14TH EUROPEAN CONFERENCE ON PRODUCT AND PROCESS MODELLING

TRONDHEIM, NORWAY

14 to 16 SEP. 2022

ENRICHING BIM-BASED CONSTRUCTION SCHEDULES WITH SEMANTICS USING BPMN AND LBD

Philipp Hagedorn

Computing in Engineering
Ruhr-Universität Bochum
Germany

Motivation

BIM-based scheduling (**4D BIM**)

- numerous **advantages** for planning and construction
- **rare** practical implementation
- **time-consuming** manual creation and linkage
- **simulation** is a powerful tool analyzing complex systems
- **enormous input effort** prevents from exploiting the full potential

Source: [Synchro PRO 4D BIM]

Motivation

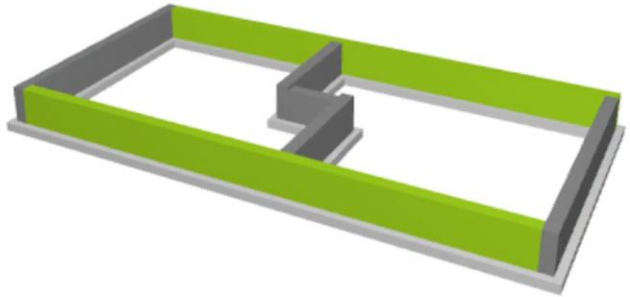
- 4D BIM - Status Quo
  - **only** for the **visualization** of the construction sequences
  - low level of detail
  - lack of semantics
  - insufficient formalization and representation of construction knowledge

RQ: How can the process knowledge generated in 4D BIM be acquired, expanded, harnessed and shared?

Calendar Week 26 - 01.07.2022

WBS	Name	Start	Finish	Duration	
1	**Duplex building**	06.06.2022	20.12.2022	142.00 days	13 %
1.2	**foundation wall**	20.06.2022	01.07.2022	10.00 days	100 %
1.2.2	**foundation wall - east**	21.06.2022	01.07.2022	9.00 days	100 %
1.2.2.5	formwork removal	01.07.2022	01.07.2022	1.00 days	100 %

... more active tasks

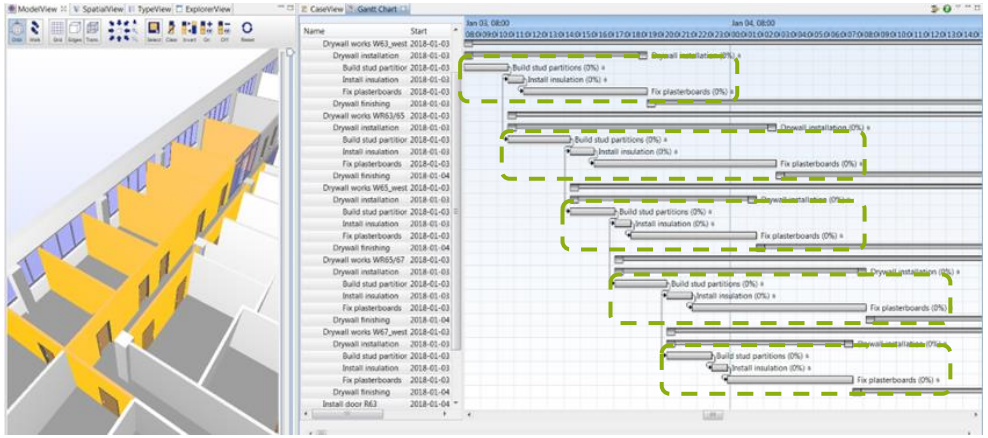


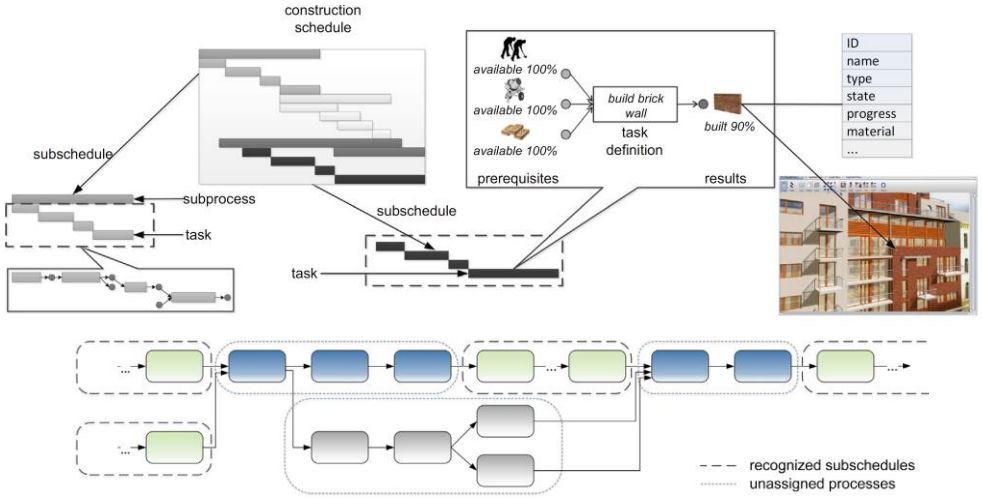
Previous Research (Katharina Sigalov)

Recogintion of process patterns

for BIM-based construction schedules

- **constraint-based modeling** and automated **generation** of schedules
- **formalization** of process knowledge
- schedule **decomposition**
- **process pattern** recognition

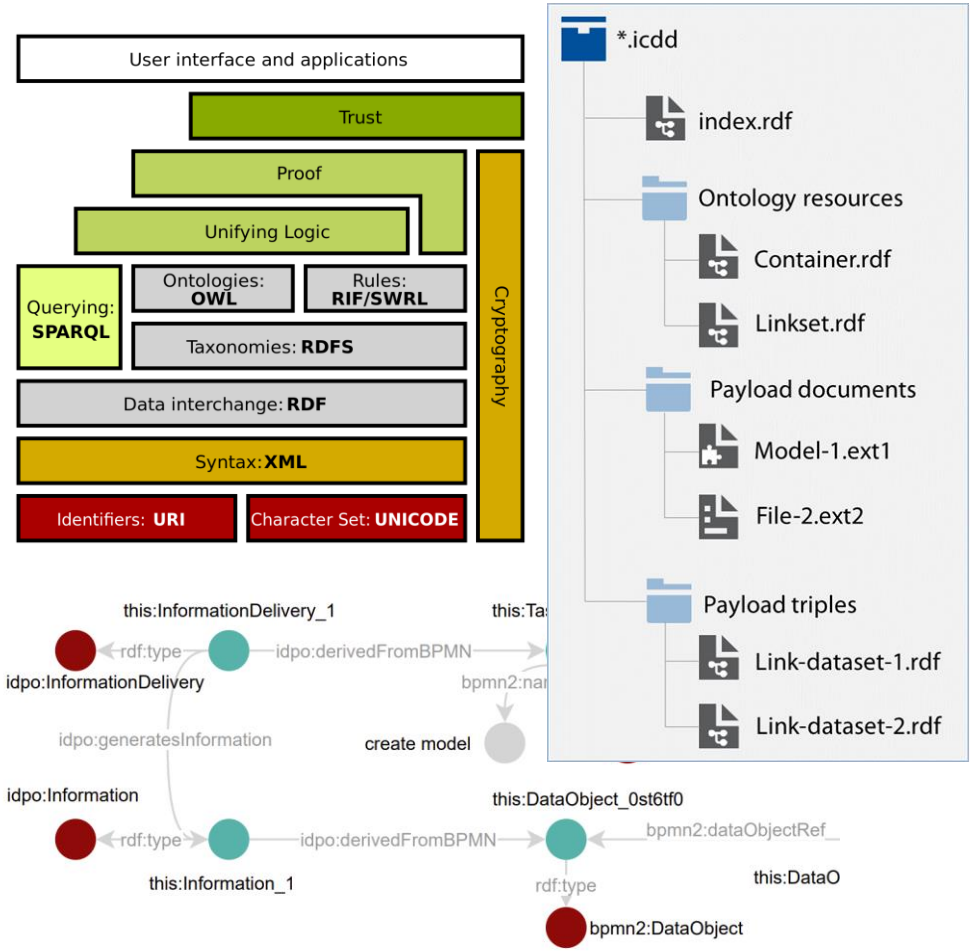


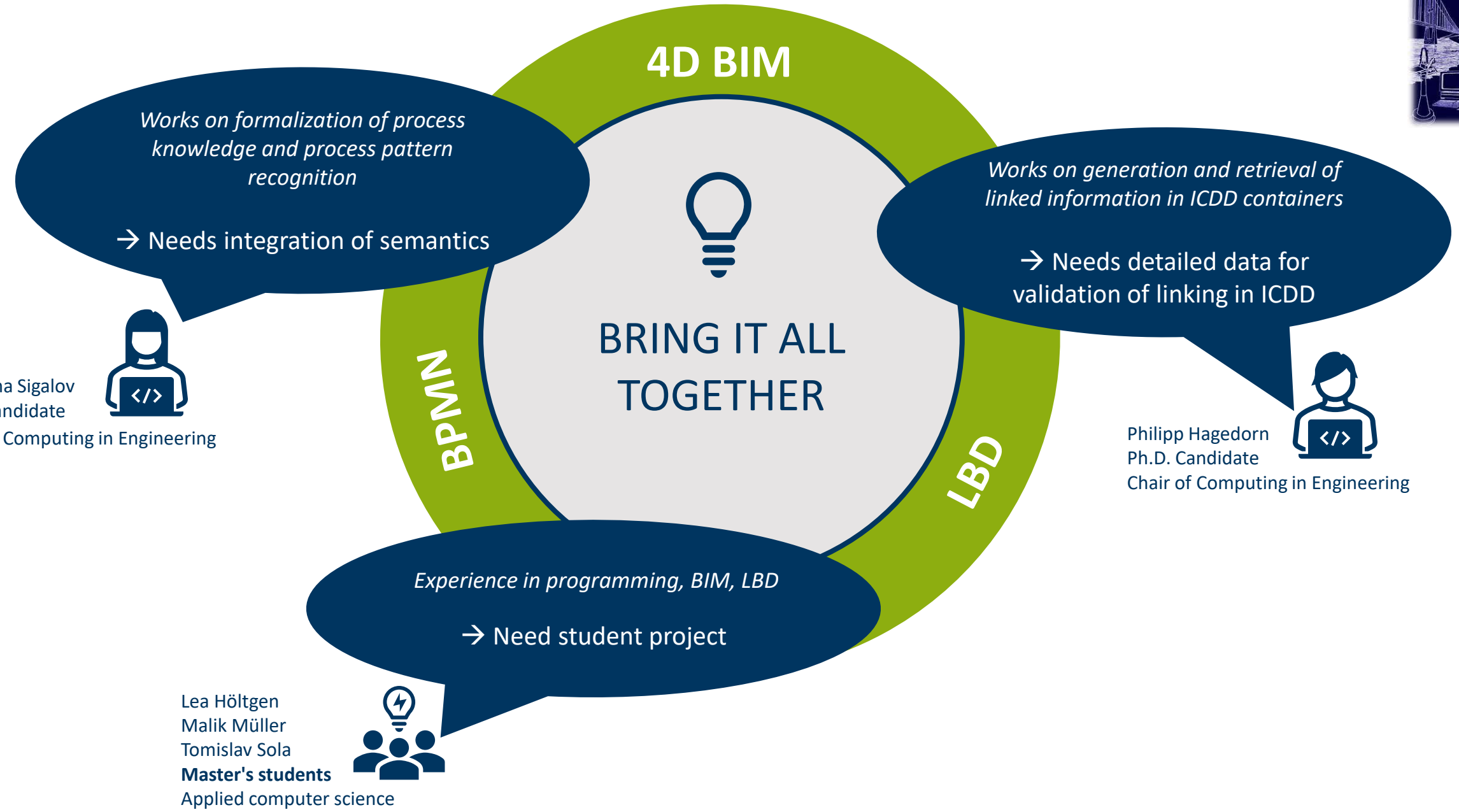


Previous Research (Philipp Hagedorn)

Generation and retrieval of linked data in information containers

- using original data (IFC, XML, …) converted to Linked Building Data **(LBD)**
- reasoning, enrichment, querying, and validation in Information Container for linked Document Delivery **(ICDD)**
- transforming Business Process Modeling and Notation **(BPMN)** information delivery processes into LBD



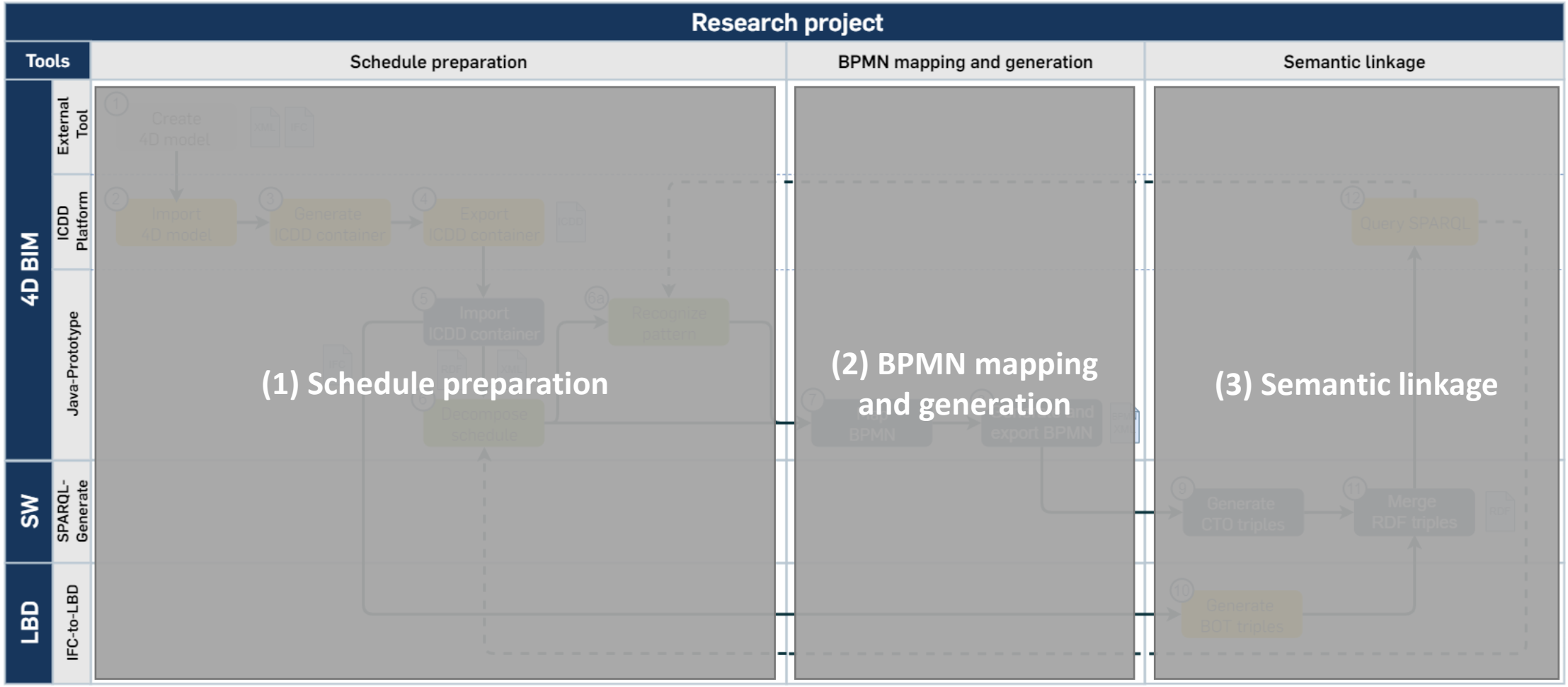


Katharina Sigalov
Ph.D. Candidate
Chair of Computing in Engineering

Philipp Hagedorn
Ph.D. Candidate
Chair of Computing in Engineering

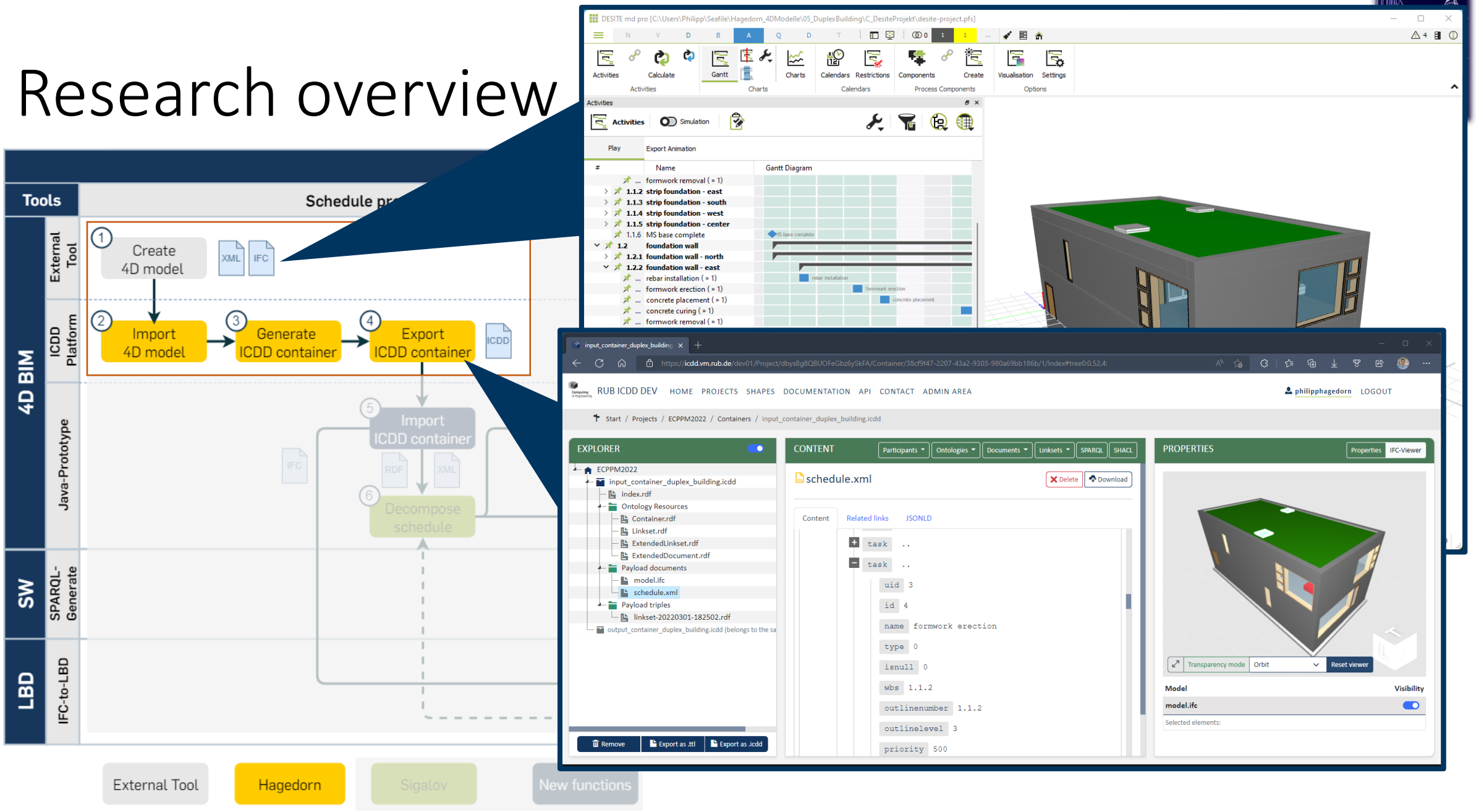
Lea Höltgen
Malik Müller
Tomislav Sola
Master's students
Applied computer science

Research overview

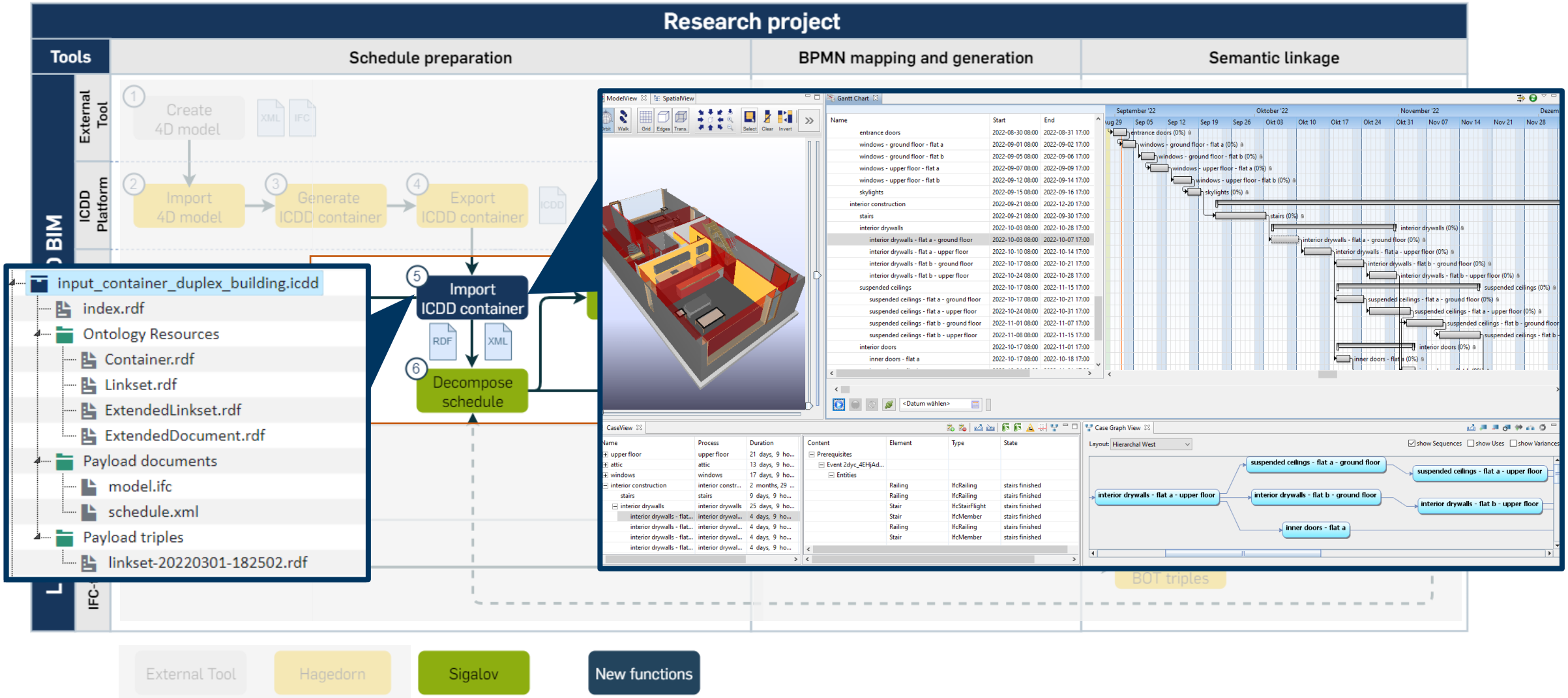


Presented at the 14th European Conference on Product and Process Modelling, Trondheim, Norway

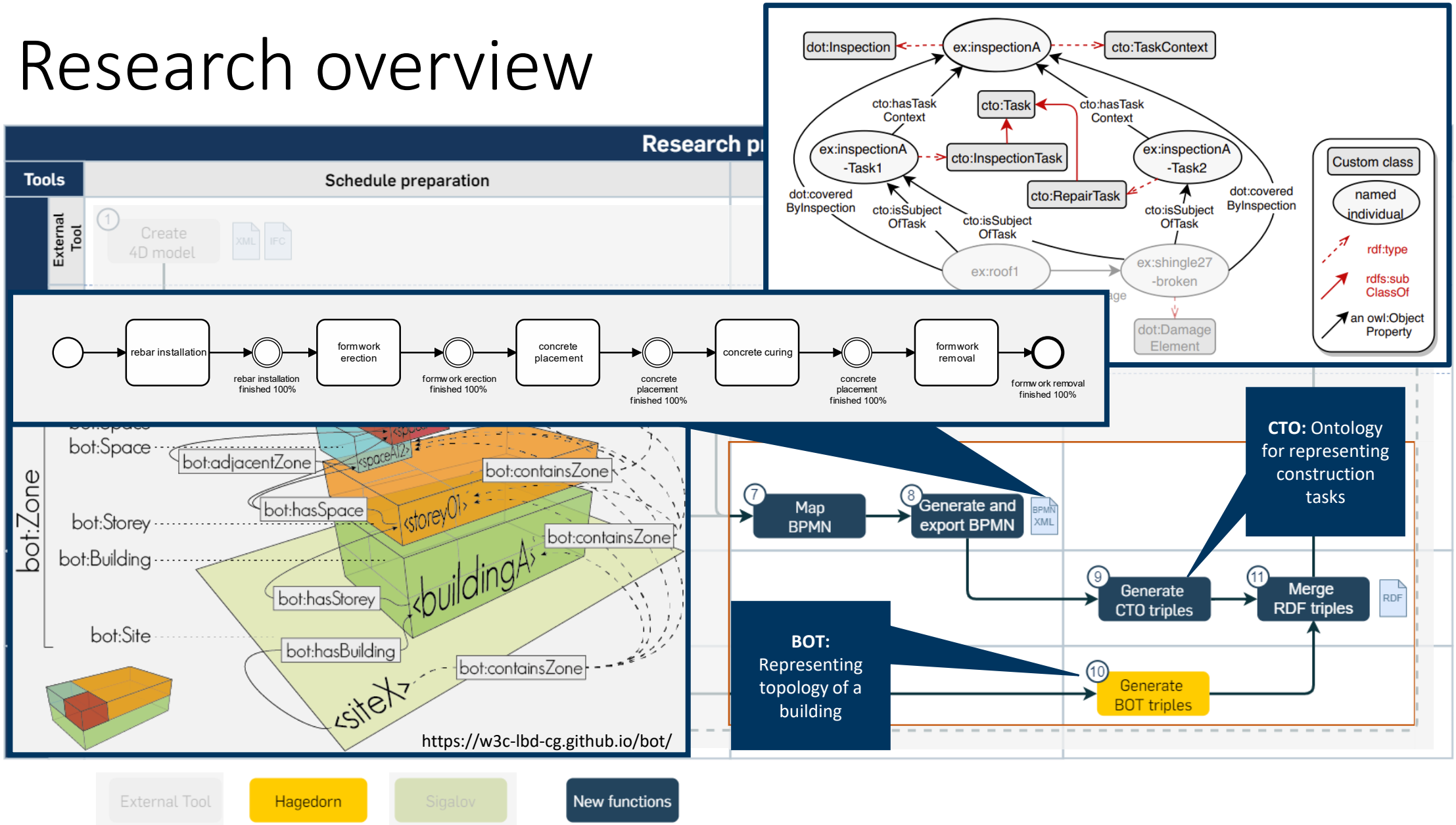
Research overview

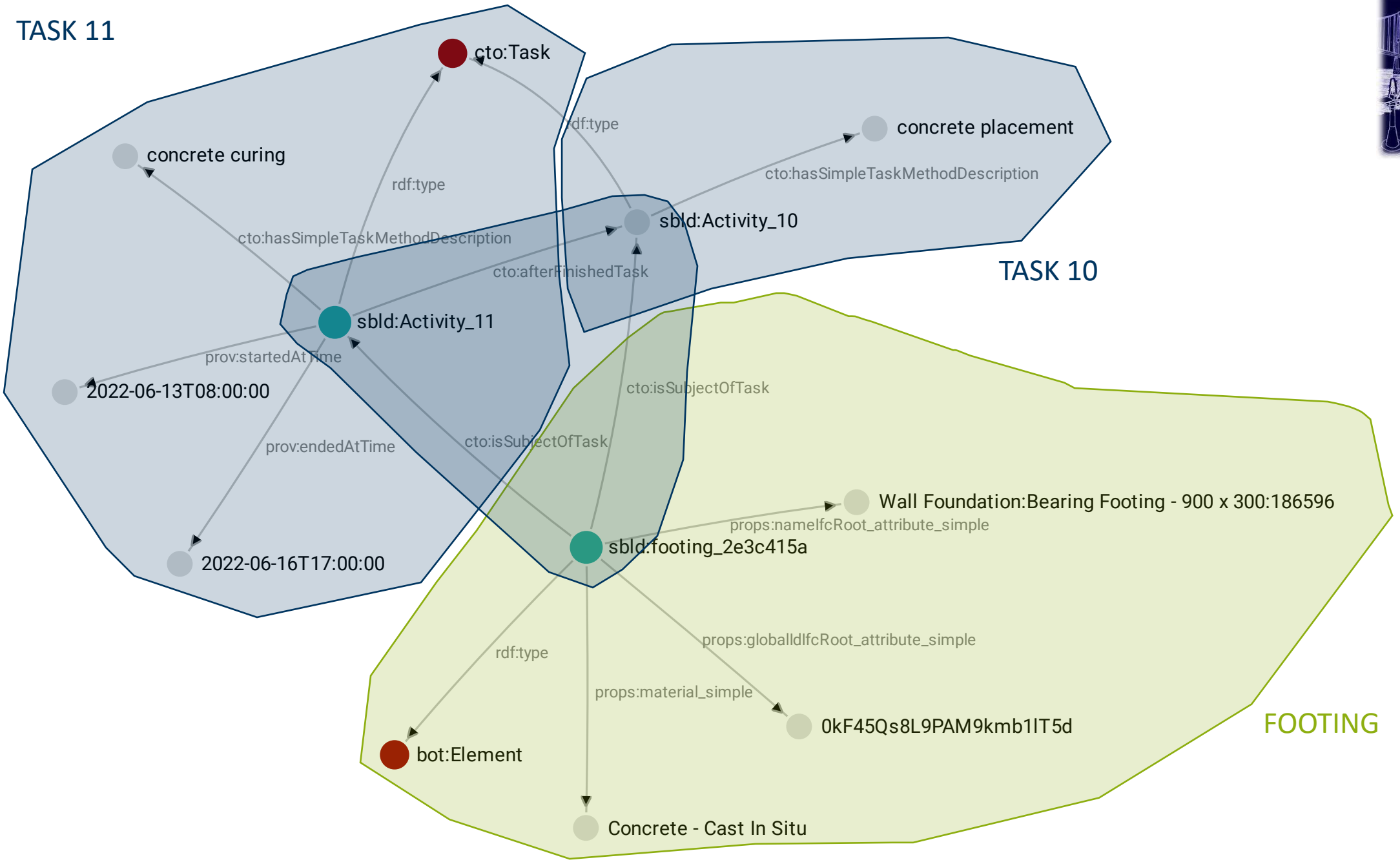


Research overview

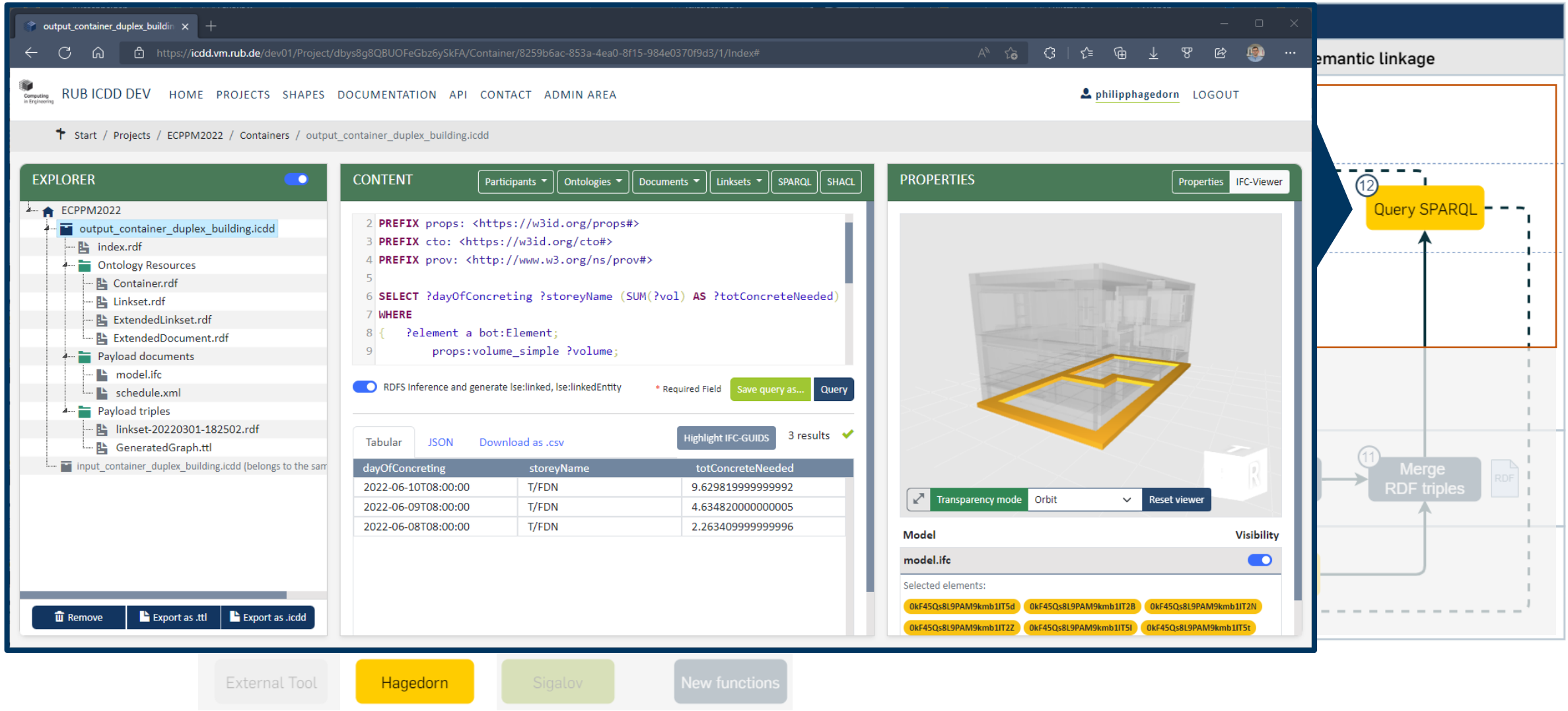


Research overview




TASK 11
cto:Task
concrete curing
rdf:type
cto:hasSimpleTaskMethodDescription
sbld:Activity_11
prov:startedAtTime
2022-06-13T08:00:00
prov:endedAtTime
2022-06-16T17:00:00
rdf:type
concrete placement
cto:hasSimpleTaskMethodDescription
sbld:Activity_10
cto:afterFinishedTask
TASK 10
cto:isSubjectOfTask
cto:isSubjectOfTask
Wall Foundation:Bearing Footing - 900 x 300:186596
props:nameIfcRoot_attribute_simple
sbld:footing_2e3c415a
rdf:type
props:globalIdIfcRoot_attribute_simple
props:material_simple
0kF45Qs8L9PAM9kmb1lT5d
bot:Element
Concrete - Cast In Situ
FOOTING

Research overview



Key findings

- simple enriching with **semantic information**
- **integration** of **task groups** based on WBS and BPMN
- automated capturing of **process knowledge** in a standardized way
- **exchanging** and **querying 4D BIM** in a vendor neutral way

Outlook

- **semantic querying** that can be integrated into the pattern recognition
- **querying for patterns** in the enriched RDF graph
- integration of traceable and complex **process states**
  - process states can evolve over time
  - attachment of states to tasks and elements is further researched using Property Management Ontology (OPM)
  - states can imply other states (process hierarchy)

ENRICHING BIM-BASED CONSTRUCTION SCHEDULES WITH SEMANTICS USING BPMN AND LBD

Philipp Hagedorn

Computing in Engineering
Ruhr-Universität Bochum
Germany

Presented at the 14th European Conference on Product and Process Modelling, Trondheim, Norway