BIM-SPEED

Harmonized Building Information Speedway for Energy-Efficient Renovation

Timo Hartmann (TUB)

Consortium


Technische
Universität
Berlin
berlin


DEMO
CONSULTANTS


CSTB
le futur en construction


[TECHNOLOGY CENTRE] CARTIF


cype
SOFTWARE


planen bauen
4.0


stress


BE
ty intelligence


ARCHITECTURAL SPIES


UNS
UNSTUDIO
AMSTERDAM • SHANGHAI • HONG KONG


Mostostal
WARSZAWA


visesa


REHVA
Federation of
European Heating,
Ventilation and
Air-conditioning
Associations


FIEC


FASADA


HOCHTIEF
ViCon


ARCADIS


LKS


EBC
CONSTRUCTION SMEs EUROPE

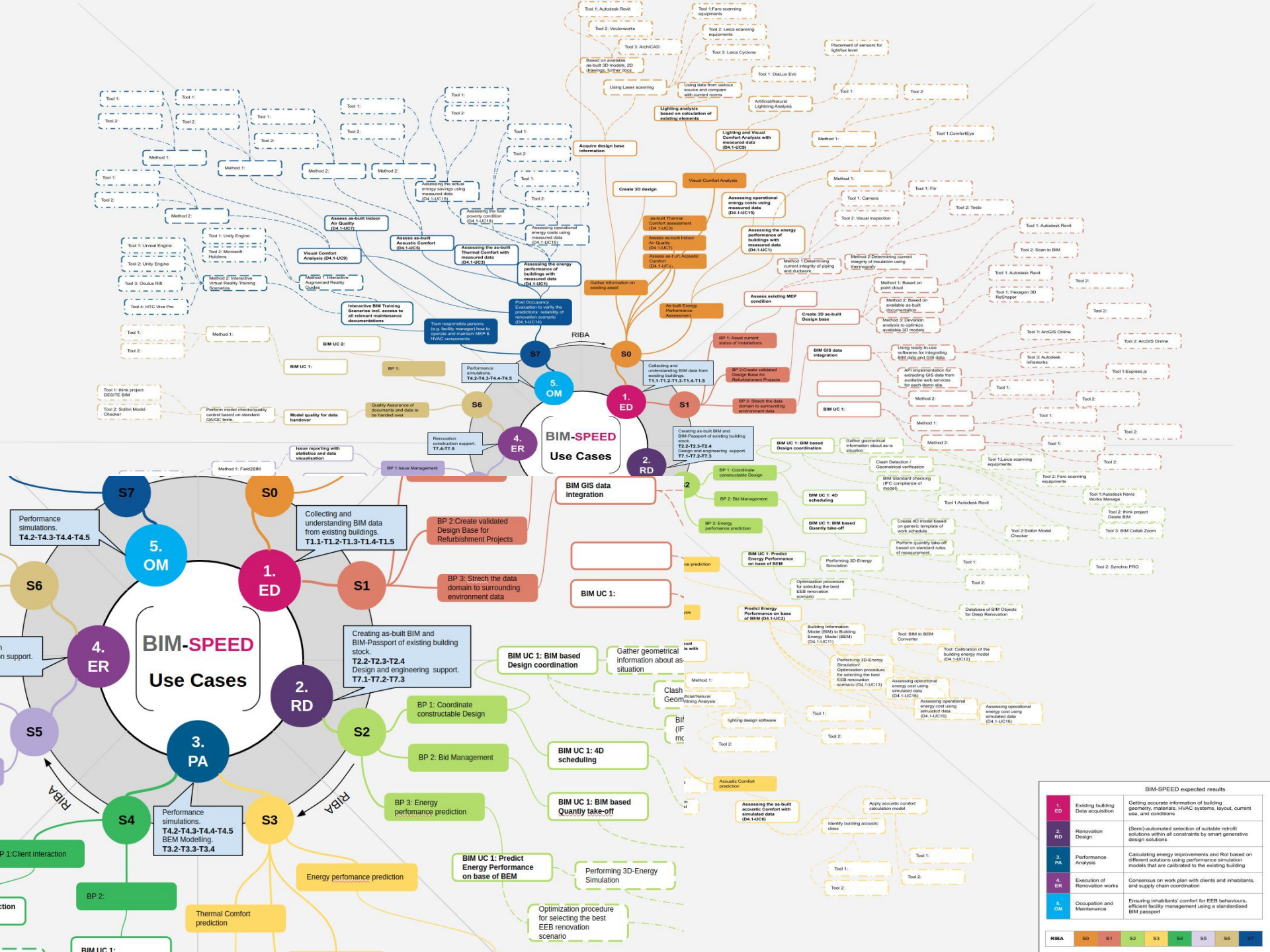

Erasmus
University
Rotterdam

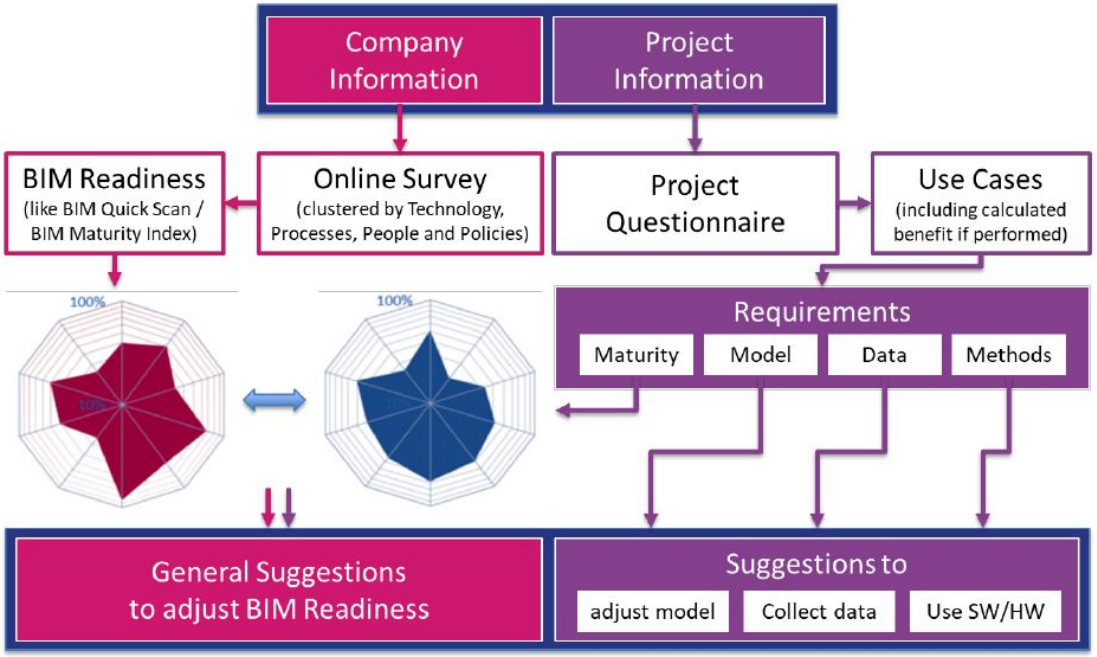

METABUILD

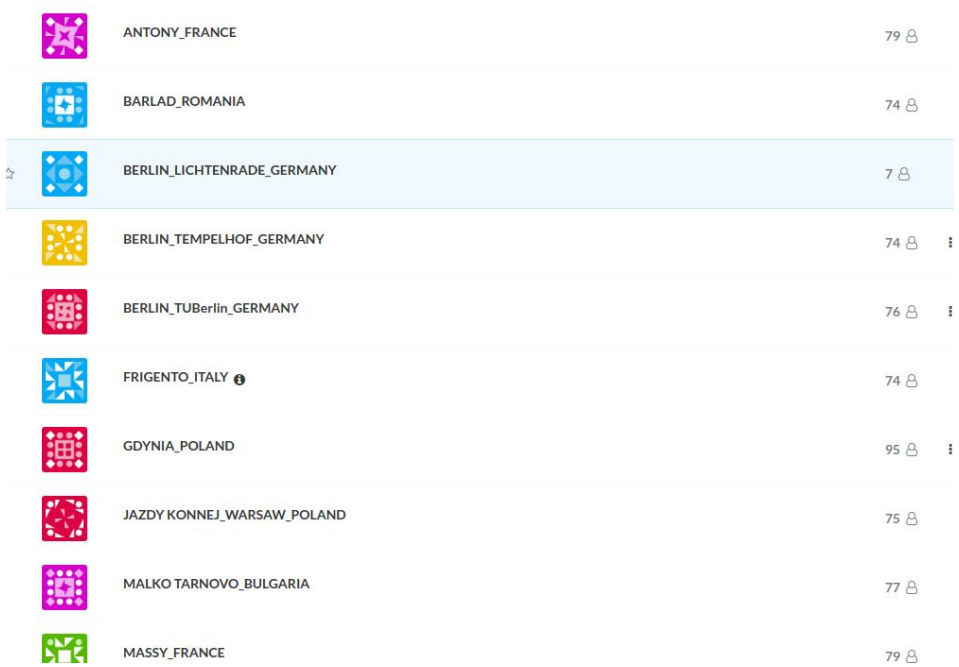
BIM- SPEED OBJECTIVES

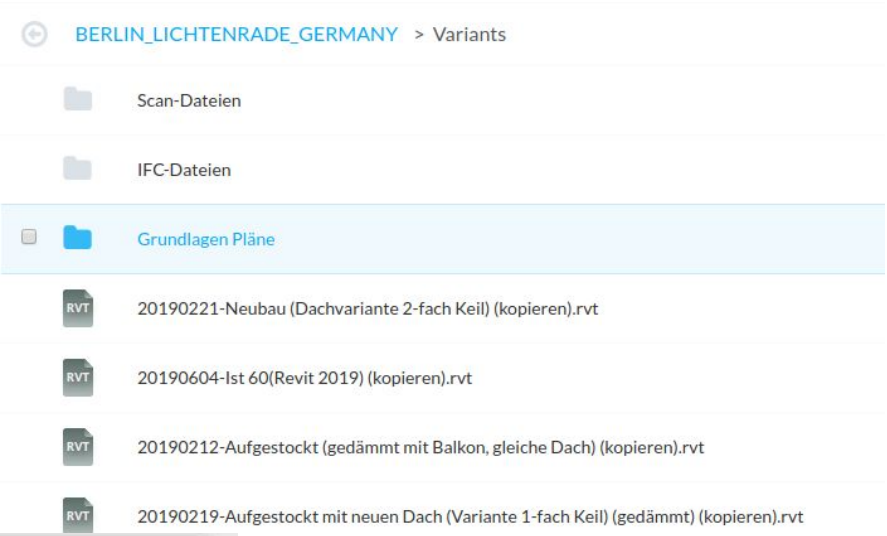
BIM- SPEED will provide all stakeholders in the housing renovation market with holistic solutions:

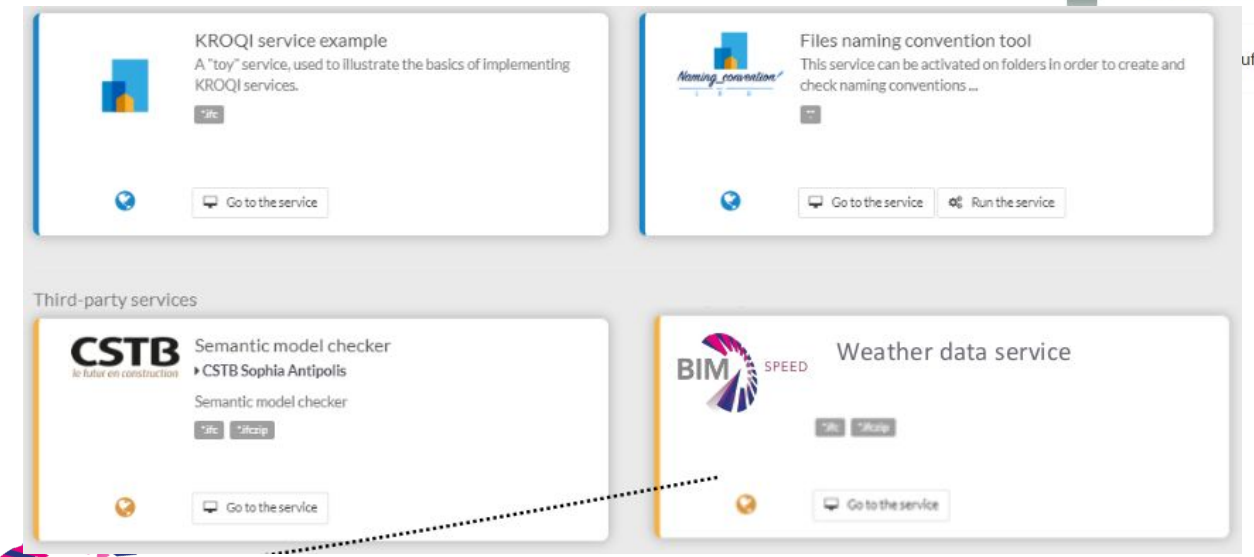
1. **An affordable cloud-base BIM platform**
2. **A set of inter-operable BIM tools**
3. **Validation and standardised procedures for implementing renovation solutions with guaranteed energy performance and inhabitants' comfort**


BIM-SPEED
Use Cases
1. ED
2. RD
3. PA
4. ER
5. OM
S0
S1
S2
S3
S4
S5
S6
S7
RIBA
Performance simulations. T4.2-T4.3-T4.4-T4.5
Collecting and understanding BIM data from existing buildings. T1.1-T1.2-T1.3-T1.4-T1.5
BP 2:Create validated Design Base for Refurbishment Projects
BP 3: Strech the data domain to surrounding environment data
Creating as-built BIM and BIM-Passport of existing building stock. T2.2-T2.3-T2.4 Design and engineering support. T7.1-T7.2-T7.3
BP 1: Coordinate constructable Design
BP 2: Bid Management
BP 3: Energy perfomance prediction
Performance simulations. T4.2-T4.3-T4.4-T4.5 BEM Modelling. T3.2-T3.3-T3.4
BIM GIS data integration
BIM UC 1: BIM based Design coordination
Gather geometrical information about as-situation
BIM UC 1: 4D scheduling
BIM UC 1: BIM based Quantity take-off
BIM UC 1: Predict Energy Performance on base of BEM
Performing 3D-Energy Simulation
Optimization procedure for selecting the best EEB renovation scenario
Energy perfomance prediction
Thermal Comfort prediction
BIM UC 1:
BP 2:
P 1:Client interaction
BIM-SPEED expected results
1. ED
Existing building Data acquisition
Getting accurate information of building geometry, materials, HVAC systems, layout, current use, and conditions
2. RD
Renovation Design
(Semi)-automated selection of suitable retrofit solutions within all constraints by smart generative design solutions
3. PA
Performance Analysis
Calculating energy improvements and RoI based on different solutions using performance simulation models that are calibrated to the existing building
4. ER
Execution of Renovation works
Consensus on work plan with clients and inhabitants, and supply chain coordination
5. OM
Occupation and Maintenance
Ensuring inhabitants' comfort for EEB behaviours, efficient facility management using a standardised BIM passport
RIBA
S0
S1
S2
S3
S4
S5
S6
S7


Company Information
Project Information
BIM Readiness
(like BIM Quick Scan / BIM Maturity Index)
Online Survey
(clustered by Technology, Processes, People and Policies)
Project Questionnaire
Use Cases
(including calculated benefit if performed)
100%
100%
Requirements
Maturity
Model
Data
Methods
General Suggestions to adjust BIM Readiness
Suggestions to
adjust model
Collect data
Use SW/HW







https://bimspeed.kroqi.fr/login/#/


LAS VEGAS USA
JACK
DEWALT
AIR FORCE
Ford
FUSION


CityGML
gbXML
GMAO
MERRA-2
Reno-Inst Ontology:
An ontology for installation of components in building renovation projects
LCA-C Ontology:
An ontology for LCA/LCC assessments in renovation projects
BEM-Reno Ontology:
An ontology for BEM development in renovation projects
ThingsBoard


magictouch
UÇANOK
TRI-ACE
GİZAL GARAJ
BRAKING
MoTeC
Nitto
OS GIKEN

BIM Speed HVAC DL inference

BIM SPEED

[TECHNOLOGY CENTRE] CARTIF

Model Folder

Resnet101

Backend

OPENCV

Target

CPU

Confidence: 0,15

NMS: 0,5

Size: 700 X 700

Inference

Save Results

Remove

Image number: 33

Image Validation (22).jpg

Inference (ms): 6688,55

Id	Class	Confidence
0	Boiler	1,000
1	Radiator	0,258

Resnet101

OPENCV

CPU

Confidence: 0,15

NMS: 0,50

Size: 700 X 700

Behavioral digital twin

Data collection

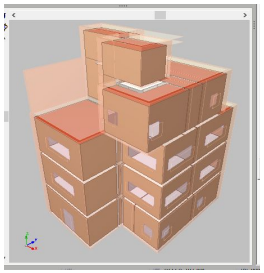
Objective measurements

Dynamic measurements

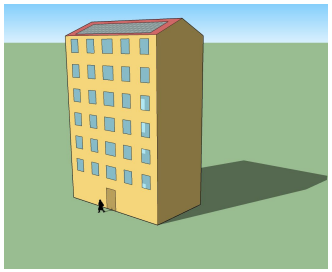
Subjective measurements

Energy and IEQ data

BIM

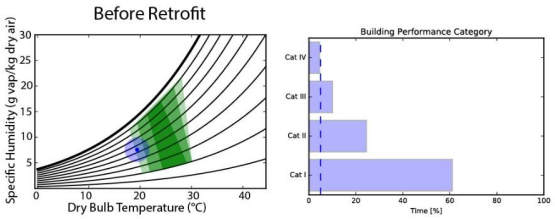


Building simulation Energy, Lighting, Accoustic



Performance assessment

AS-IS scenario



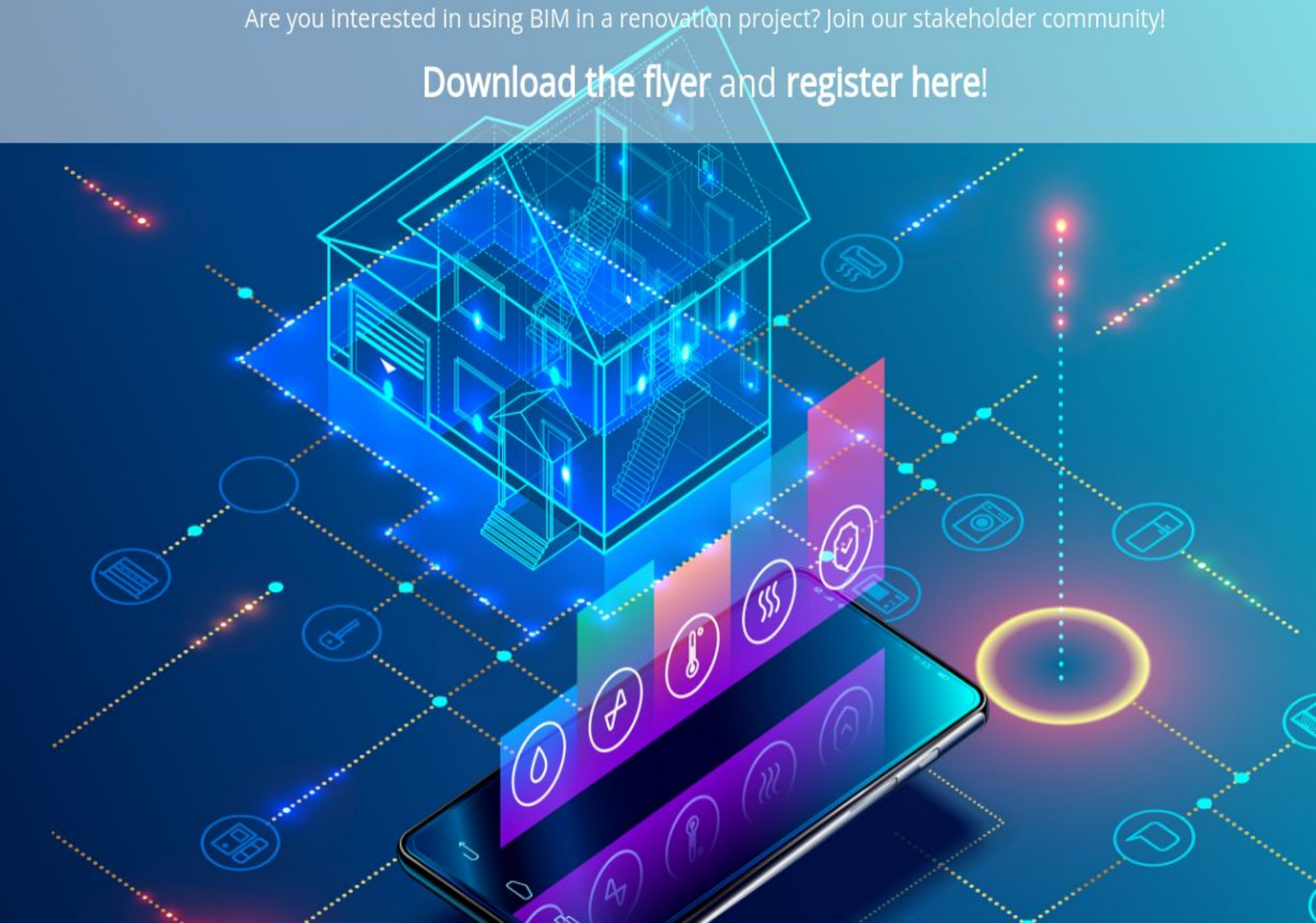
Sensitivity Analysis

Renovation scenarios

BIM Speed competition
13 Demonstration Projects
Standardization, Dissemination, and Exploitation

Are you interested in using BIM in a renovation project? Join our stakeholder community!

Download the flyer and **register here**!



COLOPHON

28.10.2020

Project Pitch at Sustainable Places

TUB

https://www.bim-speed.eu/

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BIM-SPEED INDUSTRY DAY

BIM-SPEED COMPETITION

26 November 2020 - Spyridon Pantelis (REHVA)

AGENDA

- Goals & Objectives
- Competition Overview
- Eligible Participants
- Application
- Competition Tasks
- Available Tools
- Deliverables
- Awards
- Timeline

GOALS & OBJECTIVES

- Promote the BIM-SPEED platform beyond consortium
- Promote the integrated/featured tools of partners and help them reach a wider audience
- Receive user/market feedback on the platform and tools to develop them further

COMPETITION OVERVIEW

- The competition aims to invite **professionals and students active in the design and construction industry** to present a **residential building** renovation project that applies the **BIM tools and methods** developed by the BIM-SPEED partners

- The challenge is to **develop a renovation project** (using BIM-SPEED platform for collaboration) in a way that allows **energy saving for the occupants**, improves their **comfort** while **reducing the time and the cost** of the overall process

ELIGIBLE PARTICIPANTS

- Architects
- Engineers (civil, HVAC, mechanical etc.)
- Contractors
- Surveyors
- Students

Teams of professionals/students

No individual applications

APPLICATION

Minimum requirements	Application via BIM-SPEED website
	Multidisciplinary team (not individuals)
	Renovation of Residential Buildings
	Energy Savings category
	Use BIM-SPEED platform
	Use at least one of the BIM-SPEED tools

COMPETITION TASK

Evaluation criteria	Collaboration during the project: use of BIM-SPEED platform
	Time and cost savings in the project by using the platform
	Use of the BIM-SPEED tools
	Renovation design applying sustainable strategies
	User comfort
	User involvement

AVAILABLE BIM –SPEED TOOLS

Possible tools to be used for the competition

- CYPE Architecture
- IFC Builder
- Open BIM Construction Systems
- Open BIM analytical model
- CYPETHERM Eplus
- CYPETHERM Improvements Plus
- GIS data collector service
- 3DASH plug-in
- Thingsboard (IoT platform) proxy service
- Thingsboard (IoT platform) exporter
- ECOtool
- BIMtoBEPS
- Indoor environmental quality KPIs
- MEREEN weather service

DELIVERABLES

Different types of professionals and teams..

...comparable deliverables?

- A report
- IFC File
- Visual material

AWARDS

Considered awards for making the competition more attractive…

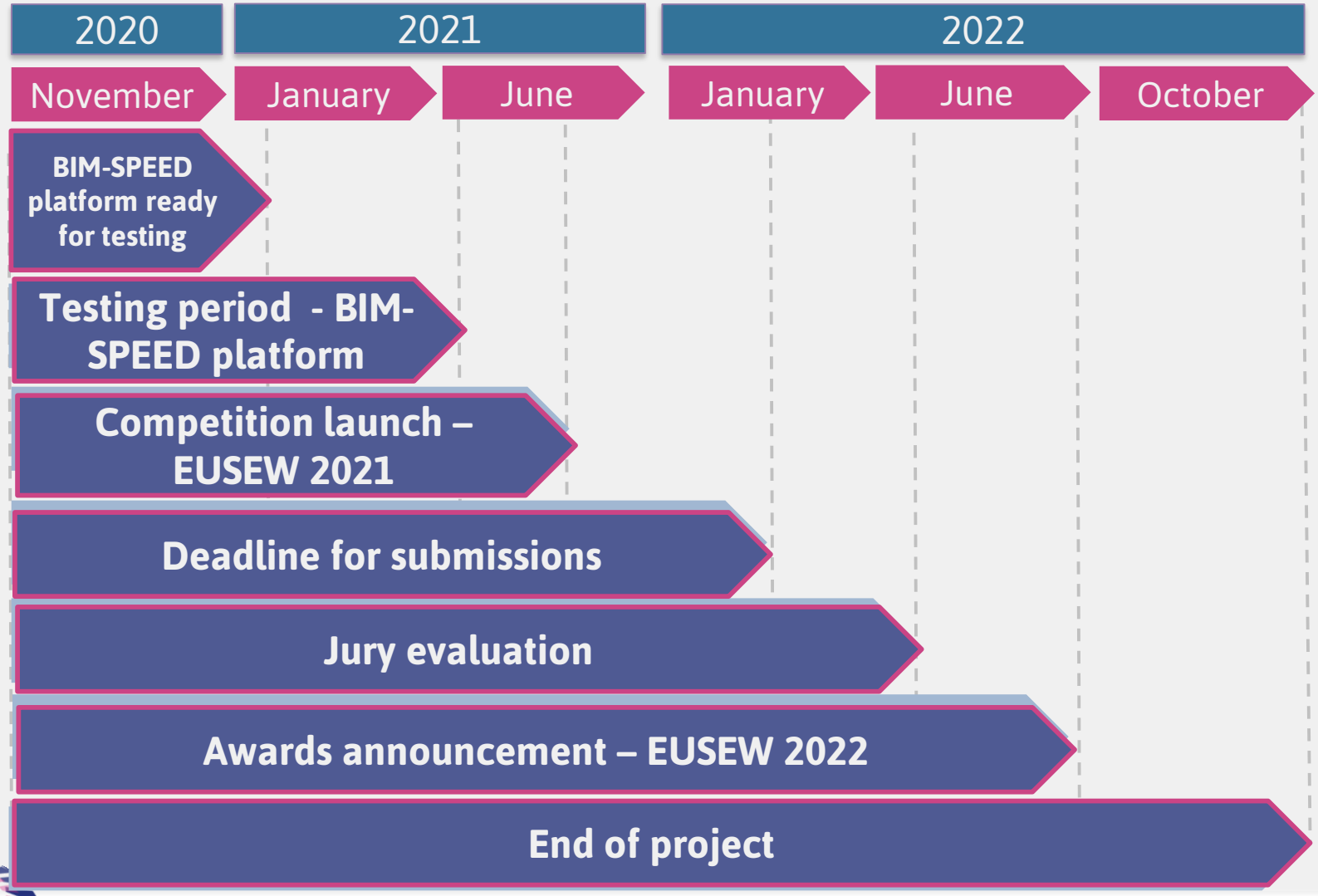
PROFESSIONALS

- EU-wide exposure through BIM-SPEED professional groups and dissemination channels
- Monetary awards
- Free educational licence for BIM tools
- Free licence for BIM-SPEED platform

- EU-wide exposure through BIM-SPEED dissemination channels and network of partners
- Presentation of renovation project on ACE General Assembly
- Presentation of renovation project during EUSEW2022
- 3 months internship in EU Research and Innovation projects

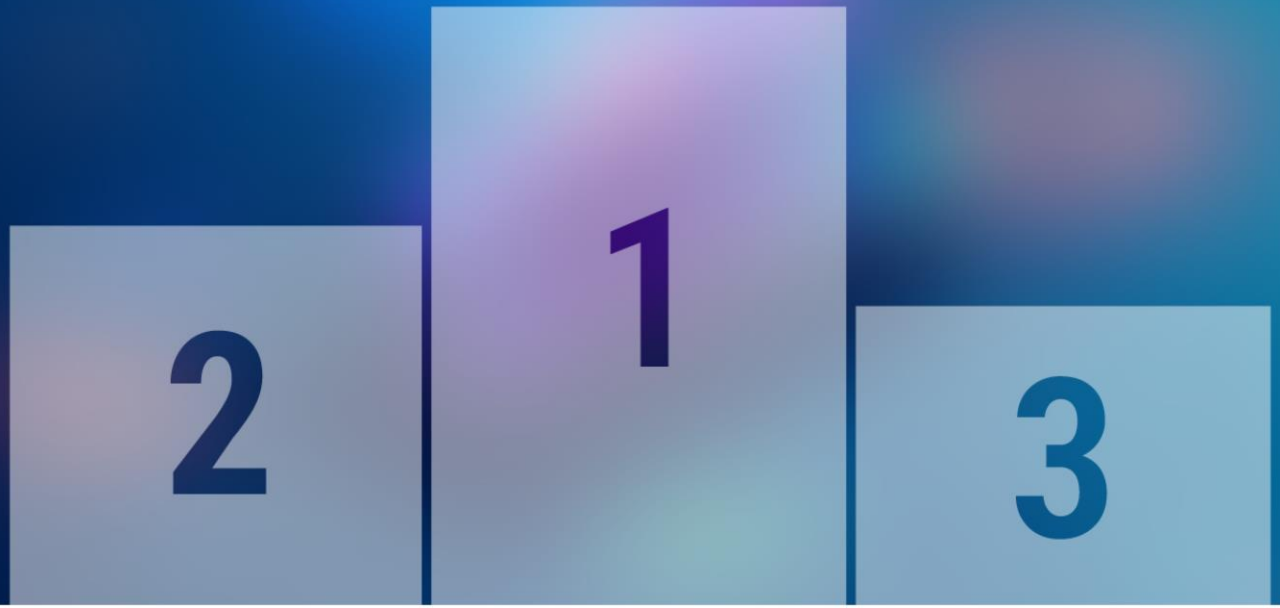
STUDENTS

TIMELINE


2020
2021
2022
November
January
June
January
June
October
BIM-SPEED platform ready for testing
Testing period - BIM-SPEED platform
Competition launch – EUSEW 2021
Deadline for submissions
Jury evaluation
Awards announcement – EUSEW 2022
End of project

BIM-SPEED Competition coming in 2021

More information will follow soon



COLOPHON

THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS?

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BIM-SPEED CLOUD PLATFORM

Nicolas Pastorelly

CSTB
le futur en construction

BIM-SPEED Industry Day 2020

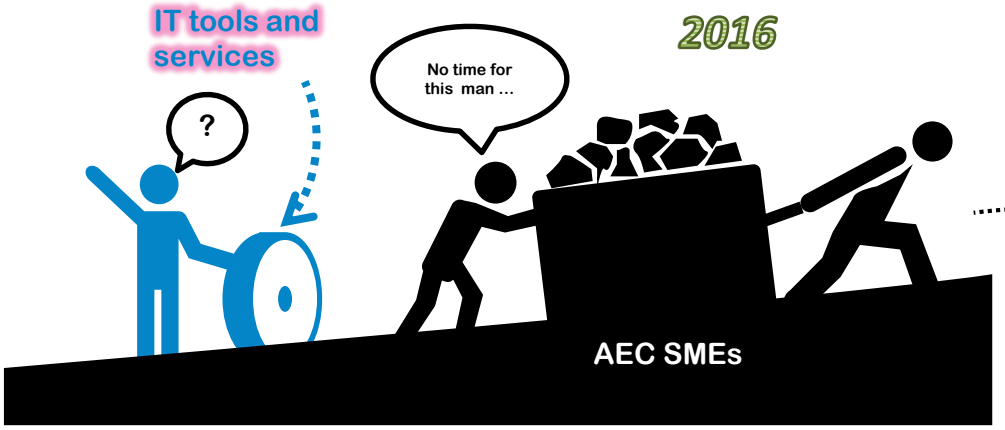
26.11.2020

PRESENTATION OVERVIEW

- BIM-SPEED platform overview & history
- Sample videos
  - Collaboration suite
  - Naming convention service
  - Weather data service
  - GIS data service

  - Videos can be found here along with user guide.

KROQI HISTORY IN THE FRENCH CONTEXT



KROQI PTNB project

- Focus on usage : 30k users

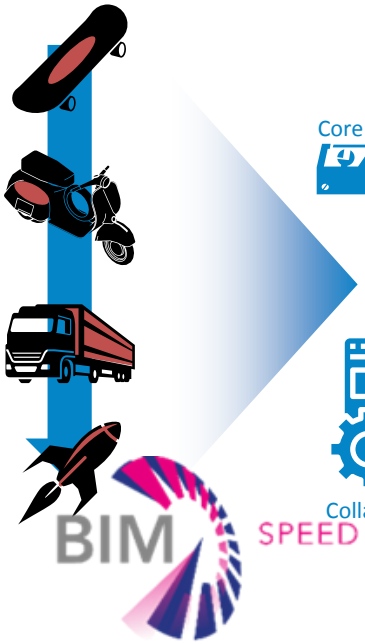
2019

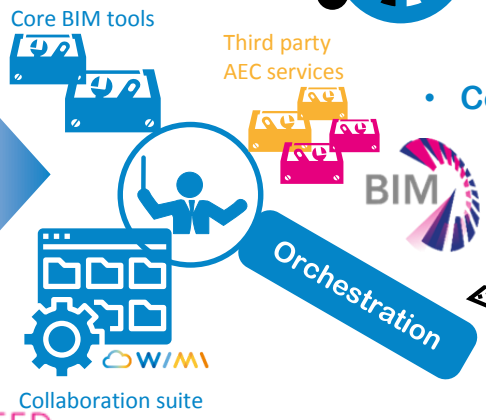
Heterogenous needs

Share files, easy quotation creation

BIM level 3, BIM for operation…

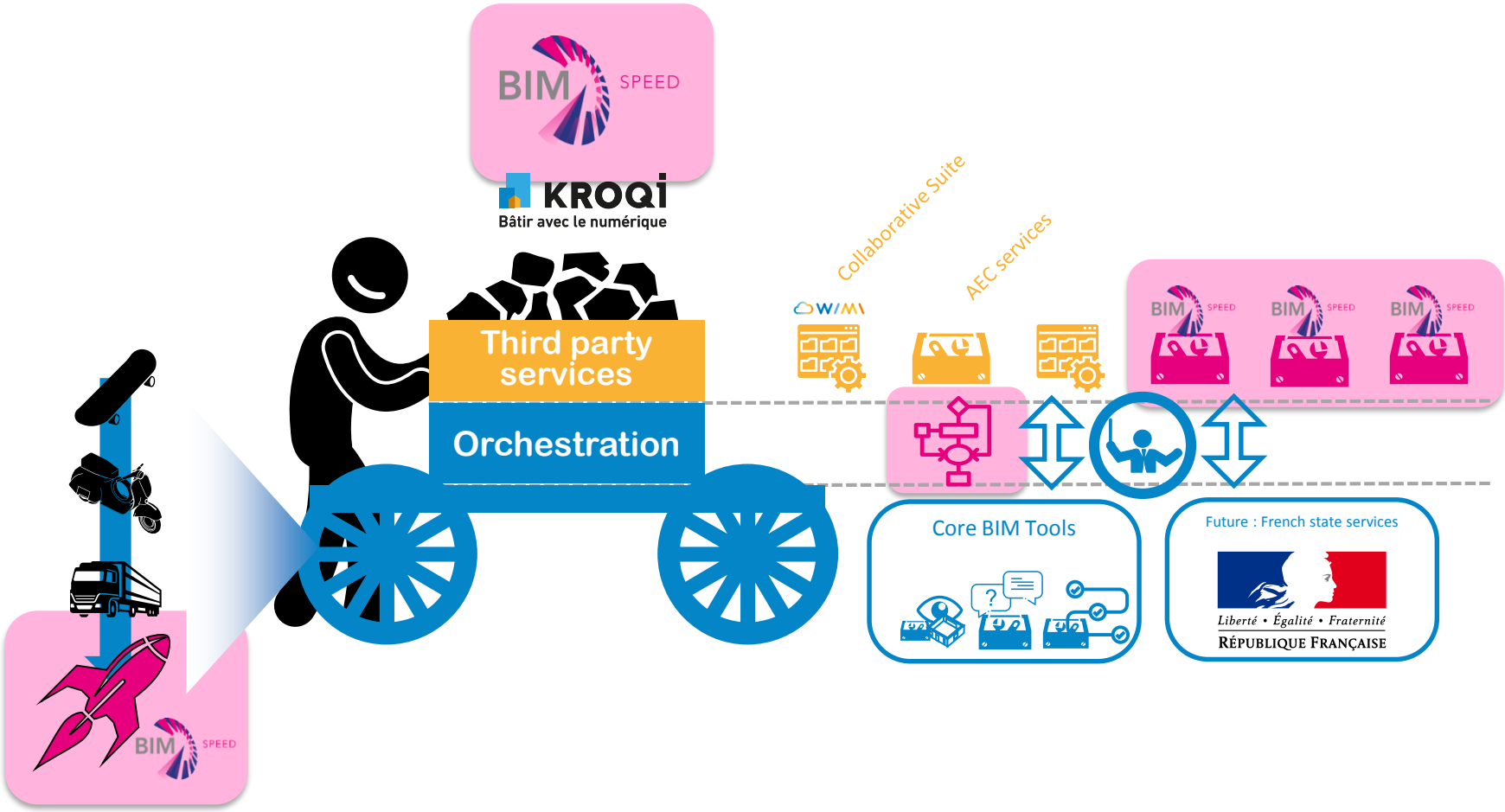
BIM for renovation



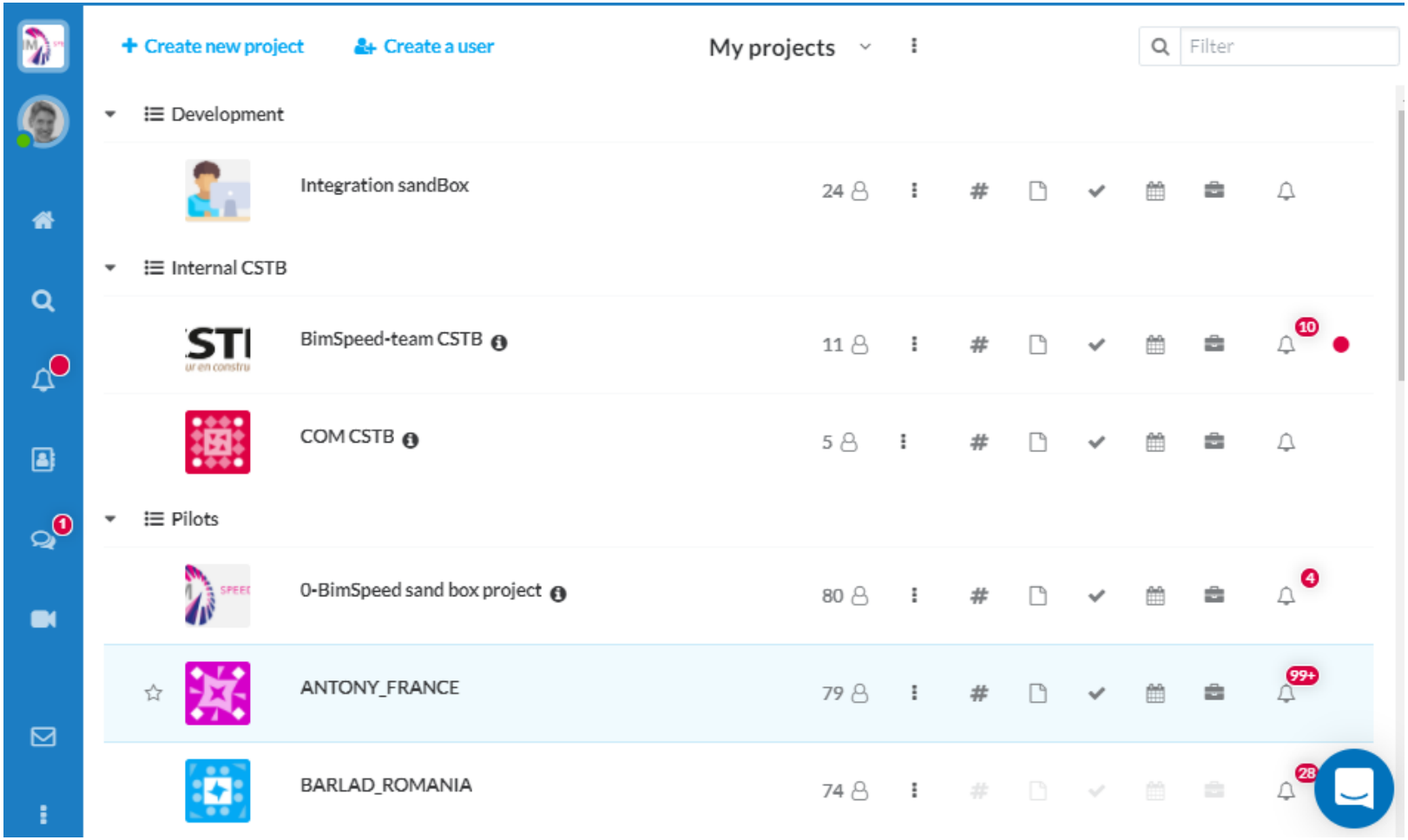


- Core architecture
- Ecosystem promotion

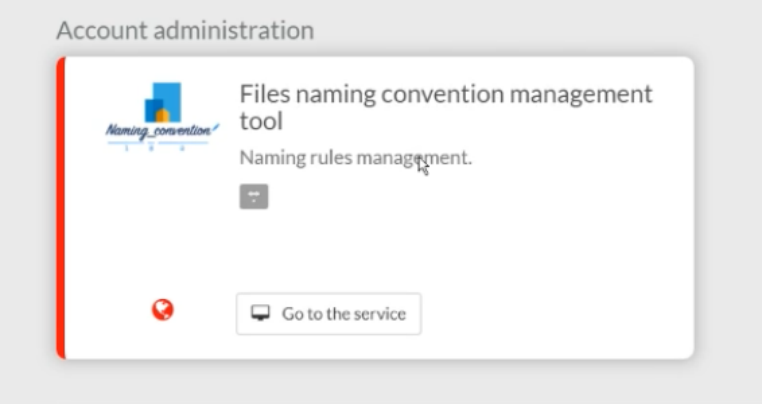
BIM-SPEED PLATFORM & SERVICES

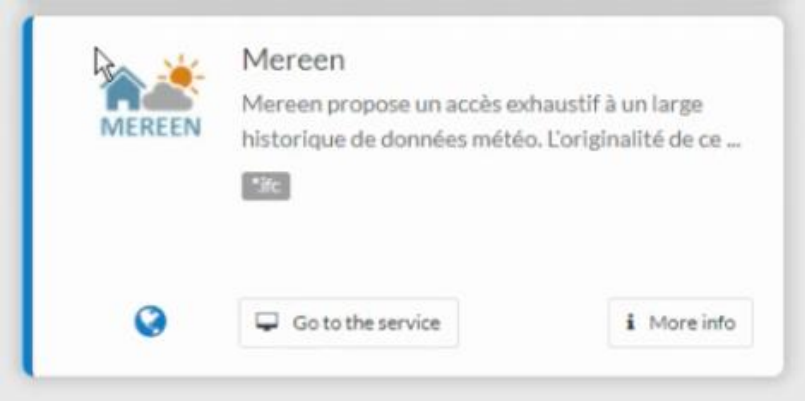


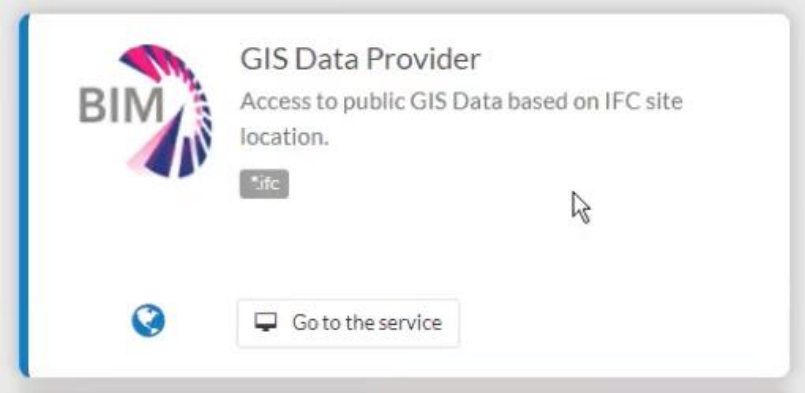
BIM-SPEED COLLABORATION FEATURES



SAMPLE SERVICES



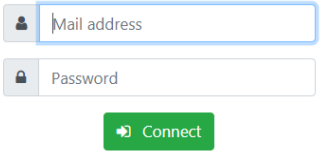




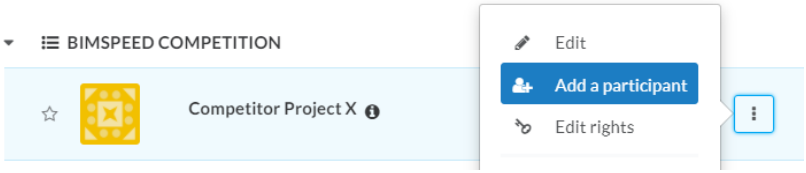
BIM-SPEED COMPETITION PROCESS PREVIEW

- A renovation project manager will be able to register his project for competition on the competition website.

- The BIM-SPEED platform manager will create a project on the BIM-SPEED platform for the applicant *BIM-SPEED.kroqi.fr/#/competitor-project-x/*
  - The Competing-project's administrator will receive BIM-SPEED platform connection credentials



- Competing-project's administrator can manage his project :
  - He connects to his project on the BIM-SPEED platform
  - As project administrator, he can invite any relevant user to collaborate on the platform



- Competing-project's users will then be able to exchange files and use services from the BIM-SPEED platform interface

COLOPHON

26.11.2020

BIM-SPEED Industry Day 2020

Nicolas Pastorelly

Thank you!

Questions?

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OPEN BIM ENERGY ANALYSIS

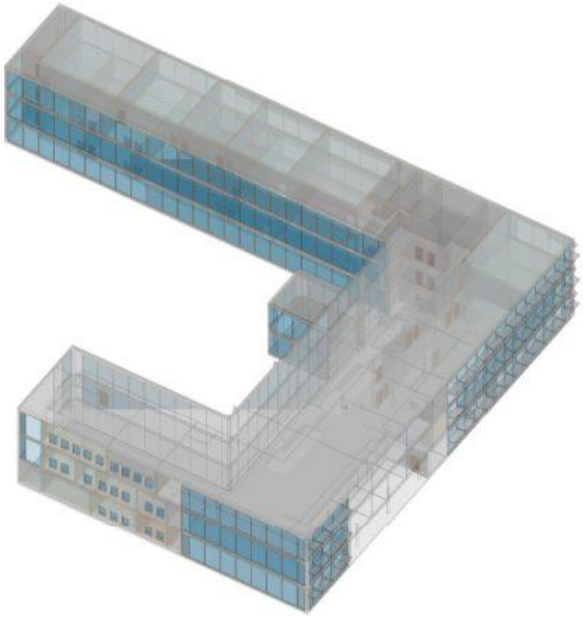
Antonio González Viegas
Architect and BIM developer in CYPE

BIM-SPEED Industry Day 2020
26.11.2020

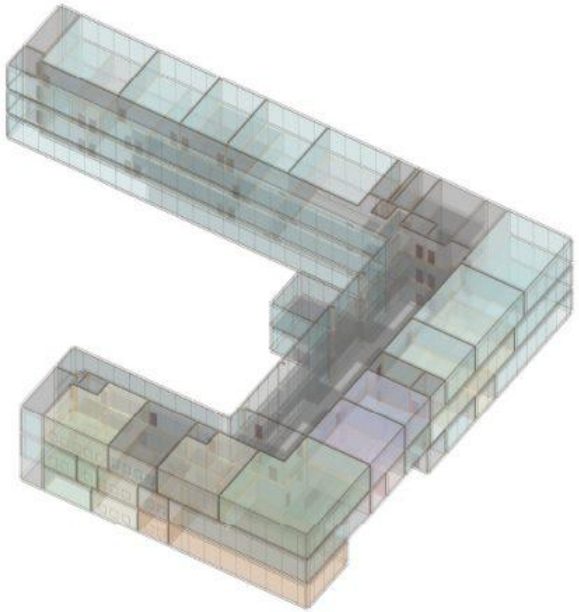
PRESENTATION OVERVIEW

- Open BIM
- Workflow: BIMserver.center
- BEM: Open BIM Analytical Model
- Energy Analysis: CYPETHERM Eplus

OPEN BIM

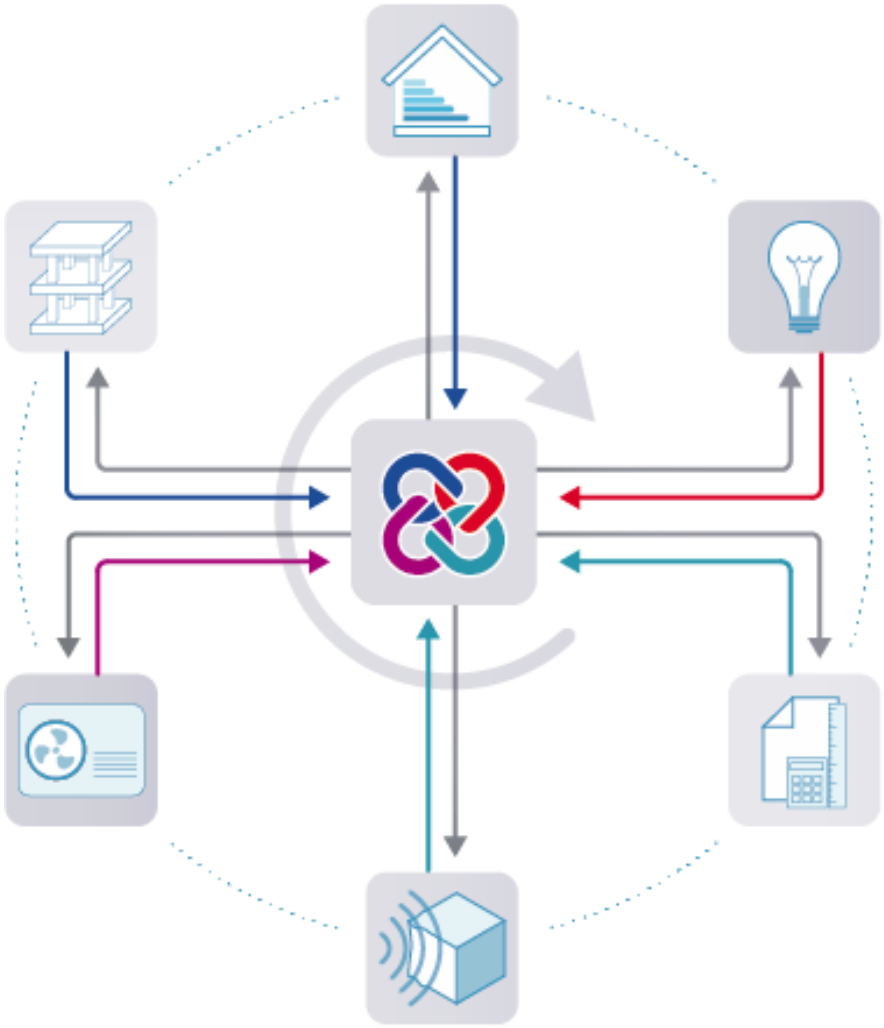


IFC MODEL

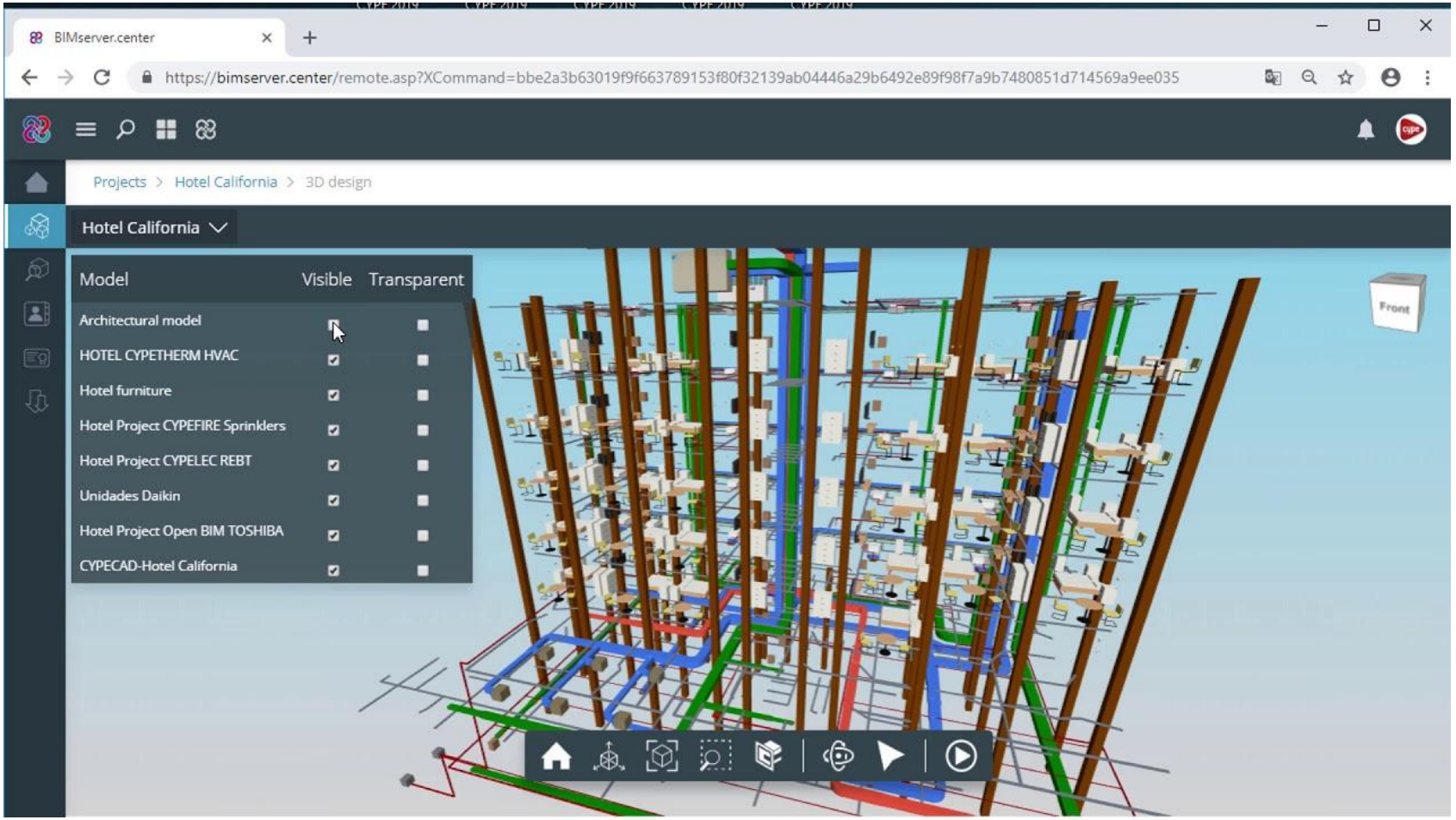


ANALYTICAL MODEL

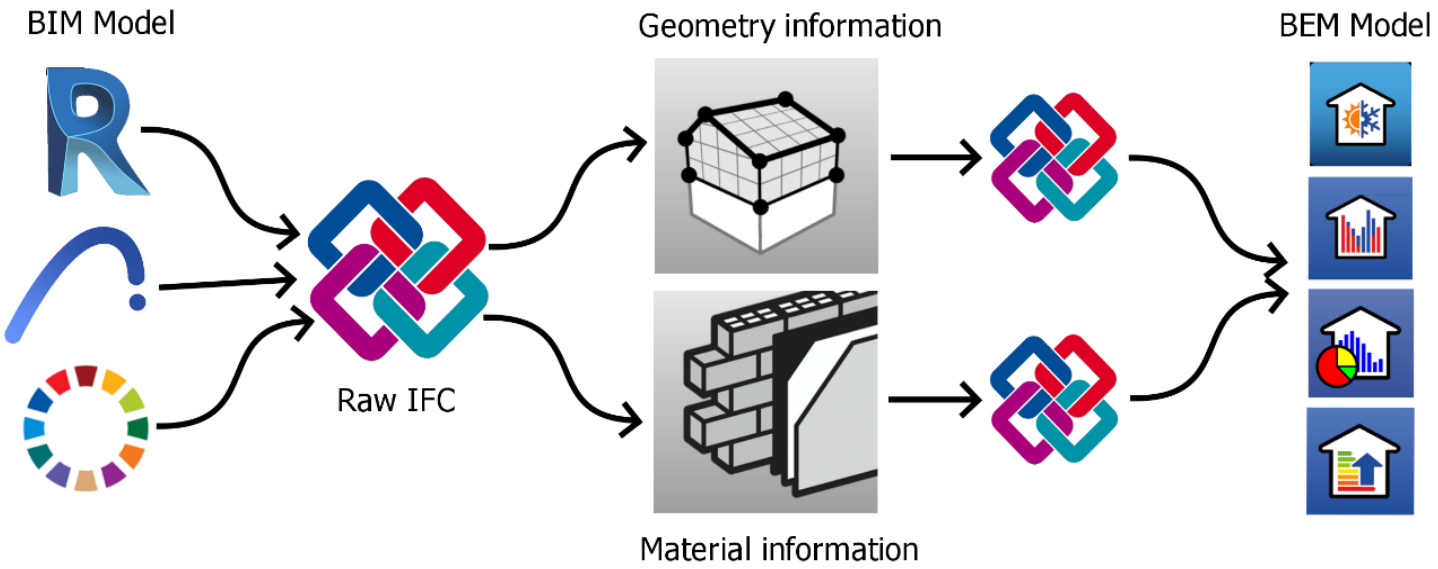
OPEN BIM



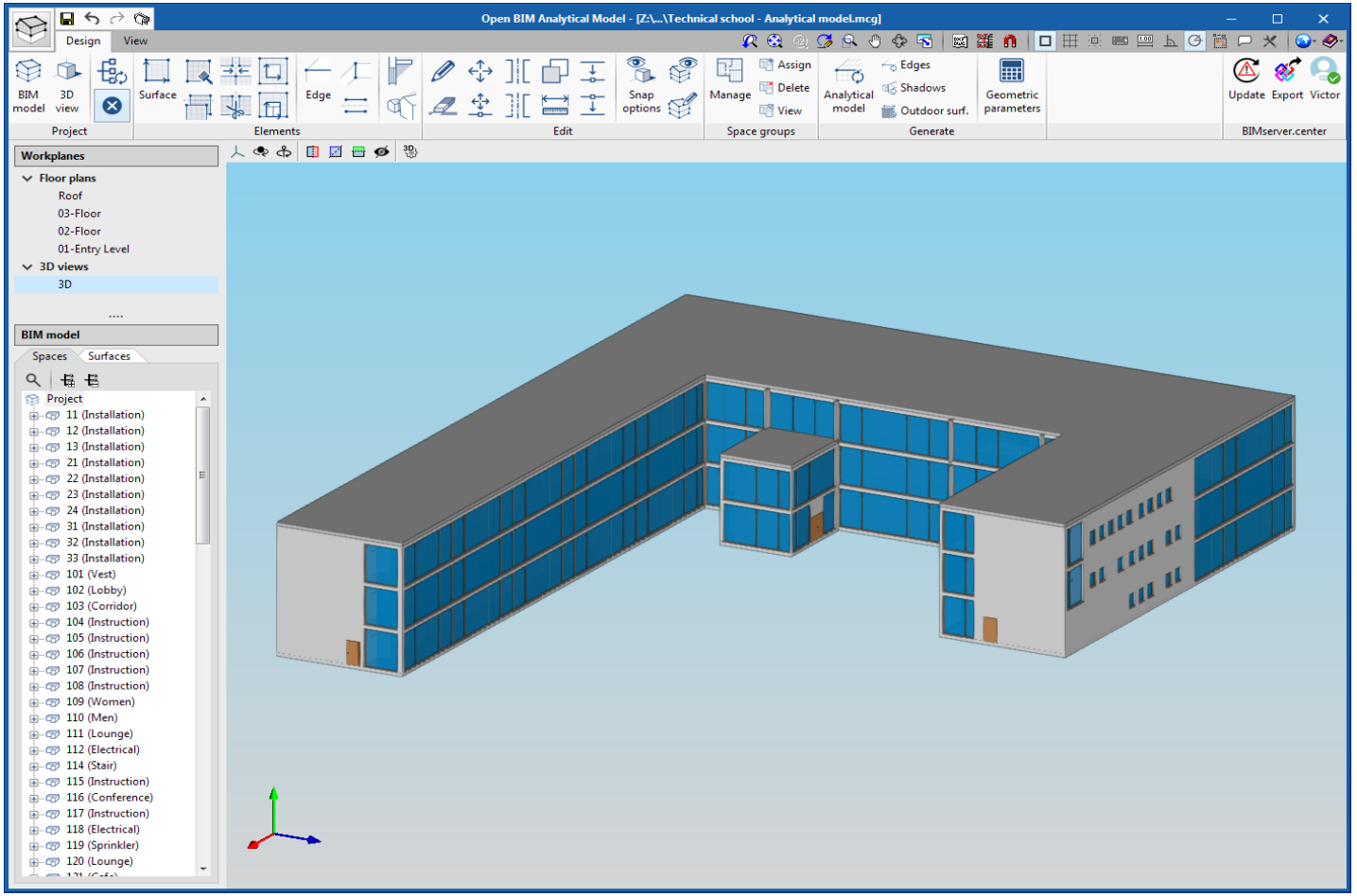
CDE: BIM SERVER CENTER



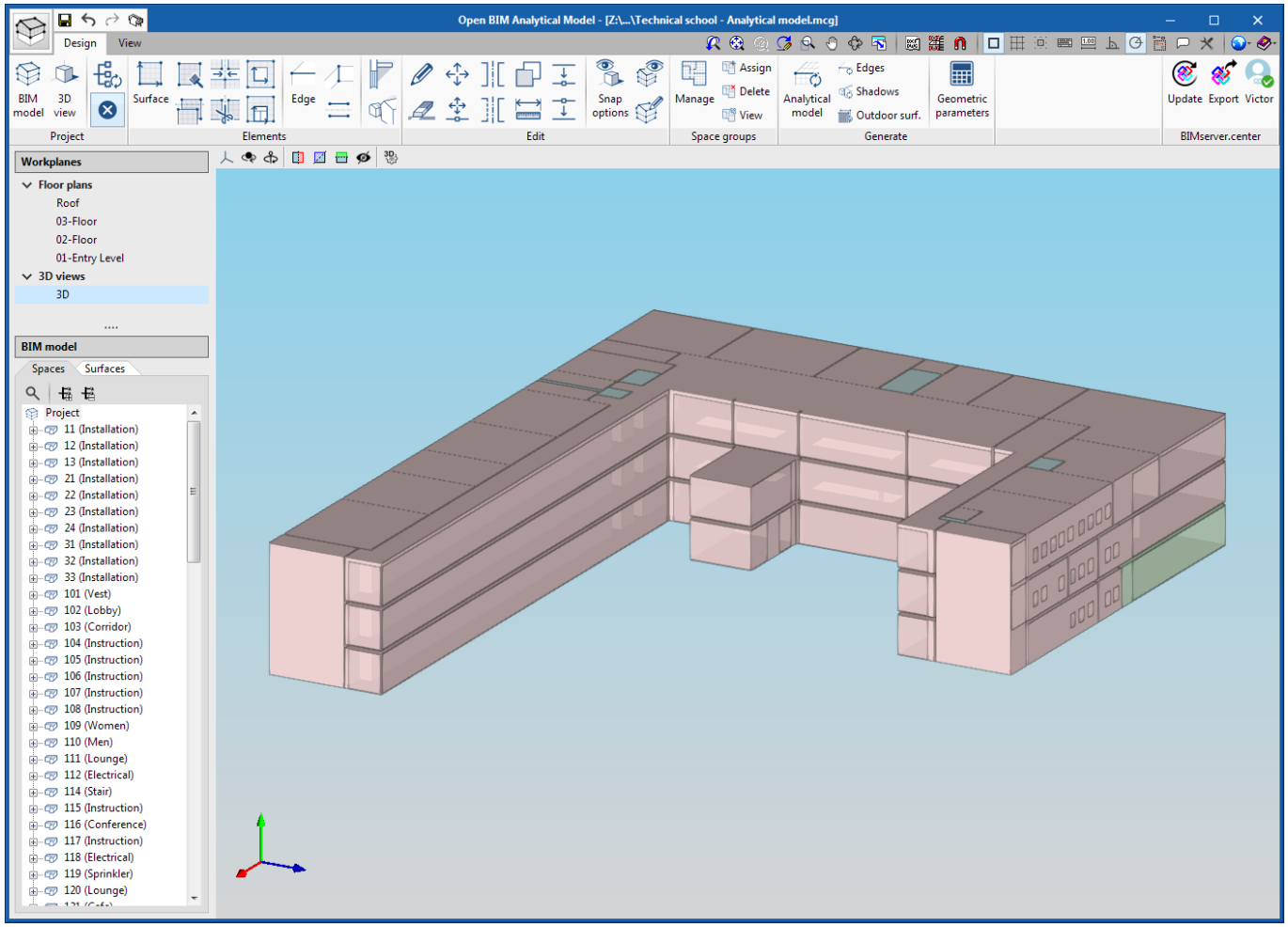
WORKFLOW


BIM Model
Raw IFC
Geometry information
Material information
BEM Model

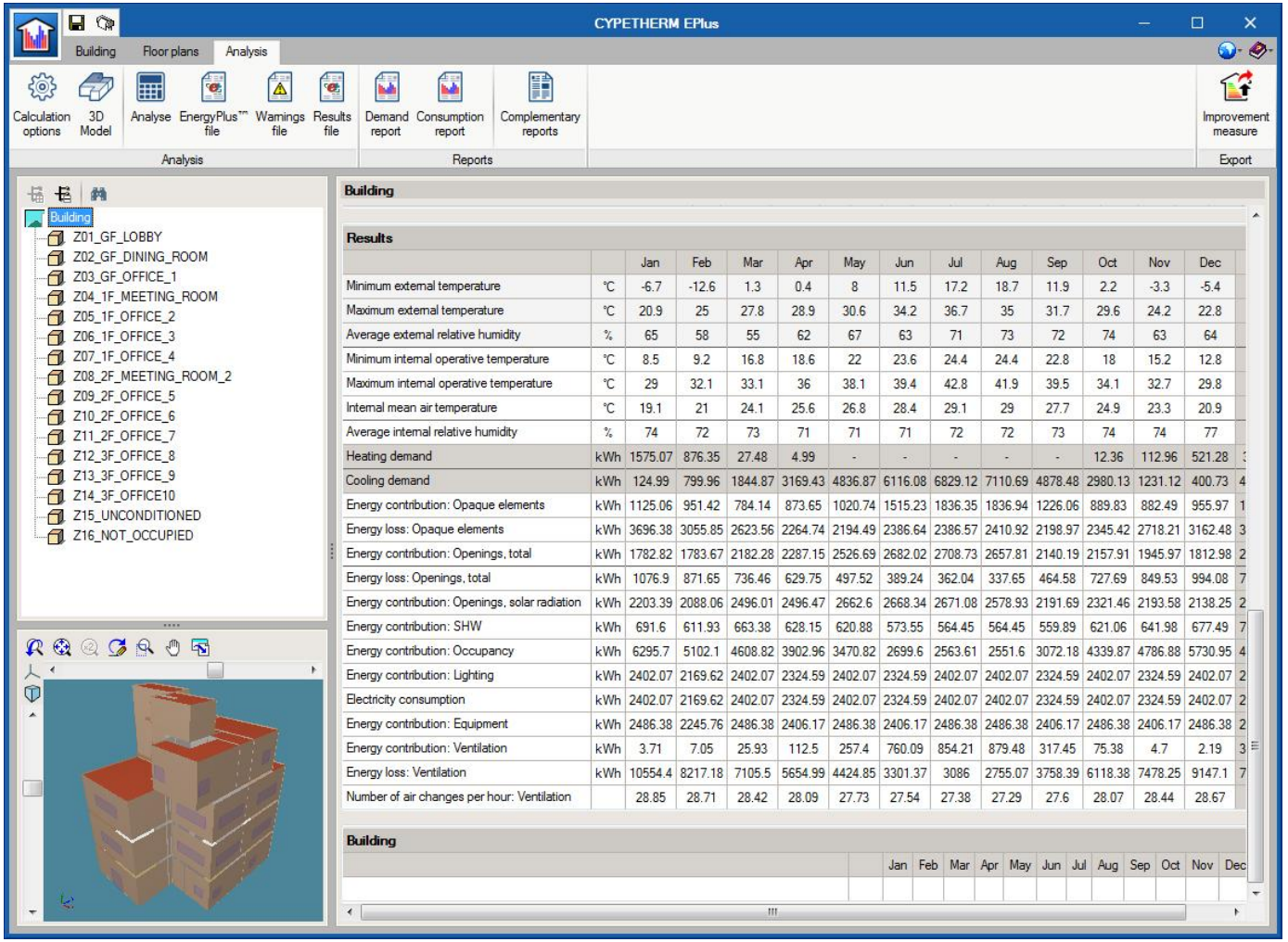
OPEN BIM ANALYTICAL MODEL



OPEN BIM ANALYTICAL MODEL



CYPETHERM EPLUS



		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum external temperature	℃	-6.7	-12.6	1.3	0.4	8	11.5	17.2	18.7	11.9	2.2	-3.3	-5.4
Maximum external temperature	℃	20.9	25	27.8	28.9	30.6	34.2	36.7	35	31.7	29.6	24.2	22.8
Average external relative humidity	%	65	58	55	62	67	63	71	73	72	74	63	64
Minimum internal operative temperature	℃	8.5	9.2	16.8	18.6	22	23.6	24.4	24.4	22.8	18	15.2	12.8
Maximum internal operative temperature	℃	29	32.1	33.1	36	38.1	39.4	42.8	41.9	39.5	34.1	32.7	29.8
Internal mean air temperature	℃	19.1	21	24.1	25.6	26.8	28.4	29.1	29	27.7	24.9	23.3	20.9
Average internal relative humidity	%	74	72	73	71	71	71	72	72	73	74	74	77
Heating demand	kWh	1575.07	876.35	27.48	4.99	-	-	-	-	-	12.36	112.96	521.28
Cooling demand	kWh	124.99	799.96	1844.87	3169.43	4836.87	6116.08	6829.12	7110.69	4878.48	2980.13	1231.12	400.73
Energy contribution: Opaque elements	kWh	1125.06	951.42	784.14	873.65	1020.74	1515.23	1836.35	1836.94	1226.06	889.83	882.49	955.97
Energy loss: Opaque elements	kWh	3696.38	3055.85	2623.56	2264.74	2194.49	2386.64	2386.57	2410.92	2198.97	2345.42	2718.21	3162.48
Energy contribution: Openings, total	kWh	1782.82	1783.67	2182.28	2287.15	2526.69	2682.02	2708.73	2657.81	2140.19	2157.91	1945.97	1812.98
Energy loss: Openings, total	kWh	1076.9	871.65	736.46	629.75	497.52	389.24	362.04	337.65	464.58	727.69	849.53	994.08
Energy contribution: Openings, solar radiation	kWh	2203.39	2088.06	2496.01	2496.47	2662.6	2668.34	2671.08	2578.93	2191.69	2321.46	2193.58	2138.25
Energy contribution: SHW	kWh	691.6	611.93	663.38	628.15	620.88	573.55	564.45	564.45	559.89	621.06	641.98	677.49
Energy contribution: Occupancy	kWh	6295.7	5102.1	4608.82	3902.96	3470.82	2699.6	2563.61	2551.6	3072.18	4339.87	4786.88	5730.95
Energy contribution: Lighting	kWh	2402.07	2169.62	2402.07	2324.59	2402.07	2324.59	2402.07	2402.07	2324.59	2402.07	2324.59	2402.07
Electricity consumption	kWh	2402.07	2169.62	2402.07	2324.59	2402.07	2324.59	2402.07	2402.07	2324.59	2402.07	2324.59	2402.07
Energy contribution: Equipment	kWh	2486.38	2245.76	2486.38	2406.17	2486.38	2406.17	2486.38	2486.38	2406.17	2486.38	2406.17	2486.38
Energy contribution: Ventilation	kWh	3.71	7.05	25.93	112.5	257.4	760.09	854.21	879.48	317.45	75.38	4.7	2.19
Energy loss: Ventilation	kWh	10554.4	8217.18	7105.5	5654.99	4424.85	3301.37	3086	2755.07	3758.39	6118.38	7478.25	9147.1
Number of air changes per hour: Ventilation		28.85	28.71	28.42	28.09	27.73	27.54	27.38	27.29	27.6	28.07	28.44	28.67

Building

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

COLOPHON

26.11.2020

BIM-SPEED Industry day 2020

Antonio González Viegas

1.0

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BIM-SPEED MULTI-CRITERIA DECISION SUPPORT TOOL

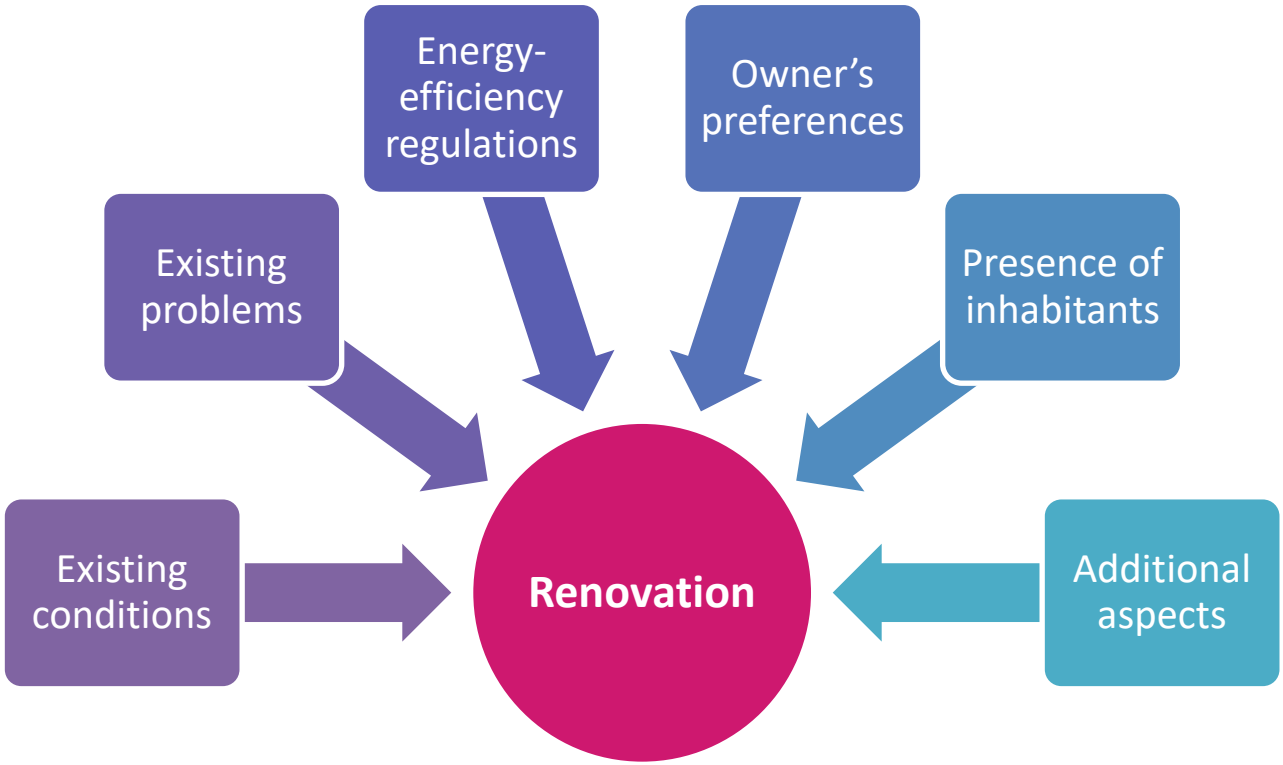
Jerson Pinzon
Research assistant TU Berlin

BIM-SPEED Industry Day 2020
26.11.2020

PRESENTATION OVERVIEW

- Decision-making in renovation projects
- BIM-SPEED decision tool
- Benefits and advantages
- Additional comments

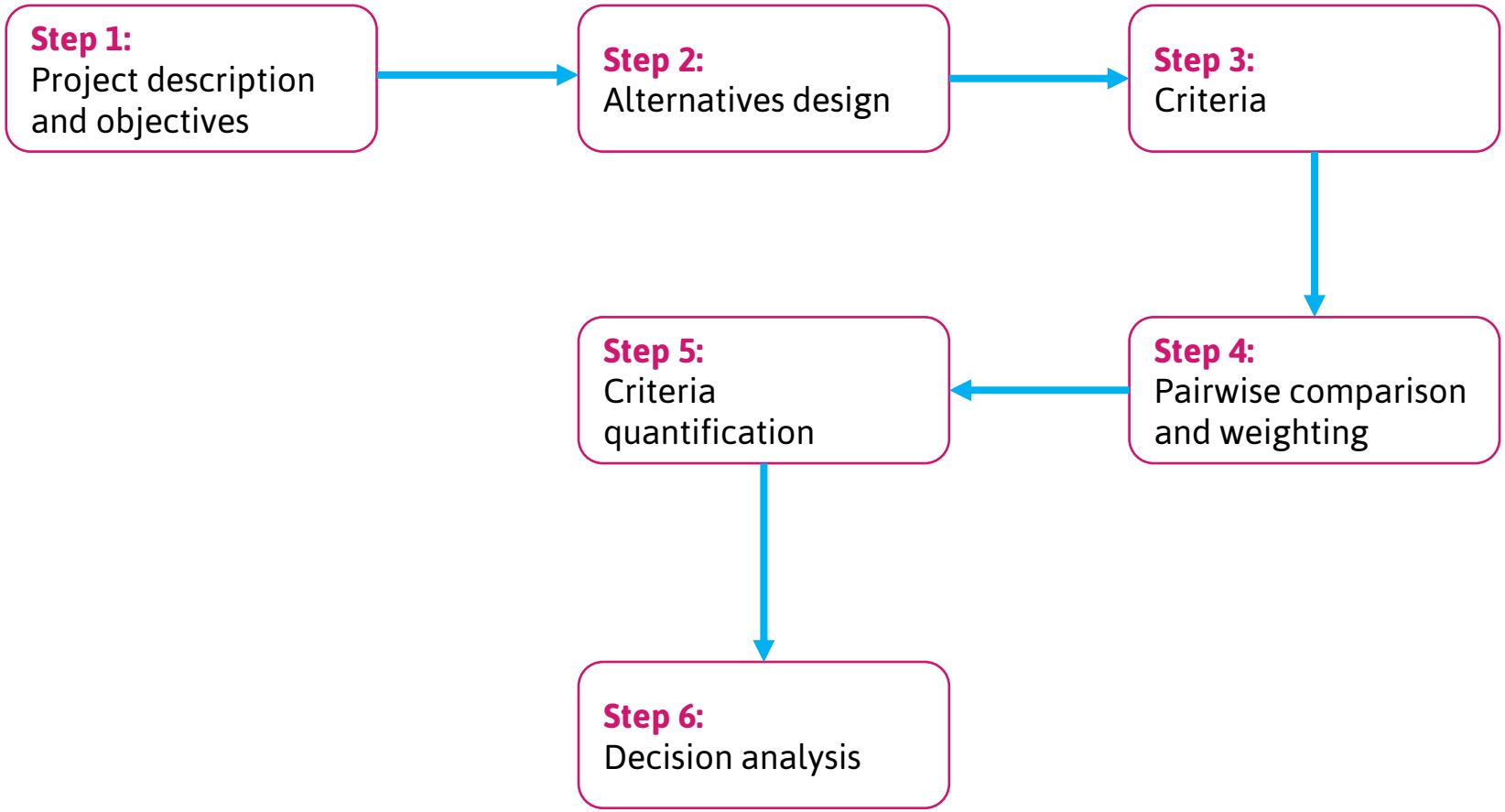
DECISION-MAKING IN RENOVATION PROJECTS



DECISION-MAKING IN RENOVATION PROJECTS

Scenario	Owner	Inhabitant	Decision
1	Single owner	Owner	Simple decision
2	Single owner	Tenants	A kind of accord/compensation may be required between the owner and tenants. In the case of multi-family units, a certain level of agreement between tenants may be also required. In this case, tenants' associations and community managers play a key role.
3	Multiple owners	Owners	Usually there is a required level of agreement/consensus that should be reached.
4	Multiple owners	Owners and tenants	Usually there is a required level of agreement/consensus that should be reached by the owners. Tenants may only be informed of the activities.
5	Multiple owners	Tenants	A kind of accord/compensation may be required between the owners and tenants. A certain level of agreement between tenants may be also required. In this case, tenants' associations and community managers play a key role.

OVERVIEW OF THE DECISION PROCESS



BIM-SPEED DECISION SUPPORT TOOL

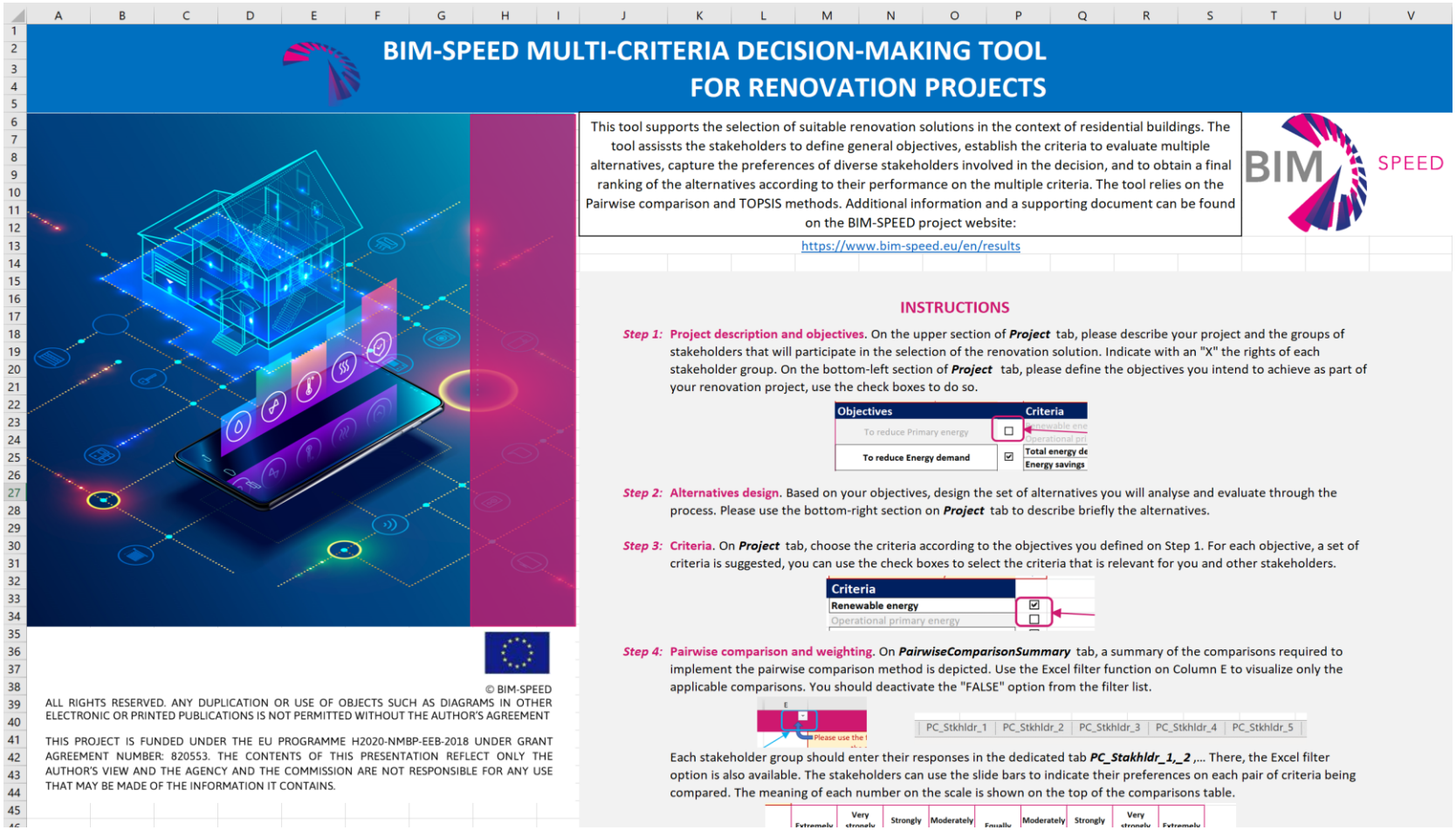


Figure 1. Decision-making tool, introductory tab

STEPS 1 AND 2: PROJECT AND ALTERNATIVE DESCRIPTION

PROJECT DESCRIPTION

Project description	
Name	BIM-SPEED demo case
Description	4-storey residential building
Location	-------
Owner, type	Single owner
Number of dwelling units	12
Units occupied by owners	0
Units occupied by tenants	12
Status	Built 50 years ago, it requires renovation
Energy efficiency	-------
Challenges	-------

Stakeholders

No.	Name	ID	Quantity	Decision-maker	can Vote	only Advise	only Informed
1	Owner	OW	1	x	x		
2	Tenants association	TA	1				x
3	Designer	DE	1			x	
4							
5							

☑ Clear All

Please select the objectives that are relevant for you

Please select the criteria that are relevant for you

Please describe the renovation alternatives you designed

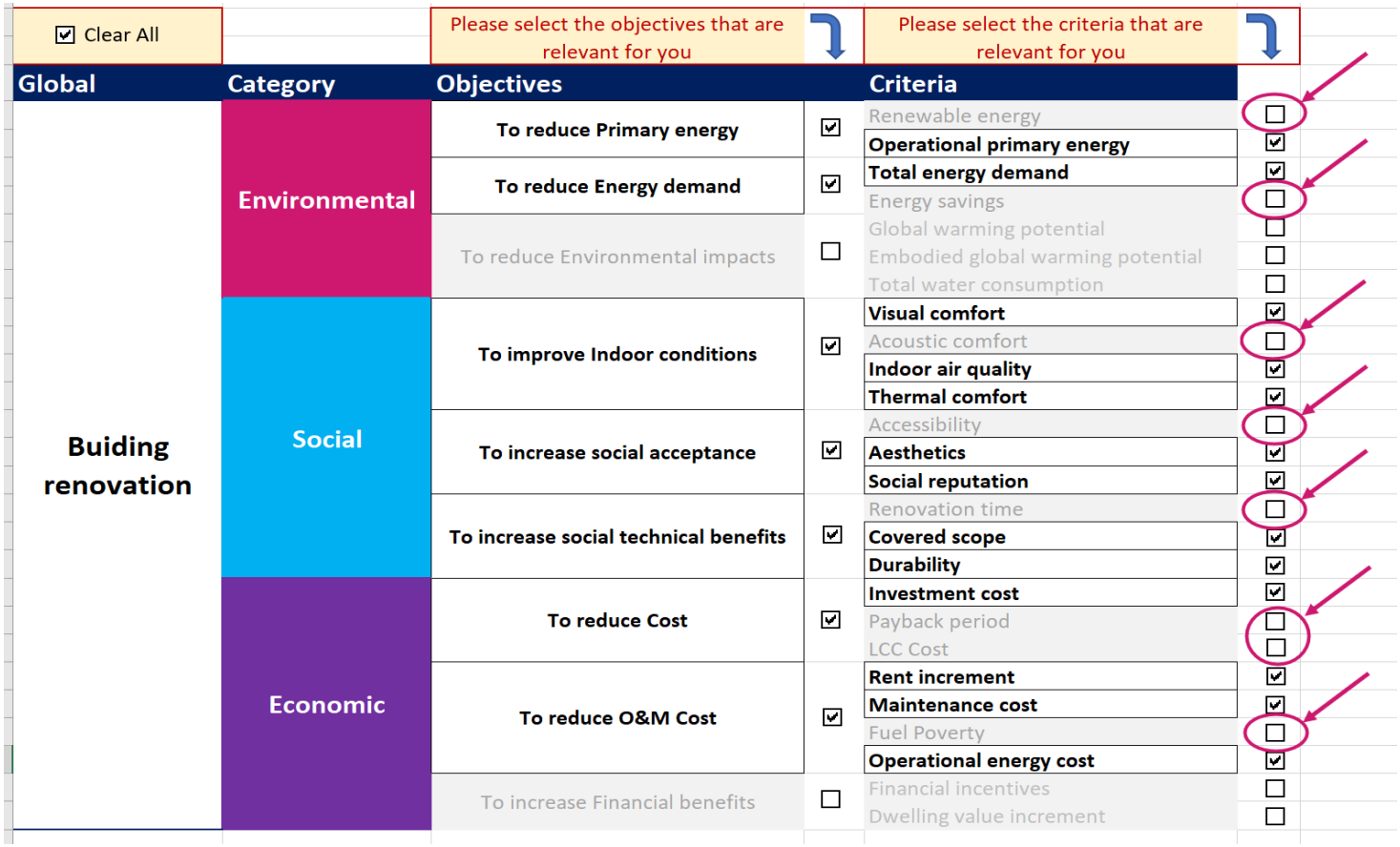
Global	Category	Objectives		Criteria	
Buiding renovation	Environmental	To reduce Primary energy	☑	Renewable energy	☑
				Operational primary energy	☑
		To reduce Energy demand	☑	Total energy demand	☑
				Energy savings	☑
		To reduce Environmental impacts	☐	Global warming potential	☐
				Embodied global warming potential	☐
				Total water consumption	☐
	Social	To improve Indoor conditions	☑	Visual comfort	☑
				Acoustic comfort	☑
				Indoor air quality	☑
				Thermal comfort	☑
		To increase social acceptance	☑	Accessibility	☑
				Aesthetics	☑
				Social reputation	☑
		To increase social technical benefits	☑	Renovation time	☑
				Covered scope	☑
				Durability	☑
	Economic	To reduce Cost	☑	Investment cost	☑
				Payback period	☑
				LCC Cost	☑
		To reduce O&M Cost	☑	Rent increment	☑
				Maintenance cost	☑
				Fuel Poverty	☑
				Operational energy cost	☑
		To increase Financial benefits	☐	Financial incentives	☐
				Dwelling value increment	☐

Alternatives description

No.	ID	Building envelope						Building syst					
		ETICS	Ventilated	Rooftop module	Windows	Second window	Indoor insulation	Lighting	Radiators	Piping	Boilers	Ventilation	D
A	BIM-SPEED_1		X		X			X	X	X	X	X	
B	BIM-SPEED_2		X			X		X	X			X	
C	BIM-SPEED_3				X		X	X					
D	BIM-SPEED_4	X			X			X					
E	BIM-SPEED_5	X				X		X	X			X	
F	BIM-SPEED_6	X		X	X			X					
G	BIM-SPEED_7	X		X		X		X					
H	BIM-SPEED_8		X	X	X			X					
I	BIM-SPEED_9	X		X				X	X		X	X	
J	BIM-SPEED_10												

Figure 2. Decision-making tool, Project tab

STEP 3: CRITERIA SELECTION



☑ Clear All		Please select the objectives that are relevant for you		Please select the criteria that are relevant for you	
Global	**Category**	**Objectives**		**Criteria**	
Buiding renovation	**Environmental**	**To reduce Primary energy**	☑	Renewable energy	☐
				Operational primary energy	☑
		To reduce Energy demand	☑	**Total energy demand**	☑
				Energy savings	☐
		To reduce Environmental impacts	☐	Global warming potential	☐
				Embodied global warming potential	☐
				Total water consumption	☐
	Social	**To improve Indoor conditions**	☑	**Visual comfort**	☑
				Acoustic comfort	☐
				Indoor air quality	☑
				Thermal comfort	☑
		To increase social acceptance	☑	Accessibility	☐
				Aesthetics	☑
				Social reputation	☑
		To increase social technical benefits	☑	Renovation time	☐
				Covered scope	☑
				Durability	☑
				Investment cost	☑
	Economic	**To reduce Cost**	☑	Payback period	☐
				LCC Cost	☐
		To reduce O&M Cost	☑	**Rent increment**	☑
				Maintenance cost	☑
				Fuel Poverty	☐
				Operational energy cost	☑
		To increase Financial benefits	☐	Financial incentives	☐
				Dwelling value increment	☐

Figure 3. Project tab, criteria tree adjustment

CRITERIA TREE EXAMPLE

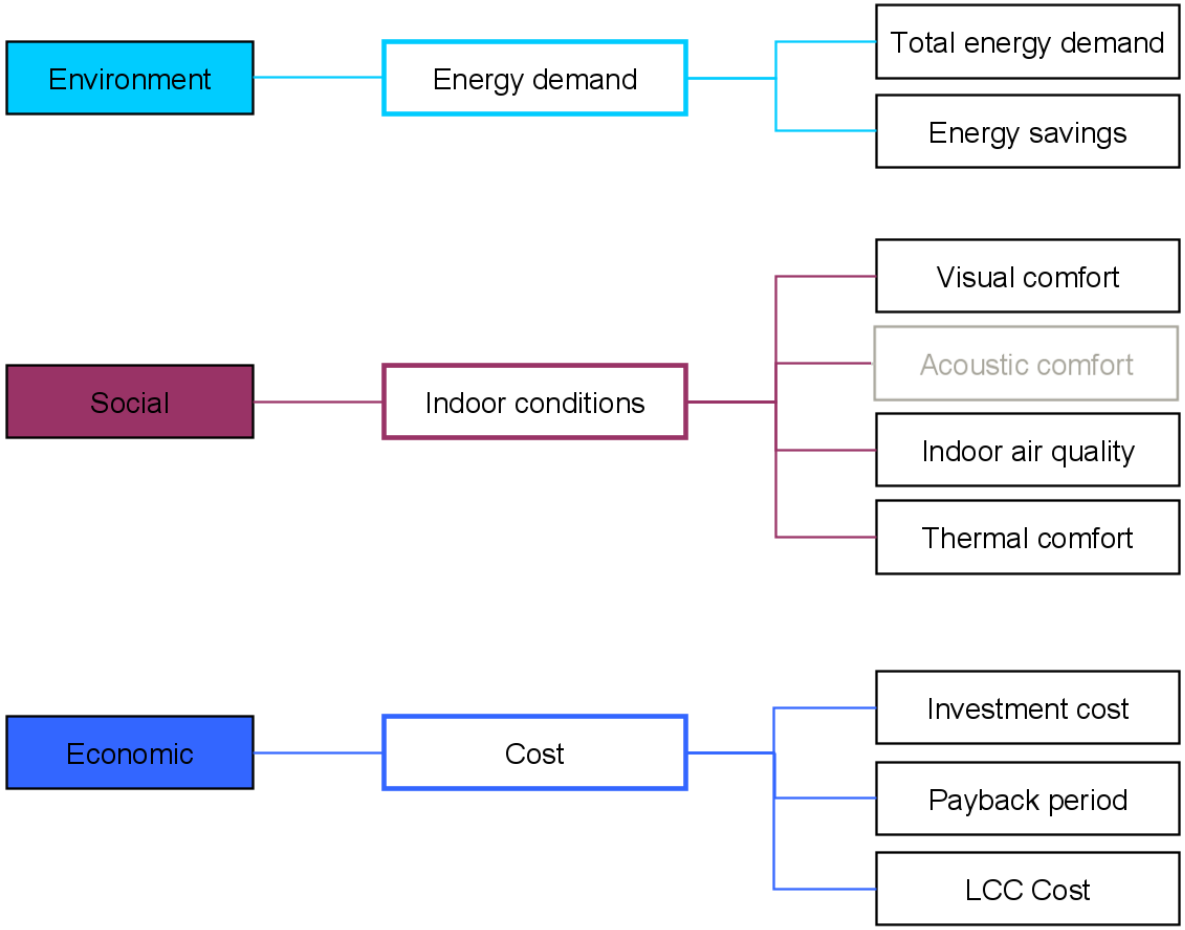
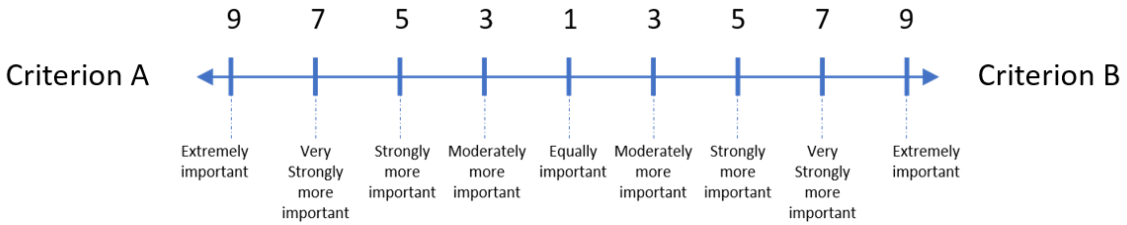


Figure 4. Criteria tree example

STEP 4: PAIRWISE COMPARISON AND WEIGHTS



PAIRWISE COMPARISON STAKEHOLDER 1: Owner

Please use the filter to adjust the comparisons tha should be performed

Please compare each paior of criteria according to the scale

			Extremely important	Very strongly more important	Strongly more important	Moderately more important	Equally important	Moderately more important	Strongly more important	Very strongly more important	Extremely important		Comparison by stakeholders, 1-9 AHP scale (used for calculations)
			9	7	5	3	1	3	5	7	9		Owner
1st level	TRUE	Environmental										Social	1/3
	TRUE	Social										Economic	1/5
	TRUE	Economic										Environmental	7
2nd level	TRUE	To reduce Primary energy										To reduce Energy demand	5
	TRUE	To improve Indoor conditions										To increase social acceptance	7
	TRUE	To increase social acceptance										To increase social technical benefits	1
	TRUE	To increase social technical benefits										To improve Indoor conditions	1/5
	TRUE	To reduce Cost										To reduce O&M Cost	1/5
	TRUE	Operational primary energy	----------No comparison required----------										
	TRUE	Total energy demand	----------No comparison required----------										
3rd level	TRUE	Indoor air quality										Thermal comfort	1/3
	TRUE	Thermal comfort										Visual comfort	5
	TRUE	Visual comfort										Indoor air quality	1/3
	TRUE	Aesthetics										Social reputation	5
	TRUE	Covered scope										Durability	3
	TRUE	Investment cost	----------No comparison required----------										
	TRUE	Rent increment										Maintenance cost	1/5
	TRUE	Operational energy cost										Rent increment	3
	TRUE	Maintenance cost										Operational energy cost	3

Figure 5. Decision-making tool, PC_Stkhldr_1 tab

STEP 4: PAIRWISE COMPARISON AND WEIGHTS

INTERNAL DATA: WEIGHTS FOR EACH STAKEHOLDER GROUP

Please use the filter to see only the criteria tree that applies to your project

			Level weights	STAKEHOLDERS					Level weights	STAKEHOLDERS					Level weights	STAKEHOLDERS				
			Owner	tenants	Designer	0	0		Owner	tenants	Designer	0	0		Owner	tenants	Designer	0	0	
		Right to vote -->	TRUE	FALSE	FALSE	FALSE	FALSE	Right to vote -->	TRUE	FALSE	FALSE	FALSE	FALSE	Right to vote -->	TRUE	FALSE	FALSE	FALSE	FALSE	
Buiding renovation	Environmental		0.083	0.083	0.083			To reduce Primary energy	0.833	0.900	0.833			Operational primary energy	1.000	1.000	1.000			TRUE
								To reduce Energy demand	0.167	0.100	0.167			Total energy demand	1.000	1.000	1.000			TRUE
	Social		0.193	0.193	0.193			To improve Indoor conditions	0.746	0.746	0.746			Visual comfort	0.106	0.777	0.777			TRUE
														Indoor air quality	0.260	0.155	0.155			TRUE
														Thermal comfort	0.633	0.069	0.069			TRUE
								To increase social acceptance	0.120	0.120	0.120			Aesthetics	0.833	0.750	0.750			TRUE
														Social reputation	0.167	0.250	0.250			TRUE
								To increase social technical benefits	0.134	0.134	0.134			Covered scope	0.750	0.750	0.750			TRUE
														Durability	0.250	0.250	0.250			TRUE
	Economic		0.724	0.724	0.724			To reduce Cost	0.167	0.250	0.250			Investment cost	1.000	1.000	1.000			TRUE
								To reduce O&M Cost	0.833	0.750	0.750			Rent increment	0.106	0.083	0.083			TRUE
														Maintenance cost	0.633	0.724	0.724			TRUE
														Operational energy cost	0.260	0.193	0.193			TRUE

Figure 8. Decision-making tool, CriteriaWeightsSummary tab

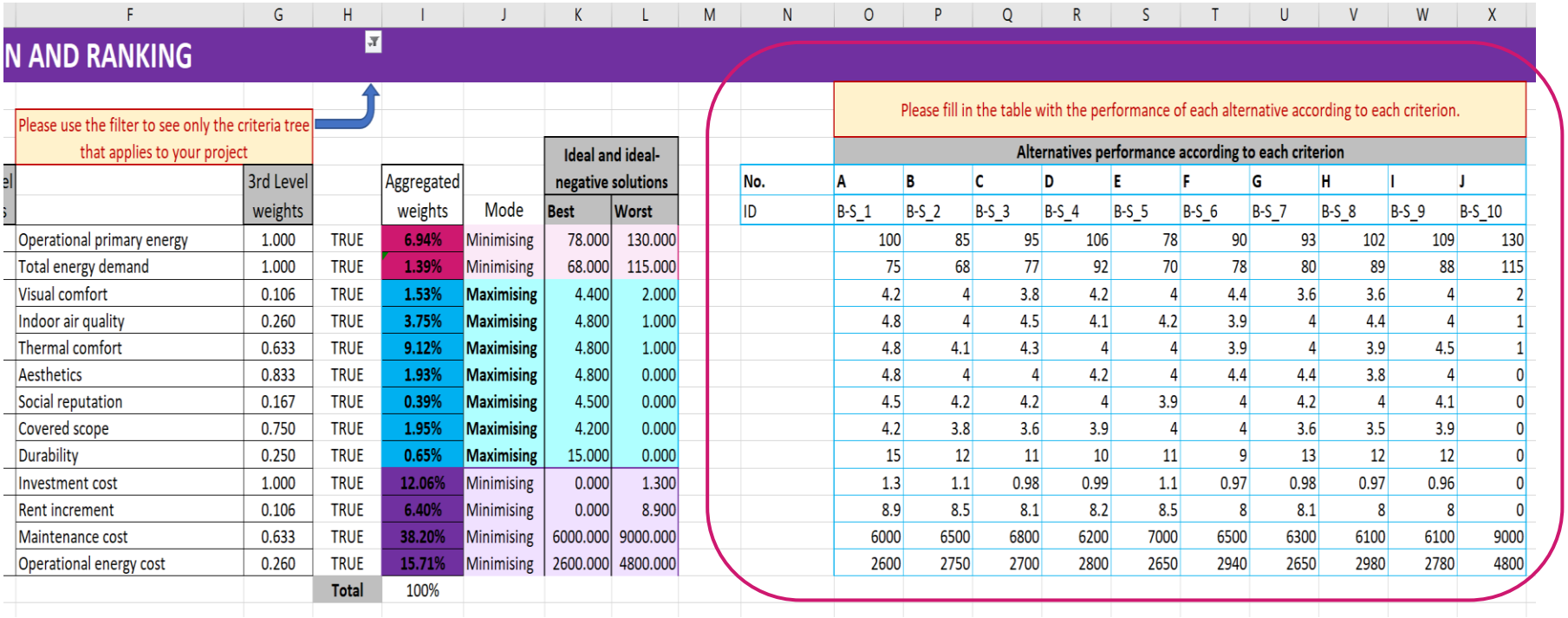
WEIGHT AGGREGATION AND RANKING

Please use the filter to see only the criteria tree that applies to your project

	1st Level weights		2nd Level weights		3rd Level weights		Aggregated weights	Mode	Ideal and ideal-negative solutions	
									Best	Worst
Environmental	0.083	To reduce Primary energy	0.833	Operational primary energy	1.000	TRUE	6.94%	Minimising	78.000	130.000
		To reduce Energy demand	0.167	Total energy demand	1.000	TRUE	1.39%	Minimising	68.000	115.000
Social	0.193	To improve Indoor conditions	0.746	Visual comfort	0.106	TRUE	1.53%	Maximising	4.400	2.000
				Indoor air quality	0.260	TRUE	3.75%	Maximising	4.800	1.000
				Thermal comfort	0.633	TRUE	9.12%	Maximising	4.800	1.000
		To increase social acceptance	0.120	Aesthetics	0.833	TRUE	1.93%	Maximising	4.800	0.000
				Social reputation	0.167	TRUE	0.39%	Maximising	4.500	0.000
		To increase social technical benefits	0.134	Covered scope	0.750	TRUE	1.95%	Maximising	4.200	0.000
				Durability	0.250	TRUE	0.65%	Maximising	15.000	0.000
Economic	0.724	To reduce Cost	0.167	Investment cost	1.000	TRUE	12.06%	Minimising	0.000	1.300
		To reduce O&M Cost	0.833	Rent increment	0.106	TRUE	6.40%	Minimising	0.000	8.900
				Maintenance cost	0.633	TRUE	38.20%	Minimising	6000.000	9000.000
				Operational energy cost	0.260	TRUE	15.71%	Minimising	2600.000	4800.000
						Total	100%			

Figure 7. Final aggregated criteria weights

STEP 5: CRITERIA QUANTIFICATION



N AND RANKING

Please use the filter to see only the criteria tree that applies to your project

	3rd Level weights		Aggregated weights	Mode	Ideal and ideal-negative solutions Best	Worst
Operational primary energy	1.000	TRUE	6.94%	Minimising	78.000	130.000
Total energy demand	1.000	TRUE	1.39%	Minimising	68.000	115.000
Visual comfort	0.106	TRUE	1.53%	Maximising	4.400	2.000
Indoor air quality	0.260	TRUE	3.75%	Maximising	4.800	1.000
Thermal comfort	0.633	TRUE	9.12%	Maximising	4.800	1.000
Aesthetics	0.833	TRUE	1.93%	Maximising	4.800	0.000
Social reputation	0.167	TRUE	0.39%	Maximising	4.500	0.000
Covered scope	0.750	TRUE	1.95%	Maximising	4.200	0.000
Durability	0.250	TRUE	0.65%	Maximising	15.000	0.000
Investment cost	1.000	TRUE	12.06%	Minimising	0.000	1.300
Rent increment	0.106	TRUE	6.40%	Minimising	0.000	8.900
Maintenance cost	0.633	TRUE	38.20%	Minimising	6000.000	9000.000
Operational energy cost	0.260	TRUE	15.71%	Minimising	2600.000	4800.000
		Total	100%			

Please fill in the table with the performance of each alternative according to each criterion.

	Alternatives performance according to each criterion									
No.	A	B	C	D	E	F	G	H	I	J
ID	B-S_1	B-S_2	B-S_3	B-S_4	B-S_5	B-S_6	B-S_7	B-S_8	B-S_9	B-S_10
	100	85	95	106	78	90	93	102	109	130
	75	68	77	92	70	78	80	89	88	115
	4.2	4	3.8	4.2	4	4.4	3.6	3.6	4	2
	4.8	4	4.5	4.1	4.2	3.9	4	4.4	4	1
	4.8	4.1	4.3	4	4	3.9	4	3.9	4.5	1
	4.8	4	4	4.2	4	4.4	4.4	3.8	4	0
	4.5	4.2	4.2	4	3.9	4	4.2	4	4.1	0
	4.2	3.8	3.6	3.9	4	4	3.6	3.5	3.9	0
	15	12	11	10	11	9	13	12	12	0
	1.3	1.1	0.98	0.99	1.1	0.97	0.98	0.97	0.96	0
	8.9	8.5	8.1	8.2	8.5	8	8.1	8	8	0
	6000	6500	6800	6200	7000	6500	6300	6100	6100	9000
	2600	2750	2700	2800	2650	2940	2650	2980	2780	4800

Figure 9. Criteria quantification

STEP 6: DECISION ANALYSIS

	Please select the objectives that are relevant for you		Please select the criteria that are relevant for you
Category	**Objectives**		**Criteria**
Environmental	To reduce Primary energy	☑	Renewable energy
			Operational primary energy
	To reduce Energy demand	☑	**Total energy demand**
			Energy savings
	To reduce Environmental impacts	☐	Global warming potential
			Embodied global warming potential
			Total water consumption
Social	To improve Indoor conditions	☑	**Visual comfort**
			Acoustic comfort
			Indoor air quality
			Thermal comfort
	To increase social acceptance	☑	Accessibility
			Aesthetics
			Social reputation
	To increase social technical benefits	☑	Renovation time
			Covered scope
			Durability
Economic	To reduce Cost	☑	**Investment cost**
			Payback period
			LCC Cost
	To reduce O&M Cost	☑	**Rent increment**
			Maintenance cost
			Fuel Poverty
			Operational energy cost
	To increase Financial benefits	☐	Financial incentives
			Dwelling value increment

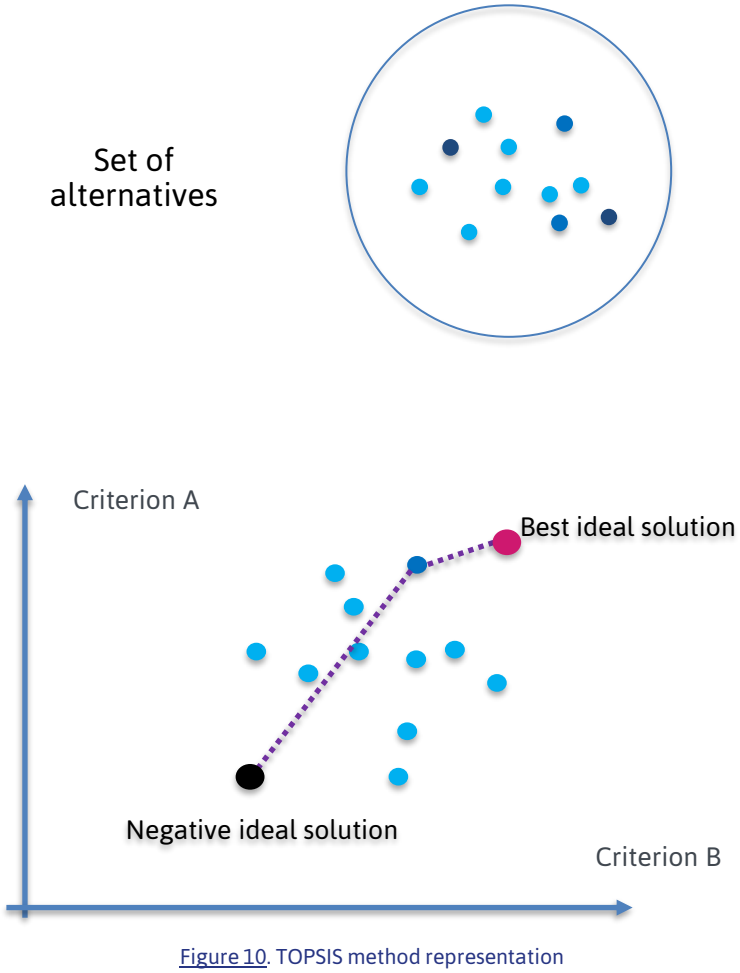


Figure 10. TOPSIS method representation

STEP 6: DECISION ANALYSIS

WEIGHT AGGREGATION AND RANKING

Please use the filter to see only the criteria tree that applies to your project

	1st Level weights		2nd Level weights		3rd Level weights		Aggregated weights	Mode	Ideal and ideal-negative solutions Best	Worst
Environmental	0.083	To reduce Primary energy	0.833	Operational primary energy	1.000	TRUE	6.94%	Minimising	78.000	130.000
		To reduce Energy demand	0.167	Total energy demand	1.000	TRUE	1.39%	Minimising	68.000	115.000
Social	0.193	To improve Indoor conditions	0.746	Visual comfort	0.106	TRUE	1.53%	Maximising	4.400	2.000
				Indoor air quality	0.260	TRUE	3.75%	Maximising	4.800	1.000
				Thermal comfort	0.633	TRUE	9.12%	Maximising	4.800	1.000
		To increase social acceptance	0.120	Aesthetics	0.833	TRUE	1.93%	Maximising	4.800	0.000
				Social reputation	0.167	TRUE	0.39%	Maximising	4.500	0.000
		To increase social technical benefits	0.134	Covered scope	0.750	TRUE	1.95%	Maximising	4.200	0.000
				Durability	0.250	TRUE	0.65%	Maximising	15.000	0.000
Economic	0.724	To reduce Cost	0.167	Investment cost	1.000	TRUE	12.06%	Minimising	0.000	1.300
		To reduce O&M Cost	0.833	Rent increment	0.106	TRUE	6.40%	Minimising	0.000	8.900
				Maintenance cost	0.633	TRUE	38.20%	Minimising	6000.000	9000.000
				Operational energy cost	0.260	TRUE	15.71%	Minimising	2600.000	4800.000
						Total	100%			

Please fill in the table with the performance of each alternative according to each criterion.

Alternatives performance according to each criterion										
No.	A	B	C	D	E	F	G	H	I	J
ID	B-S_1	B-S_2	B-S_3	B-S_4	B-S_5	B-S_6	B-S_7	B-S_8	B-S_9	B-S_10
	100	85	95	106	78	90	93	102	109	130
	75	68	77	92	70	78	80	89	88	115
	4.2	4	3.8	4.2	4	4.4	3.6	3.6	4	2
	4.8	4	4.5	4.1	4.2	3.9	4	4.4	4	1
	4.8	4.1	4.3	4	4	3.9	4	3.9	4.5	1
	4.8	4	4	4.2	4	4.4	4.4	3.8	4	0
	4.5	4.2	4.2	4	3.9	4	4.2	4	4.1	0
	4.2	3.8	3.6	3.9	4	4	3.6	3.5	3.9	0
	15	12	11	10	11	9	13	12	12	0
	1.3	1.1	0.98	0.99	1.1	0.97	0.98	0.97	0.96	0
	8.9	8.5	8.1	8.2	8.5	8	8.1	8	8	0
	6000	6500	6800	6200	7000	6500	6300	6100	6100	9000
	2600	2750	2700	2800	2650	2940	2650	2980	2780	4800

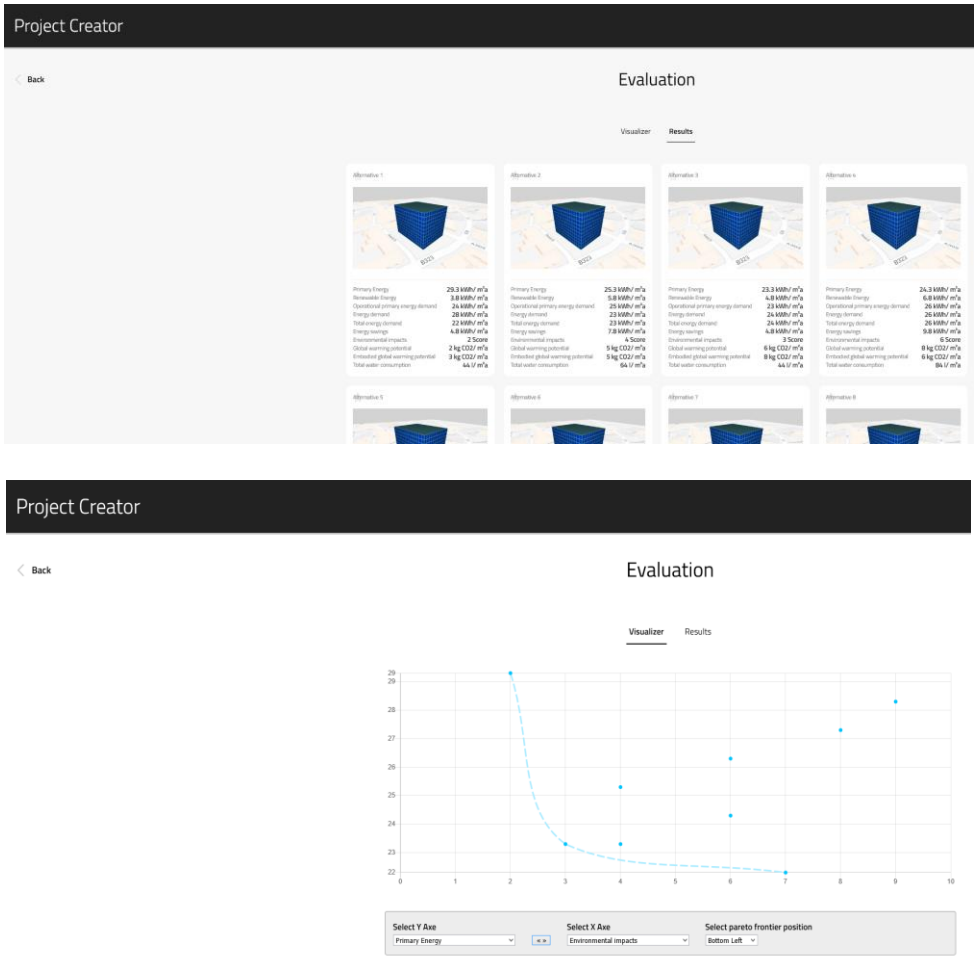
Alternative positions										
Position	7	8	6	4	9	5	2	3	1	10
Alternative	A	B	C	D	E	F	G	H	I	J
Score	0.567866	0.563542	0.571502	0.598412	0.531441	0.5809	0.602895	0.602211	0.617102	0.429103

FINAL RANKING

Position	1	2	3	4	5	6	7	8	9	10
Alternative	I	G	H	D	F	C	A	B	E	J
Score	0.6171	0.6029	0.6022	0.5984	0.5809	0.5715	0.5679	0.5635	0.5314	0.4291

Figure 11. Decision-making tool, FinalRanking tab

BIM-SPEED DASHBOARD



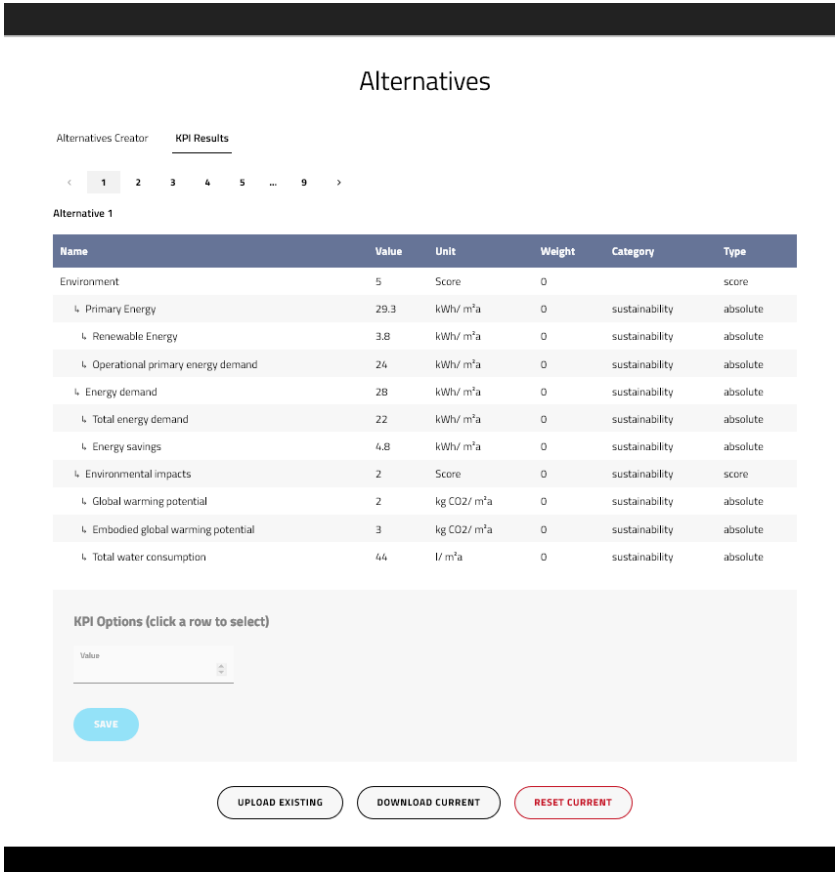


Figure 11. BIM-SPEED Decision-making dashboard

BENEFITS AND ADVANTAGES

- A structured approach to engage different stakeholders and conduct the decision-making process in renovation projects
- To capture the preferences of different stakeholders' groups considering their roles in the process
- A transparent way to identify which renovation alternatives are more suitable according to the objectives and preferences of the different stakeholders involved in the project
- A sustainable approach considering environmental, social, and economic aspects
- An intuitive and accessible tool based on an excel file, easy to understand and to work with

ADDITIONAL COMMENTS

- https://www.bim-speed.eu/en/results
- https://www.youtube.com/watch?v=vIVi9PGANb8&feature=youtu.be
- http://dx.doi.org/10.14279/depositonce-10659

Thank you!

Questions?

COLOPHON

26.11.2020

BIM-SPEED Industry Day

Jerson Pinzon

1.0

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