

3D User Interfaces – Tutorial 5

Speaker: Linda Rudolph, M.Sc. (Teaching Assistant)

Responsible Professor: Prof. Gudrun Klinker, Ph.D.

Summer Semester 2023

09:00 – 10:00 time for individual questions

10:00 - ~11:00 lecture part

Topics Today

System design and engineering for immersive applications

Travel-Homework

Use Case Pitches

XR and The Search for a Killer App

For which application do we really NEED mixed reality and 3DUI?

3 | SOCIAL AND EXPERIENTIAL CHALLENGES

Besides the difficult technical challenges, there are a host of nontechnical challenges that are obstacles to achieving the vision of ubiquitous consumer AR systems. Social acceptance is crucial, along with finding compelling consumer usages. While professional and enterprise AR usages are generally unquestioned, we lack many examples of "killer applications" in consumer AR usages. Overcoming this requires establishing AR as a new medium and finding ways to take advantage of this new form of media.


Azuma, R. T. (2019). The road to ubiquitous consumer augmented reality systems. *Human Behavior and Emerging Technologies*, 1(1), 26-32.

Received: 31 October 2018 | Accepted: 9 December 2018
DOI: 10.1002/hbe2.113

SPECIAL ISSUE ARTICLE

WILEY

The road to ubiquitous consumer augmented reality systems

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The tremendous rise of interest and hype in augmented reality (AR) is justified by its long-term potential as the technology with the best chance to supplant smartphones, by becoming the dominant platform and interface for accessing digital information. However, we are still far from achieving an ideal AR system that is ubiquitously accepted by consumers and reaches this potential. This paper focuses on the two fastest paths leading to ubiquitous consumer AR systems: (a) offshoots of enterprise AR systems, and (b) systems that initially target niche consumer AR usages and subsequently expand in capabilities. To justify these two paths, this paper describes some history of AR, recent changes due to new developments, and specific obstacles and challenges. Not all challenges are technical. Social acceptance and usages are also crucial. This paper identifies specific characteristics, approaches, and strategies that are most likely to succeed, and compares these to the characteristics and development of previous successful consumer technologies, including smartphones and devices that improve human eyesight in specific situations.

KEYWORDS

augmented reality, immersive experiences, mixed reality, optical see-through, social acceptance, usages



Image by sightful, shows the “spacetop” laptop without monitor (May, 2023)

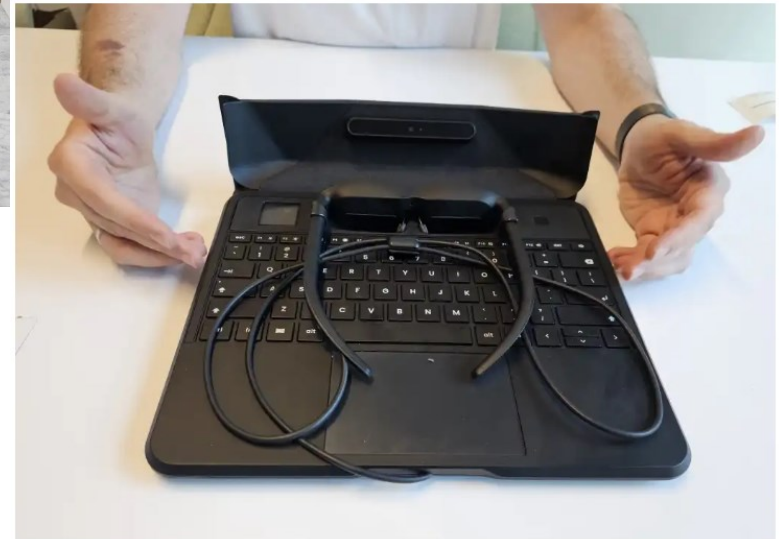


Image: Mark Hachman / IDG

Which application is important enough that people learn to work with new I/O – Devices and buy them?

If we want to design “killer apps”...

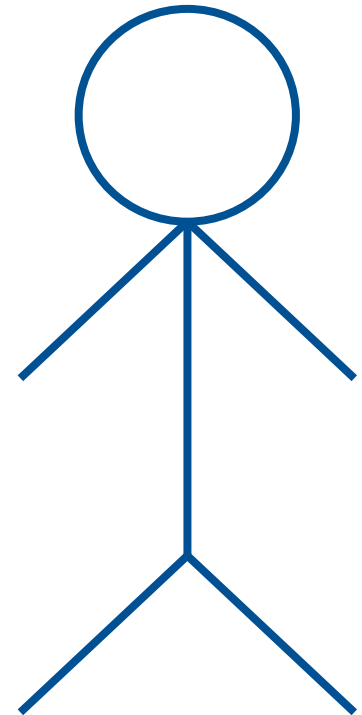
... we need to understand the goals of our users

Problem

- Programmers tend to see “user” as a homogeneous group that “uses” their products
- Since mostly no research is done about the user, programmers are doomed to design for themselves or (disrespectful) stereotypes
- User-centered research can help with identifying a target groups **needs** and **goals**

! The goal of a user is not to use your product !

Goal \neq Use Case



How Software Engineers
(mostly) depict users

Personas

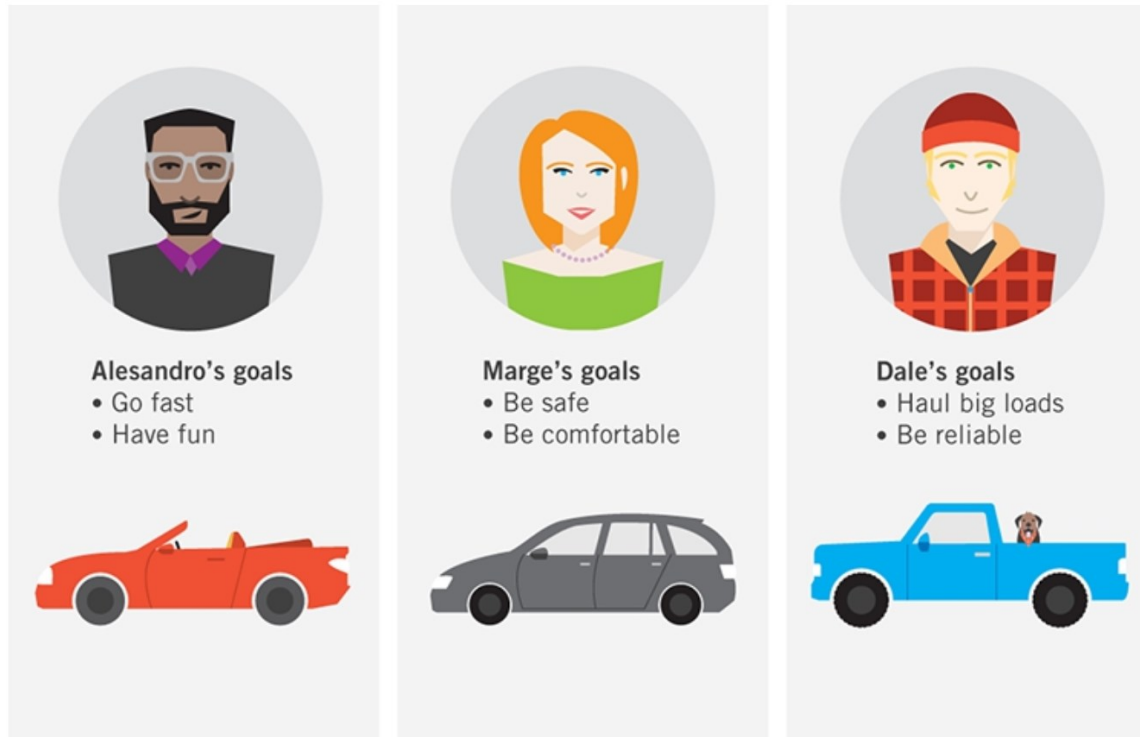


Figure 3-2: By designing different cars for different people with different specific goals, we can create designs that other people with needs similar to our target drivers also find satisfying. The same holds true for the design of digital products and software.

Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About face: the essentials of interaction design*. John Wiley & Sons.

Personas depict carefully researched and designed archetypes

! not real people

Field-study techniques

- In-context interviews
- Real-world observations

Qualitative Research

Personas

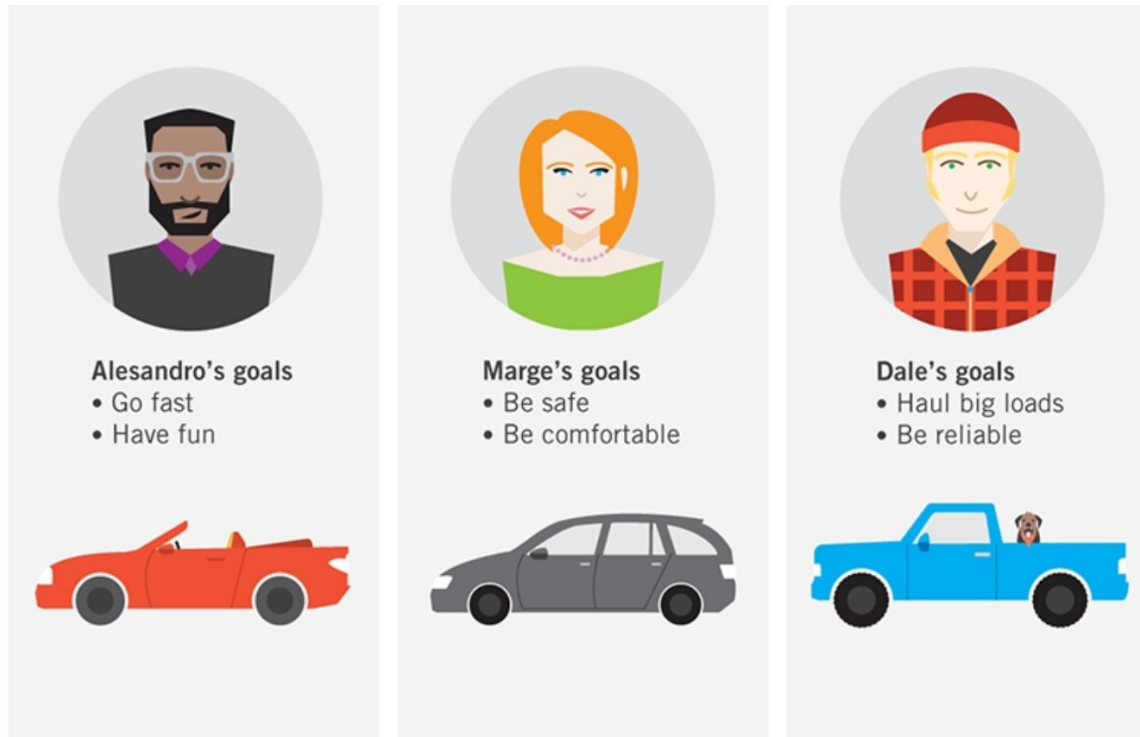


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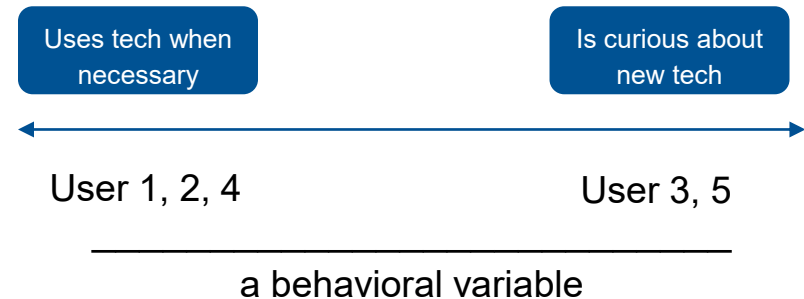
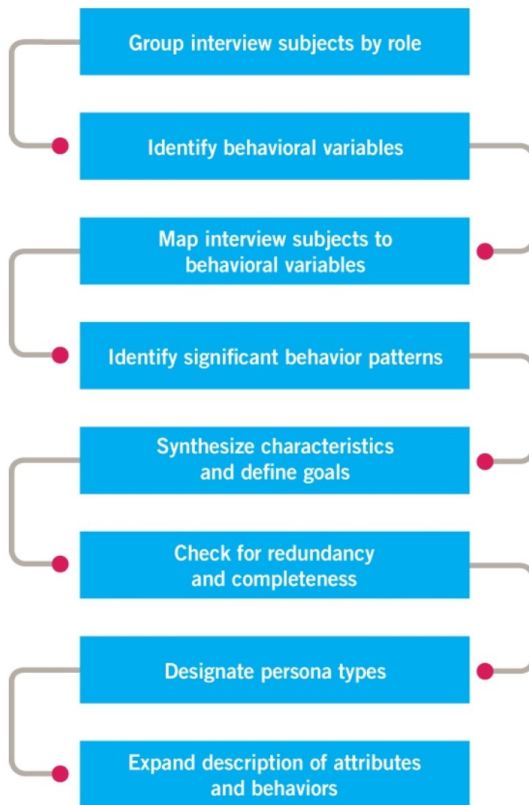
Why this effort?

Personas...

- ... act as a communication artifact in software teams
- ... can be used for acceptance evaluations
- ... can be (re)used by marketing
- ... avoid the “elastic user” problem
- ... avoid self-referenced design
- ... avoid design for edge cases

How to design a persona?

- Be aware of your persona hypotheses
- Perform interviews



Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About face: the essentials of interaction design*. John Wiley & Sons. p.81

“Provisional”, “ad-hoc” personas

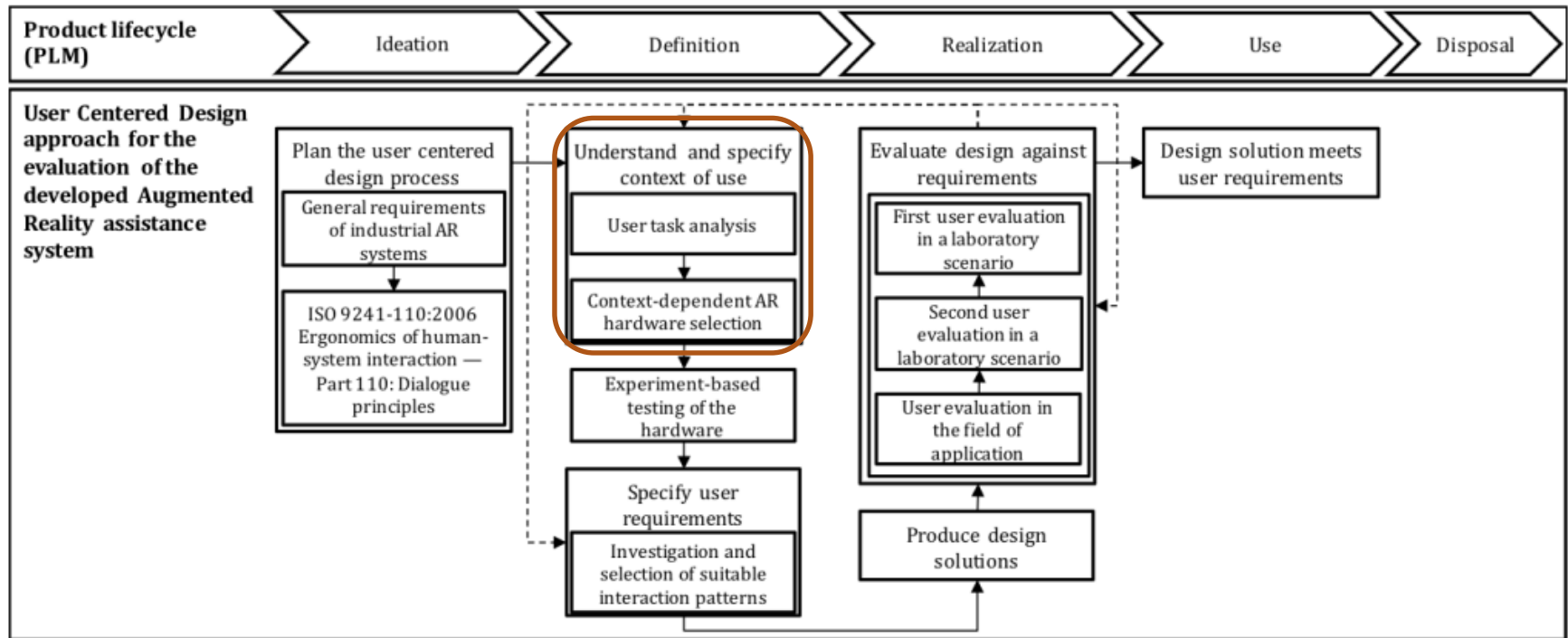


Figure 3-2: By designing different cars for different people with different specific goals, we can create designs that other people with needs similar to our target drivers also find satisfying. The same holds true for the design of digital products and software.

- Sometimes, it is not possible to design complete personas
- Label your provisional results as such

! It is better to write down biased assumptions (and have it corrected later) than to work with unconscious bias that is never corrected !

From personas to designs – the academic way



Quandt, Moritz, Thies Beinke, and Michael Freitag. "User-centered evaluation of an augmented reality-based assistance system for maintenance." *Procedia Cirp* 93 (2020): 921-926.

As-Is Task Analysis

- In industry AR is deeply integrated in (physical) business processes
- To understand the as-is situation
- More „task“ related then personas
- Tool: BPMN

Gateways

Exclusive Gateway



When splitting, it routes the sequence flow to exactly one of the outgoing branches. When merging, it awaits one incoming branch to complete before triggering the outgoing flow.

Event-based Gateway



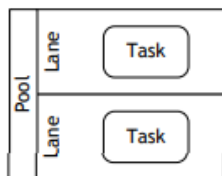
Is always followed by catching events or receive tasks. Sequence flow is routed to the subsequent event/task which happens first.

Parallel Gateway

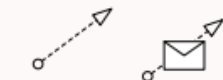


When used to split the sequence flow, all outgoing branches are activated simultaneously. When merging parallel branches it waits for all incoming branches to complete before triggering the outgoing flow.

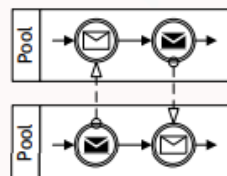
Swimlanes



Pools (Participants) and Lanes represent responsibilities for activities in a process. A pool or a lane can be an organization, a role, or a system. Lanes subdivide pools or other lanes hierarchically.



Message Flow symbolizes information flow across organizational boundaries. Message flow can be attached to pools, activities, or message events. The Message Flow can be decorated with an envelope depicting the content of the message.



The order of message exchanges can be specified by combining message flow and sequence flow.

Activities

Task

A **Task** is a unit of work, the job to be performed. When marked with a symbol it indicates a **Sub-Process**, an activity that can be refined.

Transaction

A **Transaction** is a set of activities that logically belong together; it might follow a specified transaction protocol.

Event Sub-Process

An **Event Sub-Process** is placed into a Process or Sub-Process. It is activated when its start event gets triggered and can interrupt the higher level process context or run in parallel (non-interrupting) depending on the start event.

Call Activity

A **Call Activity** is a wrapper for a globally defined Task or Process reused in the current Process. A call to a Process is marked with a symbol.

Activity Markers

Markers indicate execution behavior of activities:

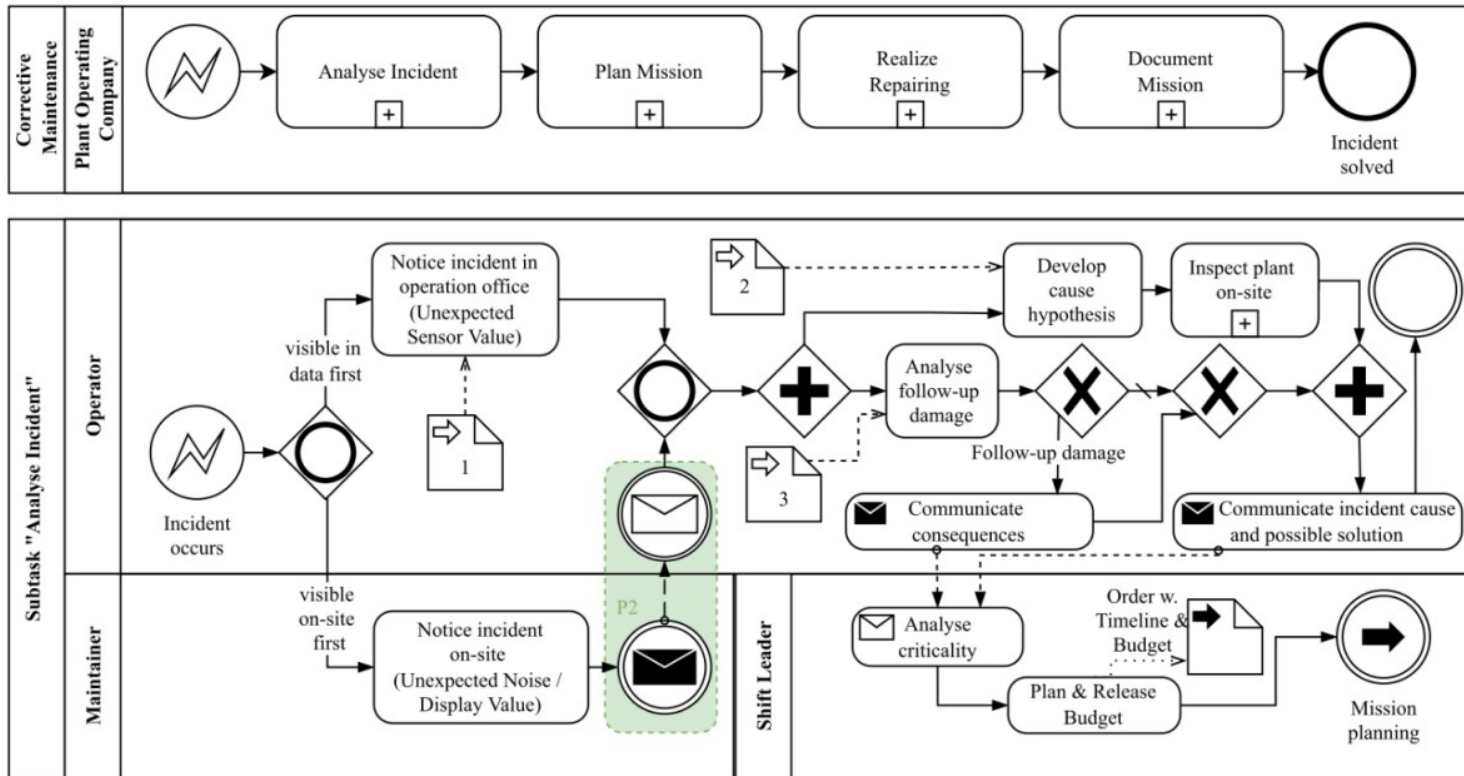
- Sub-Process Marker
- Loop Marker
- Parallel MI Marker
- Sequential MI Marker
- Ad Hoc Marker
- Compensation Marker

Task Types

Types specify the nature of the action to be performed:

- Send Task
- Receive Task
- User Task
- Manual Task
- Business Rule Task
- Service Task
- Script Task

BPMN Example



¹= In the control room, the alarm list shows a warning/alarm and in the HMI (Human-Machine Interface), a PCE location is displayed in yellow or red because a sensor value (e.g. flow sensor behind a pump) is outside the specified tolerance.

²= (historical) Process data, P&ID, temporal relationship (e.g. past maintenance procedures)

³= Recipe formula, P&ID

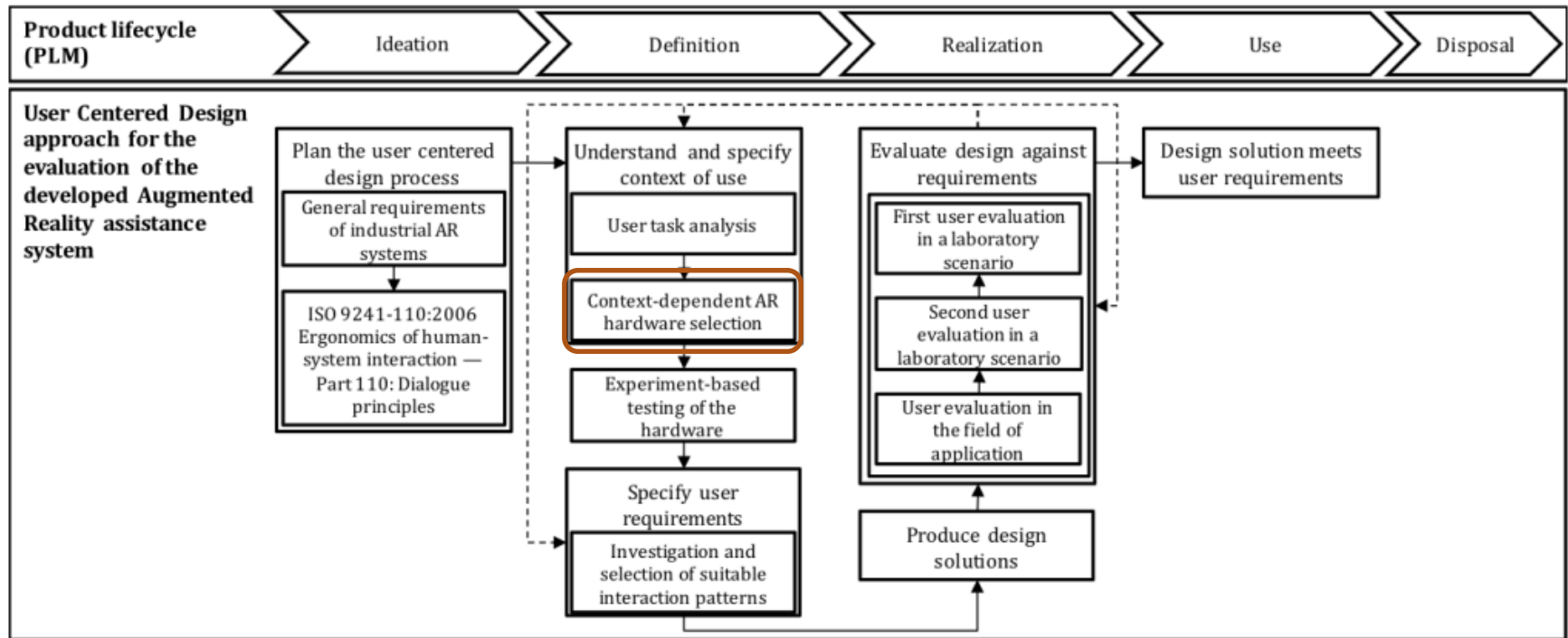
Fig. 2. BPMN visualization of the overall maintenance process and the incidence analysis. The green overlay highlights tasks that can be optimized with mixed reality and digital twins.

Rudolph L., Pantförder D., Palmas F., Fischer M., Niemann P., Klinker G., Vogel-Heuser B. **Maintenance in Process Industries with Digital Twins and Mixed Reality: Potentials, Scenarios and Requirements** IEEE International Conference on Industrial Engineering and Engineering Management (IEEM 2022)

Environmental Analysis

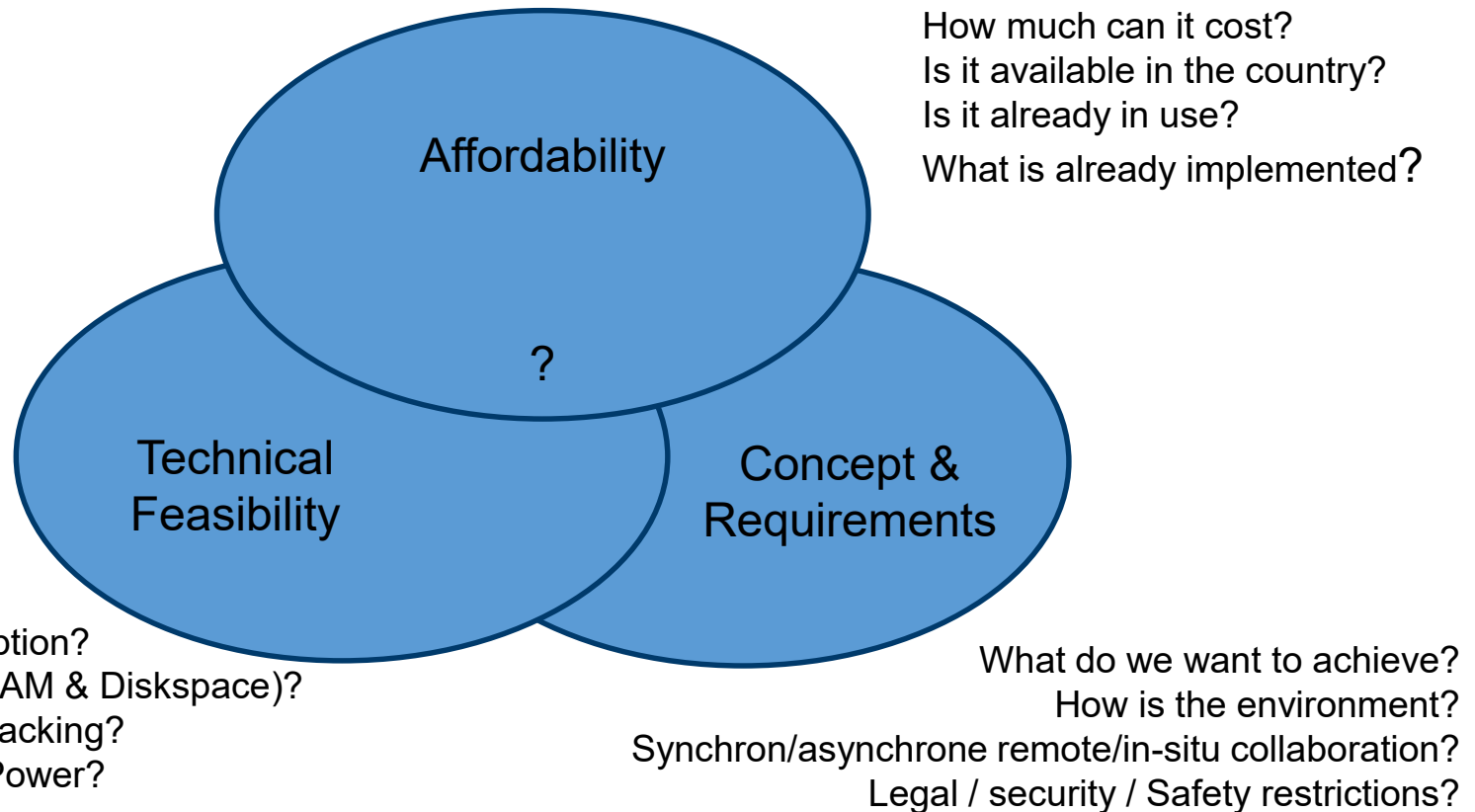
- Scale of the scene (Desk, Room, Hall, City, World)
- Illumination (Bright Enough? Infrared Light?)
- Materials (Reflective, Transparent Objects)
- Dynamic Scene Components (Construction Site, Cars, People)
- Scene Complexity (Planes, Occlusions, fine-granular Objects)
- Noise (Audio / Visual „fog“)
- Indoor / Outdoor
- User Movement Pattern (Car, Climbing, Walking, Sitting)

From personas to systems

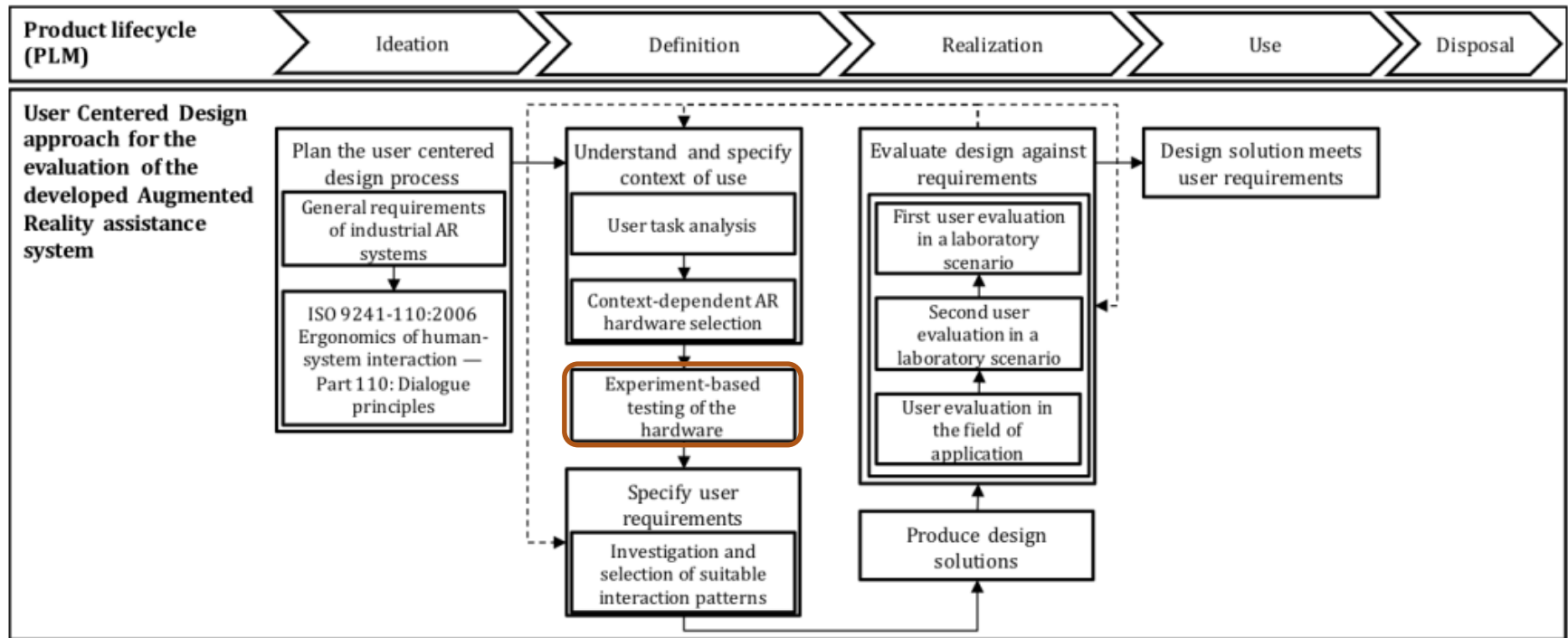


Quandt, Moritz, Thies Beinke, and Michael Freitag. "User-centered evaluation of an augmented reality-based assistance system for maintenance." *Procedia Cirp* 93 (2020): 921-926.

Context-dependent AR hardware selection



From personas to systems



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Experiment-based testing of hardware

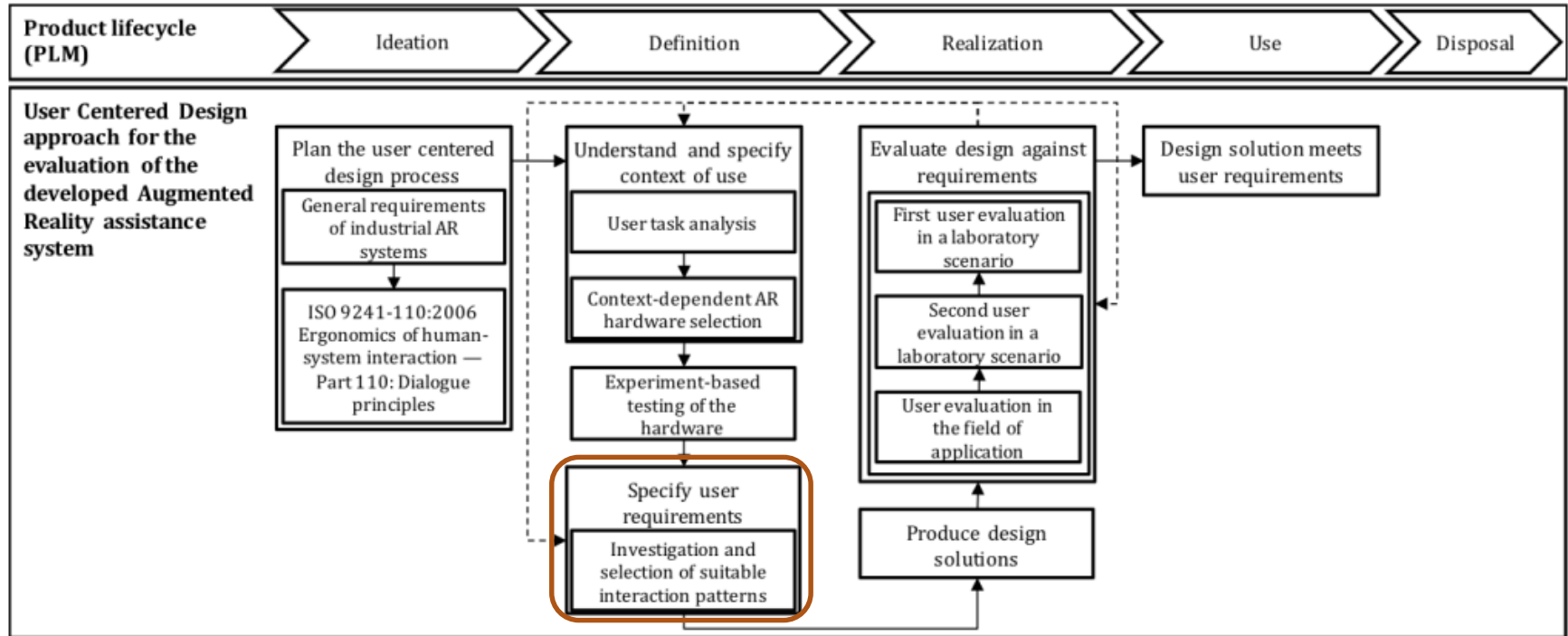
2 Cortés, Solin, Rahtu, and Kannala



Fig. 1. The custom-built capture rig with a Google Pixel smartphone on the left, a Google Tango device in the middle, and an Apple iPhone 6s on the right.

Cortés, S., Solin, A., Rahtu, E., & Kannala, J. (2018). ADVIO: An authentic dataset for visual-inertial odometry. In *Proceedings of the European Conference on Computer Vision (ECCV)* (pp. 419-434).

From personas to systems



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Homework 5: Personas

Homework 5 (until May, 29th) – Create Personas

Think about a target group, you have access to and design at least a “provisional persona”

1. Write down your hypothesis about the goals of your target group with respect to a hypothetical problem
2. Talk to people of the target group (no need for recorded and transcribed interviews) or research about the target group and reflect upon your hypothesis
3. Verbalize ad-hoc personas with behavioral patterns and goals

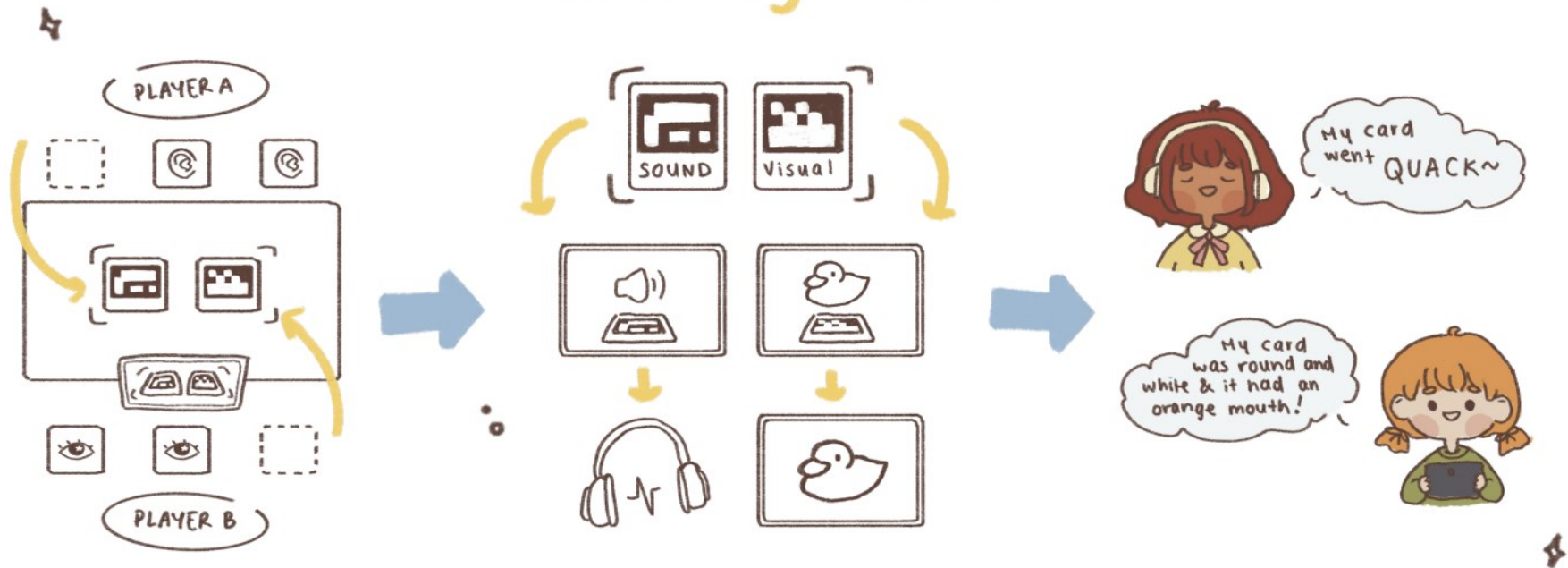
Homework 6 (until June, 5th)

Build a travel system and add it to your „homework 4“-application

1. Add a scene to travel in (e.g. the demo scene of <https://assetstore.unity.com/packages/3d/environments/urban/city-package-107224>)
2. Reuse your raycast – selection to build a teleport technique
3. Design and add an interaction method to look around in the scene (at least by rotation in the horizontal axis) with your smartphone controller as well

Reference Code for Homework 3 and Step-by-step solution for Homework 6 will be published around May, 29th

3D UI Memory Matching Game



→ **intended audience:** children ages 3–6, but expandable to other age and target groups

→ **intended outcome:** learning experience about matching sound and visuals, training memory via communication