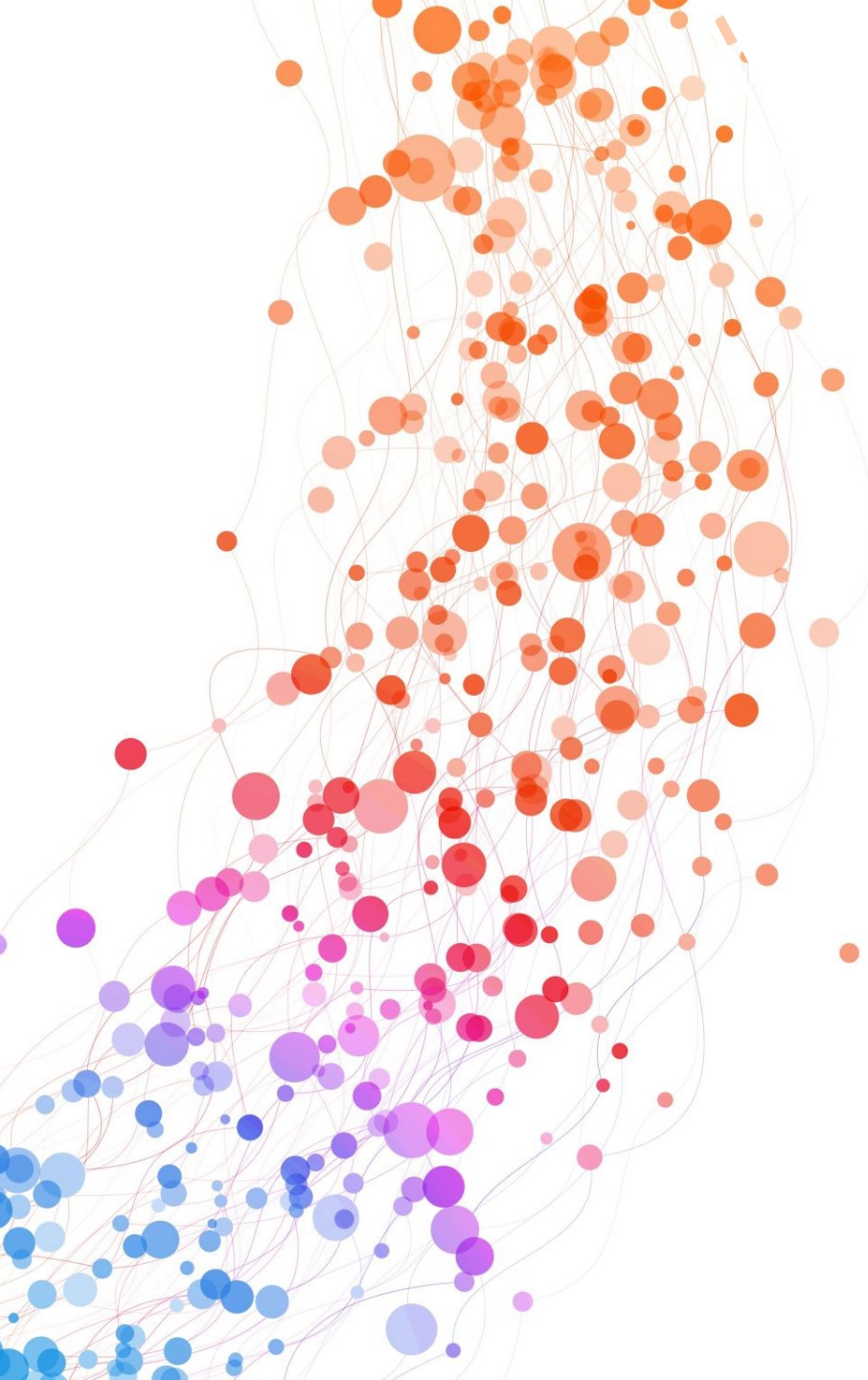
Software Engineering COMP1035

Lecture 08

Prototyping

Today's Learning Outcomes

1. Prototypes are high level designs to help to develop system requirements/specifications.
2. There are different types of prototypes – to test different ideas.
3. They are good for "communicating" and checking those ideas.
4. Prototyping risks.
5. Prototyping tools.



What are Prototypes?

System Requirements >> Prototypes

- System requirements/specifications are
  - Good for a **checklist of things to achieve**.
  - Hard to undersand (unless you wrote them) the overall idea.
  - Often full of conflicting specifications.
  - Bad for conveying the overall idea.

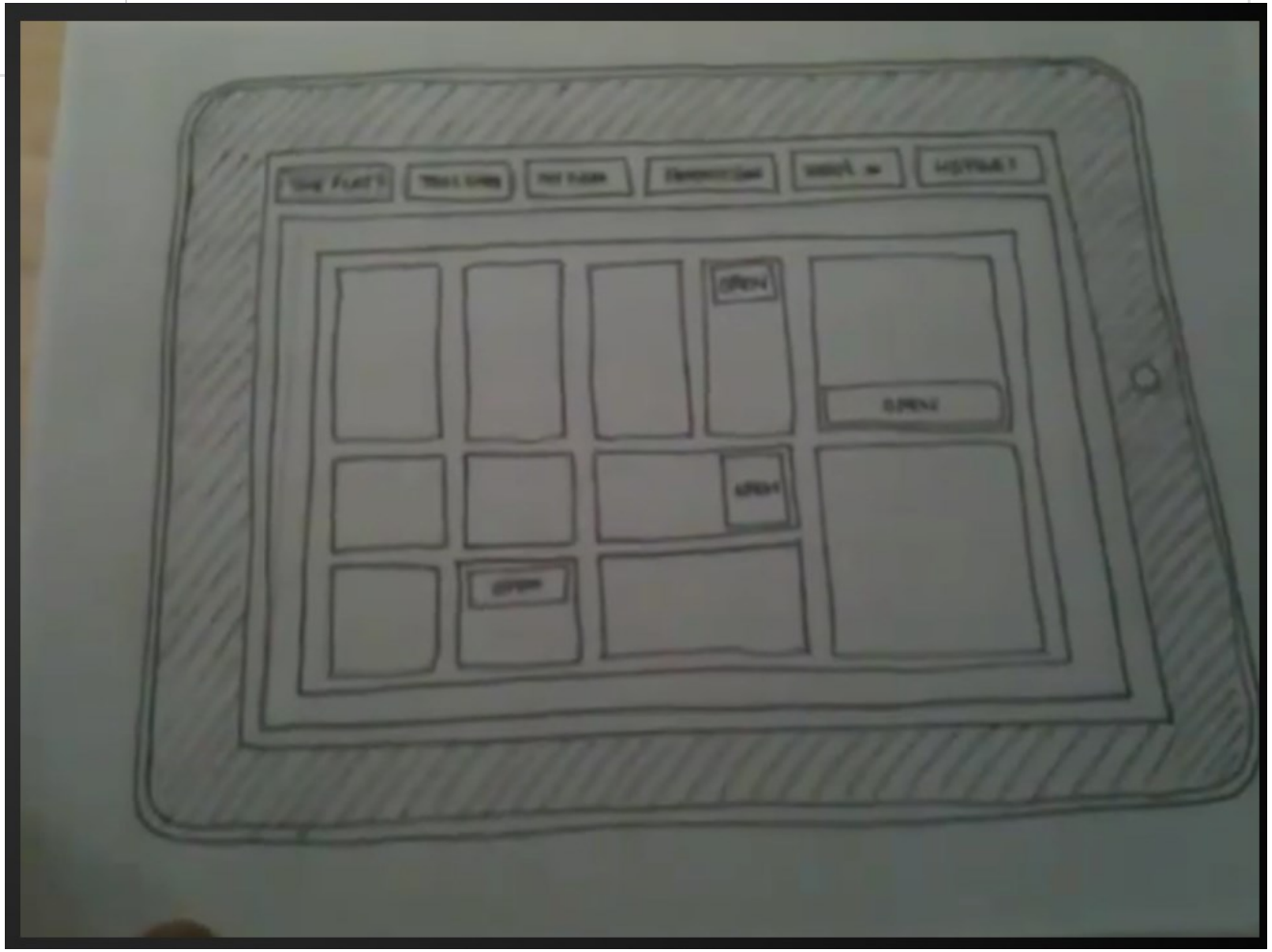
- Prototypes are
  - A way of **envisioning how all your specifications work together**.
  - A way of testing the consistency of your specifications.
  - Easy to show people and talk about.

System Requirements >> Prototypes

3.1 Capability or Functional Requirements

The requirements associated with the functionality of the APAF ground data system are itemized in the table below. The mnemonic, *FR*, is used in the requirement identifiers to show that these requirements are *F*unctional *R*equirements unless otherwise specified.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-FR-01	The APAF system shall acquire from ESOC the telemetry data of the ASPERA-3 Experiment and Mars Express Orbit/Attitude.	Demonstration	ESOC Data Disposition system Interface Document	To automatically process the data on a daily basis.
APAF-FR-02	The APAF system shall process all ASPERA-3 science data into IDFS data sets.	Demonstration and Analysis	Proposal, NASA Discovery Office Program-Level Requirements	Section 4.1.1 of Program-Level Requirements, Baseline Science Requirements. APAF PDMP
APAF-FR-03	The APAF system shall process the engineering and ancillary information necessary for calibration and science validation into IDFS data sets.	Demonstration and Analysis	NASA Discovery Office Program-Level Requirements	Section 4.5.1, Science Data Management
APAF-FR-04	Intermediate files of cleaned-up ASPERA-3 and MEX OA telemetry shall be generated in the event that cleaned-up telemetry is not provided by ESOC.	Demonstration and Analysis	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-FR-05	The ASPERA-3 and MEX OA telemetry data shall be stored on a local SwRI archive.	Demonstration	APAF Project Data Management Plan	For data availability and re-processing
APAF-FR-06	The ASPERA-3 and MEX OA IDFS data sets shall be stored on a local SwRI archive.	Demonstration	APAF Project Data Management Plan	For data availability and analysis
APAF-FR-06a	Any APAF-generated intermediate files of ASPERA-3 and MEX OA cleaned-up telemetry shall be stored on a local SwRI archive.	Demonstration	APAF Software Requirements Review Minutes	For data availability and re-processing, and to support the ASPERA-3 team
APAF-FR-07	Web-based displays of the most current ASPERA-3 data shall be provided for public view.	Demonstration	APAF Project Data Management Plan	E/PO and monitor instrument performance
APAF-FR-08	Web-based displays defined by the ASPERA-3 team shall be provided where any available ASPERA-3 data (as opposed to just the most current) can be used for science analysis.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives



What are Prototypes?

- A prototype is a concrete but partial representation or [partial] implementation of a system.

”System Prototyping, where a version of the system or **part of the system is developed quickly** to check the customer’s requirements and the feasibility of some design decisions”

- Prototypes are used extensively in most design and construction domains.

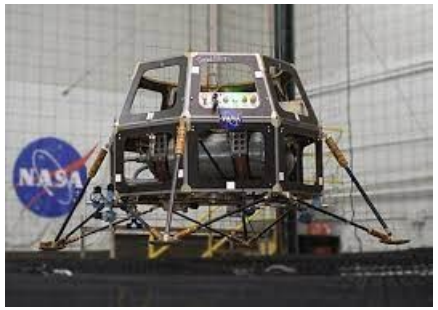
What are Prototypes?

- Can be used in a software development process to help anticipate changes:
  - **Requirement engineering process** – help with elicitation and validation of system requirements.
  - **System design process** - used to explore software solutions and in the development of a user interface for the system.

Kelly, T. J. (2012). Moon Lander: How we developed he Apollo lunar module. Smithsonian Institution.

Prototyping in Engineering

- Nasa engineers built full-size prototypes of moon lander.
- Check visibility through windows, control etc.
  - Whilst reducing weight ratio.
- Decided that astronauts should stand and not sit, to reduce window size and save overall weight.



https://edition.cnn.com/2012/08/09/us/nasa-test-crash/index.html

TM-1

Our next mockup was a full-sized wooden model of the complete LM, descent and ascent stages, containing as much engineering detail as we could get into it before the review in March 1964. Its focus was on the crew compartment—especially the support and restraint, displays and controls, equipment stowage, and lighting—and on egress to the lunar surface. We were able to include realistic mockups of some equipment, such as the ascent and descent, engines, environmental control system components, and radar and communications antennas. Working models of the hand controllers with which the astronauts would fly the LM were provided at both pilot stations, allowing the crew to experience the tactile feel of the controls as they stood in flight position hooked into the support and restraint devices.

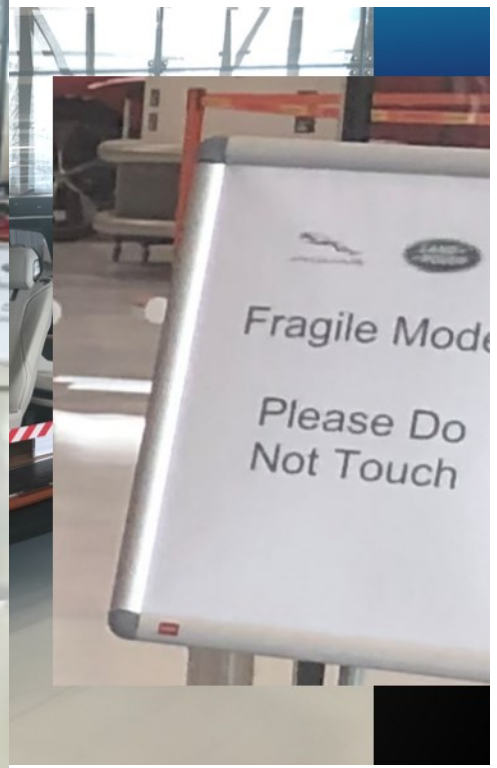
M-1

As our ideas took shape for the standup crew position and cylindrical flat-faced crew compartment with canted triangular windows, we checked out their feasibility in a simple wood-and-foam-board mockup of the forward interior portion of the cockpit. We converted this mockup into drawings and sketches from which the more complete M-1 could be made, adding the tanks, rocket engine bell, electronic equipment bay, antennas, and other external features of the LM ascent stage. Throughout spring and early summer 1963 the engineering design groups added to this mockup design definition. A formal review of M-1 was scheduled with NASA for mid-September.

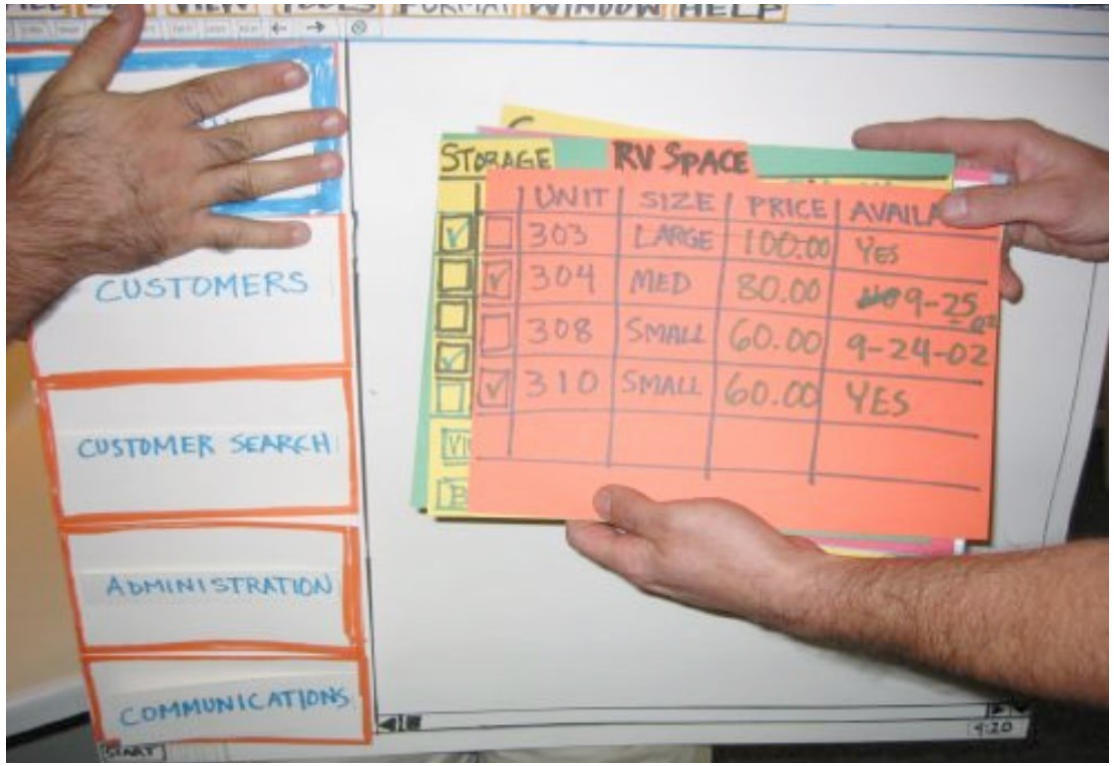
Low vs High Fidelity

Low vs High Fidelity

Low vs High Fidelity

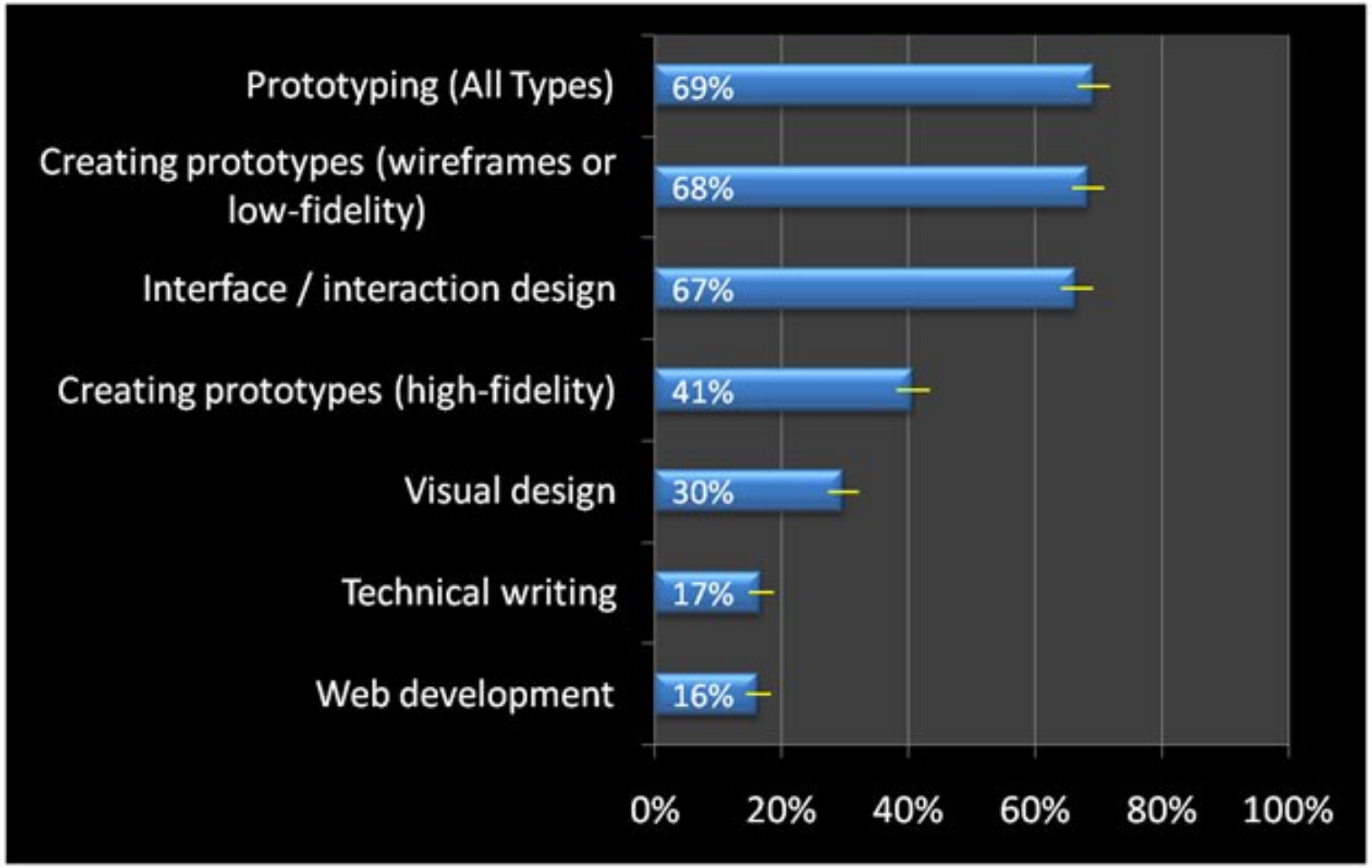


Low vs High Fidelity



Low vs High Fidelity

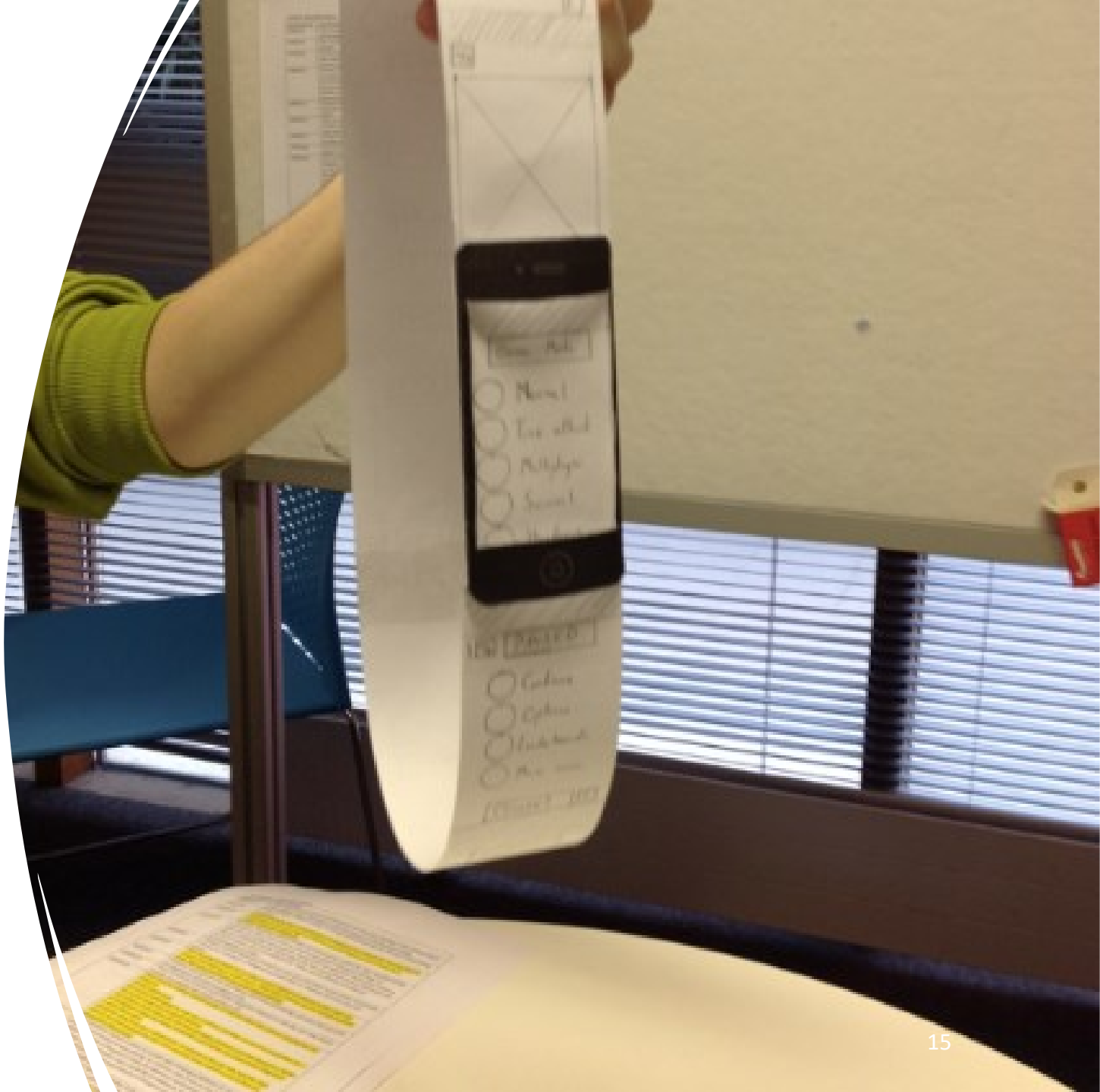
https://measuringu.com/ux-methods/



Low Fidelity: Sketching

Low Fidelity: Sketching

Paper prototype by UNUK student X years ago.



Low Fidelity Prototyping

Snyder 2003 – Paper Prototyping – the fast and easy way to design and refine user interfaces.

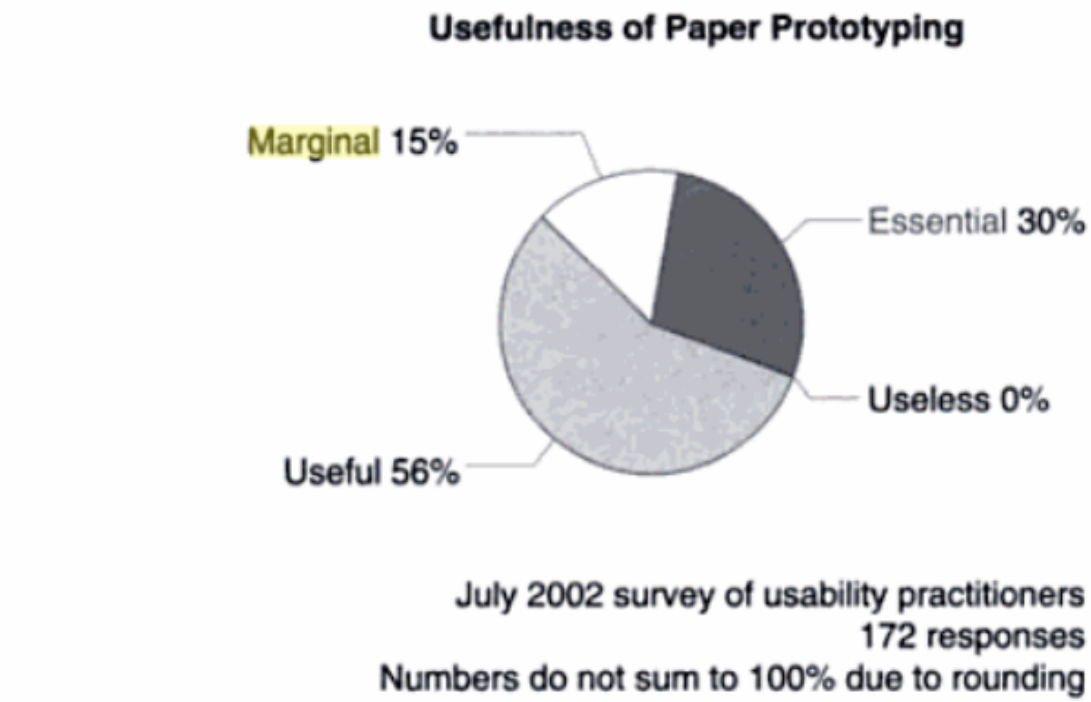
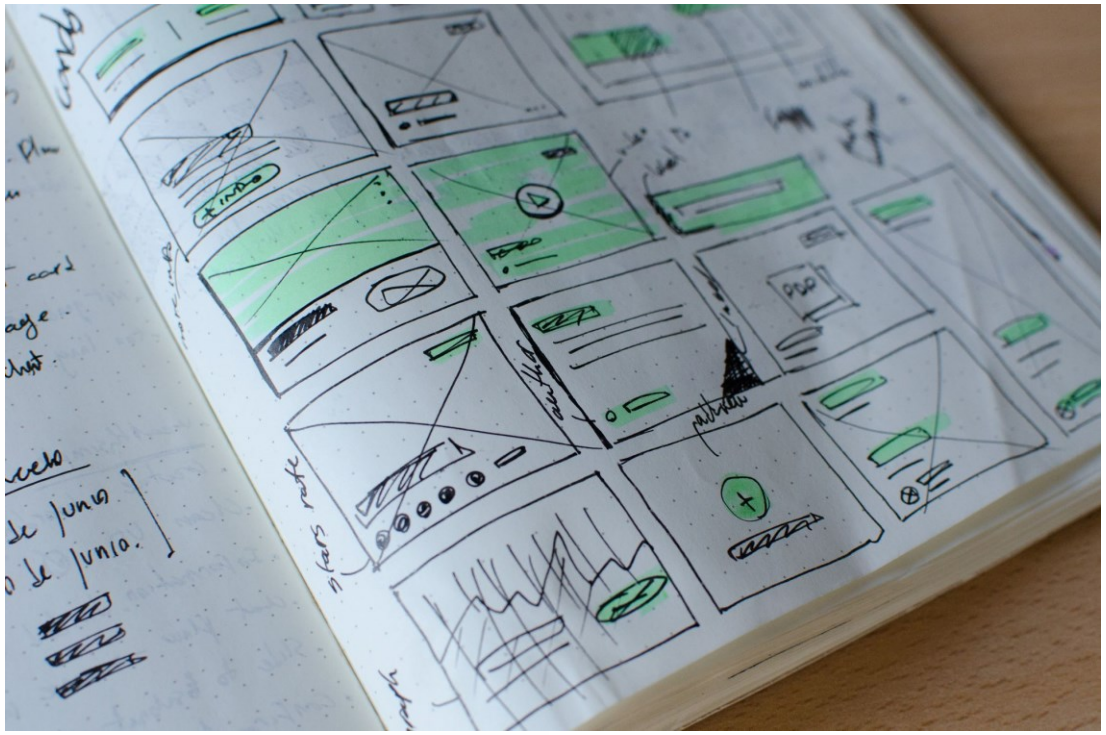
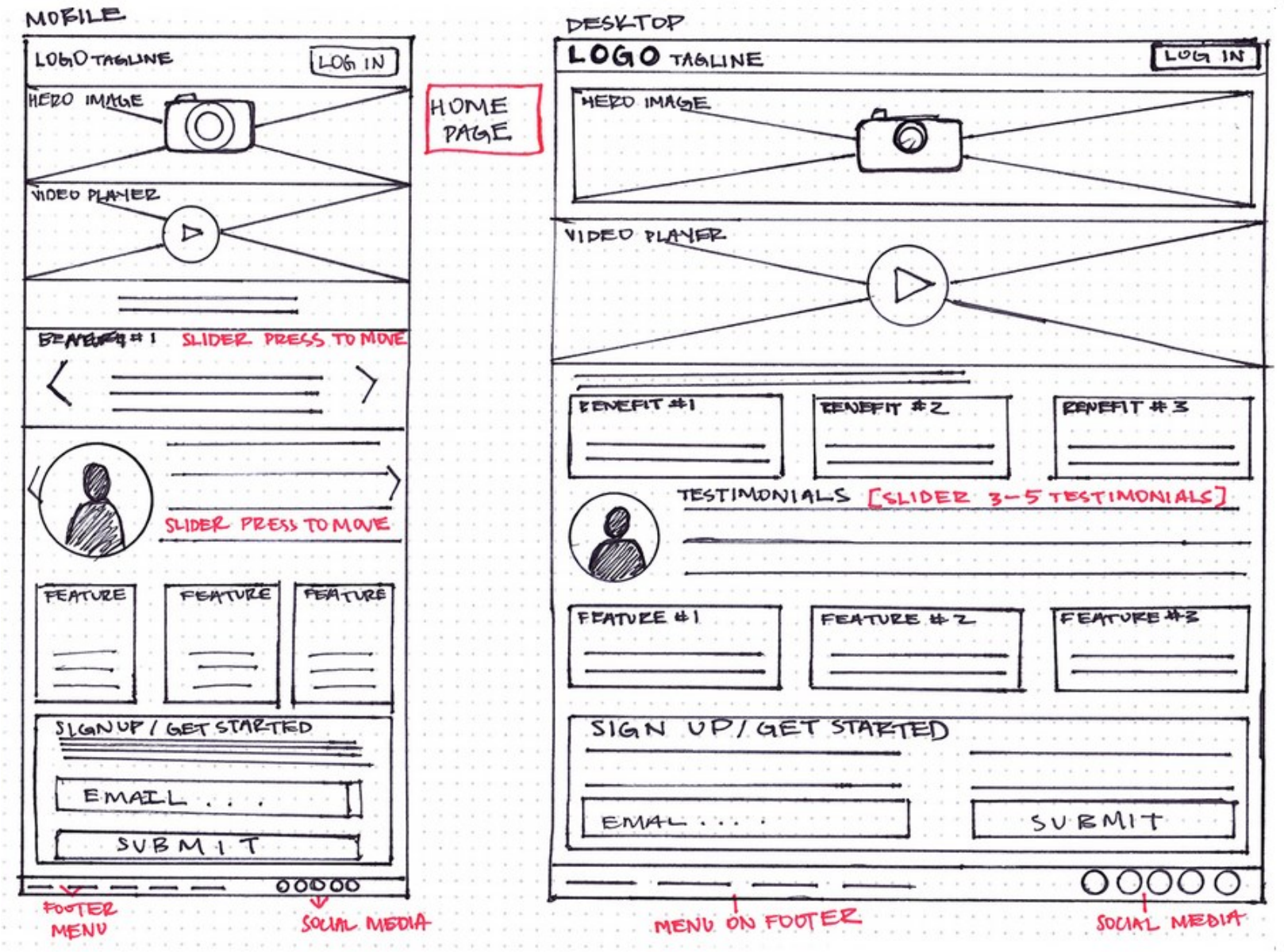


Figure 1.12 Answers to the question, "What is the importance of paper prototyping to your work?" from a July 2002 survey of usability professionals.



Low Fidelity: Wireframing



Low vs High Fidelity

Low Fidelity

- E.g., sketches/'Paper' prototypes.
- Focused on underlying ideas.
- Key functionality, content etc.
- Produced quickly.
- **Thrown away**.
- Generates many possible ideas.
- **Help client acceptance**.

High Fidelity

- Built in software for automation.
- Similar style to final product.
- Accurate detail is important.
- Finalize chosen ideas.
- Still thrown away.
- Used in realistic studies.
- Helps client acceptance.

Low vs High Fidelity

- Low-fidelity – it captures the point, the functions etc.
  - To help improve the ideas.

- High-fidelity – represents **part** of the reality.
  - To agree on the final designs.
  - E.g., the finalised look and feel.
  - E.g., the finalised functionality.

Is This High or Low?

What Are You Prototyping?

Defining Prototype Goals

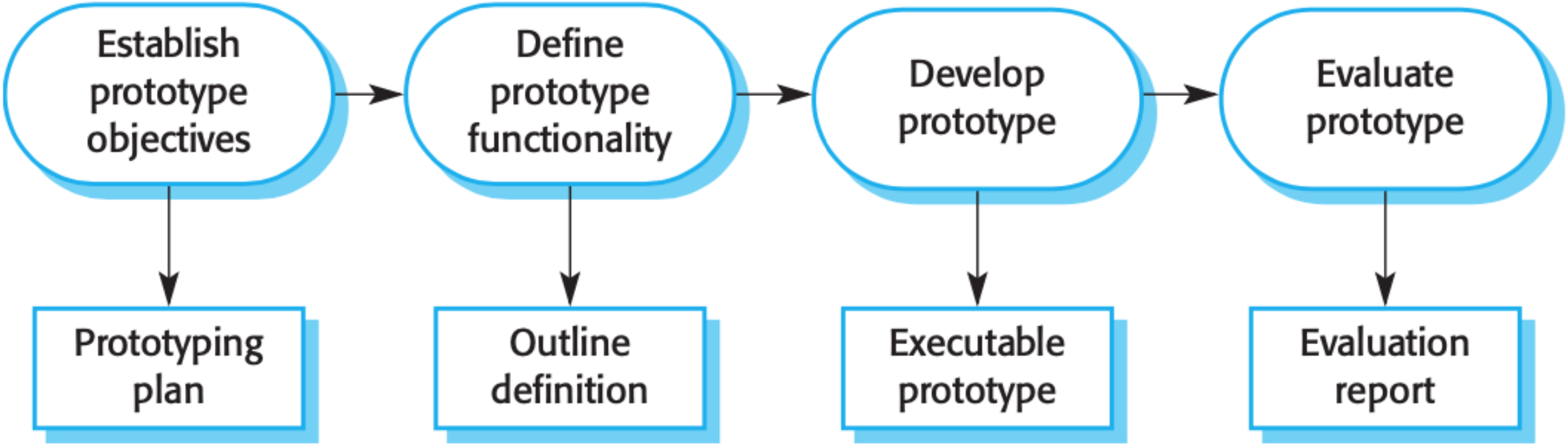
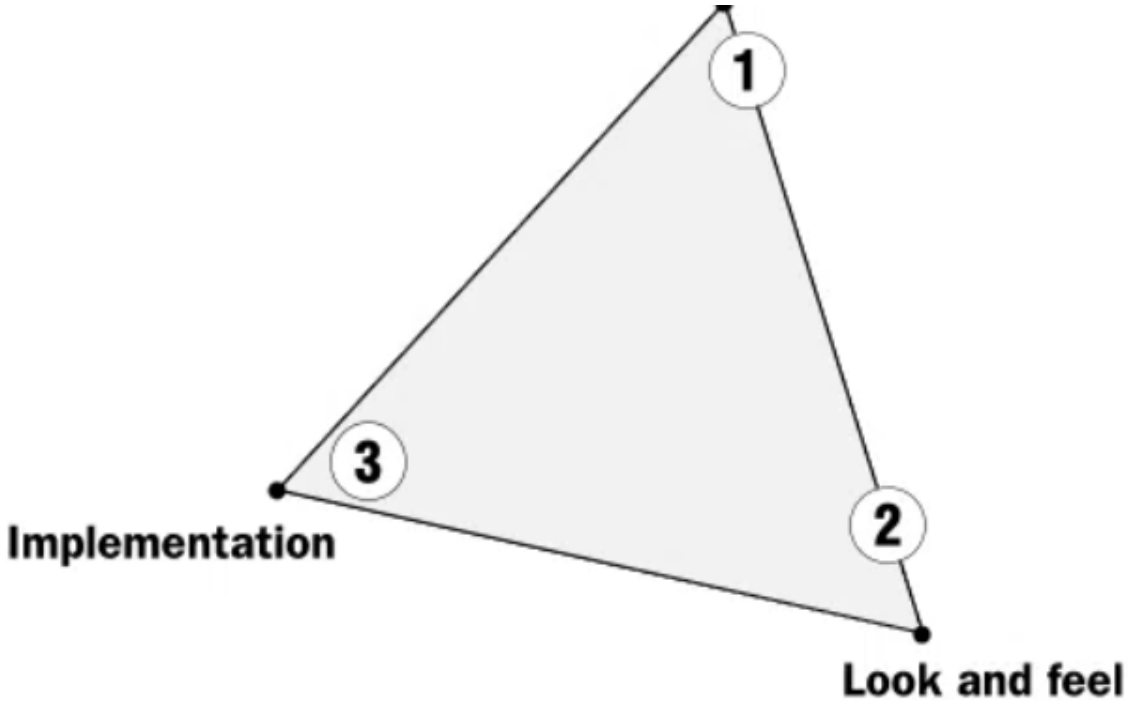


Fig: Prototype Development

3 Purposes of Prototype

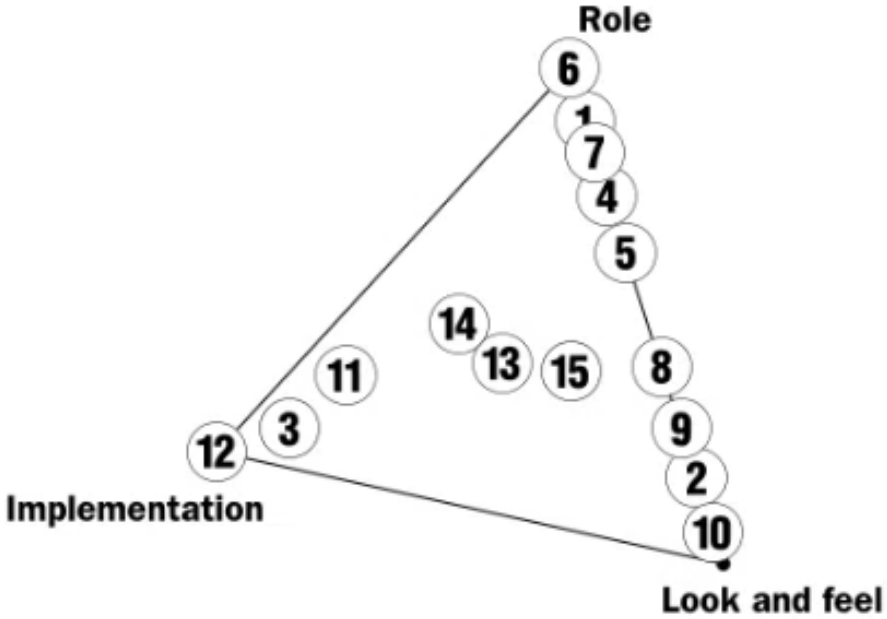


- Prototypes fill a **purpose**.
  1. Role of technology.
  2. Look and Feel.
  3. Implementation Guide.
- UI Designers do #2.
- Powerpoint or paper prototypes do more #1.
- Apple Knowledge Navigator.
  - Aimed at all employees (company vision).
  - Does #1 – Does Not Do #2 or #3.

Apple Aren’t the Only Ones

- Nokia 2006: https://www.youtube.com/watch?v=_-oPJTzPoc4
- Nokia 2009: https://www.youtube.com/watch?v=A4pDf7m2UPE
- Nokia 2015: https://www.youtube.com/watch?v=sXbPxDBzo7k
  - Includes several things
    - Personas
    - Scenarios
    - Prototype concepts.
- Microsoft: https://www.youtube.com/watch?v=w-tFdreZB94

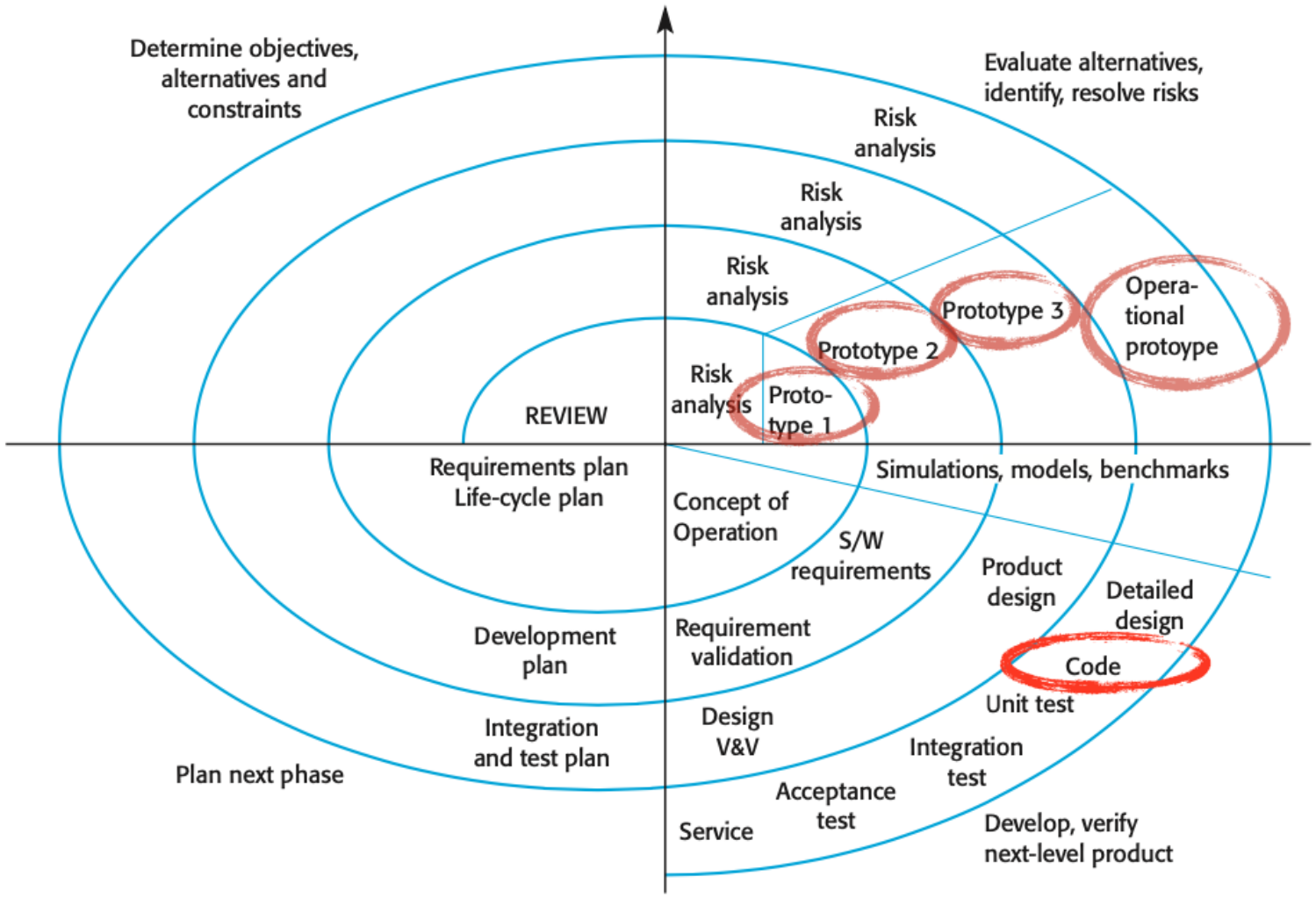
Prototypes >> Implementation



- Prototypes help everyone to **image what we are building**.
  - The customer, the manager, the developer etc.
- But we still need to be able to tell a developer.
  - You go and build X.
  - Look & Feel does it for UI Devs.
  - Powerpoints could guide Implementation.
- Sometimes we **code up prototypes**.
  - These should be partial implementations.

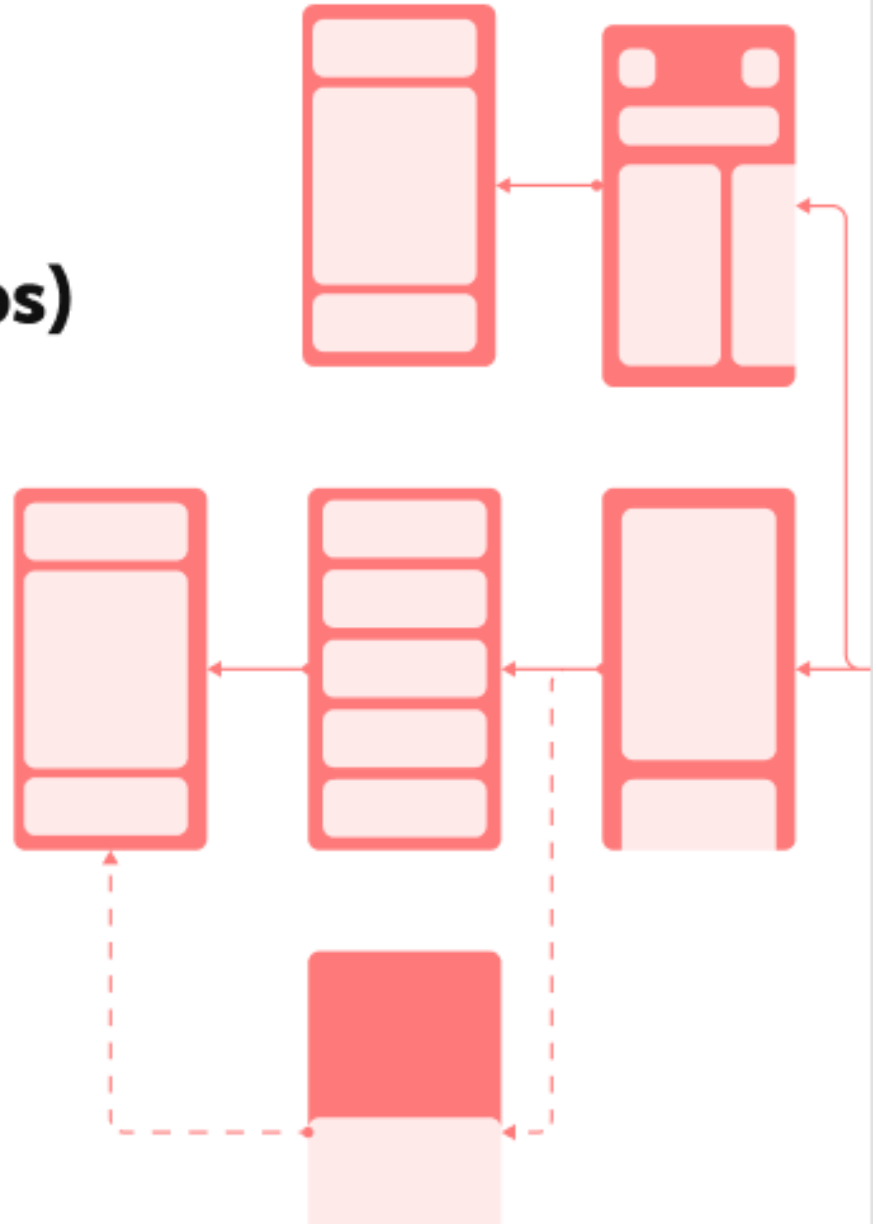
1. *3D space-planning (role)*
2. *3D space-planning (look and feel)*
3. *3D space-planning (implementation)*
4. *Storyboard for portable notebook computer*
5. *Interactive story, operating system user interface*
6. *Vision video, notebook computer*
7. *Appearance model, integrated communicator*
8. *Animation, fashion design workspace*
9. *Look and feel simulation, child's toy*
10. *Pizza-box, architect's computer*
11. *Working prototype, digital movie editor*
12. *C++ program listing, fluid dynamics simulation*
13. *Integrated prototype, sound browser*
14. *Integrated prototype, pile metaphor*
15. *Integrated prototype, garment history browser*

Prototypes >> Implementations

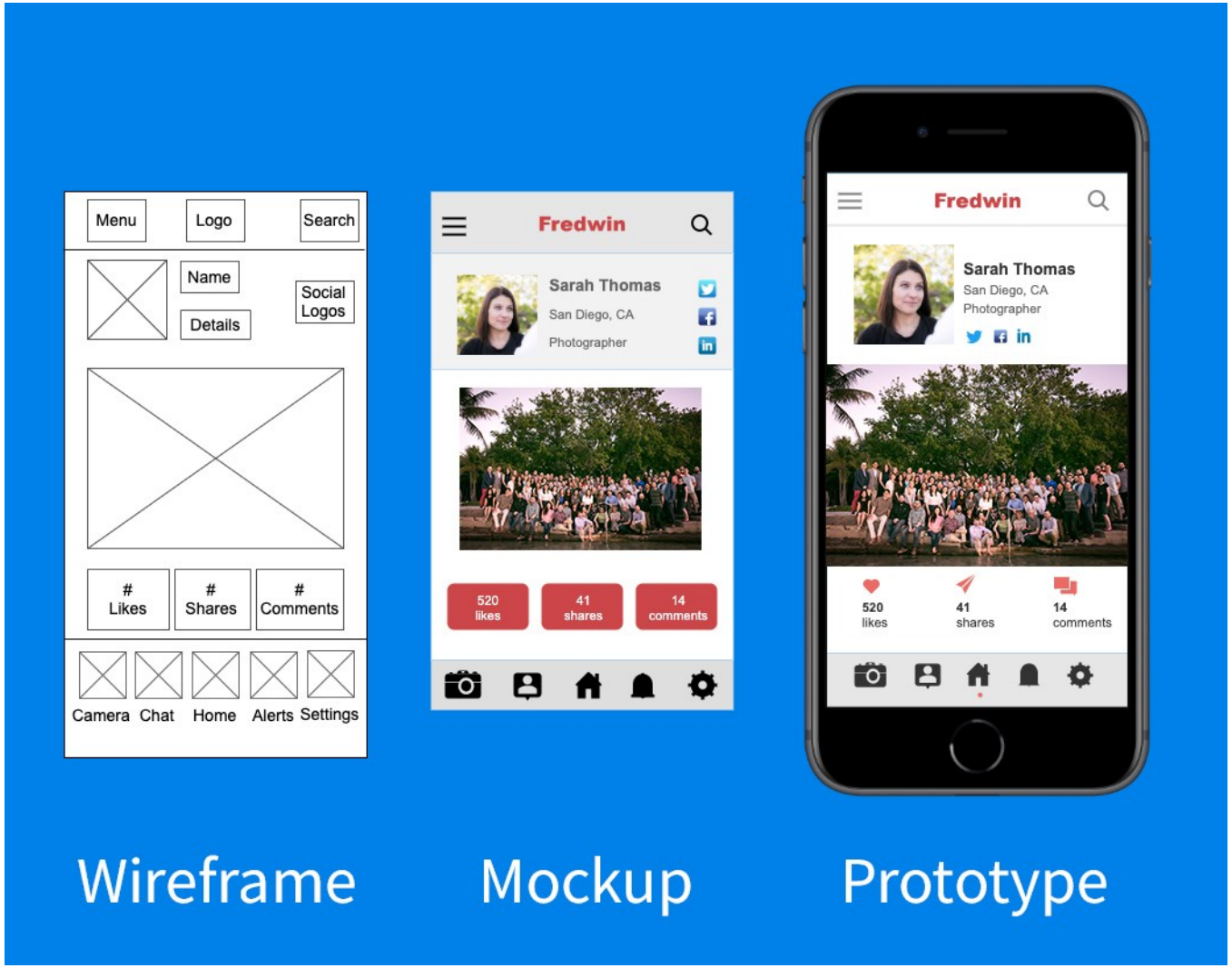


10 Types of Prototypes
(With Explanations and Tips)

- Sketches and Diagrams
- Wireframe
- 3D Printing Prototype
- Physical Model
- VR & AR Prototypes
- Feasibility
- Video Prototype
- Horizontal Prototype
- Fully Functional Rapid Prototype



Wireframe vs Mockup vs Code Prototype



Wireframe vs Mockup vs Code Prototype

	Wireframe	Mockup	Prototype
What	A **quick sketch** to convey the high-level concept of new product functionality	A realistic **visual design** that resembles what the new product functionality will look like	**Interactive simulation** of new product functionality
Purpose	To gain consensus and collect internal feedback on how new functionality will work	To facilitate more detailed critiques of visual elements and functionality so changes can be made	To collect feedback by user testing the real experience
Design fidelity	Low	Middle	High
Included elements	The format and structure of content	Additional visual elements like logos, colors, and icons	Final interactive elements and navigation
Time invested	Low	Medium	High
Creator	PM or UX Designer	UX Designer	UX Designer

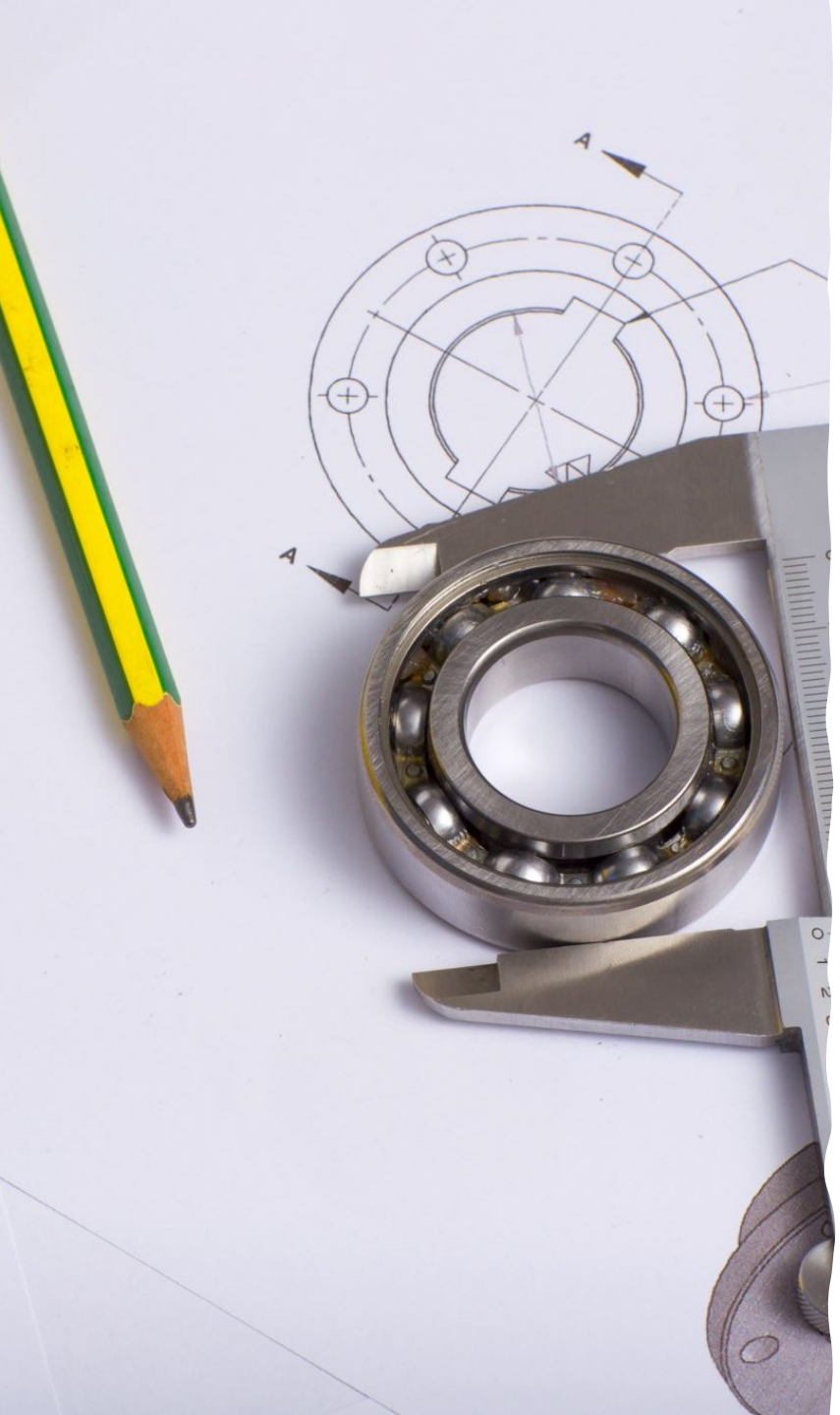
Prototype vs Model

	Prototype	Model
What	A **preliminary version of a product** or system created for testing and evaluation.	A **representation or simulation of a system** used to understand or predict its behavior.
How	Typically, physical or functional in nature.	Can be physical or virtual.
Focus	Focused on **testing and refining** a specific product or system.	Focused on **understanding and predicting the behavior** of a broader system or process.
Purpose	Used to **identify and fix design issues**.	Used to **explore different scenarios and make prediction**.
Format	May not be fully functional or representative of the final product or system.	Designed to accurately represent the system being modeled.
Stage	Created early in the development process.	Created at any stage of the development process.
Cost	Can be expensive to produce.	Can be less expensive to produce than physical prototypes.

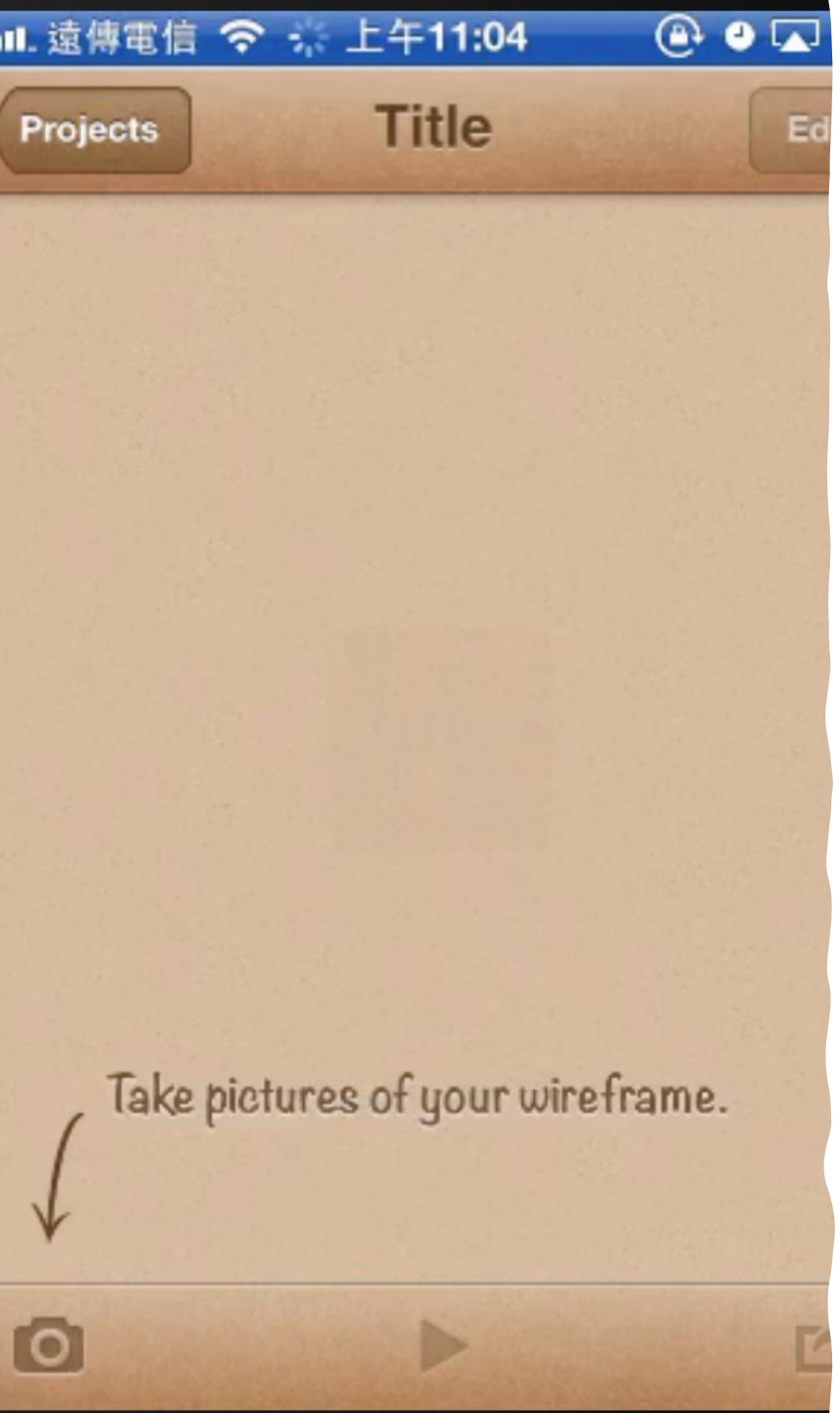
Prototyping Risks

Prototyping Risks

1. **Investing too much time/energy on high-fidelity prototypes**.
   - When a low fidelity one would let you test the point.
2. Adhoc prototyping code is **re-used** in the real system.
   - But the code wasn't produced to a professional standard.
3. **Prototying is used instead of, rather than alongside, documentation**.
   - Which may then be insufficient for software maintenance phase.
4. Prototypes might be approved by the **wrong stakeholders**.
   - E.g., managers rather than the end users.



Prototyping Tools

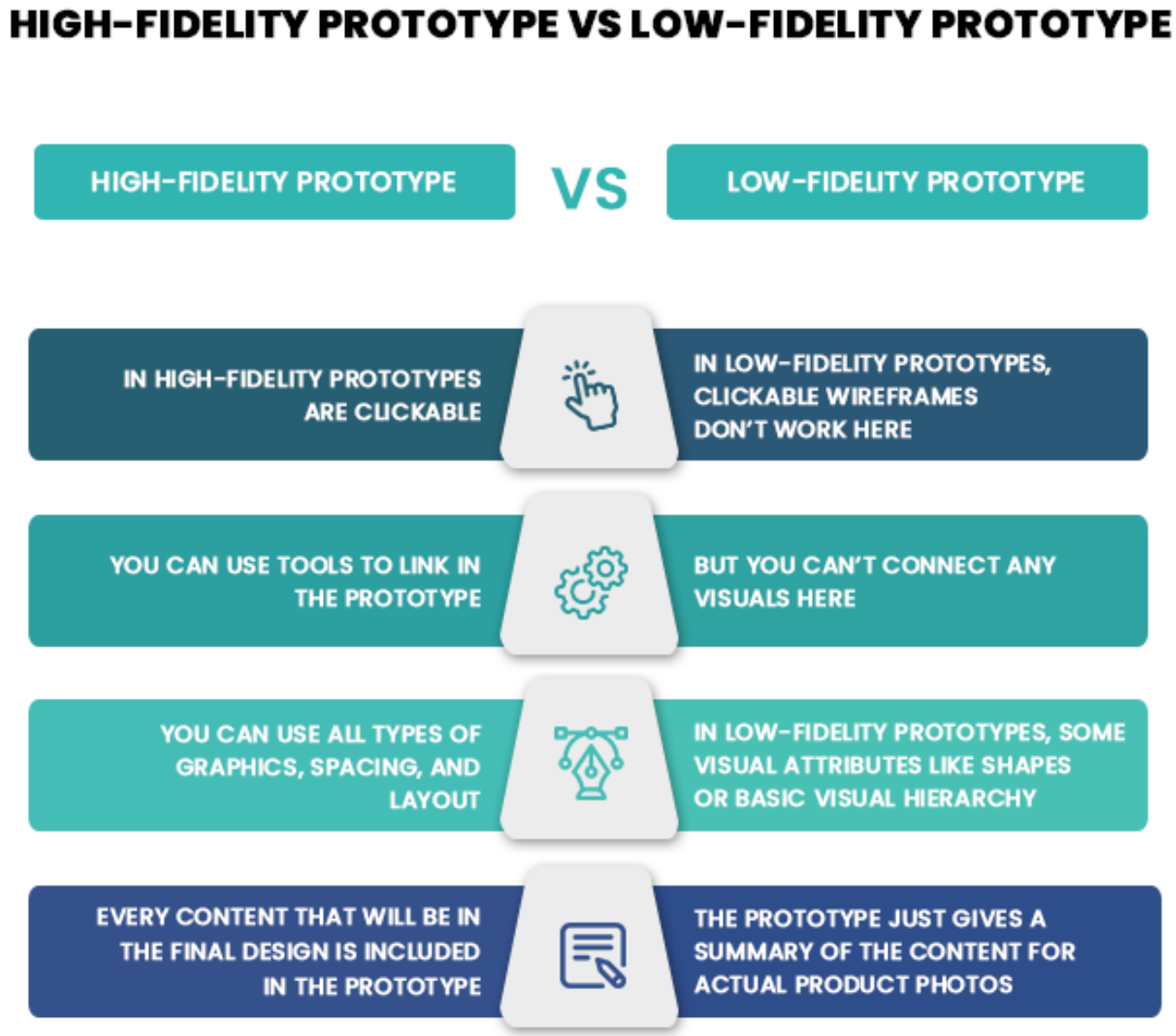


Prototyping Tools

- Paper prototyping templates.
  - E.g., https://sketchsheets.com/
- Many good prototypes can be built in e.g., PowerPoint.
  - Can be semi-interactive!
  - Buttons link to different slides.
- Apps to help prototyping.
  - https://marvelapp.com/
  - https://proto.io/en/demos/
  - https://prottapp.com/
- Hi-Fi tools e.g., https://www.sketch.com/

Summary

- System Requirements -> Prototyping -> Implementation.
- More **time and efforts are focused on documentations** rather than coding.
- There are different members (roles) working at different phases of specifications, hence, it is important to understand that SE is targeting at a team collaboration with **different roles**.
- Understand the **purpose** of prototyping.




THANK
YOU