



# **WP4: Development of DAI-DSS**

## The Final DAI-DSS Prototype

Final Review 02.10.2025

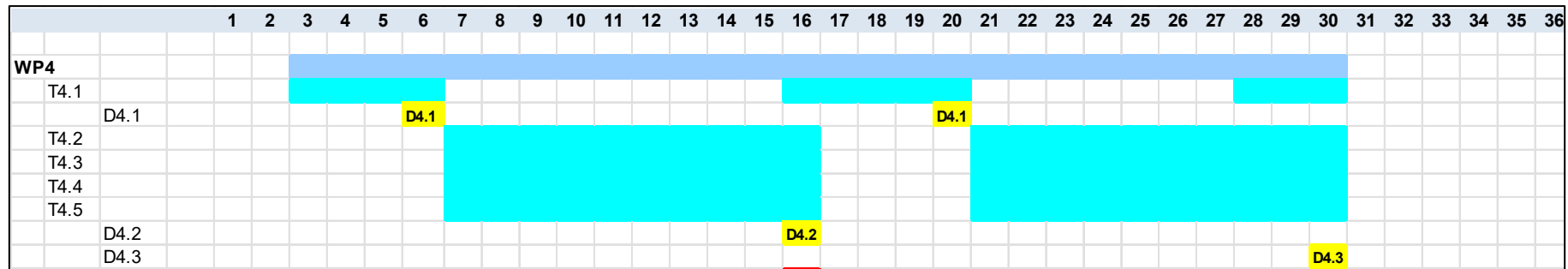
# Agenda

- Introduction and Overview
- Overview on use case scenarios
- High-Level Architecture
  - Building Block: DAI-DSS User Interface
  - Building Block: DAI-DSS Configurator
  - Building Block: DAI-DSS Orchestrator
  - Building Block: DAI-DSS Knowledge Base
  - Building Block: DAI-DSS AI-Enrichment
- Summary, Outlook and Q&A

# Overview of WP4

## Objectives:

- Architecture, Documentation, Test strategy and Test report
- DAI-DSS – Orchestrator prototypes based on Multi Agent System
- DAI-DSS – Configurator prototype based on Meta Modelling Platform
- DAI-DSS – Knowledgebase prototype based on Data lakes
- DAI-DSS – Enrichment of AI based on collection of research prototypes and AI offerings



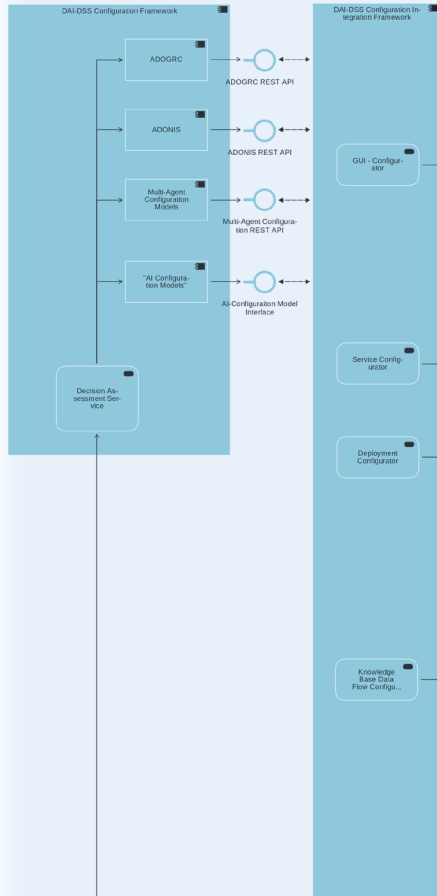
Task	Task Leader	Participants	Task Description
4.1	JR	BOC, JOTNE, RWTH, MORE	Architecture, Documentation and Testing
4.2	MORE	BOC, JOTNE, RWTH	Development of DAI-DSS Orchestrator
4.3	BOC	MORE, OMILAB	Development of DAI-DSS Configurator
4.4	JOTNE	CRF, FLEX, JR	Development of DAI-DSS Knowledge Base
4.5	RWTH	BOC, MORE	Enrichment of DAI-DSS Algorithms

# Overview on Use Case Scenarios and DAI-DSS Prototype

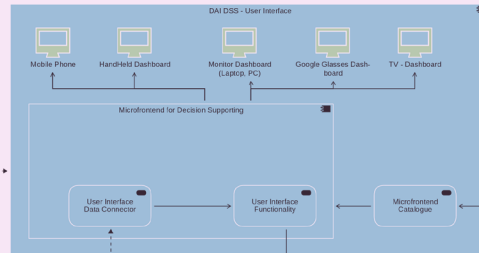
Use Case	Use Case Partner	Scenario	AI-Enrichment
Workload Balance	CRF	Assist Decisions about Fair Worker Allocation	<ol style="list-style-type: none"> <li>1. Support Understanding of Decisions through Conceptual Modelling</li> <li>2. Decision Support through Decision Tree</li> <li>3. Resource Allocation using Neural Networks</li> <li>4. Resource Allocation using Linear Sum Assignment Solver</li> <li>5. Resource Allocation MAS-based</li> </ol>
Production Planning	CRF	Assist Decisions about Production Planning	<ol style="list-style-type: none"> <li>6. Production Planning Service with a Hybrid Approach</li> </ol>
Delay of Material	CRF	Assist Decisions for Truck Loading	<ol style="list-style-type: none"> <li>7. Truck Loading Service</li> </ol>
Machine Maintenance	FLEX	Improve Information Access to Support Maintenance	<ol style="list-style-type: none"> <li>8. Support Machine Maintenance using RAG and LLM</li> </ol>
Document Transformation	FLEX	Improve Reliability of “Documentation about Quality Check”	<ol style="list-style-type: none"> <li>9. Document Transformation using LLM</li> </ol>
Compliance with Clean Room Regulations	FLEX	Improve Information Access to Cleanroom Compliance Requirements	<ol style="list-style-type: none"> <li>10. Support Compliance for Clean Room using RAG and LLM</li> </ol>
Calibration Document Certification	FLEX	Support Validation of Calibration Documents	<ol style="list-style-type: none"> <li>11. Calibration Certification Service</li> </ol>

# Overview of the DAI-DSS High Level Architecture

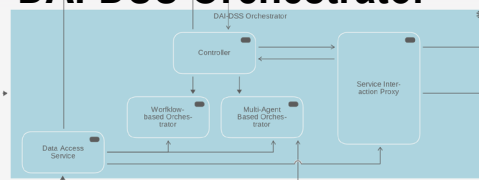
## DAI-DSS Configurator



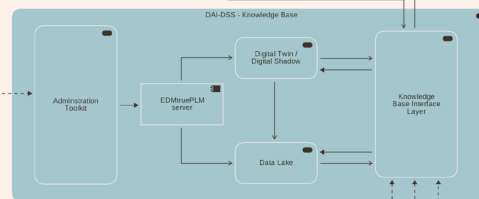
## DAI-DSS User interface



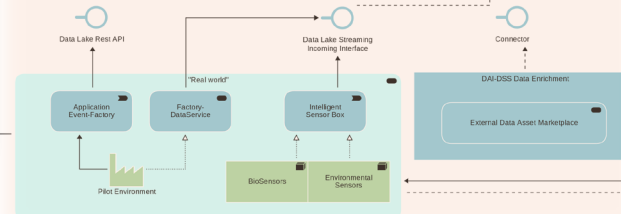
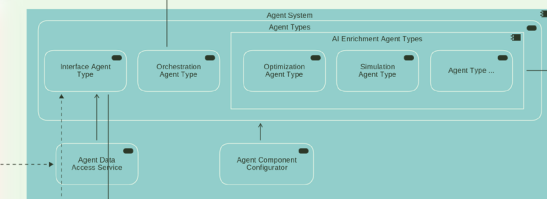
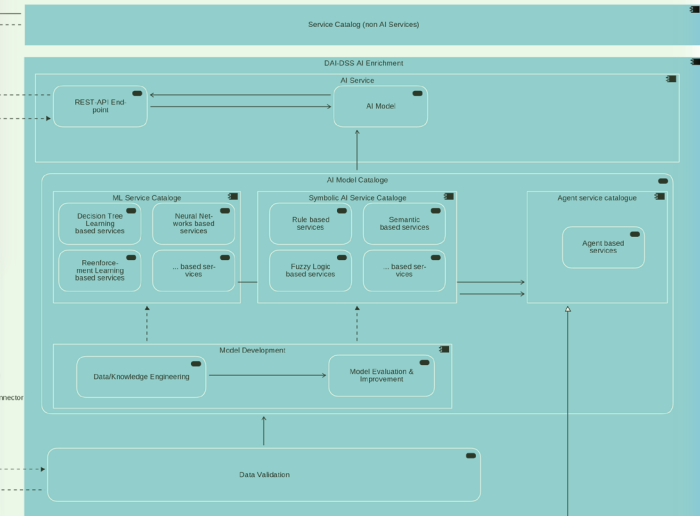
## DAI-DSS Orchestrator



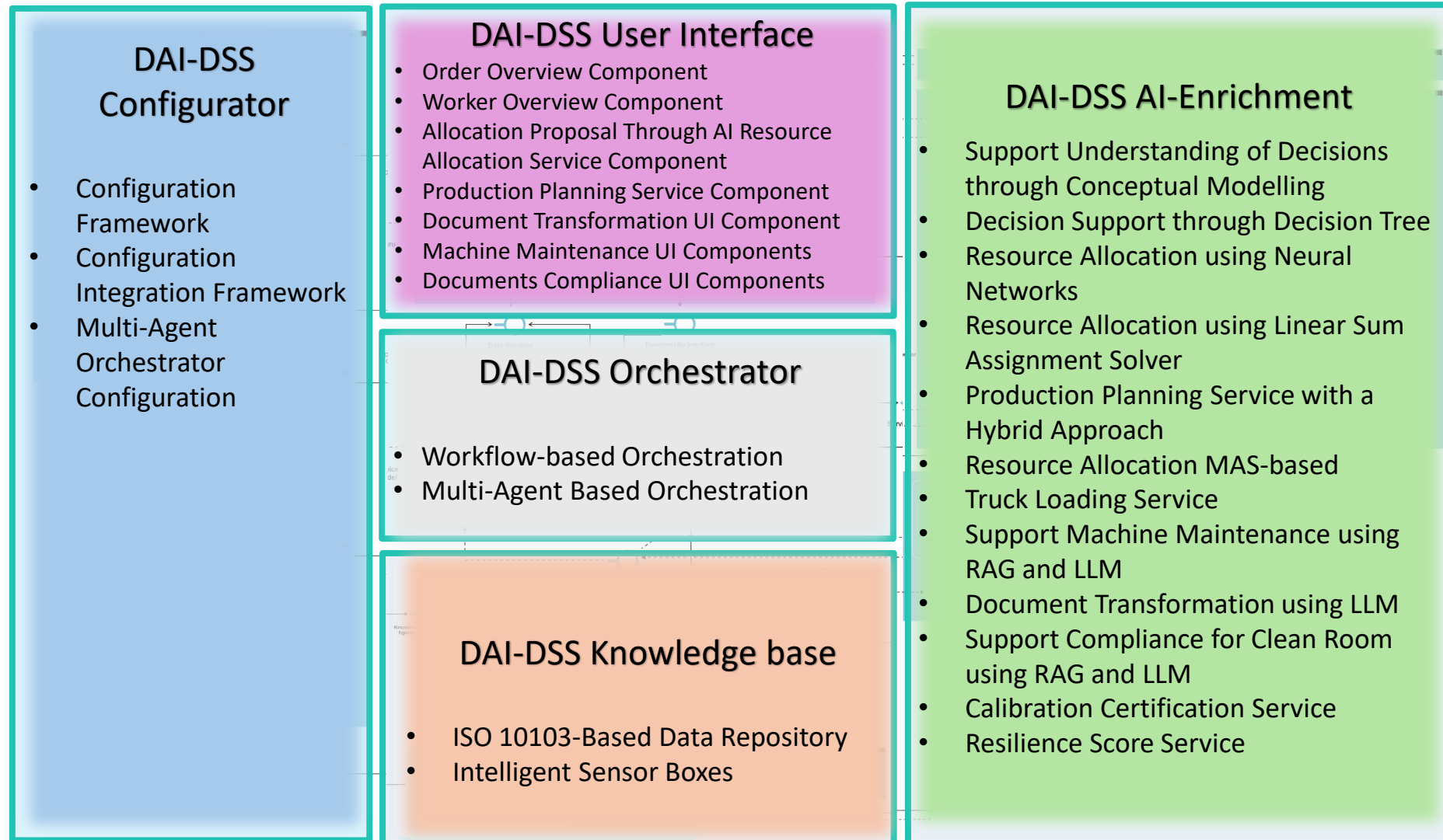
## DAI-DSS Knowledge Base



## DAI-DSS AI Enrichment

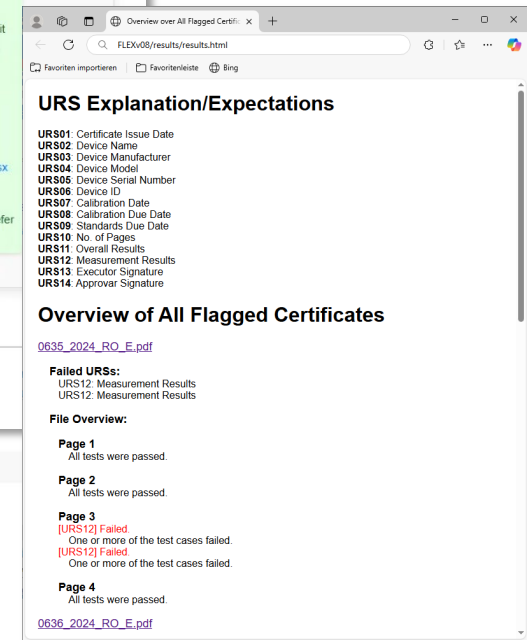
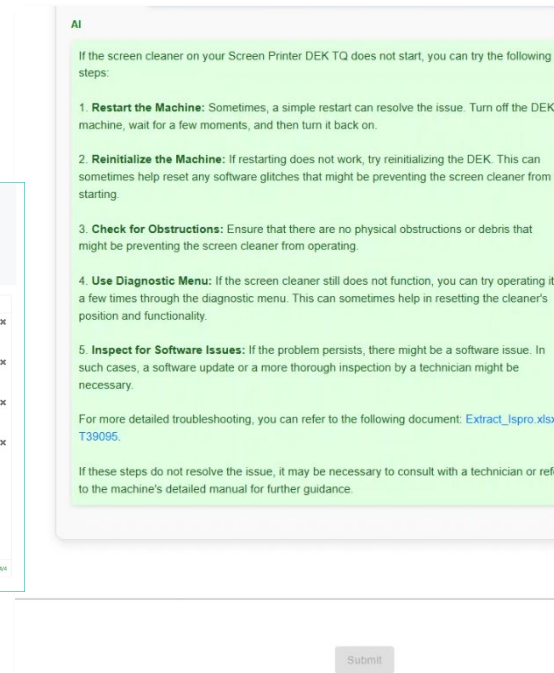
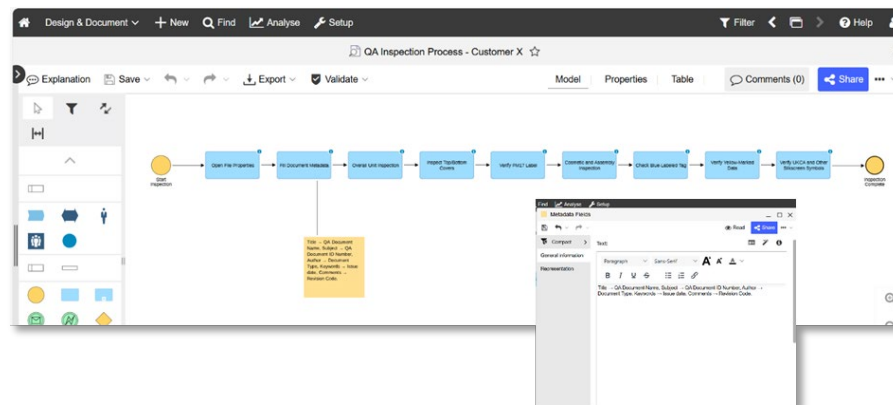
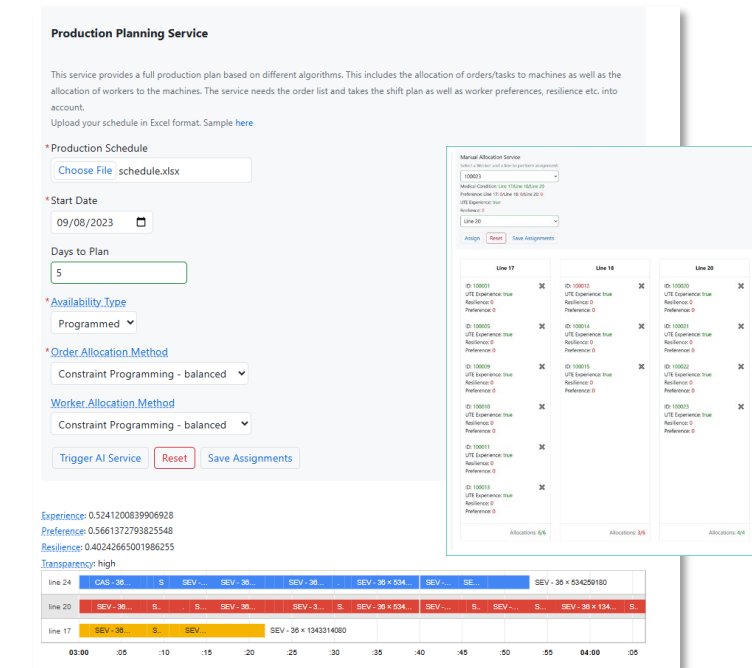
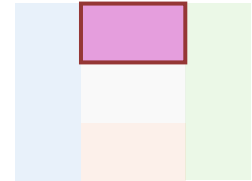


# Overview of the DAI-DSS High Level Architecture



## Building Block: User Interfaces

### Visualization of DSS Output



# Building Block: Configurator

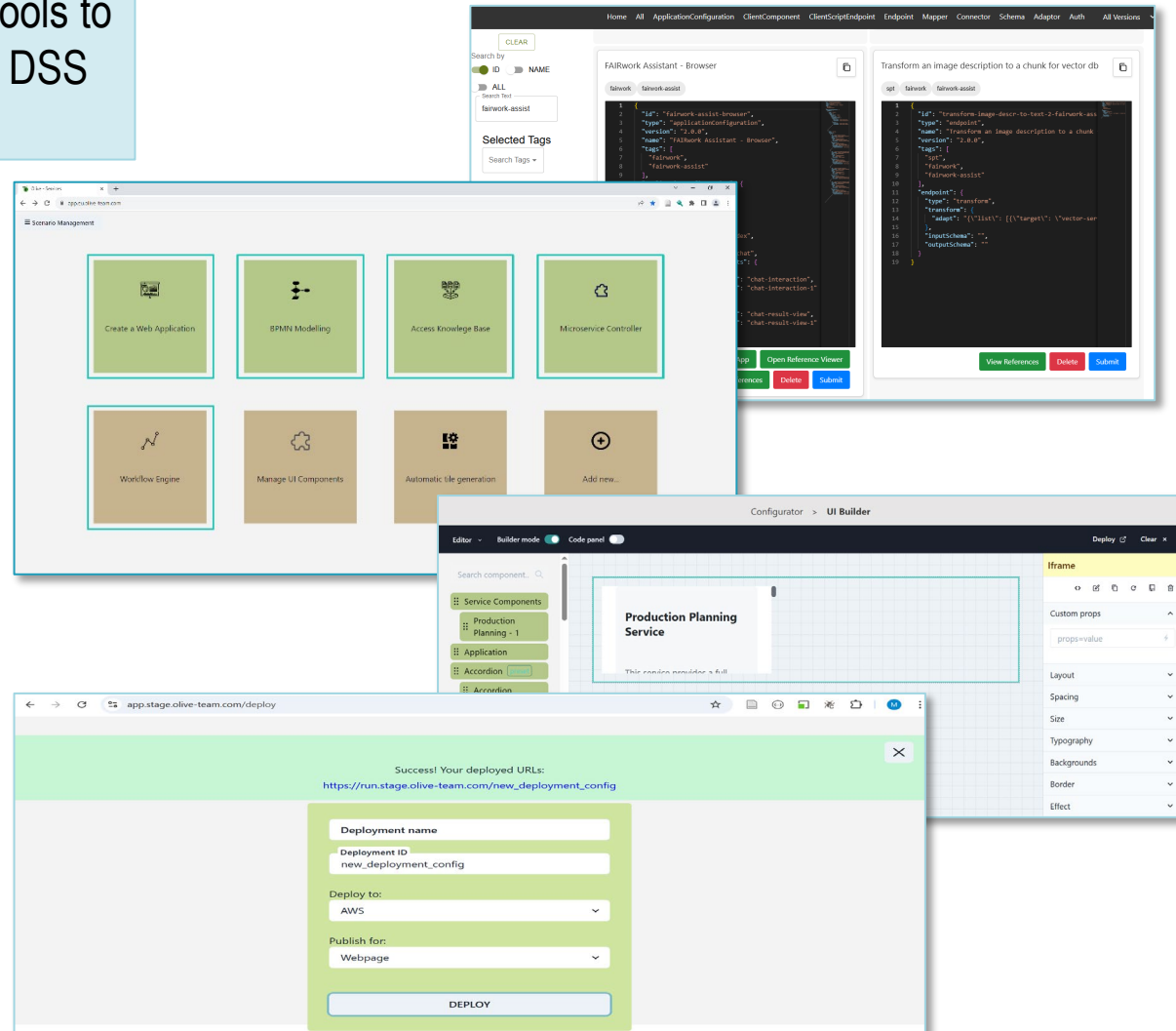
## Microservice Framework OLIVE

The configurator is a collection of tools to speed up the configuration of the DSS

1. Configuration of services and UI components

2. UI Builder

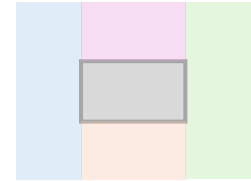
3. Deployment



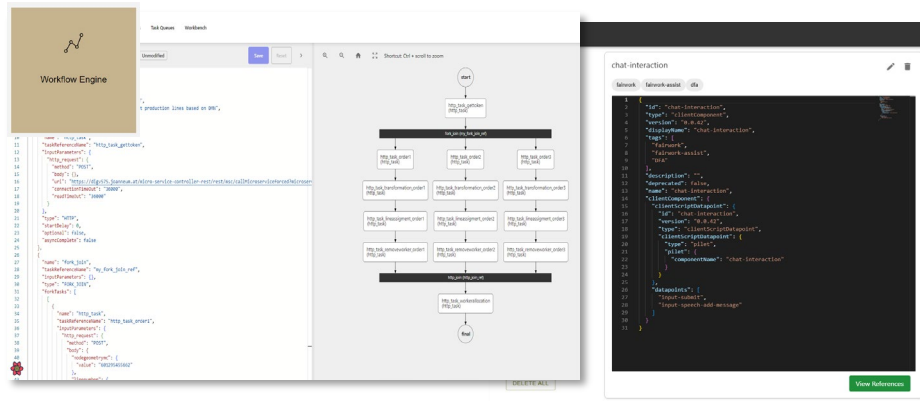


# Building Block: Orchestrator

## Workflow Orchestration with Workflow Engine



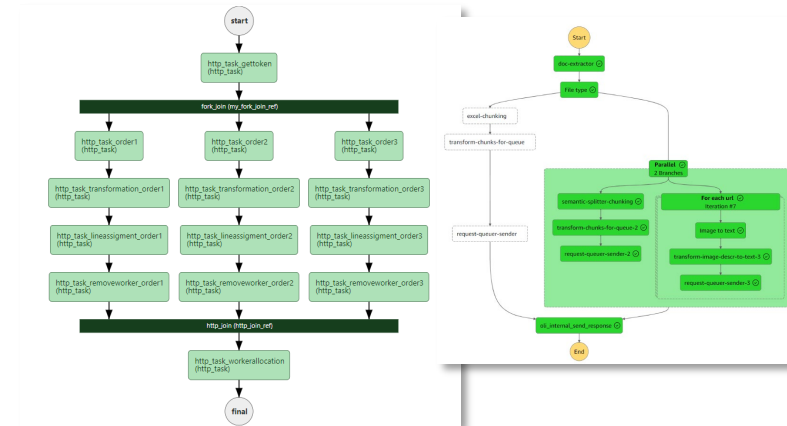
### DAI-DSS Configurator



Netflix Conductor

AWS step functions

### DAI-DSS Orchestrator



Netflix Conductor

AWS step functions

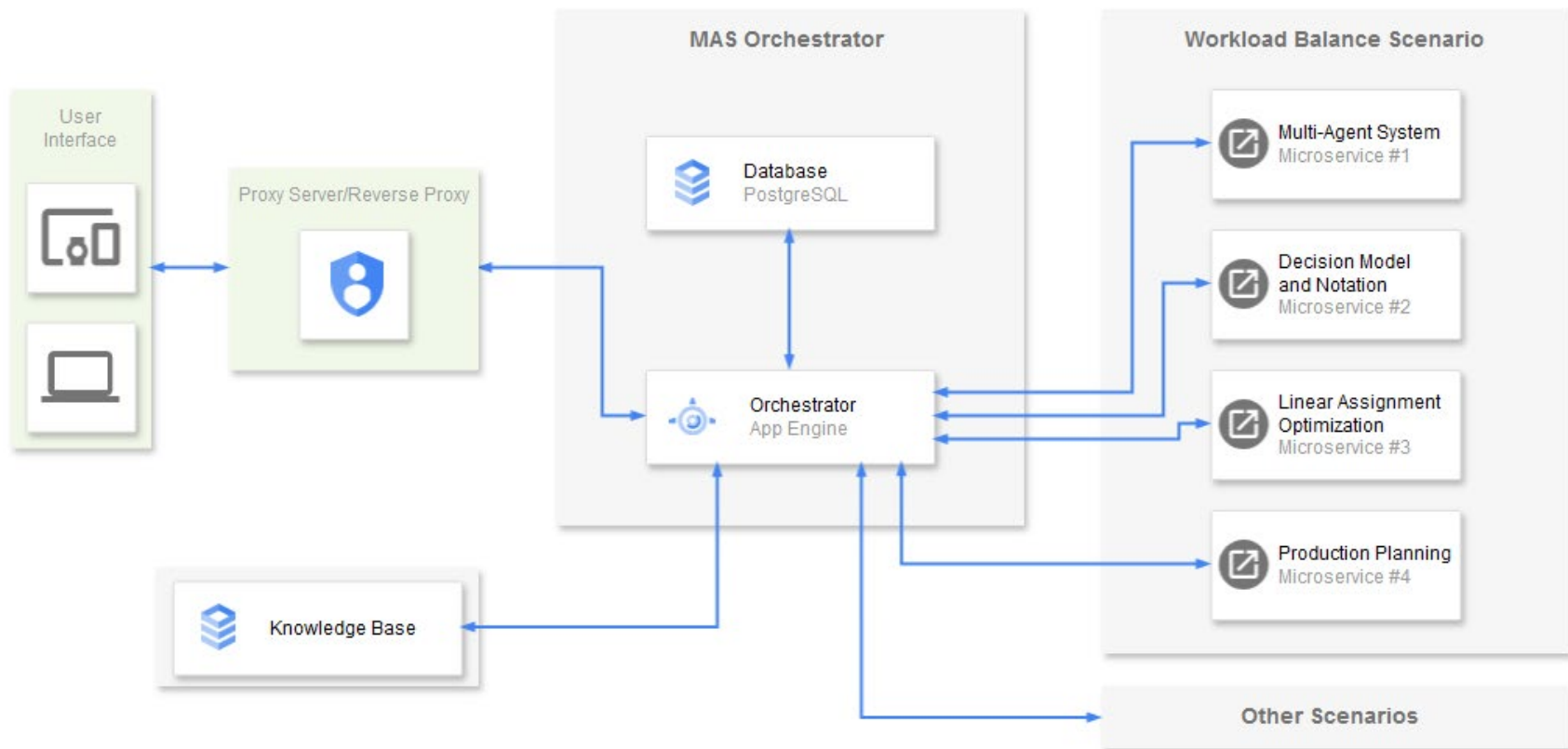
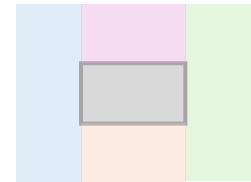
Definition

Execution

- Support for different workflows engines and definitions
- Workflows can be called using APIs from Olive Microservice Framework
- Workflows for the use case are created to:
  - Retrieve use case data from knowledge base
  - Trigger AI based allocation services

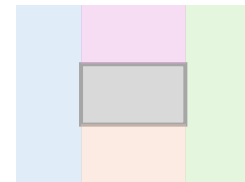
# Building Block: Orchestrator

## Multi-Agent Orchestration

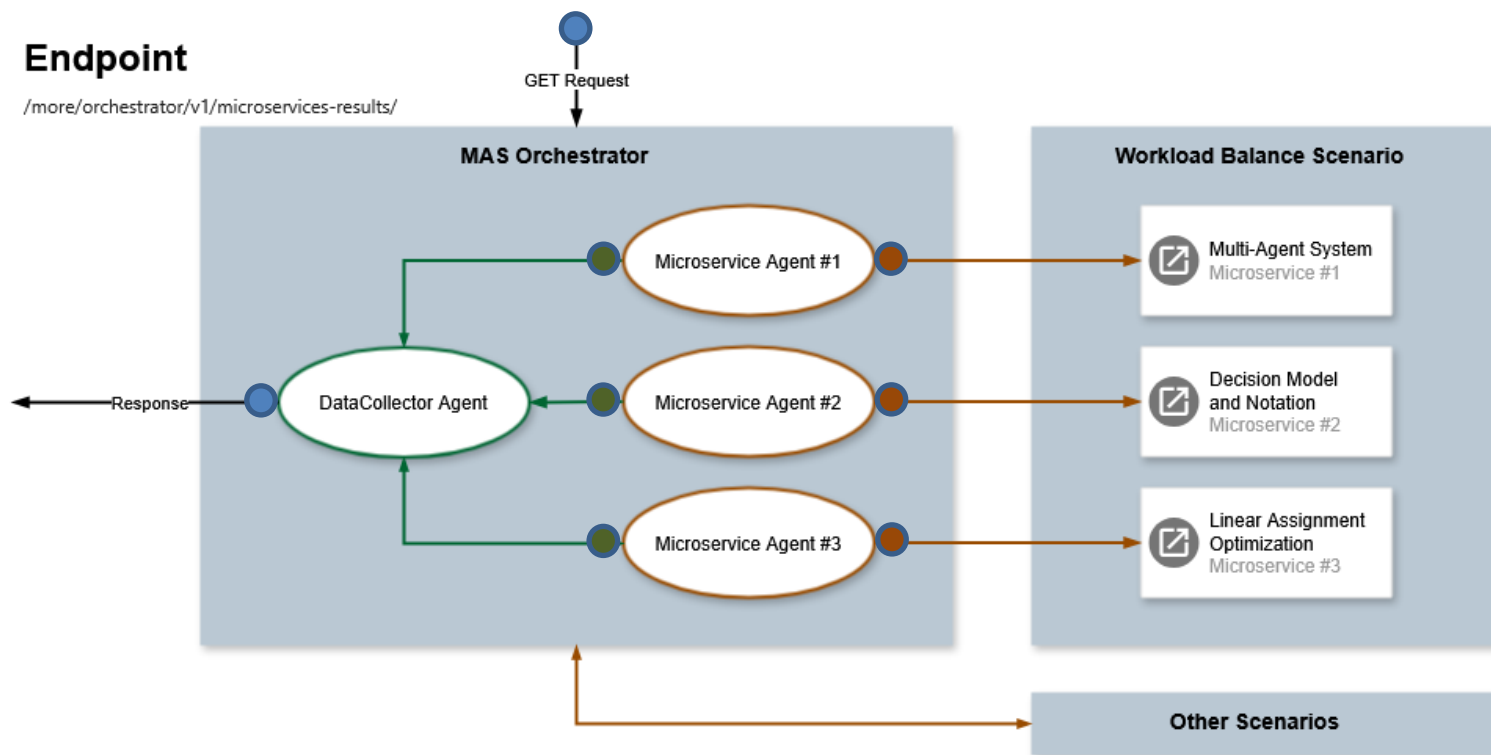


# Building Block: Orchestrator

## Multi-Agent Orchestration DEMO

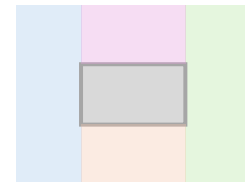


- Two types of agents:
  - Microservice Agent: one per available microservice; activated through the request parameters.
  - DataCollector Agent: unique; to merge the collected data of all active Microservice Agents.



# Building Block: Orchestrator

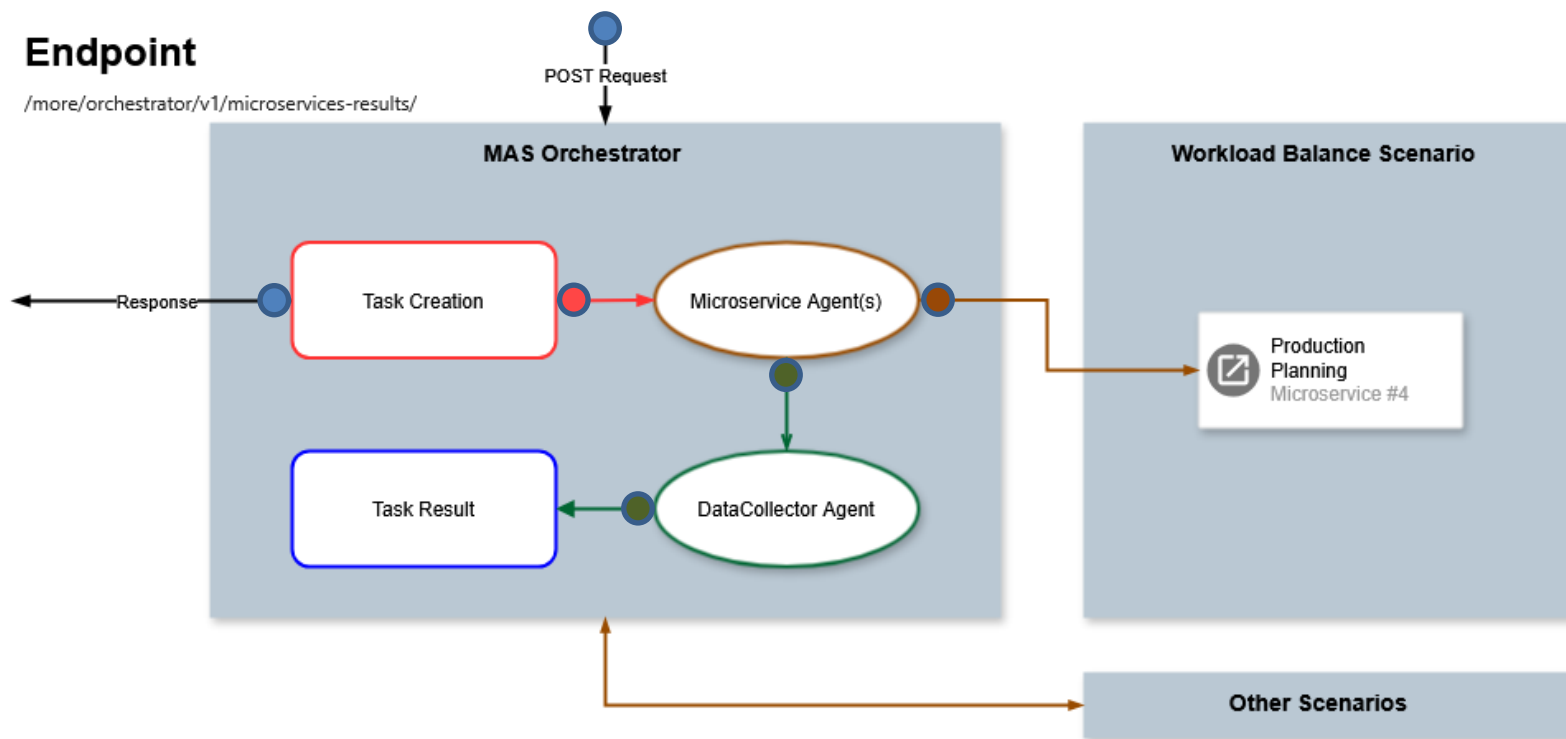
## Multi-Agent Orchestration DEMO



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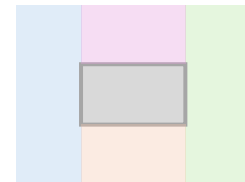
### Endpoint

/more/orchestrator/v1/microservices-results/

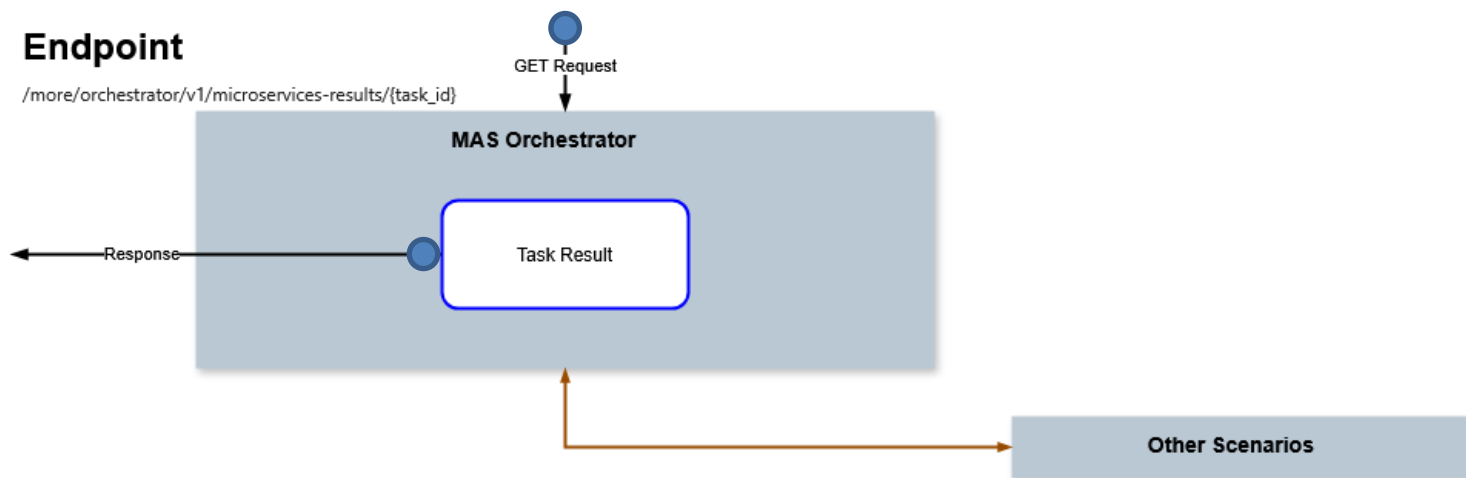


# Building Block: Orchestrator

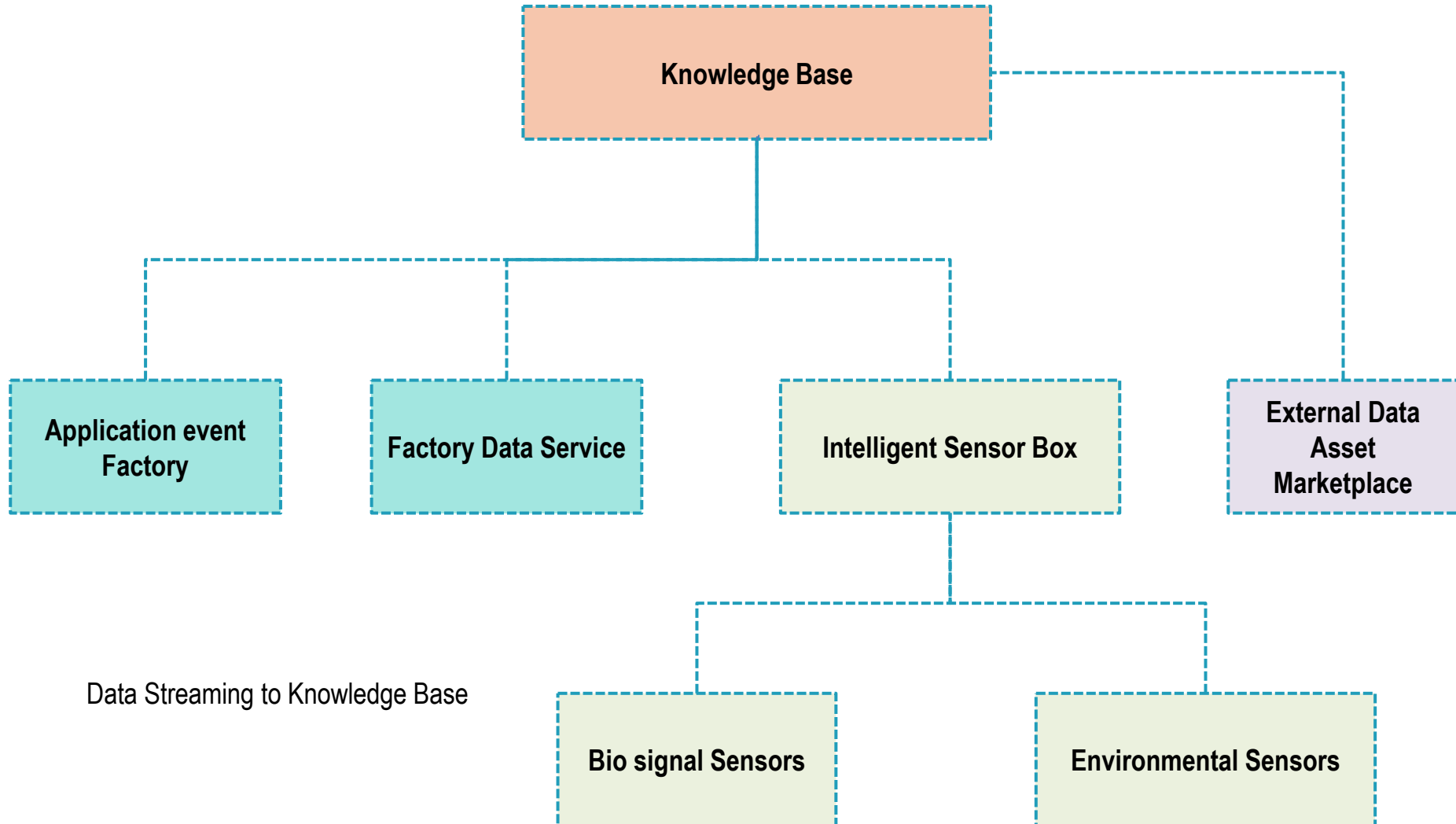
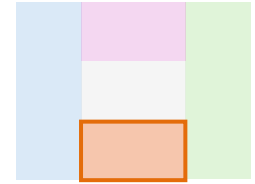
## Multi-Agent Orchestration DEMO



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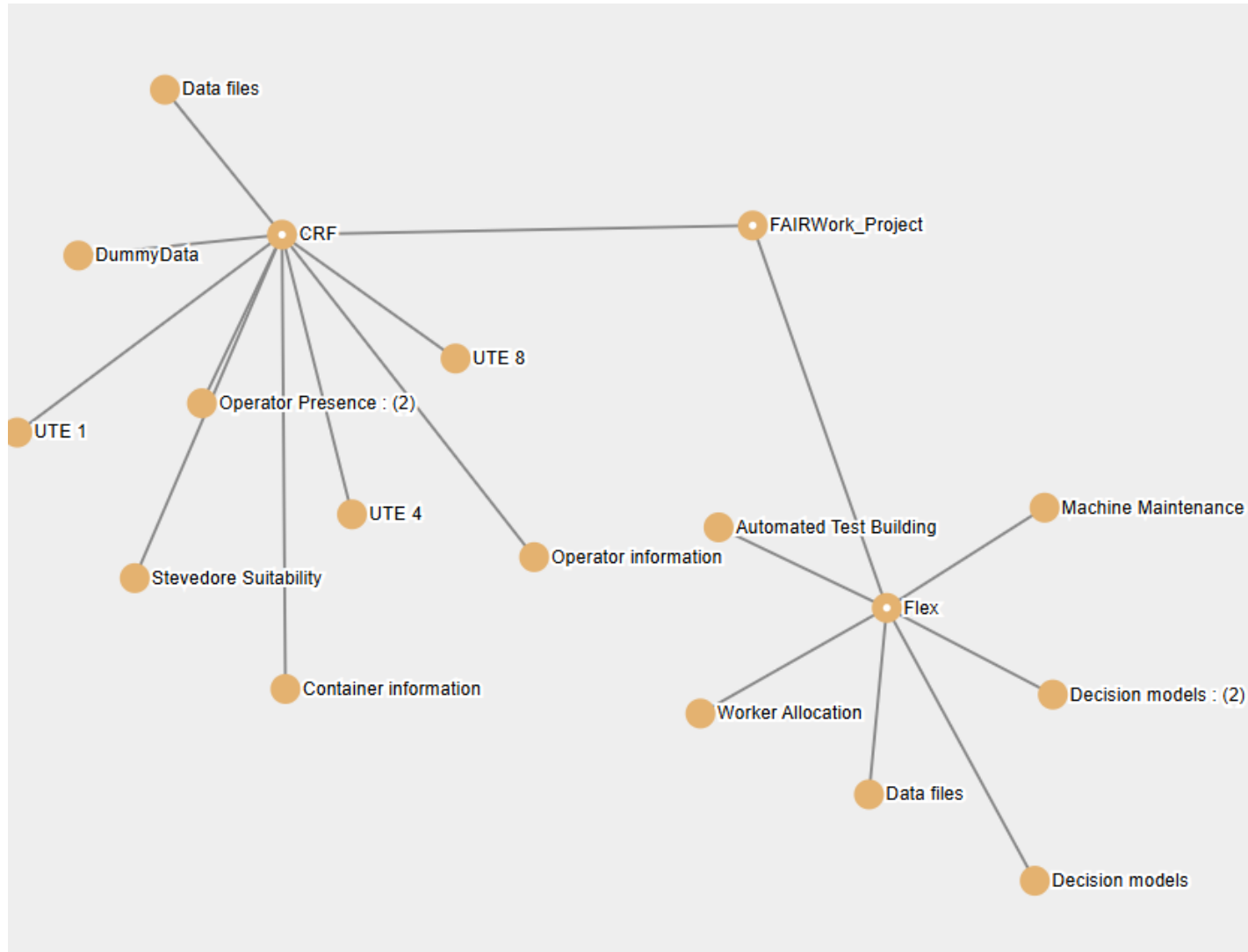
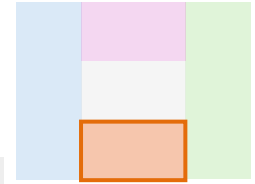


# Building Block: Knowledge Base



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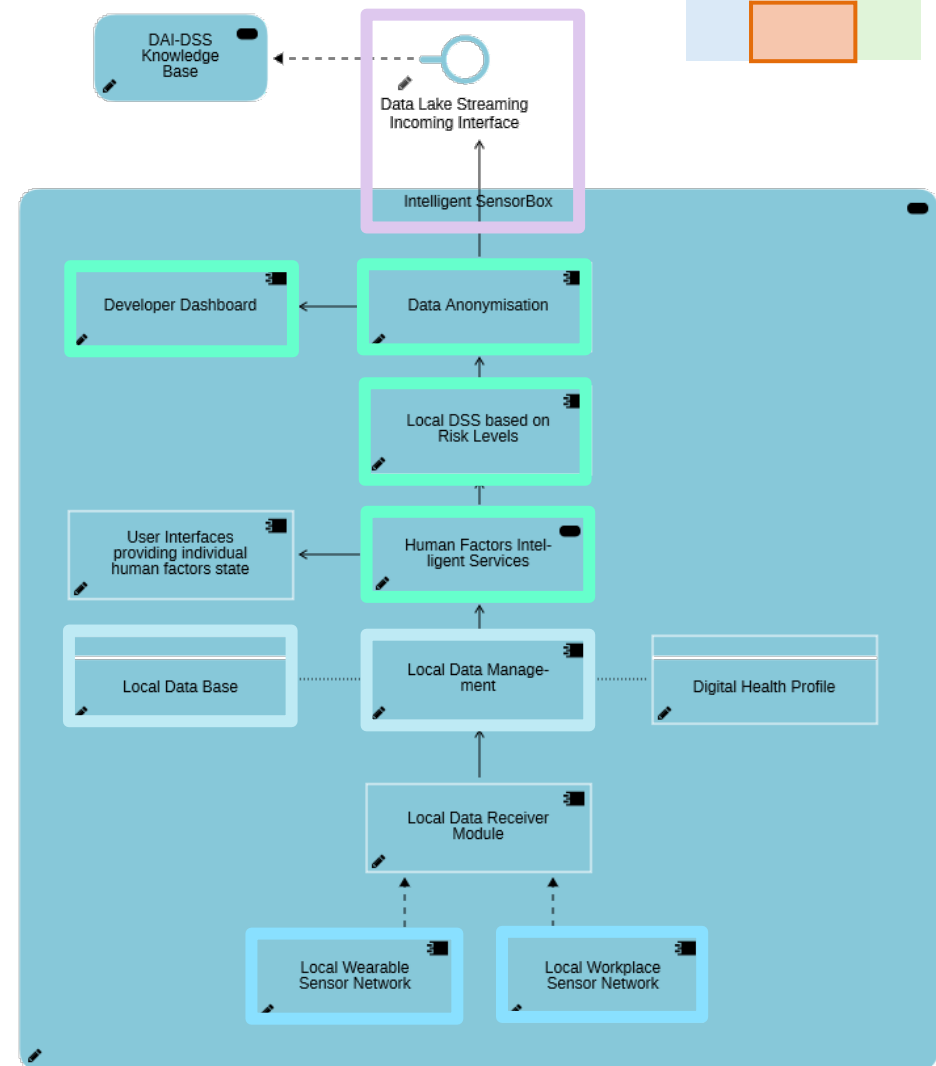
## Project Structure



# Building Block: Knowledge Base

## Intelligent Sensor Box

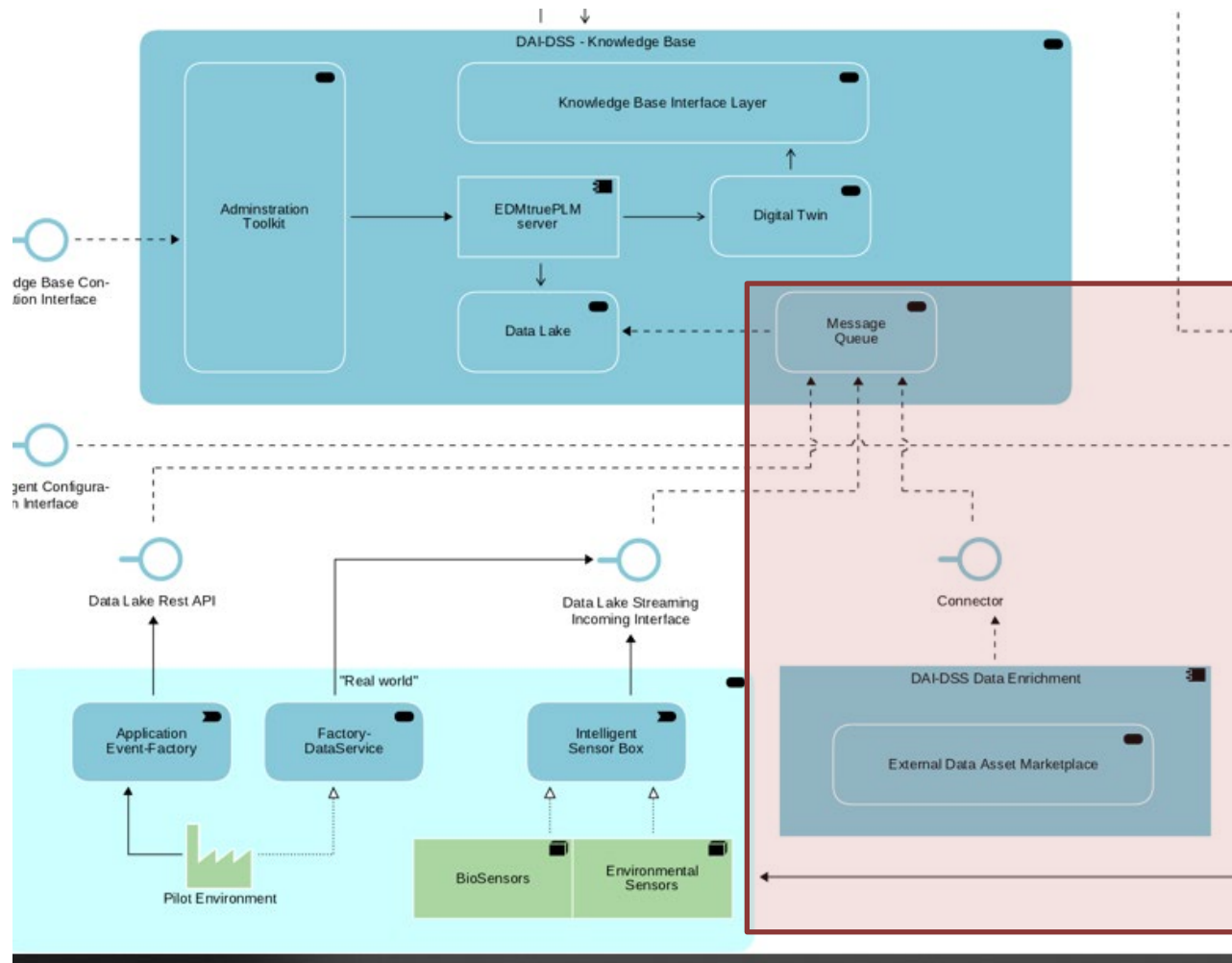
- Human & Workplace Sensors Input
- Digital Human Factors Analyses
  - Encapsulates data collecting and analysing services
  - Protects vulnerable data
  - Computing physiological and cognitive-emotional strain
  - Expert & Developer Board
- Resilience Score Output
  - Load capacity for next day
  - Function of external stress and response behaviour
  - Human-centered decision support
  - For further optimisation





## Building Block: Knowledge Base

### Integration of External Data Sets

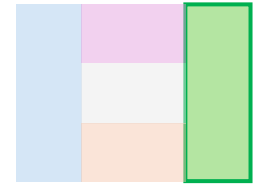


# Data Assets

Assets can be  
Integrated by  
using Data  
Asset Markets

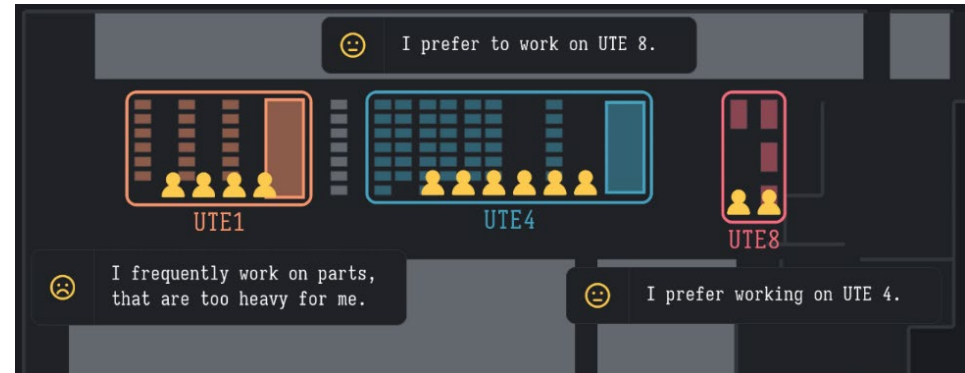
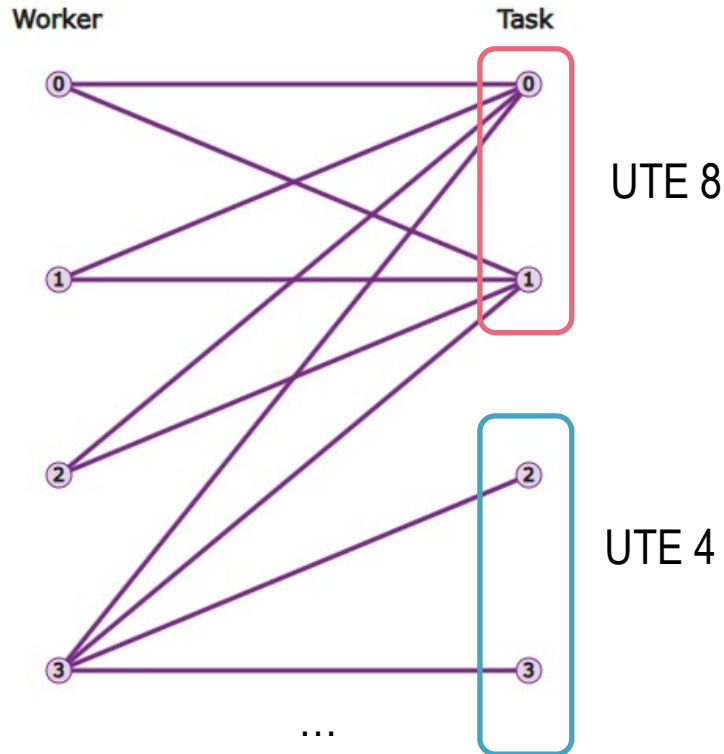
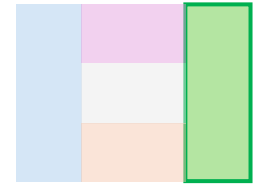
# Building Block: AI Enrichment

## Overview of Decision Services

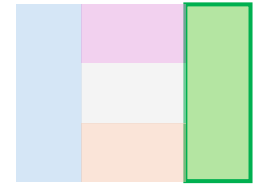


AI-service	Maturity Level	Type of AI	Reliability
Support Understanding of Decisions through Conceptual Modelling	Basic	Rule-based	High
Decision Support through Decision Tree	Basic	Supervised Machine Learning	High
Resource Allocation using Neural Networks	Intermediate	Artificial Neural Network	Medium-High
Resource Allocation using Linear Sum Assignment Solver	Intermediate	Optimization Algorithm	High
Production Planning Service with a Hybrid Approach	Advanced	Reinforcement Learning, Monte Carlo Tree Search Constraint Programming	Medium-High
Resource Allocation MAS-based	Intermediate	Multi-Agent System	Medium-High
Truck Loading Service	Basic	Optimization Algorithm	Medium
Support Machine Maintenance using RAG and LLM	Advanced	Large Language Model, RAG	Medium-High
Document Transformation using LLM	Intermediate	Large Language Model	Medium
Support Compliance for Clean Room using RAG and LLM	Intermediate	Large Language Model, RAG	Medium-High
Calibration Certification Service	Advanced	Rule-based, Algorithm	High
Resilience Score Service	Intermediate	Rule-based, Algorithm	High

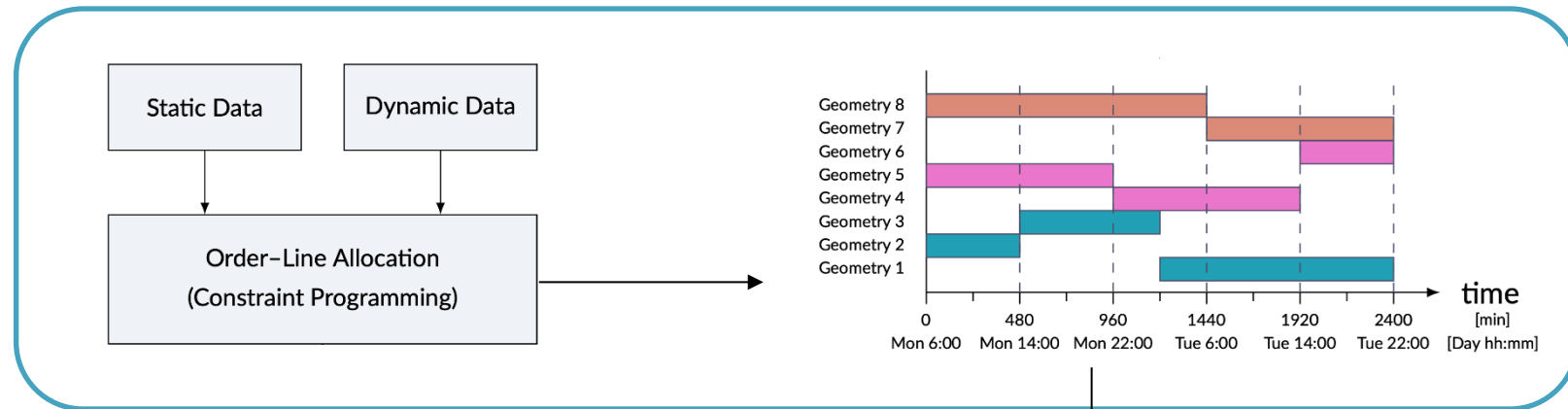
# Fair Worker Allocation



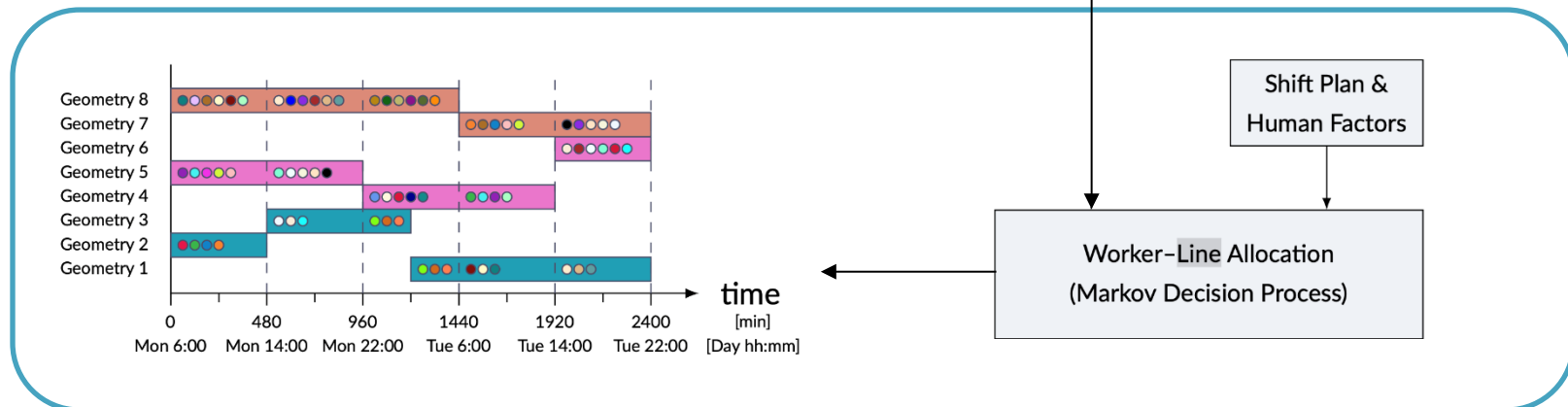
# Production Planning



## Layer 1

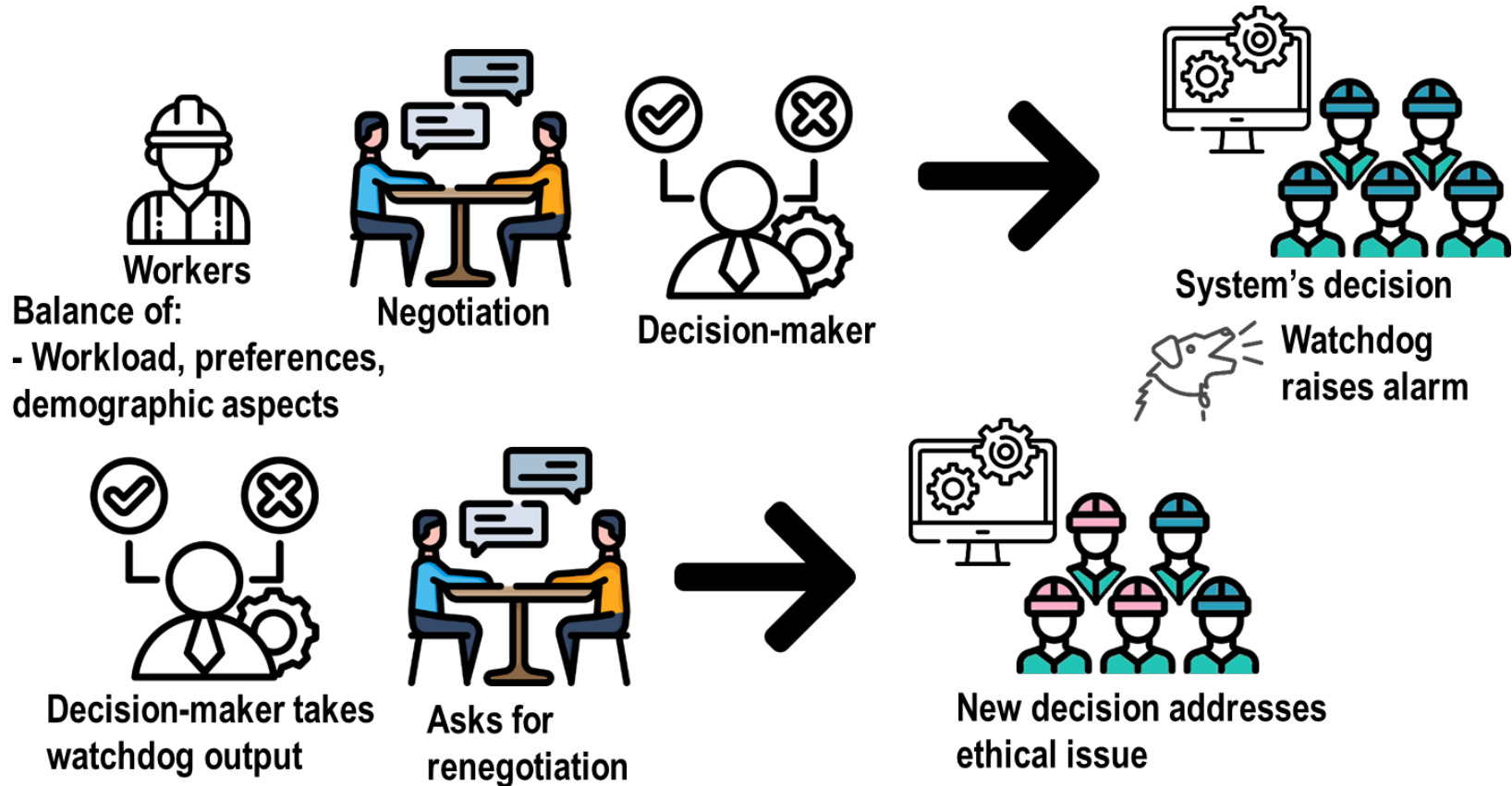
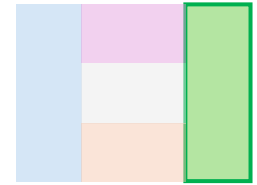


## Layer 2



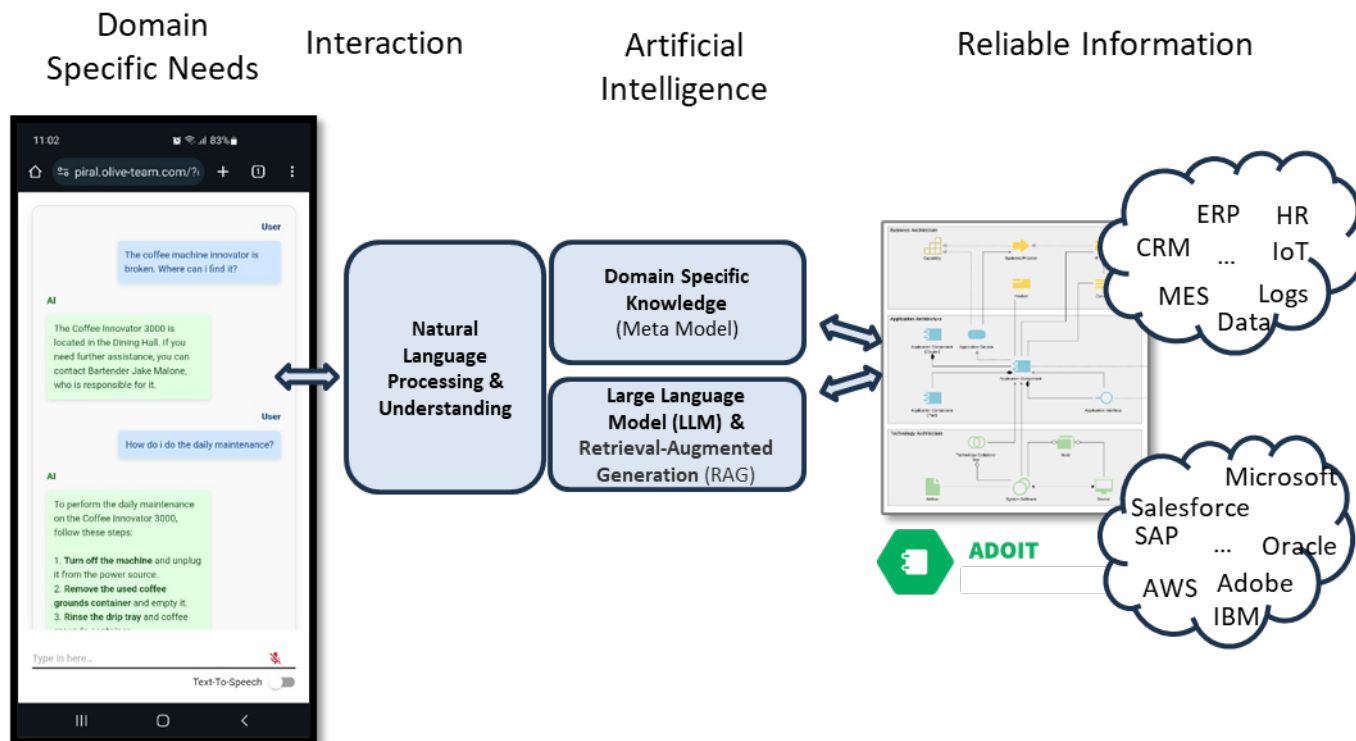
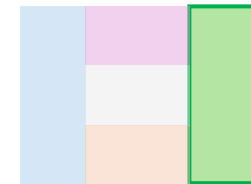
# Demo: MAS-based Fair Worker Allocation

## Ethical Watchdog



Available at: <https://digv575.joanneum.at/more/watchdog/>

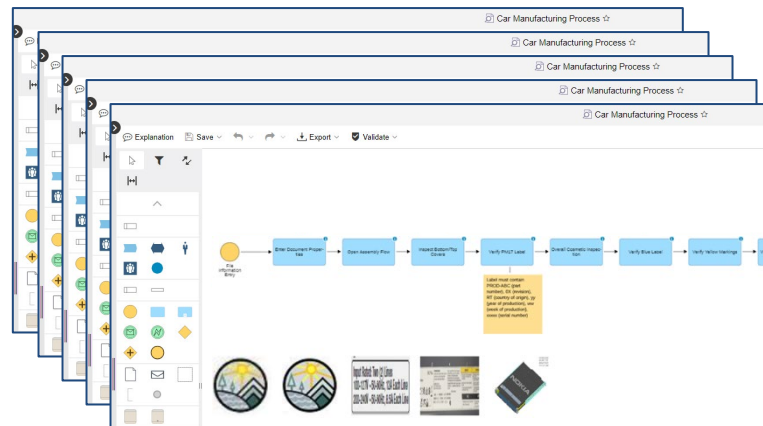
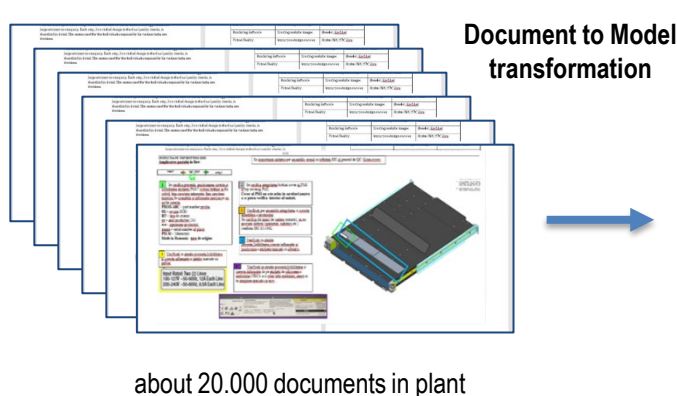
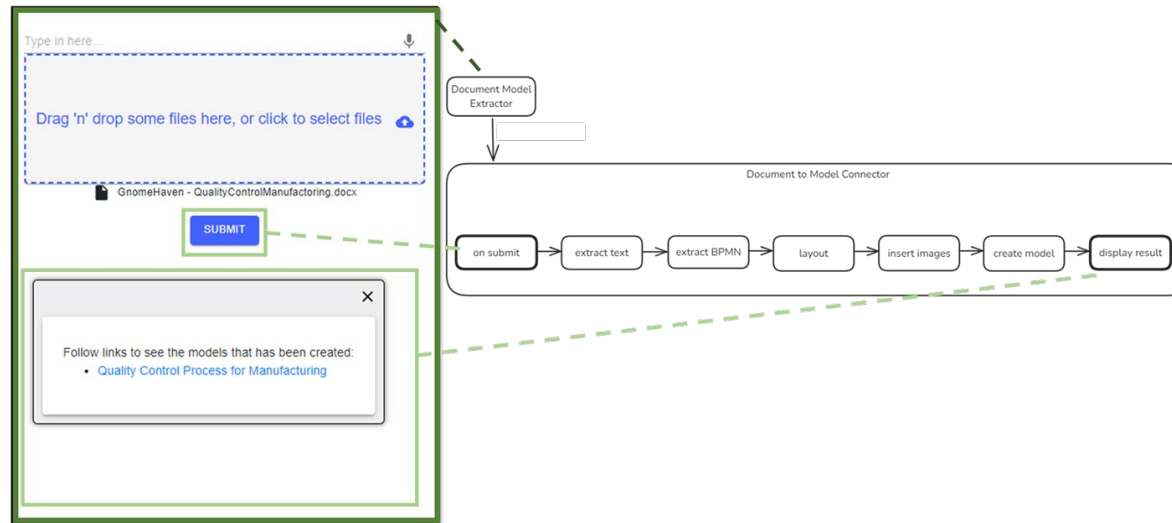
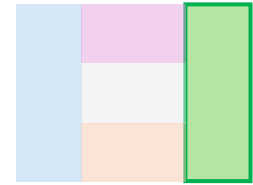
# Improve Information Access to Support Maintenance



Two main processes where the general-purpose LLM model "GPT-4o" from OpenAI is used:

1. Initialize data into the vector database
2. Agentic retrieval

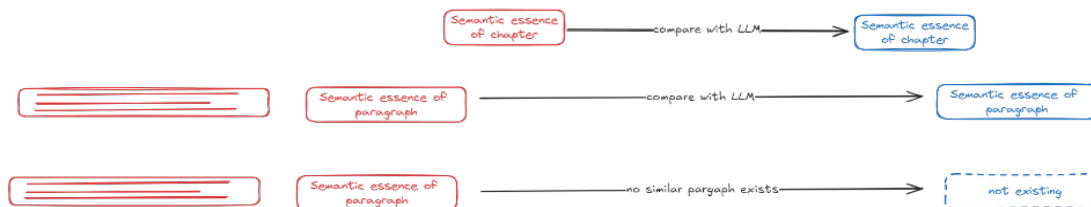
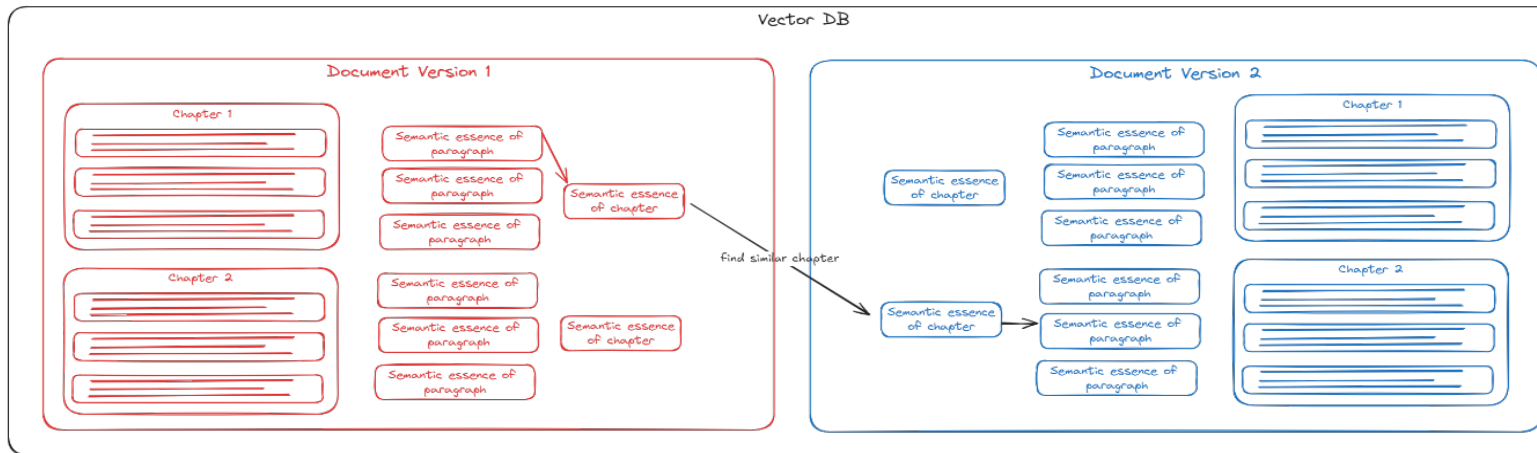
# Improve Reliability of “Documentation about Quality Check”



## Model to X Transformation

- REST
- XML, JSON
- CSV
- DOCX
- Web
- Confluence
- Dashboard
- ...

# Improve Information Access to Cleanroom Compliance Requirements



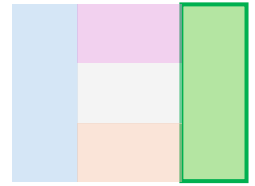
1. Document Chunking & Vector Storage
2. Semantic Search for Similar Content
3. Paragraph-Level Comparison
4. Categorization & Summary

Summary of differences between Measurement\_Analysis-and-Improvement-Version-D and Measurement\_Analysis-and-Improvement-Version-E:

The documents exhibit several substantive differences, particularly in the chapters discussing responsibilities, continuous improvement, and the management system. The second document clarifies specific responsibilities and deadlines for quality reporting that are not as explicitly outlined in the first document. Additionally, there is a shift in focus regarding continuous improvement strategies, with the second document highlighting cost control and waste reduction instead of primarily emphasizing customer dissatisfaction. Notably, the final chapter on record retention in the second document provides more detailed guidelines compared to the general compliance focus of the first. Furthermore, the second document is missing the content for chapter 11, which could indicate a revision or update in the structure.



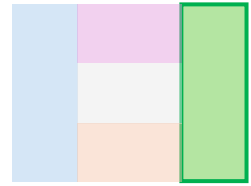
# Assist Decisions for Truck Loading



- First-Fit Decreasing (FFD) Heuristic
  - Sorts containers by decreasing order of size, weight, and stackability
  - For each container, places it in the first truck (bin) with enough capacity (space + weight)
  - If no truck can accommodate it, a new truck is used.



# Assist Decisions for Truck Loading

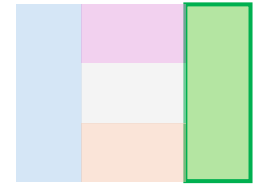


- **Efficient:** runs in  $O(n \log n)$  due to the sorting operation
- **Good approximation:** FFD is proven to use at most bins, with  $\eta$  being the optimal minimum.
- **Simple to implement & explain:** Easy for logistics staff and managers to understand—pack the largest items first, then fill gaps.
- First step towards improved packing recommendations vs. manual strategy



# Support Validation of Calibration Documents

- Large number of documents, currently checked manually
- Automatic scanning of calibration documents using AI
- What we improve?
  - The certificate issue date lies in the past.
  - Calibration device name matches with the name stated in the document
  - The certificate was issued only after the verification measurements were conducted



1. The certificate issue date lies in the past. ➡ [URS01] Passed.
2. The calibration device ID can be retrieved. ➡ [URS06] Passed.
3. Calibration device name matches with the name stated in the document ➡ [URS03] Failed.  
Given manufacturer information does not match with DB.

**TEST**  
Laboratori e servizi alle imprese  
Sistema di Gestione della Qualità  
certificato dal norme ISO 9001:2015

**CALIBRATION LABORATORY**

**Calibration Certificate N.0461\_2024\_BO\_E**

It is composed of: 3 pages

- date: 23 July 2024
- address: S.C. FLEXTRONICS ROMANIA S.R.L.
- application: --
- date: --

Referring to:

- device: SENSOR AND INSERTER ROBOT ASSY
- manufacturer: ALPHR TECHNOLOGY EUROPE
- model: ROBOTIQ FT 300-S
- s.n. (asset number): FTS-13385 - STATION 3 (12832)
- date of measurements: 23 July 2024
- due date: 23 July 2025
- laboratory reference: RLT\_BO\_2024\_E

**1. Traceability:**

The applied procedure is: P\_OHP\_01.  
Standards used to calibrate inspection, measuring and test equipment are traceable to national and international standards.  
The following reference standards have been used for calibration:

Asset Number	Serial Number	Certificate	Due date
TE01314+TE01367	13002+460462	0909_2023_AB_C	2024-12-20

## REPORT

Page 4

[URS01] Passed.  
[URS06] Passed.  
[URS02] Failed.  
Wrong calibration device info.  
DB Device Name: Load Cell  
Document Device Name: SENSOR AND INSERTER ROBOT ASSY  
[URS03] Failed.  
Given manufacturer information does not match with DB.  
DB Manufacturer: ROBOTIQ  
Document Manufacturer: ALPHR TECHNOLOGY EUROPE  
[URS04] Failed.  
Given model number does not match with DB.  
DB Model Number: FT 300-S  
Document Model Number: ROBOTIQ FT 300-S  
[URS05] Passed.  
[URS07] Passed.  
[URS08] Passed.  
[URS09] Passed.  
[URS10] Passed.  
[URS14] Passed.

Page 2

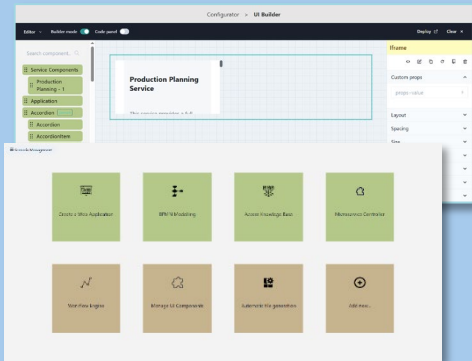
[URS11] Passed.  
[URS13] Passed.  
[URS14] Passed.

Page 3

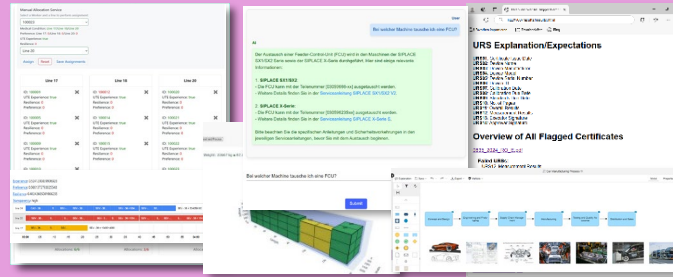
[URS12] Passed.  
[URS13] Passed.  
[URS14] Passed.

# DAI-DSS Prototypes of Reference Architecture

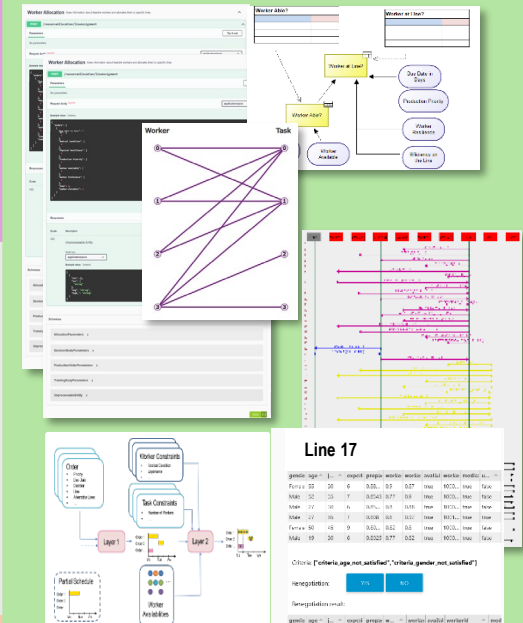
## DAI-DSS Configuration Framework



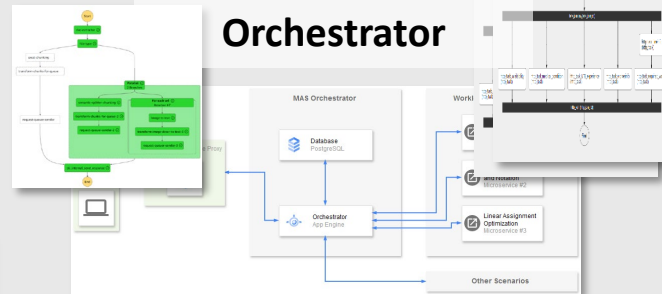
## DAI-DSS UX



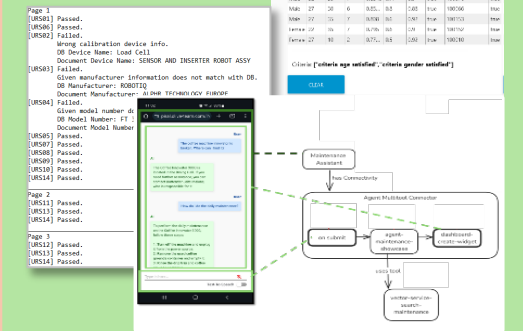
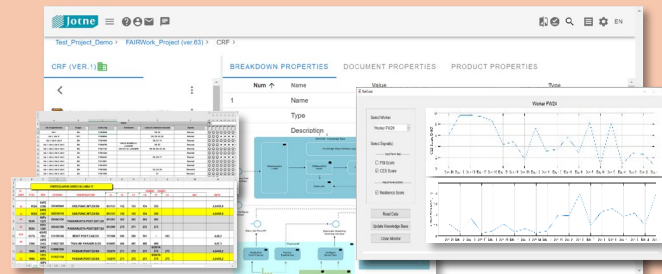
## DAI-DSS AI Enrichment Services



## DAI-DSS Orchestrator



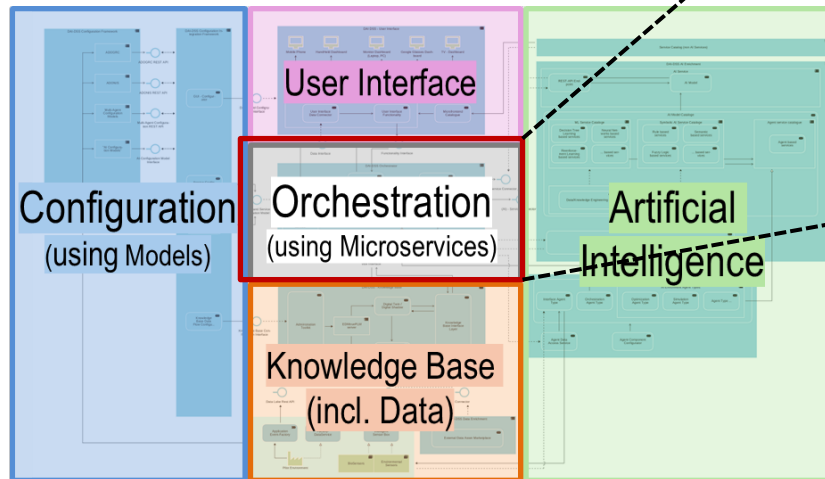
## DAI-DSS Knowledgebase



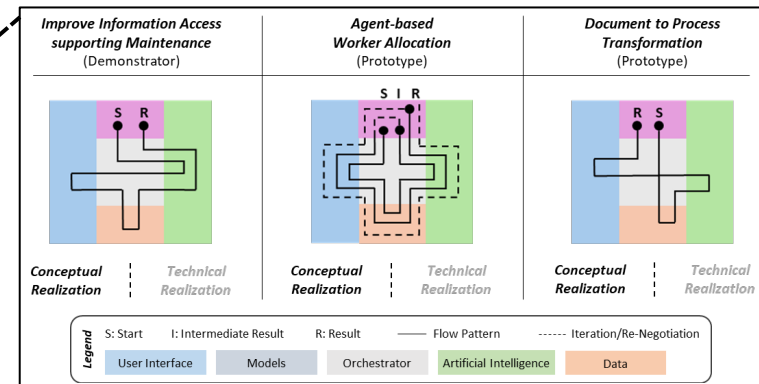
# Outlook: Contribution to European Reference Framework & Architecture

## Reference Framework and Architecture

- Foundation for a trusted and sustainable AI-Ecosystem
- Commonly agreed standards, protocols and patterns (MCP, IDSA, BPMN, ...) between AI-assets.
- Domain-specific formalization of AI-assets.
- Instantiation with European Technologies coming from research (e.g. LUCIE-7B) or from industry (e.g. Mistral)
- Operation in European Infrastructure (e.g. AI Factories)



## Orchestration using Domain-specific AI-Interaction Paths



- High performant and high availability provisioning domain-specific AI-Interaction Paths
- Realization using implementation Technology of Agentic approaches (e.g. Multi Agent System, Workflows, No-Code Orchestrators,...)

Thank you for your attention!

# Q&A