Emerging Technologies
PPM Course

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PPI

CIFE
CENTER FOR INTEGRATED FACILITY ENGINEERING

Who wants to deliver all their projects fast and at low cost?

Questions

- How much of the information used to build your projects is last touched by a human?
- How much time does your staff spend on tasks a computer could do?
- How many things are you not doing because they take too long?
- How often does a project team make a poor decision because they cannot see the big picture?
- How often do executives make a poor decision because they don’t understand an important detail?

Do your practices with respect to these questions increase or decrease variability on your projects?

How much of the information used to build your projects is last touched by a human?

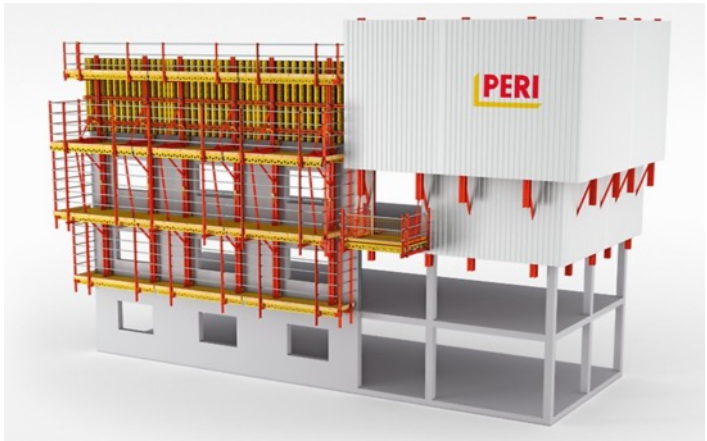
Construction Schedule Workshop on May 25, 26, and 28, 2018

Find the “best” formwork and sequencing option for a high-rise building project

Participants:

- Skanska Property Development, Construction, and Quality Control
- ALICE
- CIFE-Stanford Researchers

Key construction decisions: formwork and sequencing

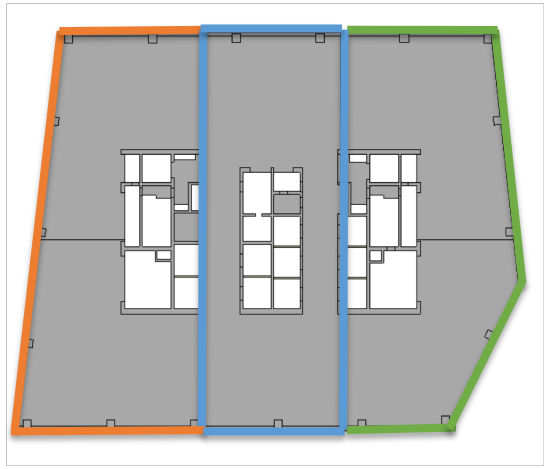


- **Peri RCS Rail Climbing System**
- $165,000 / month
- Time to raise / set up formwork: 20 hours
- Time to close formwork: 6 hours
- Crane required to raise and close formwork

- **Peri ACS Core 400 Self-Climbing System**
- $295,000 / month
- Time to raise / set up formwork: 10 hours
- Time to close formwork: 2 hours
- No crane required to raise and close formwork

Z1 → Z2 → Z3

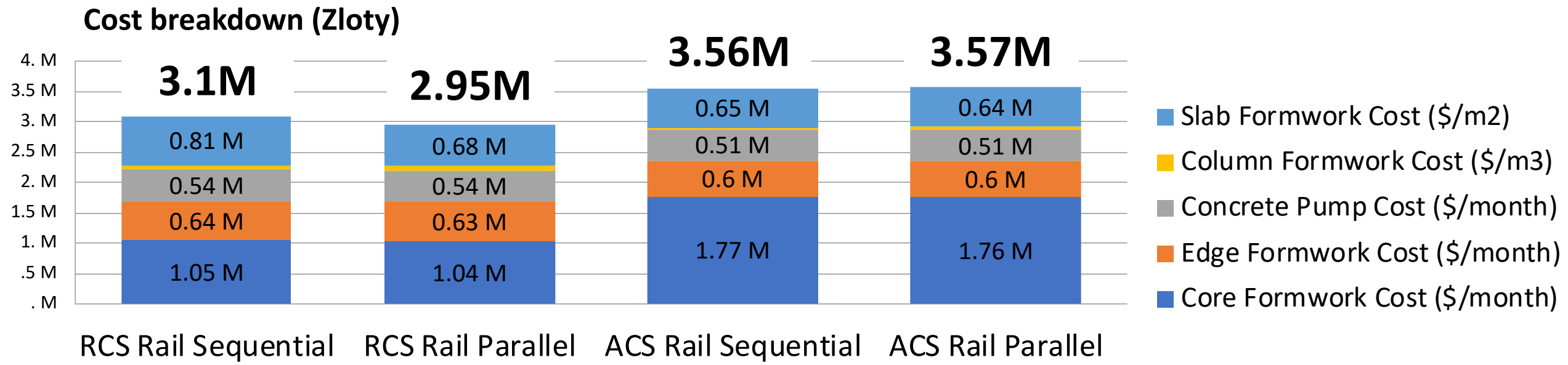
Sequential

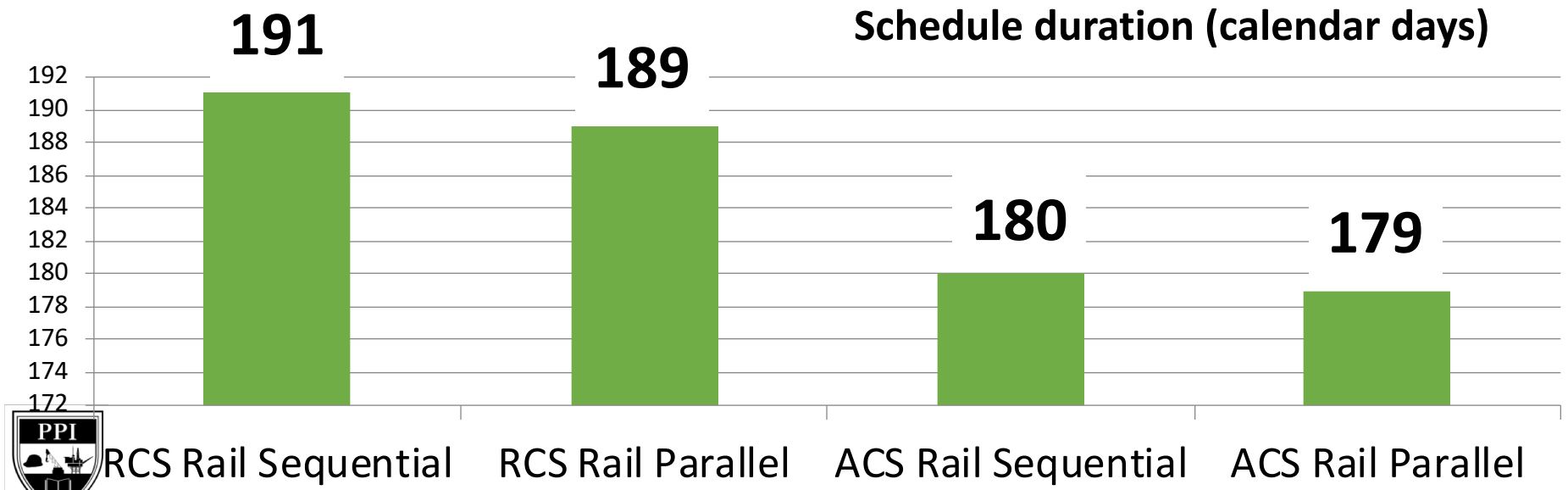


Z1 ← Z2 → Z3

Parallel

Results overview: cost and schedule





Results Overview – Slab + Column Formwork

Find slab and column formwork required to achieve the “optimal” schedule for each option

RCS

ACS

Formwork Needed: **3,182 m2**

Formwork Needed: **2,701 m2**

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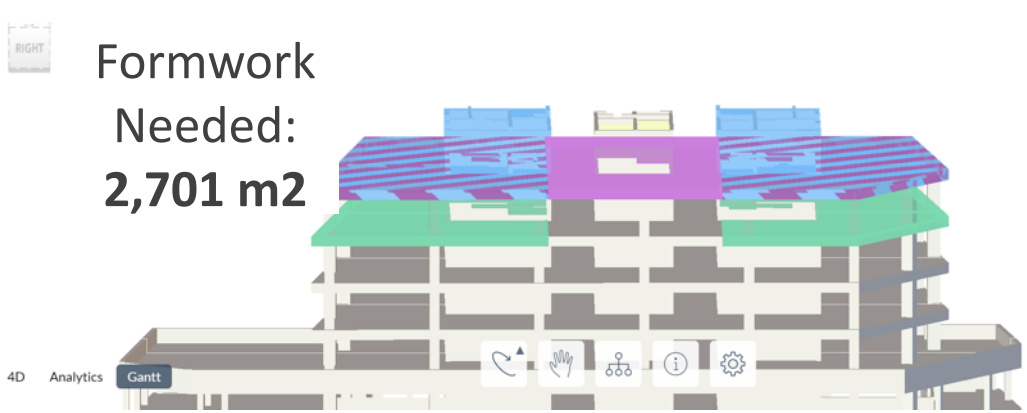


Sequential

Parallel

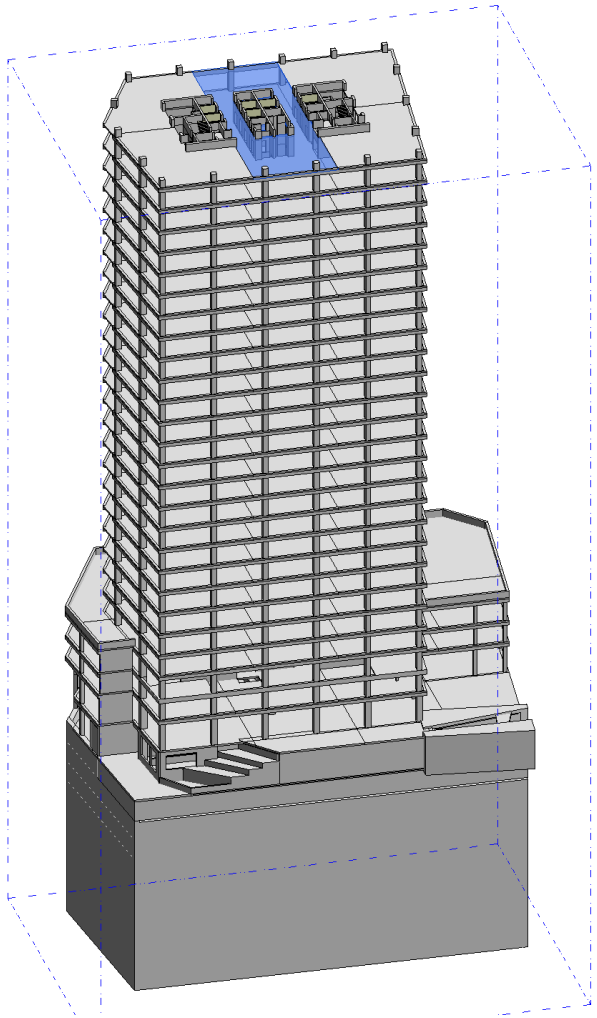
Key simulation and collaboration information

# Schedule scenarios generated	341
# Optimization runs	65
# Schedule scenarios used for analysis	24
Average time to reschedule	10 mins

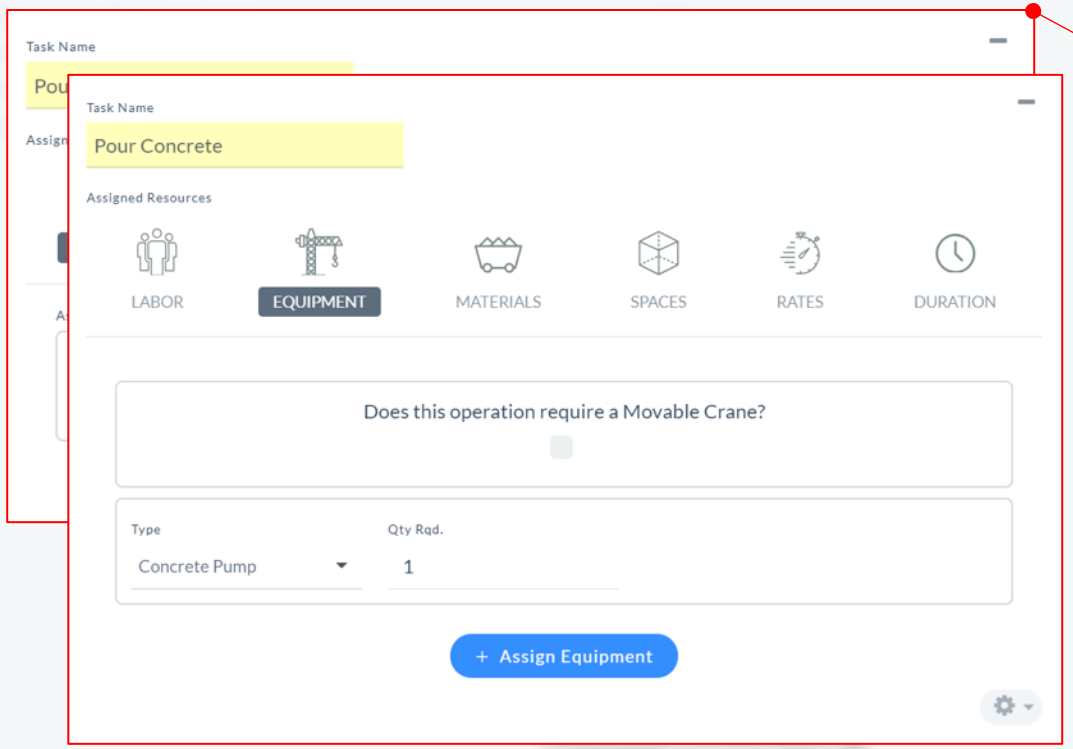
BIM simplification and zone breakdown

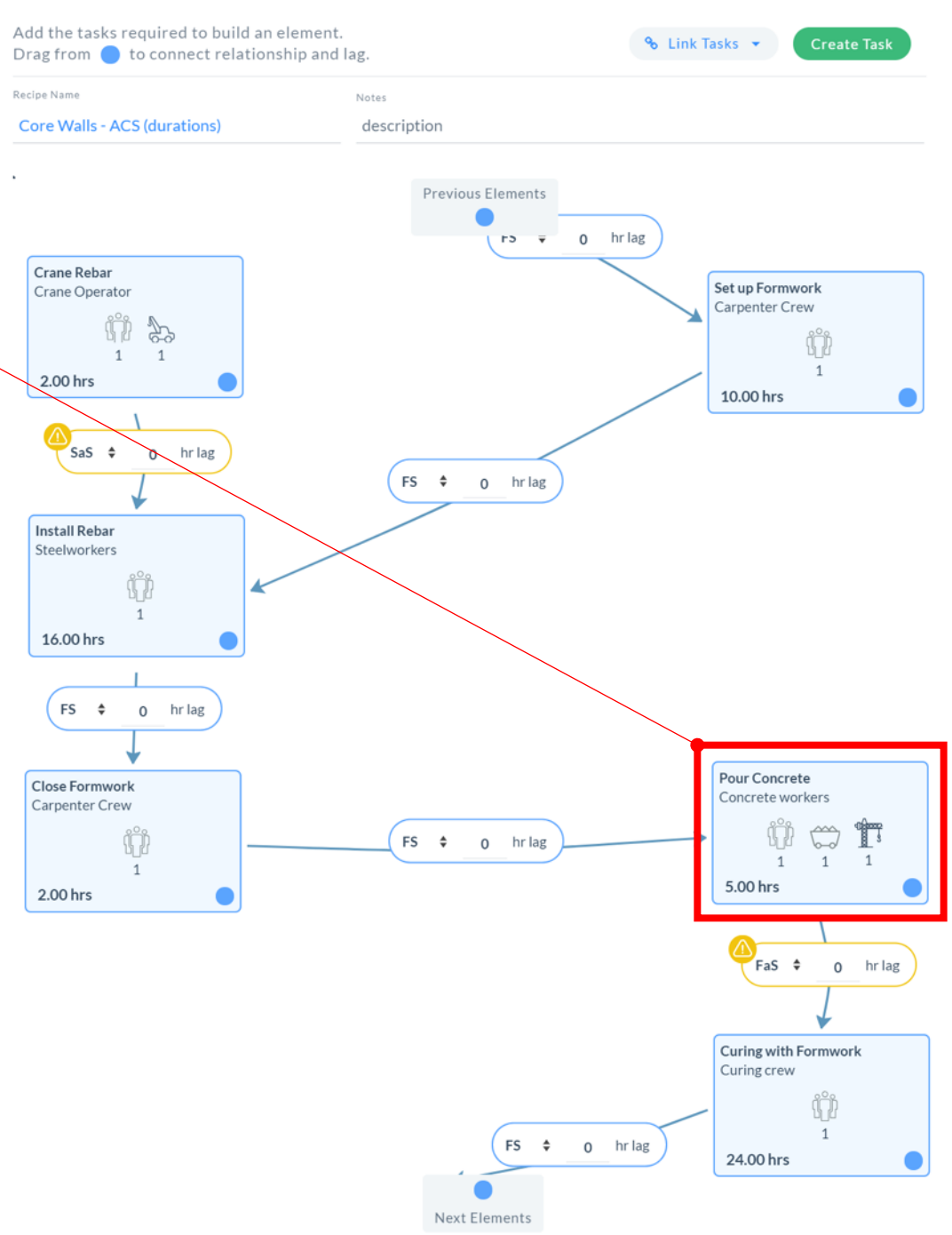
Input: Structural Model
Required Revit modeling time: 2 days

3,860 building components
344 construction elements

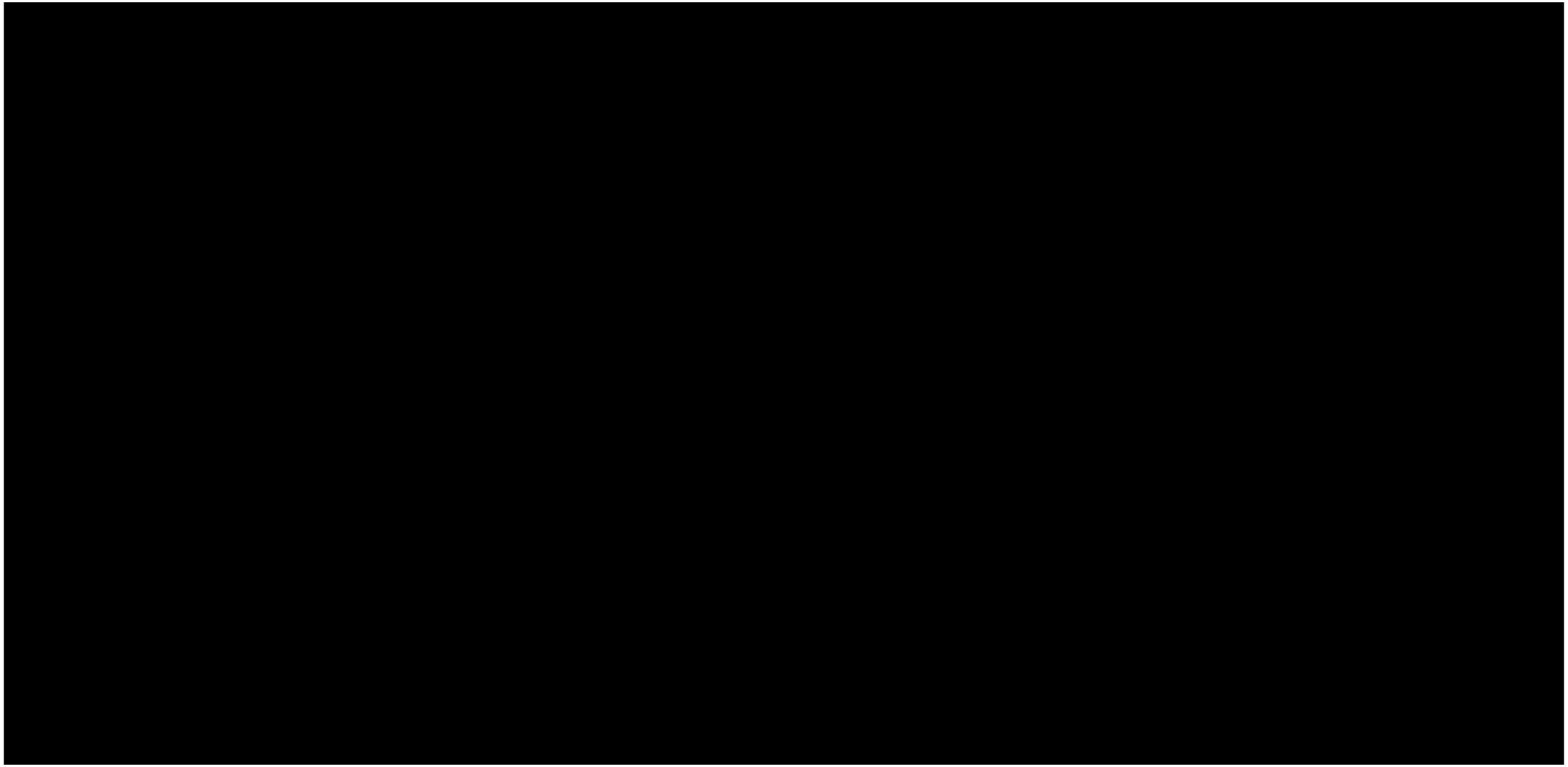


Construction recipes





Given the recipes and BIM, 4D models are generated automatically



Develop calibrated schedules

Issue: Central core rising too fast, waiting for too long to start slabs on zone 1 and 3

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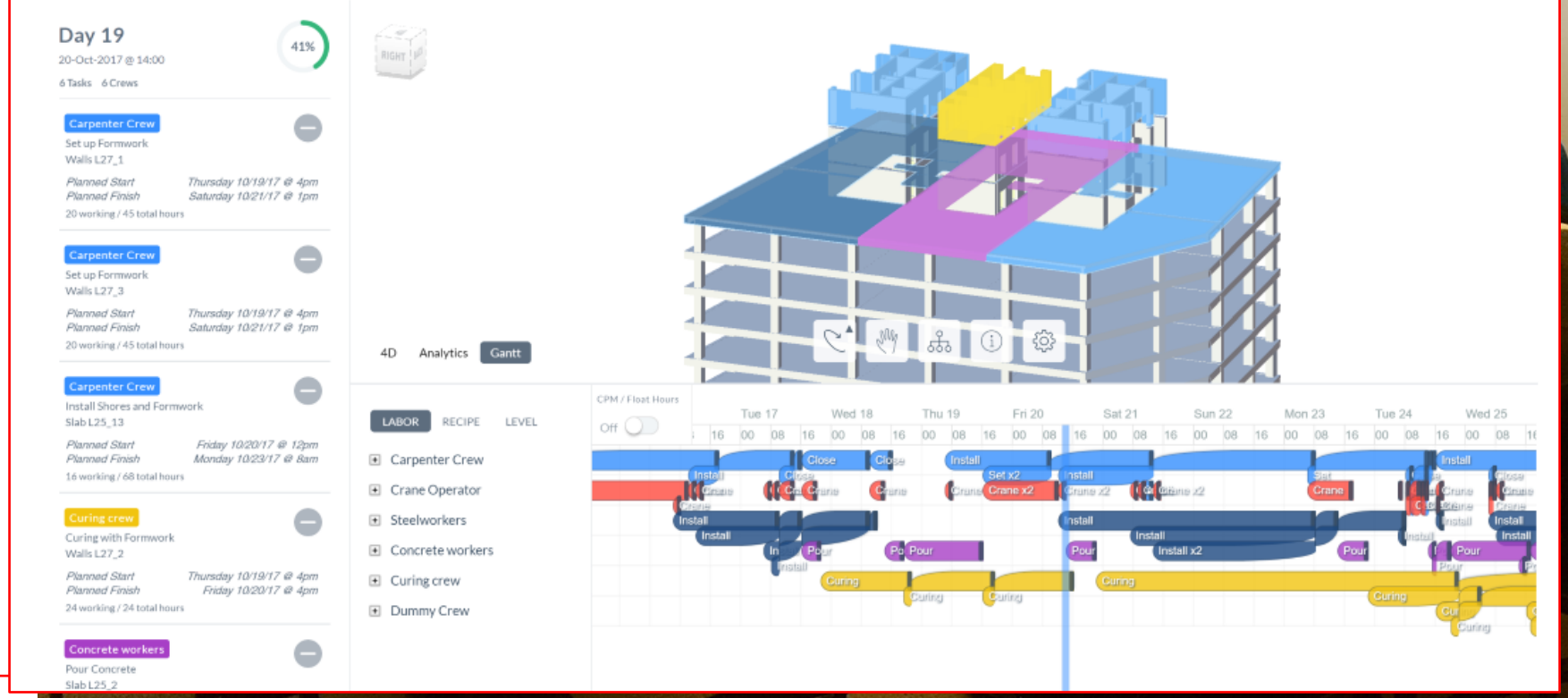
Issue: Zone 3 slab has not added rebar before zone 2 pour

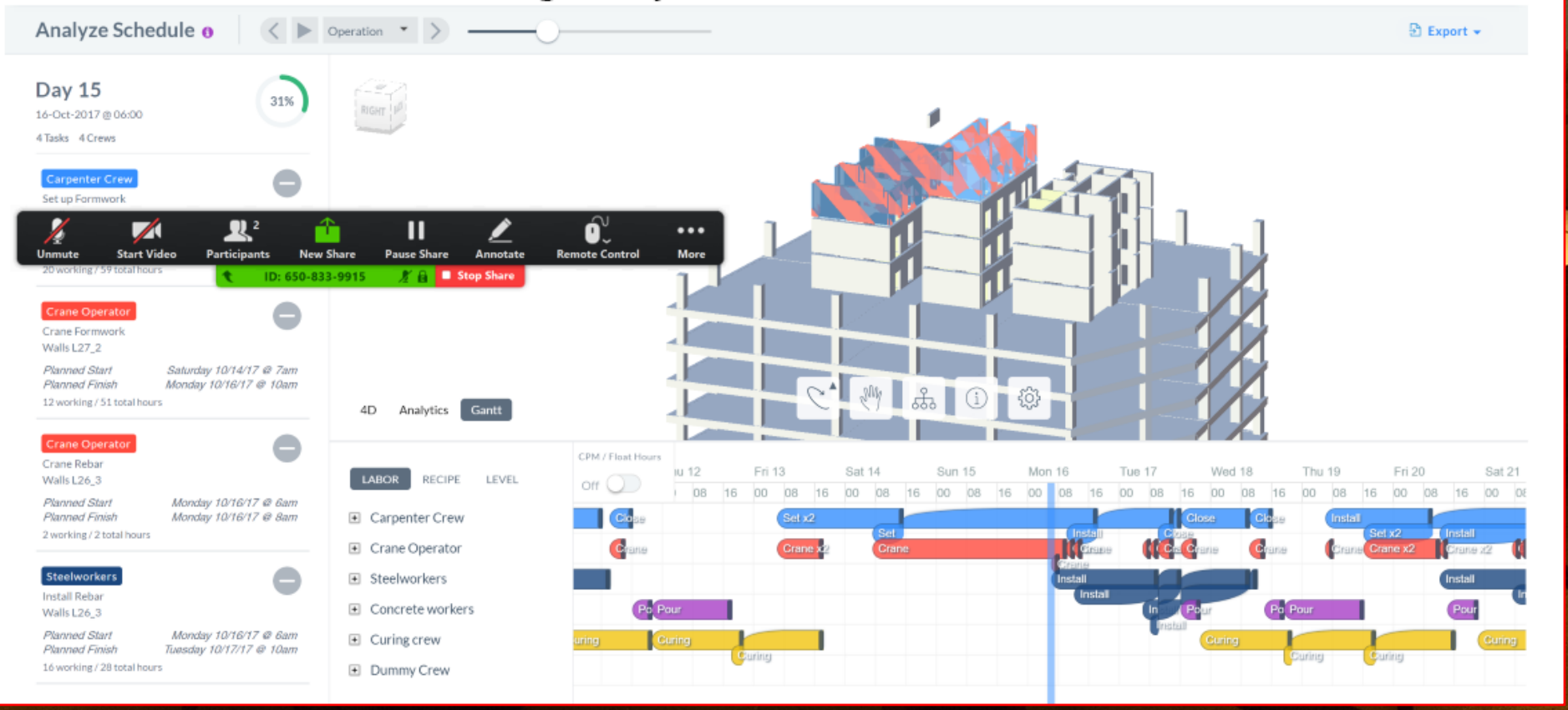


Develop calibrated schedules

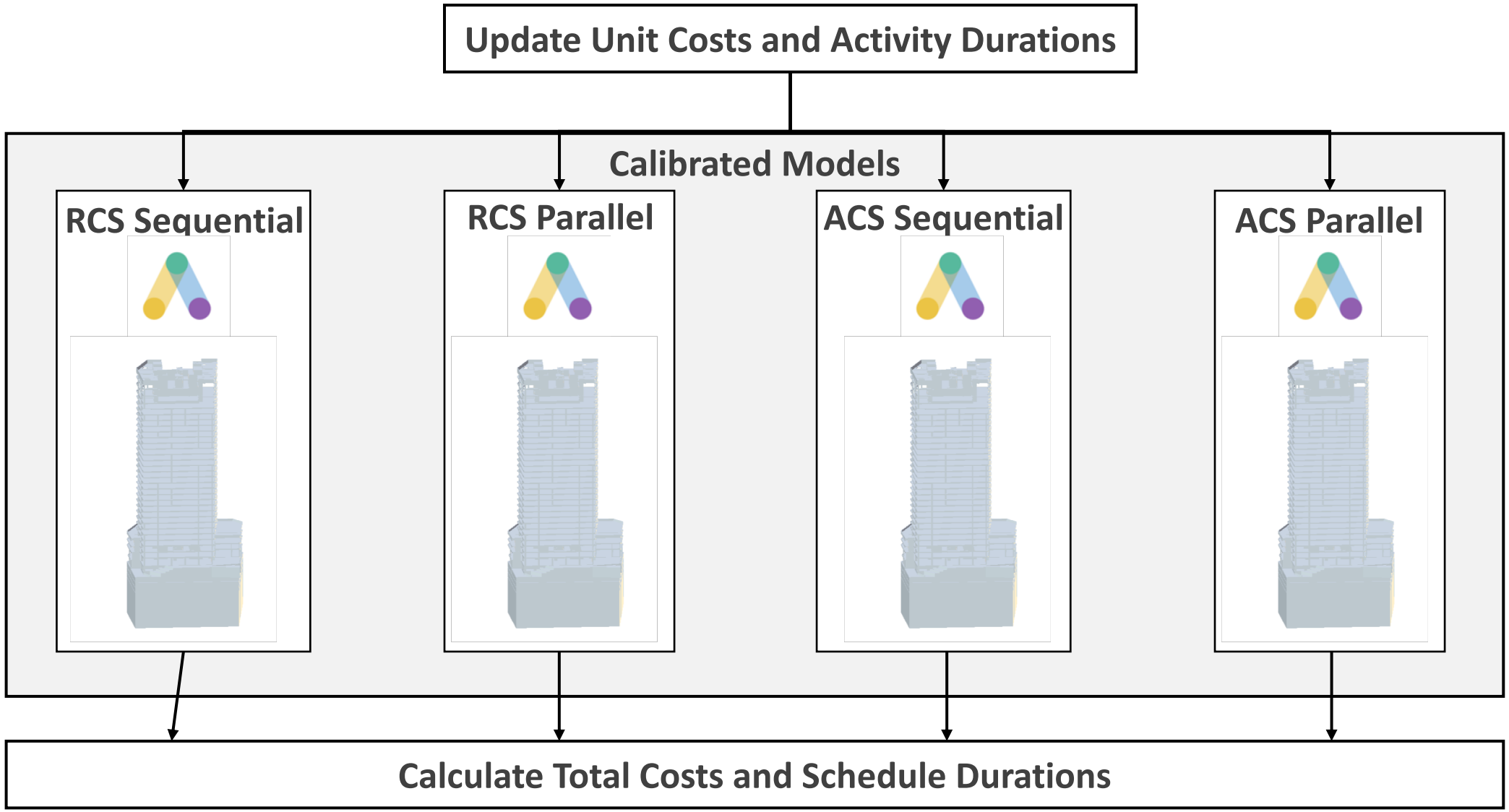
Issue: Central core rising too fast, waiting for too long to start slabs on zone 1 and 3

Issue: Zone 3 slab has not added rebar before zone 2 pour

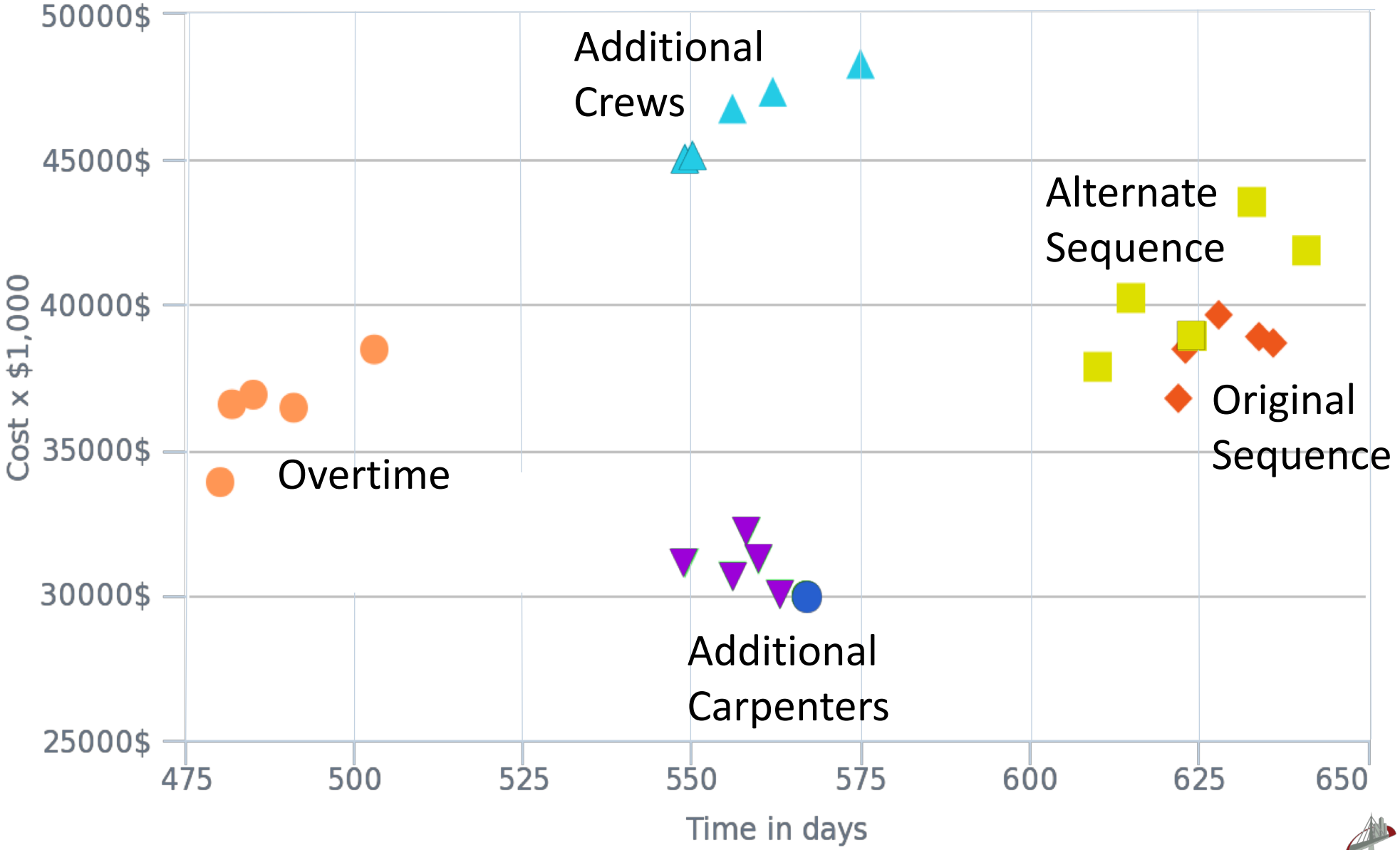
Issue: Cannot have cranes working on adjacent cores even on different levels.



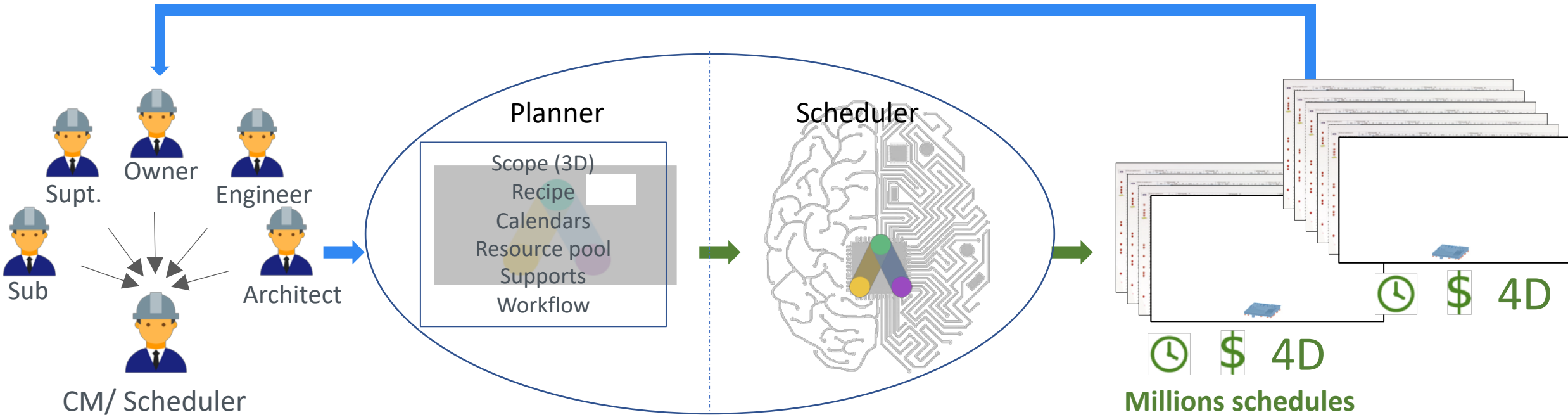
ALICE allows set-based construction scheduling



… for many conditions or situations



Using people and computers really well



Planning

Rule Set

Scheduling parameters

Scheduling

Resource allocation

Sequence variation

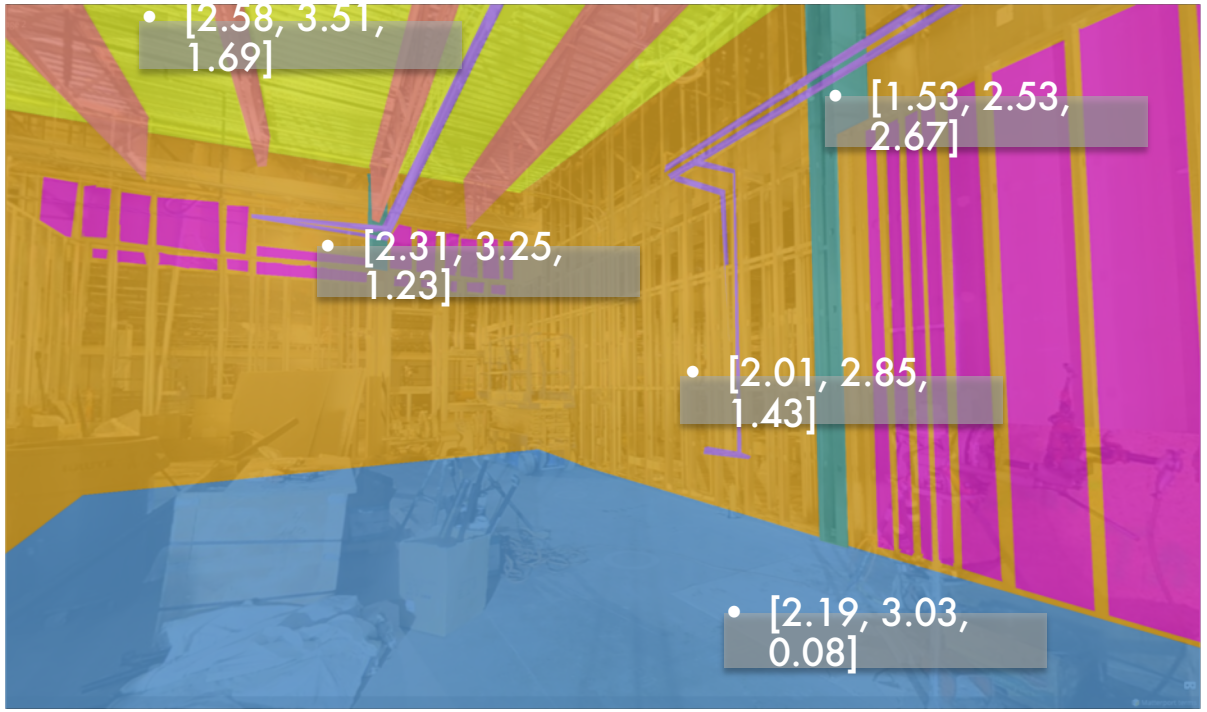
How much time does your staff spend on tasks a computer could do?

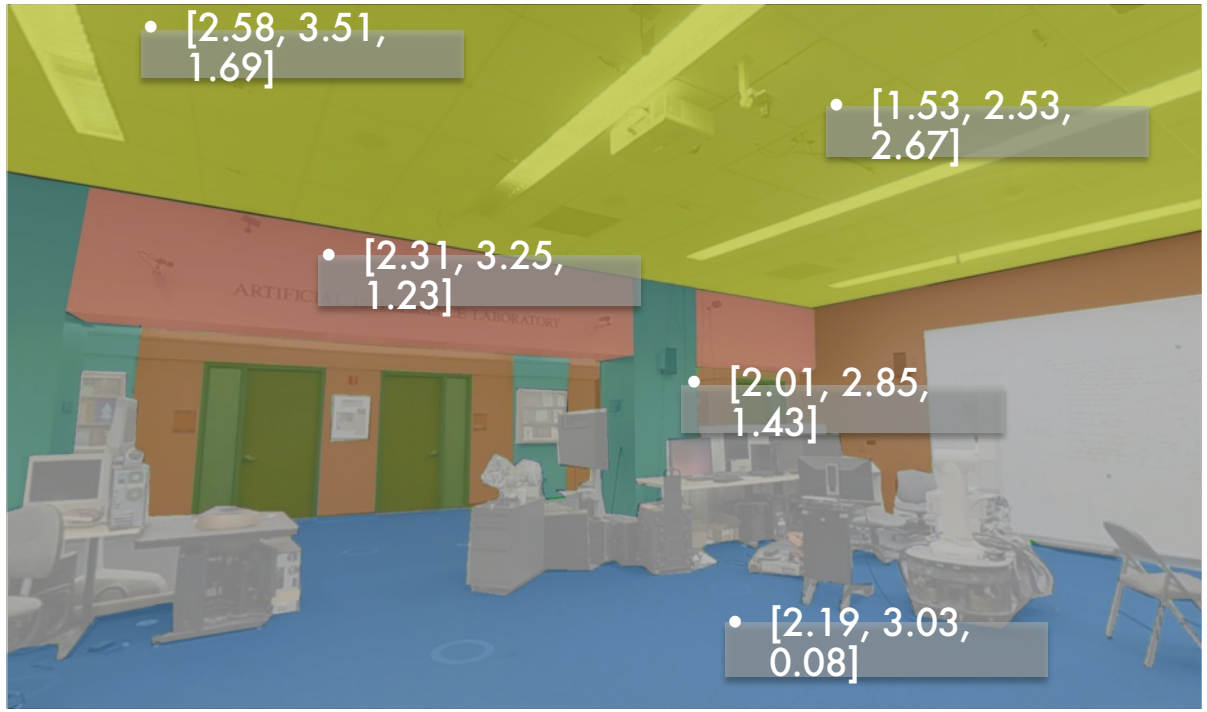
How many things are you not doing because they take too long?

Automatically generating a BIM from a laser scan

Where is it?

What is it?





construction

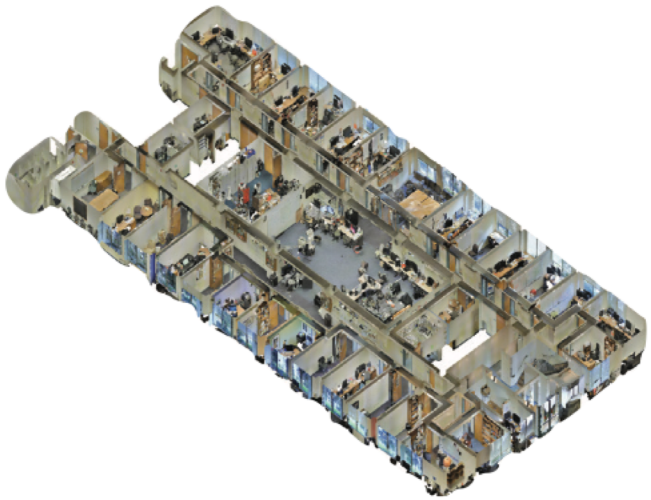
post - occupancy

Semantic Building Parser Research

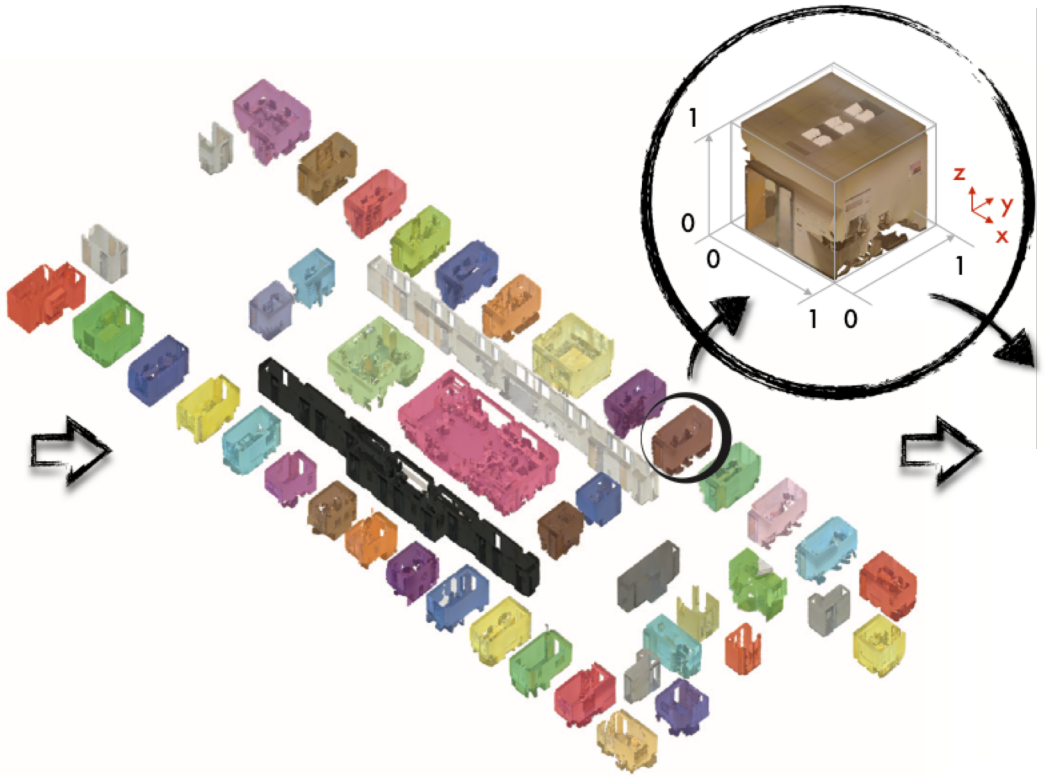
With Silvio Savarese, Iro Armeni, Amir Zamir, buildingparser.stanford.edu

Making BIM for Existing Buildings Affordable

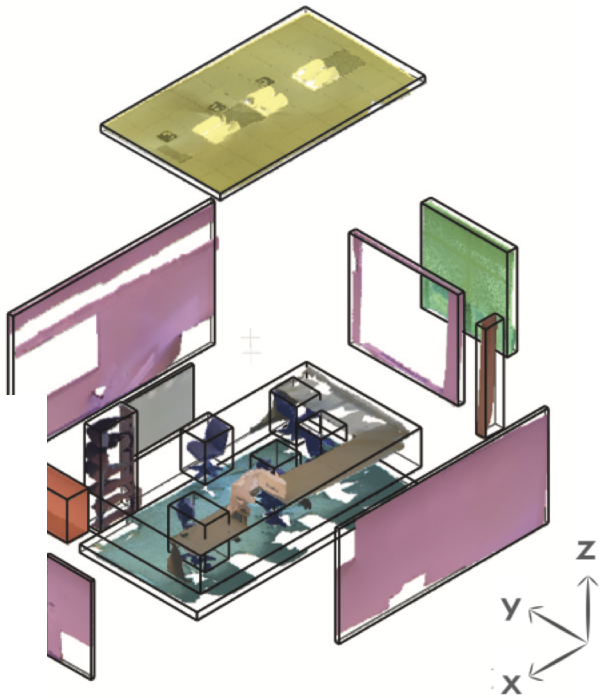
Raw Point Cloud



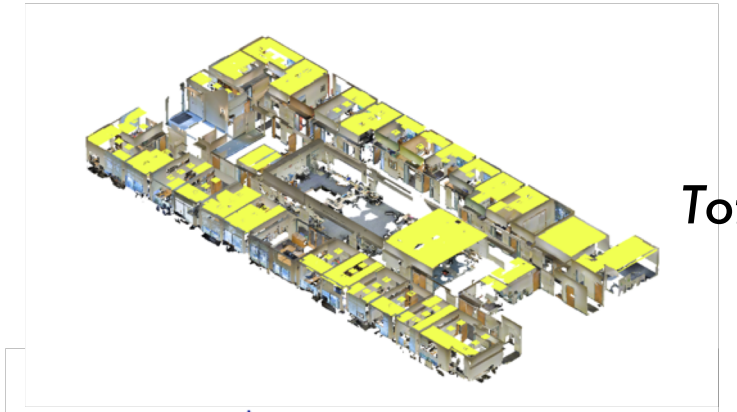
Disjoint Space Parsing



Building Element Detection



Automatically Generated Space Statistics

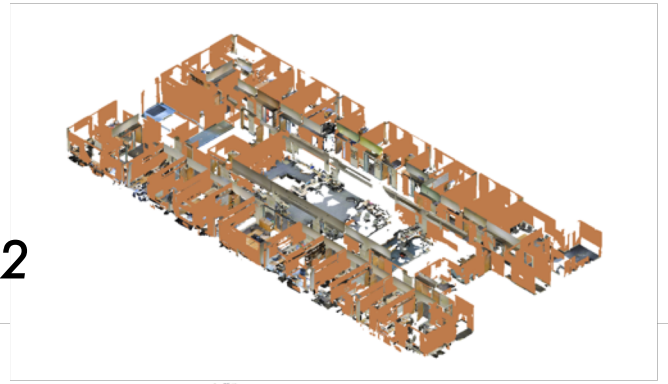


Ceiling

Total Area: 667.67 m2

Walls

Total Number: 42
Total Area: 479.5 m2

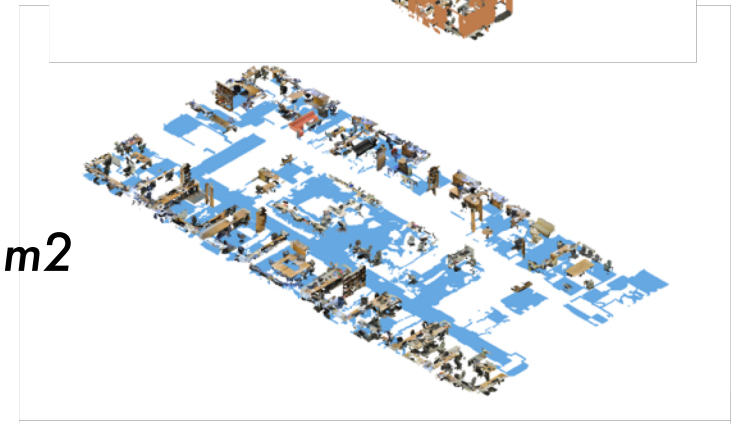


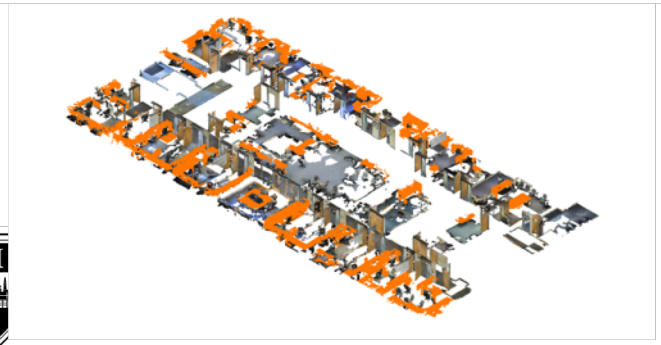
Chairs

Total Number: 106

Floor

Total Area: 639.36 m2



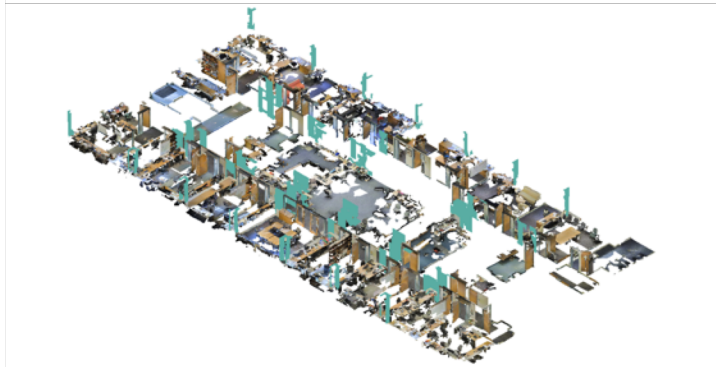


Table

Total Number: 45

Columns

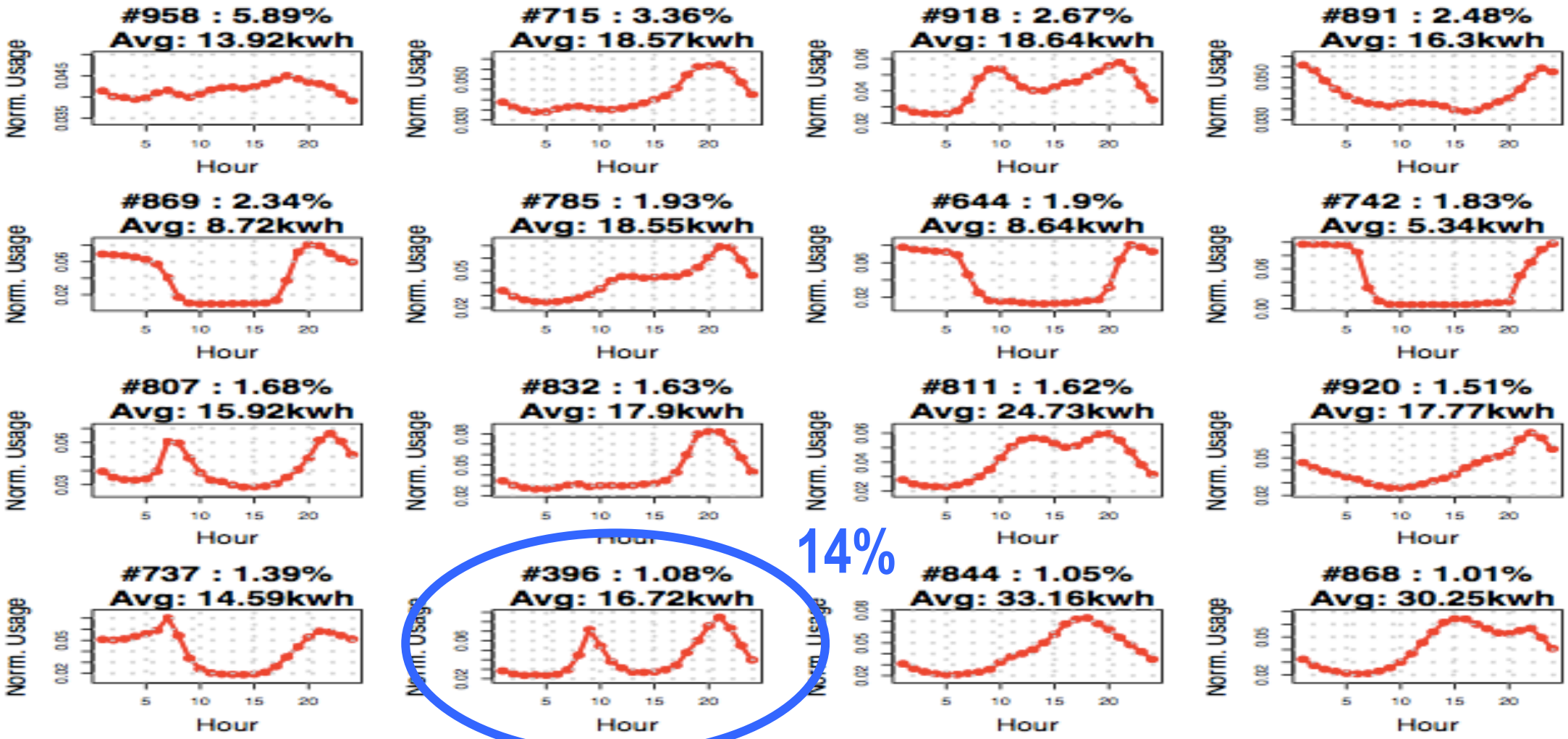
Total Number: 39



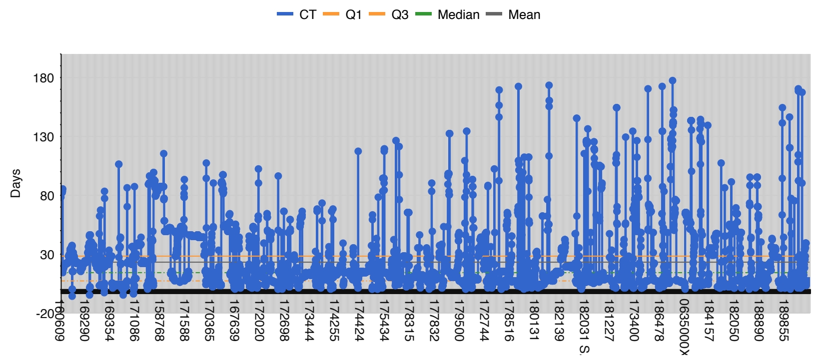
How often does a project team make a poor decision because they cannot see the big picture?

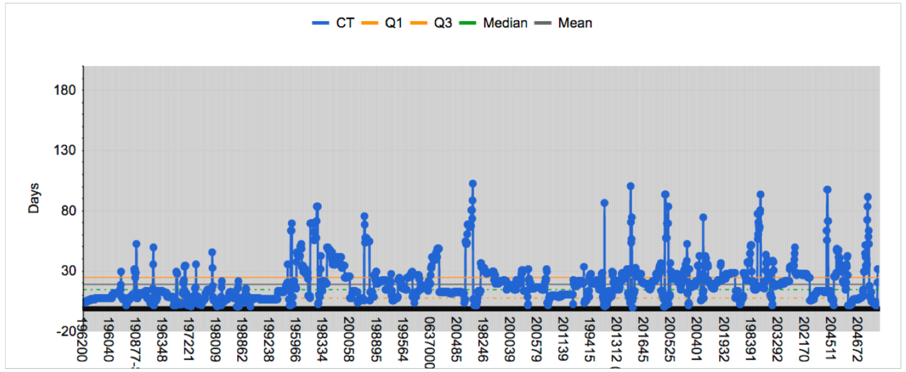
How often do executives make a poor decision because they don’t understand an important detail?

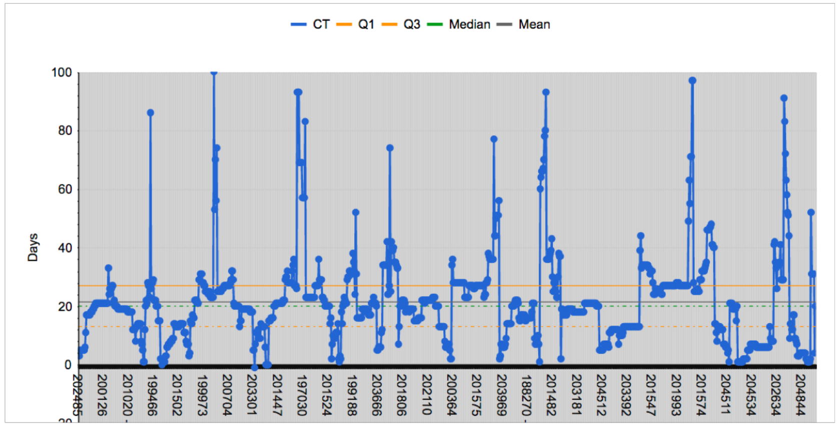
Consumption Patterns

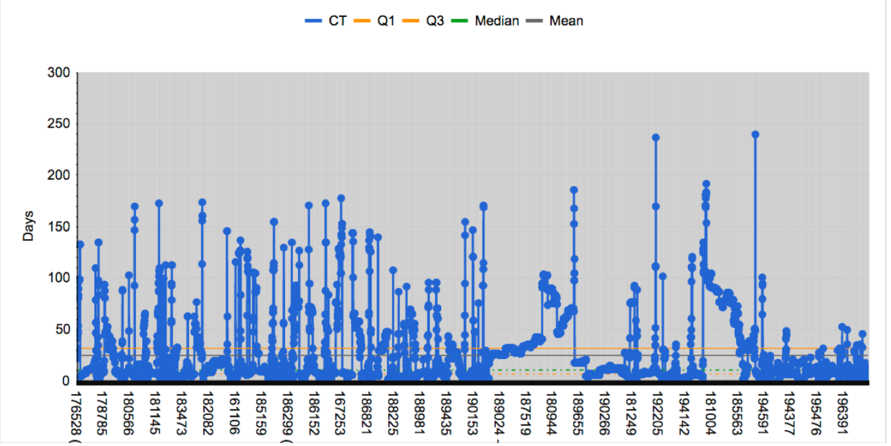


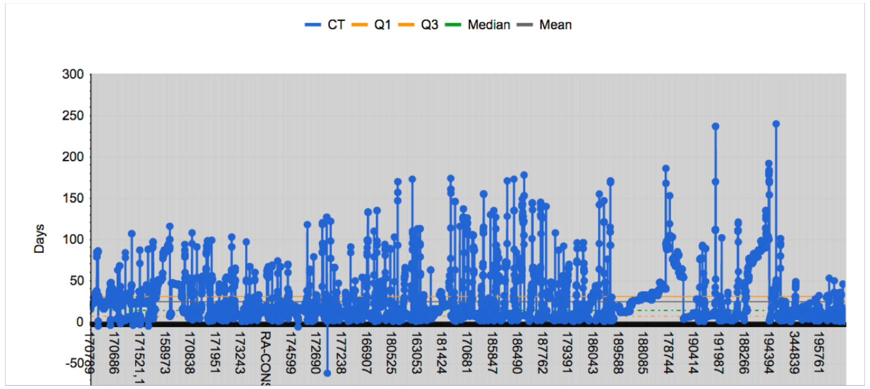
Household Energy Consumption Segmentation Using Hourly Data, J. Kwac, J. Flora and R. Rajagopal, IEEE Trans. Smart Grid, 5:1, pp 420-430, 2014.

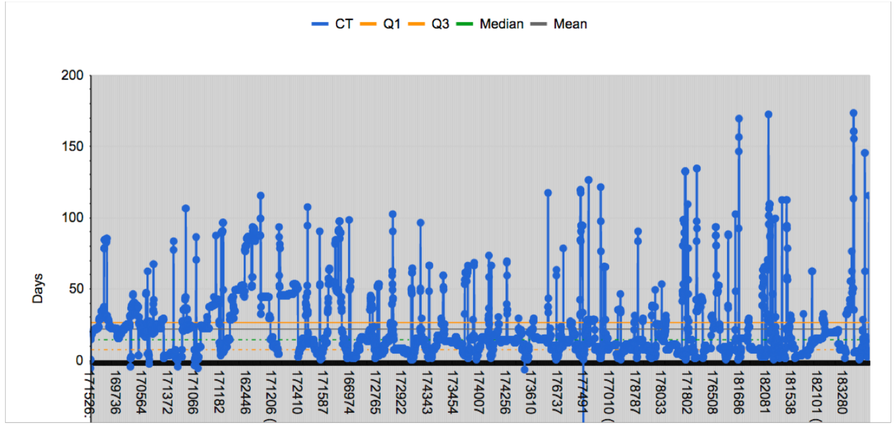








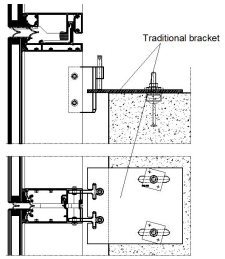


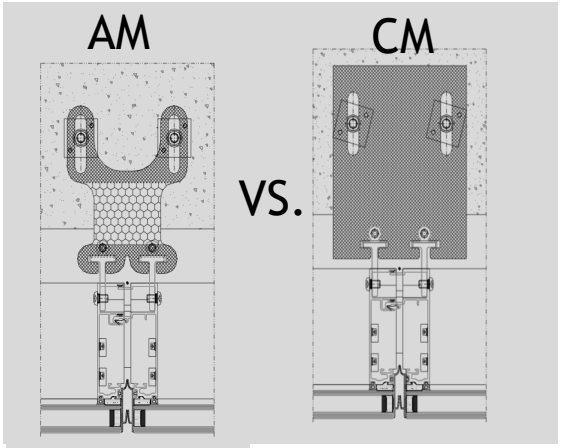


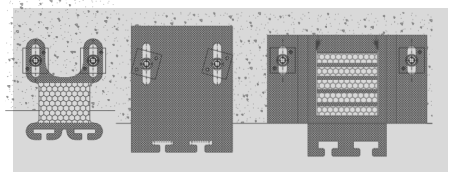
STRATEGIC PROJECT SOLUTIONS®

The material revolution is not far behind the digital revolution.

Additive Manufacturing is (not yet) cost/schedule-competitive, but environmentally advantageous (work by Nataša Mrazović)





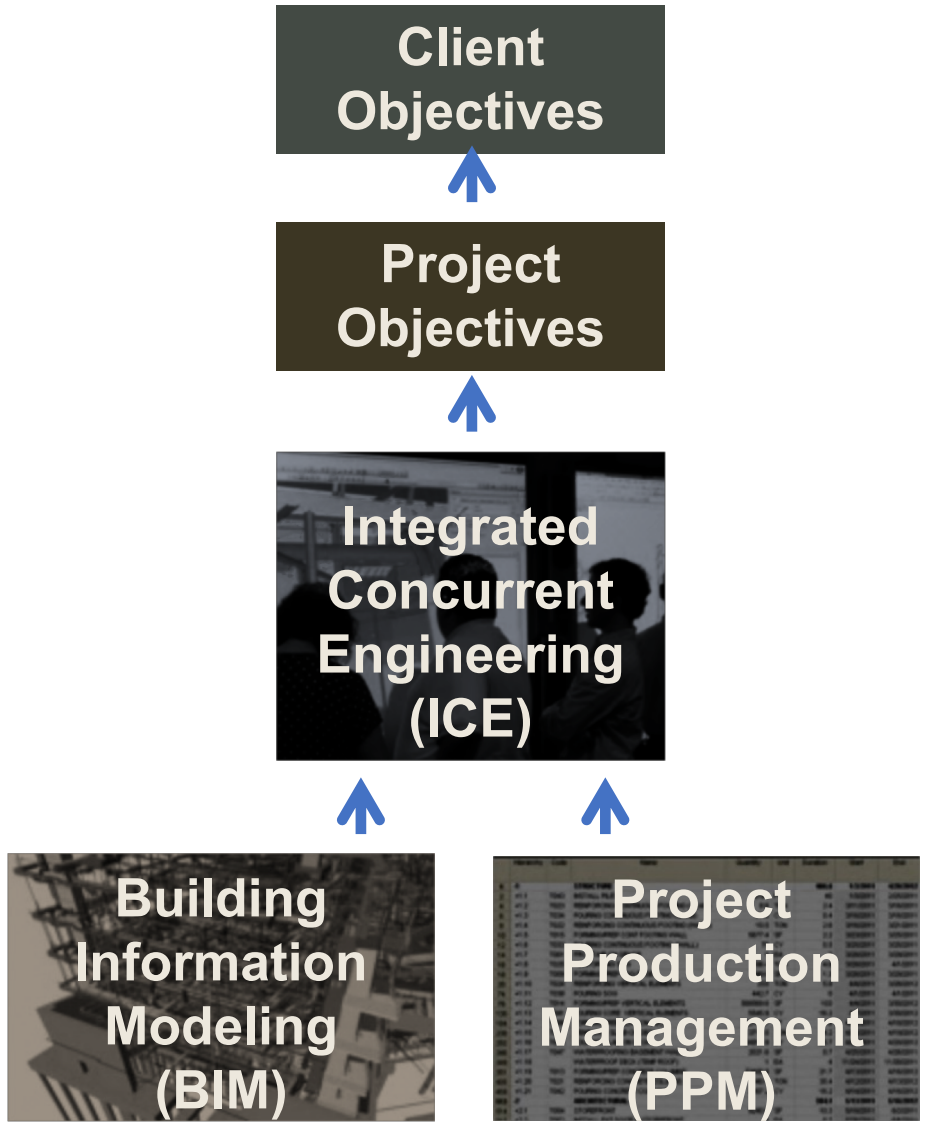


CATEGORY		AM (EBM - DMLS)	CM
A	Technology Applicability	✓	✓
S	Schedule	7x	1x
E	Environmental impact (kg CO2)	1x	7x
C	Costs	10x	1x

2019 resolutions

- Generate 10% of the information from which you build directly from a computer.
- Free up 5% of your staff's time from repetitive tasks.
- Do 2 new "things" because they are (partially) automated.
- Connect the detail and the big picture for 2 issues.
- 3D-print 10 physical objects needed on projects, 2 of them repeatedly.

11-year collaboration between SPS/PPI and CIFE on Virtual Design and Construction (VDC) 1.0



VDC 2.0 → PPM

PPI and CIFE are developing a professional education program on PPM.

- 1-week introductory course
- 6-month implementation with check-ins and support
- 2-day synthesizing event

- Learn PPM concepts and their application
- Understand the role of technology in the context of PPM
- Apply PPM on projects
- Create a community and culture of PPM