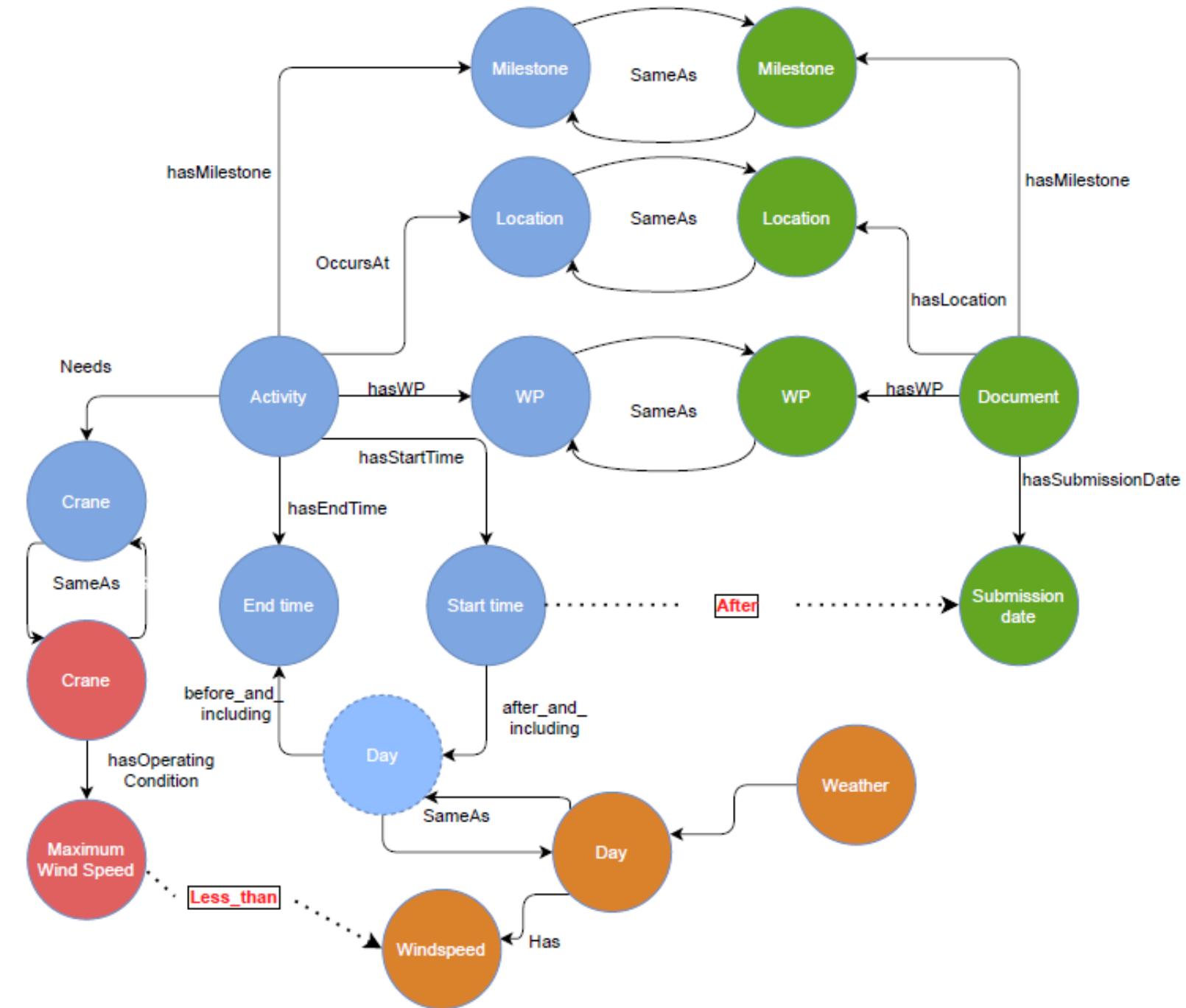


LBD and Construction Management

Dr Ranjith K Soman, TU Delft



Doctor of Philosophy

Centre for Systems Engineering and Innovation
Dept. of Civil and Environmental Engineering
Imperial College London
United Kingdom
The Alan Turing Institute, UK

Master of Science (By Research)

Building Technology and Construction Management
Dept. of Civil Engineering
Indian Institute of Technology Madras
India

Bachelor of Technology

Dept. of Civil Engineering
University of Calicut
India



Assistant Professor of Digital Construction

Section of Infrastructure Design and Management
Dept. of Materials, Mechanics, Management & Design (3MD)
Faculty of Civil Engineering and Geosciences
TU Delft

Post-doctoral Researcher

Centre for Systems Engineering and Innovation
Dept. of Civil and Environmental Engineering
Imperial College London
United Kingdom

Post-doctoral Researcher

*Chair of Innovative and Industrial
Construction*
Dept. of Civil, Environmental and
Geomatic Engineering
ETH Zürich
Switzerland



2013
-
2016

2017
-
2020

2020
-
2021

2021
-
2022

What are your back grounds?

Still in school

Feasibility and conceptual design

Architectural design

Structural design

Construction

Operation

Retire/reuse/disassembly

MEP Design

Computer science

Others

Got hands dirty working in the messy construction sector

Feasibility and conceptual design

Architectural design

Structural design

Construction

Operation

Retire/reuse/disassembly

MEP Design

Others

Computer science



models safety approvals budget
orders

risk construction schedules protocols cost

meeting bim videos management
communication visualizations material quality lists progress
estimates procedures timelines timelines photos

change procurement
reports minutes drawings plan
site control escalation specifications

plans

Level 1

Aircraft System

Aircraft Systems WBS
(MIL-HDBK-881)

Level 2

Air Vehicle	SE/ Program Mgmt	System T&E	Training	Data	Peculiar Support Equipment	Common Support Equipment	Op/Site Activation	Industrial Facilities	Initial Spares and Initial Repair Parts
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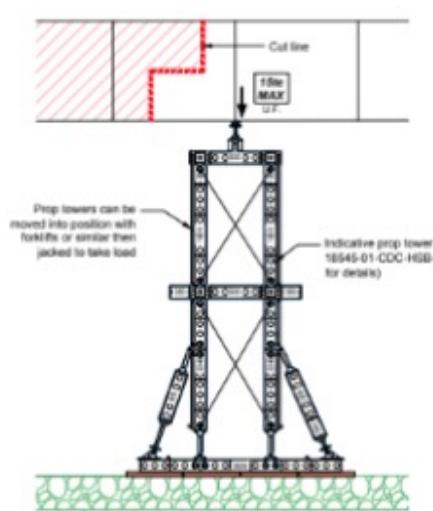
Airframe	DT&E	Equipment	Tech Pubs	Test and Measurem't	Test and Measurem't	Sys Assembly,	Construction/Conversion/Expansion		
Propulsion	OT&E	Services	Engrg Data	Support Data	Support and Handling Equipment	Installation and Checkout on Site	(Specify by Allowance List, Grouping or H/W Element)		
Application Software	Mockups	Facilities	Support Data	Support and Handling Equipment	Support and Handling Equipment	Contractor Tech Support	Equipment Acquisition or Mod		
System Software	T&E Support		Management Data	Management Data			Maintenance		
Com/Identification	Test								
Navigation/Guidance	Facilities		Data Depository						
Central Computer									
Fire Control									
Data Display and Controls									
Survivability									
Reconnaissance									
Automatic Flight Control									
Central Integrated Checkout									
Antisubmarine Warfare									
Armament									
Weapons Delivery									
Auxiliary Equipment									

Level 3

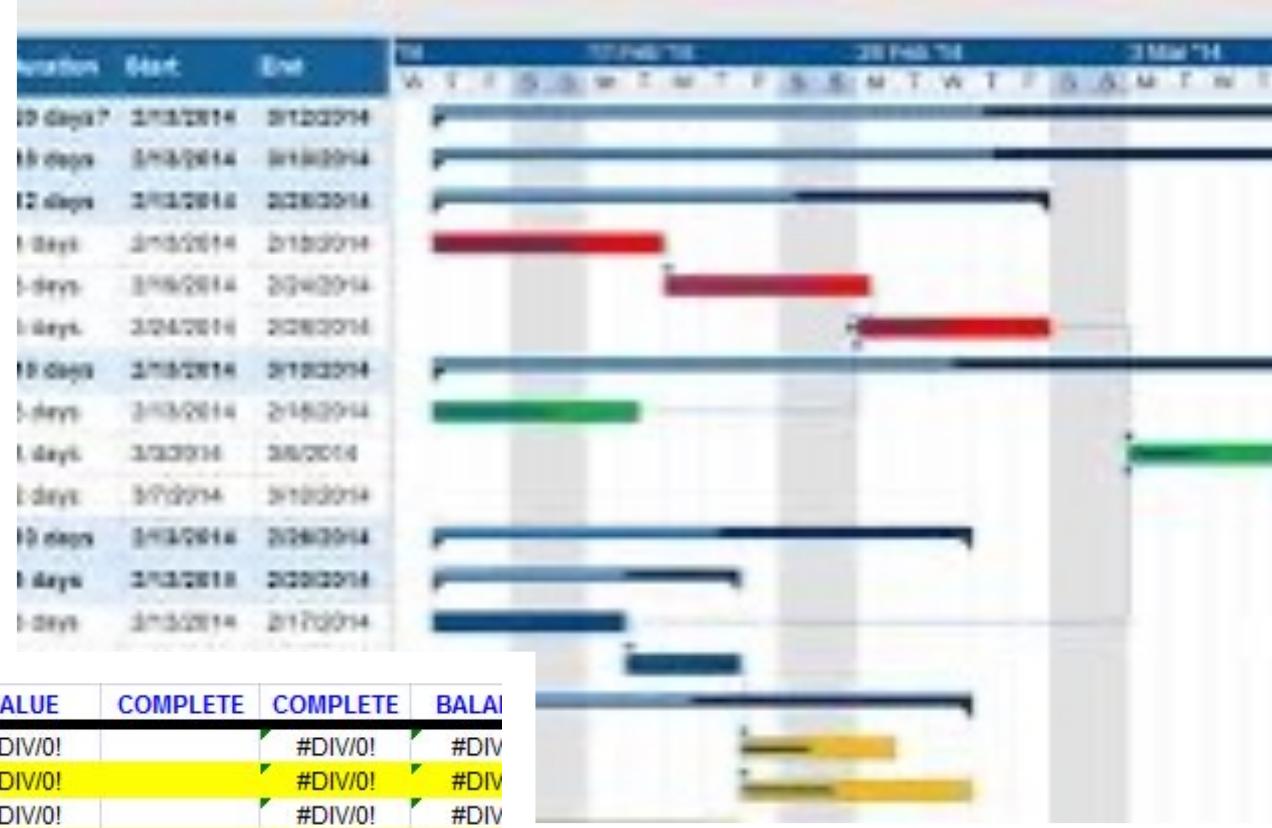
#	Div	Value	Complete	Complete	Balance
1	1	Testing	#DIV/0!	#DIV/0!	#DIV
2	2	Grading and Excavation	#DIV/0!	#DIV/0!	#DIV
3	2	Site Utilities	#DIV/0!	#DIV/0!	#DIV
4	2	Paving Walks and Signs	#DIV/0!	#DIV/0!	#DIV
5	2	Unusual Site Conditions	#DIV/0!	#DIV/0!	#DIV
6	2	Lawns and Planting	#DIV/0!	#DIV/0!	#DIV
7	2	Other Site Work	#DIV/0!	#DIV/0!	#DIV
8	2	Demolition	#DIV/0!	#DIV/0!	#DIV
9	2	Environmental	#DIV/0!	#DIV/0!	#DIV
10	3	Concrete	#DIV/0!	#DIV/0!	#DIV
11	4	Masonry	#DIV/0!	#DIV/0!	#DIV
12	5	Metals	#DIV/0!	#DIV/0!	#DIV
13	6	Rough Carpentry	#DIV/0!	#DIV/0!	#DIV
14	6	Finish Carpentry	#DIV/0!	#DIV/0!	#DIV
15	7	Moister Protection	#DIV/0!	#DIV/0!	#DIV
16	7	Insulation	#DIV/0!	#DIV/0!	#DIV
17	7	Roofing	#DIV/0!	#DIV/0!	#DIV
18	7	Sheet Metal	#DIV/0!	#DIV/0!	#DIV
19	7	Siding	#DIV/0!	#DIV/0!	#DIV
20	8	Doors & Hardware	#DIV/0!	#DIV/0!	#DIV
21	8	Windows & Glazing	#DIV/0!	#DIV/0!	#DIV



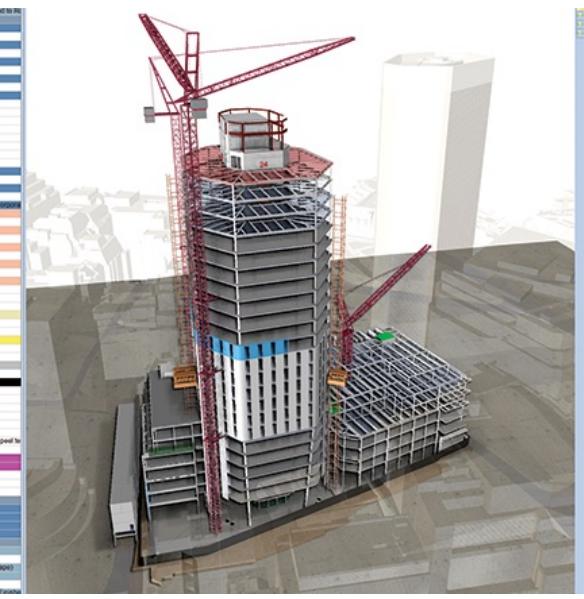
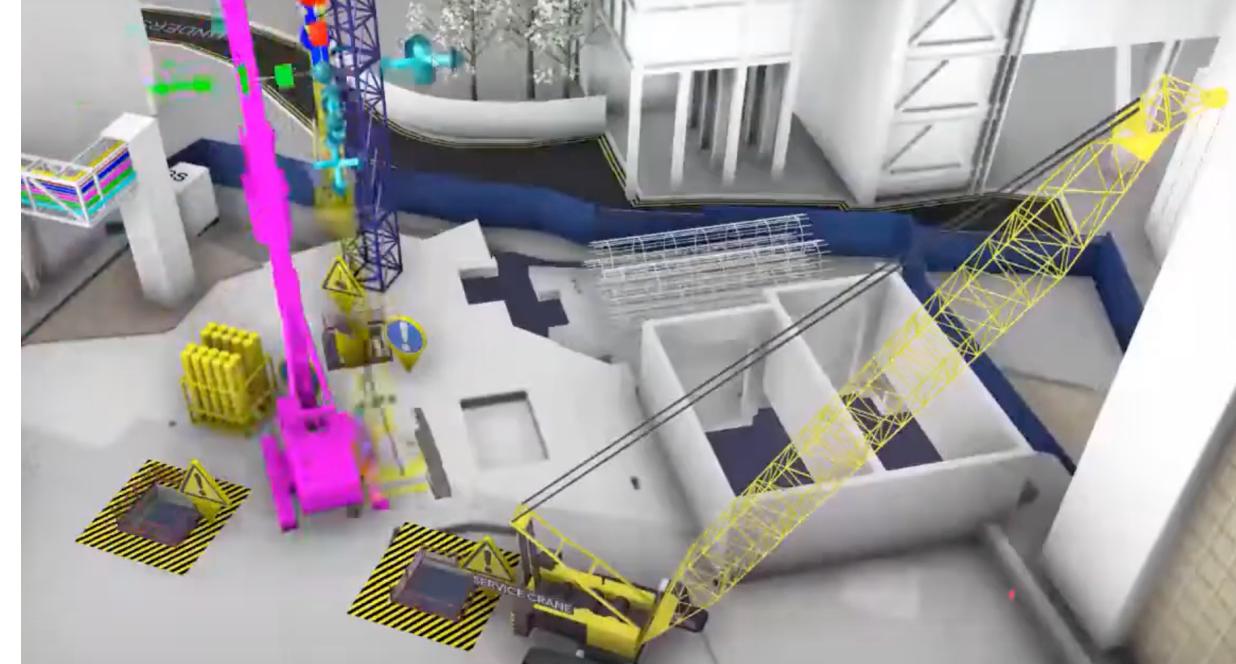
SECTION A-A 1:500



SECTION B-B 1:75



Sr. No.	Item Description	No.	Length (m)	Width/Breadth (m)	Height/Depth (m)	Quantity
1	Earthwork in Excavation in Foundation:					
	Footing (1m x 1m)	12	1.50	1.50	1.50	40.50 cu m
	Depth From GL = 1.5 m					
2	P.P.C. in Foundation					
	Footing (1m x 1m)	12	1.3	1.3	0.1	2.03 cu m
	Thickness = 0.10					
3	Column(300mm x 300mm)					
	Base(1m x 1m)	12	1.00	1.00	0.15	1.80 cu m
	Thickness = 0.15					
	Stem(0.30 x 0.30)					
	height = 1.25+0.55 = 1.80 m	12	0.30	0.30	1.80	1.94 cu m
	Total					3.74 cu m
4	Plinth Beam					
	Beam (300 mm x 300 mm)					
	Beam - 1 (3m length)	4	3.00	0.30	0.30	1.08 cu m
	Beam - 2 (4m length)	7	4.00	0.30	0.30	2.52 cu m



L04 to L06 Phase 24

Harrow Road
W.² 570

Gate 4

03:00 - 03:30
 03:30 - 03:45
 03:45 - 08:00
 08:00 - 08:45
 08:45 - 09:45
 09:45 - 10:00
 10:00 - 10:30
 10:30 - 10:45
 10:45 - 11:15
 11:15 - 11:30
 11:30 - 14:00
 13:00 - 14:00
 14:00 - 14:30

Note 2

~~16:00-18:30
11:00-12:00
14:00-15:00~~

Grade 3

09:00 - 09:30
12:00 - 12:30
13:00 - 13:30
14:00 - 14:30

Tanner Lane

22139-44180

14:00 - 15:30



Do you think
we need
linked data in
construction?
If so why?



3 applications of semantic web technologies in Construction Management

Construction activities are **fragmented**
into many packages which are hard to
manage.

Project stakeholders focus on their individual tasks and data and ignore interdependencies of the tasks and data with other stakeholders resulting in higher emissions, delays, cost overruns and rework.

What was planned!

Week 1	Excavation Zone A	Subcontractor 1
Week 2	Assembly Zone A	Subcontractor 2
Week 2	Piling Zone B	Subcontractor 3



Access road



What actually happened!

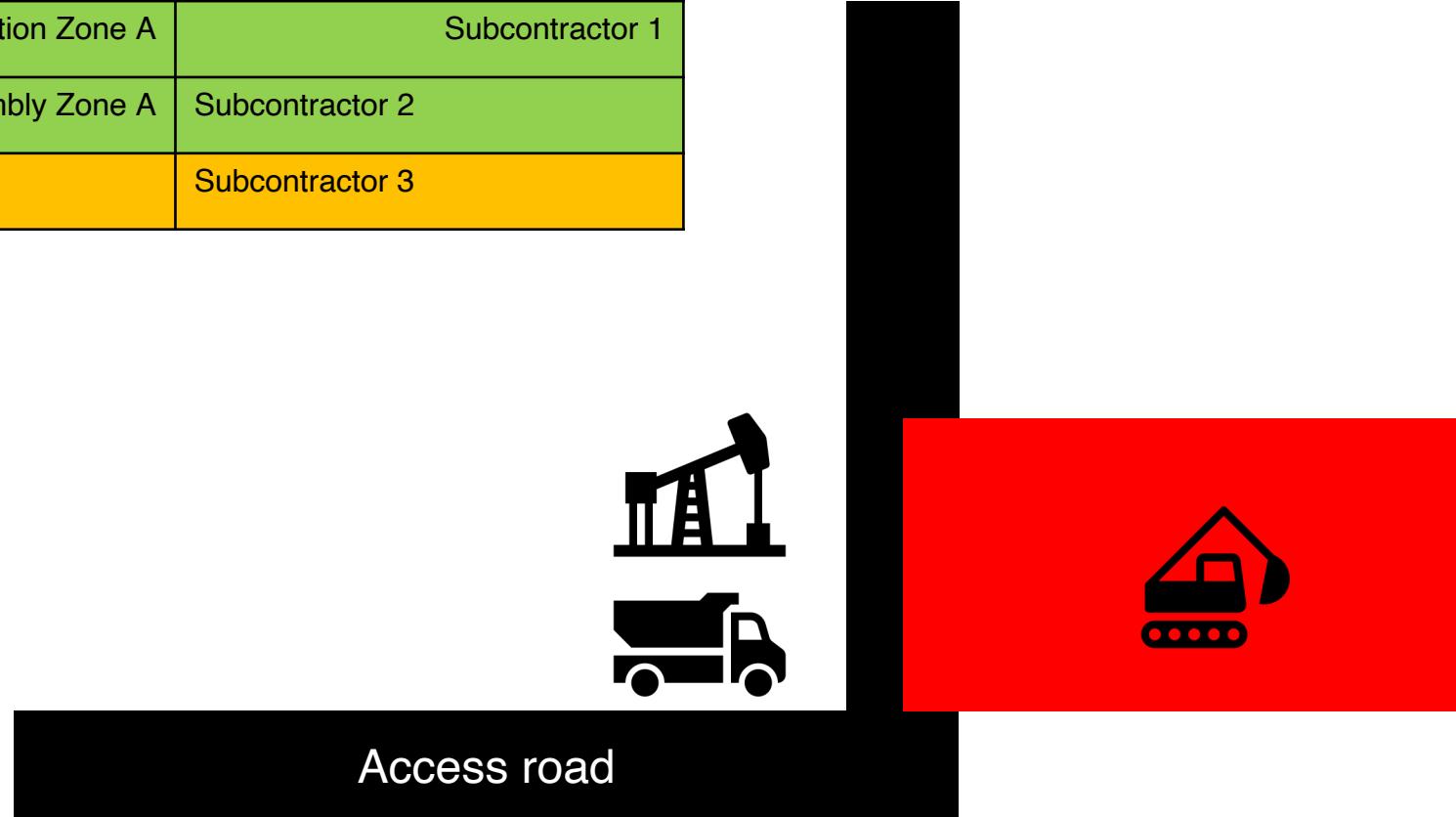
Week 1	Excavation Zone A	Subcontractor 1
Week 2	Assembly Zone A	Subcontractor 2
Week 2	Piling Zone B	Subcontractor 3

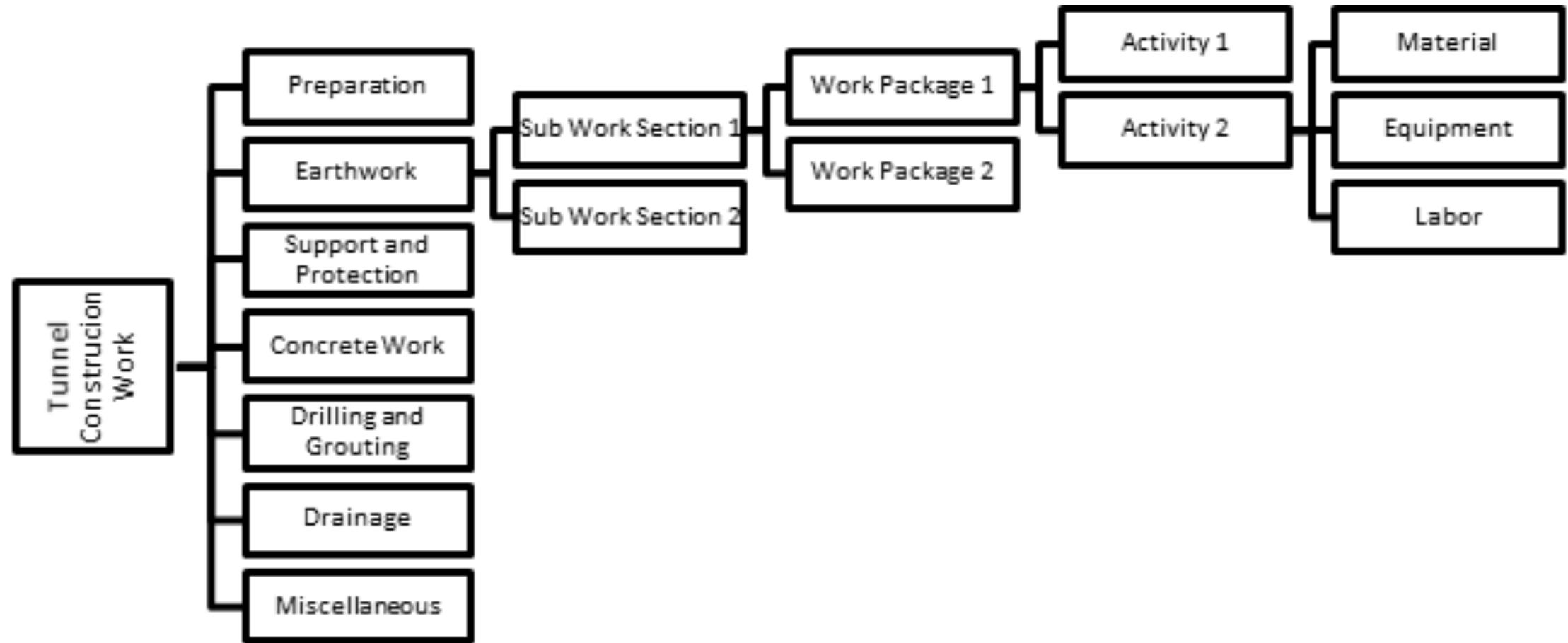


Access road



Week 1	Excavation Zone A	Subcontractor 1
Week 2	Assembly Zone A	Subcontractor 2
Week 3	Piling Zone B	Subcontractor 3





1. Can we use Semantic Web
Technologies to integrate Information
in fragmented construction?

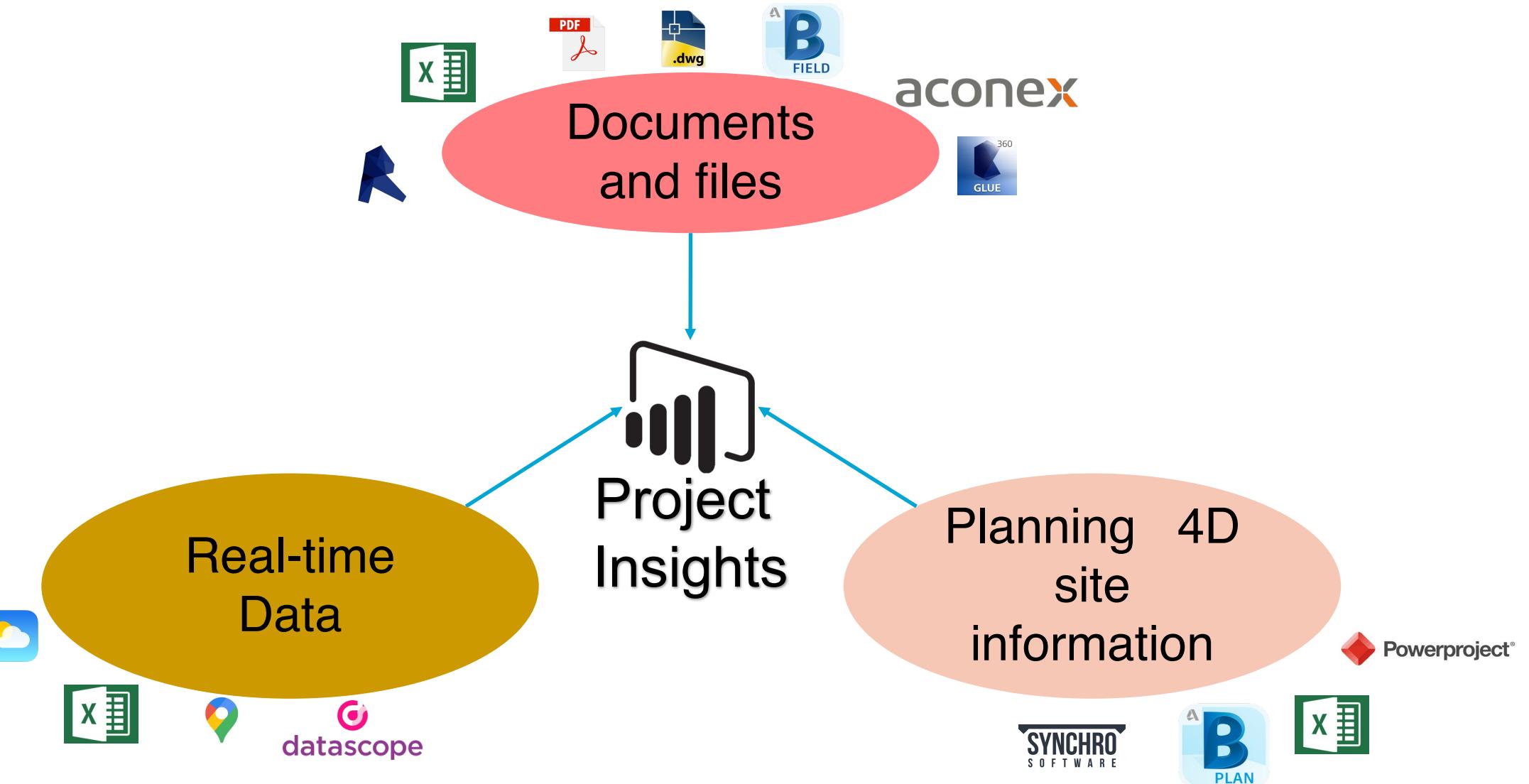
What is the problem that we are facing?

material want to integrate

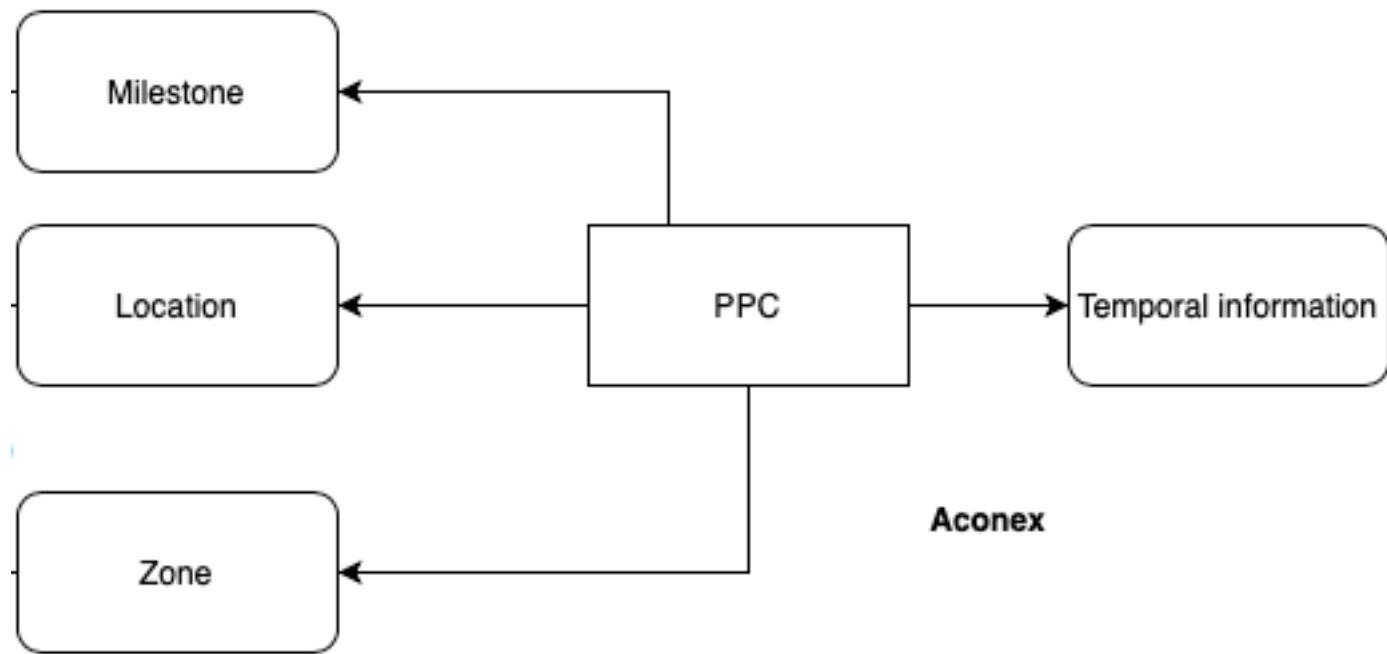


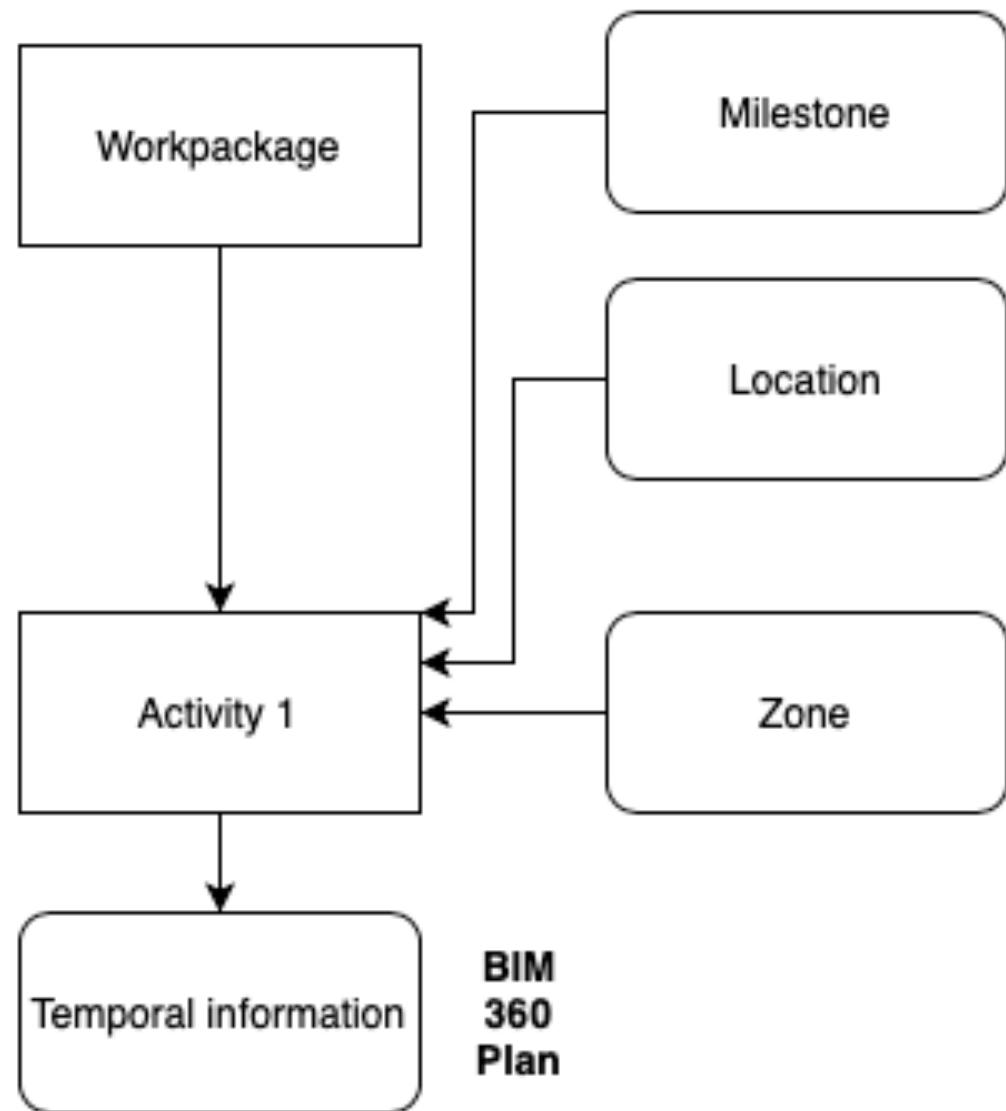
informational want to fragment

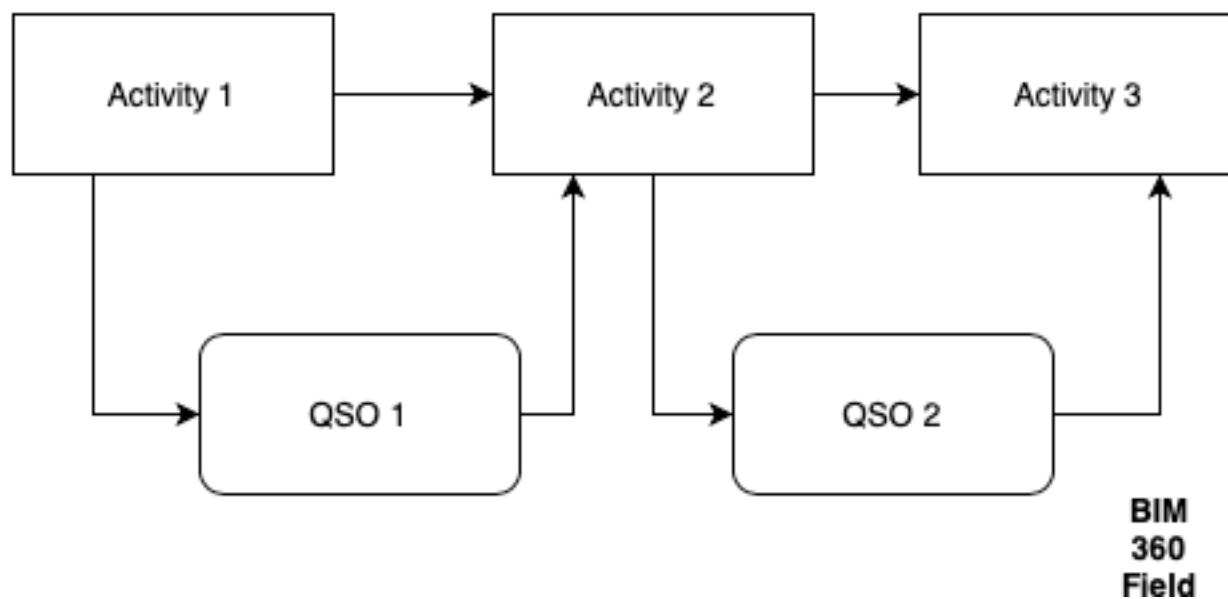




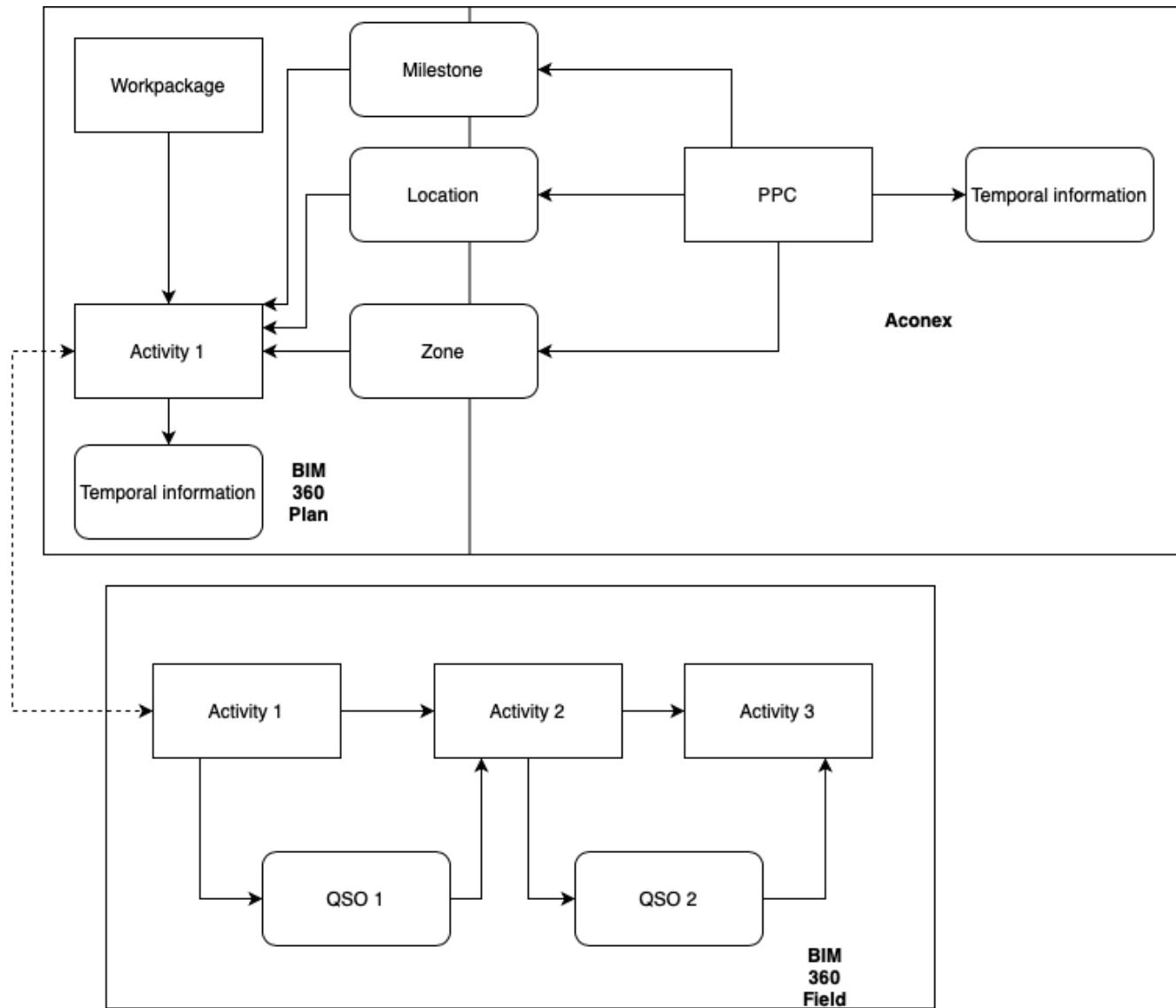
Data Source	Count	Total Number
Internal meeting	25	50 hrs
Interviews with stakeholders from the demonstrator projects	8	12 hrs
Look ahead meetings in site	9	9 hrs
Bi-weekly meeting with the demonstrator representatives	20	20 hrs
Accessing utilised platforms/software in the demonstrator projects	7	-
Workshops on site	3	9 hrs



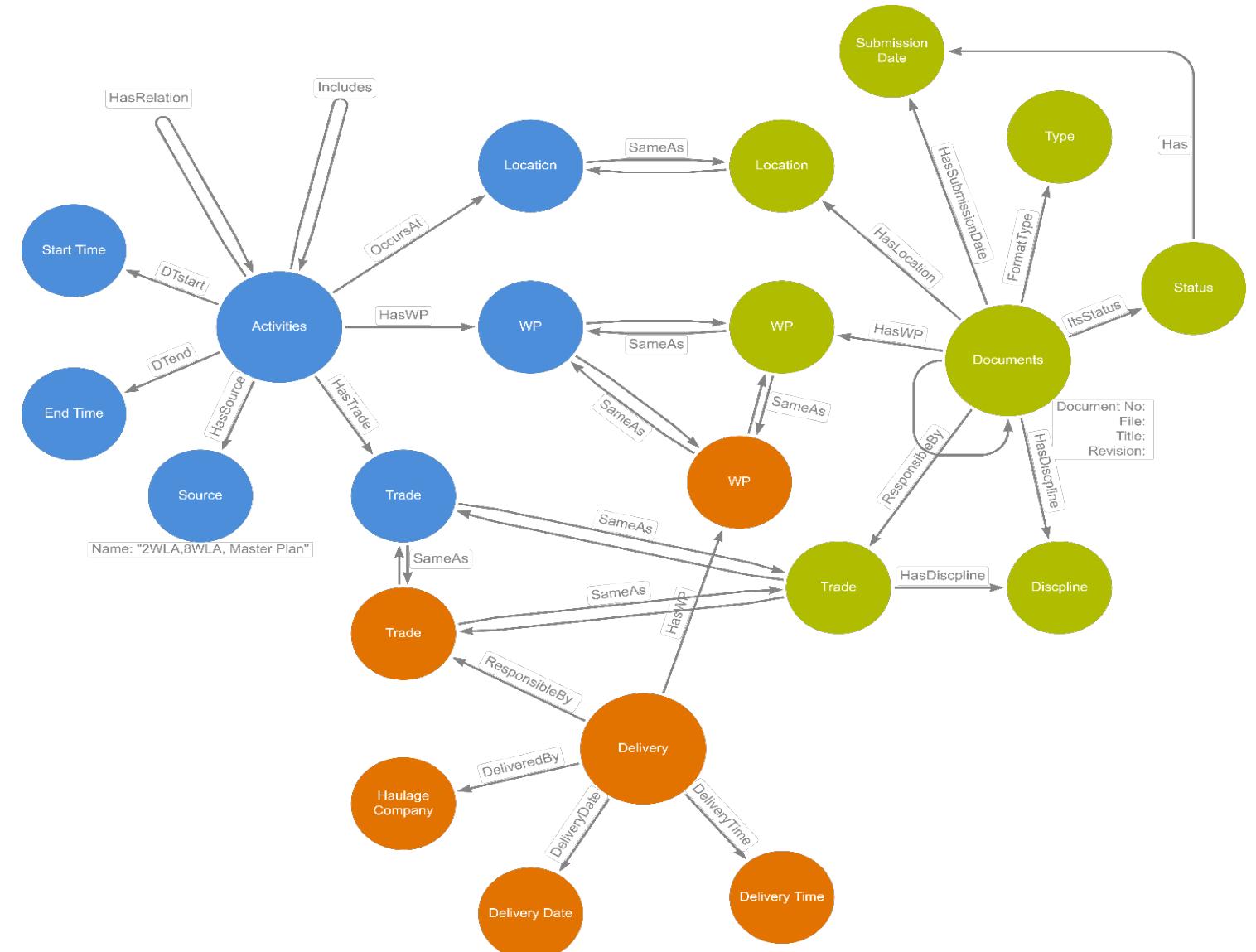


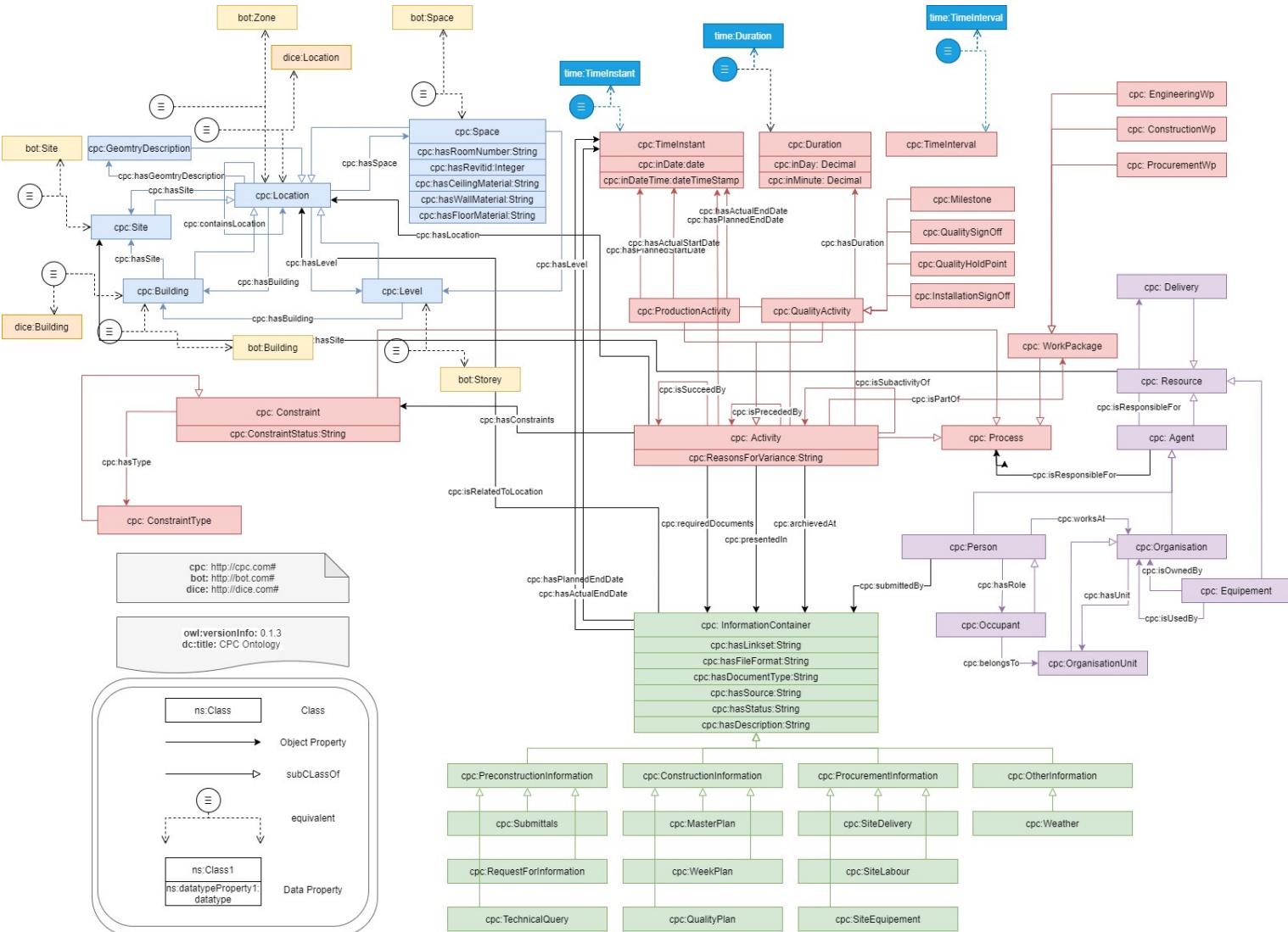


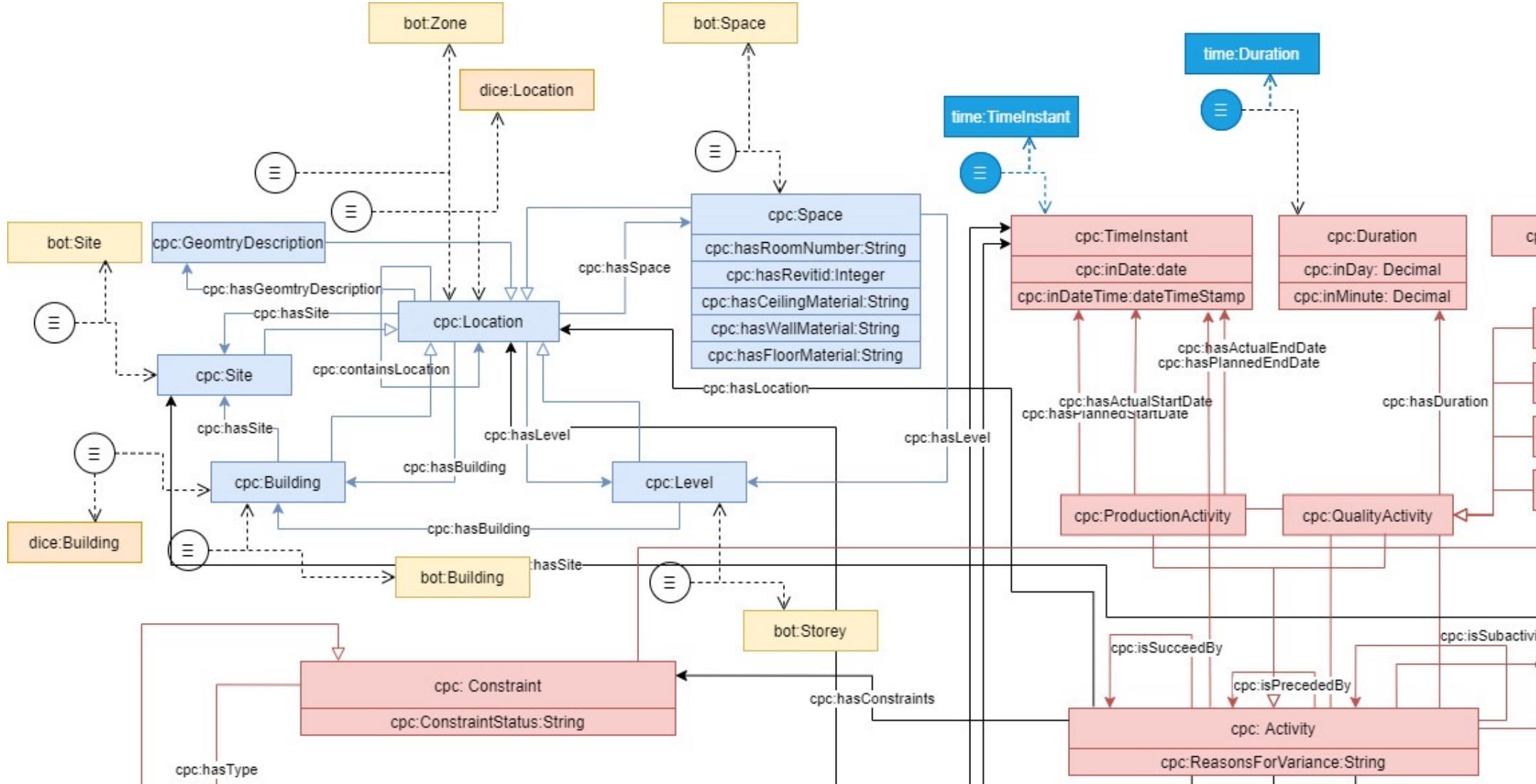
**BIM
360
Field**

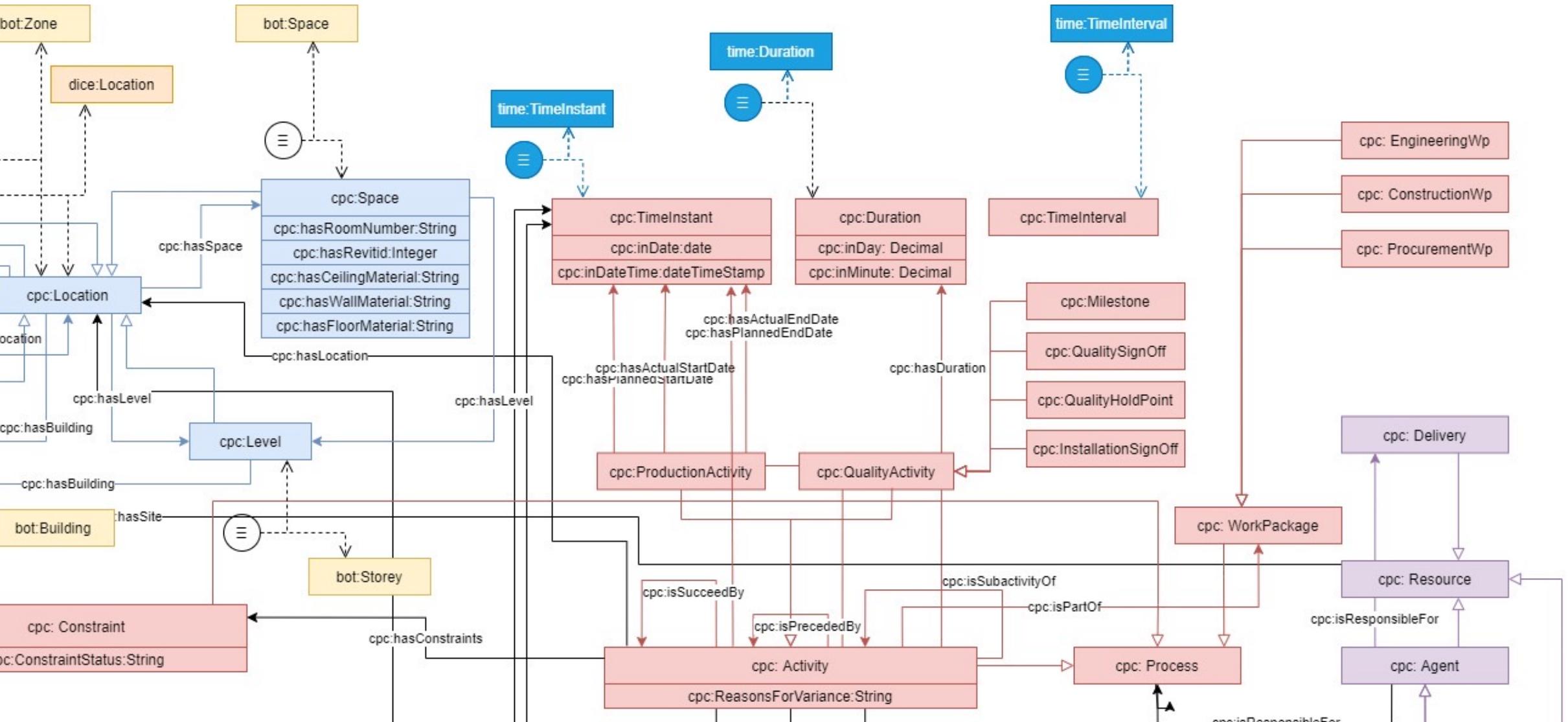


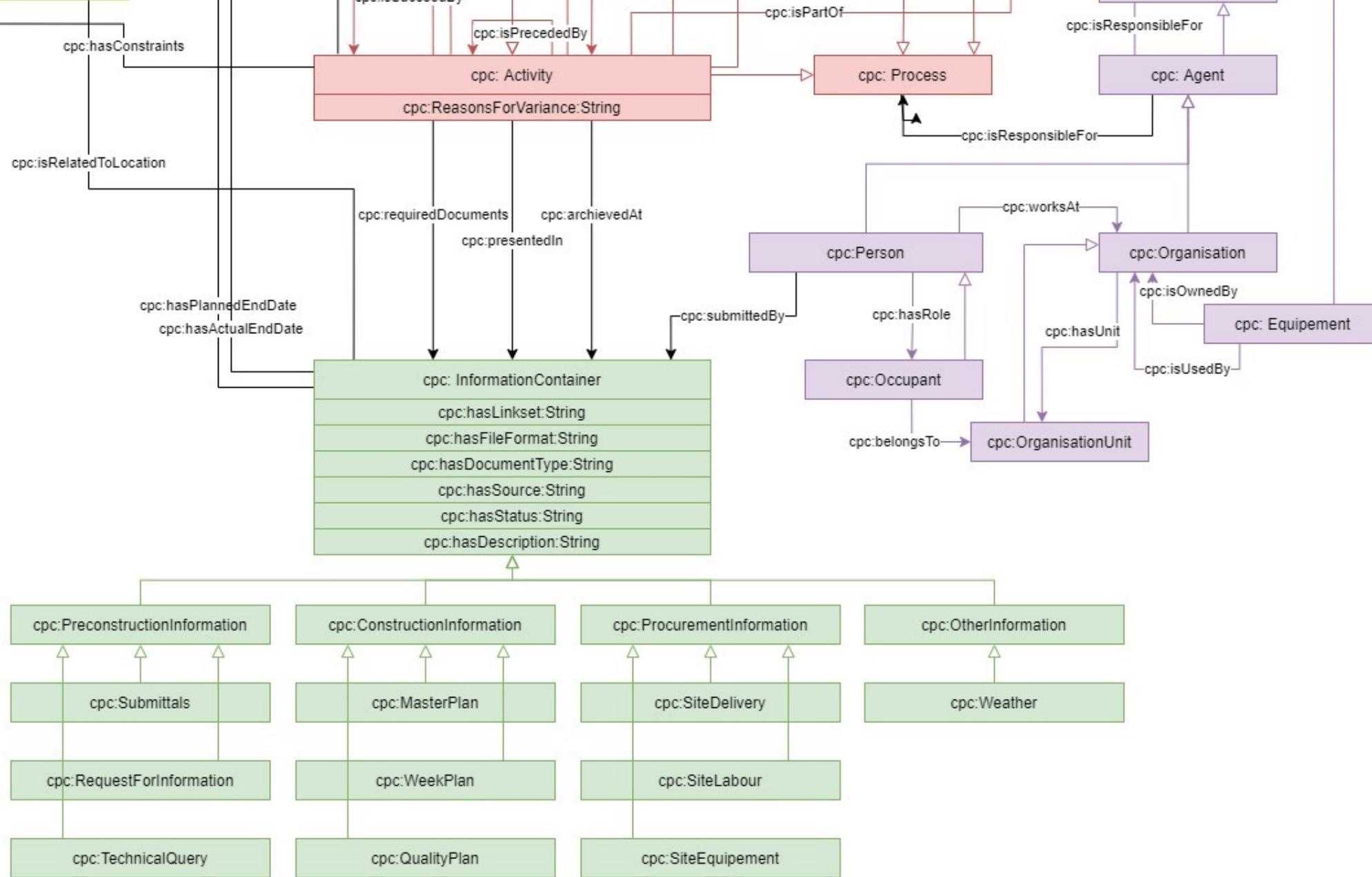
Finding the intersections in the data...

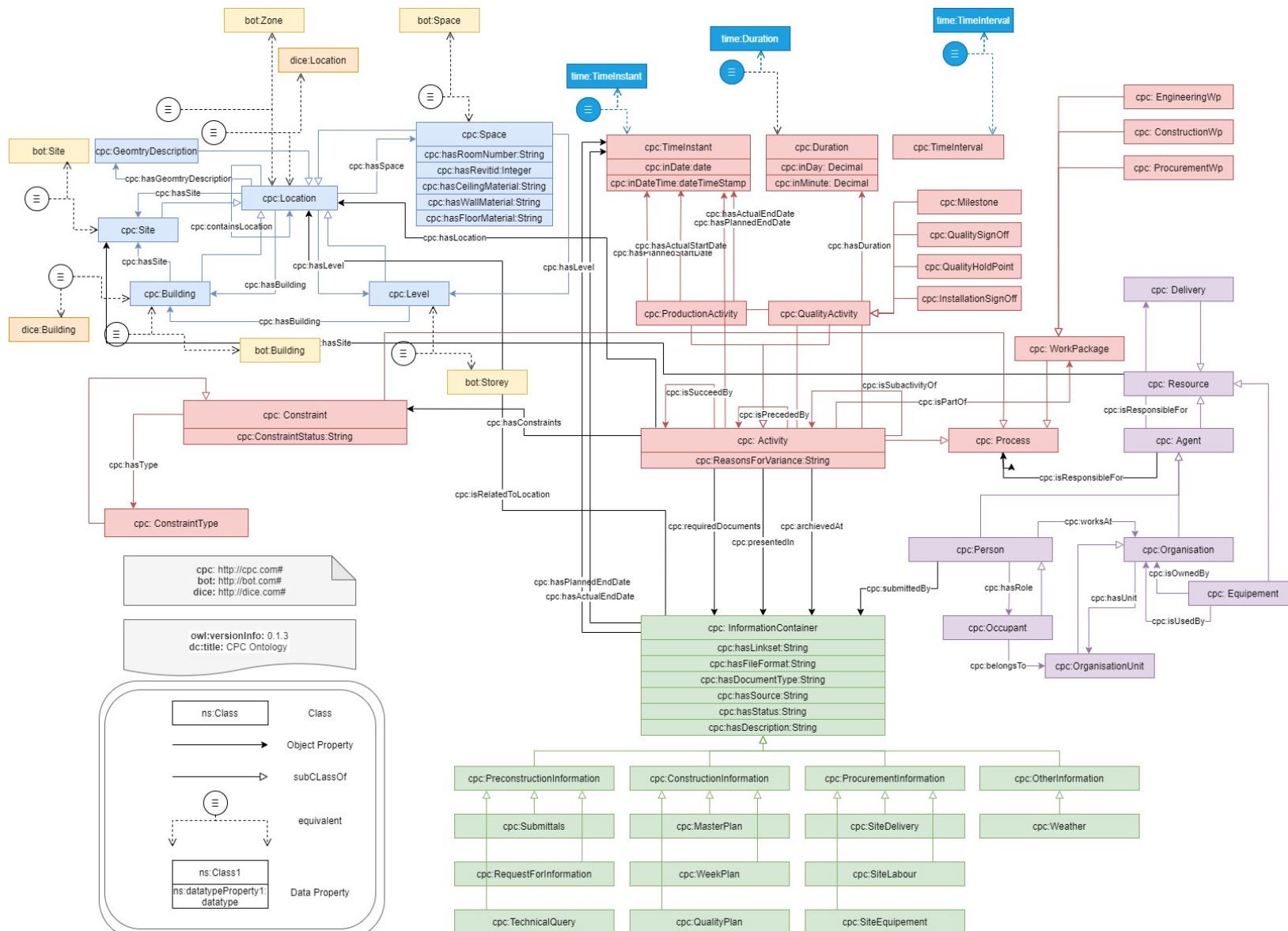




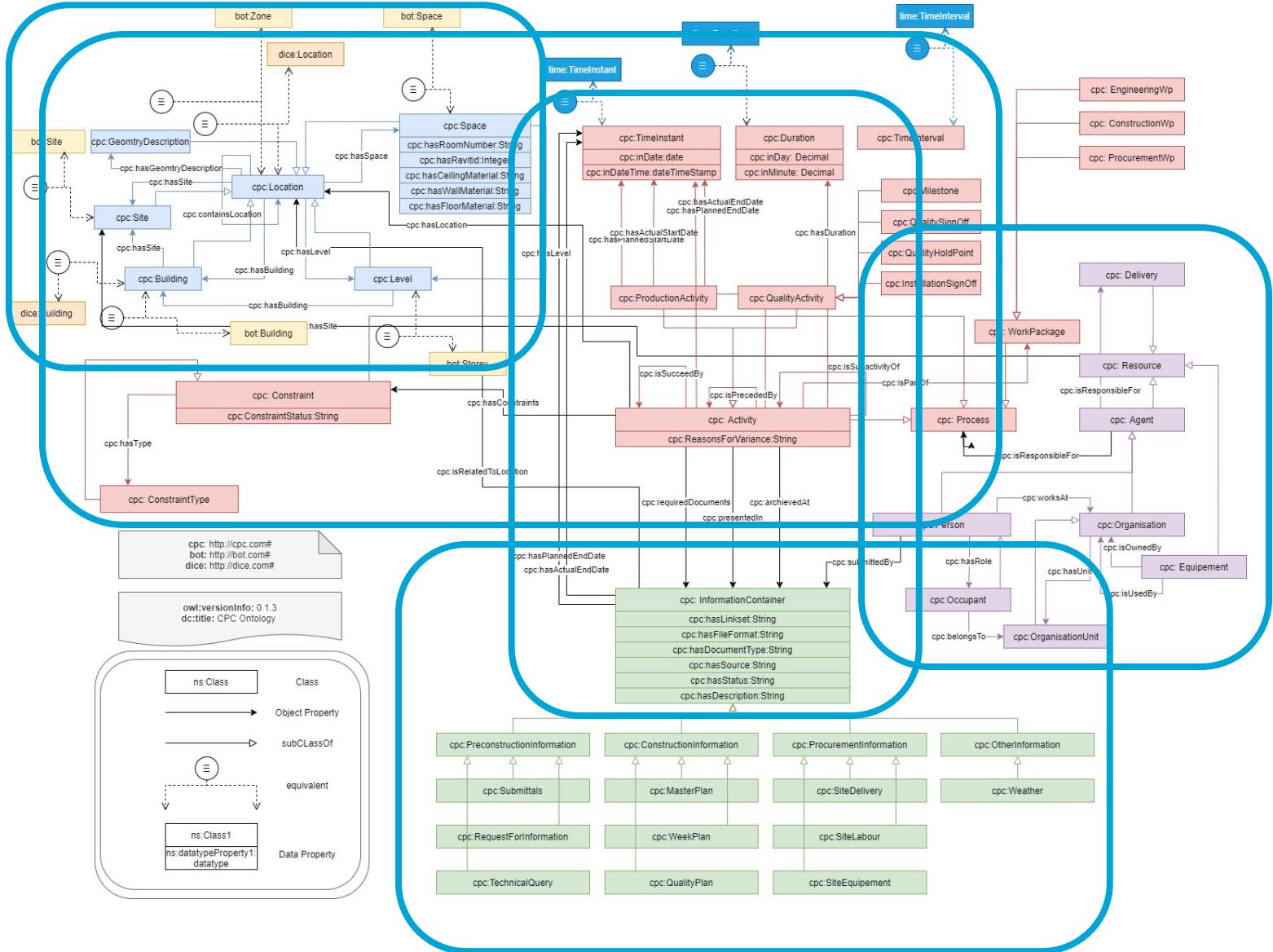






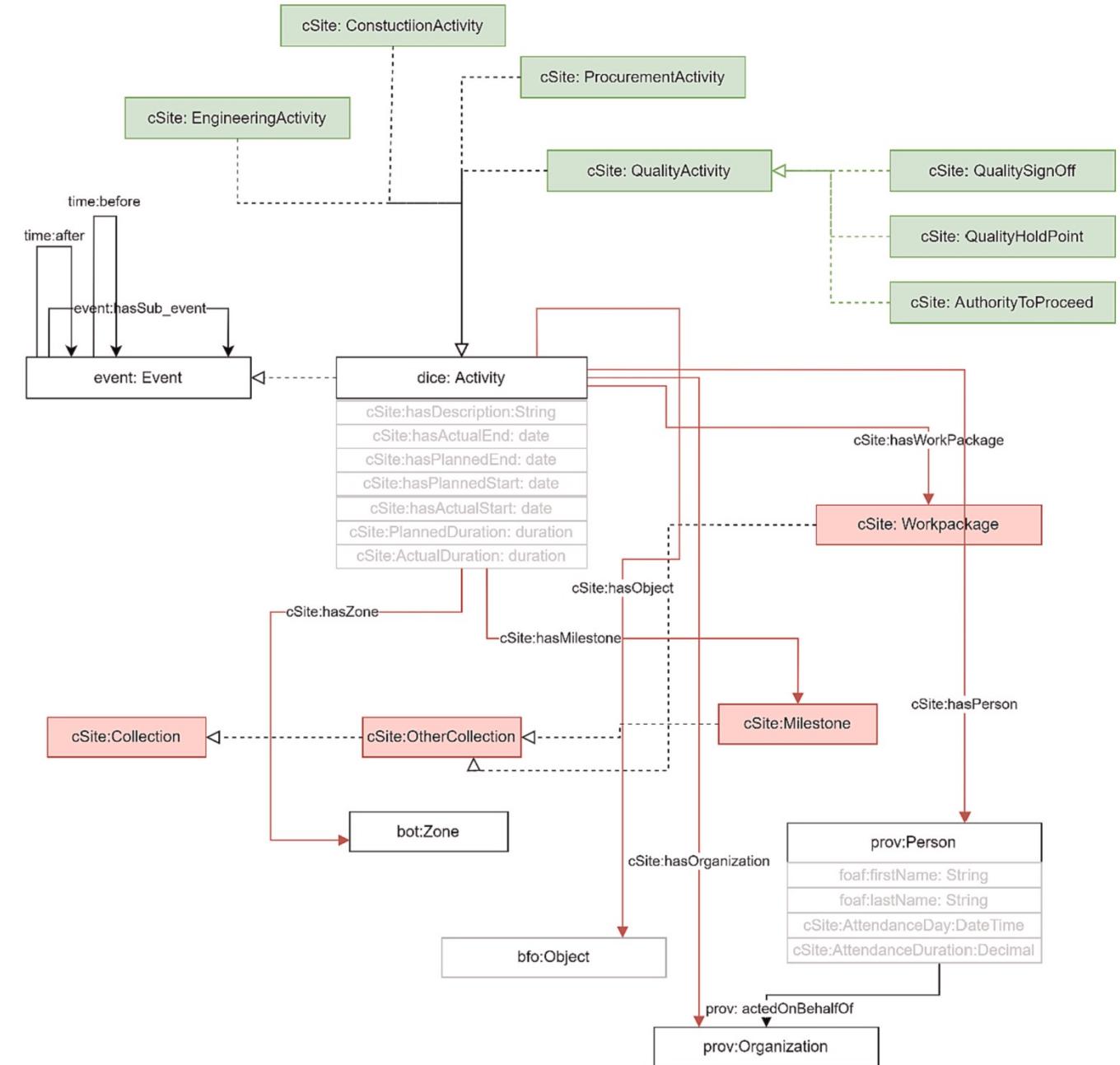


- o BOT
- o DIC
- o Brick
- o IfcOWL
- o ICDD
- o DCAT
- o Event
- o Time
- o Foaf
- o Prov



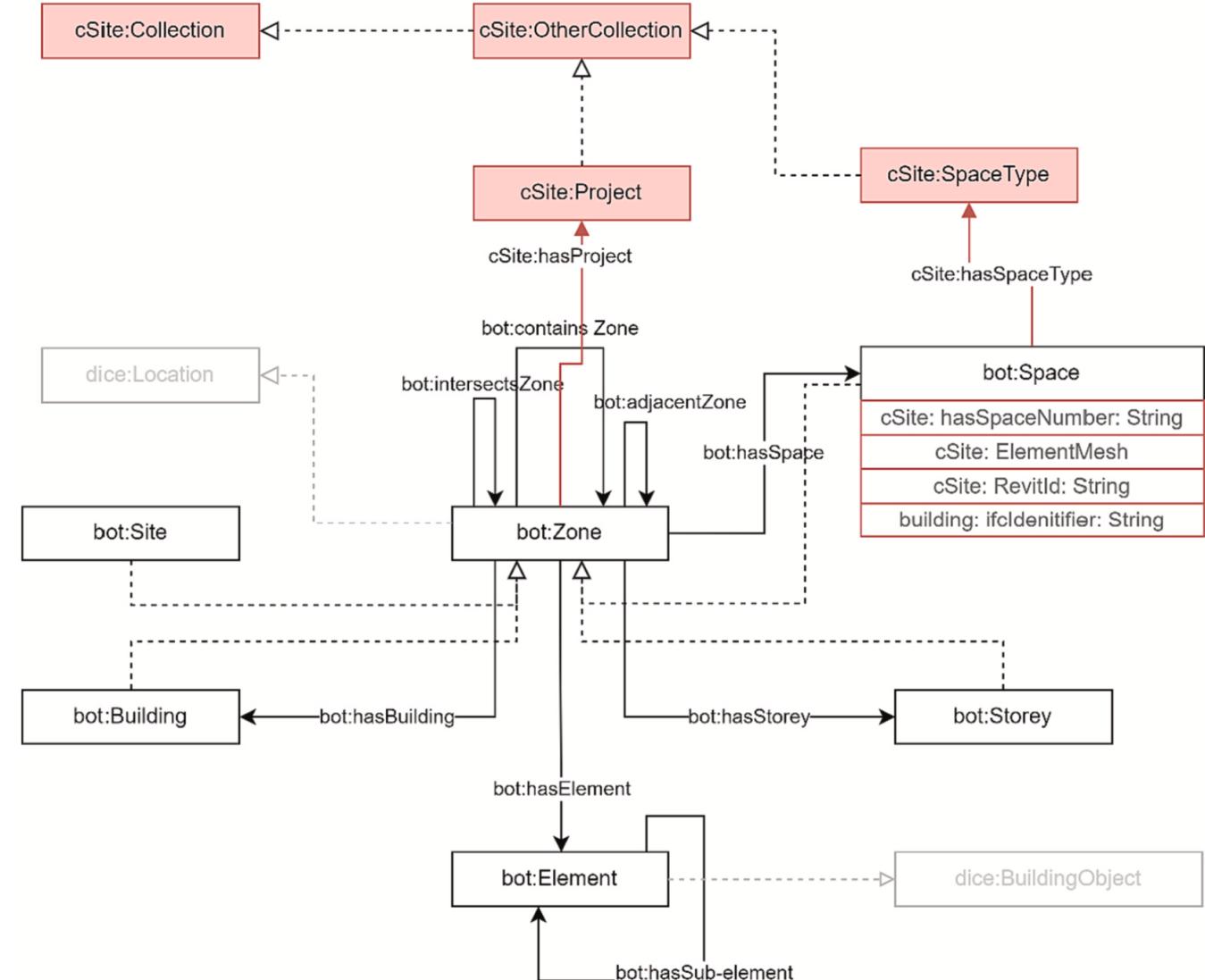


Process concepts and relationships



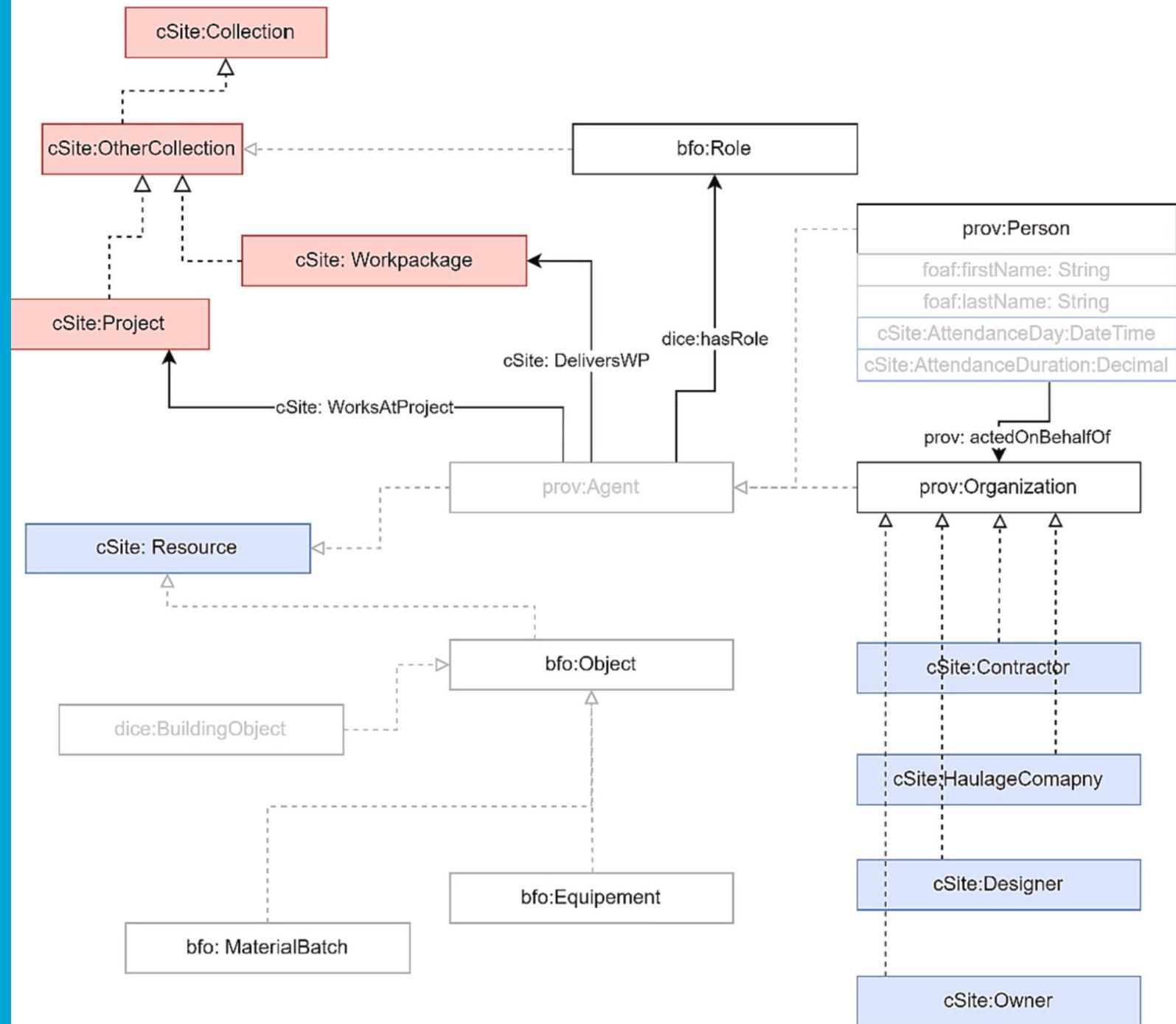


Location concept and properties



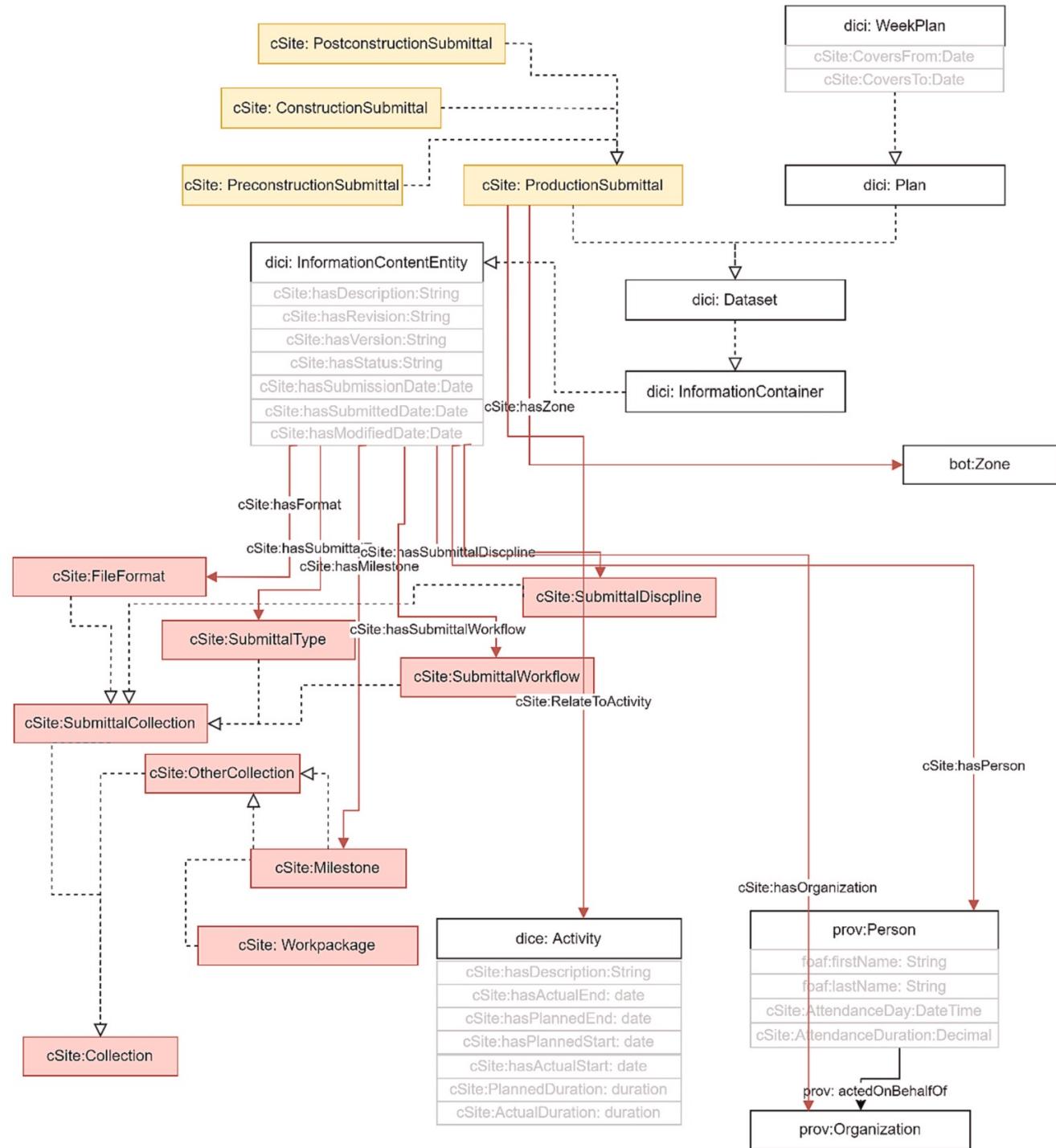


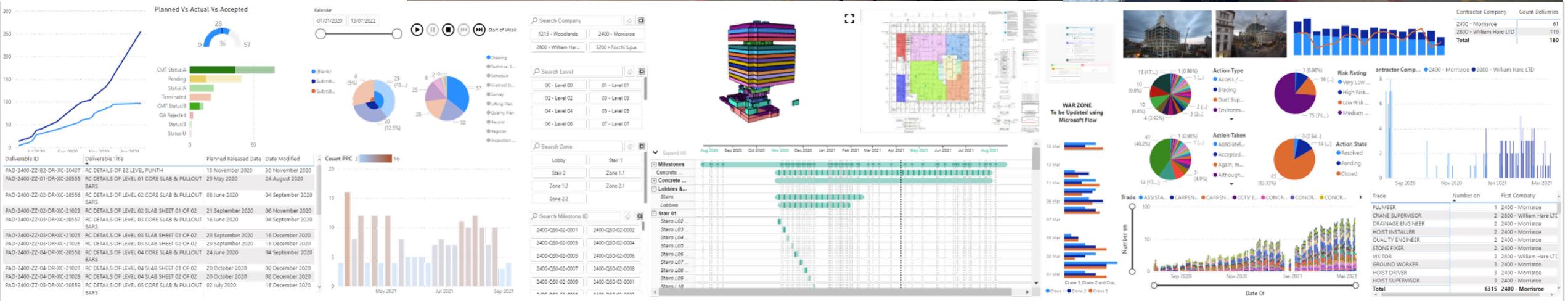
Resource concept and relationships





Document concept and relationships





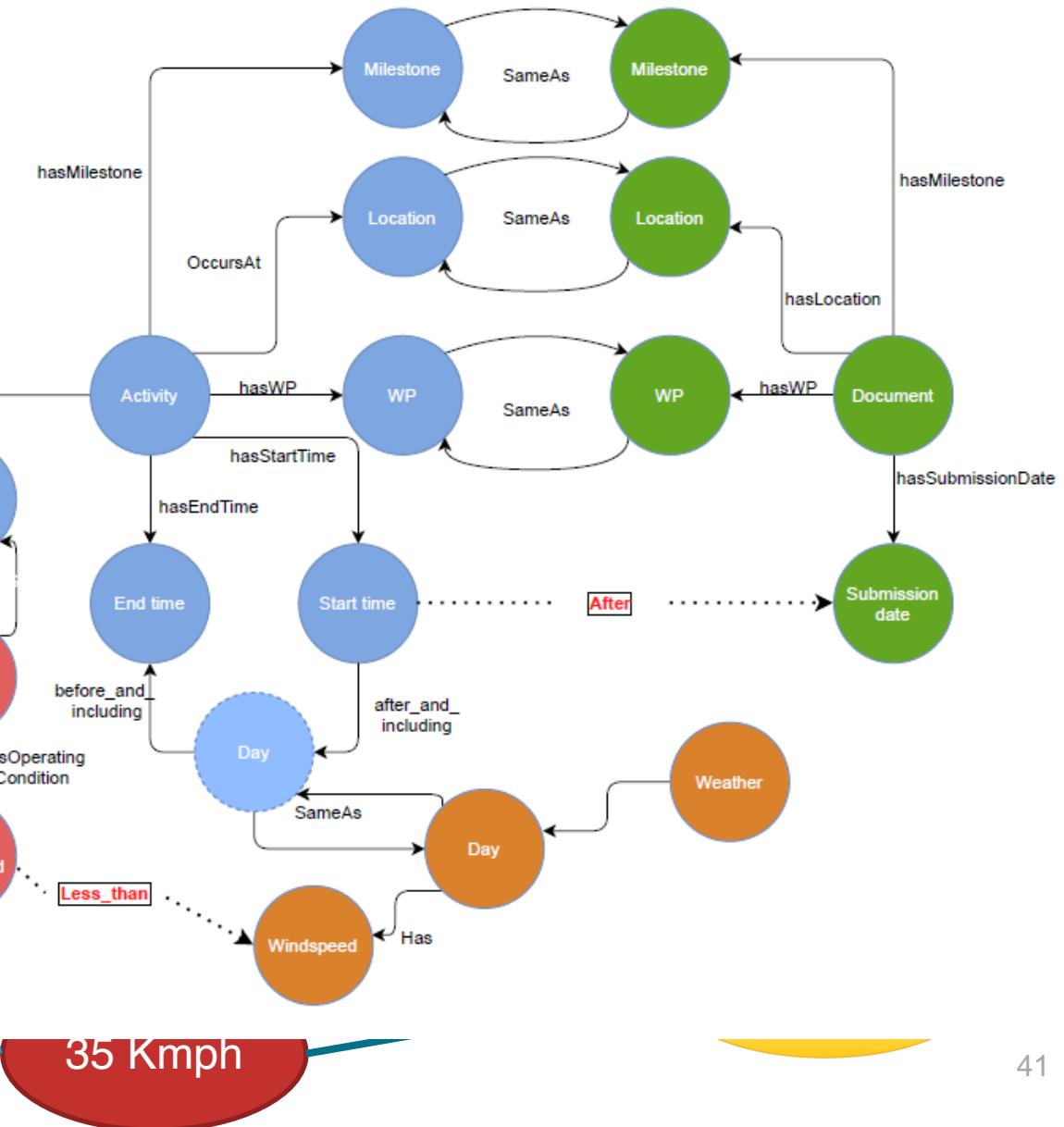
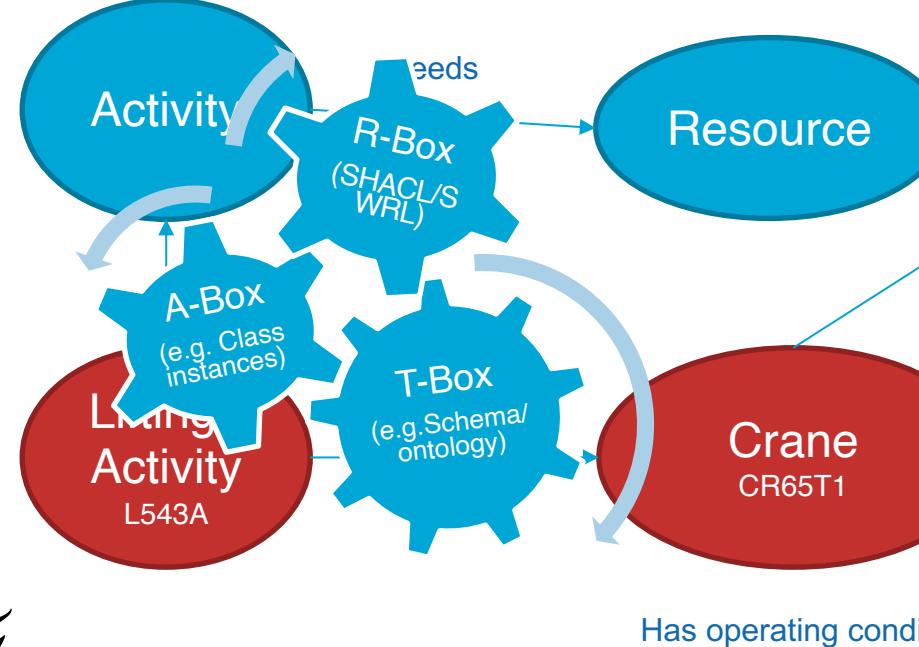
2. Can we add intelligence to the construction information using semantic web technologies?

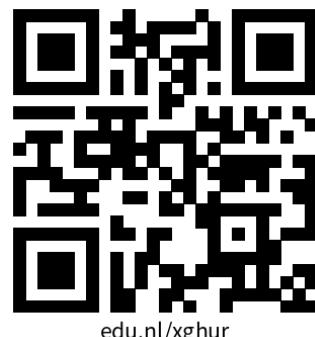
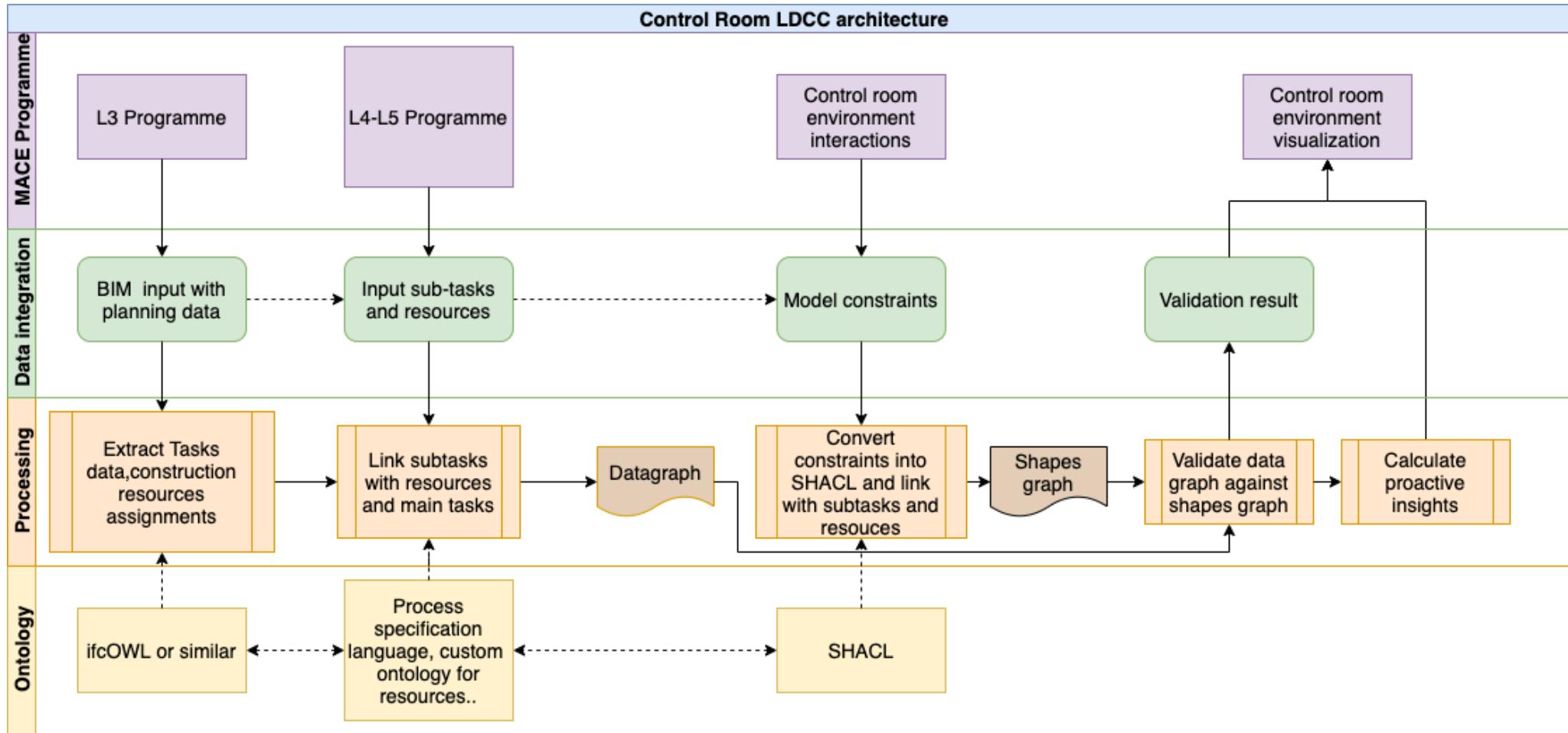
T-Box, A-Box and R-Box

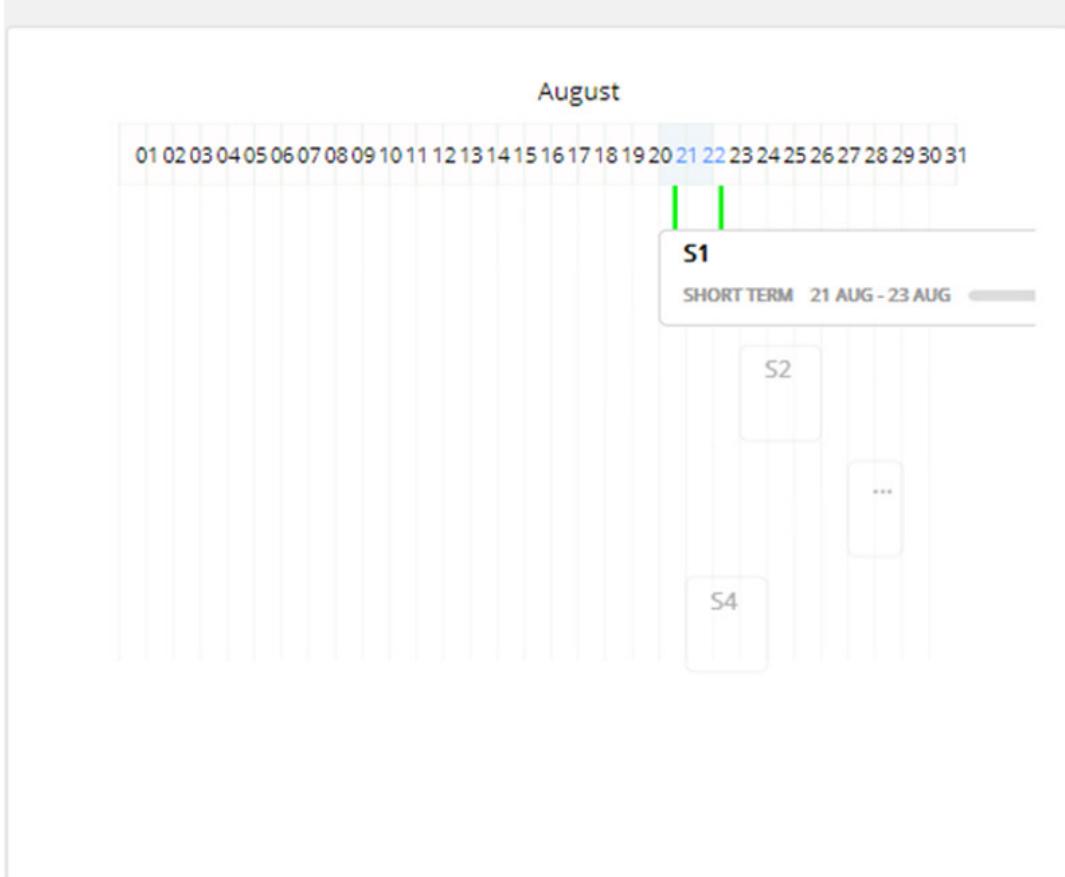
Terminology Box (T-Box)

Assertions Box (A-box)

Relation-Box (R-box)







Task Details

id: 1 Name: S1

Sub-Activities

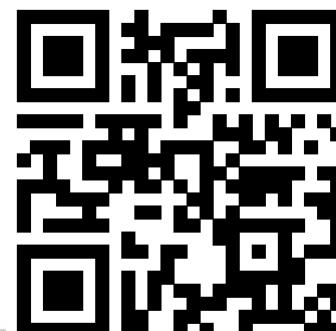
validation success

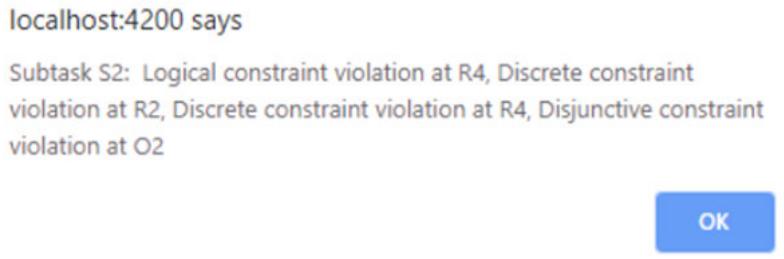
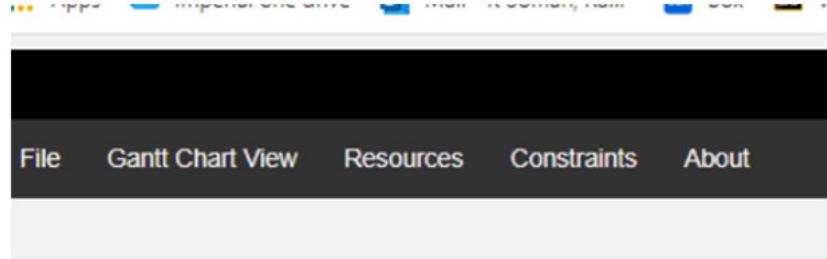
Resource Details

ID	Type	Property	Value	Server
R1	Truck	5000	localhost:5200	
R3	Towercrane	5000	localhost:7200	
O1	Module	4500	localhost:6200	

Constraint Details

ID	Type
C1	Precedence
C2	Disjunctive
C3	Discrete
C4	Logical





Task Details

id:S 2 Name: Lift Zone 2
Sub-Activities [Refresh](#)
[Validate Task](#) Not validated

Resource Details

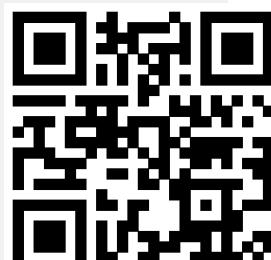
ID	Type	Property Value	Server
R2	Truck	5000	localhost:5200
R4	Towercrane	3000	localhost:7200
O2	Module	4500	localhost:6200

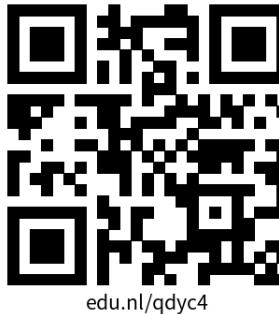
[Add resource](#)

Constraint Details

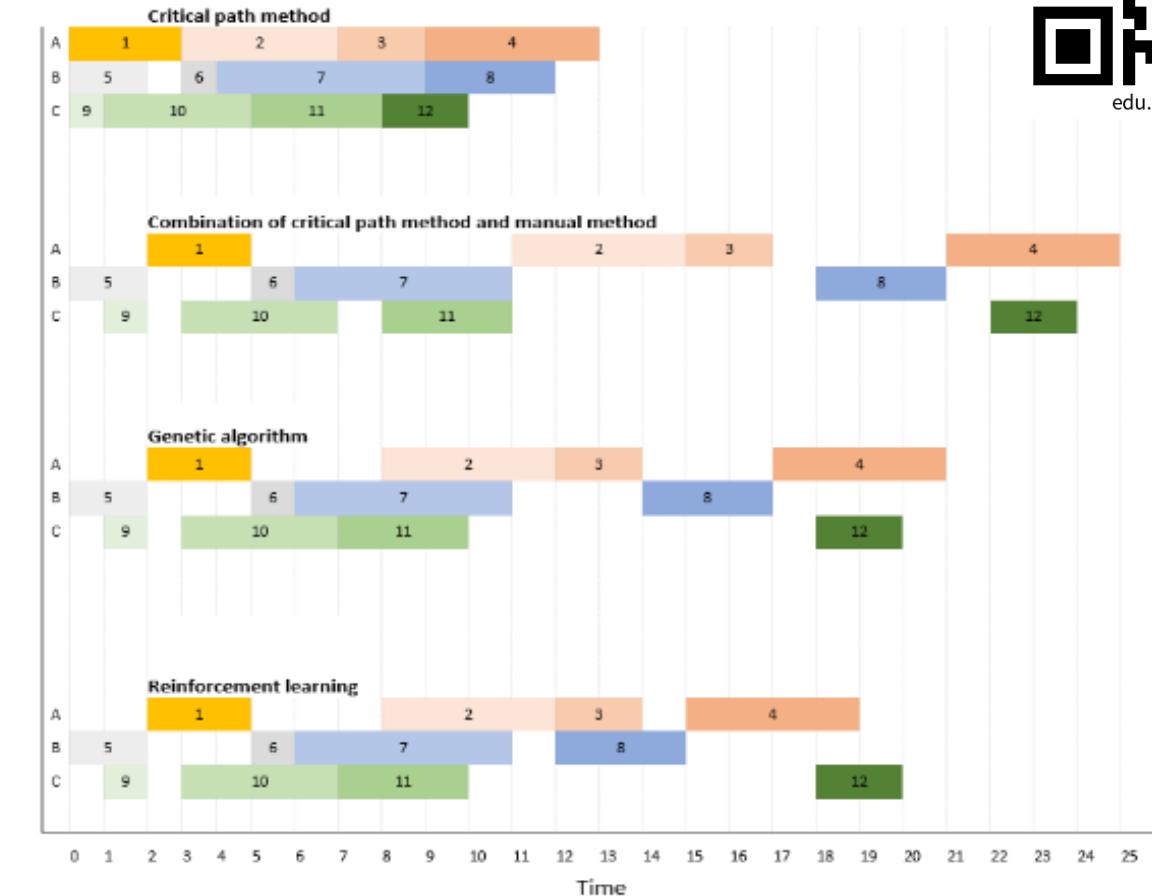
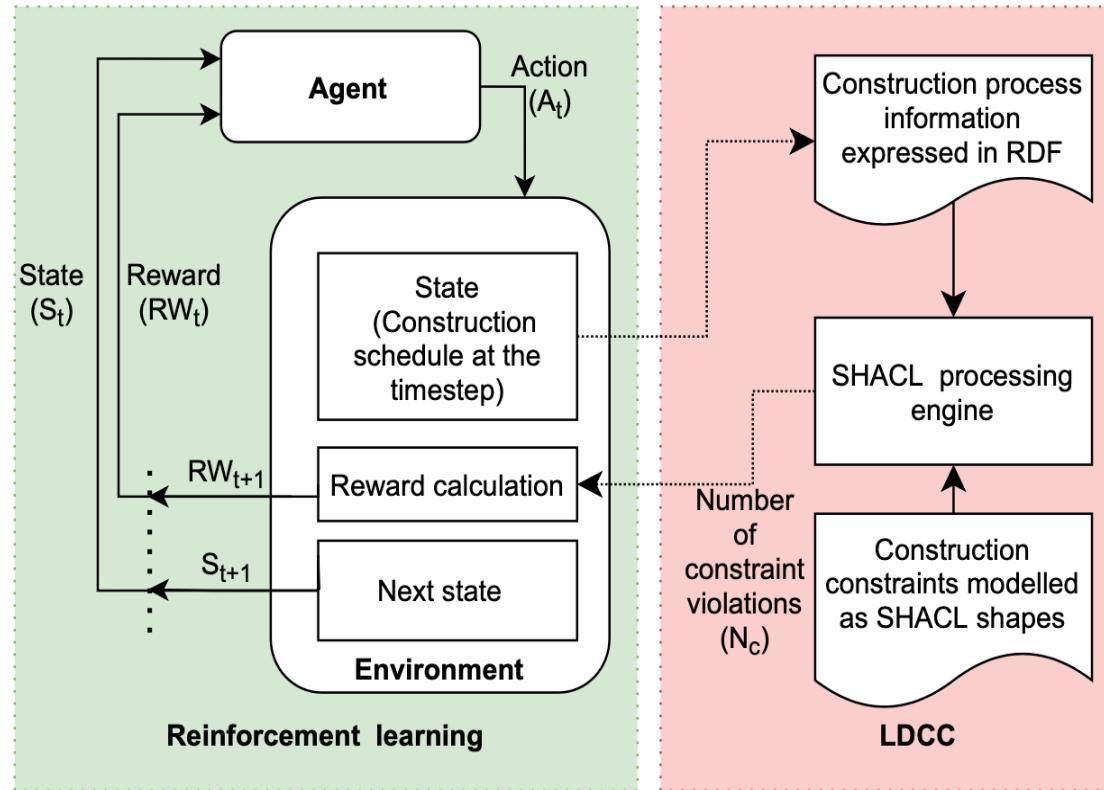
ID	Type
C4	Logical
C1	Precedence
C2	Disjunctive
C3	Discrete

[Add constraint](#)





Look ahead schedule generation



	Project duration	Time taken	Number of constraint violations
Critical path method	13	2 seconds	6
Critical path method + Manual method	25	~15 minutes	0
GA	22	15 seconds	0
RL	20	2 seconds	0

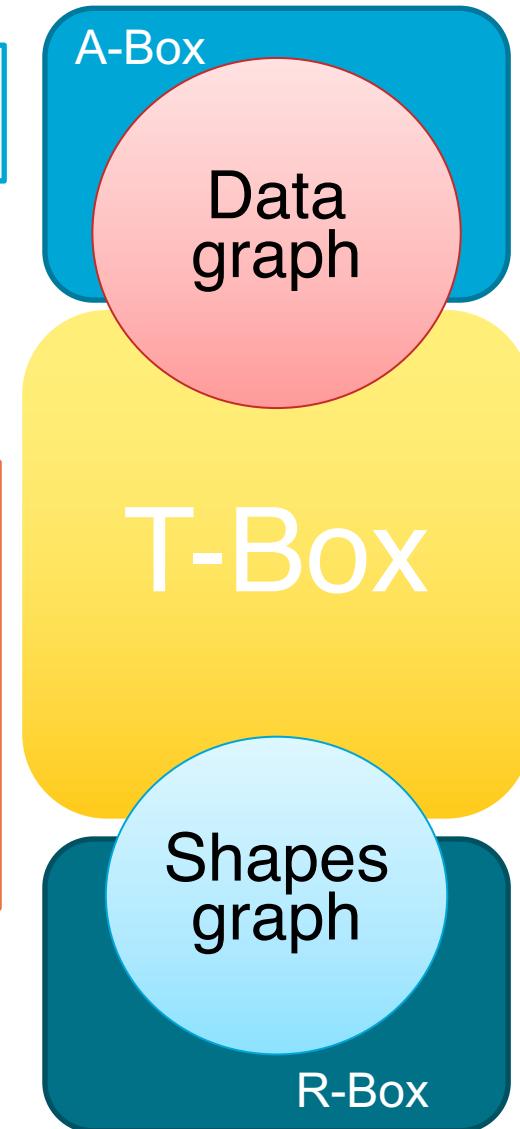
In conventional construction, **team members** come together **temporarily** for a single project and then disperse.

They're unable to innovate because knowledge and relationships aren't easily, or fully, transferred and/or developed from project to project.

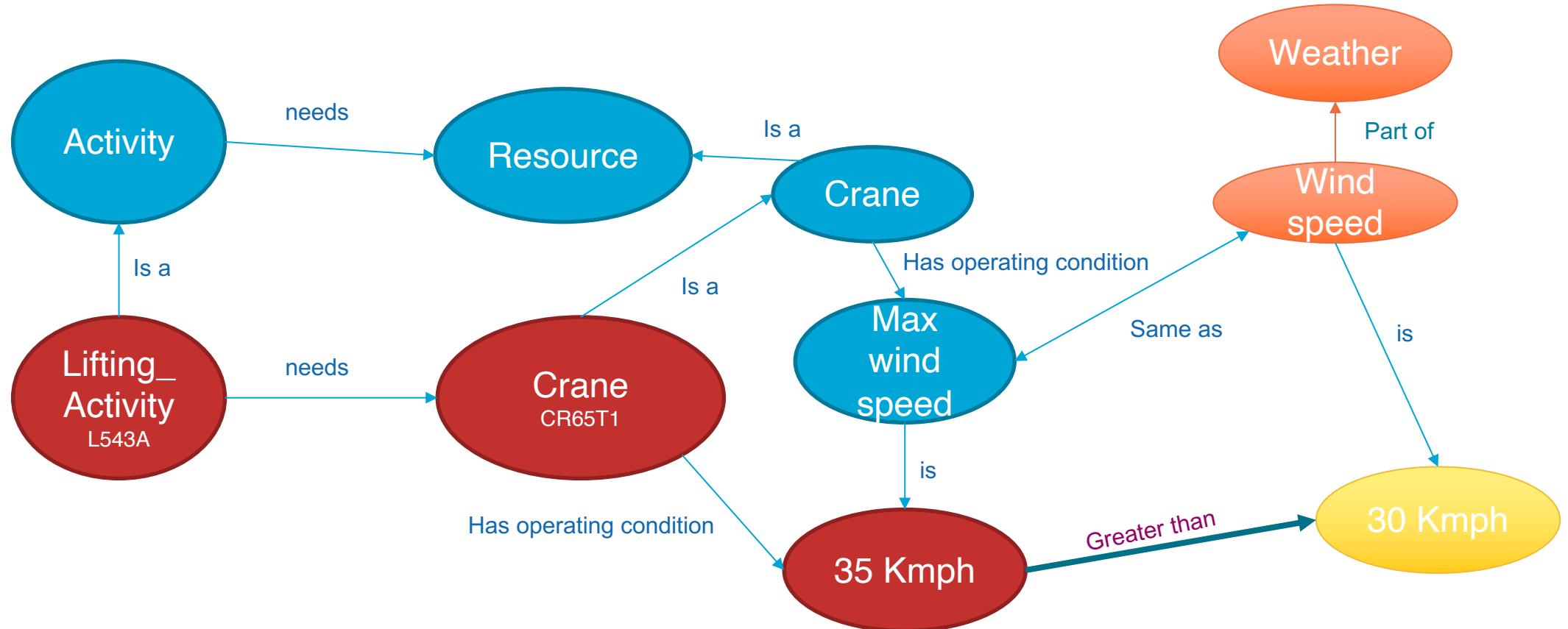
3. Can we use semantic web technologies to codify Tacit Project Knowledge to augment decision making?

Project Knowledge

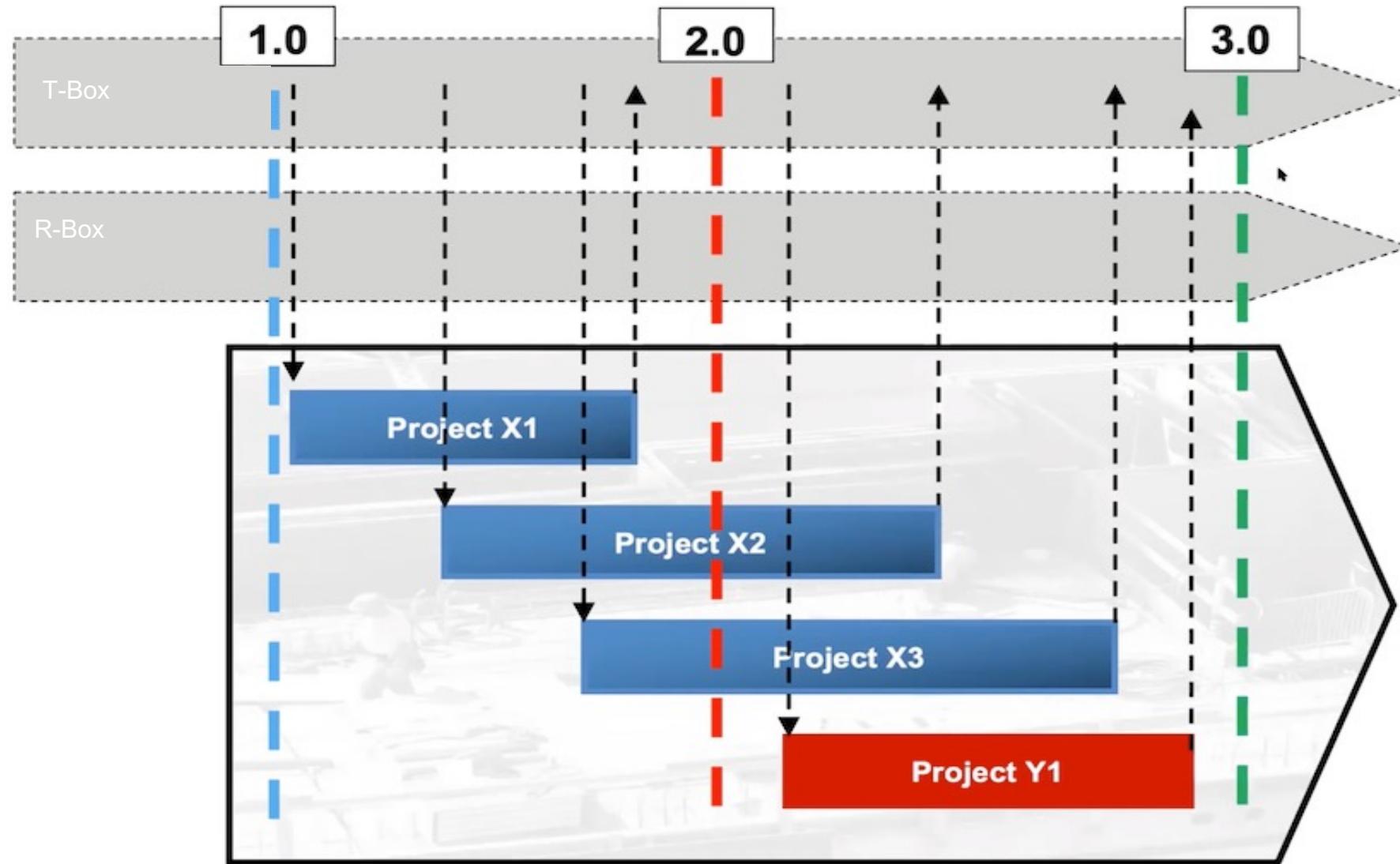
Project Data



Reuse knowledge across project



50



Semantic Web Technologies can codify tacit construction knowledge into reusable machine- readable formats, add intelligence and help mitigate fragmentation challenges

Thank you for your attention

Name