

How to study Future Human Robot Interaction in the Wild?

Presentation Summerschool 2025

ACM SIGSOFT Summer School for

Software Engineering in Robotics

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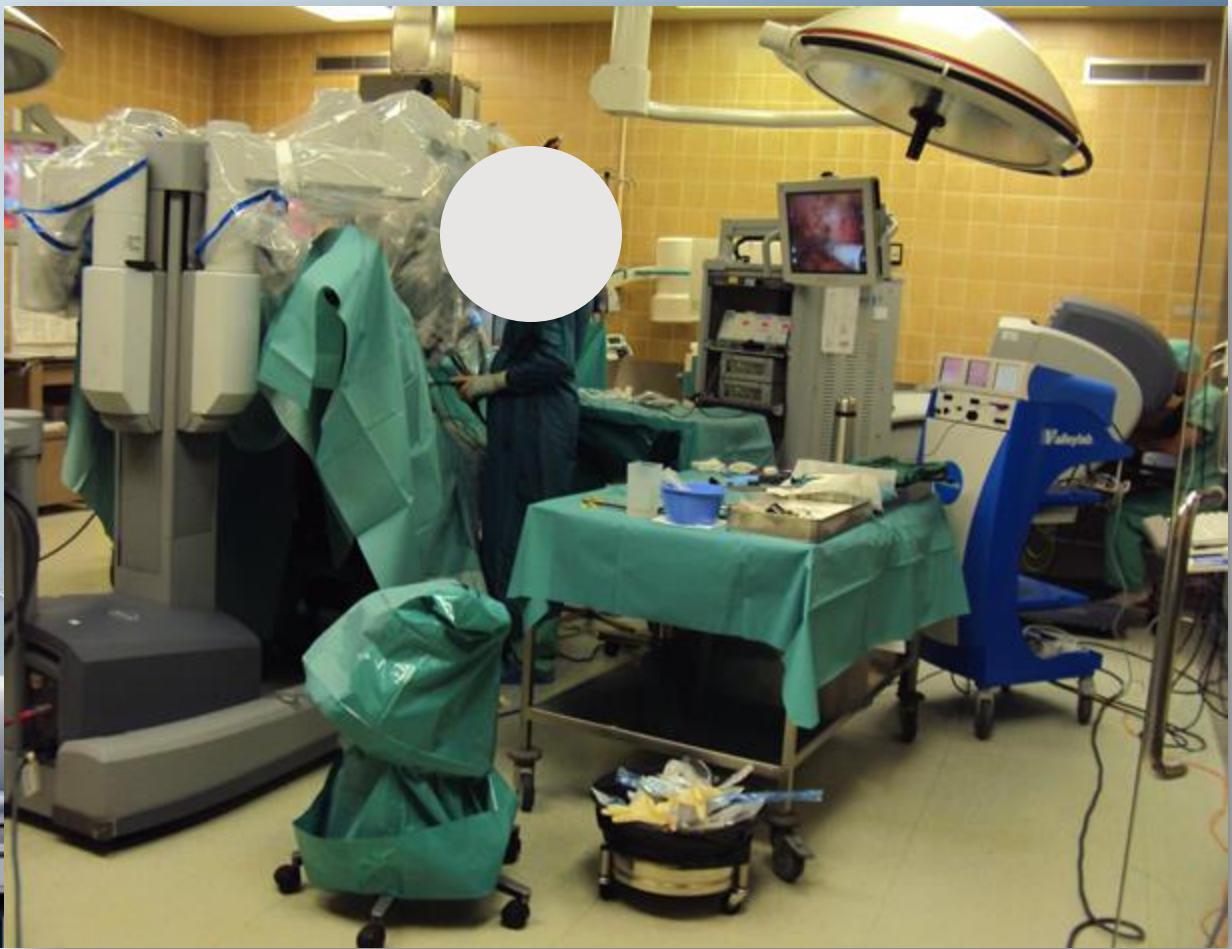
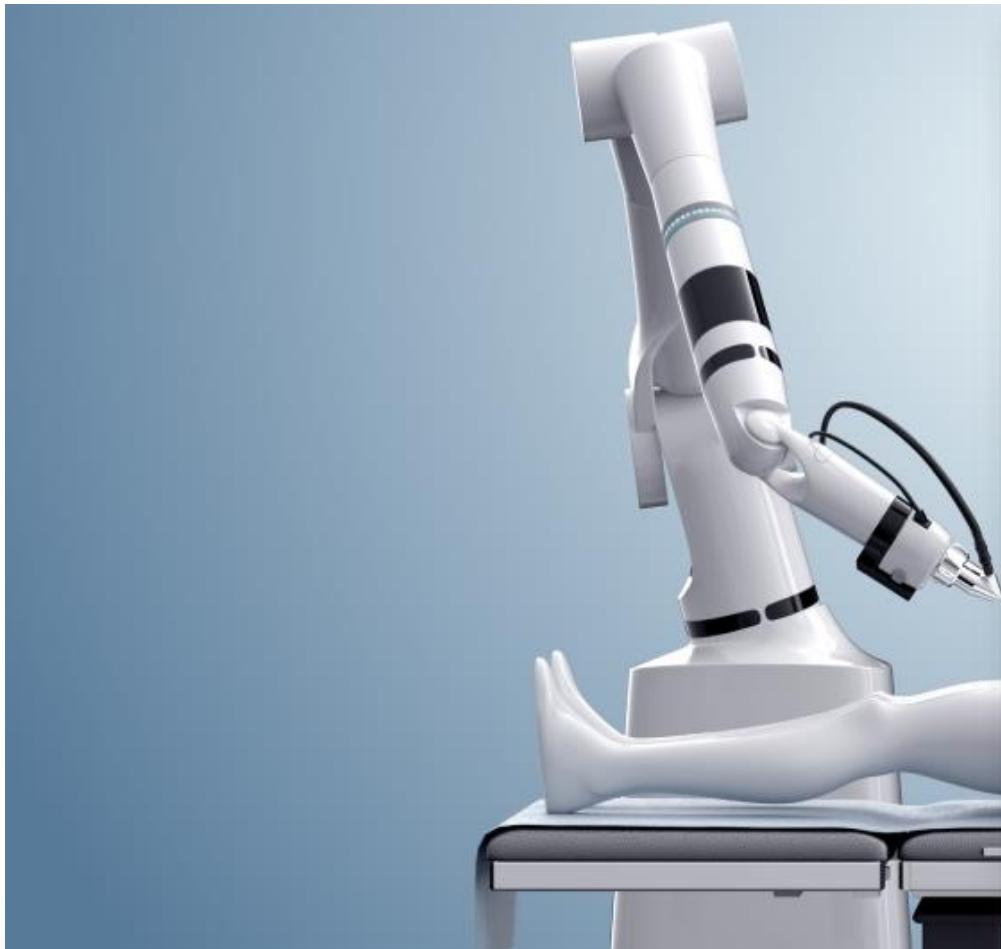
DIGITAL HEALTH & WORK – TEAM, lead prof. An JACOBS

Cocreate & evaluate future practices

Study current practices micro-meso-macro to ideate on new ideas/concepts of digital services in health and work



IN THE WILD ... WHY CARE ?

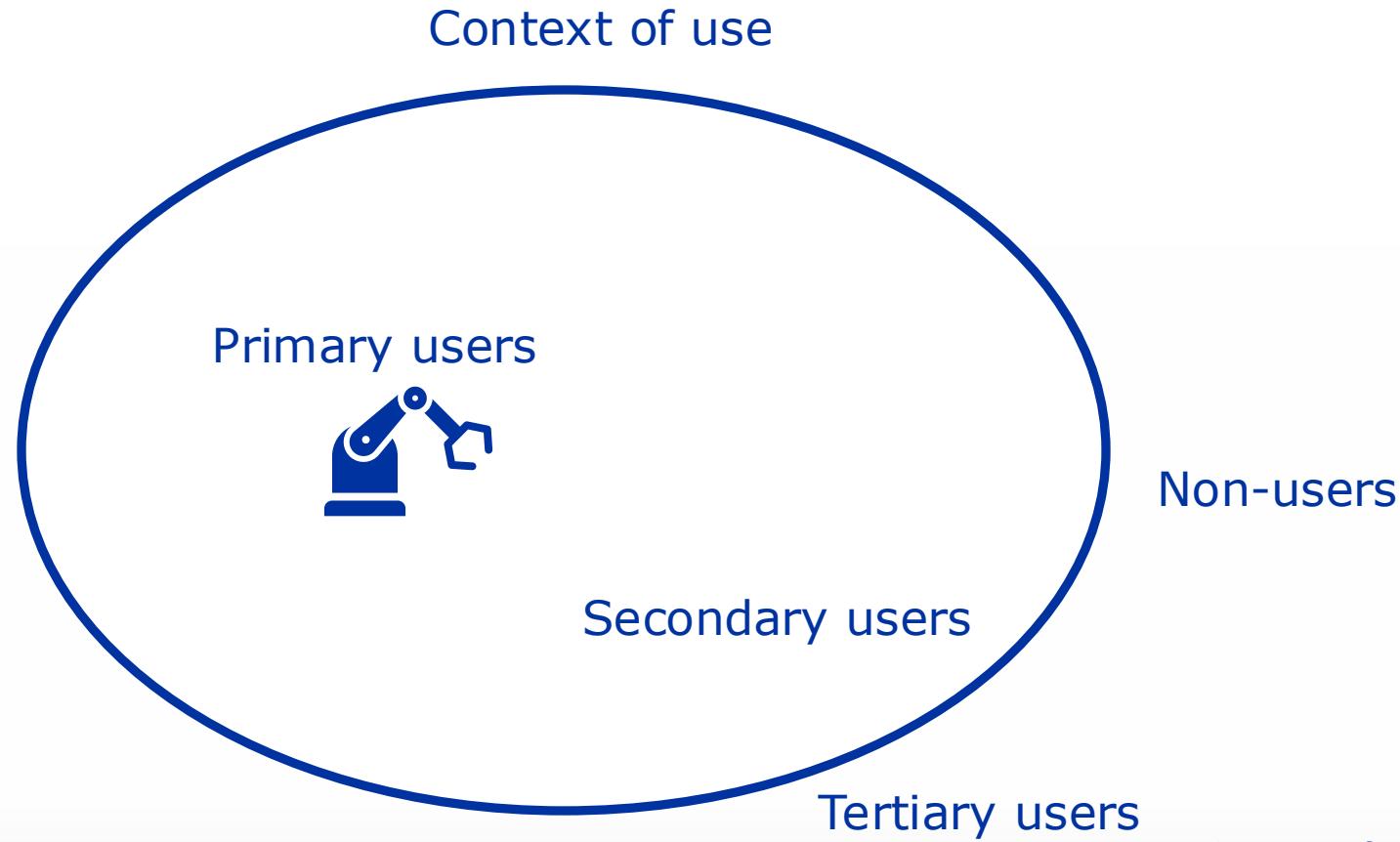


Relation between
human-robot & -
human-AI interaction and
the quality of life/work



TYPES OF END USERS

WHO ARE THE STAKEHOLDERS?



Concepts from Eason (1989) and Wyatt (2014)

TYPES OF END USERS

WHO ARE THE STAKEHOLDERS?

Context of use

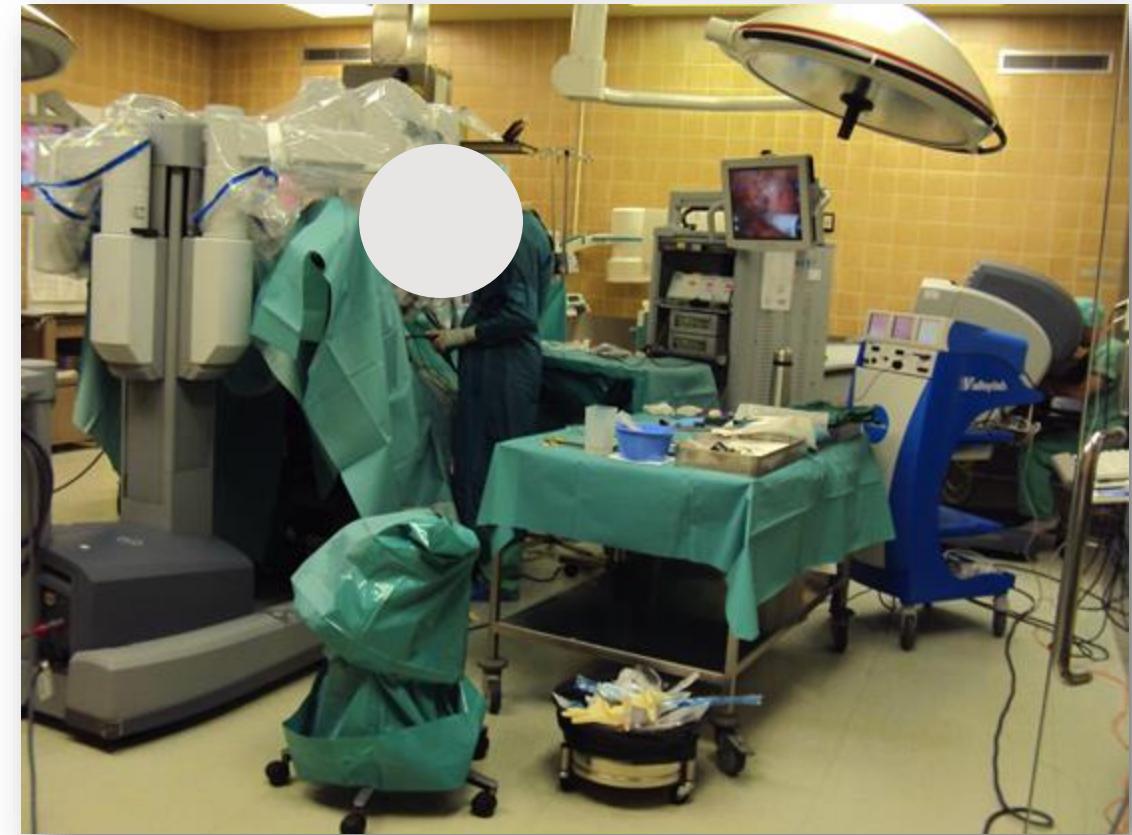
Primary users: surgeon



Da Vinci robot

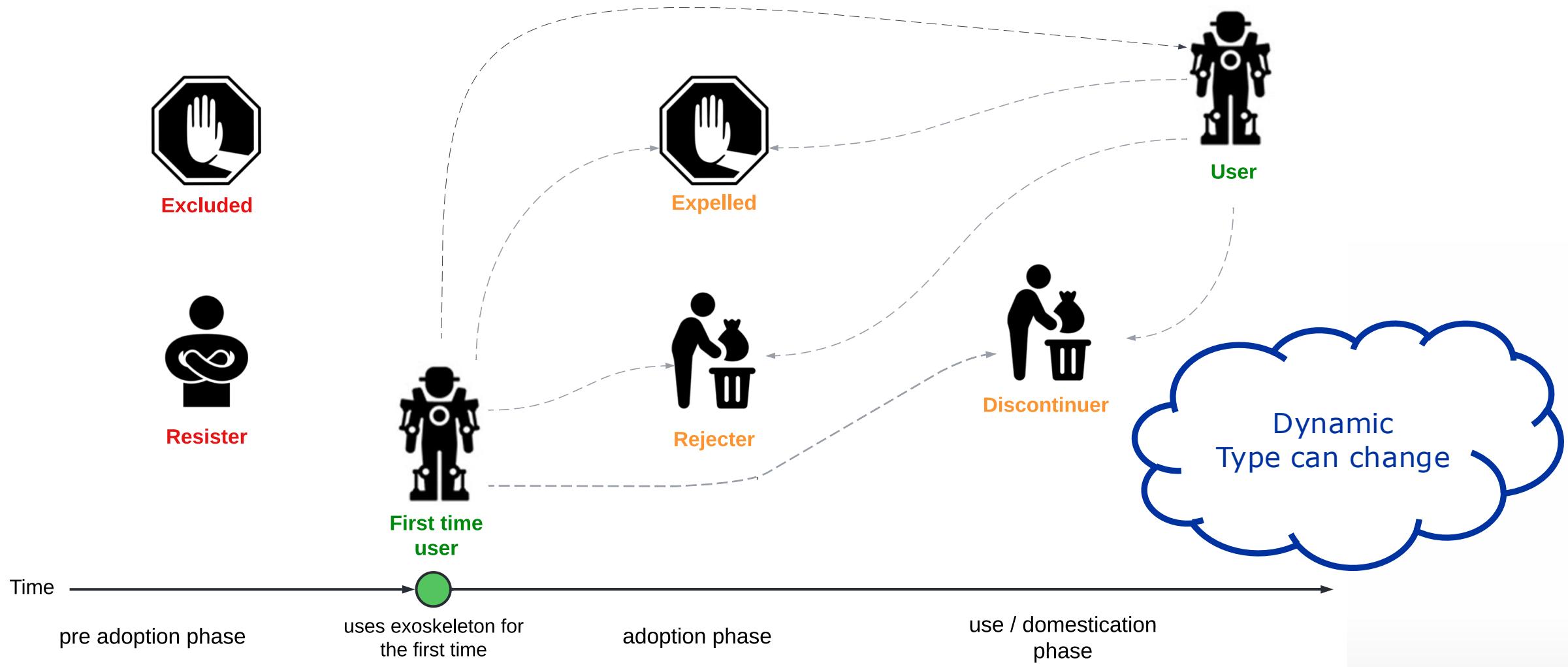
Secondary users:
scrub nurse

Tertiary users: circulating nurse, patients



Non-users: surgeons who do not want to work with Da Vinci robot

TYPES OF (NON) USERS



Studying future
HRI solutions in
the wild ?

An recent example on
self-driving vehicles
in a warehouse

CHI 2025

April 26–May 1, 2025 in Yokohama, Japan

colruyt

INTRODUCING ROBOTS IN A WAREHOUSE LESSONS LEARNED FROM A FIELD STUDY AT A SUPERMARKET CHAIN

KRISTÝNA SIRKA-KACAFÍRKOVÁ, SHIRLEY ELPRAMA, MELISSA WITTENS, AN JACOBS



Image from De Morgen

imec

VUB



STUDIES IN MEDIA,
INNOVATION & TECHNOLOGY
RESEARCH GROUP

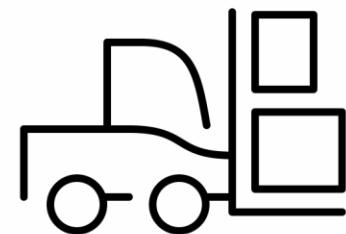
Sirka Kacafírková et al. (2025)

<https://doi.org/10.1145/3706599.3706668>

euROBIN

SUPERMARKET CHAIN

COLRUYT



Created by fae frey
from Noun Project

Warehouse



Loading in trucks



Image from De Morgen

Delivered to supermarket

Reasons for implementing AMRs:

- ▶ Worker shortages
- ▶ Improving logistics efficiency
- ▶ Minimise repetitive tasks for workers

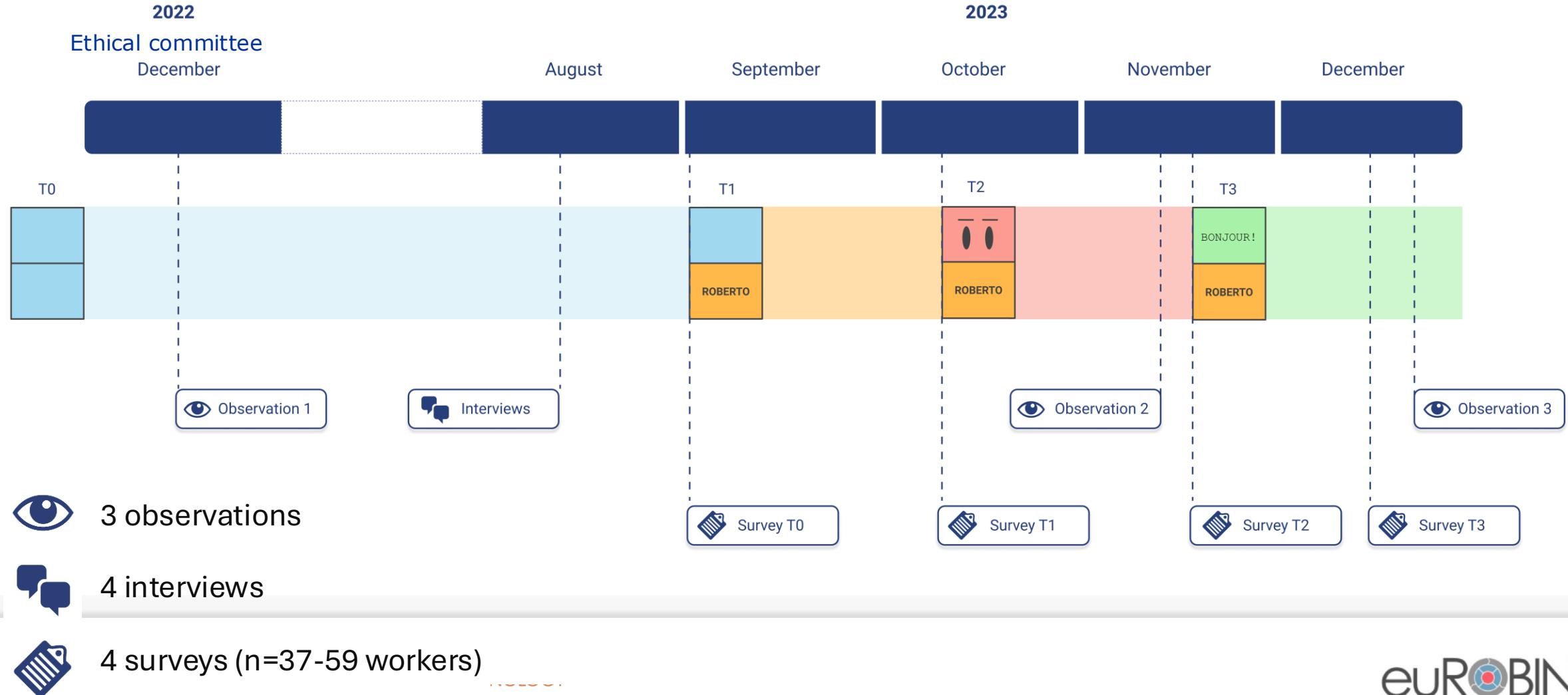
CASE STUDY: AMRS IN A WAREHOUSE

Goal of the Study

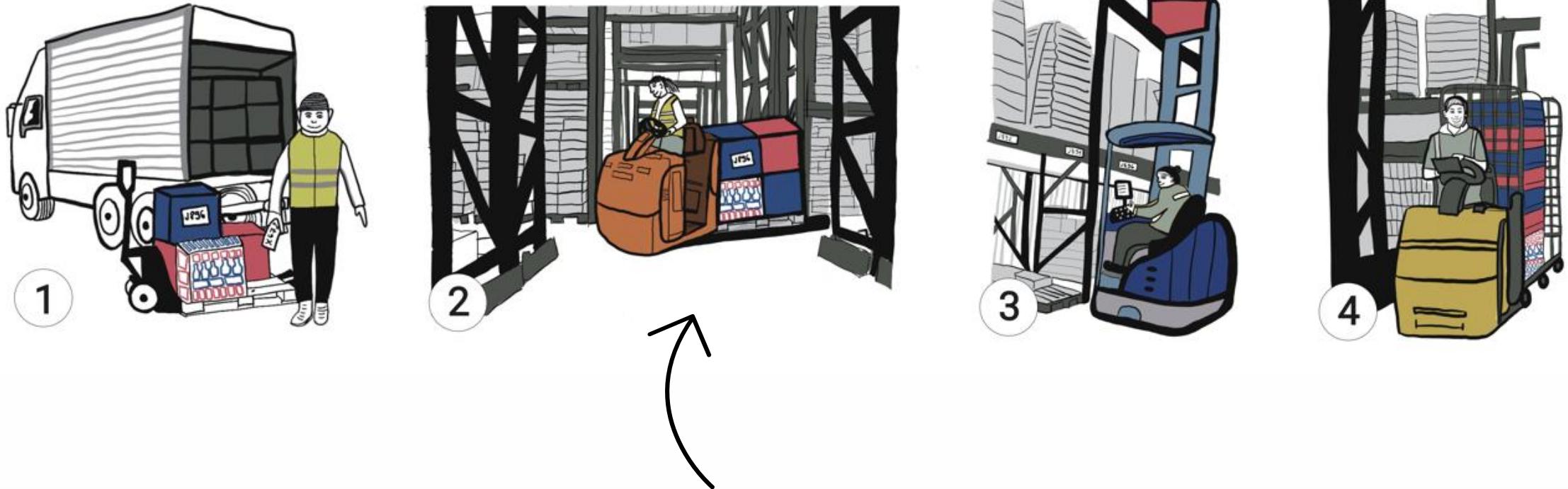
- What is employees' experience with AMRs?
- What features improve acceptance of AMRs?

METHODS

TIMELINE



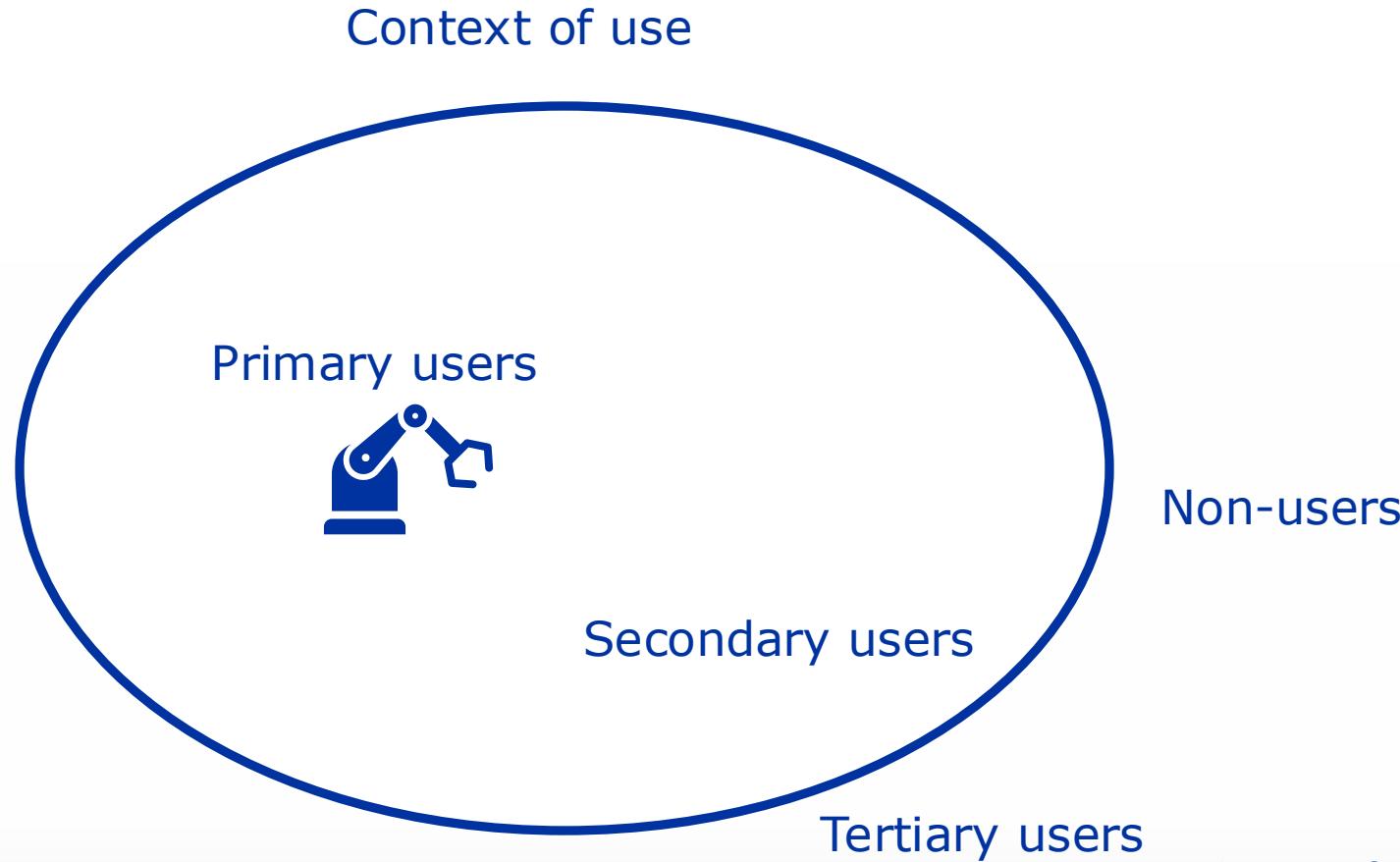
CURRENT PROCESS IN THE WAREHOUSE



will be supported by AMRs
[autonomous mobile robots]

TYPES OF END USERS

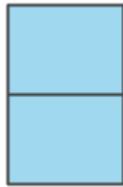
WHO ARE THE STAKEHOLDERS?



Concepts from Eason (1989) and Wyatt (2014)



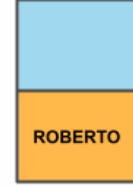
T0



AMR without
any features



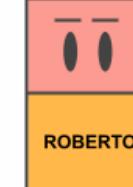
T1



AMR with
name



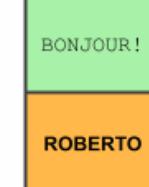
T2



AMR with
name &
eyes



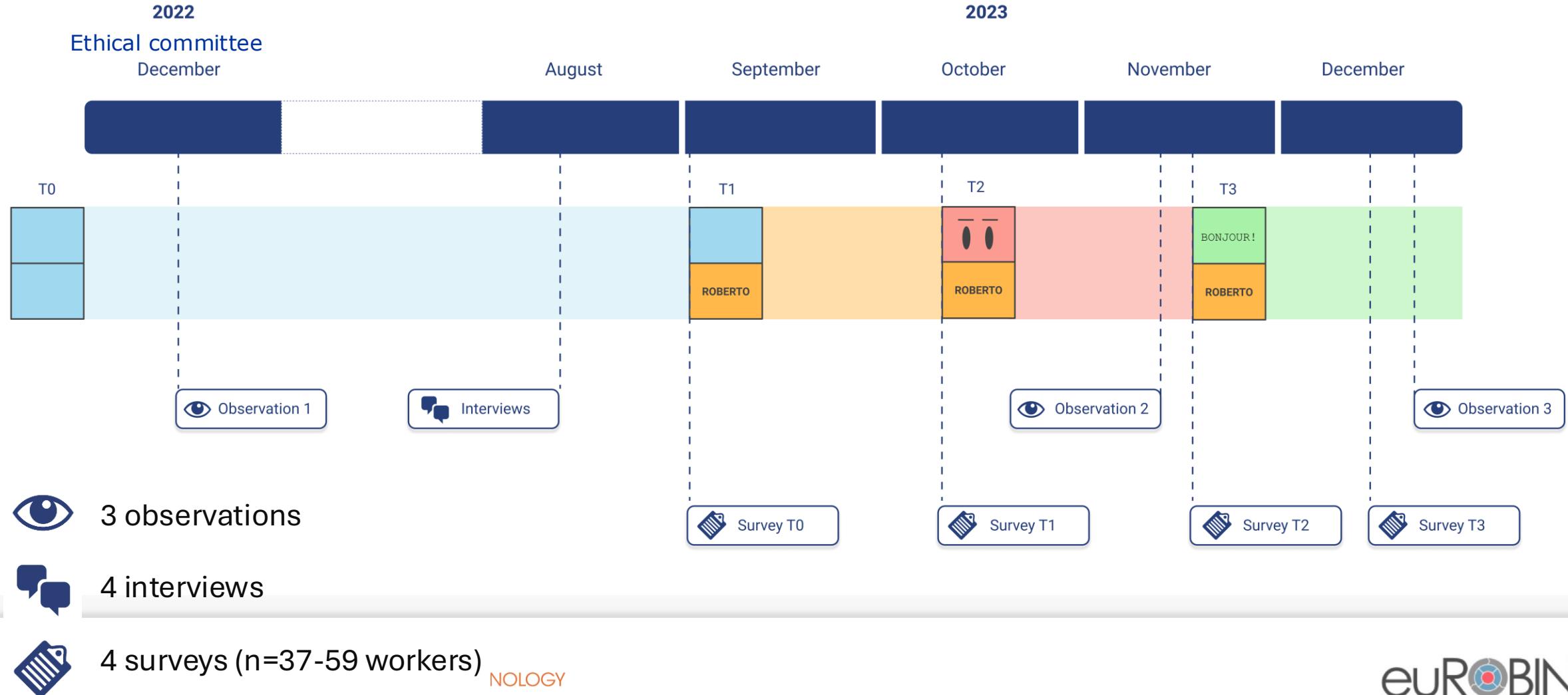
T3



AMR with
name &
display

METHODS

TIMELINE

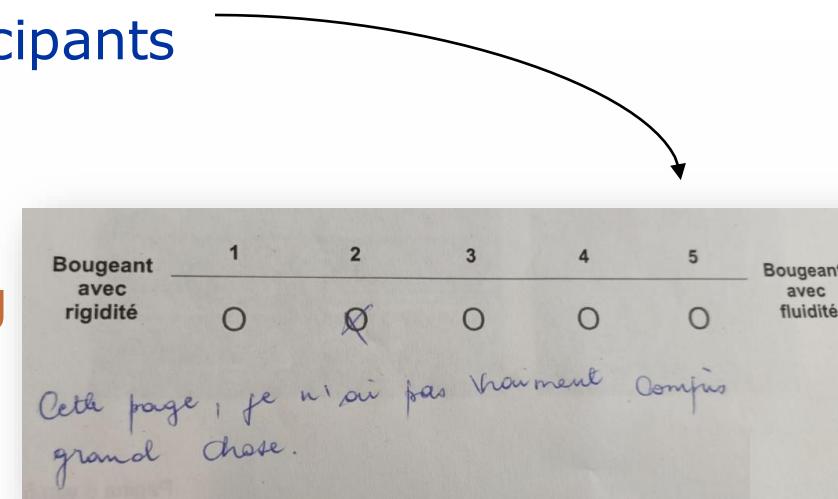


FINDINGS

- Dust
- Contact: engineers vs. drivers
- Functionality was more important for workers than design
- Biggest concern: Robot speed & technical robustness
- Some features were not visible enough
- No significant difference found in Trust, Performance expectancy, Safety and Intention to use
- Anthropomorphic scale: AMR with eyes performed the worst, seen as the least human-like
- Workers needed more information about future of AMRs
- 73% (n=41) of workers liked being involved in the study

LESSONS LEARNED

1. Observation and **field work necessary** for the context
2. **Survey was not always straightforward** to participants
3. Busy environment requires **flexibility**
4. Clear **communication with workers was missing**
5. **Technical delays** had an impact on the research
6. **Outsourcing** the data collection added to the **limitations**



1. Start early on
2. Be **flexible** and make and **adaptable** research design
3. Keep a **research diary**
4. Use a **mixed method approach**
5. **Adapt the research tools** towards the workers
6. Be ready for **traditional** procedures
7. Count on **technical delays** during development
8. **Be in touch with the development team** as much as possible
9. **Maximise your presence when you can**

RECOMMENDATIONS



How do you design such a
such a study to assess the
future HRI in the wild ?

We have a 3 step
approach to
tackle this

HOW ? LIVING LAB : ITERATIVE – REAL LIFE – PARTICIPATION OF MULTI-ACTORS



Exploring
current health/work context



Envisioning
future health/work context



Evaluating
new health/work context



HOW ? LIVING LAB APPROACH

GOAL LIVING LAB : ITERATIVE – REAL LIFE – PARTICIPATION OF USERS

EXPLORING THE CURRENT WORK CONTEXT



Observations - interviews - surveys

- robots always in cages
- due to experience with caged robots:
 - fear of job loss
 - less social contact
 - experience with workload reduction

HOW ? LIVING LAB APPROACH

GOAL LIVING LAB : ITERATIVE – REAL LIFE – PARTICIPATION OF USERS

ENVISIONING THE FUTURE WORK CONTEXT



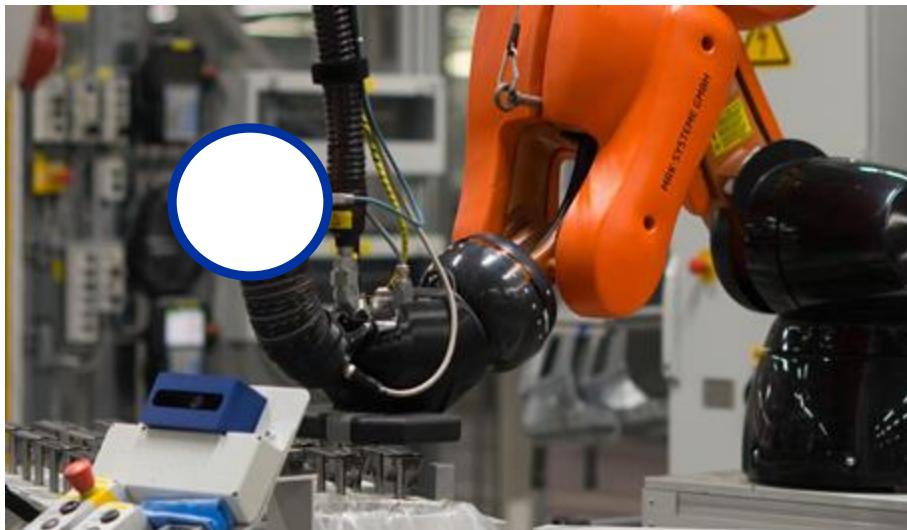
Wizard of Oz experiments - interviews - co-creations

- more humanlike features are enjoyable & are more accepted
- mapping preference of gesture types

HOW ? LIVING LAB APPROACH

GOAL LIVING LAB : ITERATIVE – REAL LIFE – PARTICIPATION OF USERS

EVALUATING NEW WORK CONTEXT



Probing - observations - interviews

- workers would like a cobot that supports heavier tasks & works faster
- robot is part of the team:
 - colleagues make fun of it • talk about it
 - feel safe around it
- working with latest technology (i.e the cobot) evokes a sense of pride

PRODUCT ECOLOGY APPROACH - FORLIZZI

People use technology in a **specific context or environment**

- A specific **place**,
but also a **space** with a specific meaning
- With norms, values, rules
- while using other tools
- while doing other tasks, and activities
- With other people : collaborating, disturbing, ...

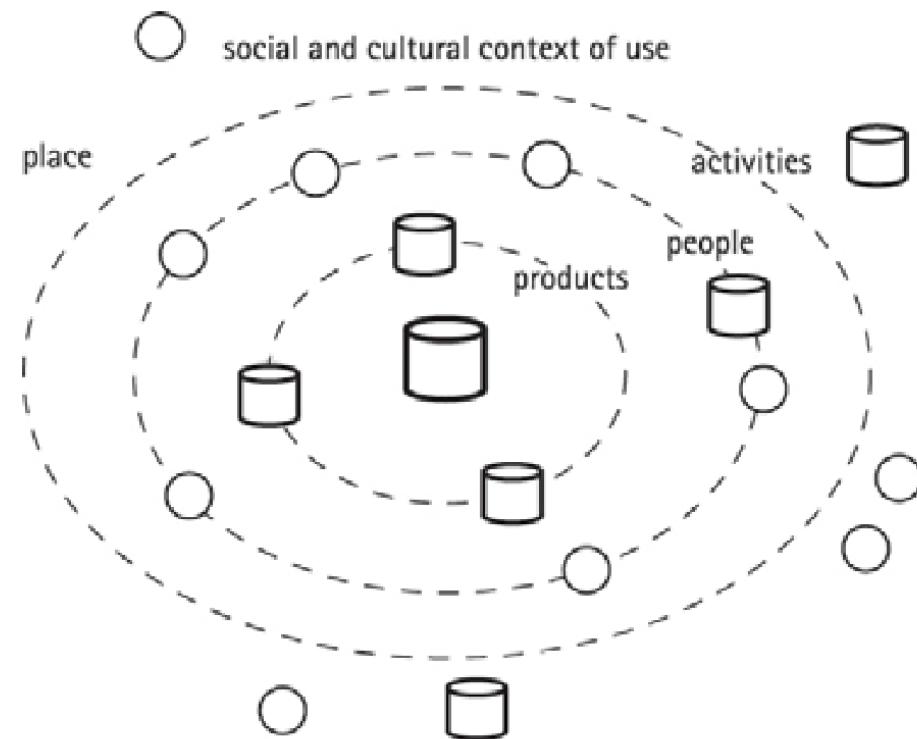


Figure 2. Schematic diagram of the home as an ecology, containing people, products, activities, and interactions within a bounded environment.

DIFFERENT PRODUCT ECOLOGIES

WITH OR WITHOUT INTERVENTION

CURRENT PRODUCT ECOLOGY?

AS IS

Without robot

AS IS

With robot



TO BE: add
robot or new
features with
robot



EMBODIED EXPERIENCE
WITH ROBOT

DATA COLLECTION TECHNIQUES



OBSERVATION

With and without
WIZARD of OZ

Ethnographic approach

ACTIVATION &
PARTICIPATION
TECHNIQUES

DEPTH-
INTERVIEW



IN DEPTH INTERVIEW

Prepare

Execute

Process

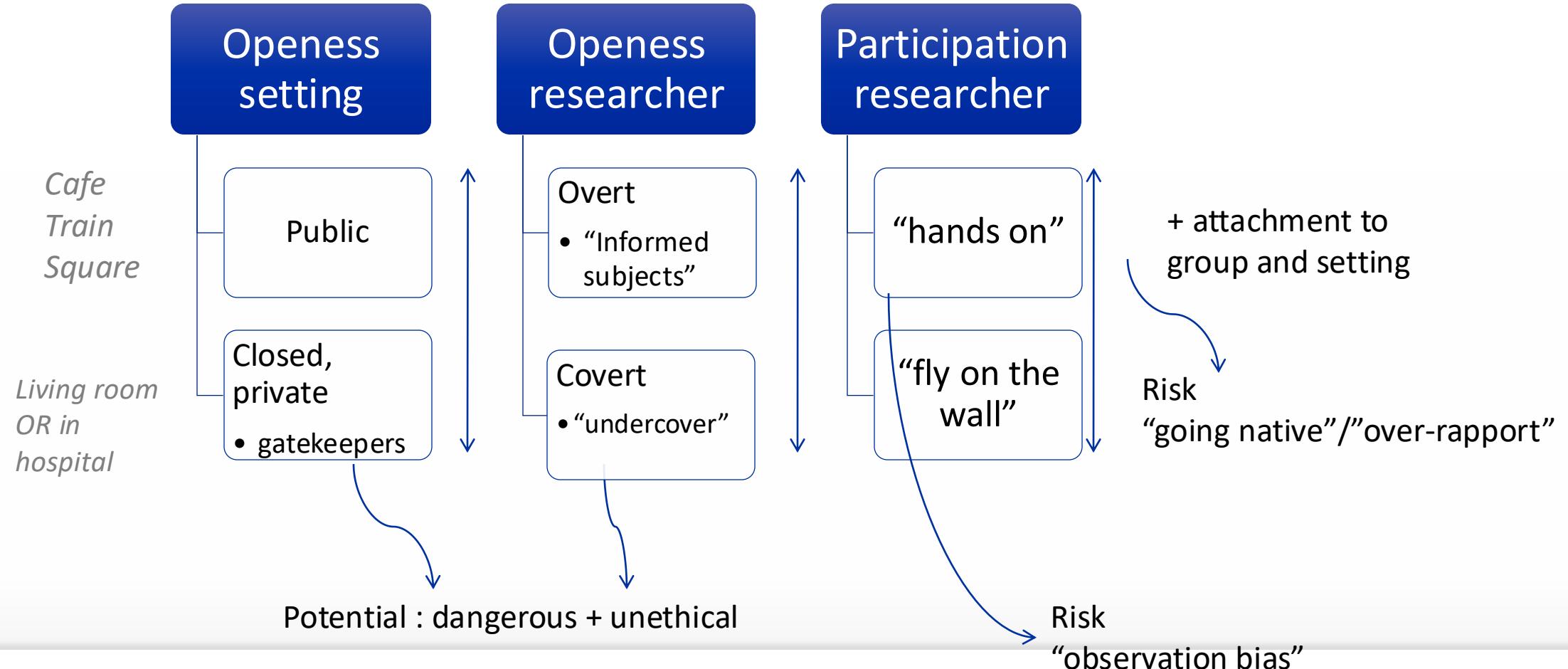


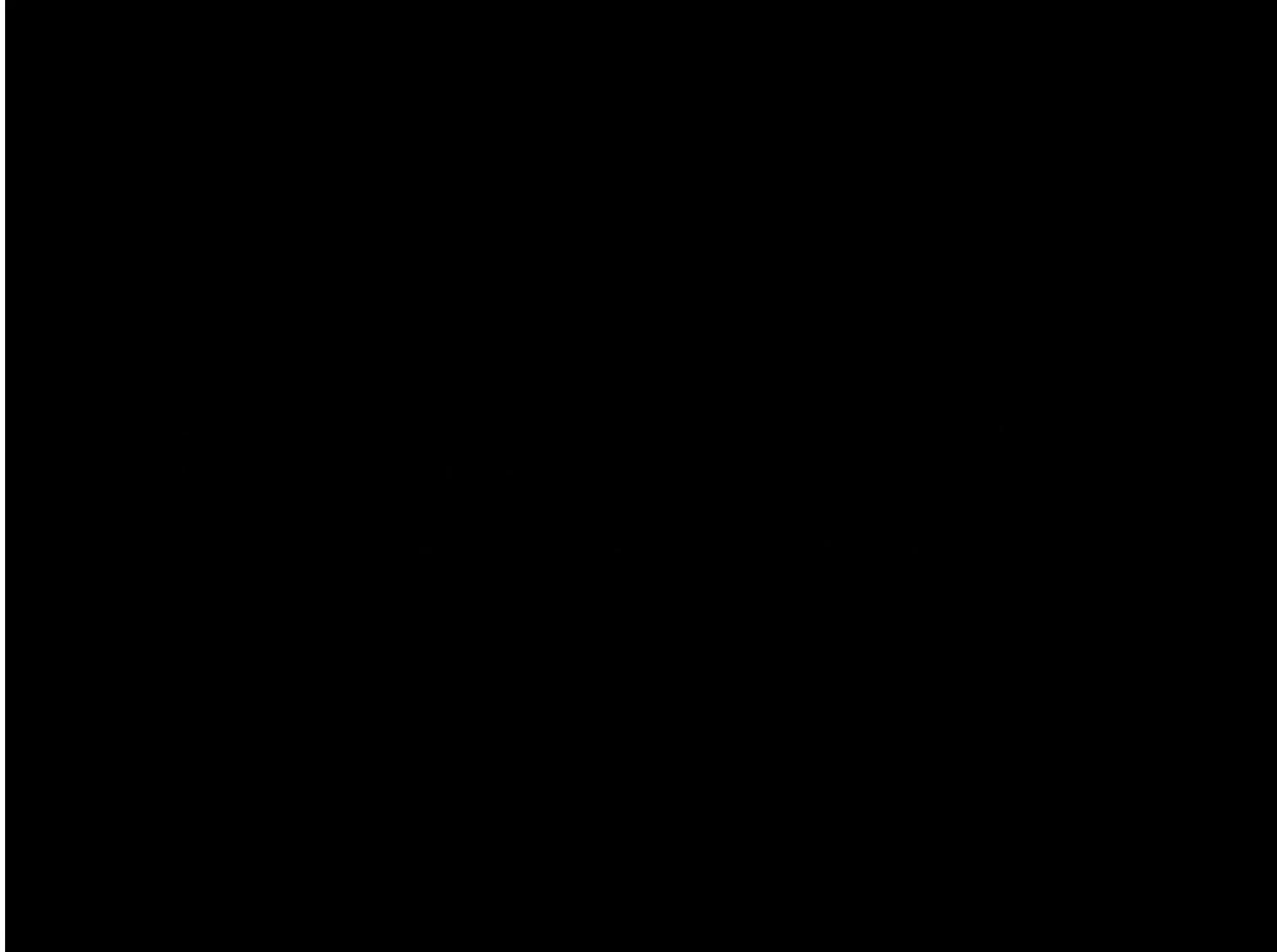
ASKING QUESTIONS, REGISTER INFORMATION RIGHT ANSWERS ('HEARING DATA')

POSITION OF INTERVIEWER (KVALE, 1996)

- “**miner**” (post-postivistic school) :
all info exist in the head of the interviewee
- “**traveler**” (constructivist school) :
data is result of interactive construction between
the two parties

OBSERVATION: SOME FUNDAMENTAL CHOICES





Changing attention points during observation

Place : physical place(s)

Actor : people present/involved

Object : material things around

Actie: single something someone does

Activity : series of connected actions of people

Event : series of connected activities

Time: sequence of time over something

Goal: what people try to attain with actions

Emotions: feelings people express

Source:
Spradley 2008 in Mortelmans, 2009

FROM DATA TO INSIGHT

"Coding" to find new patterns in data over different observations, interviews and activities

= hearing data

Looking from the point of view of the "users"

MAXQDA Reader (24.1.0)

exo_review2020_v5.0 - extra papers added

Home Variables Analysis Reports

New Project Open Project Reset Activations Logbook Teamwork Merge Projects Save Project As Save Anonymized Project As Project from Activated Documents External Archive Files Data

Documents

Codes

Cha et al. (2020)

Document (1)

1060

... wonder exo as personal device or interchanged among maintenance influences adoption (easy fix, exo u financial investment would influence widespread ... how long exo lasts ... sterility of device (if changed among colleagues) ... wonder about sterility of device if it were to be interc ... wonder where exo would be stored ... wonder if someone easily access exo ... new tools in OR can cause unwanted delays and frustrati ... participants have seen exo tech in press ... representative of exo to address safety/repair conc ... representative of exo to address safety/repair conc ... exo zou niet onder verantwoordelijkheid van technologist v ... awareness of exo in industry influenced impression of exo ... storage is logistical factor exo ... maintenance is logistical factor exo ... cleaning exo logistical factor ... usage mainly influenced by exo use ... perception of exo by others would influence exo use ... exo use depends on freely moving around OR ... exo use depends on e.g. not hindering colleagues ... R01 exo need to be survive dirt & water & corrosion ... most workers stated looked cool with exo ... exo use depends on prep process ... some mentioned exo looked funny ... popularity and perception from others may influence ... exo should not feel heavy ... weight influences exo use ... fit of exo influences exo use

Retrieved Segments

were mentioned. Participants asked hypothetically whether the technology would be better fitted as a personal device or would be interchanged among workers, and if it were to be interchanged, the sterility of the device, where it was stored, and if it could be accessible quickly (i.e., in each individual OR or in a storage room). These were significant concerns that would influence their decision to use it.

Some participants indicated experiencing frustration with other novel tools or equipment implemented in the OR, where breakdowns or troubleshooting often caused unwanted delays. A company representative to address any safety or repair concerns was also stated as a facilitator for implementation, as the hospital technologists would not be responsible for the device; however, this would be an added cost and investment (4b). These logistical factors such as storage (3g), maintenance (4a), and cleaning of the exoskeleton were identified by participants (21%).

Factors of familiarity (3b), perception (3e), buy-in from the team (3c), and immediate observable results (3a) would influence the use of an exoskeleton during every procedure. Although most workers stated that they looked "cool" with the exoskeleton, some mentioned "it looks funny" and that popularity and perception from others may influence their use (3e). Regardless of team perception, conspicuous equipment during patient-facing activities was likely not acceptable in current culture. In parallel to

cally monetary, and maintenance (4a) of equipment would likely influence widespread adoption: "just how long they last versus how long they take to get back up and running. If something that your own facility's clinical engineering guy can fix versus the company has fix" would be a consideration.

Finally, evidence of the exoskeleton work (4d) was categorized separately to represent public perception (e.g., scientific literature : media). When explaining exoskeleton technology to participants who were unfamiliar with examples of passive exoskeleton use in different manufacturing industries (i.e., automotive : aviation) were given, and participants recalled that they have seen press on this technology. This awareness of evidence of exoskeleton working in the different industries shaped participants' impression of the overall technology.

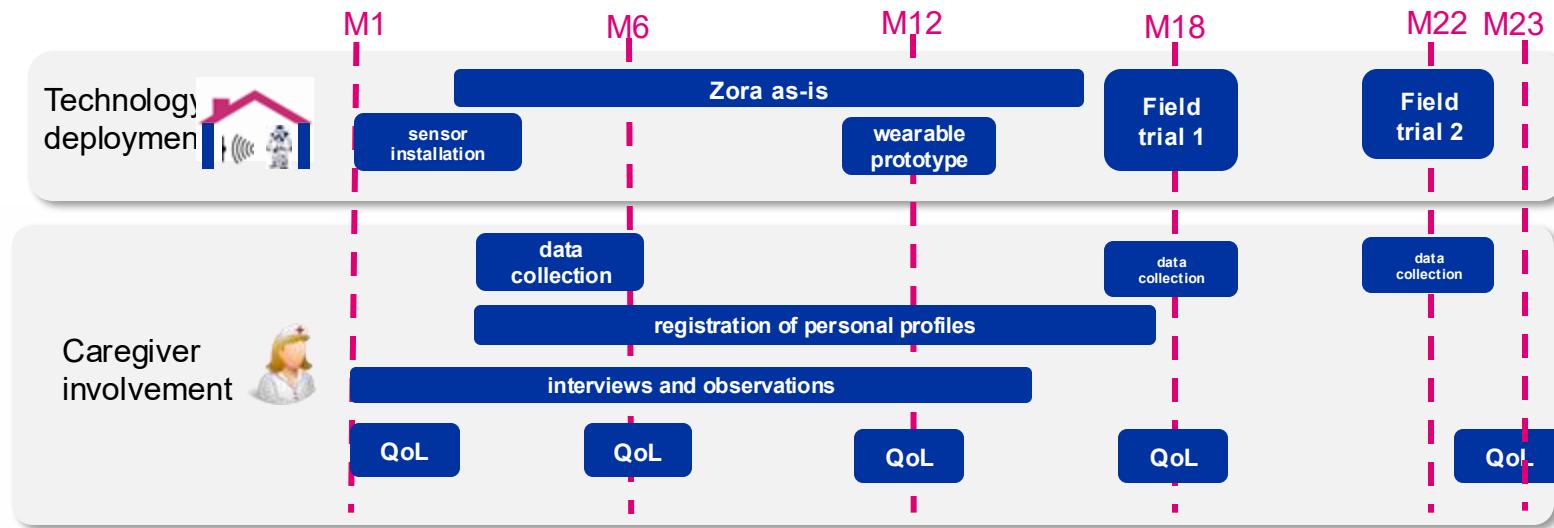
Usability of the exoskeleton (4d) was indicated as having a large influence on adoption (93%). All worker roles noted that whether they used the exoskeleton during surgical procedures would depend on its impact on externalities such as not hindering other workers, their ability to freely move around the OR, and the preoperative process. Furthermore, the weight and anthropometric fit were specified. Work especially those of smaller stature, noted that technology should not feel heavy or distribute weight poorly, as these aspects will influence the exoskeleton during surgery.

We now know the basic methods, and then ?

...and so we first focus on the current context

How to improve service cobots?

iMinds ICON project *WONDER* (2015-2017)



QBMT



Tight involvement of care stakeholders (caregivers, residents, family)
Field trials in real-life environments



Xetal







Impact on work processes

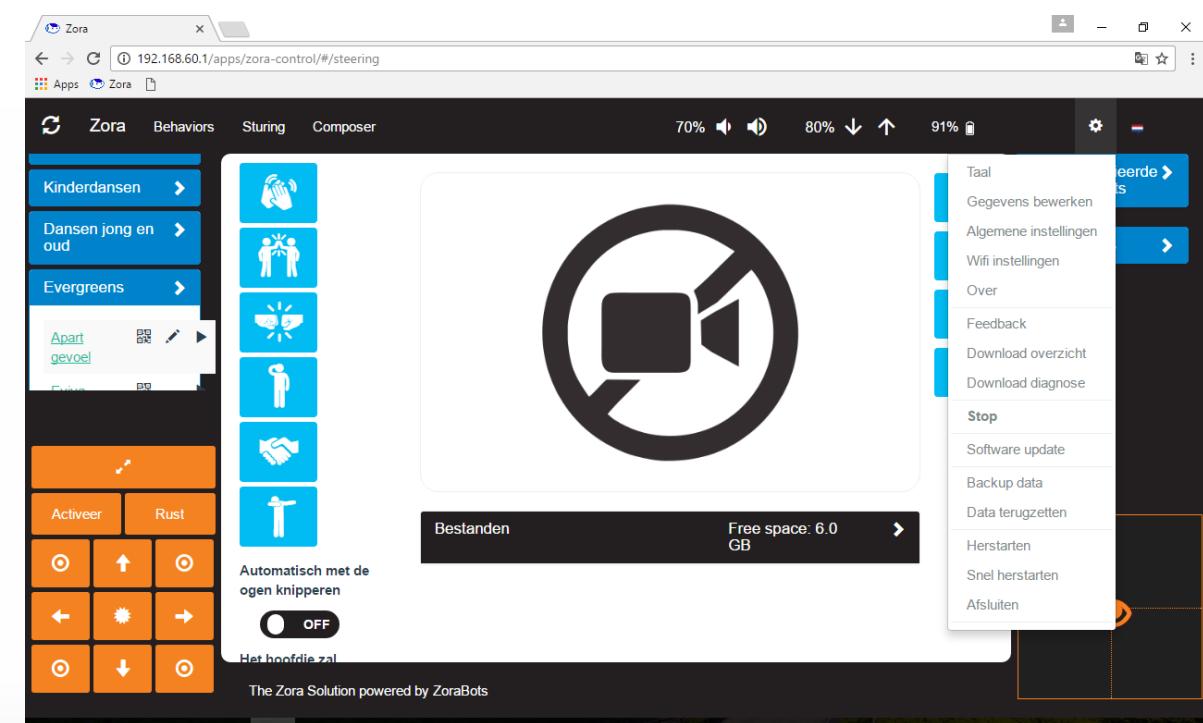
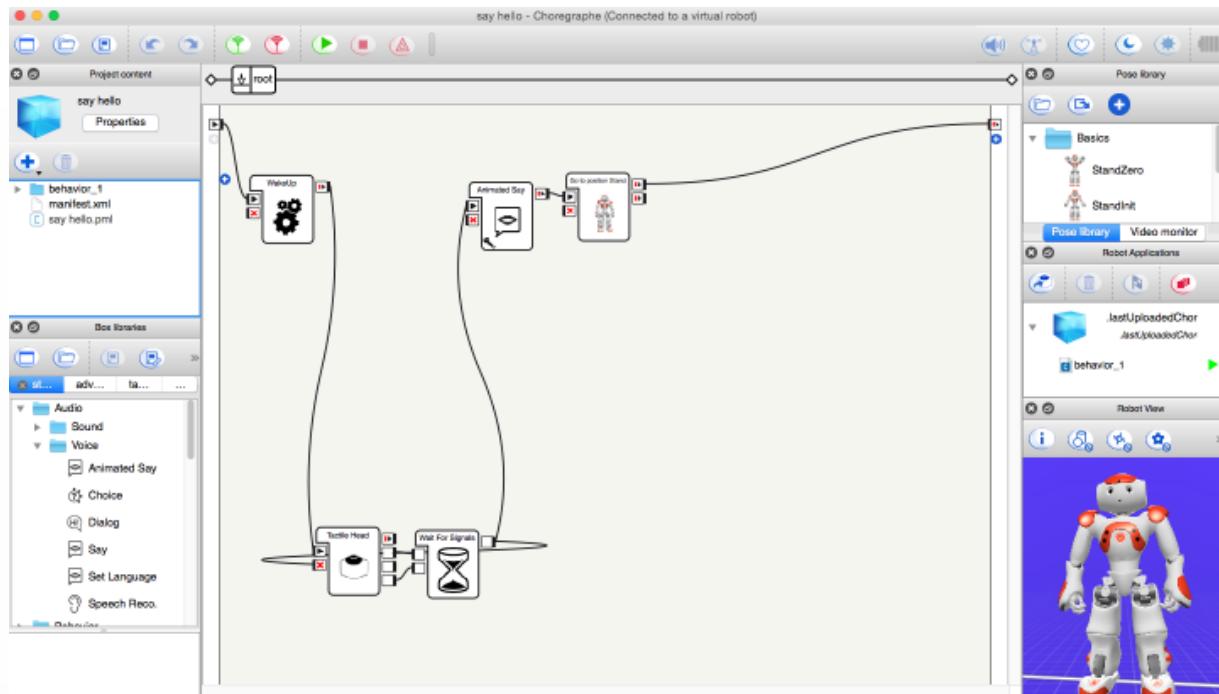
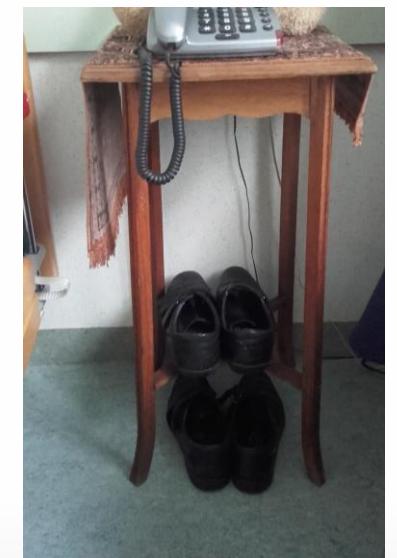
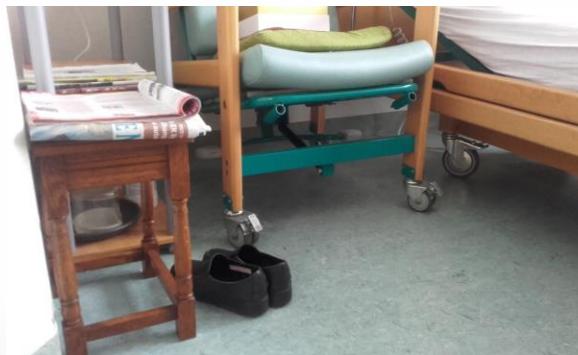


Fig. 1. Choregraphe Operating Interface



OPPORTUNITY FOR SENSOR IN SHOE ? STUDYING SHOE PRACTICES



Ok so we explored the
current practices, and
then?

... we start
cocreating and
envisioning the
future

COCREATION strategies to alleviate wandering behavior with healthcare professionals ?

- What should robot do when approaching person?
- What should robot do in interaction with person?
- Added value for health professionals



Example strategies to alleviate wandering with & without robots

Resident behavior	Cause	Current staff intervention	Robot intervention
Excessive wandering	Exhaustion, hunger, thirst	Encourage resident to rest & replenish with food or drink	Encourage resident to rest (don't give food or a drink)
Attempting to elope / lingering around exit	Dangerous for wanderer	Distracting resident with a conversation	Distract resident with conversation, song or dance
Trespassing (e.g. entering rooms of other residents)	Dangerous for wanderer; upsetting other residents	Remind resident of forbidden areas; guiding them further	Remind resident of forbidden areas; invite resident to follow robot to other nursing home activities.

S.A. ELPRAMA, K. KILPI, C. JEWELL, F. ONGENAE, F. DE BACKERE, F. DE TURCK, P. SIMOENS, A. JACOBS.

Opportunities to use robots to alleviate behavioral disturbances of nursing home residents. Gerontechnology 2016;15

So together with the multidisciplinary team this inspired to create a POC ?

... yes and we try to evaluate that as well in real life

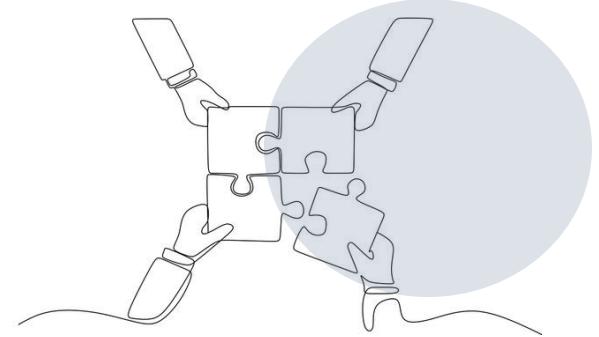






NATIONAL
GEOGRAPHIC

EU PROJECTS



Our expertise – social sciences:

- Acceptance & ethics
- Human oversight
- Explainable AI
- Living Labs
- User involvement
- Robots, cobots, exoskeletons
- Peri-menopause

• Interested in:

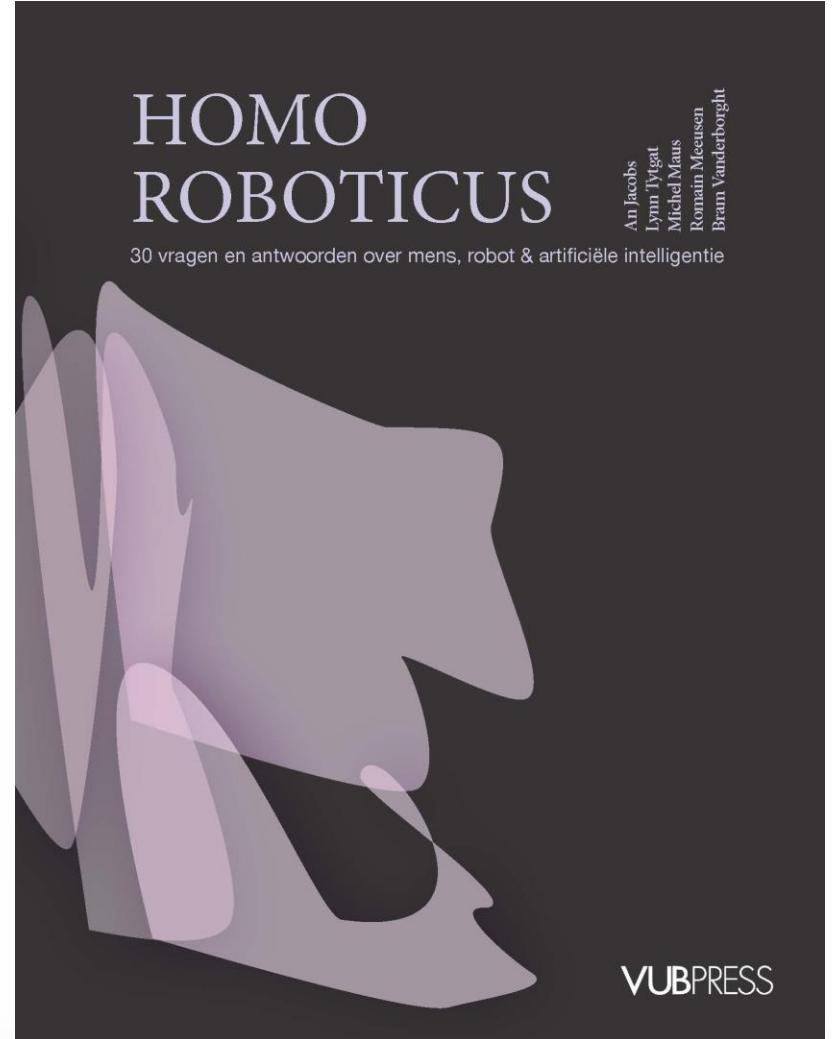
- HORIZON-CL4-INDUSTRY-2025-01-TWIN-TRANSITION-02:
Physical and cognitive augmentation in advanced manufacturing
- HORIZON-CL4-2025-03-DIGITAL-EMERGING-07: **Robust and Trustworthy Generative AI for Robotics and Industrial Automation**
- HORIZON-CL4-2025-03-HUMAN-15: **Generative AI for Virtual Worlds - Immersive and inclusive experiences**
- ... and other calls

Thank you, time for questions!

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“Jacobs, A., Elprama, S., Jewell, C. (2020). Evaluating Human-Robot Interaction with Ethnography. Pp. 257-268. In Human-Robot Interaction Evaluation Methods and Their Standardization, Springer”



PRACTICAL ASSIGNMENT

PREPARING FOR FIELD TESTING

1. Study overview
2. Stakeholders
3. Ethics and consent
4. Context
5. Equipment
6. Data collection
7. (Debriefing)

CASE STUDIES

DESCRIPTION

- Trustworthy information robot at a train station (Jesus)
- Trustworthy luggage carrying robot at a train station (Jesus)
- Mobile omnidirectional robot for safe interaction in a warehouse (Sahar)
- Ship simulator: helping the ship master to run the ship (steer, drive) in a safe way (robot as a helper) (Sahar)
- Robot handshake (Adnan)



1. STUDY OVERVIEW

PREPARING FOR FIELD TESTING

- What will the robot be used for?
- What will be tested?
- What the research question(s)?
Pick one to focus on for this exercise.
- Which scenario(s) will be tested? Pick one to focus on for this exercise.
- Which methodology? (one or more)
Observation, interview, experiment, questionnaires,...

2. STAKEHOLDERS

PREPARING FOR FIELD TESTING

- Who are the primary users?

People affected by the system (Eason, 1989)

- Who are the secondary users?

People who occasionally or indirectly use the system (Eason, 1989)

- Who are the non-users?

Types of non-users excluded, resisters, rejecters, expelled, discontinuer
(Wyatt et al., 2002; De Graaf et al., 2017) (can change over time)

- Who will be the participant(s) of the study?

- Who can you involve in setting up this field test?
(look at the (non-)users you have already identified)

3. ETHICS AND CONSENT

PREPARING FOR FIELD TESTING

- **What are potential risks (physical, psychological, etc.) for the participant?**
- **How can you mitigate these risks?**

Risk	Mitigation

Checklist

- Who needs to provide informed consent?
- Is approval of an ethical committee (EC) needed?
- Where can you find out what approval is needed?
- Does the journal you intend to submit your work to require EC?
- Does your funding require EC?

4. CONTEXT

PREPARING FOR FIELD TESTING

- How can you create a situation that matches the real use case as close as possible? Try to match the participant's needs.
- Which part of the day will the test take place? (morning, afternoon, evening, night, etc.)? If any, what are the implications for your test?
- Where will the test be conducted? Be as specific as possible.
- What other context-related factors need to be considered? (e.g. dusty environments, environments with a little amount of light, with changing amounts of light,...)

5. EQUIPMENT

PREPARING FOR FIELD TESTING

- What equipment/tools are needed to conduct the study?
(For example, wearable to measure EDA, camera to record videos, chargers, power banks, notebook, pencil, tablet, internet connection...)

Checklist

- How will the robot be transported to the context of study?
- Where will you store the robot (safely and securely) during the field test?
- Is there a (stable) internet connection in the field?
- Do you have internet access in the field?

6. DATA COLLECTION

PREPARING FOR FIELD TESTING

- What data will you collect?
- What are possible bottlenecks to bring this study into the wild?
- Which social scientist / HRI researcher can you consult and ask to do the field study?