Agenda

08:45-09:00 Walk in
09:00-09:30 Presentation
09:30-09:45 Questions
09:45-10:30 Discussion

P5 Presentation | Aylin Ozcan

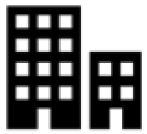
Source: Campus development TU Delft

Towards energy sufficient buildings and thermal comfort in the built environment

Aylin Ozcan | P5 | 24th January 2020

WHAT

Retrofitting existing building stock into low energy Buildings.



40% energy use

WHAT

Retrofitting existing building stock into low energy Buildings.

Energy performance gap = | Predicted energy consumption - Actual energy consumption |

Energy performance gap

WHAT	WHY
Retrofitting existing building stock into low energy Buildings.	There is a discrepancy between the given standards and end-users wishes and needs.

WHAT	WHY	HOW
Retrofitting existing building stock into low energy Buildings.	There is a discrepancy between the given standards and end-users wishes and needs.	A strategic approach towards energy sufficient building design that focusses on adding value to the environment, economy and end-users.

How to integrate the Building Management System (BMS) requirements to optimize the energy performance and user satisfaction in retrofitted residential buildings?

Research sub-questions

- *What are the influential factors related to energy consumption?*
- *How should the project be organised with respect to these influential factors in order to achieve energy performance?*
- *What are the drivers and barriers for project managers for the BMS implementation to optimize the energy performance of retrofitted residential buildings?*


ROTTERDAM
SCIENCE
TOWER

Steps towards energy sufficient buildings

Minimize energy consumption

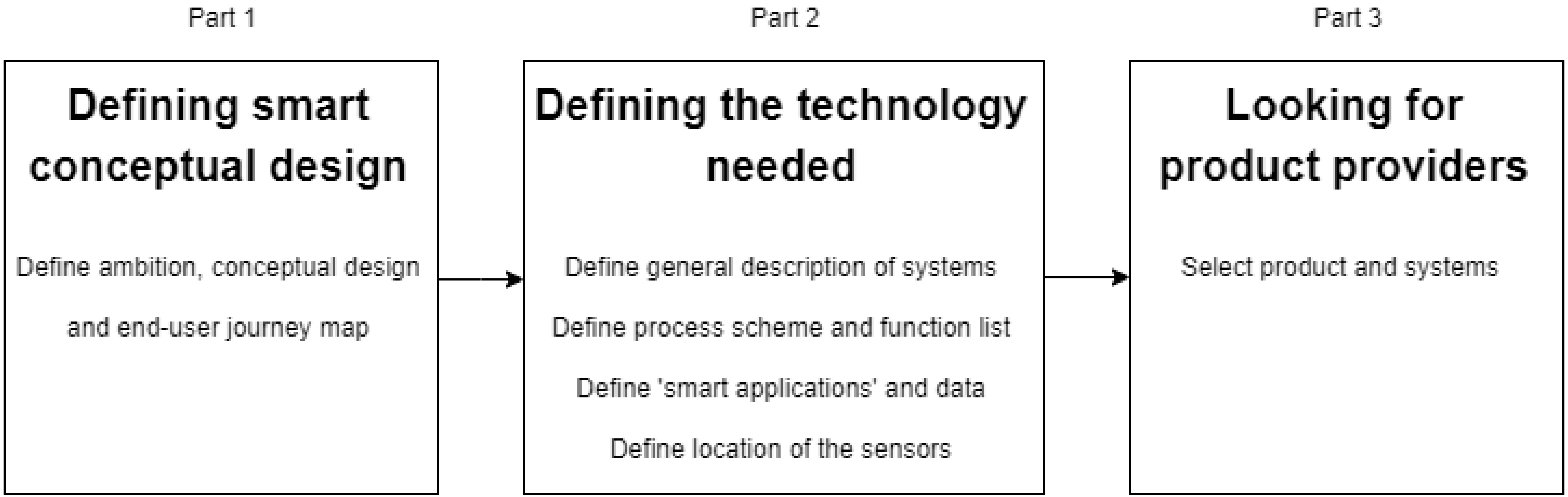
Use of sustainable energy generation

Efficient use of fossil fuel

Trias Energetica strategy by Duijvestein (1996)

Building Management System (BMS) integration

BMS implementation process



Part 1. Defining the smart conceptual design

- Define ambitions
- Define conceptual design
- End-user journey map

Part 2. Defining the technology needed

- Define general description of systems
- Define process scheme and function list
- Define smart application and data
- Define location of sensors

Process scheme and function list (based on the six categories of ISSO69)

Automatic controlling	• Windows (opening in %) • Blinds open at night and close at day if temperature is too high • Temperature control from systems, opening and closing
Switching	• HVAC off if windows or garden wall is open • Lights off if there's daylight
Guarding	• Deploying blinds and windows only during safe weather conditions.
Optimizing	• Cloud system to upgrade the house/systems
Manual controlling	• Windows • Blinds • Lights
Managing	• Energy consumption per appliance

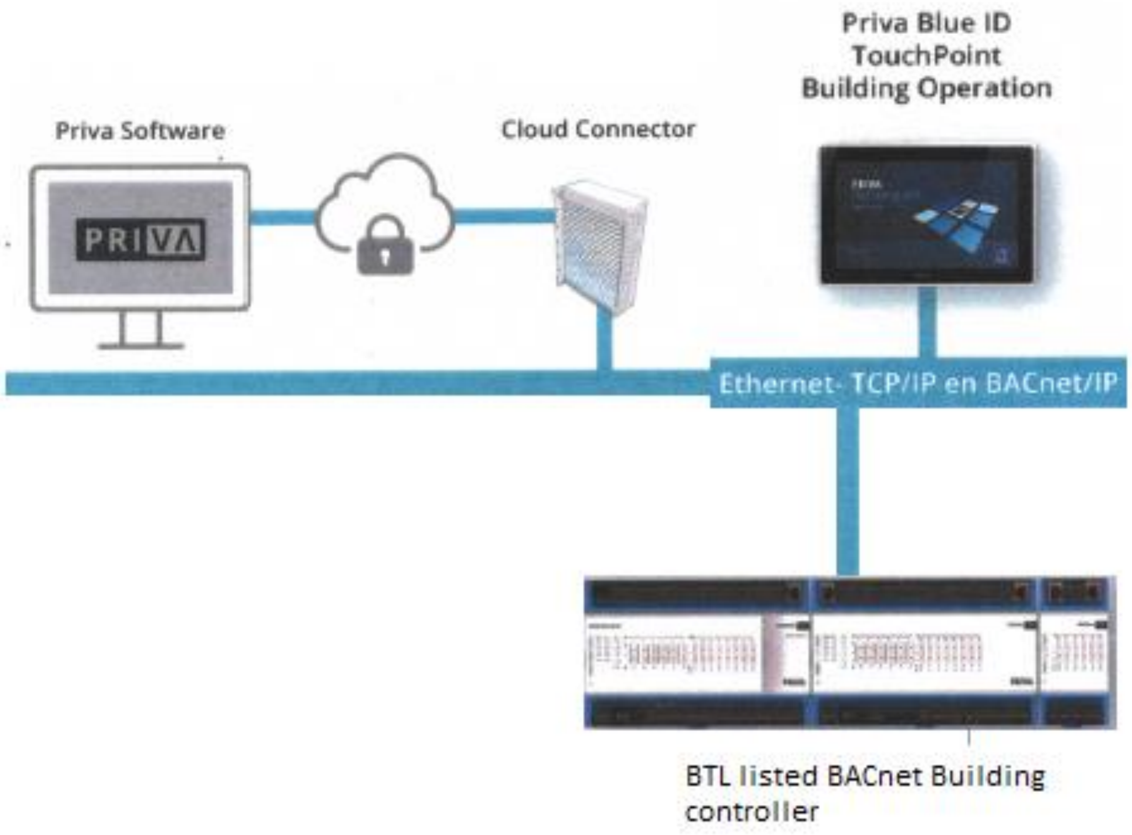
Part 3. Looking for product providers

- Define boundary conditions and constraints
- Define implementation typologies

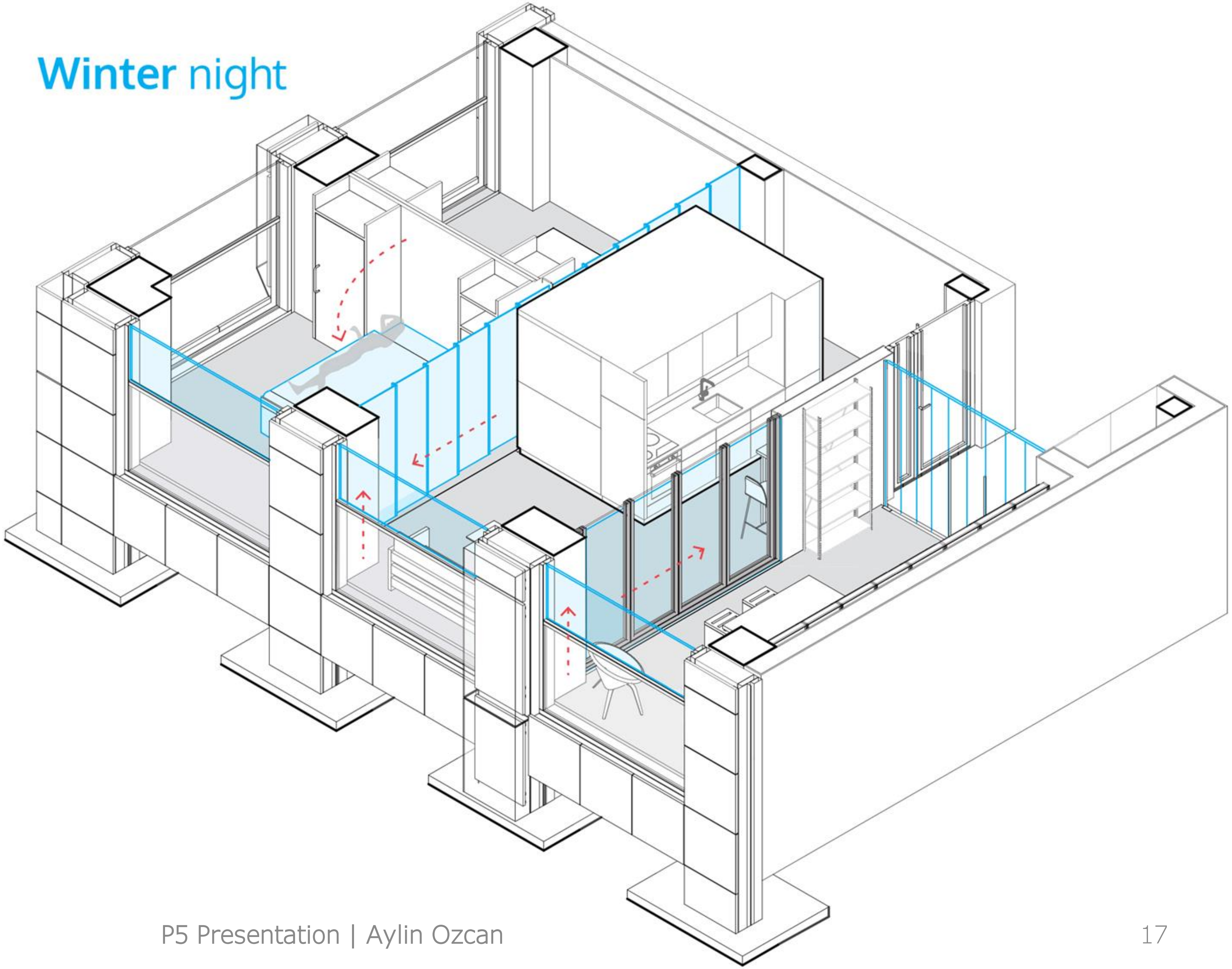
☑ Multi-criteria analysis

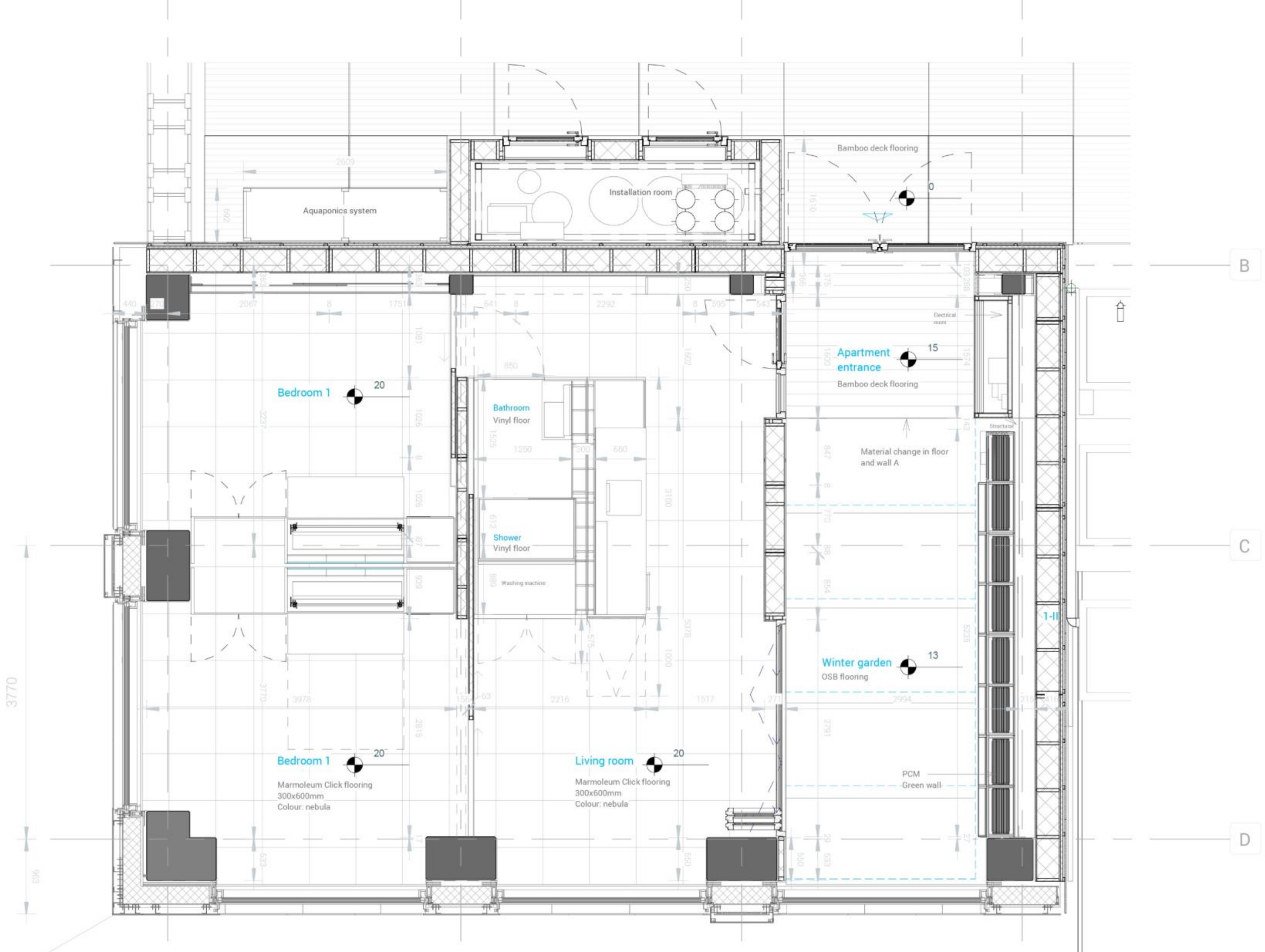
Systems description

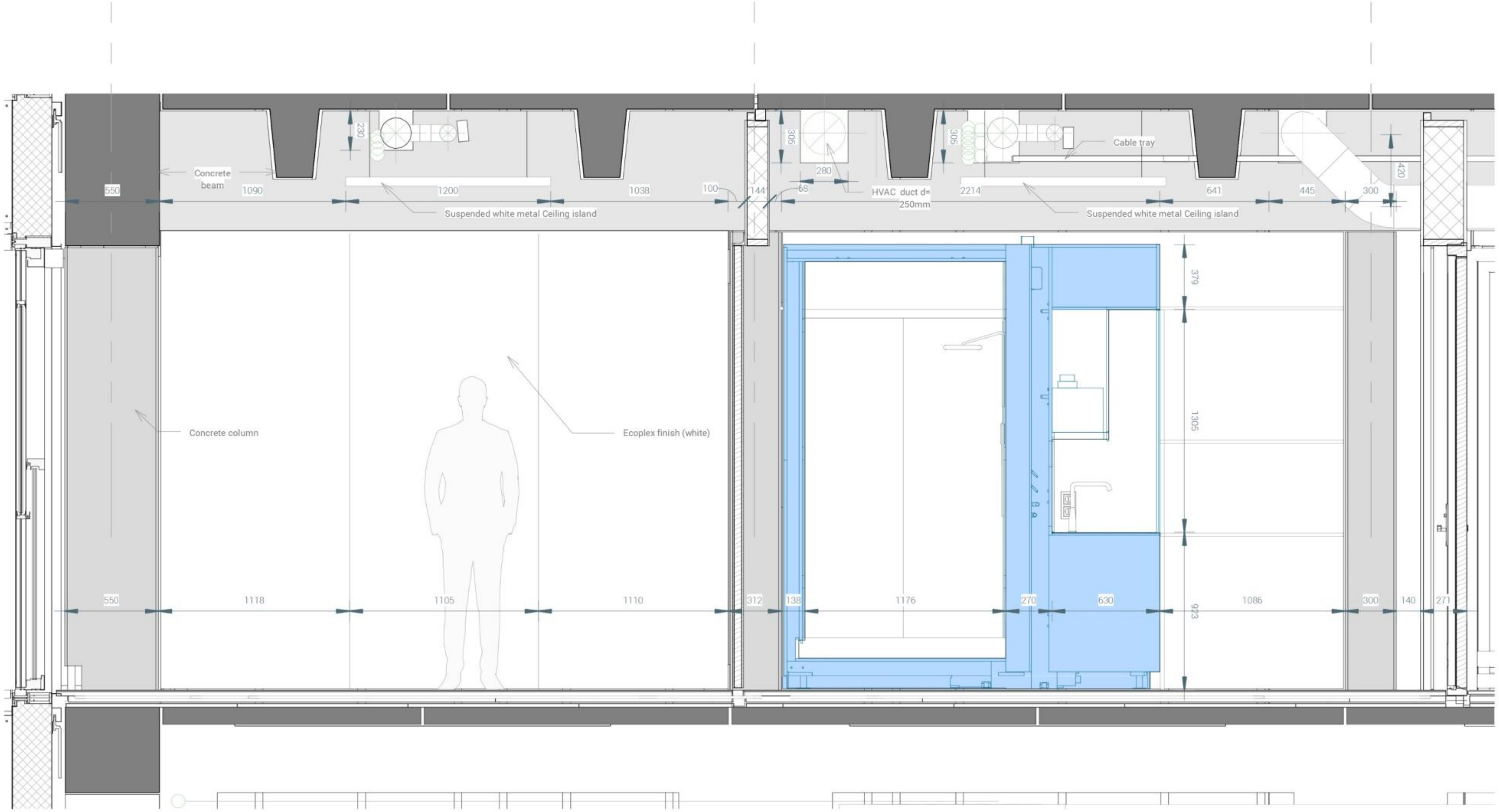
Building controller (Based on Priva)



Systems description



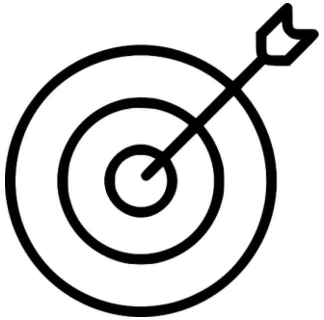

1
2
3
4
Bamboo deck flooring
Aquaponics system
Installation room
Apartment entrance
Bamboo deck flooring
Bedroom 1
Bathroom
Vinyl floor
Shower
Vinyl floor
Washing machine
Material change in floor
and wall A
Winter garden
OSB flooring
Bedroom 1
Marmoleum Click flooring
300x600mm
Colour: nebula
Living room
Marmoleum Click flooring
300x600mm
Colour: nebula
PCM
Green wall
B
C
D
3770


Concrete beam
550
1090
1200
1038
100
144
68
230
305
305
280
HVAC duct d= 250mm
2214
641
445
300
420
Cable tray
Suspended white metal Ceiling island
Suspended white metal Ceiling island
Concrete column
Ecoplex finish (white)
379
1305
923
550
1118
1105
1110
312
138
1176
270
630
1086
300
140
271

BMS implementation process: Actors

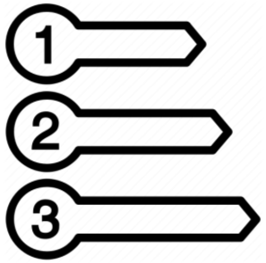
Engineering Committees | Façade Committee | Architecture Committee | Feasibility Committee | P&F | Management Committee

BMS implementation process: Barriers



Lack of strategic vision

Internal communication



Different set of priorities

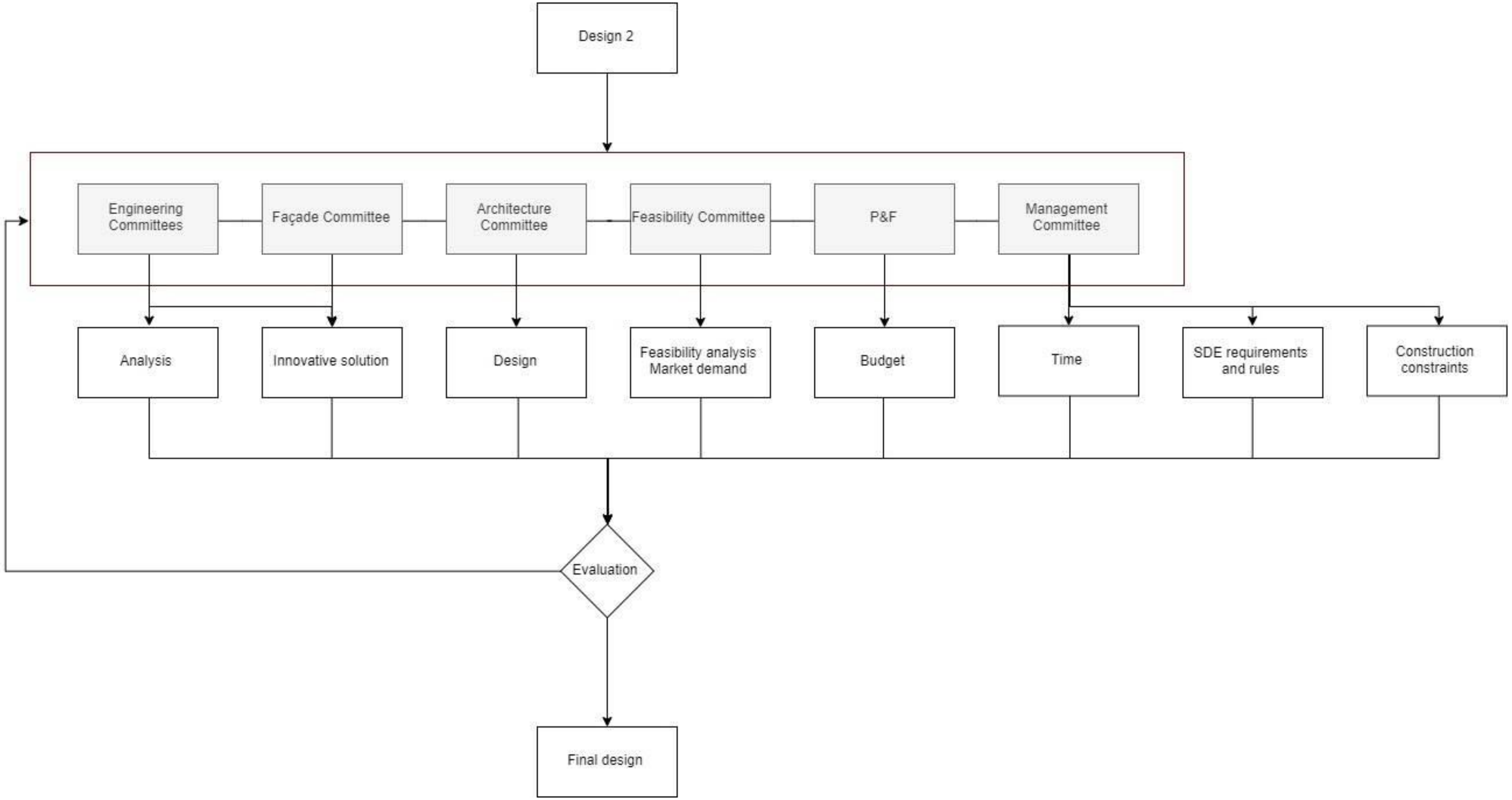
Ensuring direct feedback

Data security

Privacy concerns

Lack of knowledge

BMS implementation process: Organizational strategy



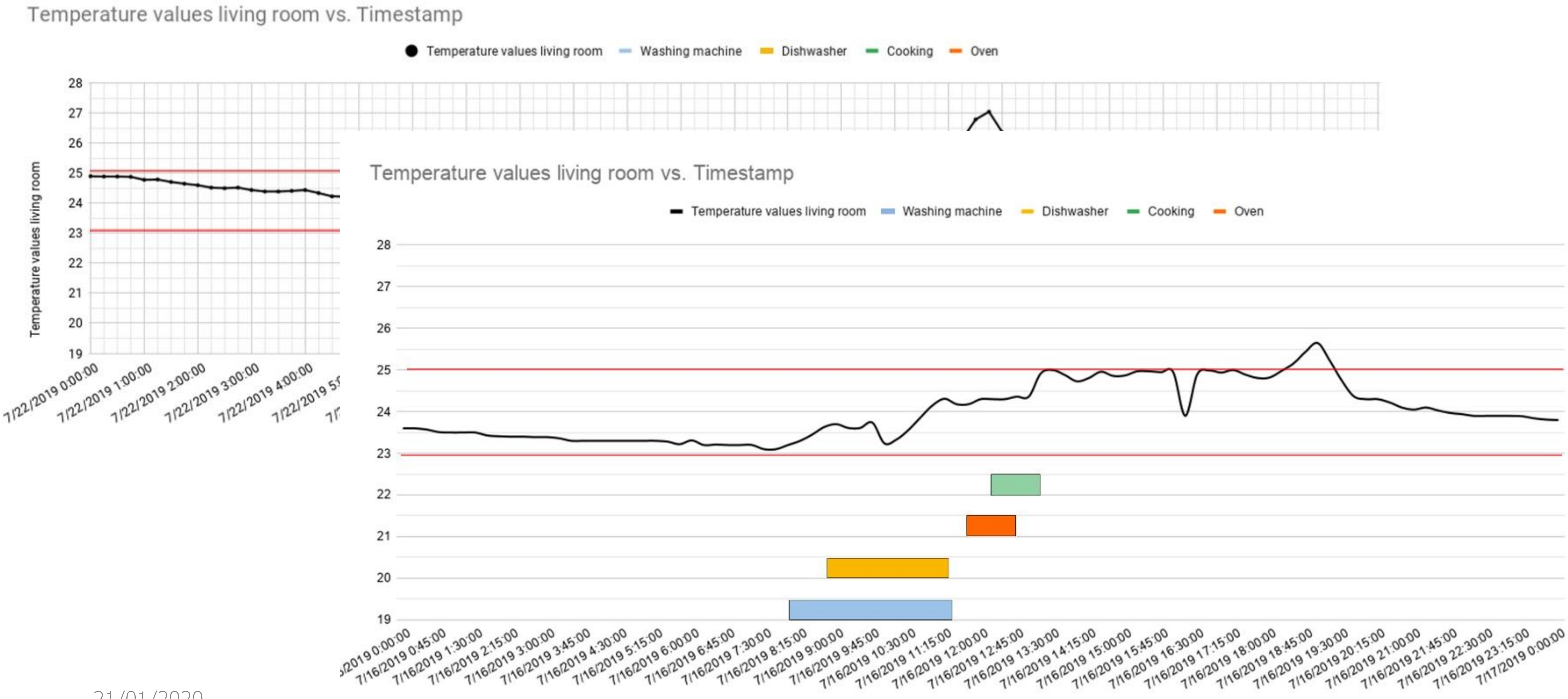
Data analysis

The competition week started on 14 July at 21:00 and ended on 25 July at 06:00

- Temperature values/Energy consumption and user interaction
- Temperature values and user comfort
- Theoretical versus actual consumption

Temperature values/Energy consumption and user interaction

Temperature values and user interaction



Temperature values and user comfort

- Generally comfort level comfortable
- Hot: executed activities
- Cold: health status

Person	Time	Actual temperature	Activity	Level of comfort	Age	Gender	Nationality	Health state	Reason
1	16-07-19 21:00	24	Dinner party	3	25	male	Spain	good	-
2	16-07-19 21:00	24	Dinner party	3	21	male	Spain	good	-
3	16-07-19 21:00	24	Dinner party	3	24	male	Hungary	good	-
4	16-07-19 21:00	24	Dinner party	3	21	male	Hungary	good	-
5	16-07-19 21:00	24	Dinner party	3	23	male	Algeria	good	-
6	16-07-19 21:00	24	Dinner party	3	26	female	Algeria	good	-
7	16-07-19 21:00	24	Dinner party	3	25	male	Romania	good	-
8	22-07-19 21:00	26	Dinner party	3	22	female	Romania	good	-
9	22-07-19 21:00	26	Dinner party	3	24	male	Spain	good	-
10	22-07-19 21:00	26	Dinner party	5	27	male	Spain	not good	sick
11	22-07-19 21:00	26	Dinner party	3	22	male	Hungary	good	-
12	22-07-19 21:00	26	Dinner party	3	21	male	Hungary	good	-
13	22-07-19 21:00	26	Dinner party	1	25	female	Belgium	good	Host - cooking
14	22-07-19 21:00	26	Dinner party	2	23	female	Netherlands	good	Host

Theoretical versus actual consumption

Predicted energy consumption	Actual energy consumption	
75.73KWh	68.75KWh	Ef (Appliances)*
76.70KWh	64.95KWh	Ev (HVAC + DHW)*
152.43KWh	133.7KWh	Total (Ef + Ev)

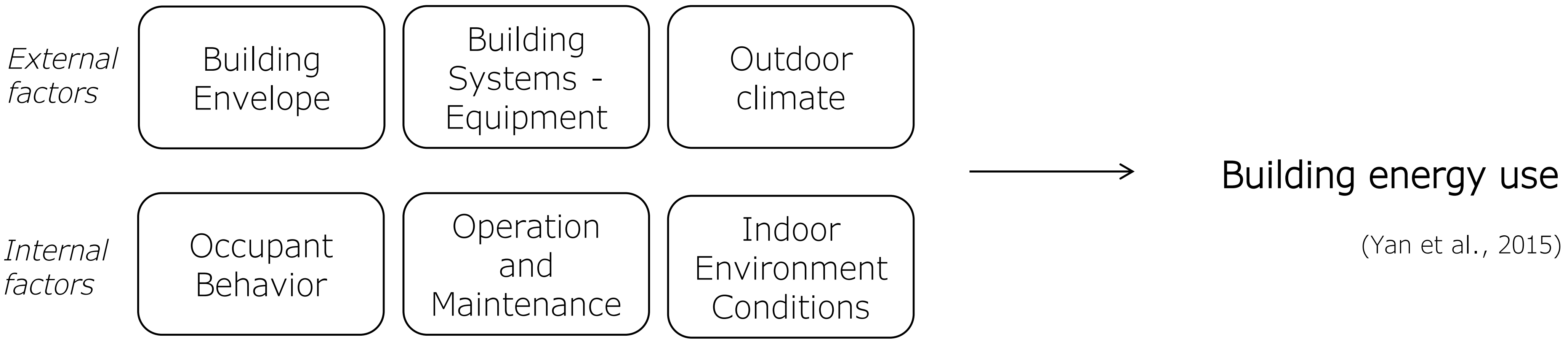
Energy performance gap = | Predicted energy consumption - Actual energy consumption |

Predicted produced energy	Actual produced energy
241.72 KWh	249.64 KWh

Self-sufficient building = | Energy production - Energy consumption |

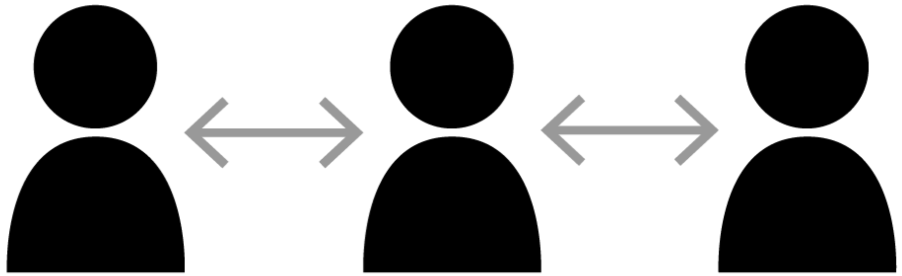
= | 249.64 KWh – 133.7 KWh|

What are the influential factors related to energy consumption?



(Yan et al., 2015)

How should the project be organised with respect to these influential factors in order to achieve energy performance?



Integrated design process

Iterative process

Communication

What are the drivers and barriers for project managers for the BMS implementation to optimize the energy performance of retrofitted residential buildings?

Barriers

- Different interest and expectations
- Different set of priorities
- Lack of knowledge in some aspects
- Decision making problems
- Lack of information sharing, transparency and trust

- Privacy constrains
- Data security

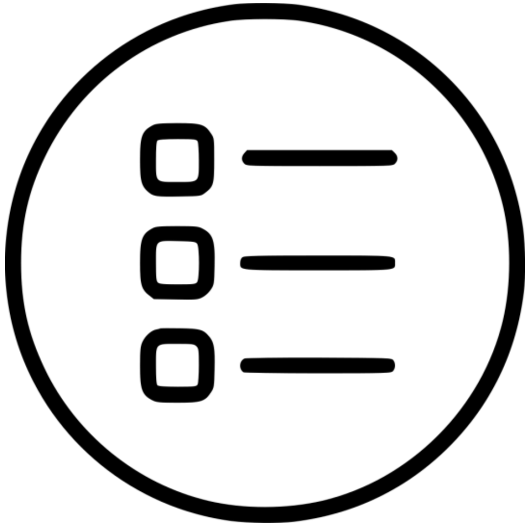
Drivers

- Same mission and vision (Energy efficient and circular built environment)
- New work environment and organization (Integrated and interdisciplinary)

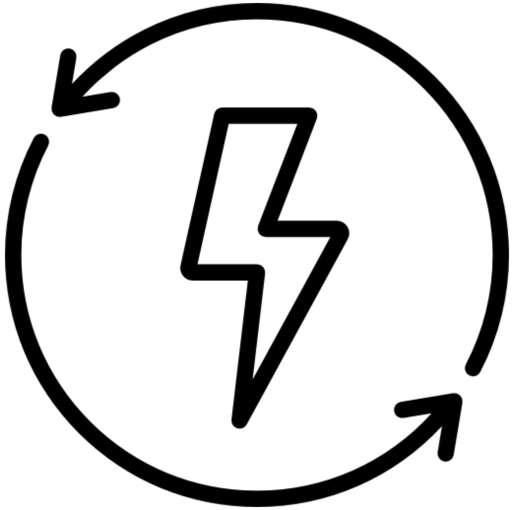
How to integrate the BMS requirements to optimize the energy performance and user satisfaction in retrofitted residential buildings?

- Implementing the comprehensive Trias Energetica concepts (Reduce – Reuse – Produce)
- Following the BMS implementation process framework
- Understanding the energy performance aspects of the building
- Integration of end-users during design process

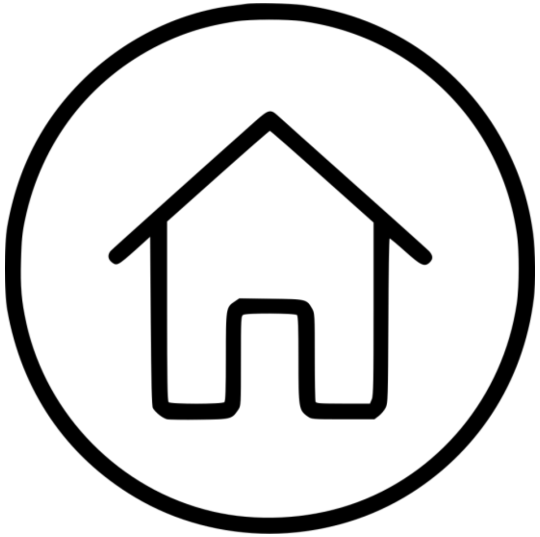
Research relevance



Policies and energy agreememts



Energy performance paradox



Future proof built environment

Limitations & further recommendations

- Further research is needed in order to generalize and research on broader scale
- Further tests need to be done
- Feedforward: adaptive learning, not only measuring and feedback but also learn the behaviours through machine learning
- Process: agile way of working
- Policies must be more ambitious and triggering to adapt itself towards future needs

Questions. Suggestions. Discussion.