Project “STREAMER” 2013-2017

GENERAL SUMMARY

This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608739

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Streamer

European research on energy-efficient healthcare districts

Semantics-driven Design through Geo and Building Information Modelling for Energy-efficient Buildings Integrated in Mixed-use Healthcare Districts

CP-IP FP7.EeB.NMP.2013-5:

Optimised design methodologies for energy-efficient buildings integrated in the neighbourhood energy systems

Streamer

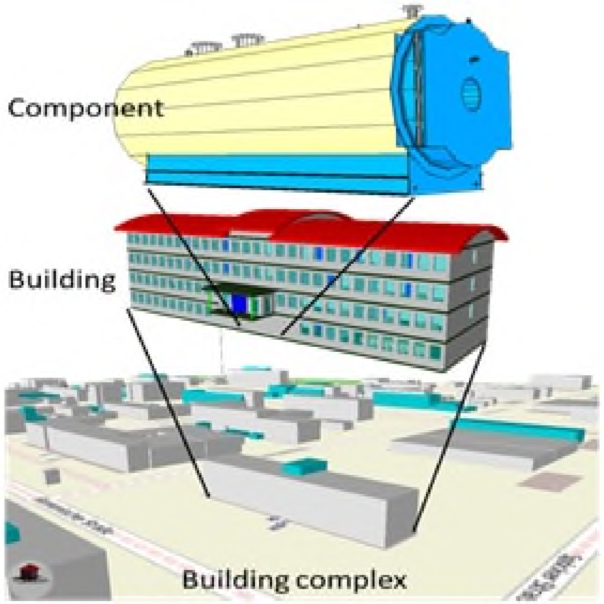
European research on energy-efficient healthcare districts

Consortium

20 partners: 7 IND + 5 SME + 4 PUB + 4 RES | 9 EU member states from 5 regions of Europe

No.	Participant organisation name	Acronym	Country	Type	Key competence
1 Coordinator	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO	TNO	NL	RES	Applied research institute
2	Ipostudio Architetti Srl	IAA	IT	SME	Architect & urban designer
3	De Jong Gortemaker Algra	DJG	NL	SME	Architect & building engineer
4	Ove Arup & Partners International Ltd	ARU	UK	IND	MEP/HVAC & structural designer
5	Becquerel Electric Srl	BEQ	IT	SME	MEP & energy system engineer
6	DWA BV	DWA	NL	SME	Environment, MEP, energy engineer
7	AEC3 Ltd	AEC	UK	SME	ICT specialist (BIM)
8	Karlsruher Institut fuer Technologie	KIT	DE	RES	ICT specialist (GIS)
9	DEMO Consultants BV	DMO	NL	SME	ICT specialist (software)
10	Bouygues Construction	BOU	FR	IND	Construction company
11	NCC AB	NCC	SE	IND	Construction company
12	Mostostal Warszawa S.A.	MOW	PL	IND	Construction company
13	Stichting Rijnstate Ziekenhuis	RNS	NL	PUB	Hospital (building owner/user)
14	Assistance Publique - Hopitaux de Paris	APH	FR	PUB	Hospital (building owner/user)
15	The Rotherham NHS Foundation Trust	TRF	UK	PUB	Hospital (building owner/user)
16	Azienda Ospedaliero-Universitaria Careggi	AOC	IT	PUB	Hospital (building owner/user)
17	Mazowiecka Agencja Energetyczna	MAE	PL	IND	Agency for energy management
18	Commissariat a l’Energie Atomique et aux Énergies Alternatives	CEA	FR	RES	Commission for energy research
19	Centre Scientifique et Technique du Batiment	CST	FR	RES	Applied research institute
20	Locum AB	LOC	SE	IND	Property developer & manager

Context and focus



Context: Hospital campus – mixed-use area with an integrated energy system, consists of various buildings (e.g. hospitals and clinics, research and educational buildings, offices)

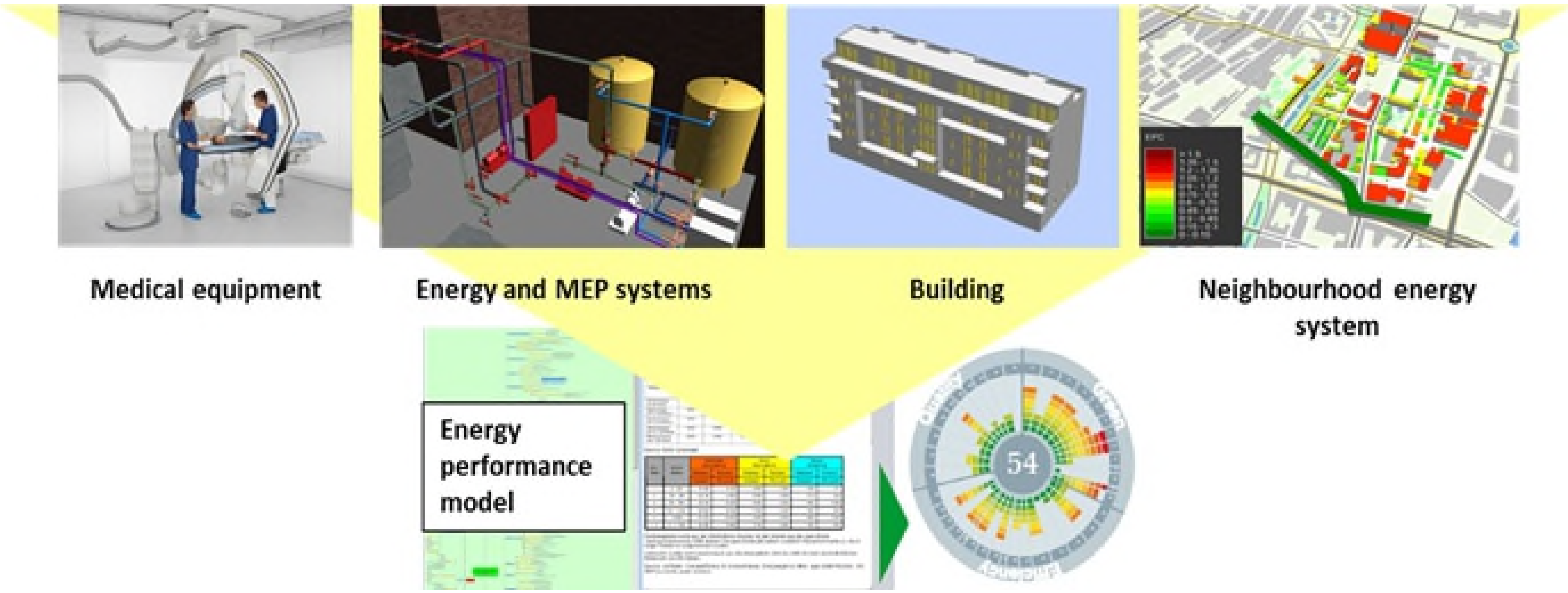
Focus: Building design – design optimization of new and existing buildings in 3 areas: MEP/HVAC systems; building envelop and spatial layout; energy grid in campus and surroundings.

Strategic aim and research goals

Aim: 50% reduced energy-use and CO_2 emission of healthcare districts in 10 years.

Research: EeB **design optimisation** in 3 levels / areas:

- **Building MEP/HVAC systems** in relation with high-tech medical equipment
- **Building envelope and spatial layout** in relation with new healthcare services
- **Building energy systems** in relation with neighbourhood systems (grid, storage, etc.)



Targeted key research achievement

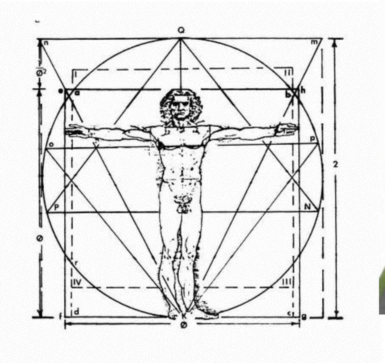
Generic semantic BIM+GIS typology models

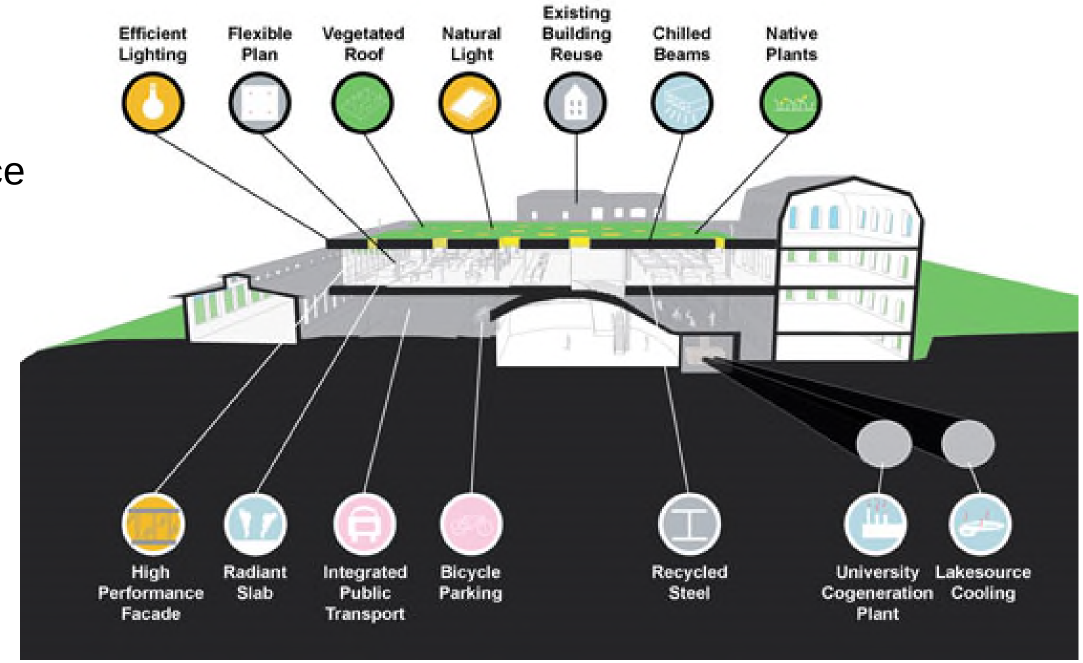
1

of Energy-efficient Buildings in healthcare districts:

adjustable semantic BIM+GIS design models as templates for new design and retrofitting.

- Object → Knowledge modelling
- Evidence → Experience
- Visualisation → Interpretation
- Data / specifications → Performance





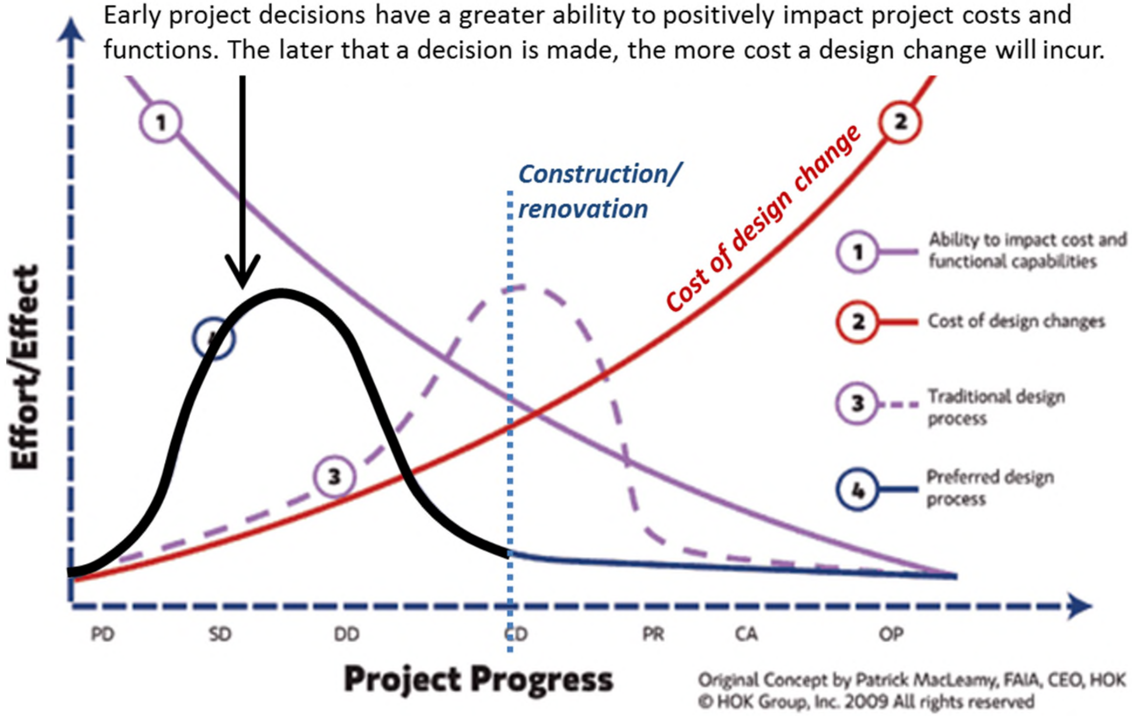
Targeted key research achievement

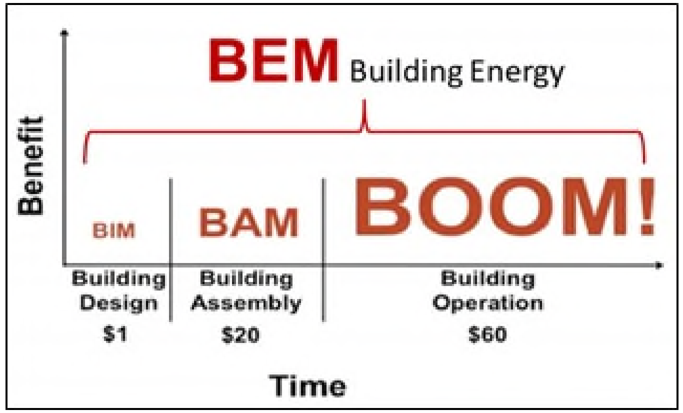
Framework for BEM (Building Energy Model)

lifecycle model inter-connecting BIM, BAM, BOOM.

2

STREAMER focuses at the early design process of new and retrofitting projects:
Early project decisions have a greater ability to positively impact project costs and functions. The later that a decision is made, the more cost a design change will incur.





Targeted key research achievement

<u>Design decision-support tool</u>

3

as an interactive tool which accommodates:

a) Inter-operable BIM and GIS models
b) Analysis of energy performance, lifecycle-cost, and functional optimisation
c) Stakeholder’s / user’s requirements, decision criteria and priorities.

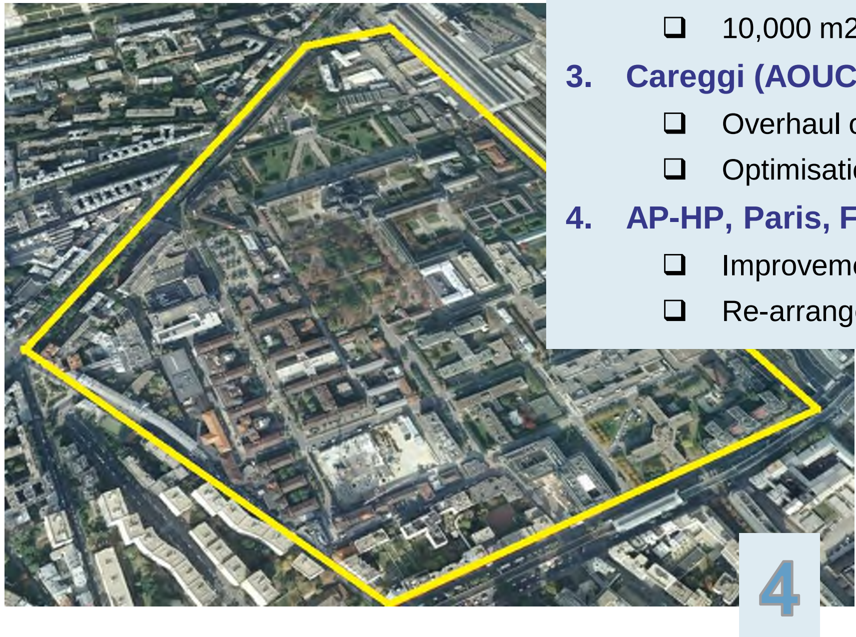



Key barriers to overcome

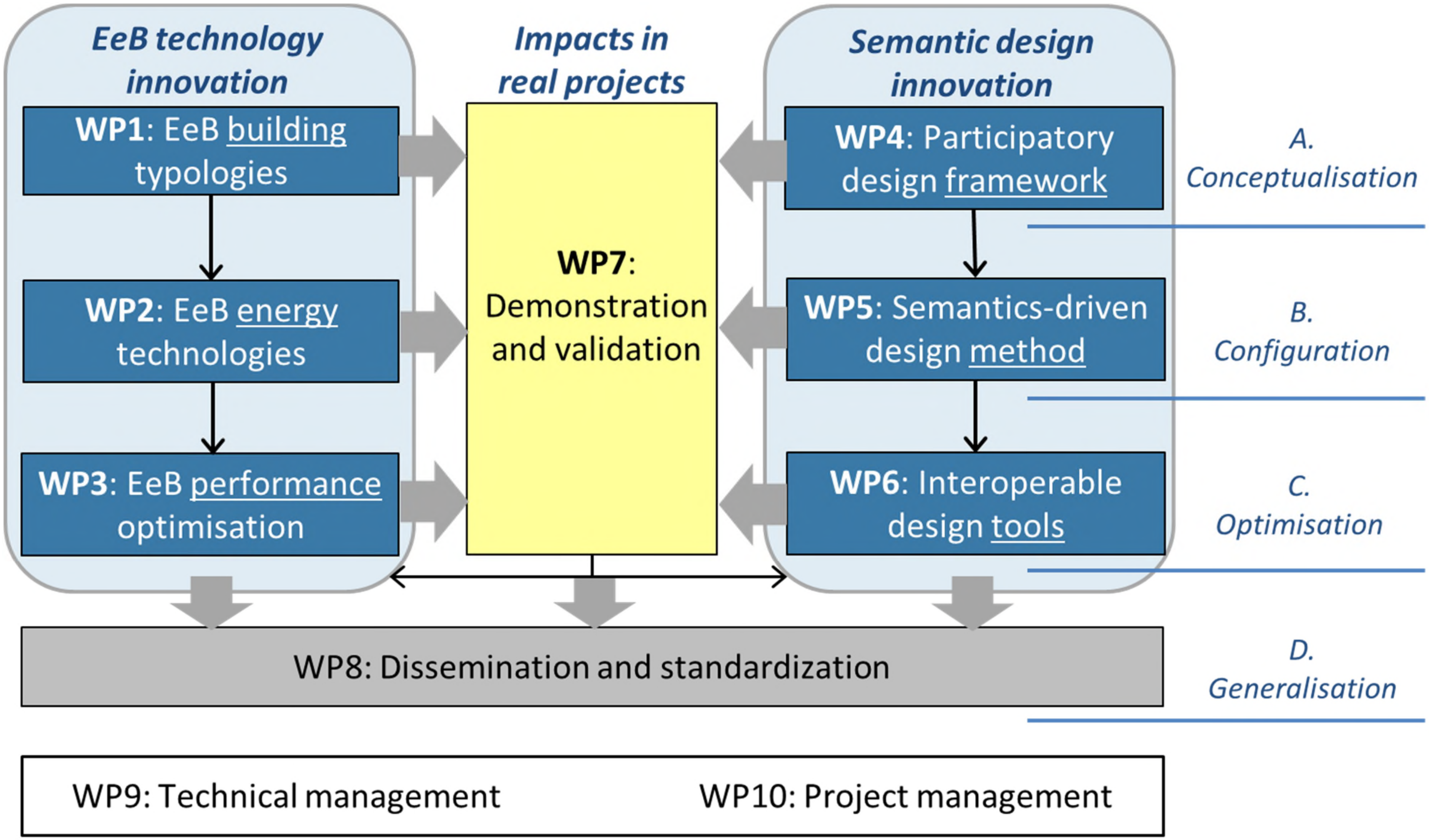
- Lack of a holistic approach to tackle multi-disciplinary complexity.
  - Design is not only about technology, but also, and mainly, about healthcare-related services and building operations: “how can we continue to provide high quality services in a context of budget cuts and reduction of personnel ?”
- Lack of a multi-scale optimisation (components – buildings – neighbourhood).
  - Trial-and-error approach causes many ad hoc changes during the construction stage. This hampers the optimal configuration of the solutions for whole lifecycle benefits as the design solutions cannot cope with rapidly changing healthcare policies, processes and technologies.

Actual projects of 4 hospital districts with real plans for EeB retrofitting or new design:

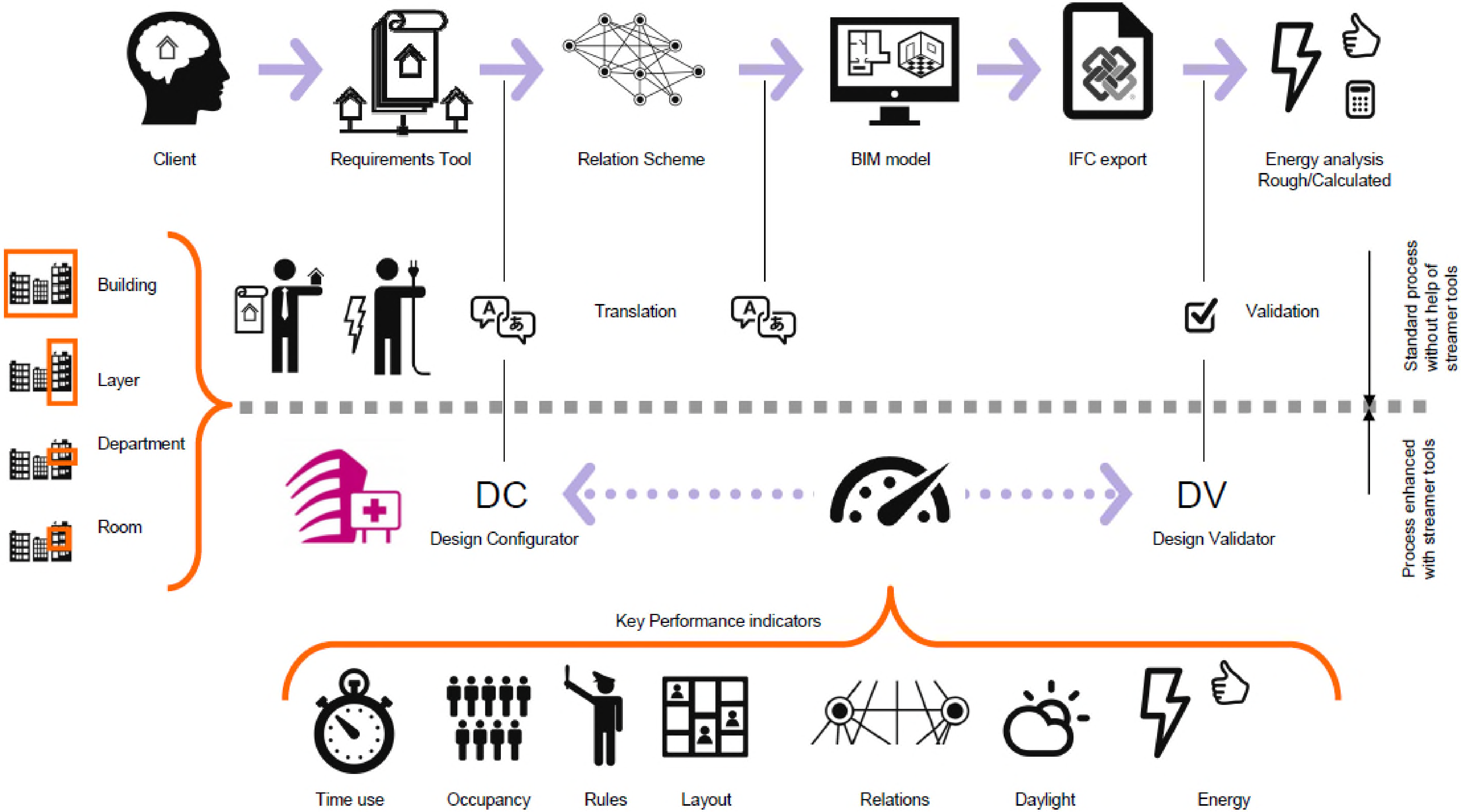
1. **NHS, Rotherham, UK**
   - ❑ Upgrade of Building Management Systems
   - ❑ Major improvements in overall building fabric
2. **Rijnstate, Arnhem, NL**
   - ❑ Mid-life renovation to replace MEP systems
   - ❑ 10,000 m2 extension and new buildings
3. **Careggi (AOUC), Firenze, Italy**
   - ❑ Overhaul of electricity and heat distribution
   - ❑ Optimisation of inter-building functions
4. **AP-HP, Paris, France**
   - ❑ Improvement of logistic and waste systems
   - ❑ Re-arrangement of building spaces



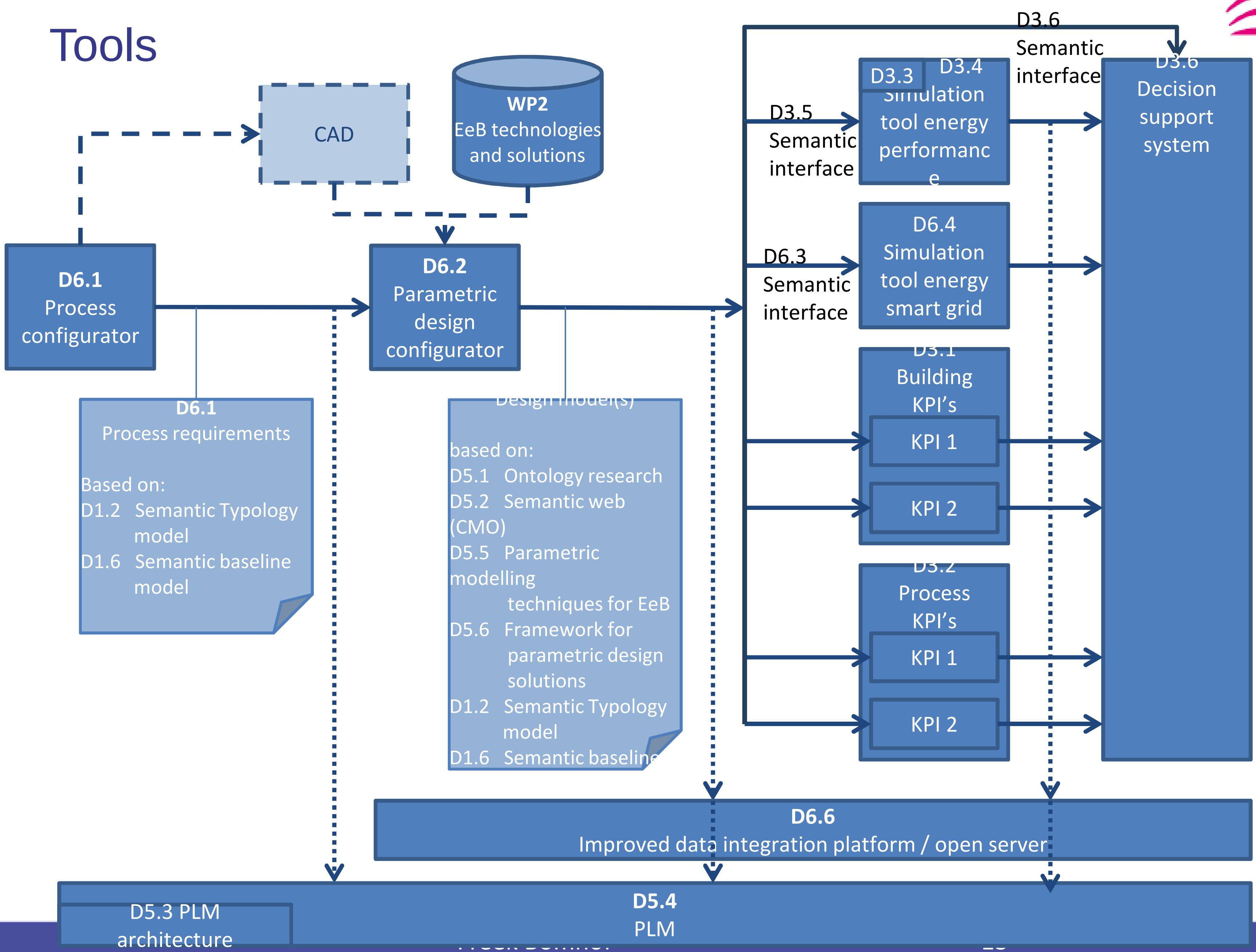
Work packages



The design process



Tools


CAD
WP2
EeB technologies and solutions
D6.1
Process configurator
D6.2
Parametric design configurator
D6.1
Process requirements
Based on:
D1.2 Semantic Typology model
D1.6 Semantic baseline model
based on:
D5.1 Ontology research
D5.2 Semantic web (CMO)
D5.5 Parametric modelling techniques for EeB
D5.6 Framework for parametric design solutions
D1.2 Semantic Typology model
D1.6 Semantic baseline
D3.6
Semantic interface
D3.5
Semantic interface
D3.3
D3.4
Simulation tool energy performance
D6.3
Semantic interface
D6.4
Simulation tool energy smart grid
Building KPI's
KPI 1
KPI 2
Process KPI's
KPI 1
KPI 2
Decision support system
D6.6
Improved data integration platform / open server
D5.3 PLM architecture
D5.4
PLM

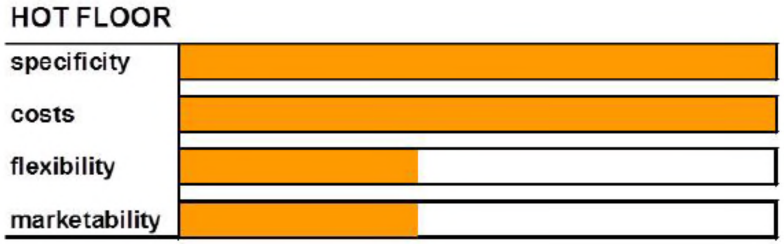
Challenges to solve

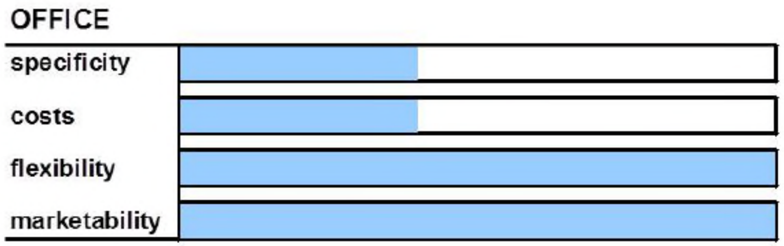
- Designing in this way is a multi-dimensional puzzle
- Energy simulation software is not our focus
- No ‘best’ model for energy simulation exists
- Often, MEP and actual usage profiles are not taken into consideration
- Energy is not the only KPI to optimize!

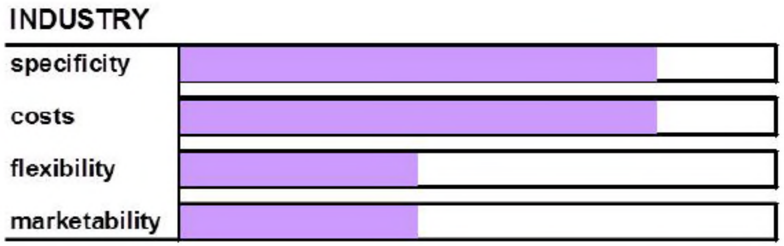
Approach:

- Use as much as possible existing software
- Use semantic technology to capture (tacit) design knowledge

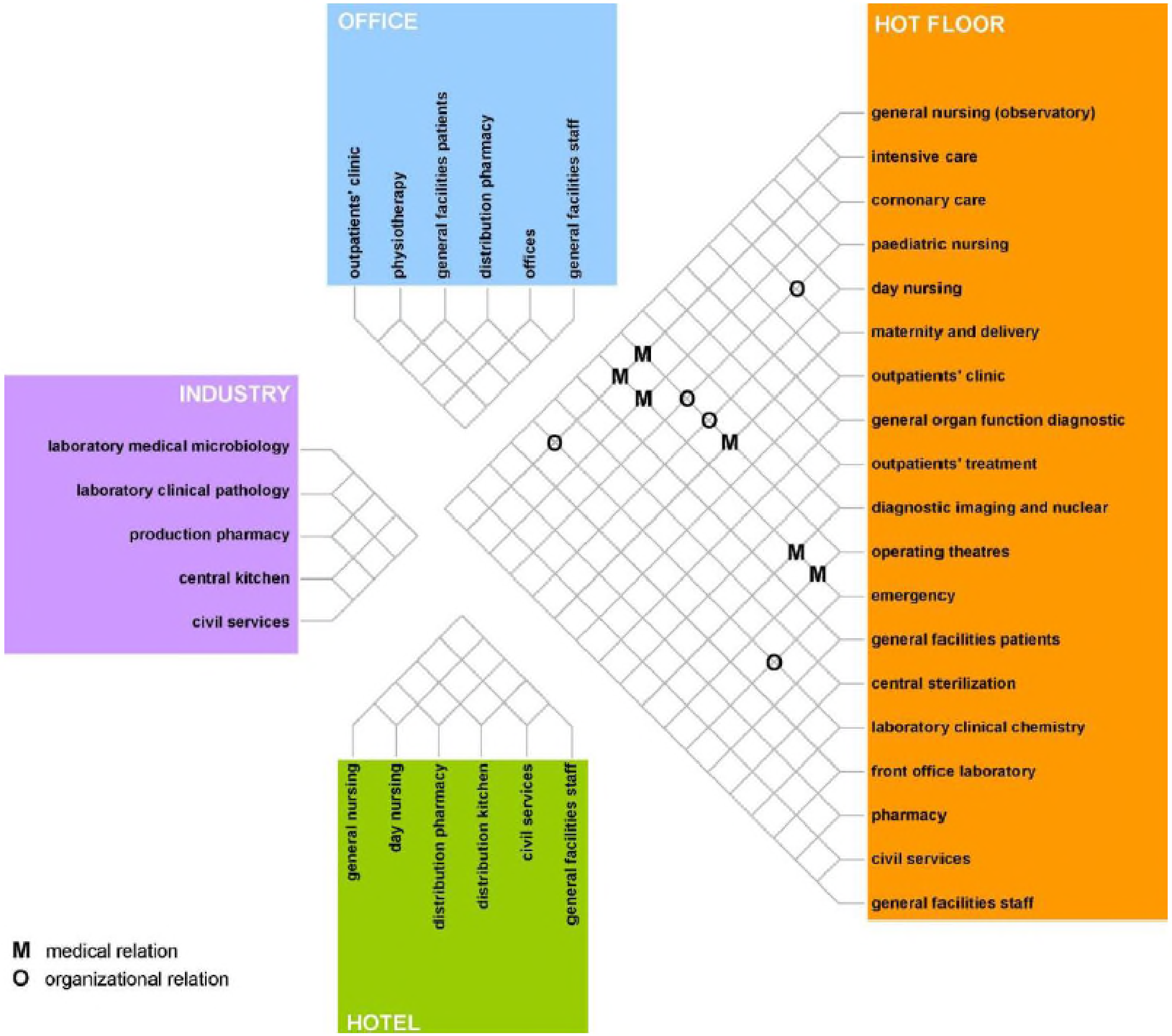
Example:
Layer model







Layer model as design guideline



One step further: labels on a functional/ room level (1/2)

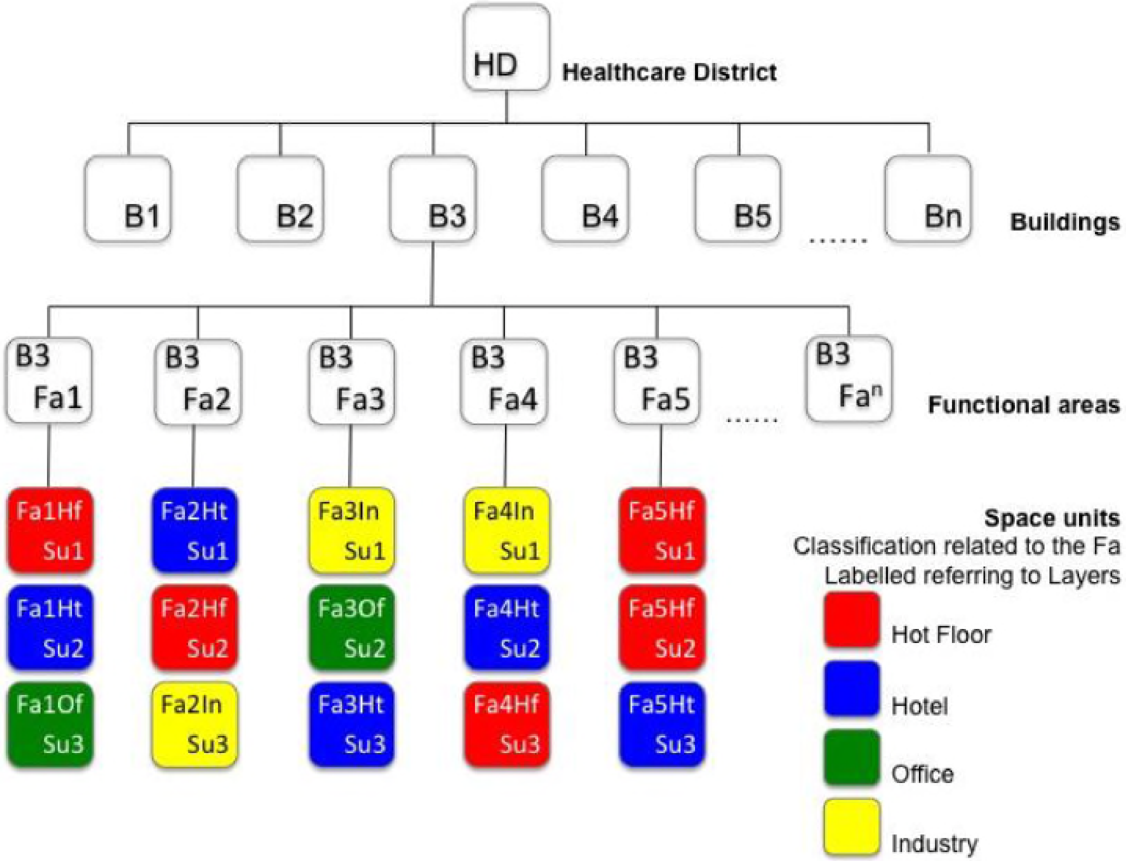
Label	Level
Hygienic classes (has a relation with amount of ventilation, air tightness, cleaning, materials)	• H1 (corridor, reception, toilet , etc.) • H2 (office, bath room, etc.) • H3 (patient room, examination room, treatment room, etc.) • H4 (operating room, insulation room, etc.) -> additional air tightness and ventilation extra ductwork is necessary • H5 (laboratory, production pharmacy, etc.) -> additional air tightness ventilation extra ductwork is necessary
Accessibility (has a relation with the position in the hospital, safety/protective/security device)	• A1 (Public) • A2 (Patients, visitors and staff) • A3 (Patients and staff • A4 (All staff members) • A5 (Specific staff members)
Equipment (has a relation with the type of function, high electric power needed, medical gasses, , ICT data points)	• EQ1 (Office level) • EQ2 (EQ1 and medical gases) • EQ3 (EQ1 and extra electric power) • EQ4 (EQ1 and extra ICT data points) • EQ5 (EQ2, EQ3 and EQ4) • EQ6 (High electrical safety) • EQ7 (special equipment)

One step further: labels on a functional/ room level (2/2)

Label	Level
Construction (has a relation with floor strength, shielding against radiation, floor height, air tightness)	• C1 (Office level) • C2 (Office level with extra floor strength) • C3 (Office level with extra floor height) • C4 (C2 and C3) • C5 (Accessible from the outside with heavy load) • C6 (Shielding against radiation) • C7 (high level of air tightness)
User profile (has a relation with the type of use)	• U1 (Monday to Friday from 8:00 – 18:00) • U2 (U1 extended till 20:00) • U3 (U1 with emergency function outside this timeslot) • U4 (24*7)

Using the labels

- For logical grouping of rooms within buildings
- For ‘clash detection’ (automated or visual)
- As a basis for energy profiles
- Additional requirements (flexibility; safety; adjacency; logistics; staff/patient satisfaction; …)



Next steps

- Incorporate energy simulation models
- Use the labeling approach in design support tools
- Automatic validation of design
- Calculation of KPIs
- Incorporate GIS information in the methodology