Competency-Oriented Requirements for Learning Factories in Circular Battery Cell Production

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Motivation

Challenges in training for circular battery cell production

- **Resource-effcient** practices **a**re essential for **long-term competitiveness** and **resilience**
- **Technical complexity** of production creates a strong demand for **highly skilled workforce** [1]
- **Rapid introduction** of new **process technologies** as well as cell **chemistries** and **formats**

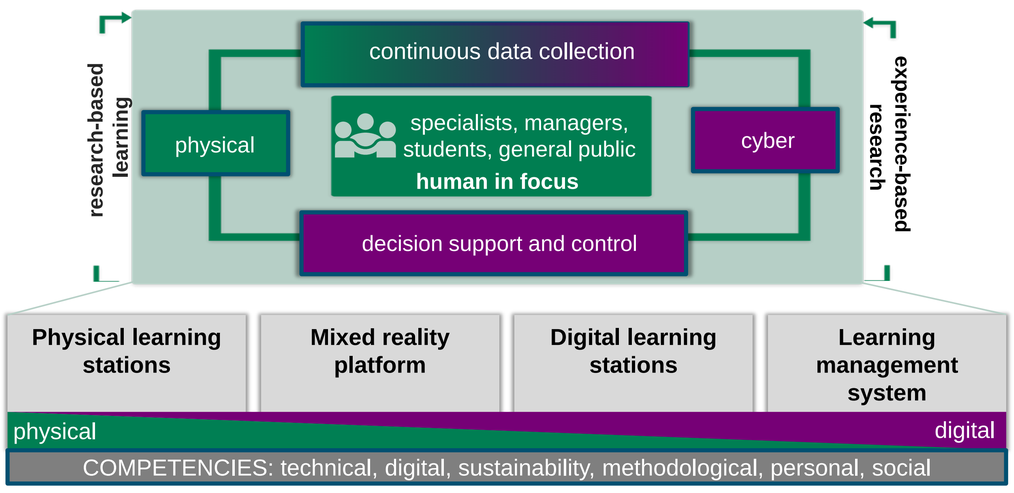
Learning factories offer **practice-oriented environments** to bridge **theoretical knowledge** and **industrial application**, representing **testbeds** for innovative technologies

Objectives

1 Investigate **competencies** required to address the ongoing transitions toward **digitalization** and **sustainability** in battery cell production

2 Propose a infrastructure, including **physical** and **digital components**, necessary to support these competencies

Learning Factory for Circular Battery Cell Production [2]



Physical learning stations

Pilot-line for the production of cylindrical **lithium iron phosphate (LFP)** battery cells in **21700 format**

Mixed reality platform [3]

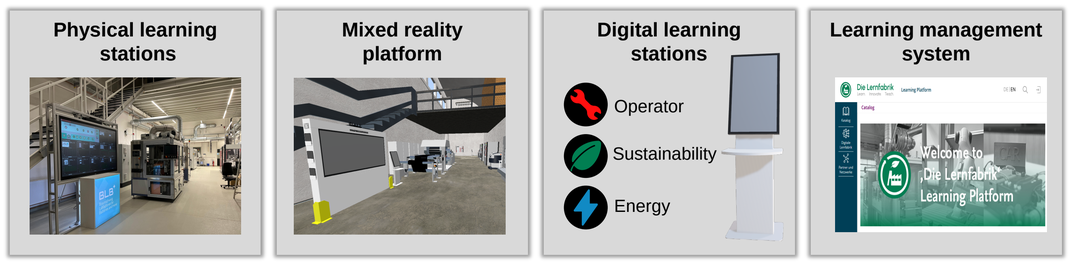
Detailed process models to support understanding of **system behavior** and enable **virtual experimentation**

Digital learning stations

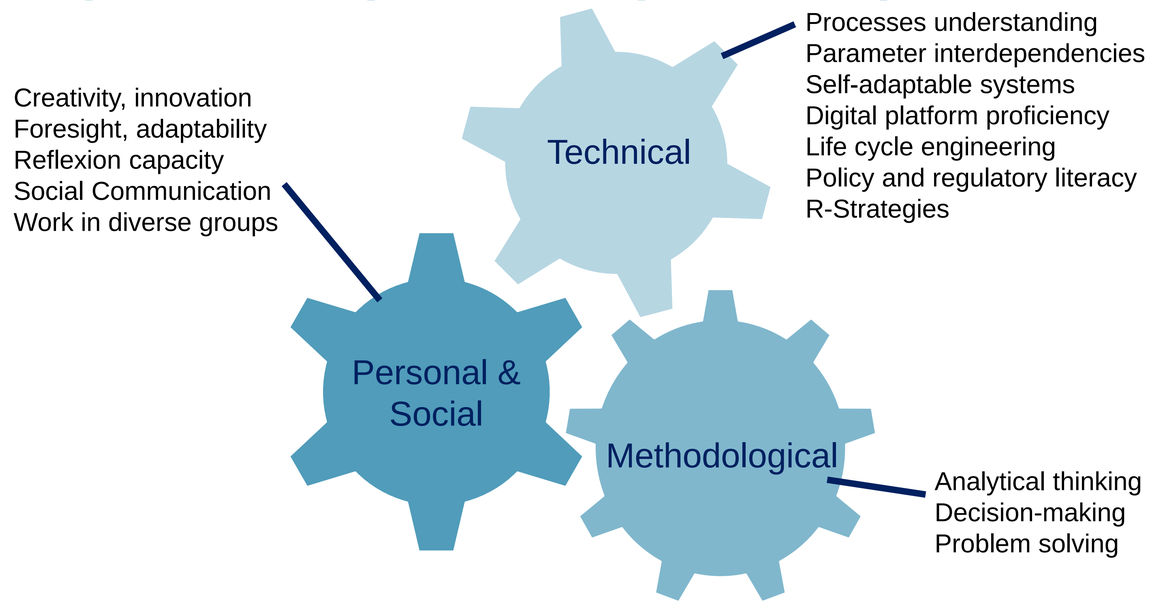
Display **information** according to the corresponding user **role** and the **selected object** (e.g., material, equipment part)

Learning management systems

Link between physical learning stations and **mixed reality** applications, while providing access to **learning materials** and **instructions**



Required Competencies (selection)



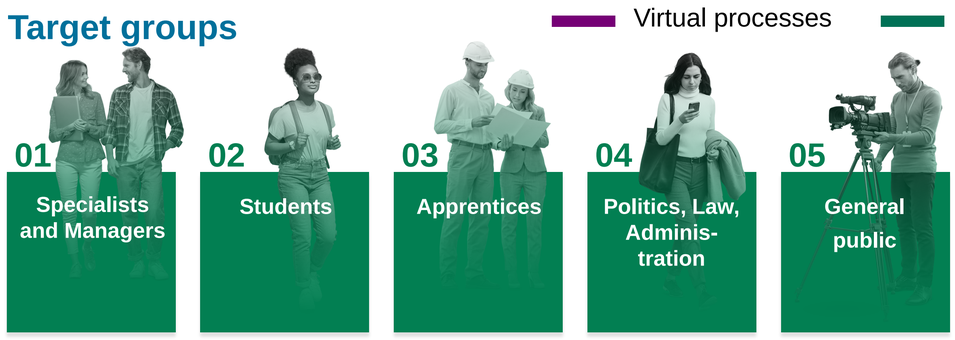
Implementation

"We enable people to shape the production of the future in a sustainable, circular and digital way."

Process chain



Target groups



Outlook

- **Opening** of the learning factory for training in **summer 2026**
- Future work will focus on developing **innovative learning content** and **formats**
- Strengthen **collaboration** and **knowledge exchange** between students and industry professionals

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References

[1] Arnold-Triangeli, L., Birner, N., Busch-Heizmann, A., Johnsen, D., Kelterborn, P., Maschke, M., Sprung, C.: Spotlight on talents in German battery industry. Tech. rep., VDI/VDE Innovation + Technik GmbH, Berlin (2023)
[2] Süß, S., Wohjan, O., Ventura Silva, G., Herrmann, C.: Learning Factory for Sustainable, Circular, and Digital Production (2026). *Submitted*
[3] Effner, B., Ventura Silva, G., Lindner, M., Herrmann, C.: A Concept for a Modular, Multi-Platform Mixed Reality Framework for Learning Factories (2026). *Submitted.*