EFFRA
EUROPEAN FACTORIES OF THE FUTURE RESEARCH ASSOCIATION

dtx Digital Transformation CoLab

IKEA Industry Paços de Ferreira

Design, Implementation and Evaluation of a Training Interface for Workers Using Augmented Reality: LÄRA

Presenter:

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AGENDA

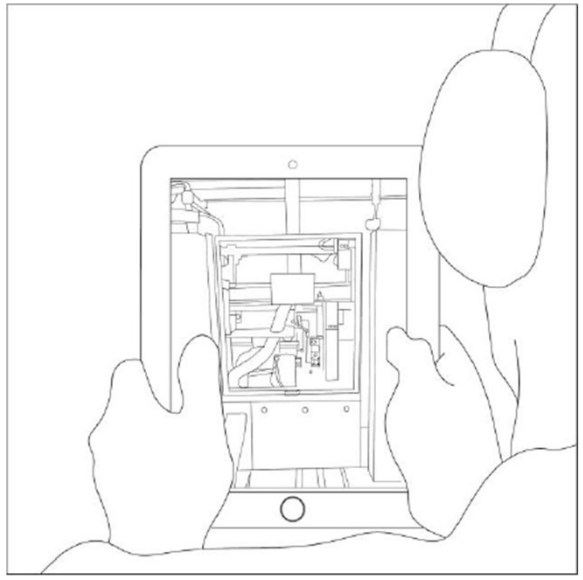
1. Motivation
2. Training Challenges
3. AR-based training Tool
4. Design Methodology
5. Results/Conclusion
6. Future Work

1 - Motivation: Digital Transformation & Industry 5.0

- **Challenges in industrial automation**:
  Growing automation demands specialized training; Sectors with skill shortages and high turnover.

- **Benefits of AR:**
  an emerging technology promising for training in industrial maintenance and assembly tasks providing interactive and multi-sensory learning environments that can save time and reduce costs (Gavish et al, 2015;Abbas et al., 2020; Bottani & Vignali, 2019; Url et al., 2020).

- **Human-Centered Approach**:
  Focus on workers' needs rather than forced adaptation to technology. (Casla et al., 2019; Breque & Petridis, 2021).

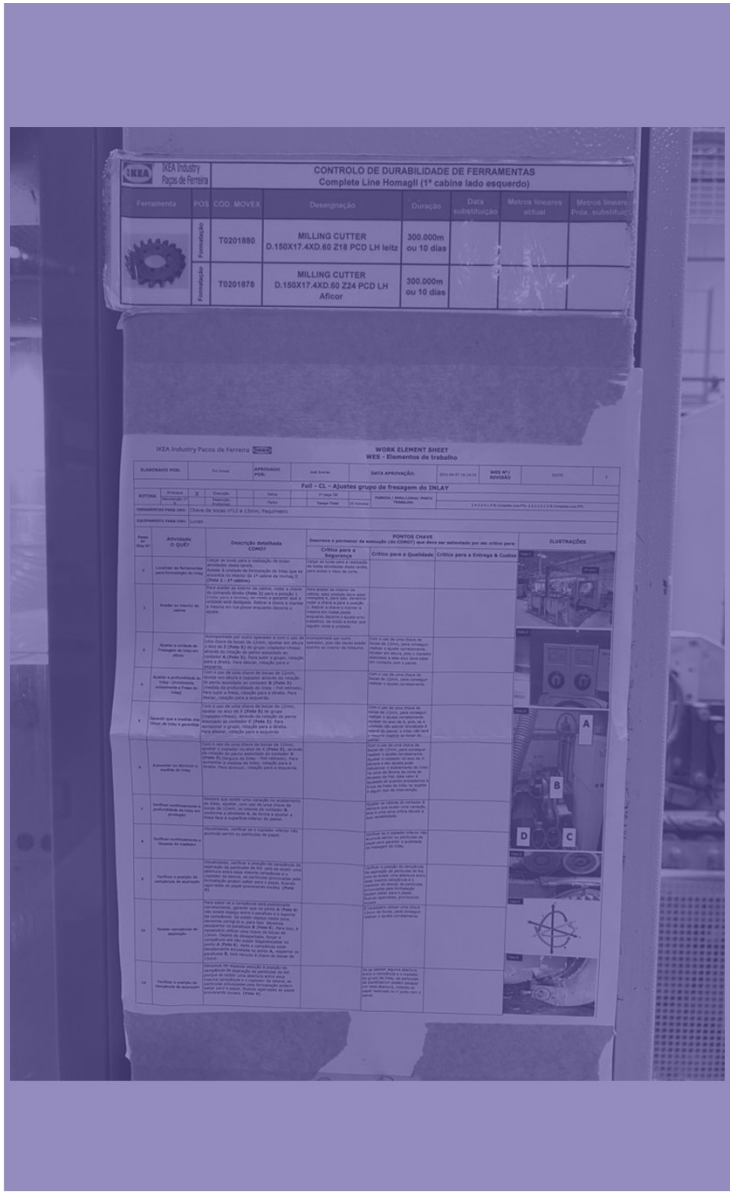


2 - Training Challenges

- Paper instructions and Excel-based WES to train new employees. These are **static, hard to update, and lack contextual guidance**.

- Workers often **depend on senior colleagues** for tacit knowledge transfer.

- Training sessions is **time-consuming** and Trainers struggle to **maintain quality consistence** across workstations;



3- LÄRA : AR-based Training Tool

LÄRA PLATFORM

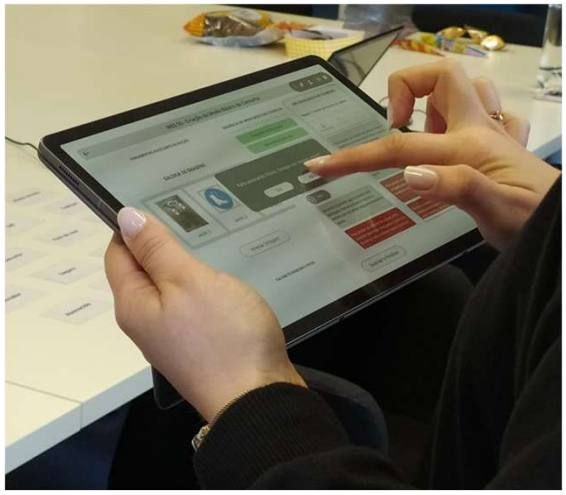
Server Platform

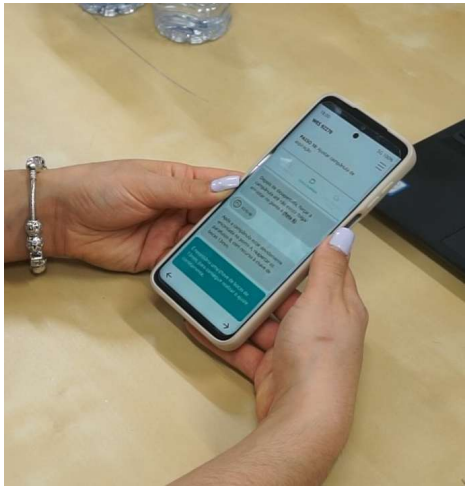
LDI – LÄRA DESIGNER INTERFACE

Allows the trainer to **create** and **edit training sessions** on a tablet

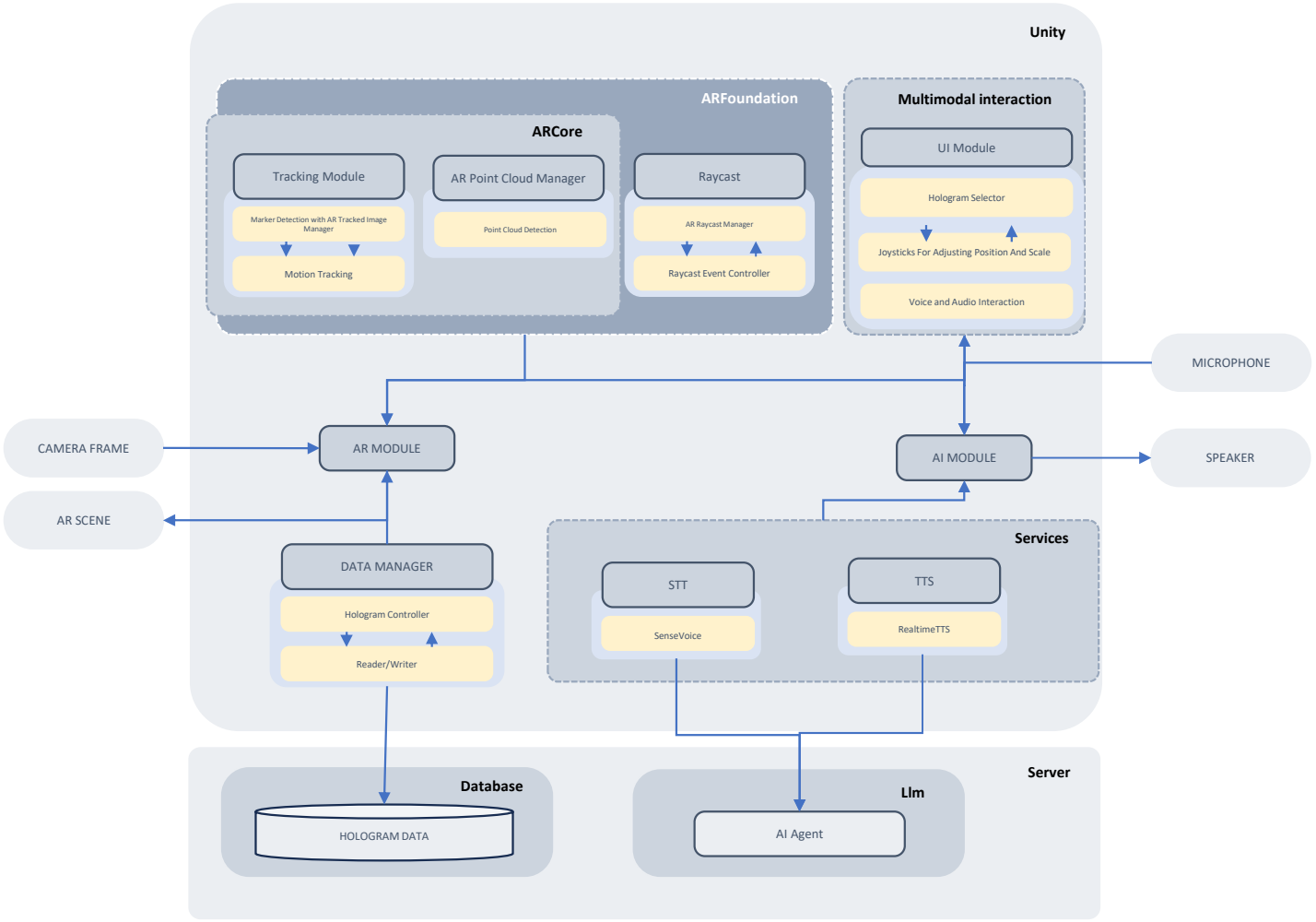
LTI – LÄRA TRAINING INTERFACE

Allows the employee to **view** and **execute the AR supported training session** on a smartphone

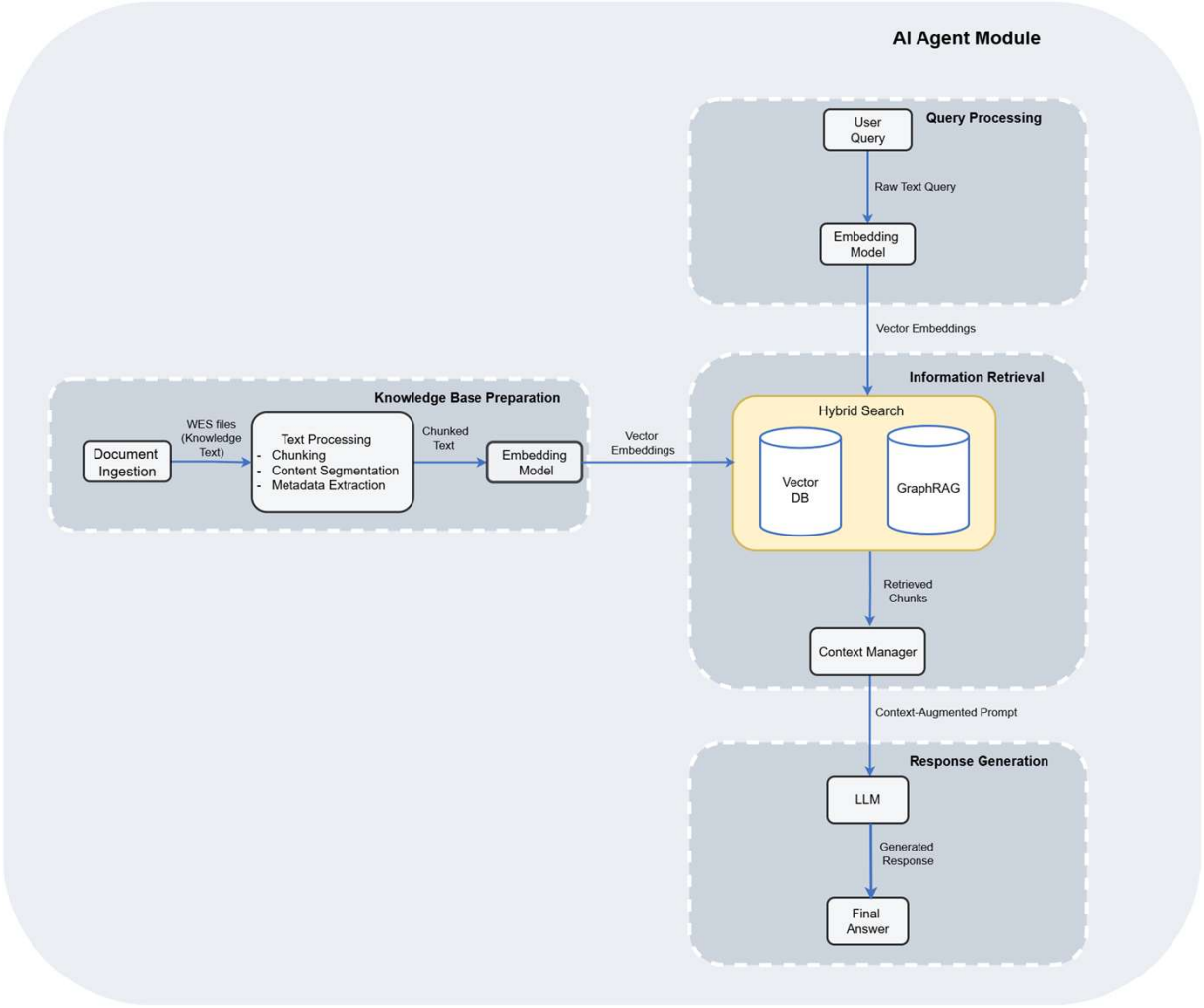




3- LÄRA : AR-based Training Tool



3- LÄRA : AI Agent

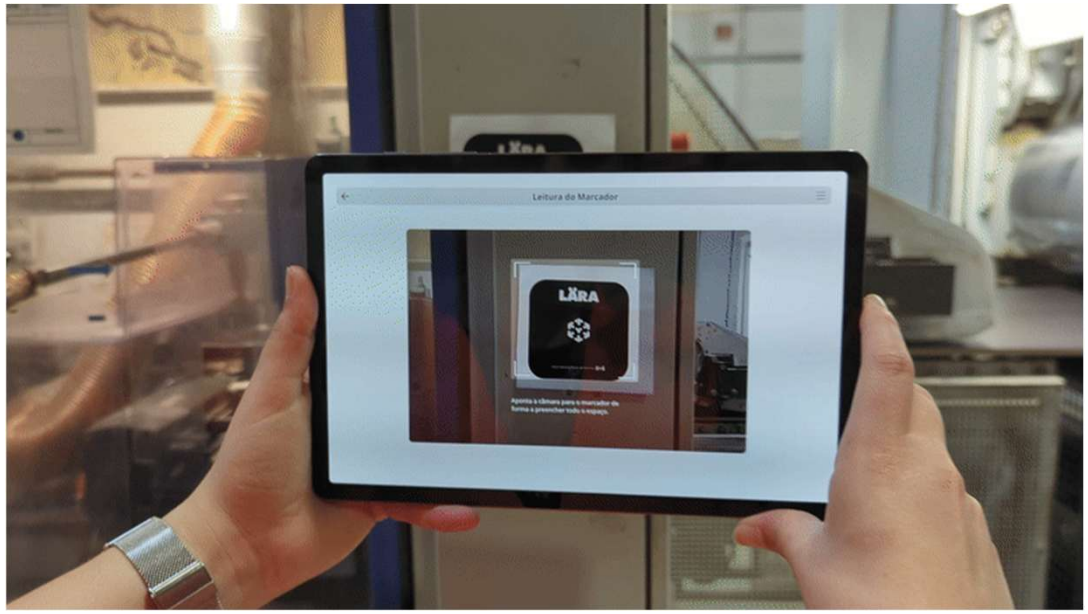


Advantages of LÄRA

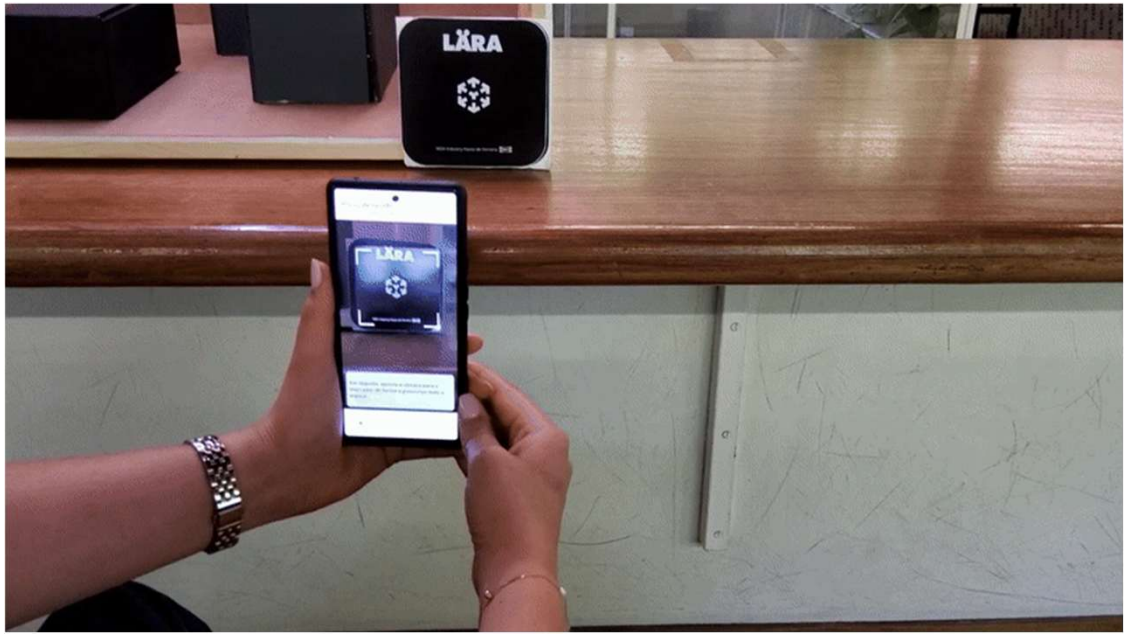
Creation of training sessions using AR quickly and without requiring any technical knowledge of AR;

Freedom to add images, videos, notes, safety requirements, tools, holograms, and Excel documents containing procedures as desired by the instructor;

The learning process becomes more interactive, immersive, and can also be faster and more effective.



LDI – LÄRA DESIGNER INTERFACE



LTI – LÄRA TRAINING INTERFACE

Advantages of LÄRA

Enhanced Learning Experience;

Higher Efficiency & Cost Reduction;

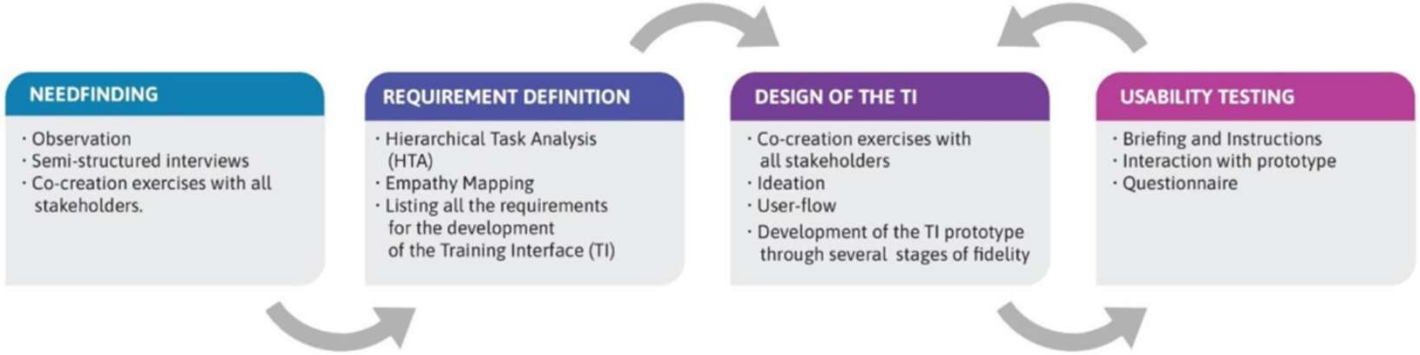
User-Centered Adoption & Satisfaction;

Flexibility & Scalability.

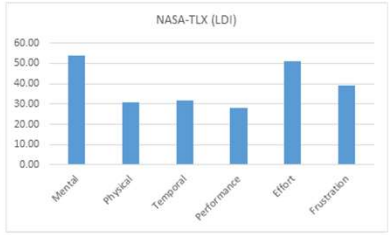
4 - LÄRA Design Methodology

Human-Centered Co-Design:

- Participatory approach involving all hierarchical levels (employees, supervisors, leaders);
- Direct observations, interviews, and document analysis to map obstacles in traditional training;
- Co-creation sessions and iterative testing from the very beginning of the project for app development.



4 - LÄRA Design Methodology

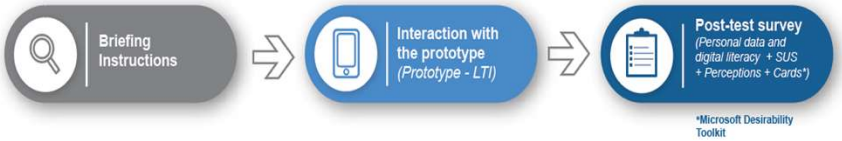


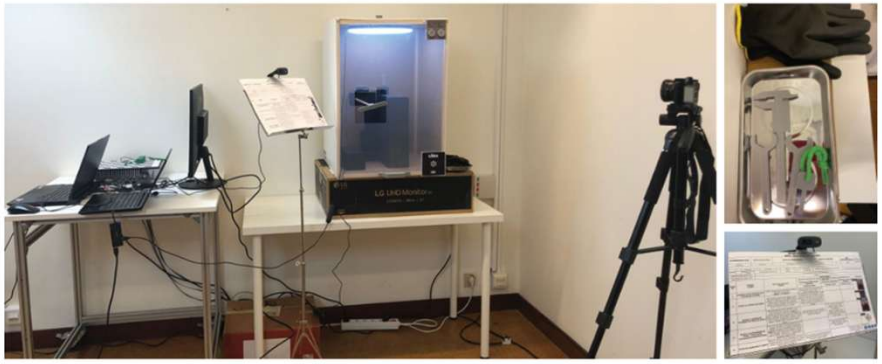
Test 1: Low Fidelity Prototype

Test 2: Mid-Fidelity Prototype

Test 3: High-Fidelity Prototype with AR

Test 4: Final Validation with real Workers at IKEA





4 – Results

Criterion	Paper (WES)	LTI (AR App)	LDI (AR App)
Task Time (initial)	✅ Faster	⚠️ Slower (learning phase)	--
Errors	❌ 111	✅ 87	--
Tool & PPE recall	⚠️ Moderate	✅ High	
Cognitive Load (NASA TLX)	⚠️ High (45)	✅ Low (18)	Low (20)
Usability (SUS)	—	✅ 75.1	88
User Experience	“Text-heavy, static”	“Visual, intuitive, motivating”	““Attractive, useful, easy to use””

5 –Conclusions

- **Involving users in development increases acceptance and loyalty.** When users are involved in creating the solution they will use, they feel more valued, which enhances their willingness to adopt and utilize it;
- **Testing prototypes with users during the development process** enables the collection of **valuable feedback**, allowing for **adjustments and improvements before the final release**.
- The **AR Tool probe to be environment-agnostic**, capable of operating reliably under various lighting conditions, with a maximum positioning drift error of 3 cm.

6 - Future work

- Adopting **GenAI to automate the creation** of training sessions;
- **Integration** of LÄRA **with Competency, Human Resource, and Operations Management System**;
- Upgrading LÄRA to a **cross-plataform solution**;
- Empower LÄRA with advanced **computer vision functionalities**.

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Published Results

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Thank you!

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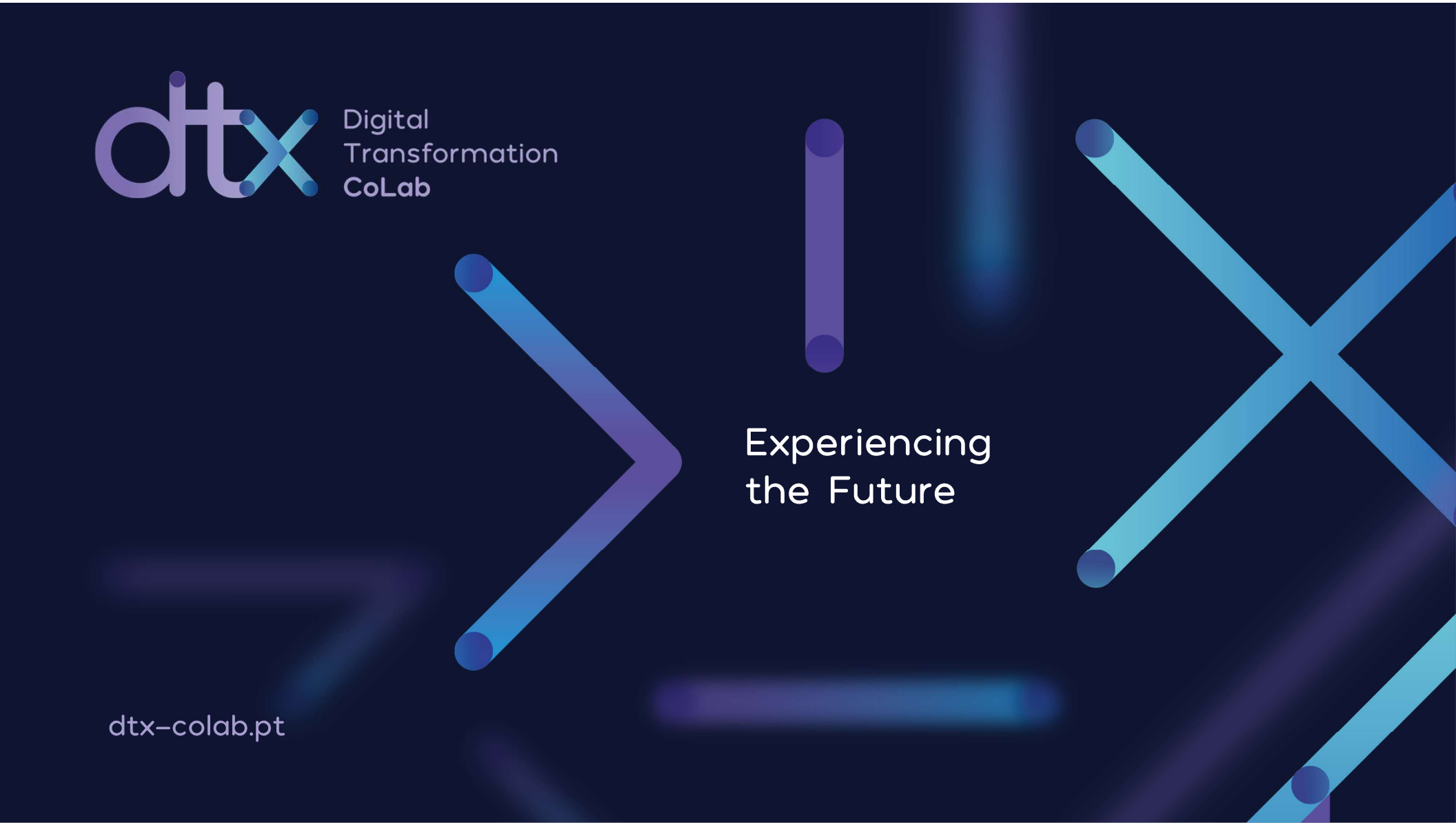
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