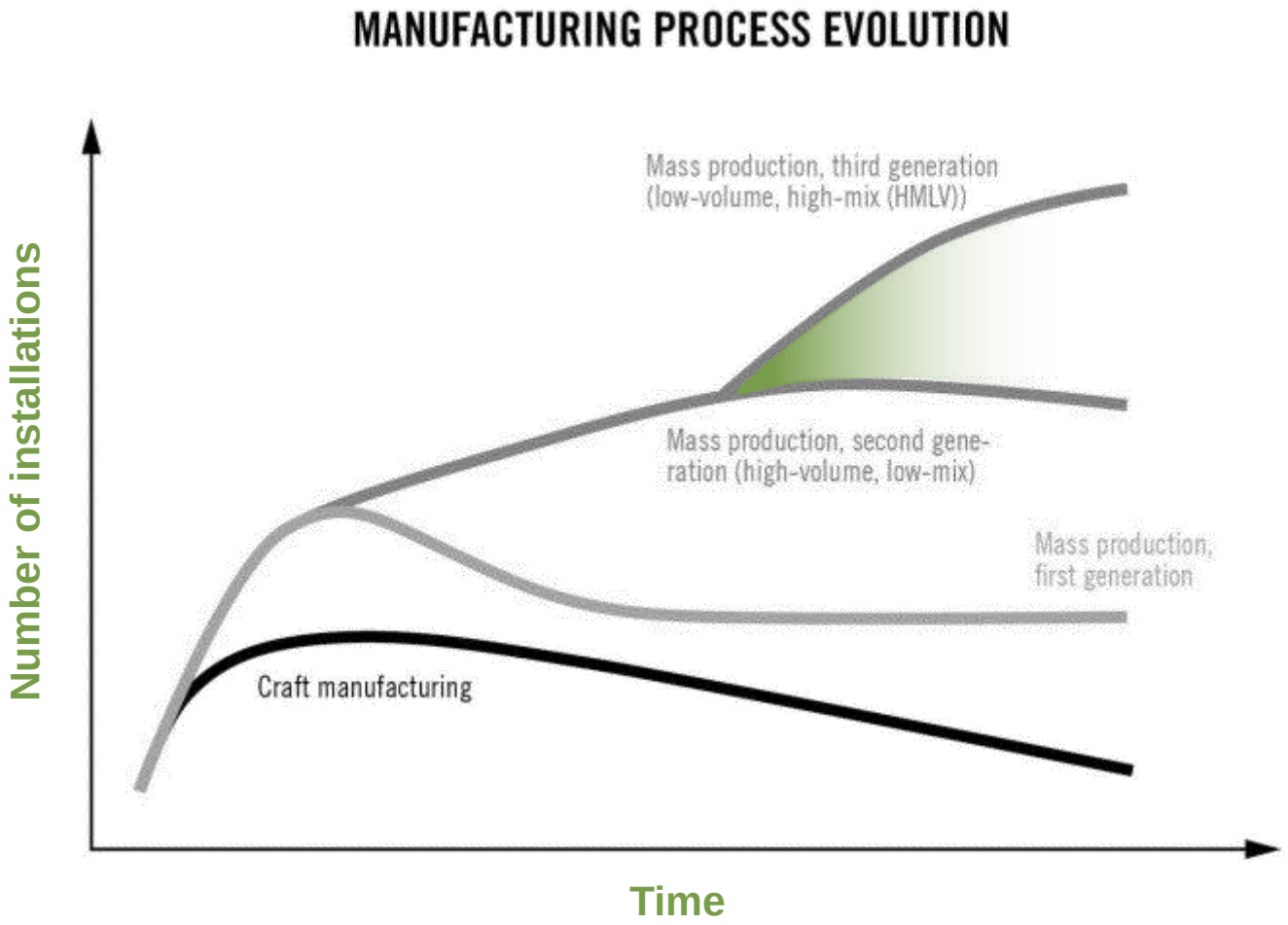
Towards hyper-modular robot cells for high mix/ low volume assembly

IROS 2019
Workshop “Current limits and potentials of autonomous assembly”
Macau, China
04 November 2019

Christian Schlette
04 November 2019

Towards agile manufacturing



Source: SECO Tools 2019

Overview

Our approach

Performance at WRC18

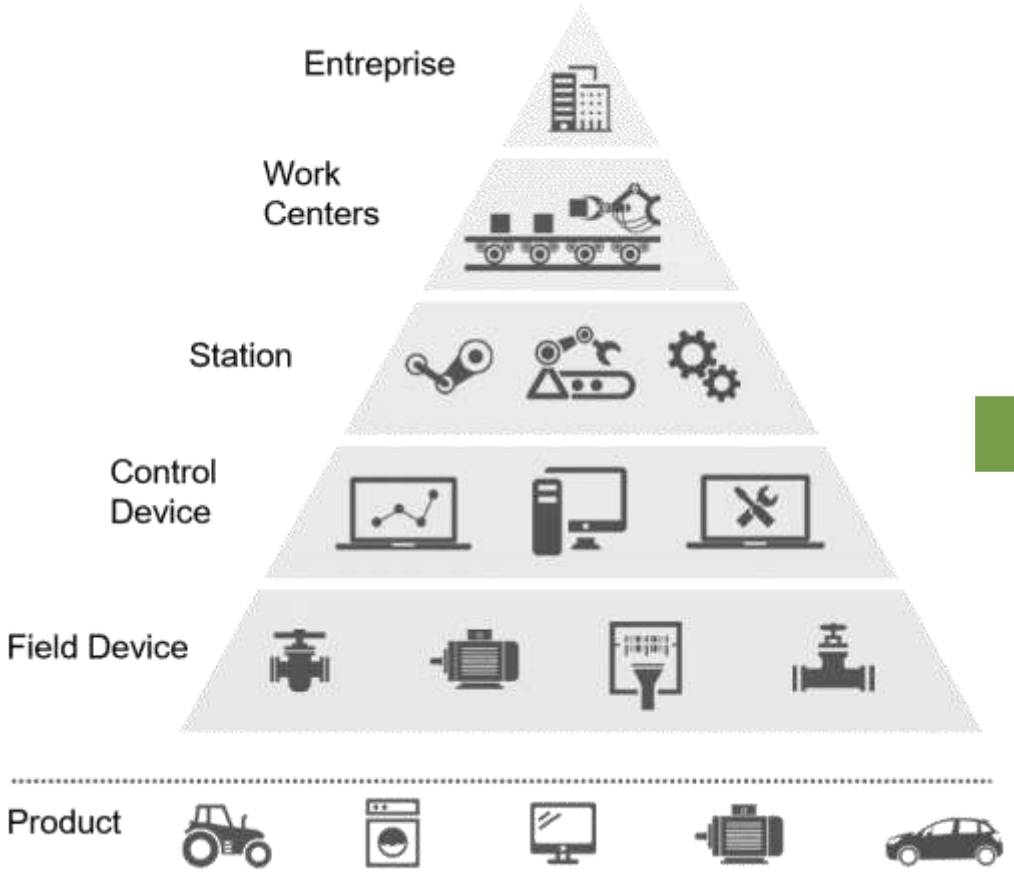
Future challenges

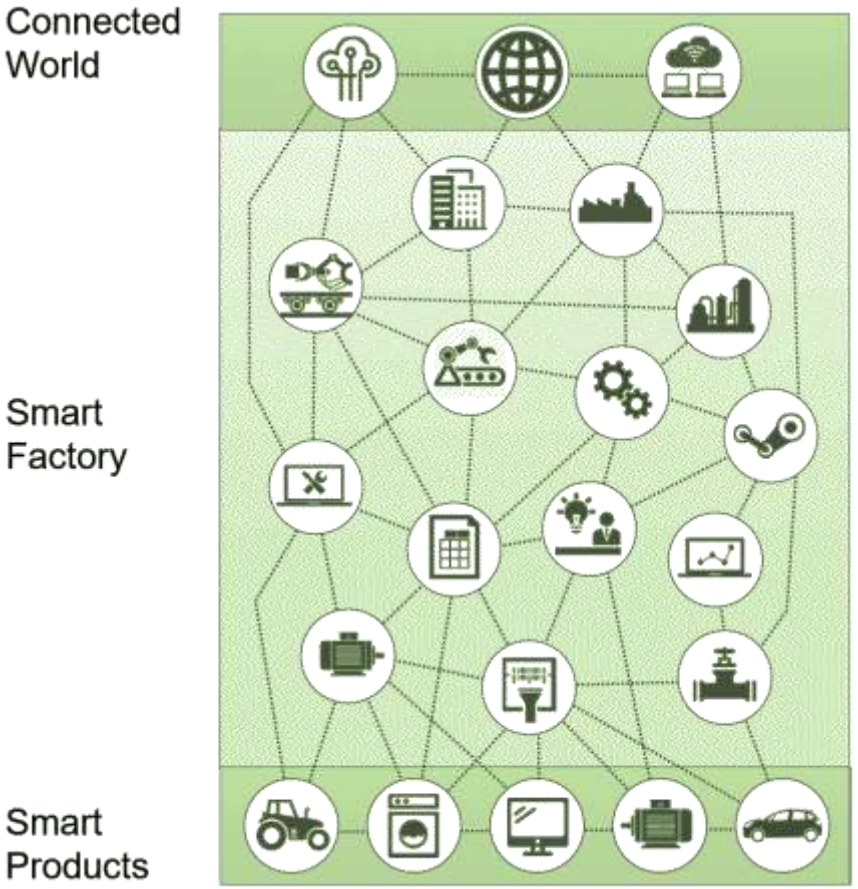
Our approach

Christian Schlette

Hyper modularity

at entreprise level

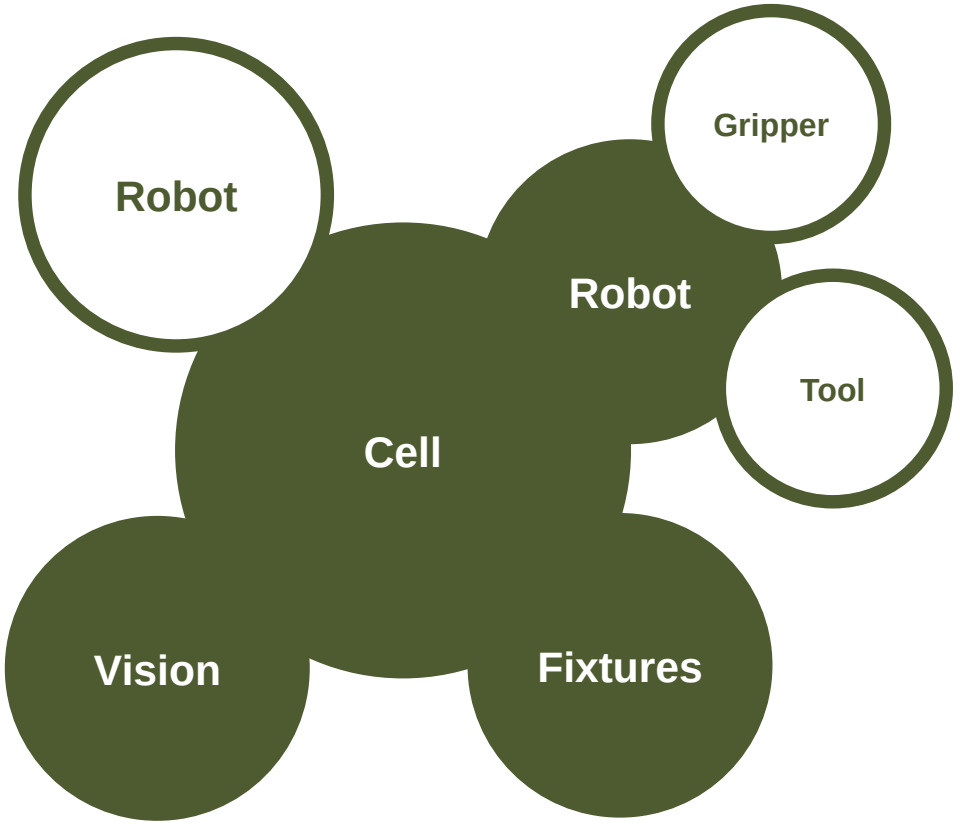




Source: Plattform Industrie 4.0 2016

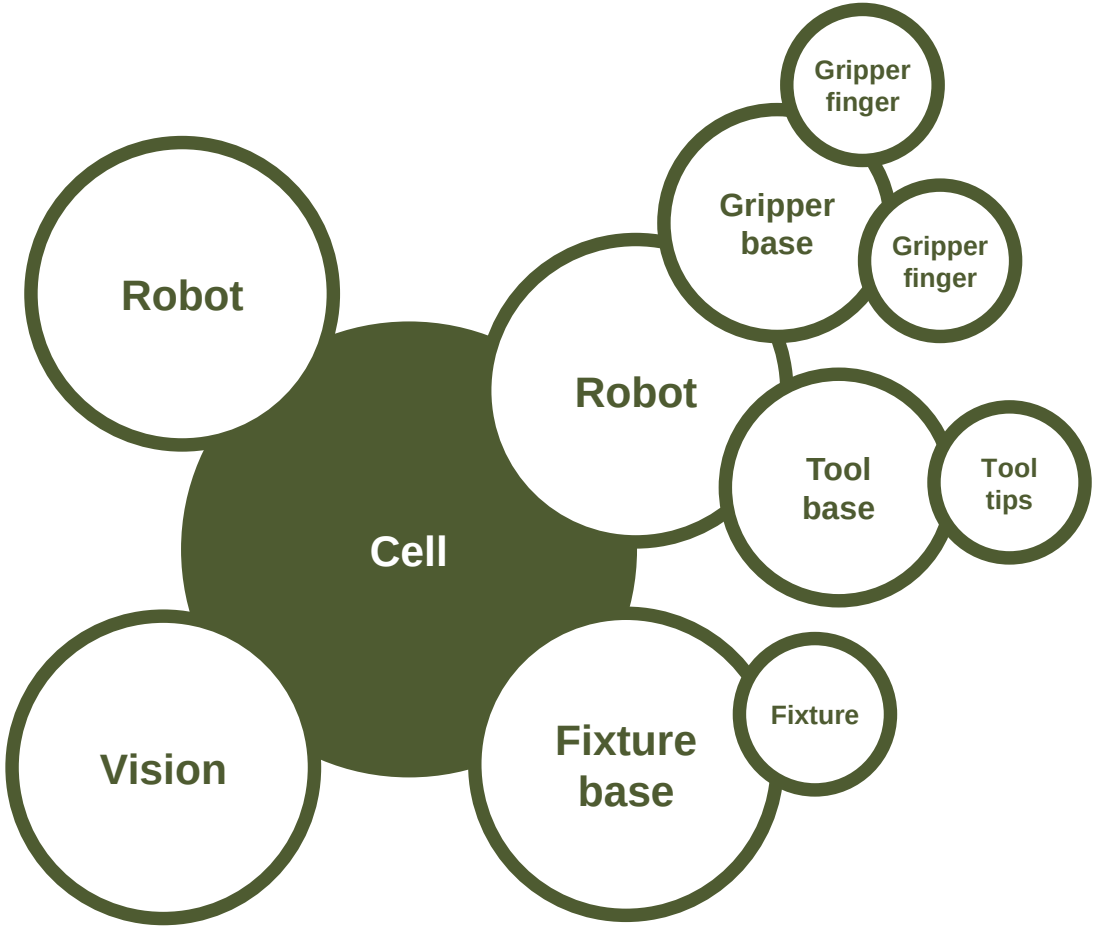
Hyper modularity

at cell level



Hyper modularity

at cell level



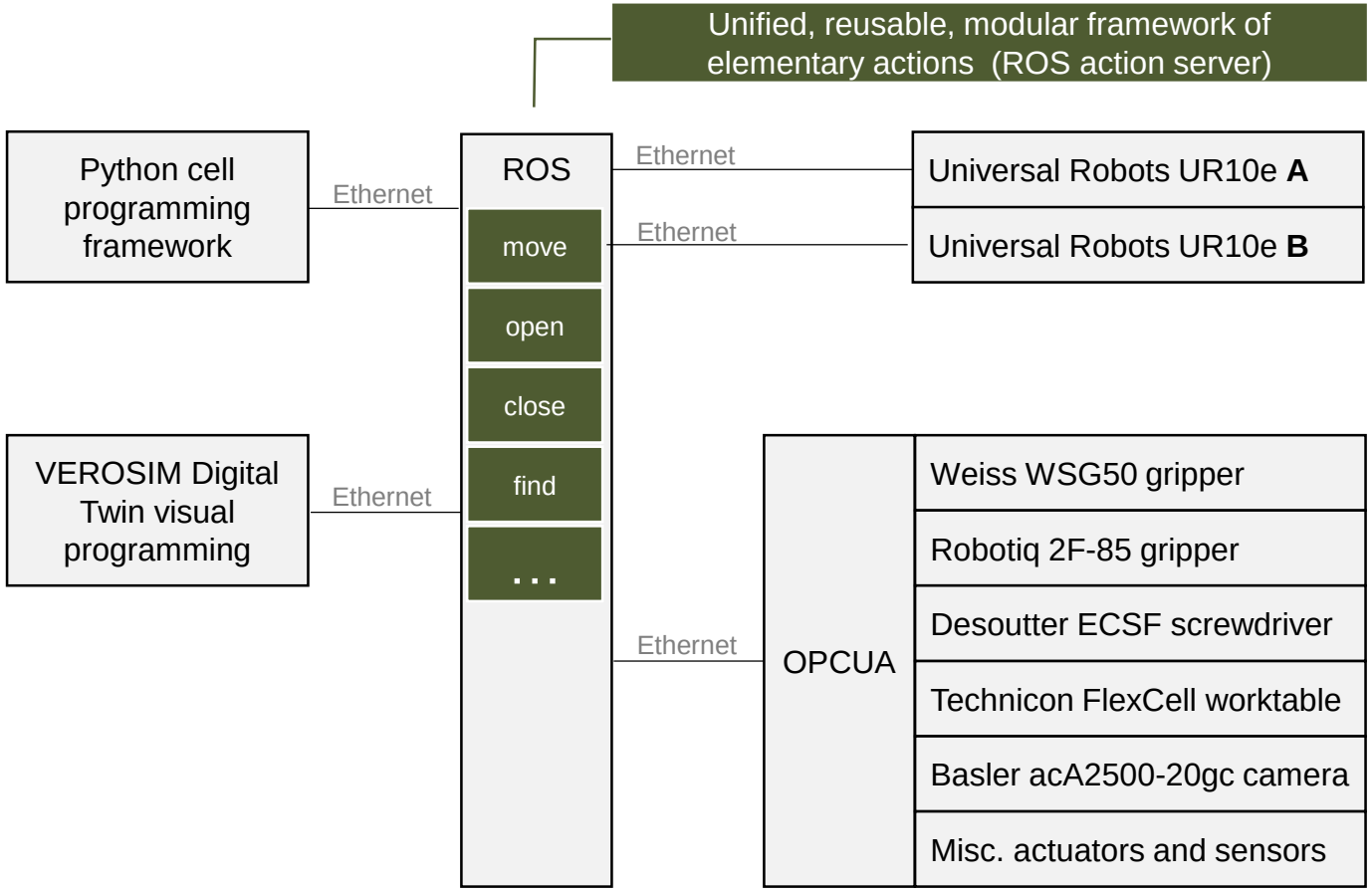
Sensor frame
- Lights
- Camera

2x industrial robots (UR10e)
- On stands
- 2x two-finger gripper
- 1x screwdriver
- 1x vacuum gripper

Worktable
- Safety PLC
- OPCUA

Cell control implementation

2018



Cell control architecture

2019

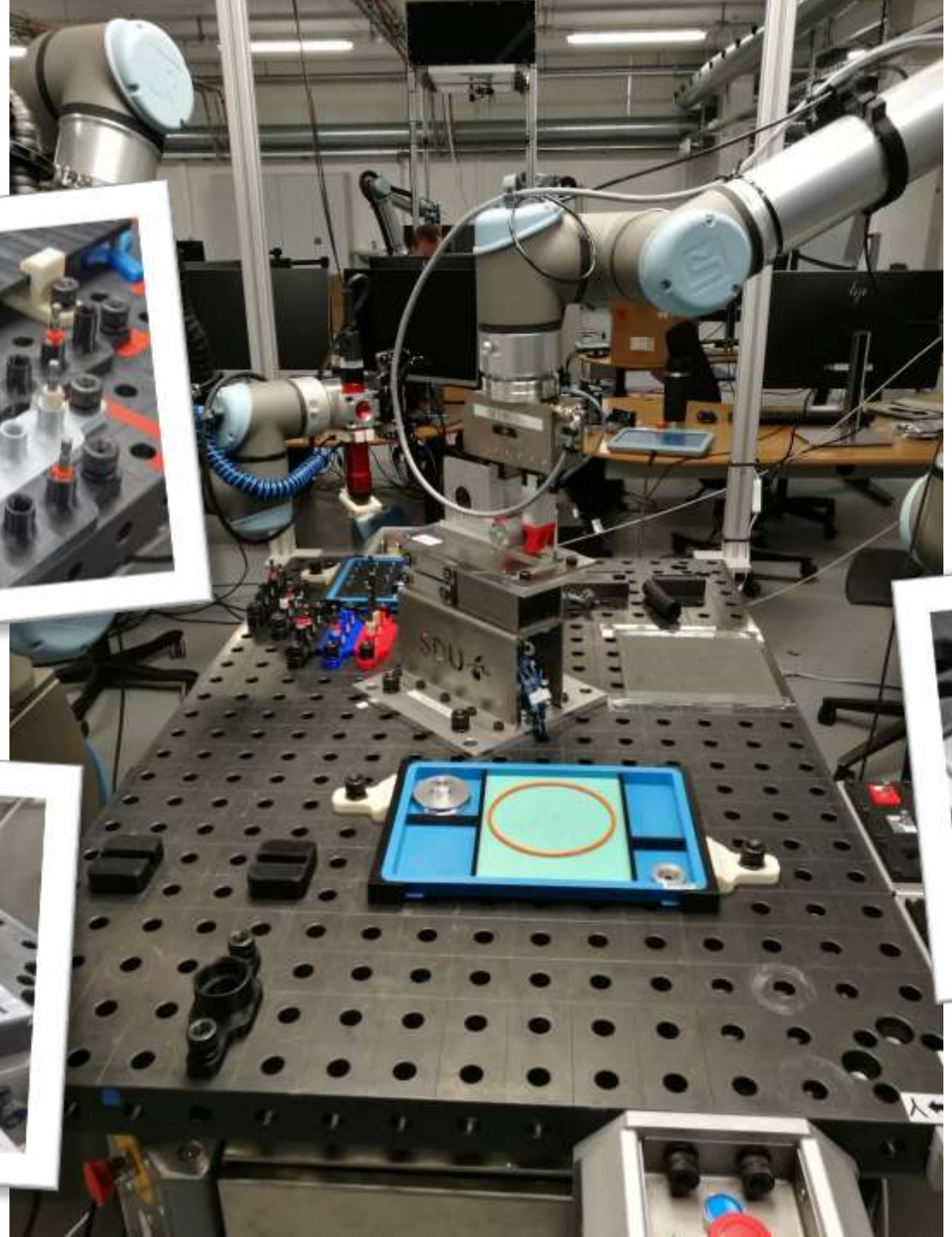
Digital Twin

Service-oriented architecture
and
databases

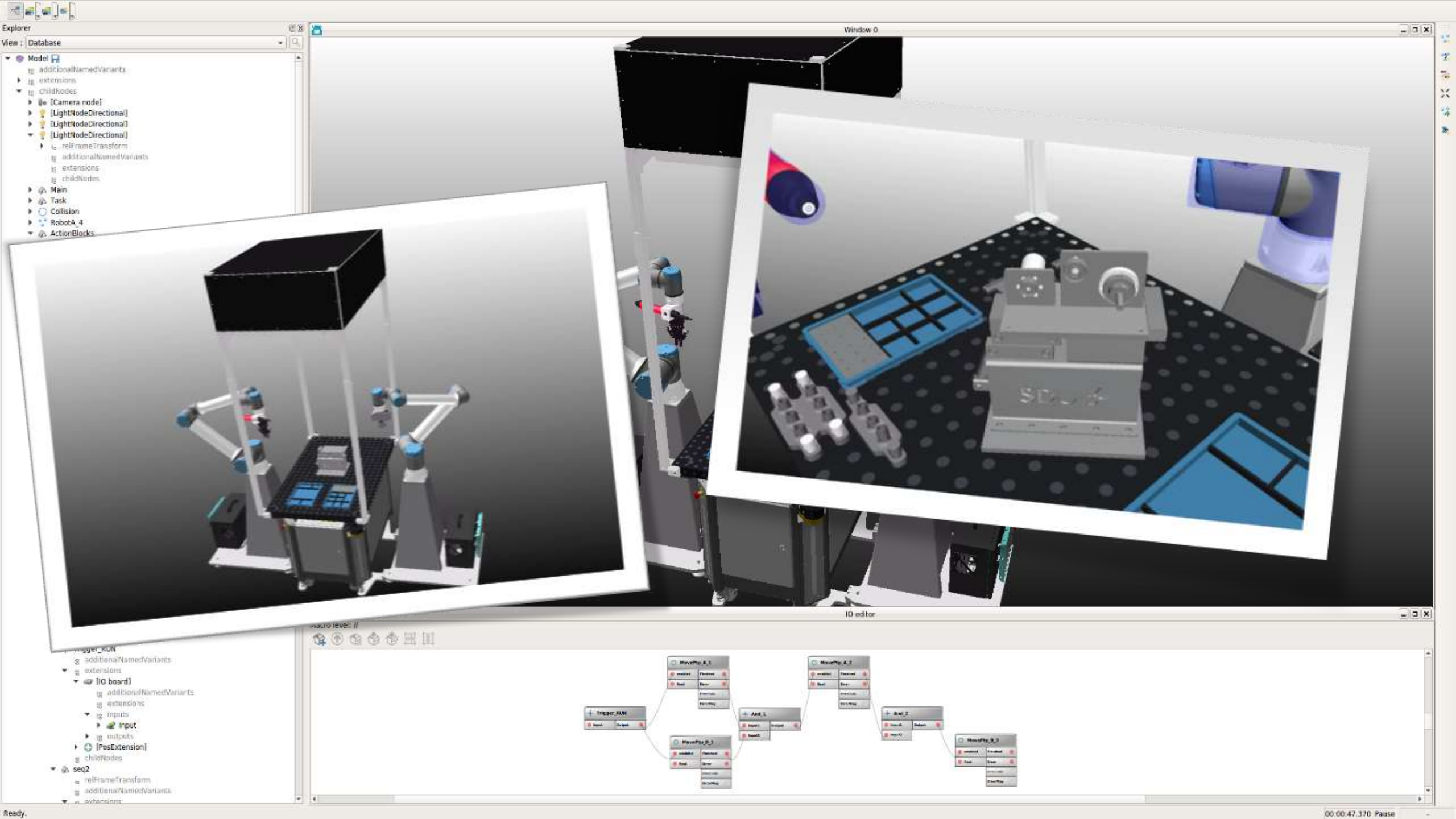
„PPP-DB“ (MongoDB)
- Poses, paths and parameters
- Assembly sequences
- Calibration frames

trollers and
lgorithms
real time)

Physical cell


SDU


1
2
3


Explorer
View : Database
Model
additionalNamedVariants
extensions
childNodes
[Camera node]
[LightNodeDirectional]
[LightNodeDirectional]
[LightNodeDirectional]
relFrameTransform
additionalNamedVariants
extensions
childNodes
Main
Task
Collision
RobotA_4
ActionBlocks
Window 0
IO editor
Trigger_RUN
additionalNamedVariants
extensions
[IO board]
additionalNamedVariants
extensions
inputs
Input
outputs
[PosExtension]
childNodes
seq2
relFrameTransform
additionalNamedVariants
Ready.
00:00:47.370 Pause


EFFIMAT

Performance at WRC18

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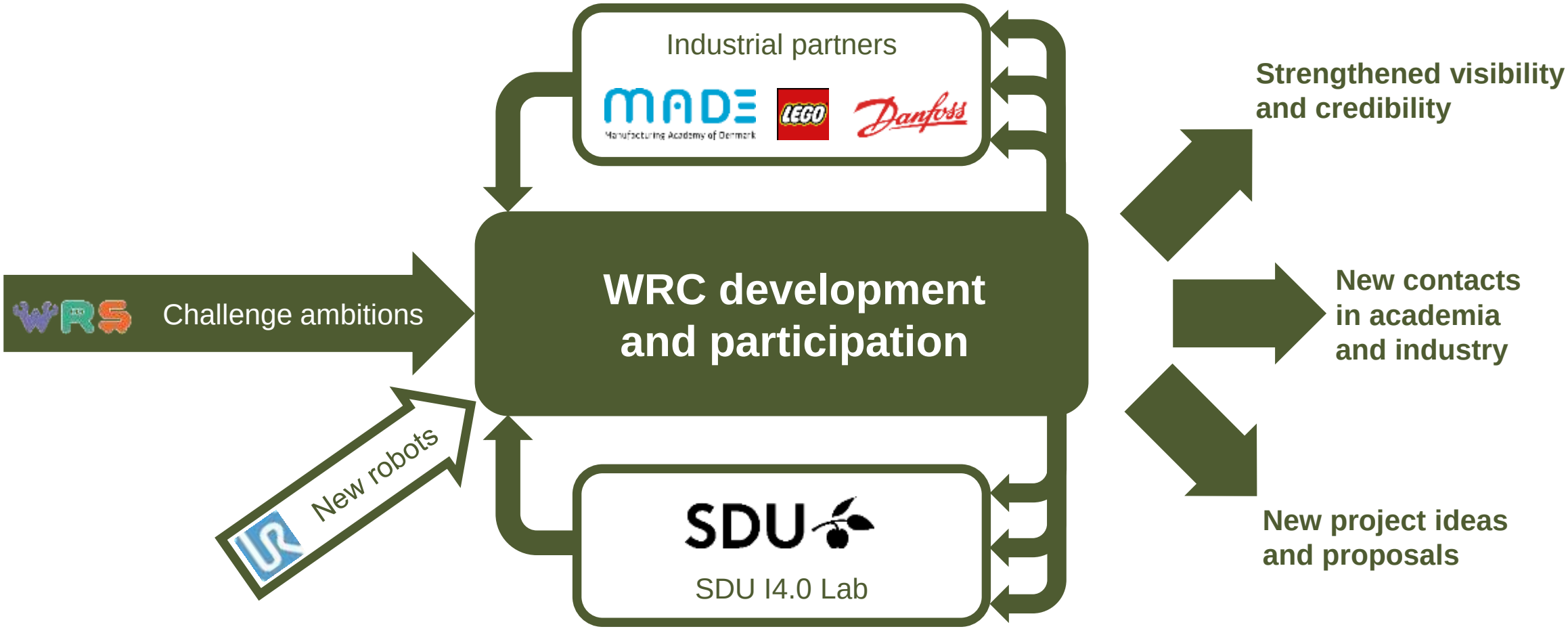
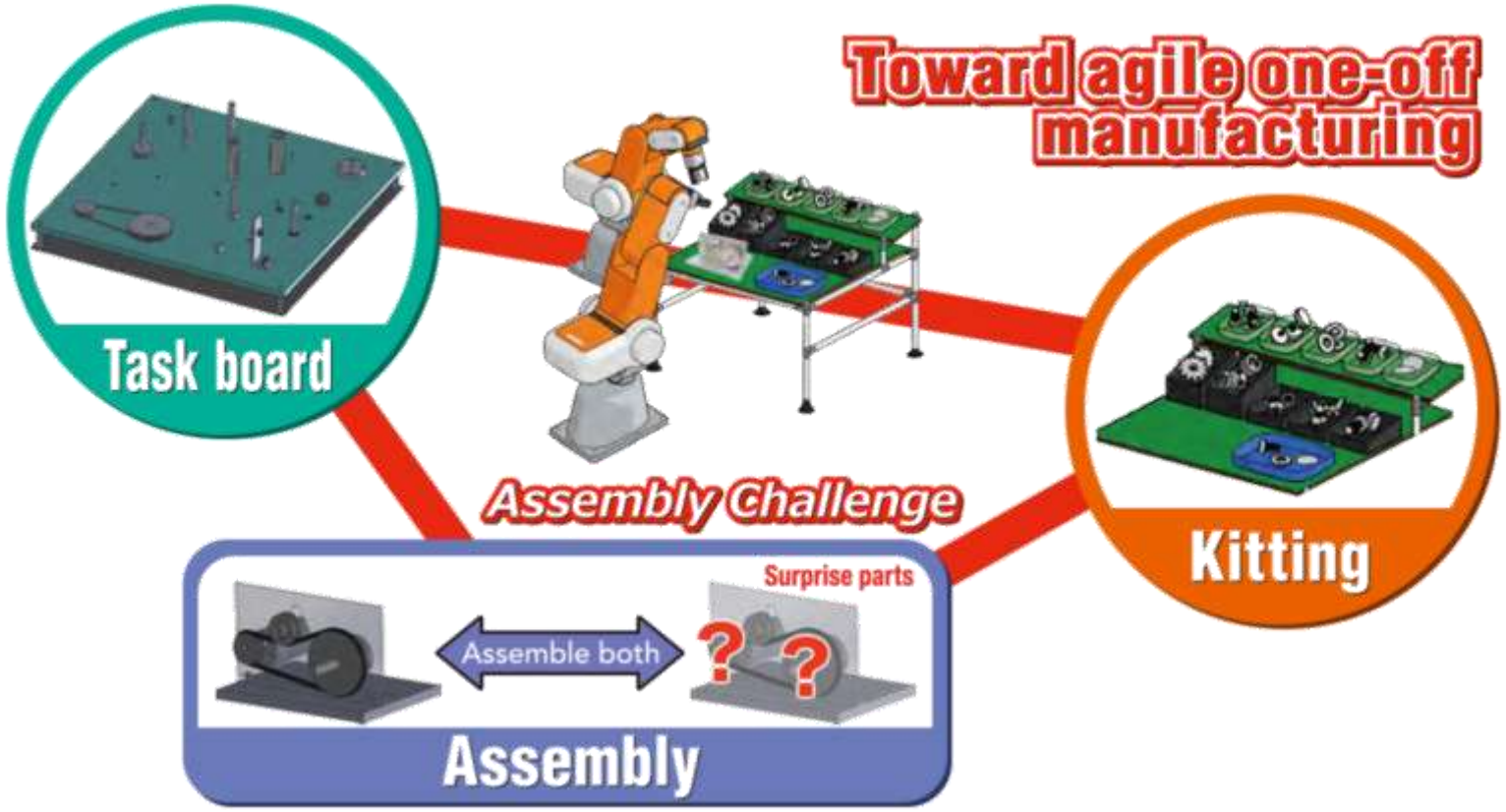
Dynamics around WRC18



Industrial Assembly Challenge at WRC18

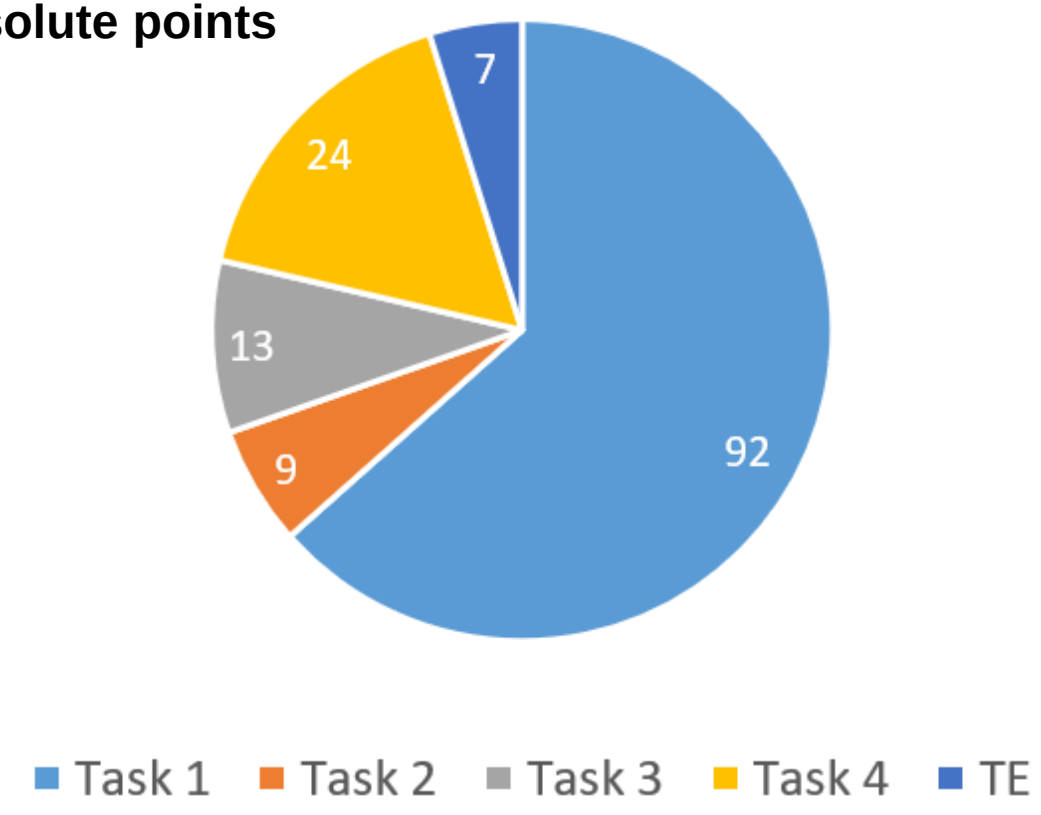
Four tasks on four days:

- Taskboard (Robot control)
- Kitting (Computer vision)
- Assembly (both)
- Assembly+ (both)

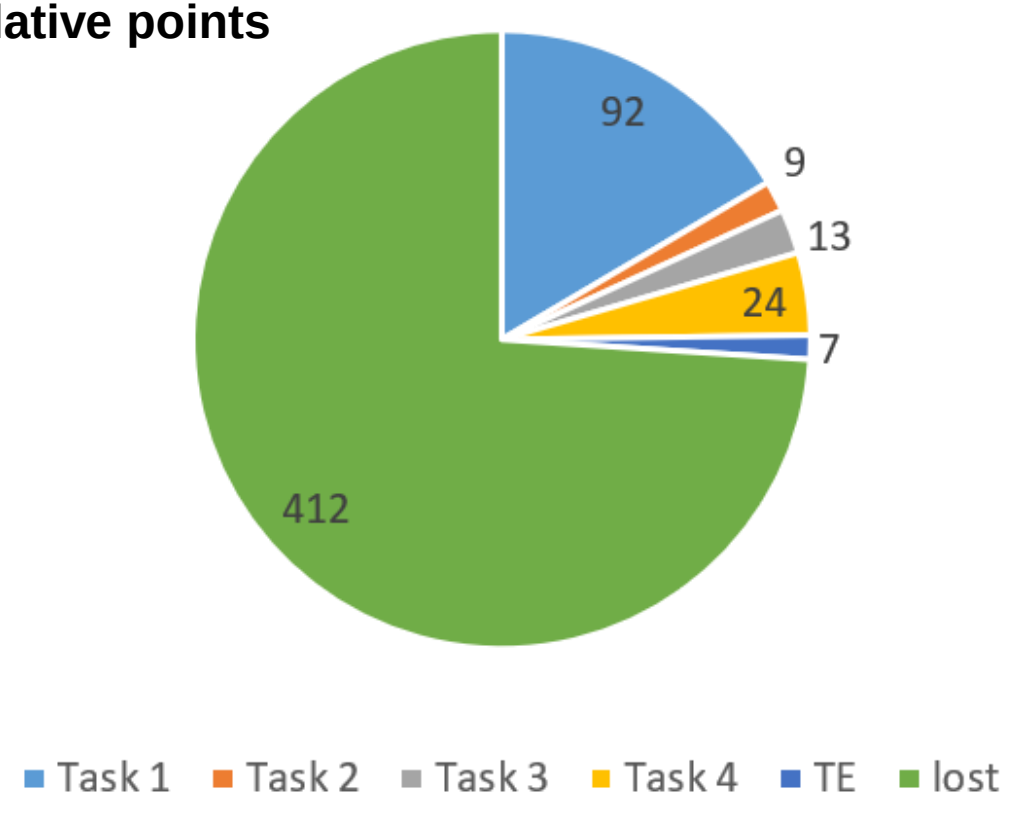


Results and interpretation

Absolute points



Relative points



Future challenges

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Challenges

Challenge 1:
Accessible user interfaces for workers,
including programming tools and exception handling

Challenge 2:
Detailed small-scale physics simulation
to cover force control and contact situations

Challenge 3:
Digital twins for human operators
to cover collaborative scenarios

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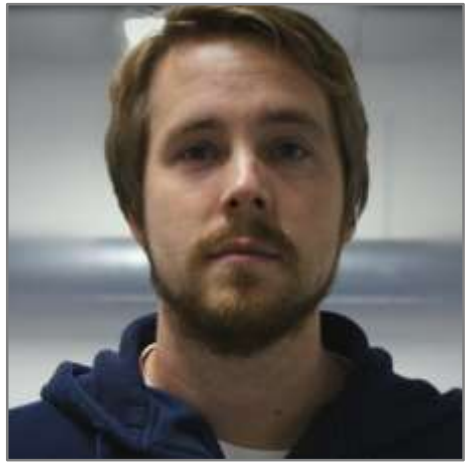
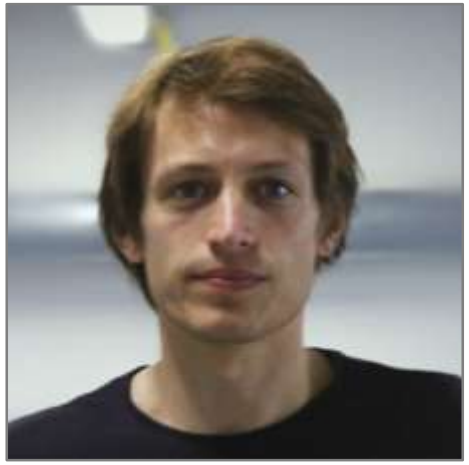
Team SDU Robotics

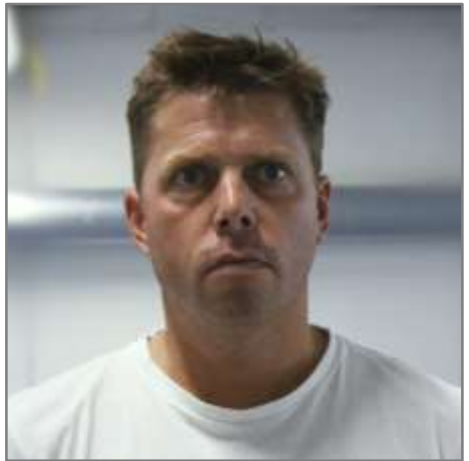
SDU







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