanical problems. Bob likes sharing his knowledge with the younger guys, as it makes him feel a valued part of the team.

Bob works rolling day and night shifts and spends his shifts attending breakdowns and lockouts (when customers lock their keys in the car). About 20% of the jobs he attends are complex and he occasionally needs to refer to his standard issue manuals. Bob tries to avoid using the manuals in front of customers as he thinks it gives the impression he doesn't know what he's doing.

Bob has seen many changes over the years with the company and has tried his best to move with the times. However he found it a bit daunting when a new computer was installed in his van several years ago, and now he has heard rumours that the computer is going to be upgraded to one with a bigger screen that's meant to be faster and better.

Bob's been told that he will be able to access the intranet on the new computer. He has heard about the intranet and saw once in an early version on his manager's computer. He wonders if he will be able to find out want's going on in the company more easily, especially as customers' seem to know more about the latest company news than he does when he turns up at a job. This can be embarrassing and has been a source of frustration for Bob throughout his time with the company.

Bob wonders if he will be able to cope with the new computer system. He doesn't mind asking his grandchildren for help when he wants to send an email to his brother overseas, but asking the guys at work for help is another story.

Task analysis

- What tasks the users will do?
- Involve users in this
- Important to include exceptions and error conditions
- Many different kinds and variations on Task Analyses
  - Nielsen’s
  - “Hierarchical Task Analysis”
  - Can also use Contextual Inquiries (CIs)
- Need tasks to design CIs, usability analysis, scenarios

User-Centered Task Analysis

- Based on what user will do
  - Not what system will do
- Not a list of system features
- High-level
- Nothing about how to accomplish at user level
  - No discussion of web pages, buttons, filling in fields, etc.
- Example, company YYY menu structure based on functions rather than tasks => Inefficient for every task!

Components of Task Analysis

- Goals:
  - What are the actions this task is supposed to accomplish?
  - Remember: not *how* it will be done, just *what*
  - Thinkalouds reveal *why*
- Information needs
  - What does the user need to know or view to do this task?
  - Includes what needs to be on the screen.
  - Both:
    - What does the system need to show?
    - What does the user need to know?

Task Analysis: Scenarios

- Scenarios (stories) of typical uses:
  - “Journey Maps”
  - Related to software engineering "use cases"
  - Specific example of how a user might use the system.
  - One scenario for each major class of users doing each kind of important task
  - Will want to make those tasks efficient and easy
  - What is important to optimize?
  - Will significantly affect the design
  - Try to include lots of exceptional cases
  - Shows how the interface will be used

Functional analysis

- What really needs to be done
- Not just the way users are doing it now
  - May be a more efficient or more appropriate way to achieve same task
- Usually, companies are good at this
  - However, may include extra functions that are not useful

Competitive Analysis

- “Know the competition”
- For usability and function
- Read trade-press reviews of products or web sites
- Visit competitor’s web sites
  - Also, web sites for related products
- Importance of various features, issues
  - Pictures, navigation, search, prices, shipping, metaphors

Goal Setting

- What does it mean to be “easy to use”?
- Some proposed definitions:
  - “I like it”
  - “I always do it that way”
  - “That is the way the xxx system does it”
  - “It is easy to implement”

Much better Goals:

Much better Goals:

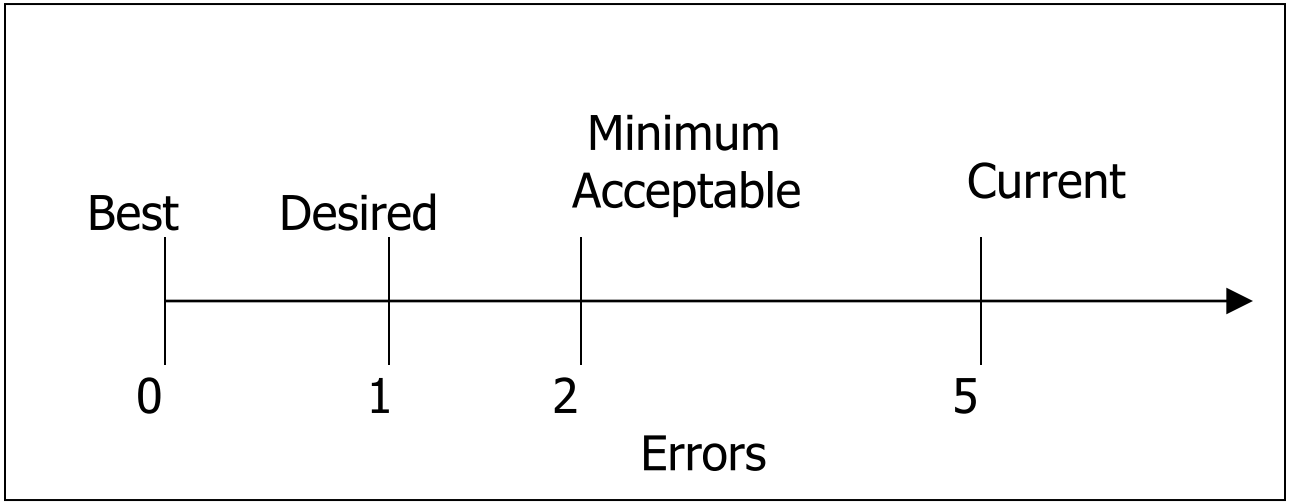
  - Can be learned in less than 2 minutes
  - User will perform 2 error-free purchases per session
  - The error rate will be lower than 2 per 10 operations
  - Tasks will be performed in 30% of the time it takes using the competitor's system
  - Users will have a high satisfaction with the system as measured by a survey.
- *Explicit, specific, measurable metrics.*
- *Allows objective decision making.*

Goals, cont.

- Tradeoffs, so have to pick relevant metrics
- Some measures:
  - Learnability: Time to learn how to do specific tasks (at a specific proficiency)
  - Efficiency: (Expert) Time to execute benchmark (typical) tasks. Throughput.
  - Errors: Error rate per task. Time spent on errors. Error severity.
  - Lots of measures from web analytics:
    - Abandonment rates, Completion rates, Clickthroughs, % completions, etc.
  - Subjective satisfaction: Questionnaire.

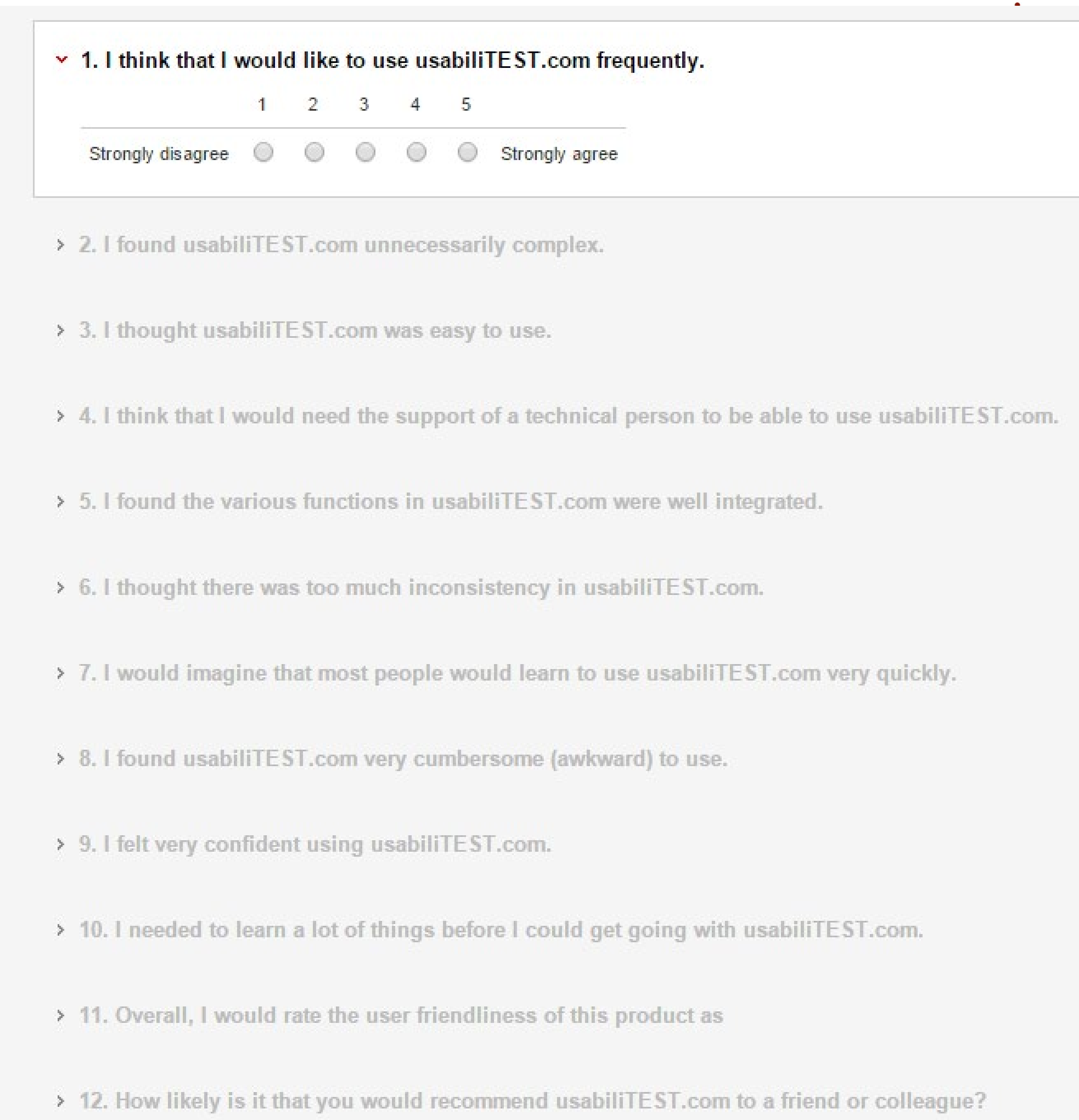
Goal Levels

- Pick Levels for your system:
  - Minimum acceptable level
  - Desired (planned) level
  - Theoretical best level
  - Current level or competitor's level



Example of validated survey

http://www.usabilitest.com/uxxc4jP



1. I think that I would like to use usabiliTEST.com frequently.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

2. I found usabiliTEST.com unnecessarily complex.

3. I thought usabiliTEST.com was easy to use.

4. I think that I would need the support of a technical person to be able to use usabiliTEST.com.

5. I found the various functions in usabiliTEST.com were well integrated.

6. I thought there was too much inconsistency in usabiliTEST.com.

7. I would imagine that most people would learn to use usabiliTEST.com very quickly.

8. I found usabiliTEST.com very cumbersome (awkward) to use.

9. I felt very confident using usabiliTEST.com.

10. I needed to learn a lot of things before I could get going with usabiliTEST.com.

11. Overall, I would rate the user friendliness of this product as

12. How likely is it that you would recommend usabiliTEST.com to a friend or colleague?

Financial impact analysis

- Prove It!
- Demonstrates the importance of usability
- # users * their salary per hour * # hours on system = cost of system per hour
  - $39,000, $613,000, $8,200,000
- Estimate savings of reduced training, error time, need for support staff, etc.
  - Support calls can cost $30 - $100 per call
- Tells how much time to spend on usability
- Whole books on this topic:
  - Randolph G. Bias and Deborah J. Mayhew, Eds. Cost-Justifying Usability: An Update for the Internet Age, Second Edition. Morgan Kaufmann, 2005
  - Randolph G. Bias and Deborah J. Mayhew, Cost-Justifying Usability, Boston: Academic Press, 1994.

Participatory Design

- Users involved during the design process through regular meetings
  - Not just at the beginning during Contextual Inquiry
- Users are good at reacting to concrete designs and prototypes
- But users are not necessarily good designers

Prototypes

- Simulation of interface
- Quick and cheap to create (no “back end”)
- Start with “low fidelity”
- Progress to higher-fidelity

Use Guidelines and Heuristic Analysis

- Designers evaluating the Interface
- Based on their experience
- Especially Consistency:
  - Most important characteristic of UI
  - Requires oversight
    - Not each department creating own section
  - May require overall design document, vocabulary guide, style guide, templates, etc.
  - Especially when using Agile design (covered later)

Empirical Testing

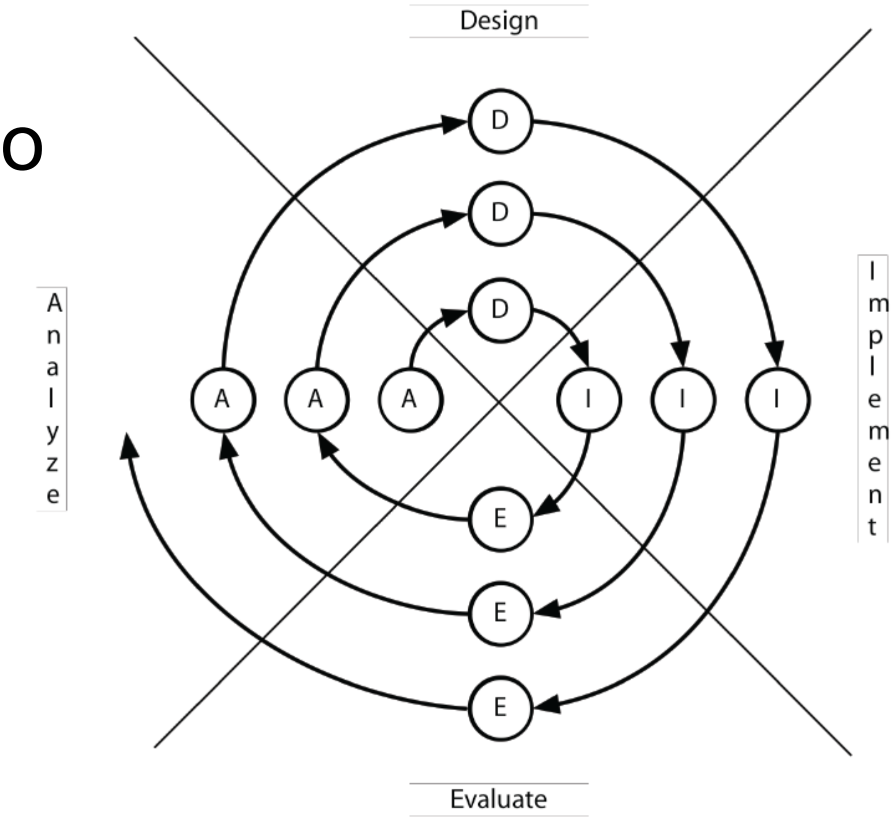
- Critical to usable products
- Designers must watch users
- Web logs are not sufficient
- Not necessarily difficult or expensive
- Test low-fidelity prototypes, high-fidelity prototypes, final system

Iterative design

- Redesign interface based on evaluation
- New design may be worse or may break something
- Keep track of reasons for design decisions
  - Called "Design Rationale"
  - So don't need to keep revisiting the same decisions
  - When future conditions suggest changing a decision will remember why made that way and what implications for change are.
- Instead of arguing about a design feature, figure out what information would tell you which way to go
  - Experiment, marketing data, etc.

Iterative Design

- Empirical testing with intention to fix the problems
- Not just goals ("be easy to use"), but a process to achieve the goals
- Successively higher-fidelity designs
- Spiral model from (Boehm, 1988)

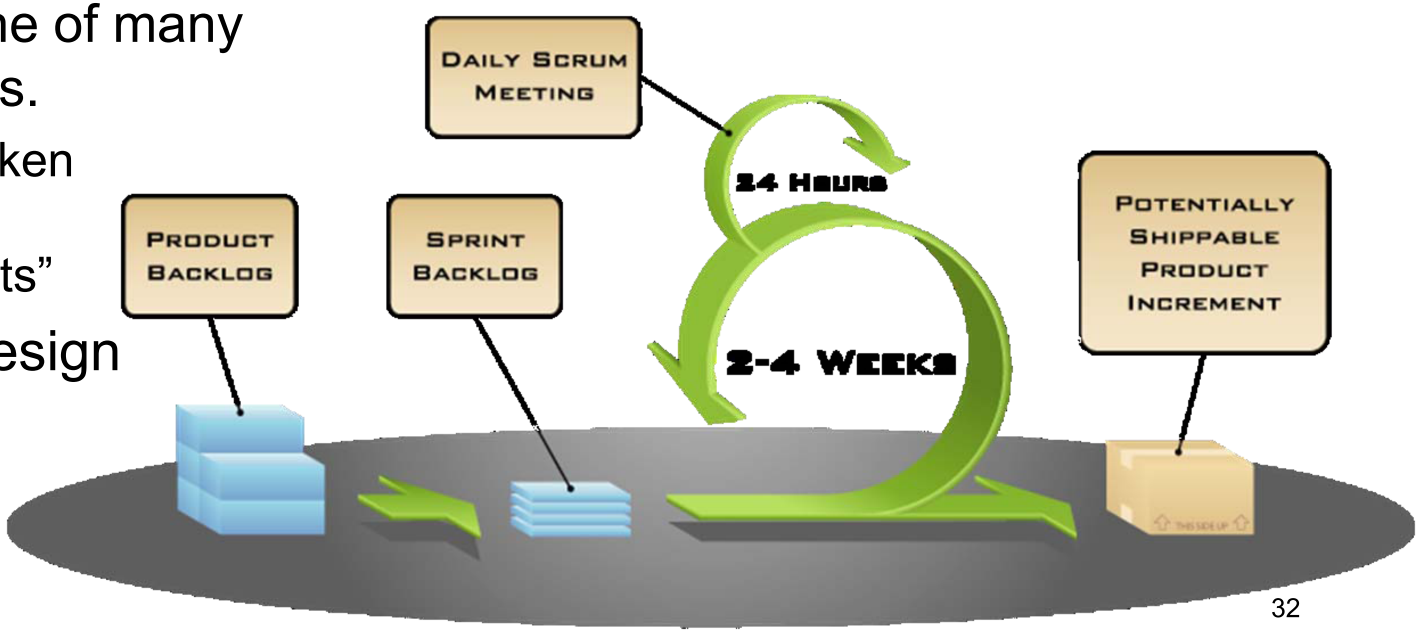


Measure Real Use

- Follow-up after release
- For the next version
- From bug reports, trainers, initial experiences (for conventional applications)
- From web logs, reports, customer support

Agile Development

- Agile has taken over the software-development world
  - “eXtreme Programming” (XP)
  - How does that interact with usability methods?
  - Agile = “development iterations, teamwork, collaboration, and process adaptability throughout the life-cycle of the project.” – Wikipedia
  - See “agile manifesto”: http://agilemanifesto.org/
  - “Scrum” is one of many agile methods.
    - Work is broken into 2 to 4 week “sprints”
  - Avoid “big design up front”



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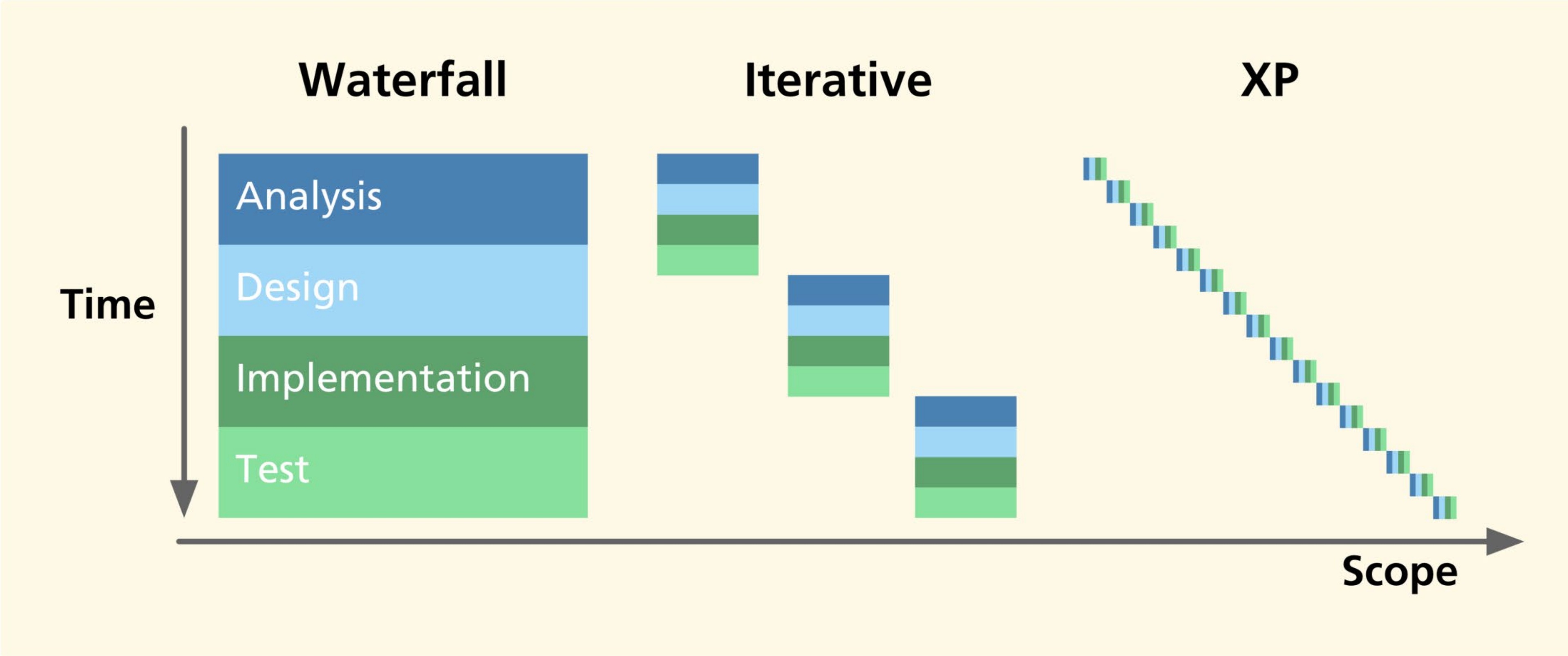
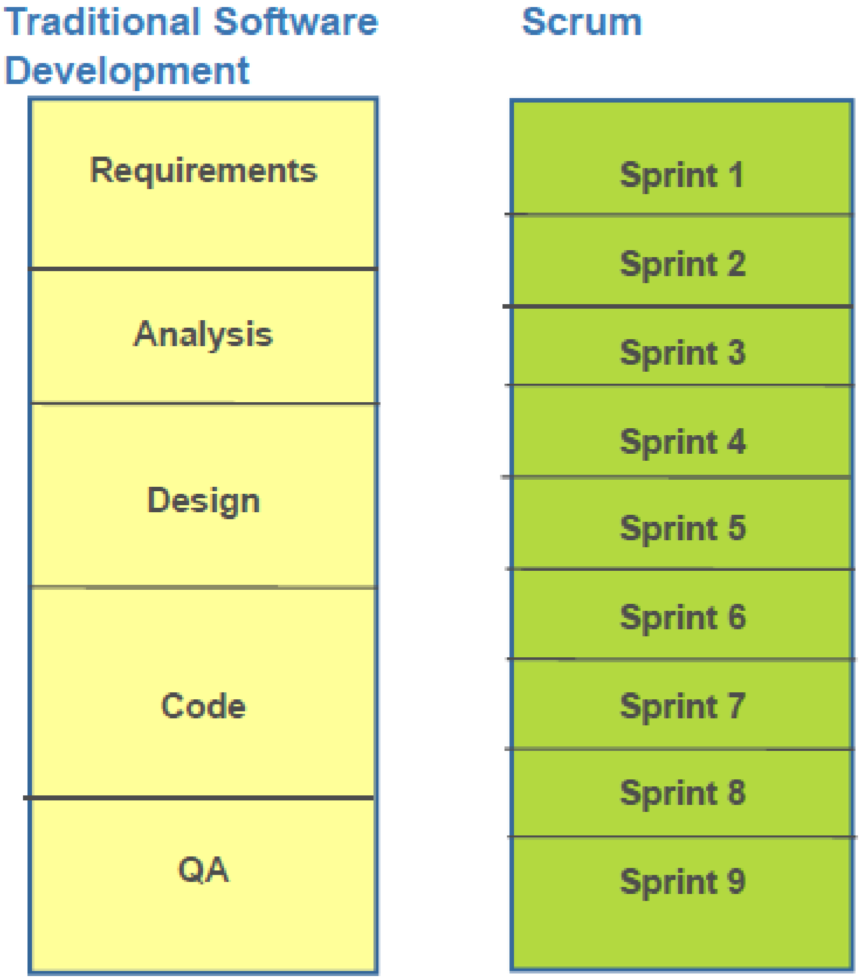
Waterfall, Iterative, XP



- from Fig. 19-1 of [Hartson & Pyla, *The UX Book*, 2012]

Scrum vs. traditional software development



Traditional Software Development

Requirements

Analysis

Design

Code

QA

Scrum

Sprint 1

Sprint 2

Sprint 3

Sprint 4

Sprint 5

Sprint 6

Sprint 7

Sprint 8

Sprint 9

Michael Budwig, http://doi.acm.org/10.1145/1520340.1520434

Shared Design and Implementation Space

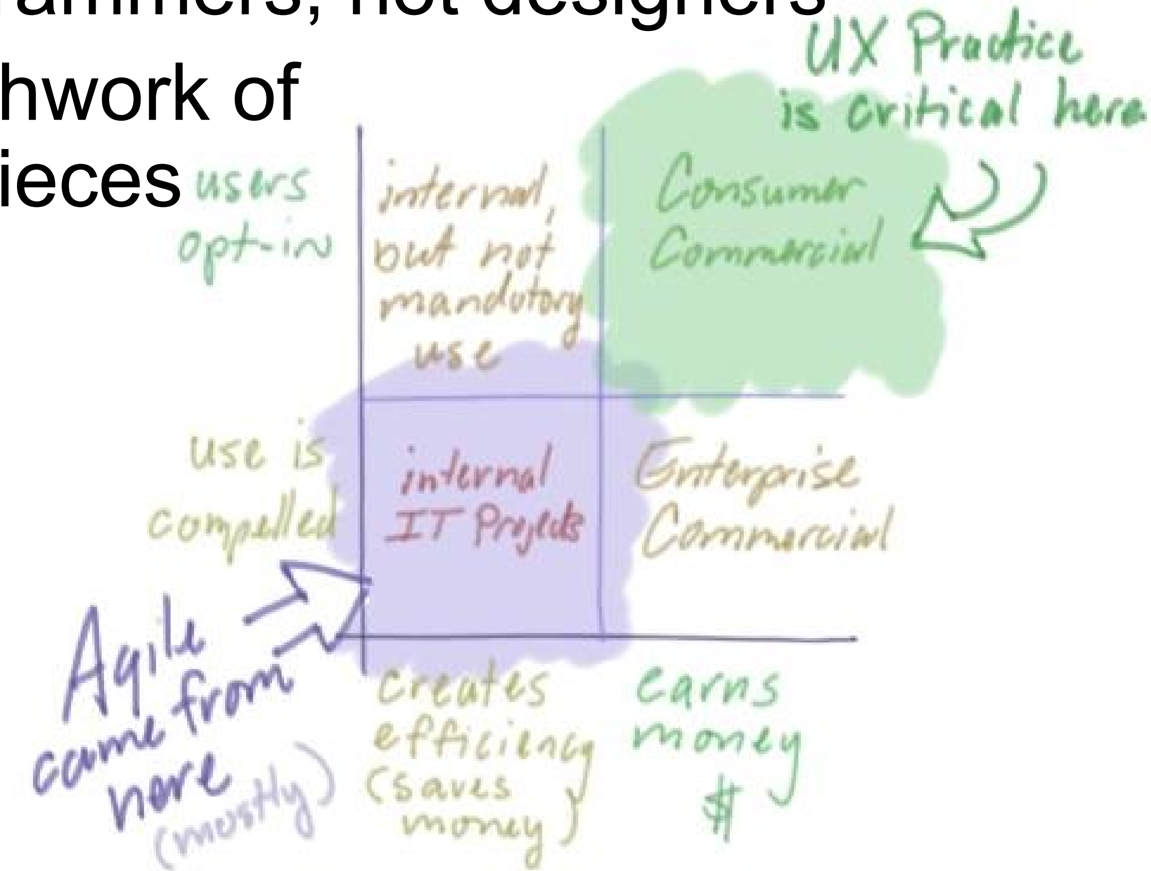
- “Radical co-location”

http://agileproductdesign.com/blog/emerging_best_agile_ux_practice.html

- Lots of new research about remote work during pandemic

Issues with Agile UX

- Created by programmers, not designers
- UI might be patchwork of non-integrated pieces
- Reducing documentation → not capturing design rationale
- No mention of iteration on *UI design*


UX Practice is critical here
users opt-in
internal, but not mandatory use
Consumer Commercial
use is compelled
internal IT Projects
Enterprise Commercial
Agile came from here (mostly)
creates efficiency (saves money)
earns money $

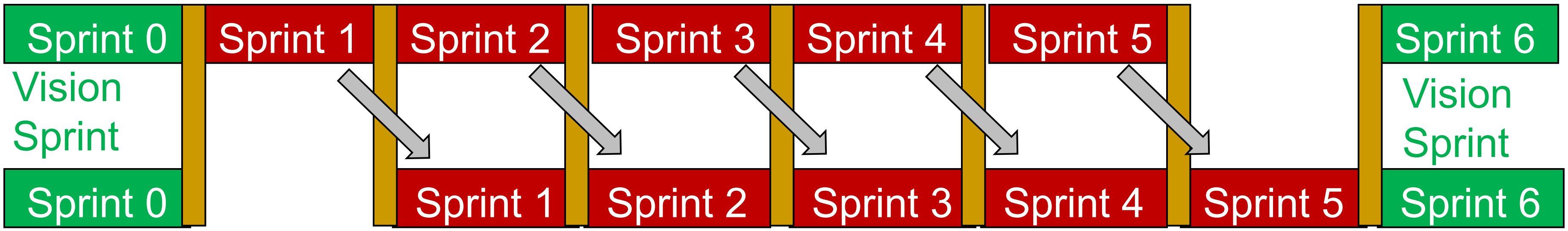
http://agileproductdesign.com/blog/emerging_best_agile_ux_practice.html

Report from PayPal

- Courtesy: Michael Budwig, User Experience Manager, Customer Experience and Merchant Solutions, PayPal, “When user experience met agile: a case study”, SIGCHI’2009, pp. 3075-3084. http://doi.acm.org/10.1145/1520340.1520434
- Separate UX team, worked 1 or 2 sprints ahead of developer teams
- Design vision sprint every 3-6 months
- Worked well

See also Fig. 19-7 of [Hartson & Pyla, *The UX Book*, 2012]

UX team



Sprint 0 Vision Sprint
Sprint 1
Sprint 2
Sprint 3
Sprint 4
Sprint 5
Sprint 6 Vision Sprint

Sprint 0
Sprint 1
Sprint 2
Sprint 3
Sprint 4
Sprint 5
Sprint 6

Dev Scrum team

Debate: UX Team Centralized or Distributed?

- (Applies to all development processes)
- Centralized UX team services all projects
  - Leverages resources, expertise
    - Can have UI people with various skills: design, testing, etc.
  - UI team has close colleagues
  - Manager of UI people better able to judge quality UI work
  - But doesn't get to know products well
- Distributed puts UX people into each project
  - More influence with project since always there
  - May not have appropriate skills
  - Team may not need UI person full-time
  - HCII Seminar talk by ANSYS – uses this organization
    - Cite with video: http://www.hcii.cmu.edu/news/seminar/event/2016/10/how-ux-techniques-promote-simulation-software-everyone
  - May work better for Agile – Nielsen http://www.useit.com/alertbox/agile-user-experience.html

Many More Resources for "Agile User-Centered Design"

- https://www.nngroup.com/topic/agile/ - dozens of articles and videos
  - Don Norman: "The Changing Role of the Designer: Practical Human-Centered Design" June 5, 2020, 4 minute video
  - Rachel Krause, "Tracking Research Questions, Assumptions, and Facts in Agile", December 15, 2019, article
  - Nielsen's Alertbox: "Agile Is not Easy for UX: (How to) Deal with It", September 24, 2017, article
  - Nielsen's Alertbox: "How Iterative Testing Decreased Support Calls By 70% on Mozilla's Support Website", August 2, 2015, article
  - Nielsen 2-minute video "Does Agile Destroy UX?": article
  - Nielsen's Alertbox: "Agile User Experience Projects", Nov. 4, 2009, article & expensive 119-page report: http://www.nngroup.com/reports/agile/
- "The Agile UX Development Lifecycle: Combining Formative Usability and Agile Methods," 04 Jan 2017 http://scholarspace.manoa.hawaii.edu/handle/10125/41219
- P. McInerney and F. Maurer, "UCD in agile projects," Interactions, vol. 12, no. 6, pp. 19-23, 2005. http://dl.acm.org/citation.cfm?doid=1096554.1096556
- *Google "Agile User-Centered Design" returns many relevant resources*