Assistance- and Knowledge-Services for Smart Production

Results from the APPsist Project

Carsten Ullrich, Matthias Aust, Roland Blach, Michael Dietrich, Christoph Igel, Niklas Kreggenfeld, Denise Kahl, Christopher Prinz and Simon Schwantzer

Michael Dietrich

Center for Learning Technology (CeLTech) im

Deutschen Forschungszentrum für Künstliche Intelligenz

michael.dietrich@dfki.de

The Workplace is Transforming

- Challenges for Europe's manufacturing industry:

Increasing flexibility…

- Ever increasing number of product variants
- Same time smaller batch sizes (batch size 1)
- Shorter product cycles

… while keeping/increasing level of competitiveness

… with fewer and fewer employees

→ Need for increasing flexibility of

- shopfloor
- usage of employees

Assistance- and Knowledge-Services for Smart Production

- Information providing and training processes will become
  - more flexible
  - integrated in the workplace
  - individualized
- Need for tools that
  - adapt themselves intelligently to the knowledge level and tasks of the human operators
  - integrate and connect the knowledge sources available in the company
  - generate useful recommendations of actions.

appsist

APPsist

Anwendung & Validierung

LPS
LEHRSTUHL
FÜR PRODUKTIONSSYSTEME
RUB IGM KOOPERATION
DFKI
Deutsches
Forschungszentrum
für Künstliche
Intelligenz GmbH
Fraunhofer
IAO
FESTO
Lernzentrum
imc

Forschung & Entwicklung

DIN
Deutsches Institut für Normung
Scheer Management
CONSULTING & SOLUTIONS
acatech
DEUTSCHE AKADEMIE DER
TECHNIKWISSENSCHAFTEN
IGM

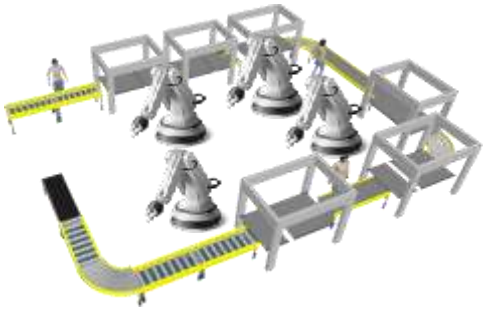
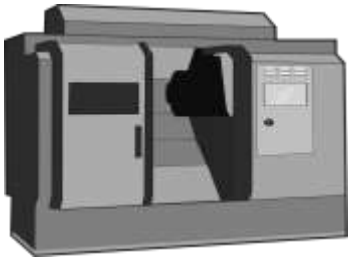
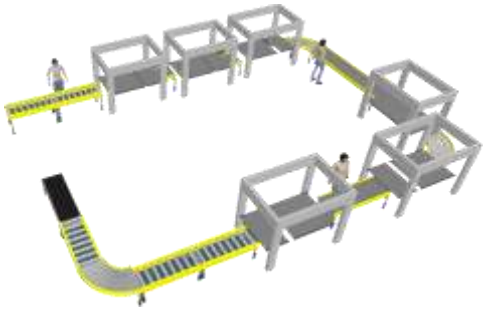
*

Beratung

Duration 1.1.2014-31.12.2016

* Partner im Unterauftrag

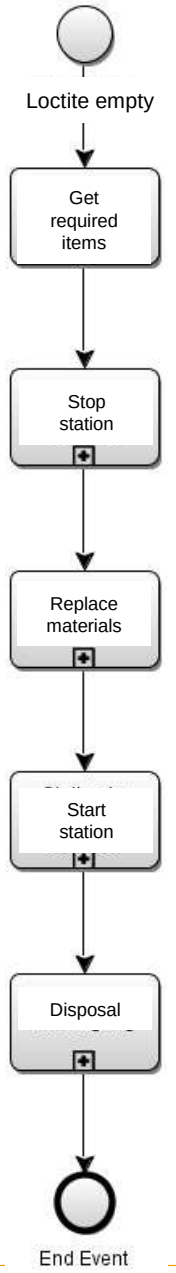
APPsist Pilot Scenarios

Partner	MBB FERTIGUNGSTECHNIK	BRABANT & LEHNERT Werkzeug- Vorrichtungsbau GmbH	FESTO
			
Pilot Area	Production line	5-axis drill	Partly automated assembly line
Pilot Scenario	Support for failure detection	Support for machine usage	Support for maintenance

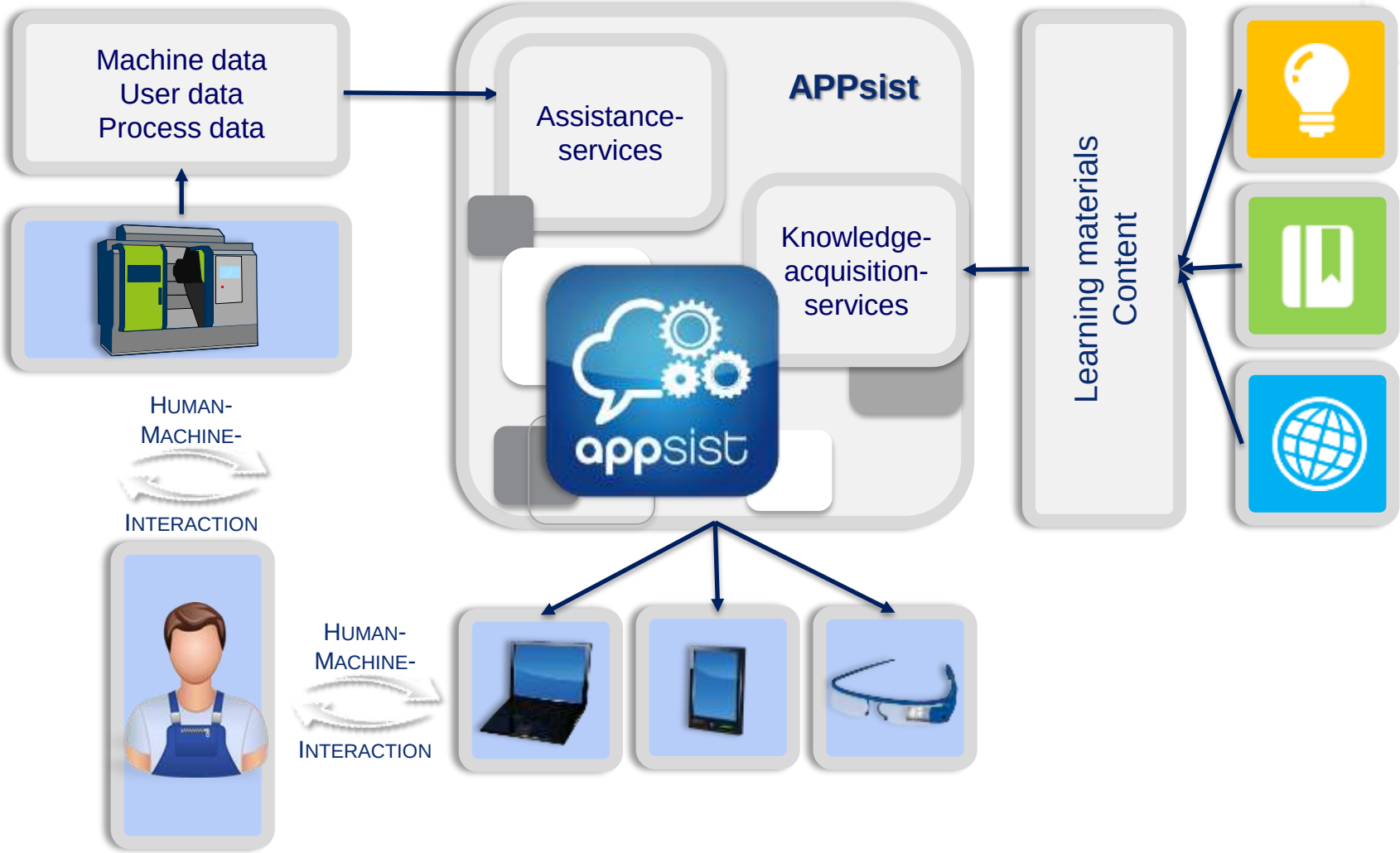
Pilot study Festo: Changing Loctite

Modelling the Maintenance Process

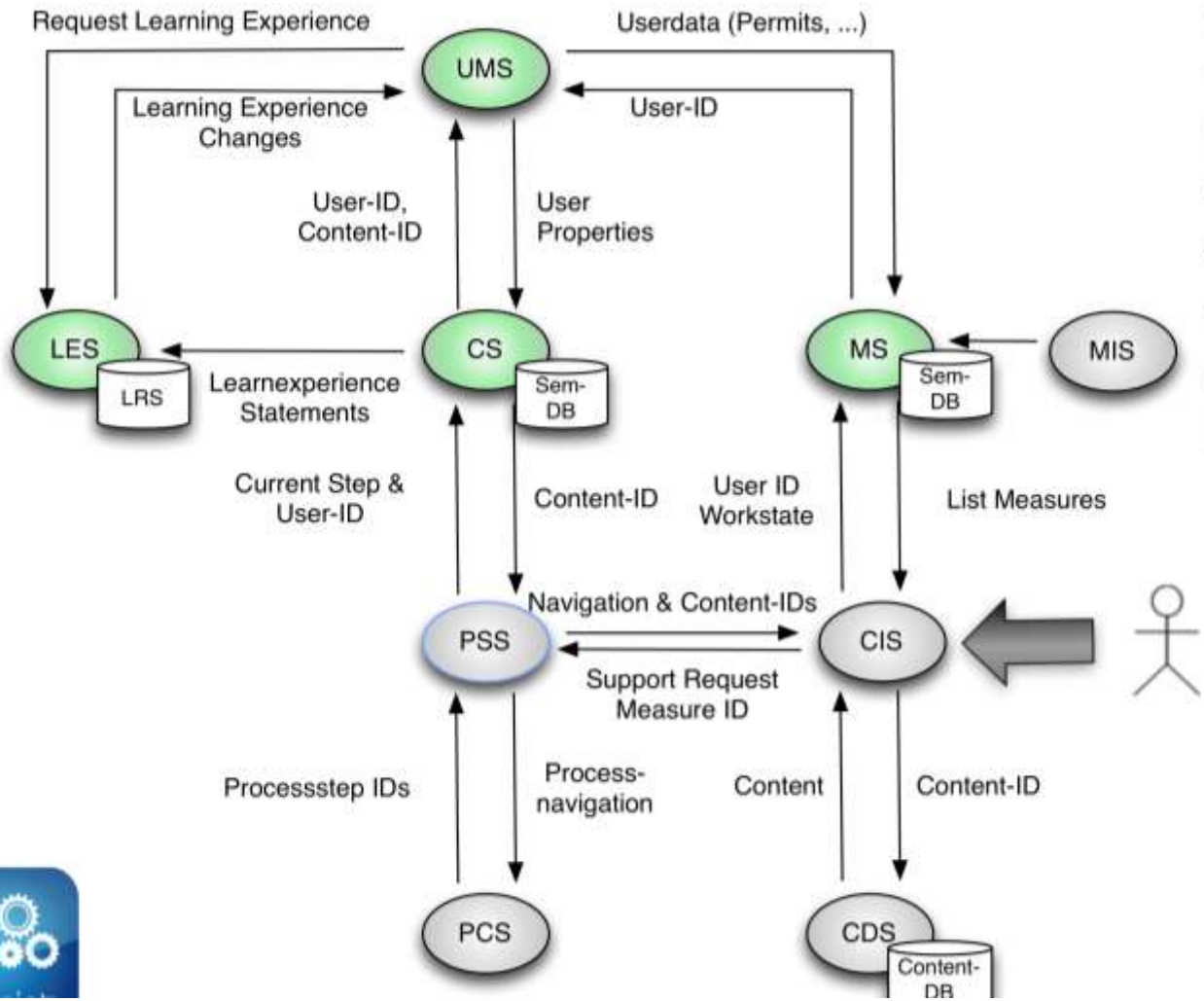
- Process models represent a complete and applicable description of steps required to perform a task
- Process models are formally defined (BPMN) and therefore
  - have a defined meaning
  - can be executed by process engines
- Used as a basis for the intelligent assistance



APPsist Architecture Overview



APPsist System Overview(Technical)



CS: Content-Selector

CIS: Content-Interaction-Service

LES: Learning-Experience-Service

MIS: Machine Information Service

MS: Measure-Selector

PCS: Process-Coordination-Service

PSS: Performance Support Service

UMS: User-Modell-Service

Overview: A few of the APPsist Services

- Content-Delivery-Service (IAD)
- Content-Interaction-Service (IID)
- Machine-Information-Service (MID)
- User-Modell-Service (BMD)
- User-Context-Service (BKD)
- Performance-Support-Service (PSD)
- Process-Coordination-Service (PKI)
- Content-Selector (IhS)
- Measure-Selector (MD)
- …

→ Integration into architecture

Service Description

- **Performance-Support-Service (PSD)**
- Guides the users through the assistance process.

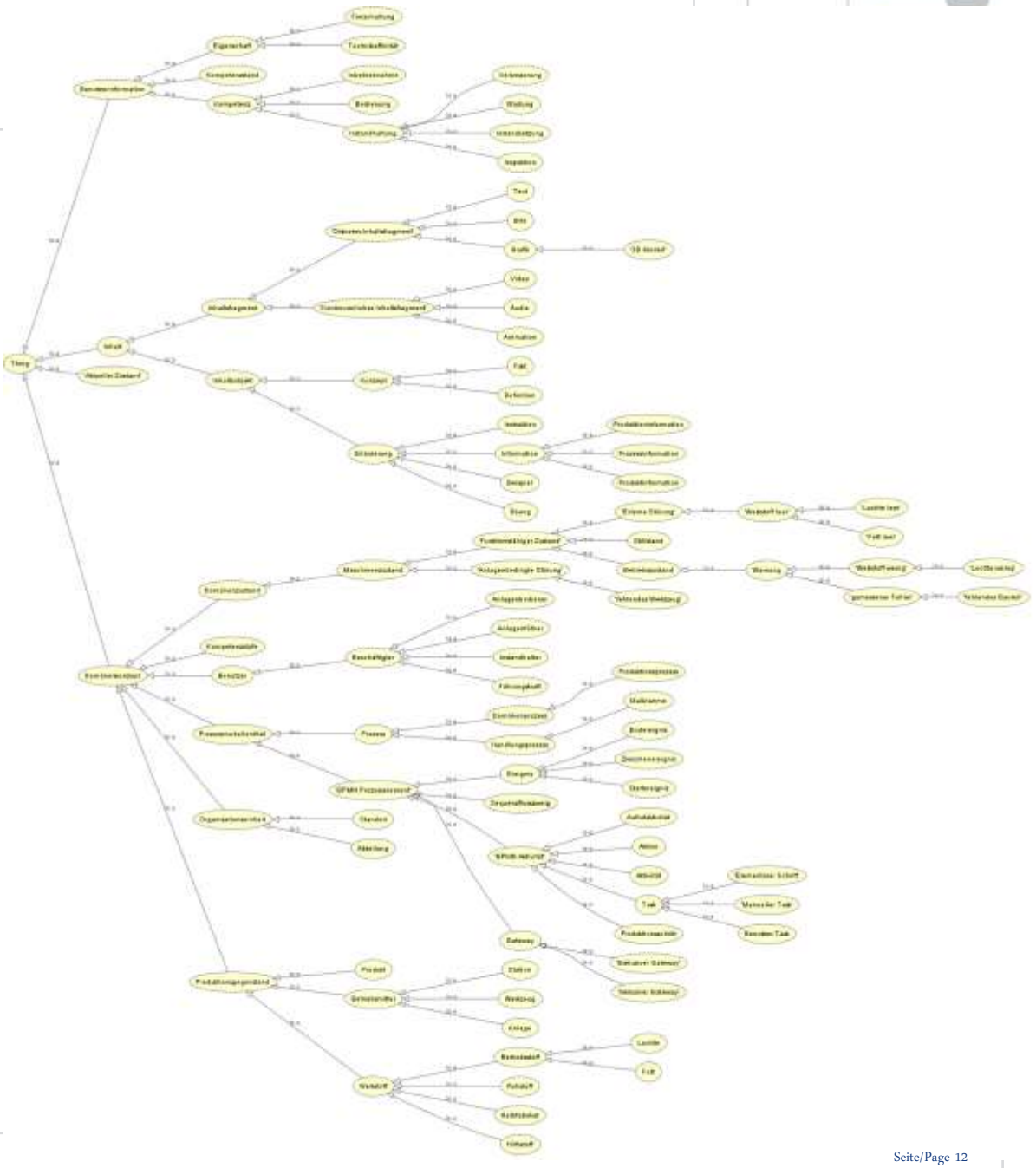
- **Process-Coordination-Service (PKI)**
- Instantiates and administers processes, reacting to incoming events and coordinates other services relevant for current process.

- **Content-Selector (IhS)**
- Retrieves content adapted to individual user and context based on rules
- Uses semantic knowledge repository for reasoning.

- **Measure-Selector (MD)**
- Determines applicable assistance processes according to user and machine state based on rules.
- Uses semantic knowledge repository for reasoning.

APPsist Ontology

- **Describes relevant concepts for and their relationships**
  - User
  - Content
  - Manufacturing
- **Representation in OWL (Semantic Web standard)**
- **Used for communication between services and for reasoning by intelligent services**



User Model (current state)

- **Connection to domain-model concepts**
  - Concepts from domain-model are enriched with user specific valuesOrdnet jedem
    - Number RUNs (for processsteps)
    - Number VIEWS (for contents/documents)
    - Number USAGES (manufacturing/production objects)

- **Relevant user properties**
  - Workplacegroups
  - Permissions
  - „State“: main working phase, side working phase
  - Development Goals
  - Mastered measures

Examples of Adaptivity in APPsist

Adaptivity with respect to three parameters:

Depending on the context:

1. Reacting to the current situation on the shop floor, e.g., Loctite is empty

Depending on the employee:

2. Reacting to recently occurring events (e.g., a large number of correctly or incorrectly performed measures)
3. Long-term development goals (e.g., working towards a new job position)

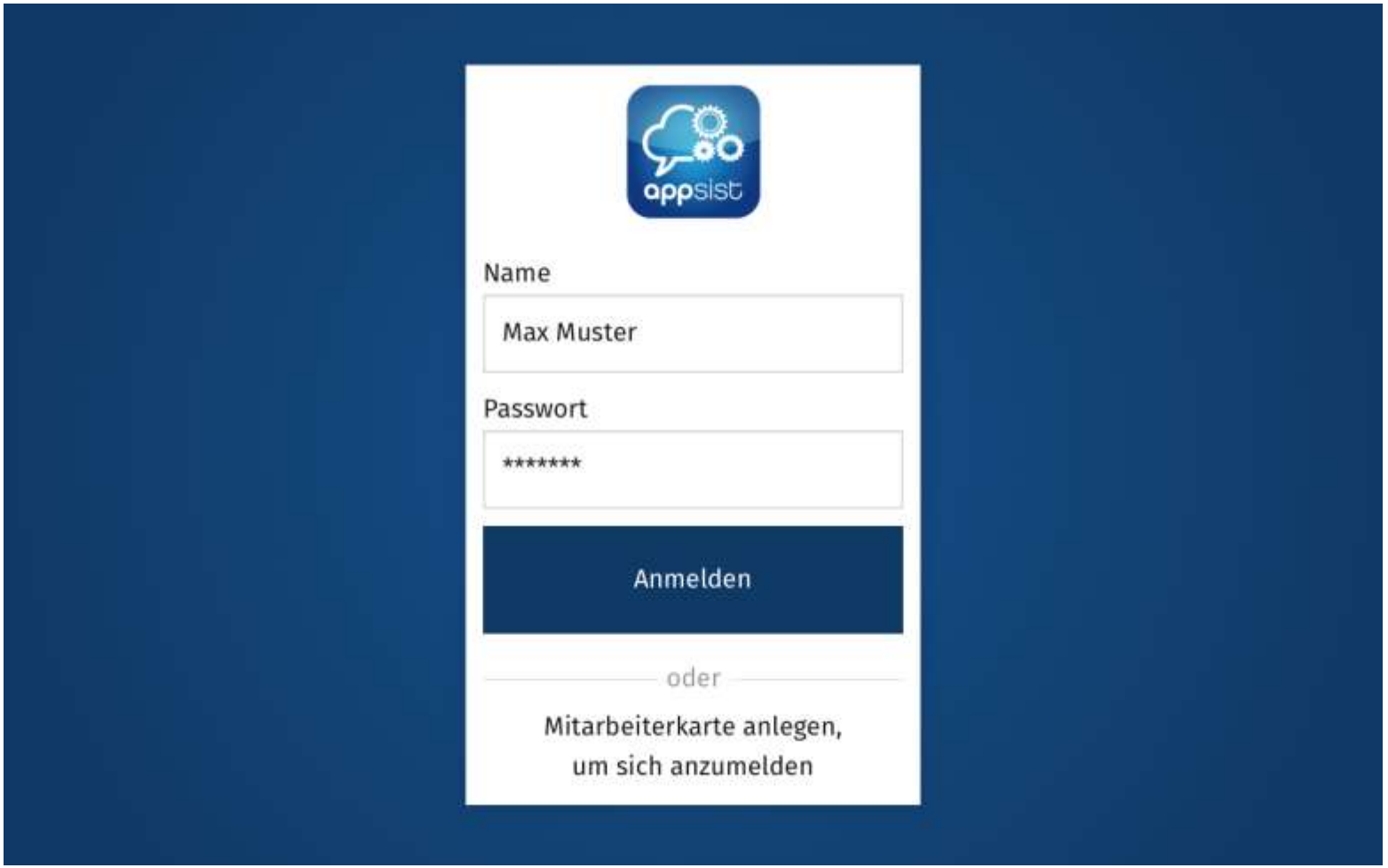
Example Rule: Determine Measure

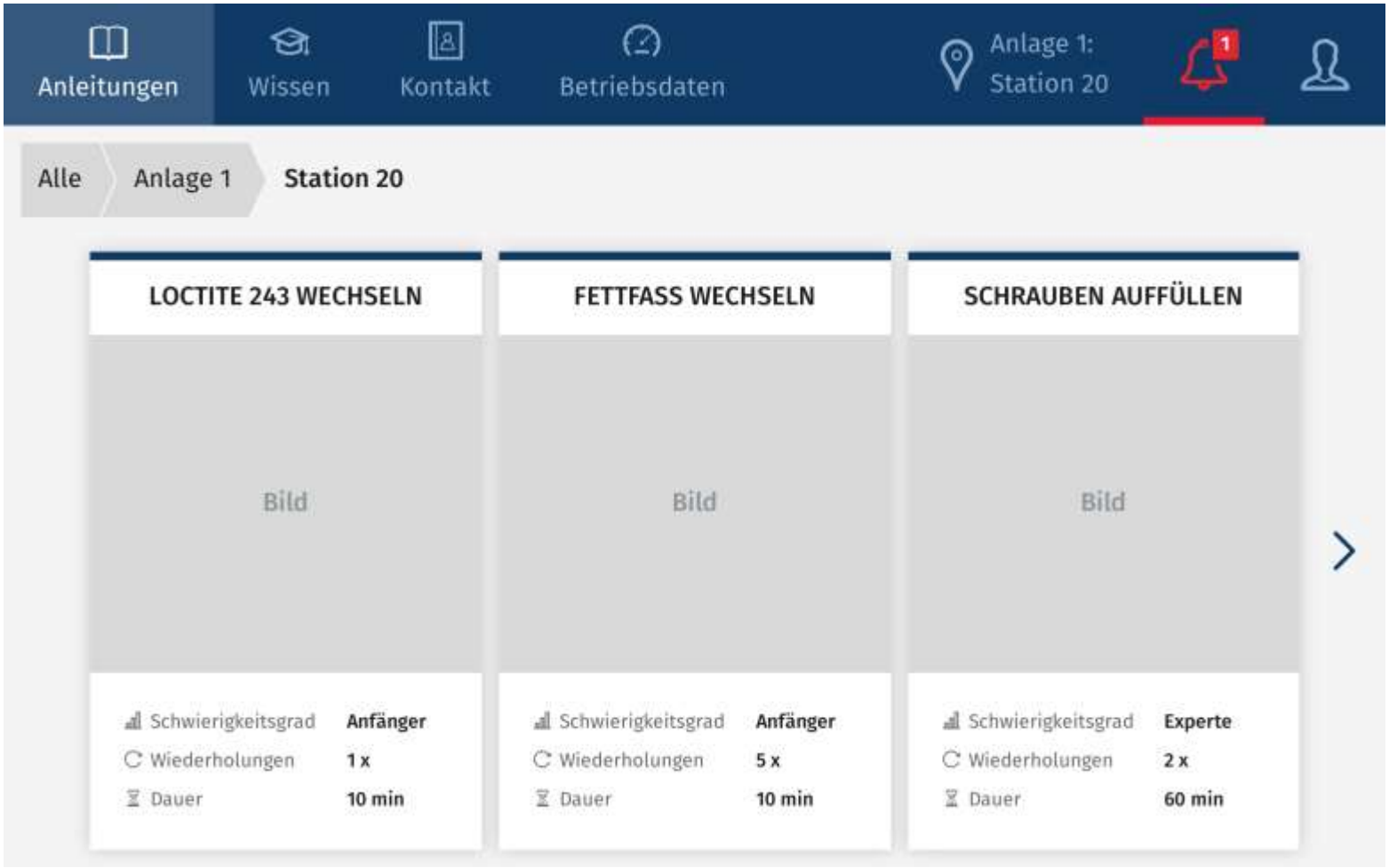
Condition:
Employee is in workstate „Learningtime“ and asks for assistance measures, then find measure relevant to his/her long-term development goals.

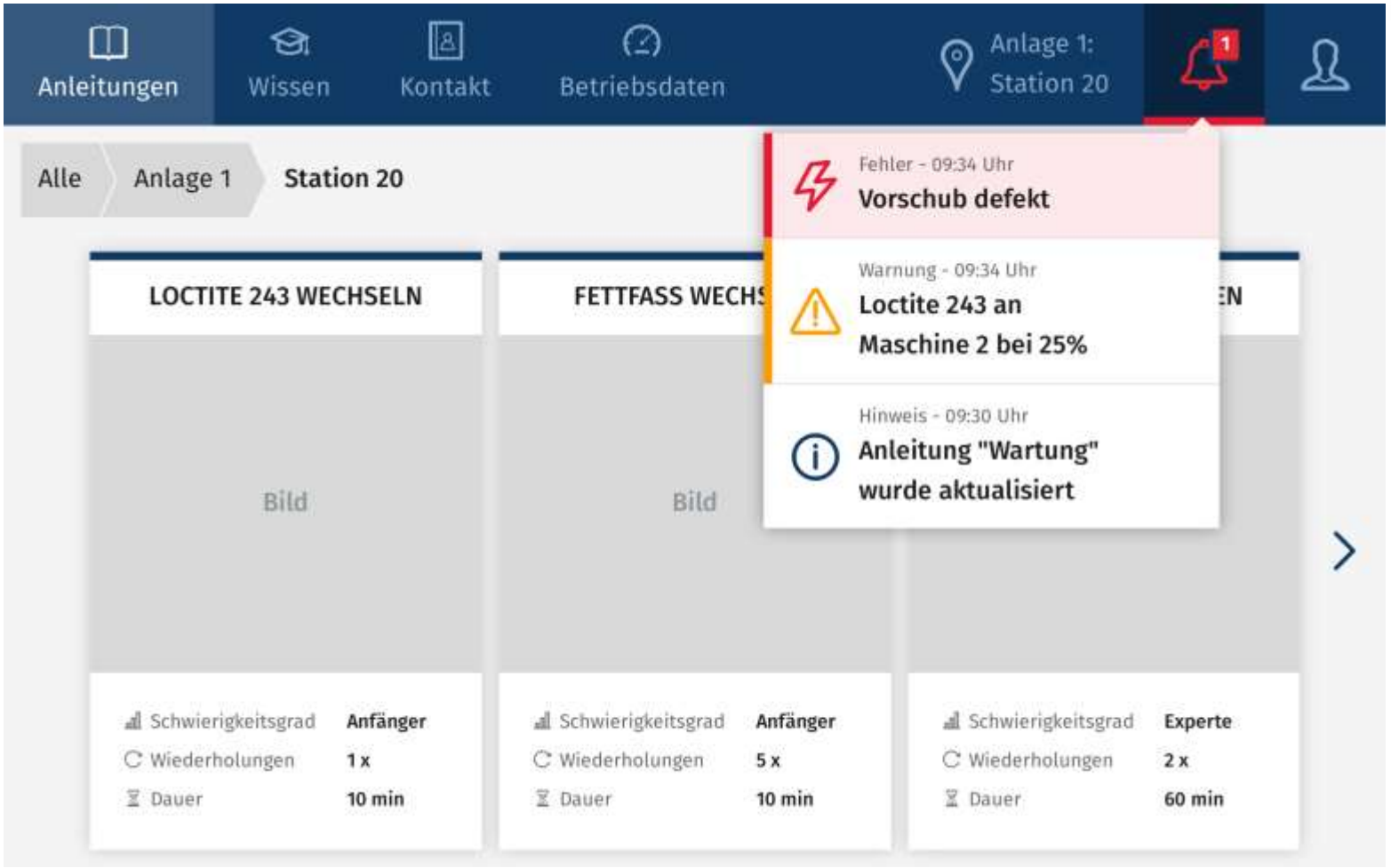
Steps:

1. D = Development Goals. [User-Model Request].
2. M = Relevant Measures for D. [Domain-Model Request]
3. M_n = Measures M without Measures which are already mastered by Employee. [User-Model Request]

Returns:
M_N, plus a note, that measures will be important in the future and that should be walked through without an actual machine.







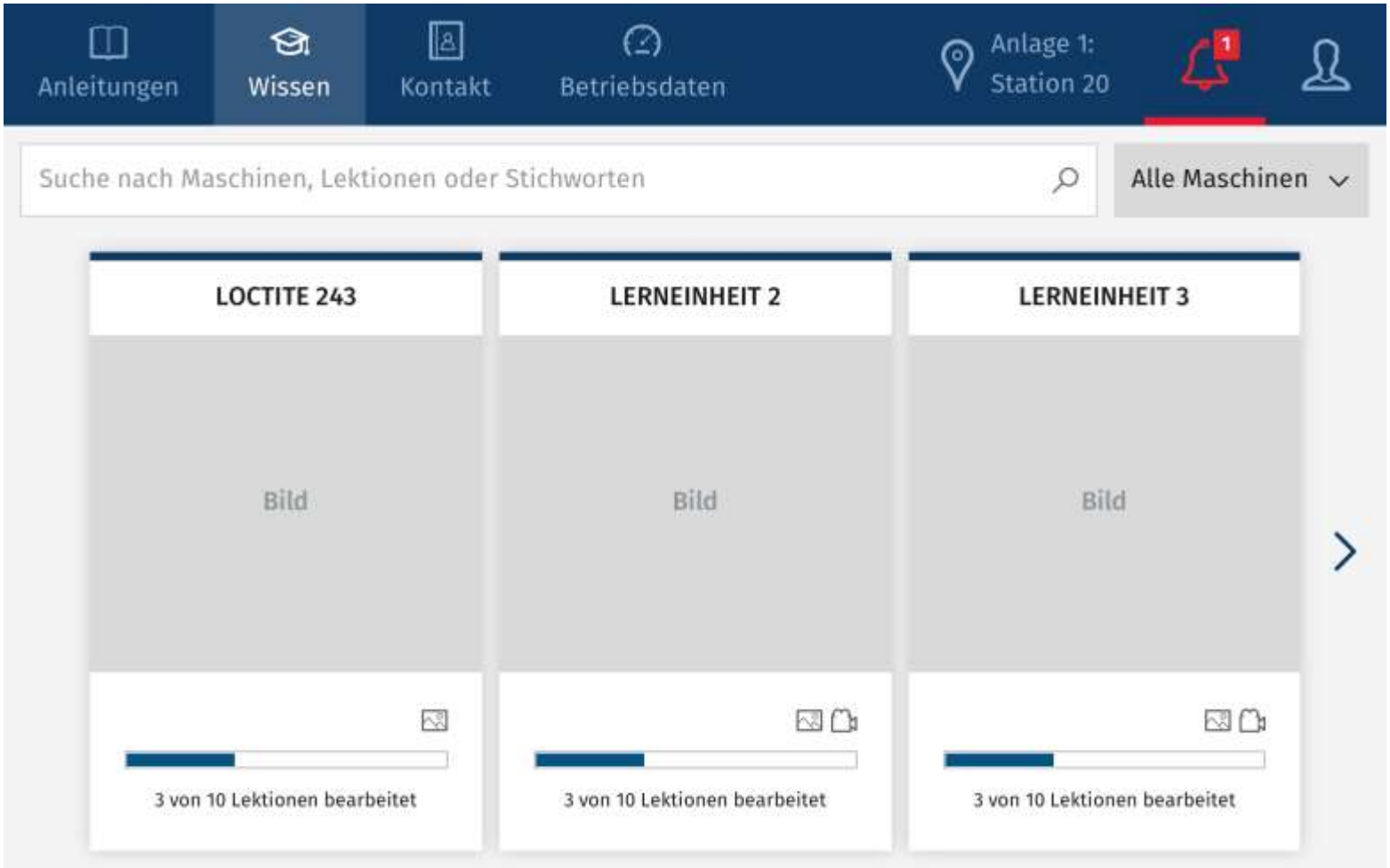
Vorheriger Teilprozess
Containerdeckel öffnen

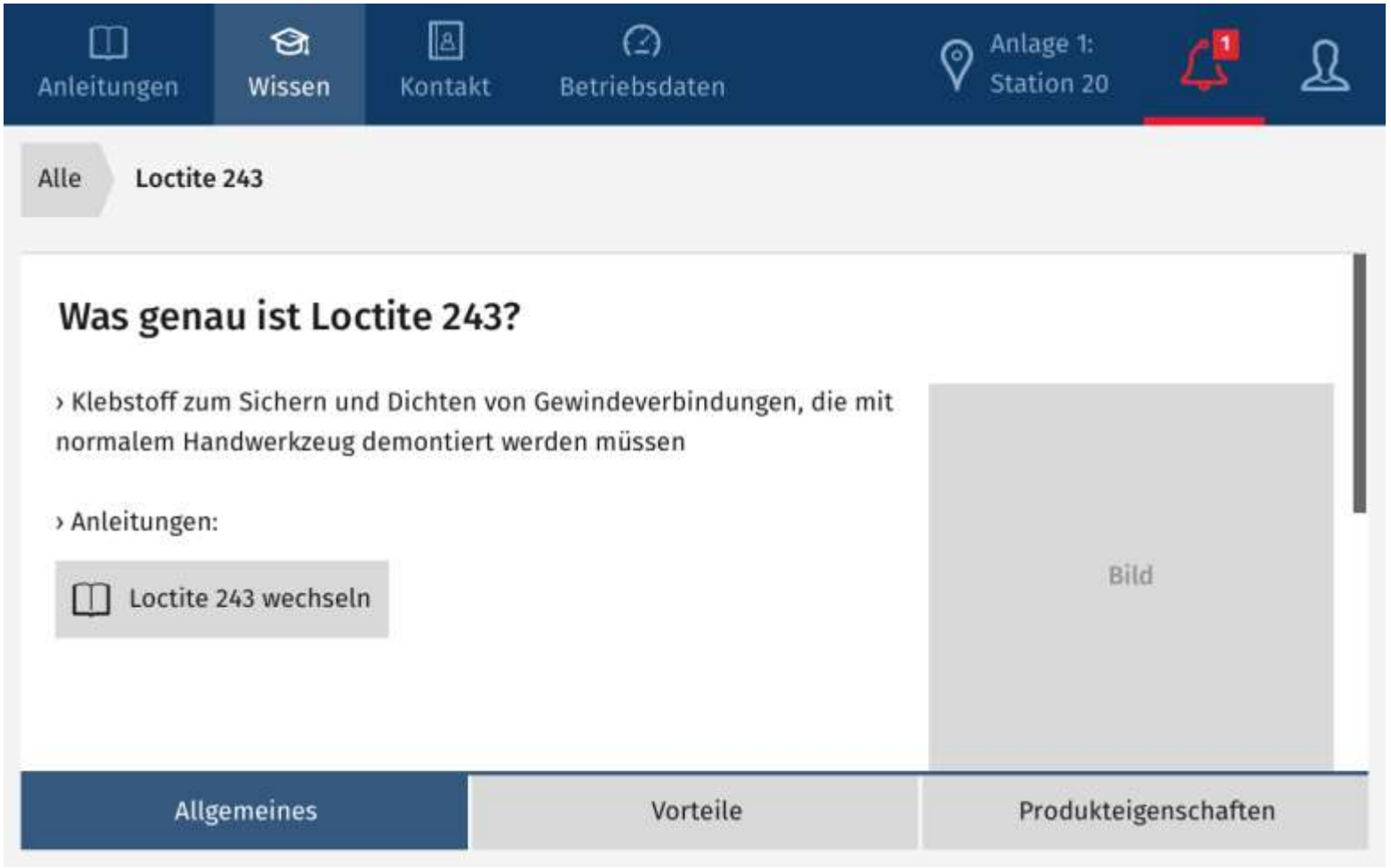
Aktueller Teilprozess
Loctite-Flasche tauschen

Nächster Teilprozess
Containerdeckel zuschrauben

Entfernen Sie die alte Flasche aus dem Container und setzen Sie eine neue Flasche Loctite 243 ein. Die Flasche muss auf dem Boden aufsetzen.

Flasche Loctite 243 eingesetzt





Outlook

- Stabilize and further improve system
- Setup installations on industrial partner sites
- Evaluate Systems
- Improve system with respect to evaluations
- Improve adaptation rules

Assistance- and Knowledge-Services for Smart Production

Results from the APPsist Project

Carsten Ullrich, Matthias Aust, Roland Blach, Michael Dietrich, Christoph Igel, Niklas Kreggenfeld, Denise Kahl, Christopher Prinz und Simon Schwantzer

Michael Dietrich

Center for Learning Technology (CeLTech) im

Deutschen Forschungszentrum für Künstliche Intelligenz

michael.dietrich@dfki.de