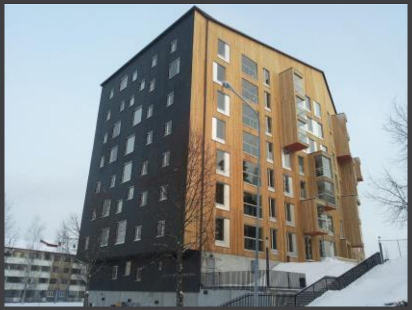
SWECO TIMBER HACK

clarifying structural timber design dataflows for parametric and AI-enabled design

Katja Rodionova 26.9.2019






Images: some of the residential multistorey timber projects delivered by Sweco Finland

OBJECTIVES

of the Finnish Environmental Agency funding programme (9.2018):

- BIM as an extended tool for enchancing productivity of timber engineering process
- Setting lasting quality standards for design tools and data transfer
- Enabling sustainable construction using digitalisation and data mining techniques

Image: (c) Katja Rodionova 2018, Heureka Jukola Tower exhibition

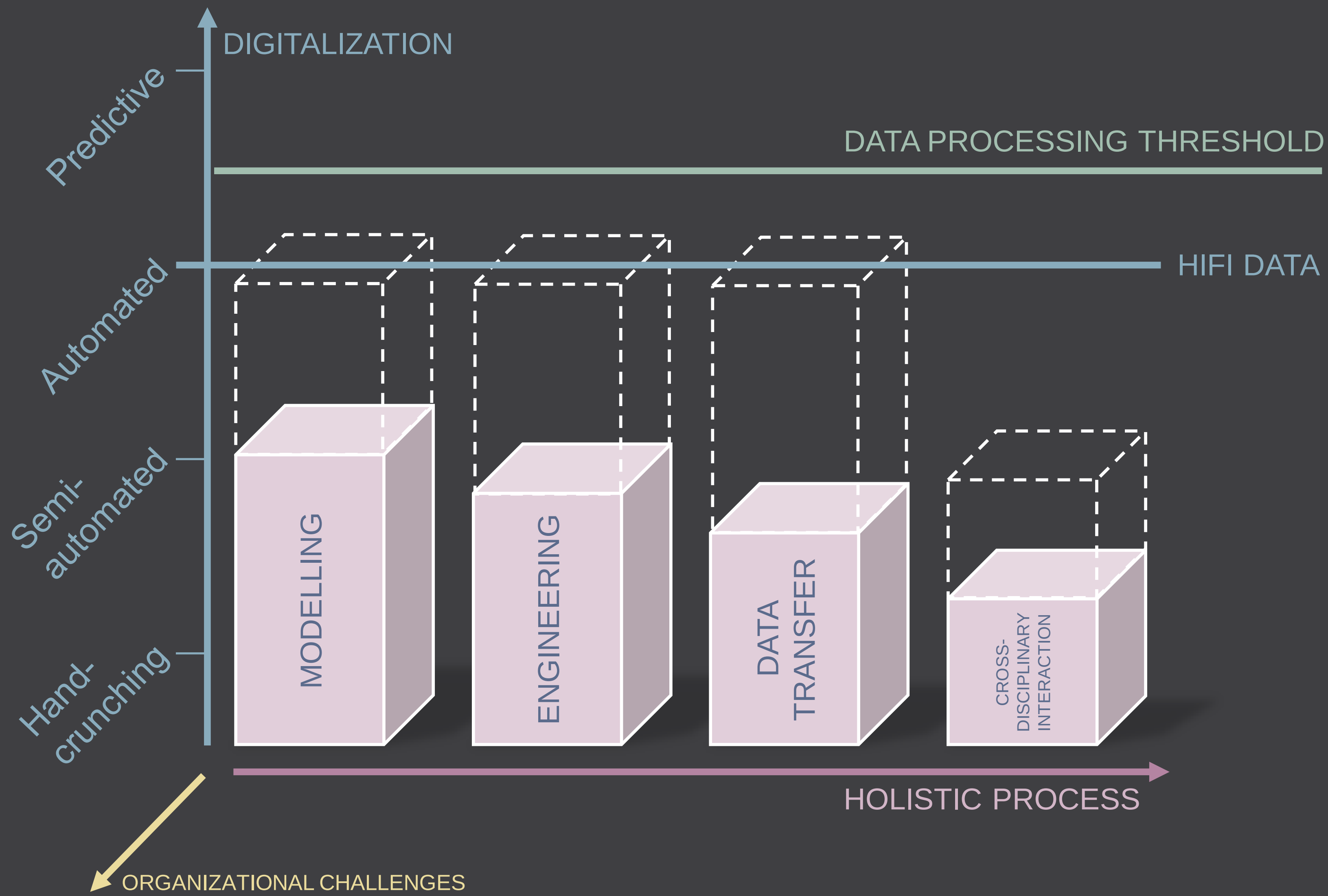
OUR PROPOSITION TIMBER HACK

- Develop data transfer to speed up the basic design process
- Collect the inputs and results of the design stage as uniform and easily readable databases
- Automate also the iterative data exchange to enable optimization (+ proactive data mining)

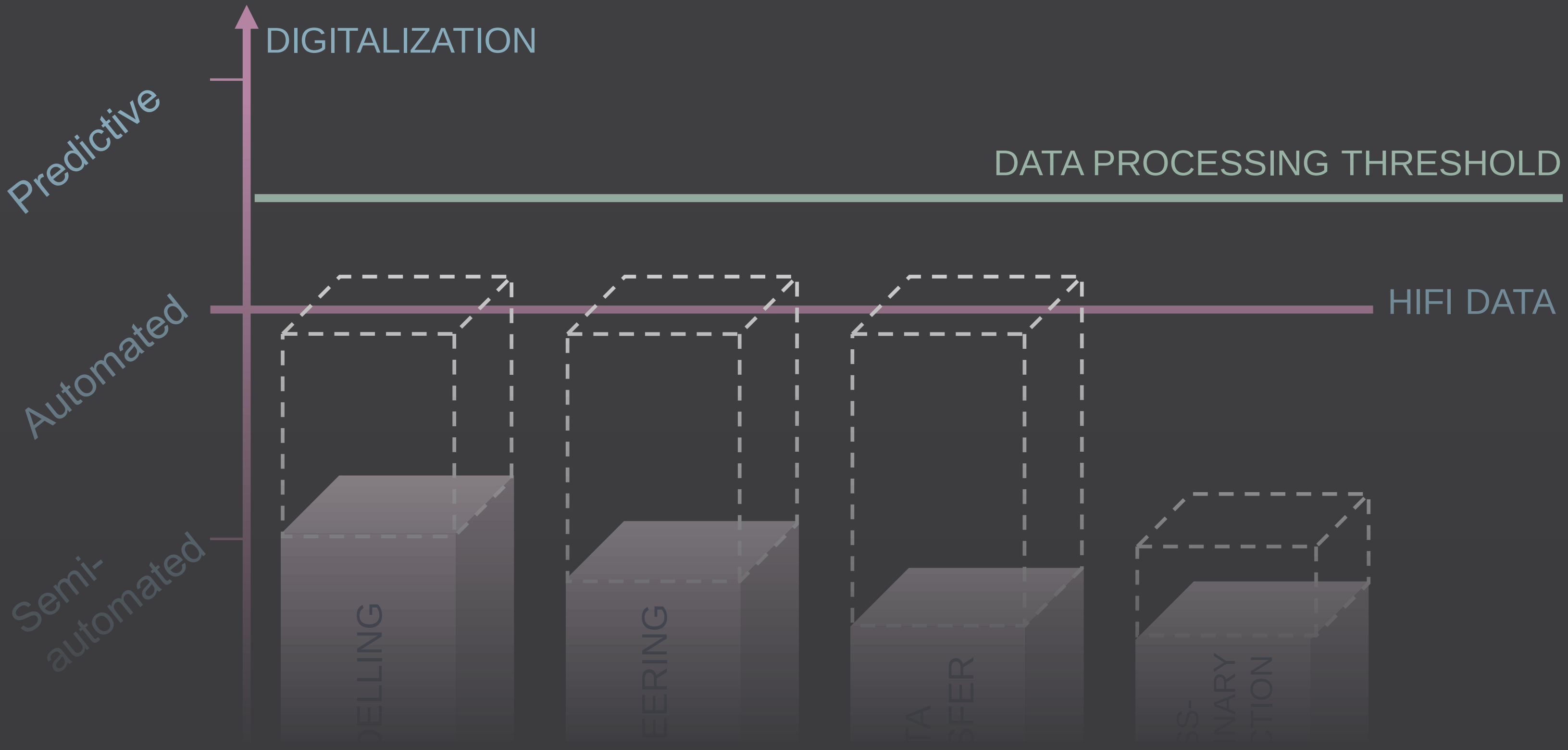
TIMBER HACK QUALITY AND ROBUSTNESS CRITERIA

- ☑ Data transfer structure optimized for data mining
- ☑ Uniform input and output structure
- ☑ Log files structured for **”lossless data design”**

WHY ”LOSSLESS DATA”?



WHY ”LOSSLESS DATA”: AN EXAMPLE



BIM *or* BIM?

Data-Driven Design and Construction: 25 Strategies for Capturing, Analyzing and Applying Building Data. Deutsch, R. 2015

SWECO TIMBER HACK: BIG PICTURE

ultimate clarification of dataflows

Environmental data

Architectural data

Structural solutions (alternative sets)

Engineering design strategy datasets

Structural design

Modeling

Interdisciplinary interfaces

Energy

HVAC

CO_2

A "value proposition" slide from internal innovation pitching competition SwecoInn 2018

DATAFLOW CLARIFICATION… HOW?

Tasks as buzzwords

Project
data structure

Database
structure

Design strategies
timber frame structural system

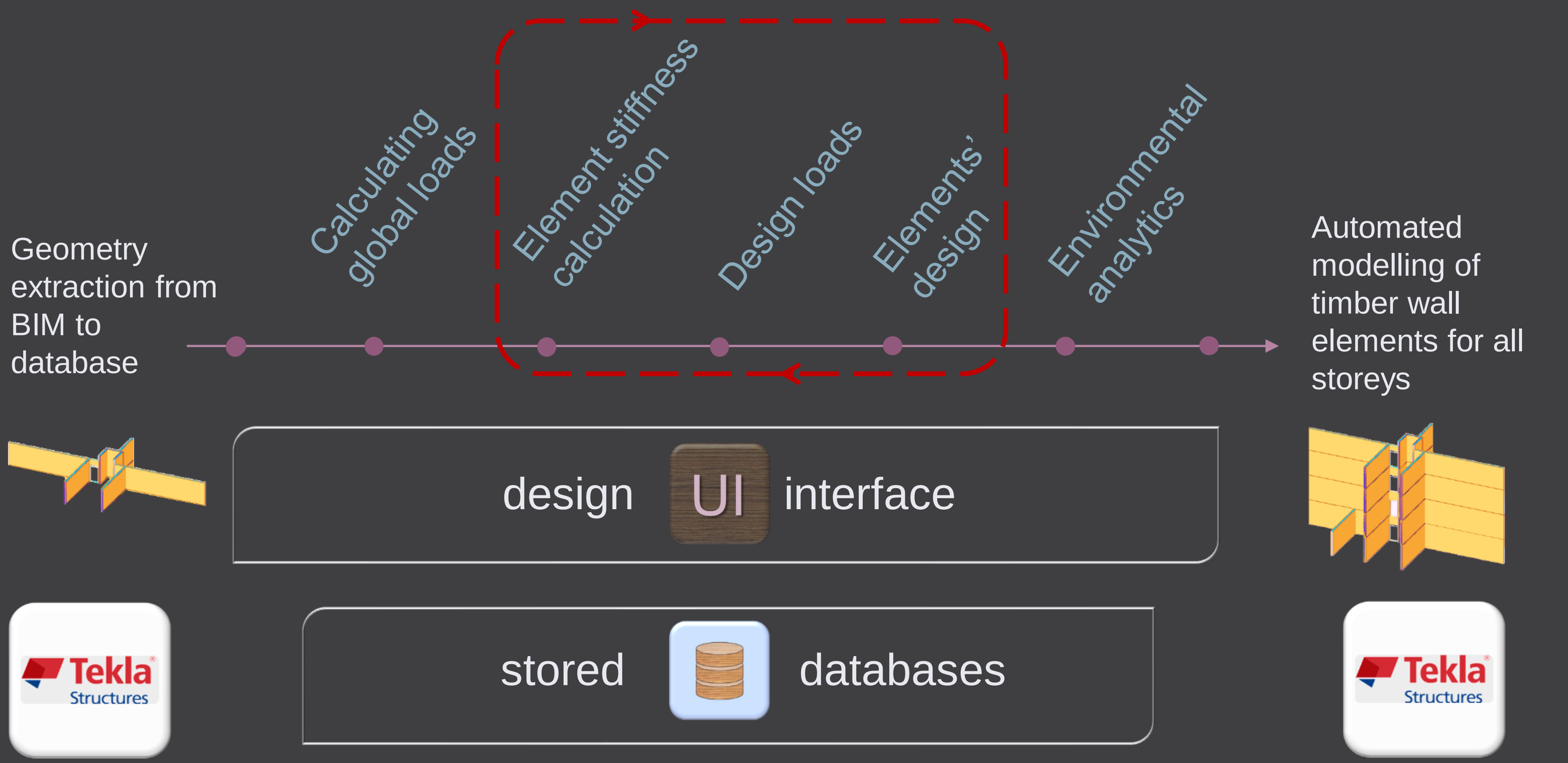
BIM numbering
adaptation

User interface
for given calculation route

Image: (c) Katja Rodionova 2018, Heureka Jukola Tower exhibition

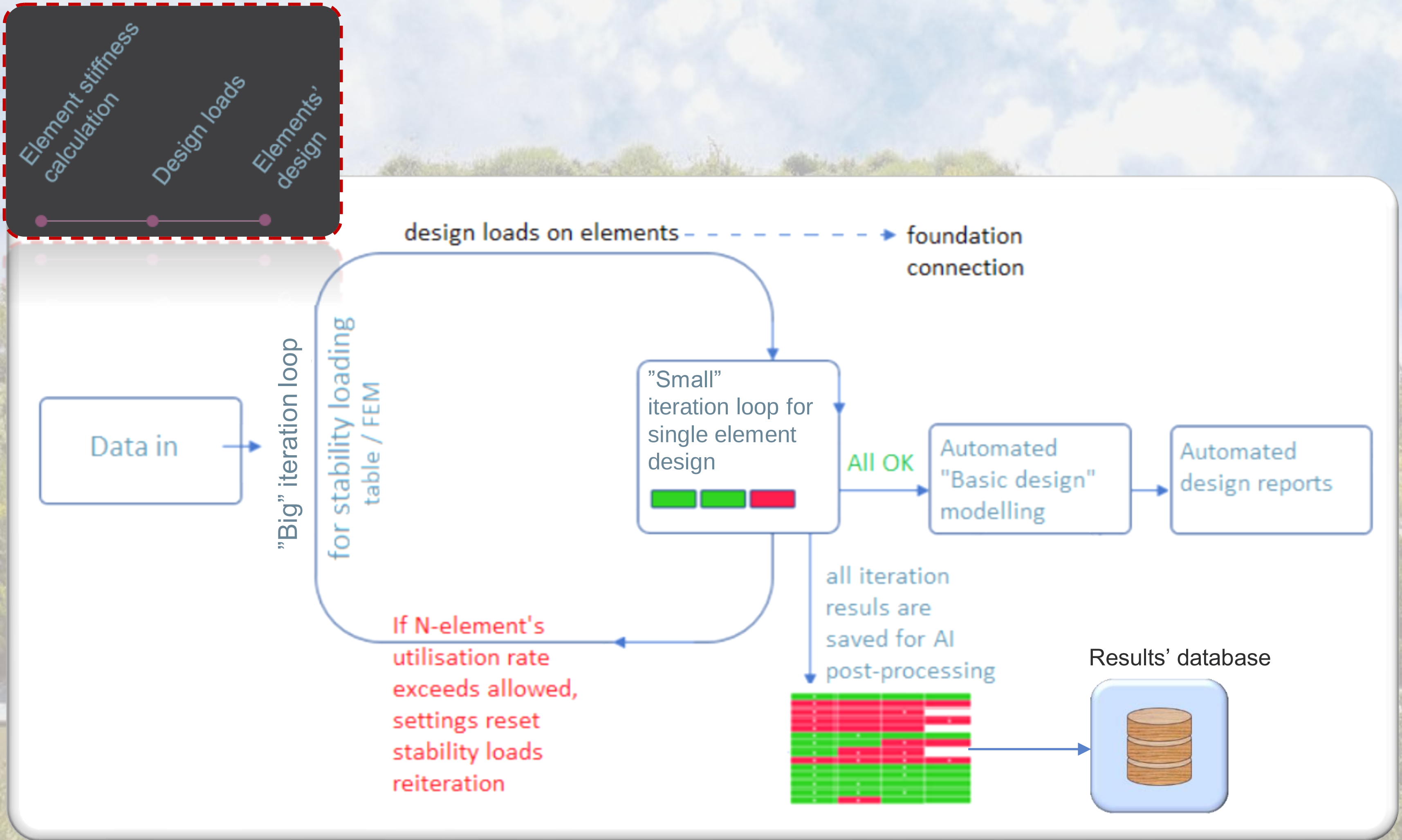
DATAFLOW STRUCTURE… BENEFITS

On example of the prototype stability calculation strategy



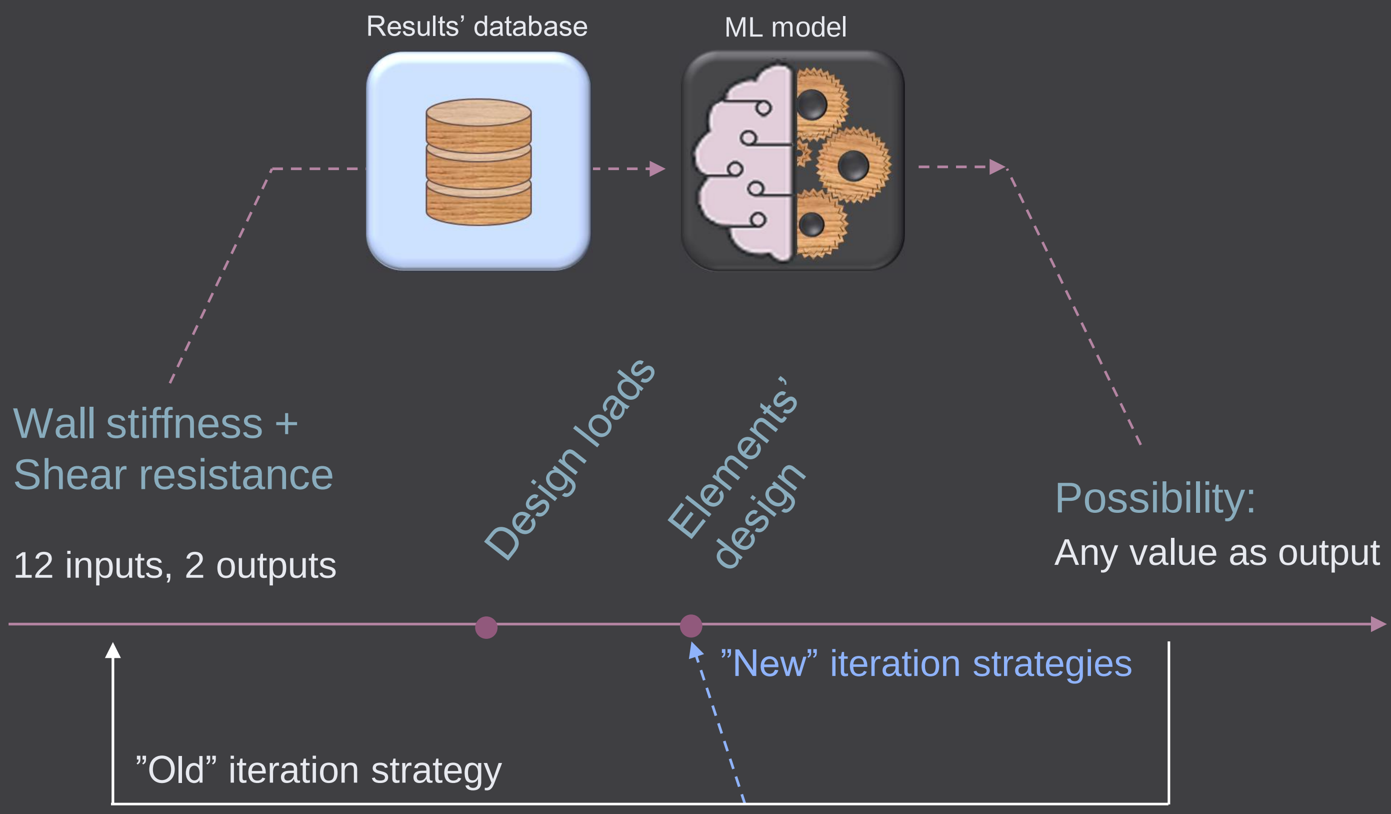
ZOOM INTO THE DETAILS

Iteration features and machine learning-enabling features



ZOOM DEEPER

Theory development to enhance iterations: early stage



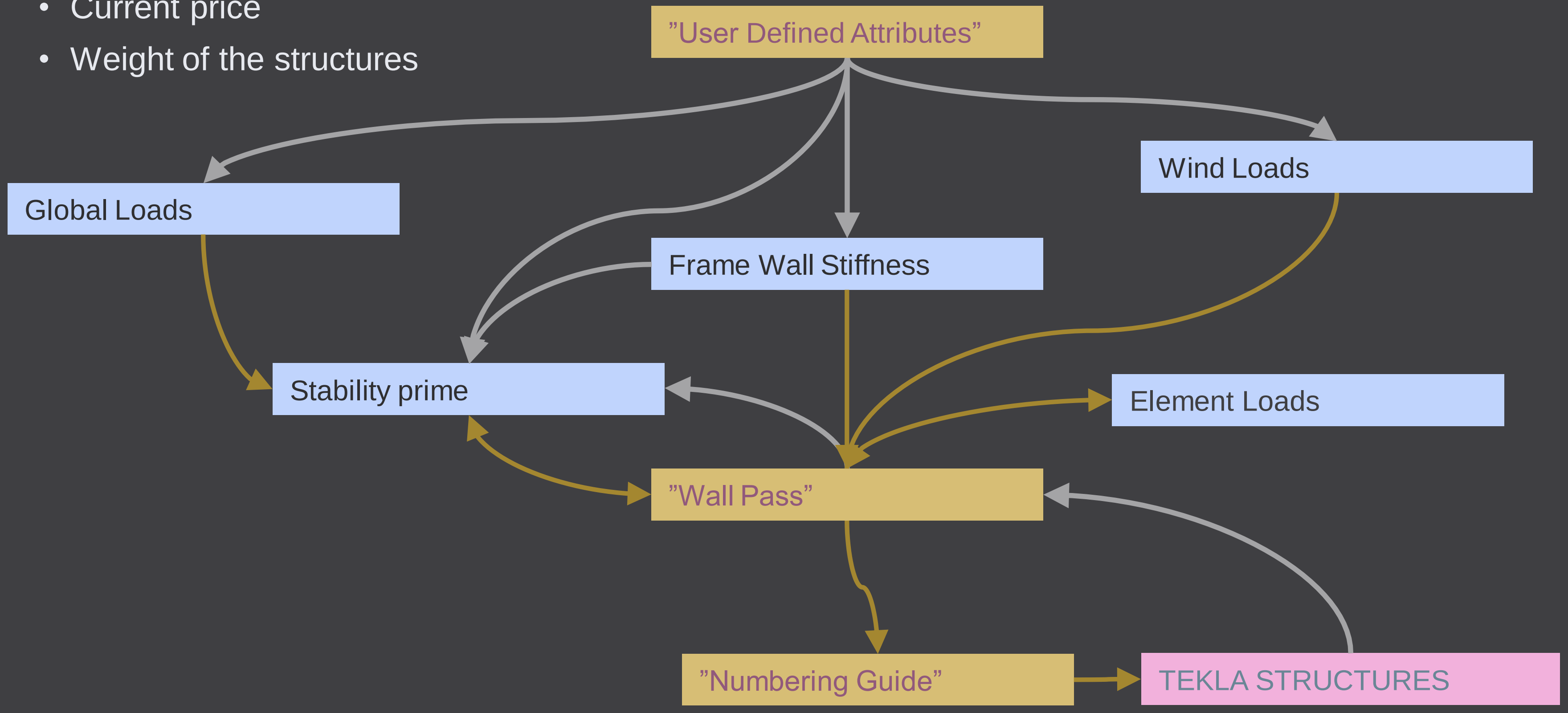
SWECO

OPTIMIZATION: COMPLEXITY CHALLENGE

Structured data collection for postprocessing and analytics purposes

Design process data is collected for the optimization criteria including:

- Load-bearing properties
- Current price
- Weight of the structures

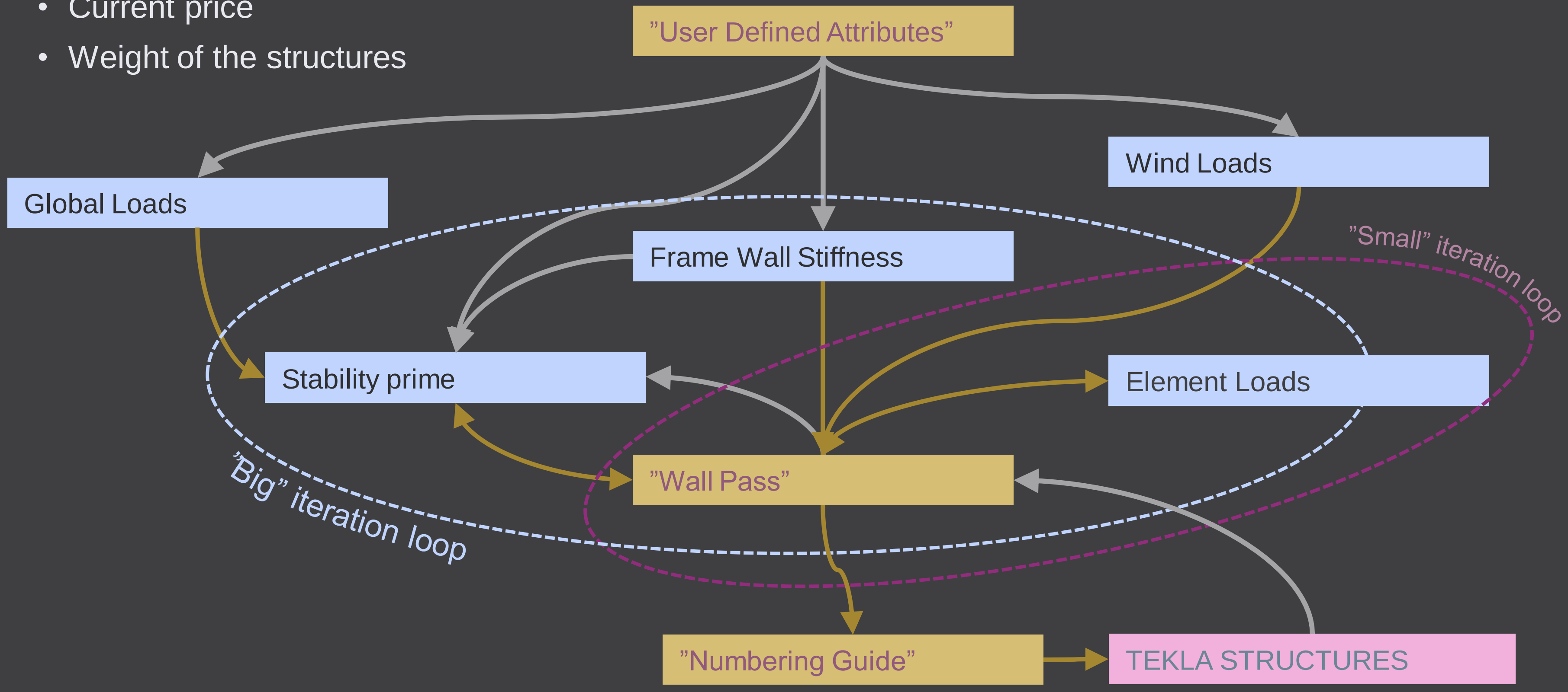


OPTIMIZATION: COMPLEXITY CHALLENGE

Structured data collection for postprocessing and analytics purposes

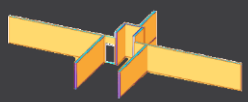
Design process data is collected for the optimization criteria including:

- Load-bearing properties
- Current price
- Weight of the structures



FURTHER DEVELOPMENT

Case: connectivity enhancement of the prototype calculation strategy

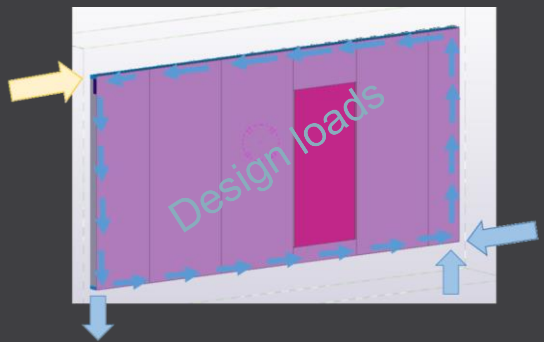


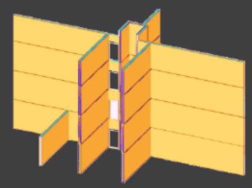
Tekla Structures

2

3

Geometry extraction





Tekla Structures

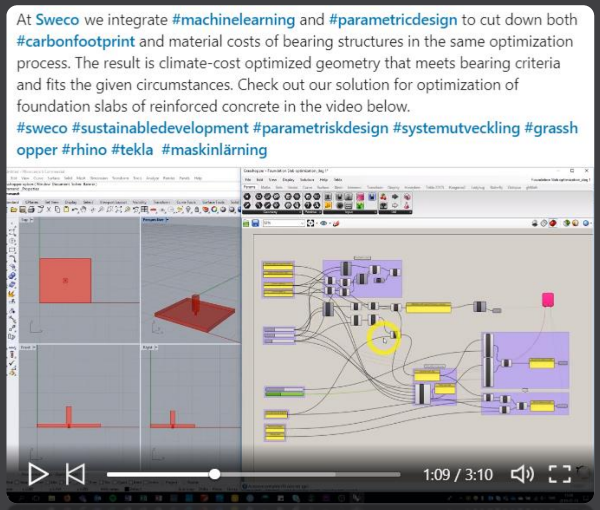
2

3

Automated modelling

Designer's interface

Design loads on foundation

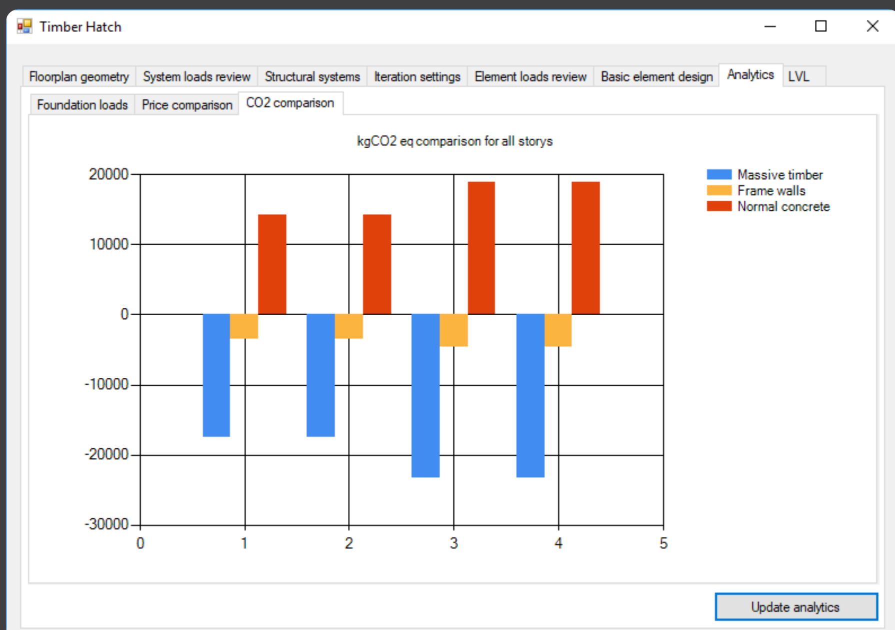


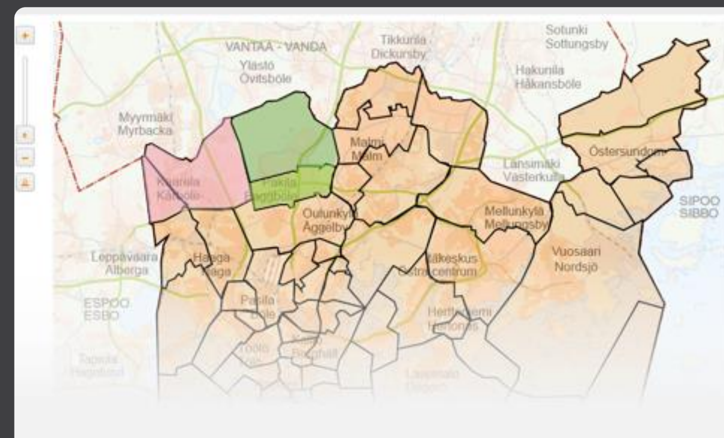
Foundation design
including environmental analytics

SUSTAINABILITY: NEW DATA FRONTIER

Case: C# Tekla – Excel plugin, available at early design stages

- Click-select parts in Tekla model
- Print the evaluation of carbon dioxide impact for three different structural systems





GIS-interface for areas' general planning

This sheet is for type US1a (CLT)

	part	Material	Area (relative) m2	Thickness mm	Density kg/m3	Greenhouse Gas Emissions gCO2 eq/kg
1	Facade	Facade product:	21,7183	23,00	495,00	70,00
2	Studs	Saw products	3,4387	32,00	480,00	70,00
3	Insulation	Mineral Wool	21,7183	180,00	35,00	990,00
4	CLT	CLT	21,7183	120,00	490,00	380,00
5	Boarding	Gypsum	21,7183	18,00	728,00	390,00

Further development includes profile library development

SWECO

FURTHER DEVELOPMENT
external prerequisites

Numerous issues with bringing together different design metodics (joining structural systems in the same stability calculations)

- Non-linearity of sound insulation in timber projects
- Quantatively aligned material values / elements’ stiffness
- Digitally readable uniform connectors’ properties databases
- Precision of joint deflection modelling (also for reusable concrete elements)

Specifically better (lightweight) ways to define timber assemblies (frame walls) and composites as 2d parts in FEM applications need to be refined to streamline industrial applications

THANK YOU!

(kiitos!)

…and questions?

SWECO