D4E- Facilitator -Guides for model uses

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3 sets of Facilitators

- Guide for BIM models and model uses in Needs Identification and Requirements & Feasibility study (see separate slide set)

- Guide for BIM models and model uses in Concept design Detailed design and Final design
  - Including integrated design review (see separate slide set)

- Guide for BIM models and model uses in Retrofit (in this slide set)

Guide for BIM models and model uses in Retrofit

Run the slides in video presentation mode.

Click areas in the process map for To-Do’s and extra information.

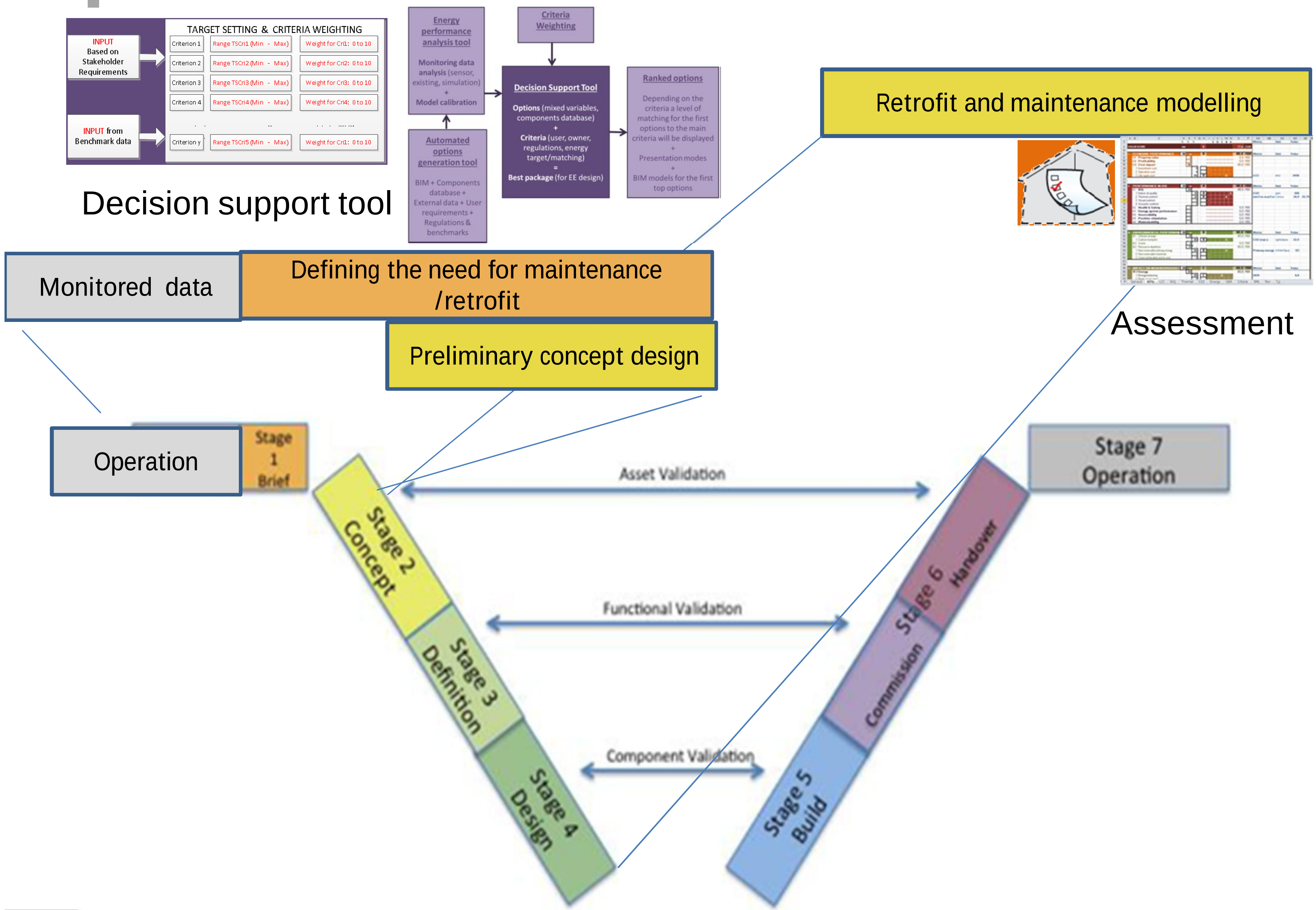
DM-TOOL: BIM PROCESS EXECUTION FACILITATOR

(D4E-FACILITATOR)

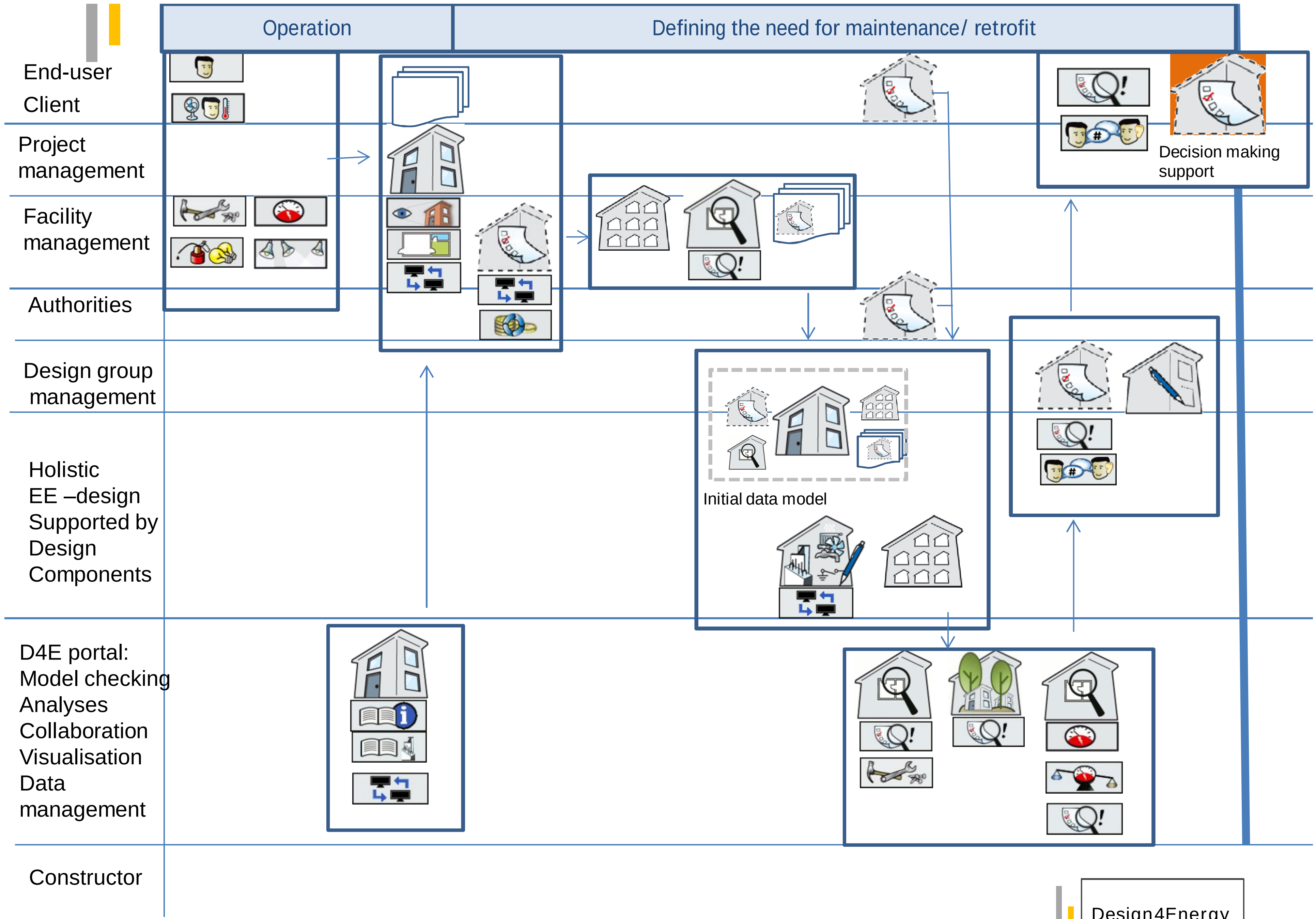
Defining the need for maintenance/ retrofit

Phase consists of

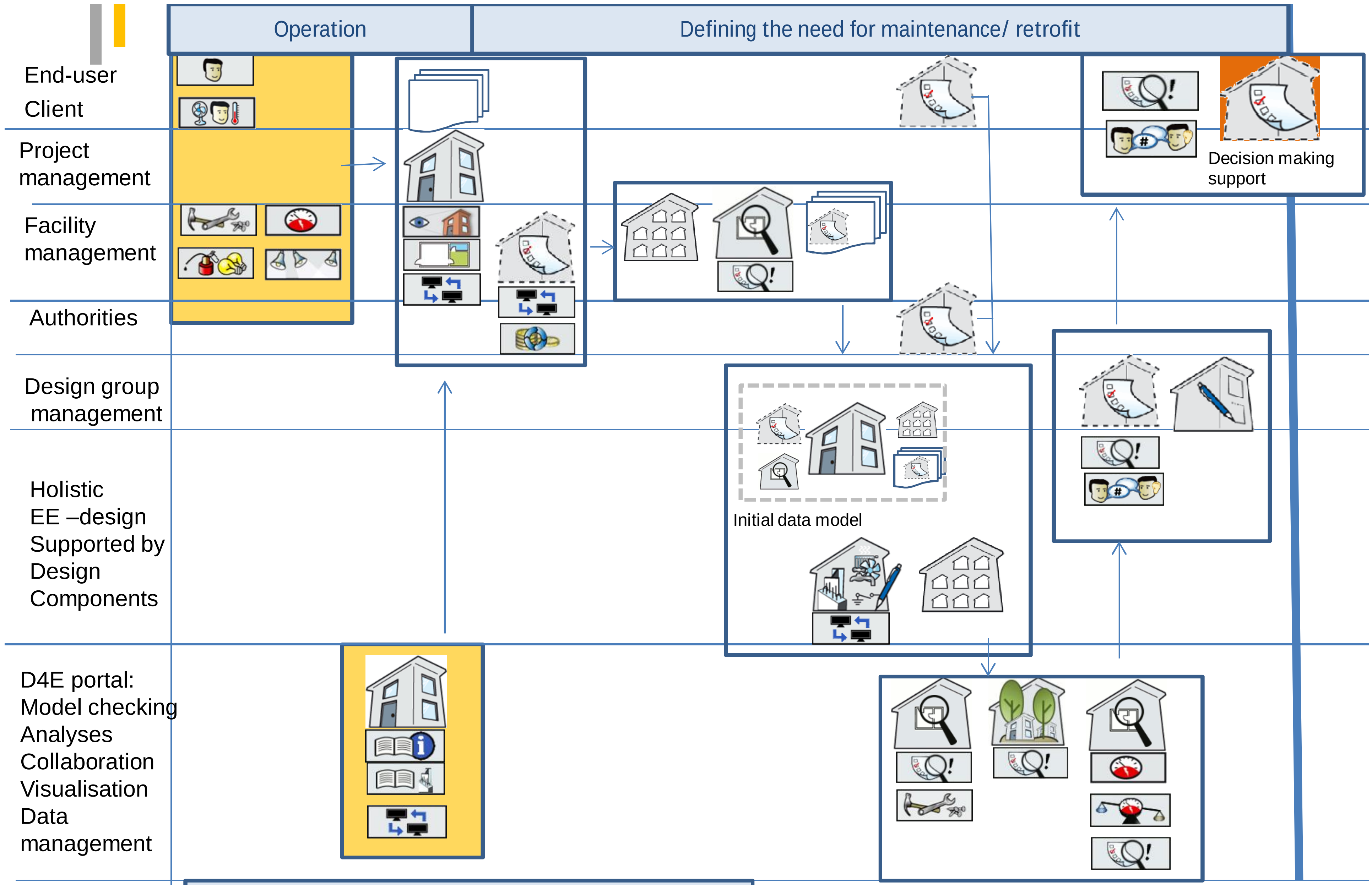
- Collecting initial data of the building consisting of monitored EE performance data.
- Analyses of retrofit concept and making a decision between
  - (1) retrofit,
  - (2) extra maintenance or
  - (3) change of behavior/change of purpose of use supported by an analysis tool.
- Designing retrofit alternative based on client's needs and performance target set with help of conducted analyses.



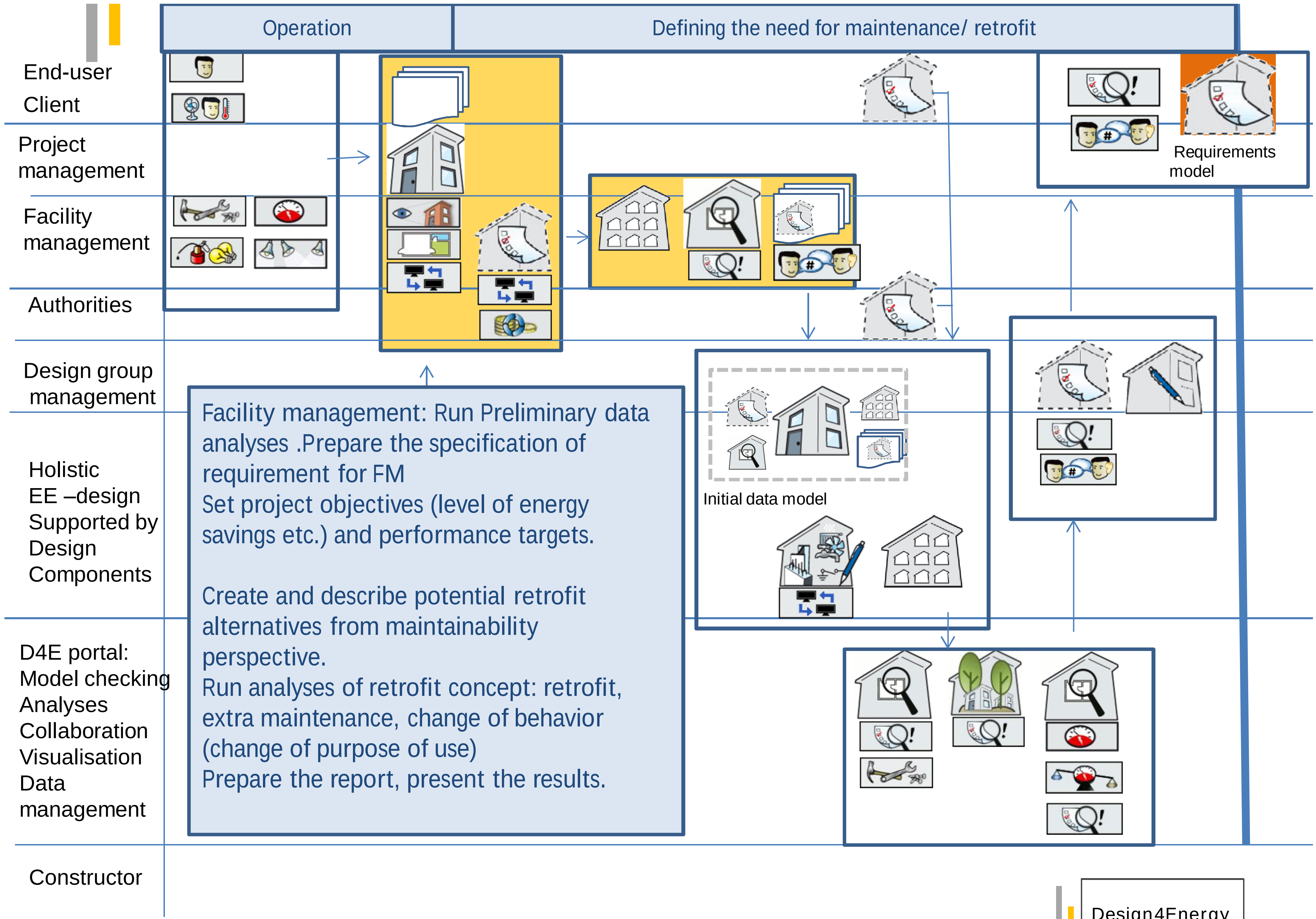
TARGET SETTING & CRITERIA WEIGHTING
INPUT Based on Stakeholder Requirements
INPUT from Benchmark data
Criterion 1
Criterion 2
Criterion 3
Criterion 4
Criterion y
Range TSCri1 (Min - Max)
Range TSCri2 (Min - Max)
Range TSCri3 (Min - Max)
Range TSCri4 (Min - Max)
Range TSCri5 (Min - Max)
Weight for Cri1: 0 to 10
Weight for Cri2: 0 to 10
Weight for Cri3: 0 to 10
Weight for Cri4: 0 to 10
Weight for Cri1: 0 to 10
Energy performance analysis tool
Monitoring data analysis (sensor, existing, simulation) + Model calibration
Automated options generation tool
BIM + Components database + External data + User requirements + Regulations & benchmarks
Criteria Weighting
Decision Support Tool
Options (mixed variables, components database) + Criteria (user, owner, regulations, energy target/matching) = Best package (for EE design)
Ranked options
Depending on the criteria a level of matching for the first options to the main criteria will be displayed + Presentation modes + BIM models for the first top options
Decision support tool
Retrofit and maintenance modelling
Assessment
Monitored data
Defining the need for maintenance /retrofit
Preliminary concept design
Operation
Stage 1 Brief
Stage 2 Concept
Stage 3 Definition
Stage 4 Design
Stage 5 Build
Stage 6 Commission Handover
Stage 7 Operation
Asset Validation
Functional Validation
Component Validation



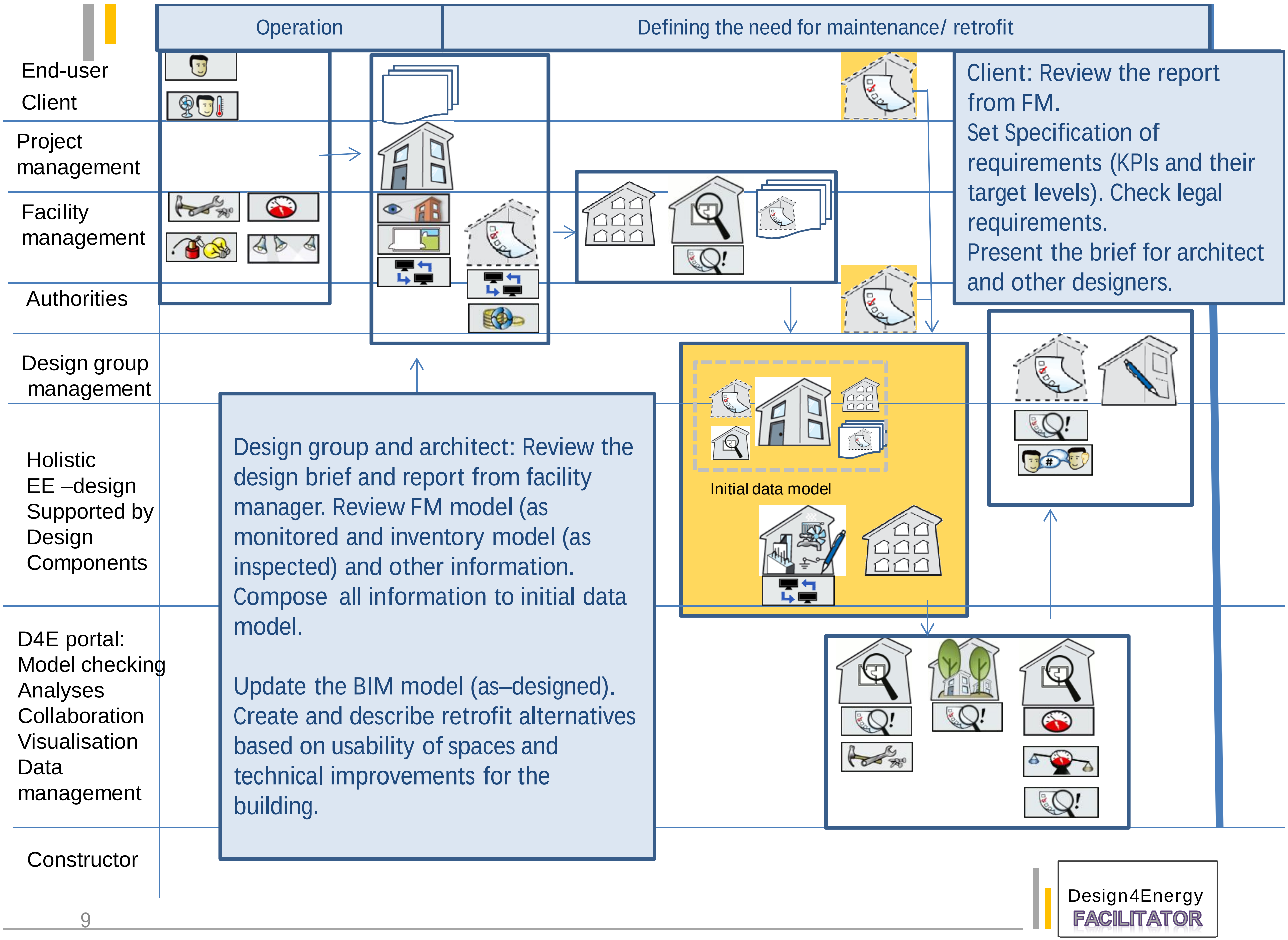
Design4Energy FACILITATOR



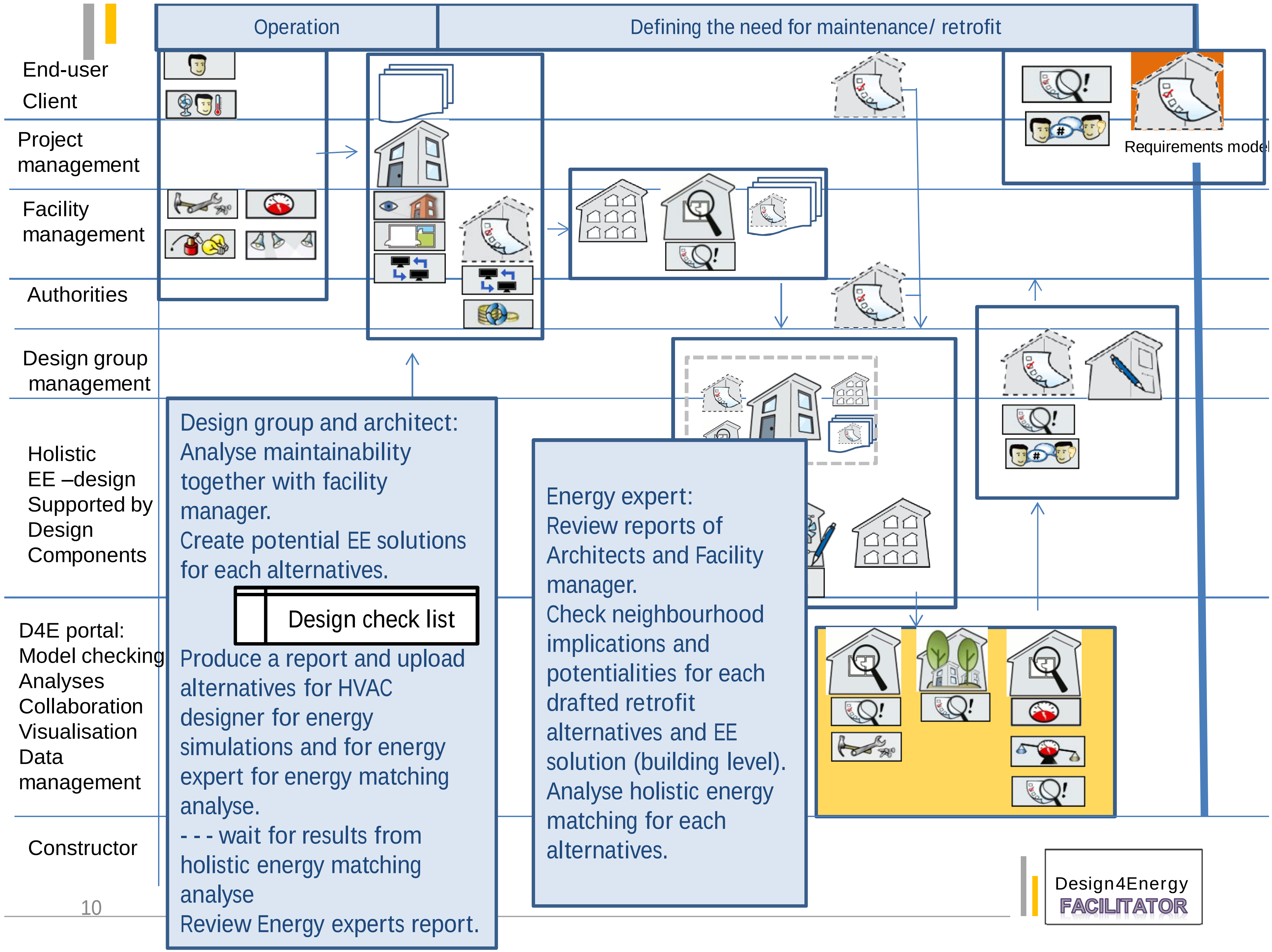
Facility management: Collect monitored data about the building operation. Study Benchmark data.



Design4Energy FACILITATOR



Operation
Defining the need for maintenance/ retrofit
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Client: Review the report from FM.
Set Specification of requirements (KPIs and their target levels). Check legal requirements.
Present the brief for architect and other designers.
Design group and architect: Review the design brief and report from facility manager. Review FM model (as monitored and inventory model (as inspected) and other information.
Compose all information to initial data model.
Update the BIM model (as–designed).
Create and describe retrofit alternatives based on usability of spaces and technical improvements for the building.
Initial data model
Design4Energy
FACILITATOR


Operation
Defining the need for maintenance/ retrofit
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Requirements model
Design group and architect: Analyse maintainability together with facility manager. Create potential EE solutions for each alternatives.
Design check list
Produce a report and upload alternatives for HVAC designer for energy simulations and for energy expert for energy matching analyse.
- - - wait for results from holistic energy matching analyse
Review Energy experts report.
Energy expert: Review reports of Architects and Facility manager. Check neighbourhood implications and potentialities for each drafted retrofit alternatives and EE solution (building level). Analyse holistic energy matching for each alternatives.
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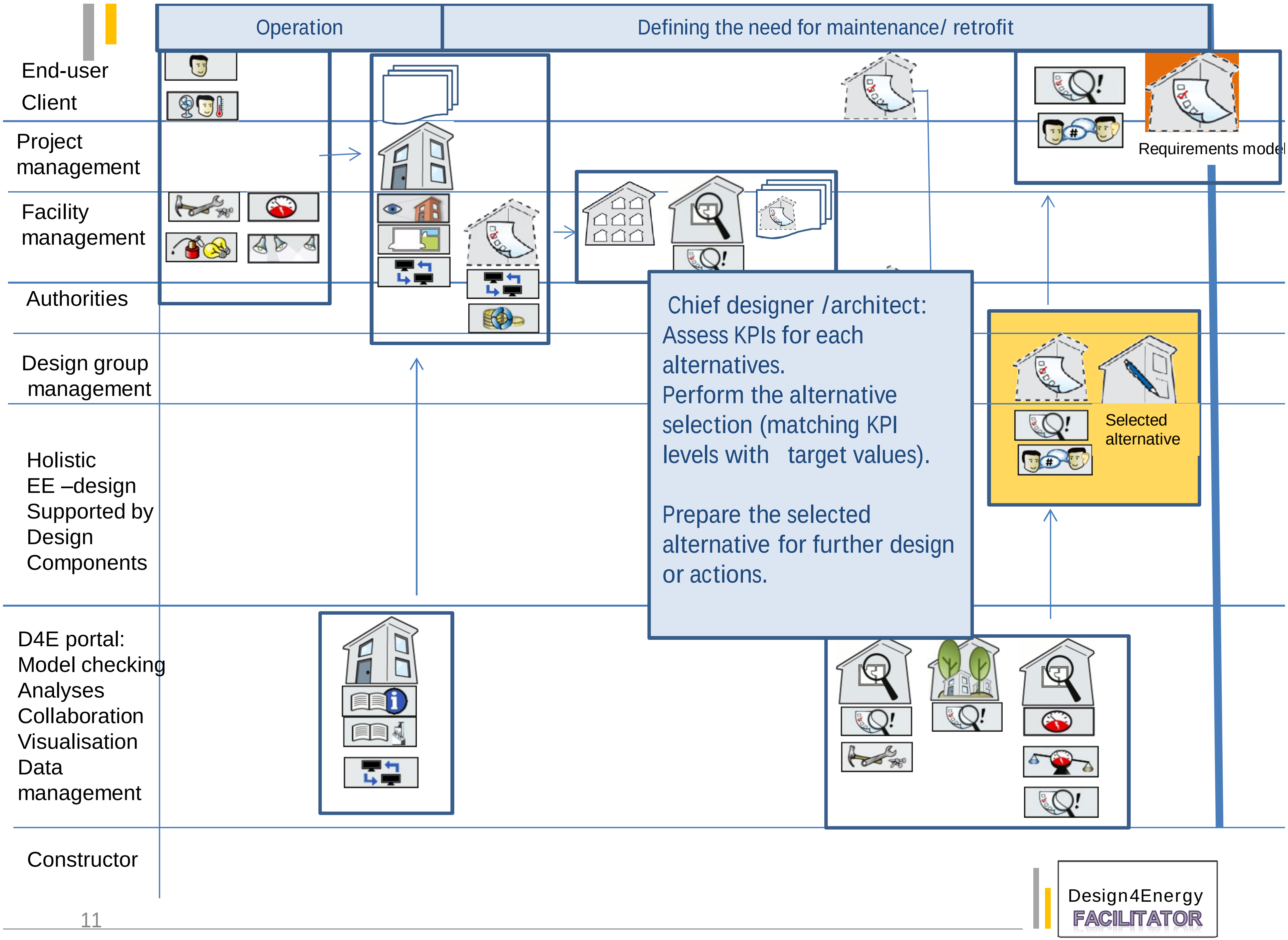
FACILITATOR


Operation
Defining the need for maintenance/ retrofit
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Requirements model
Chief designer /architect: Assess KPIs for each alternatives. Perform the alternative selection (matching KPI levels with target values).
Prepare the selected alternative for further design or actions.
Selected alternative
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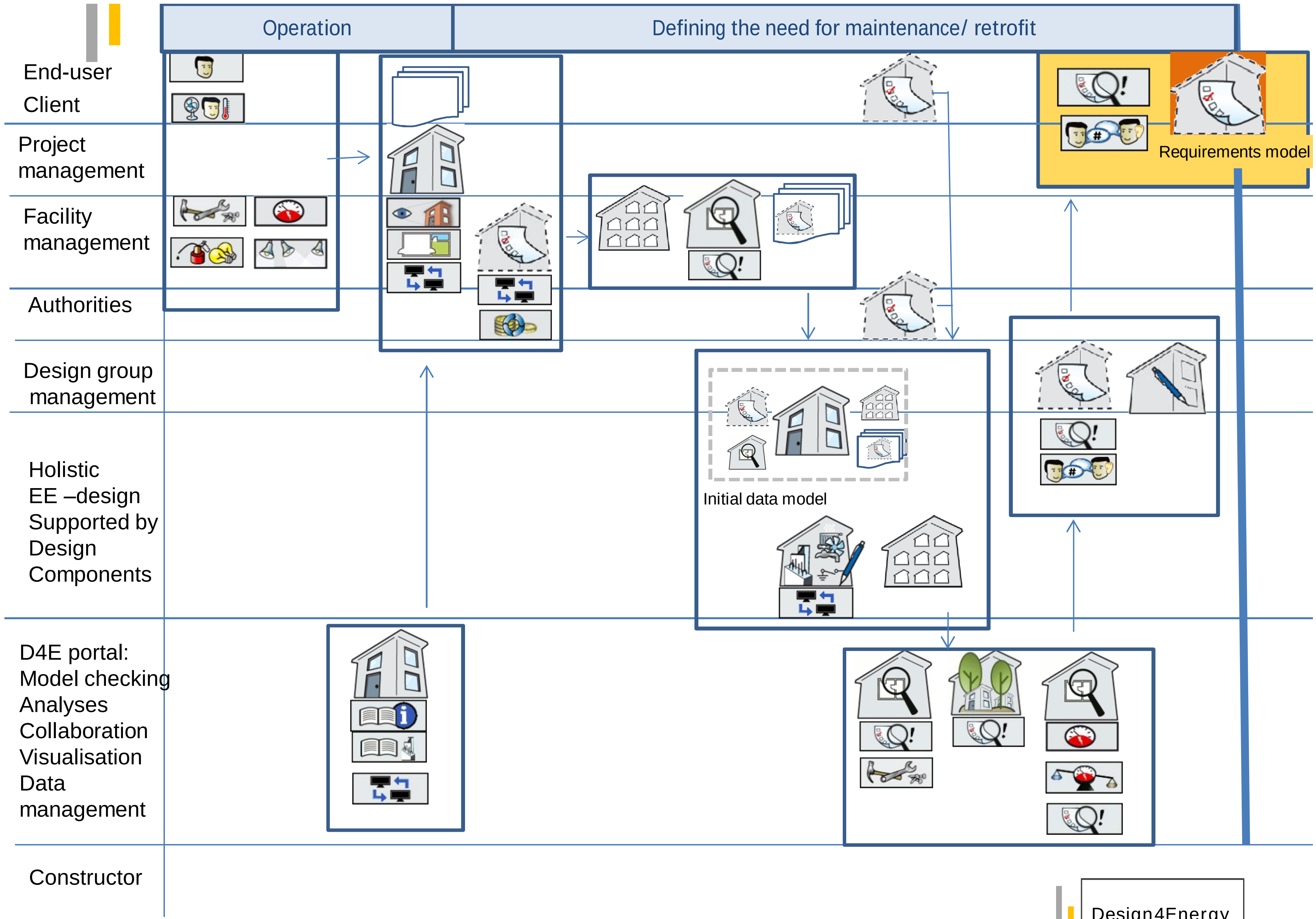
FACILITATOR



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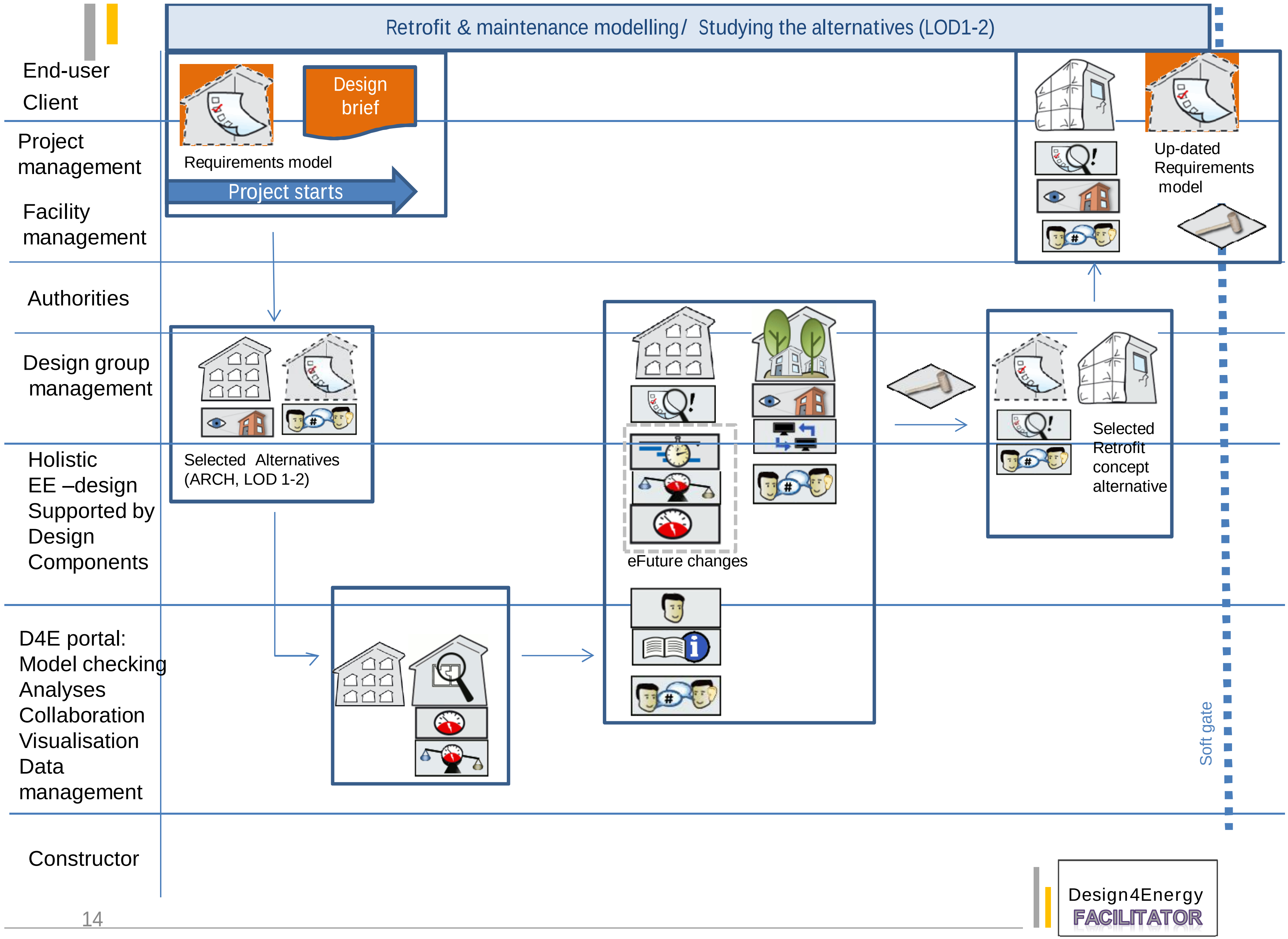
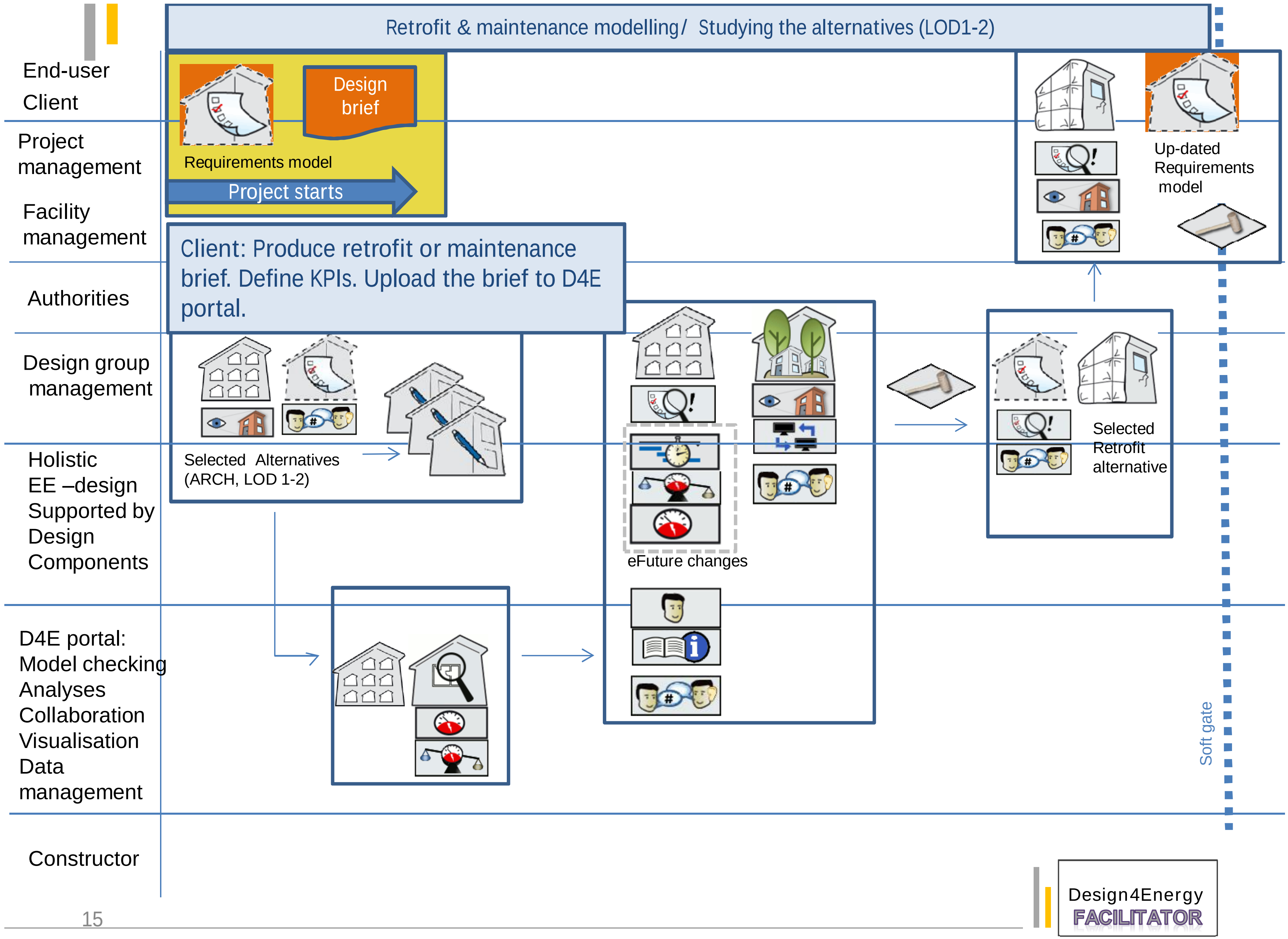
Retrofit & maintenance modelling

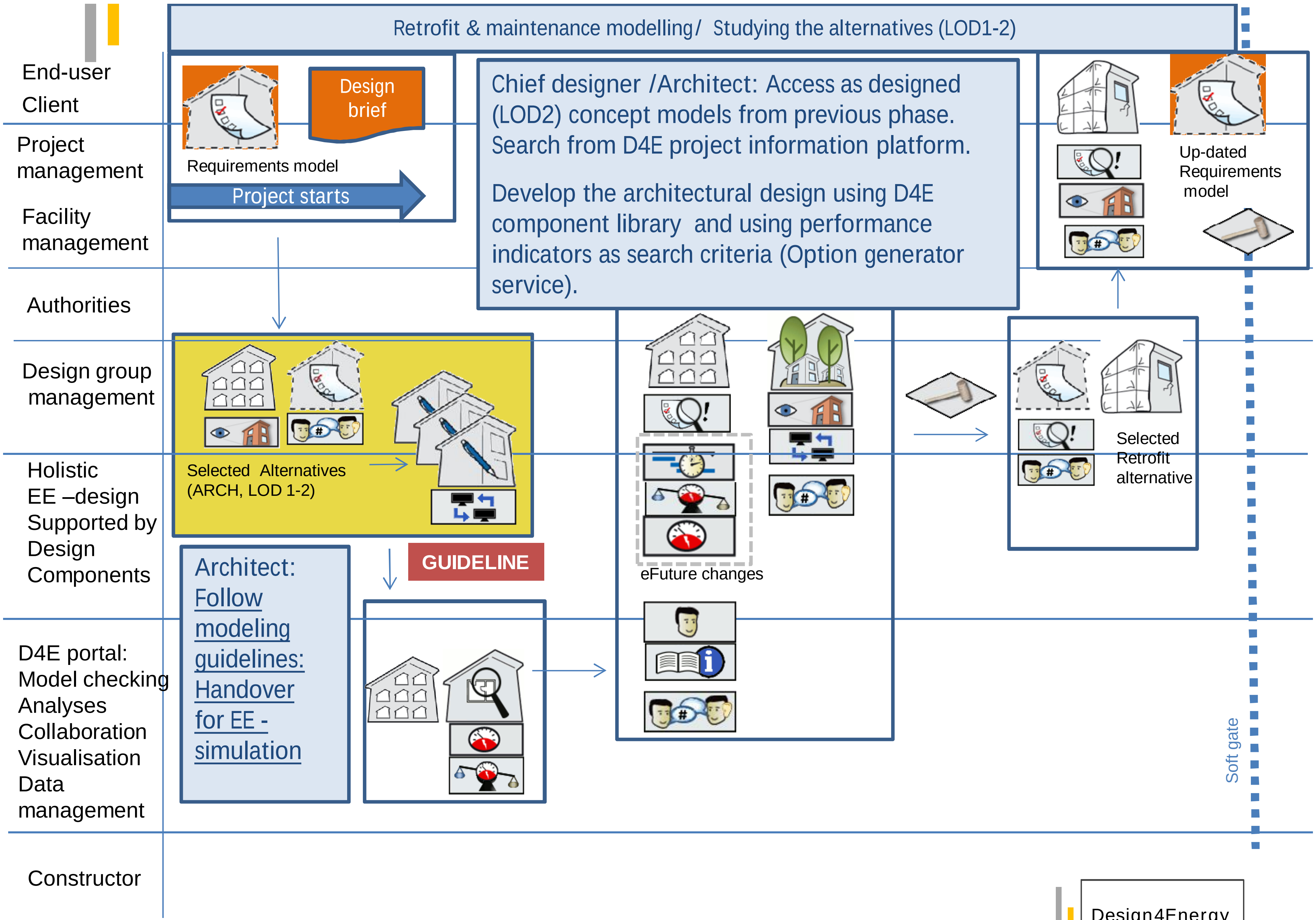
Phase consists of

- Design with developing BIM model from LOD2 to LOD4 with help of analyses and collaborative reviews
  - From Selected Alternative to Concept design solution (1/2)
  - From Concept design (LOD2) to Final Design solution (LOD 4)
- Final performance assessment to support client's decision making.

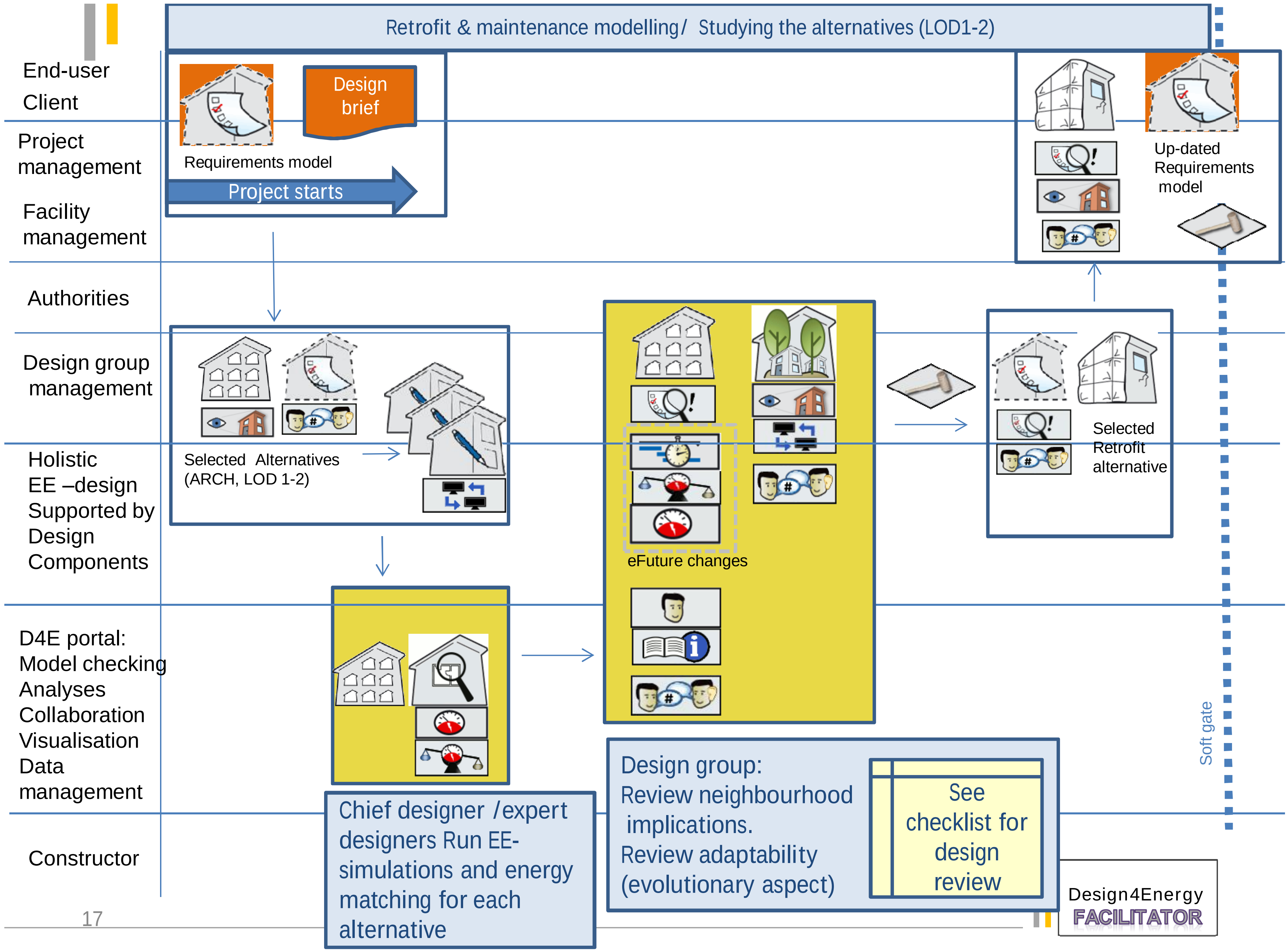

Retrofit & maintenance modelling/ Studying the alternatives (LOD1-2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Design brief
Requirements model
Project starts
Selected Alternatives (ARCH, LOD 1-2)
eFuture changes
Selected Retrofit concept alternative
Up-dated Requirements model
Soft gate
Design4Energy FACILITATOR



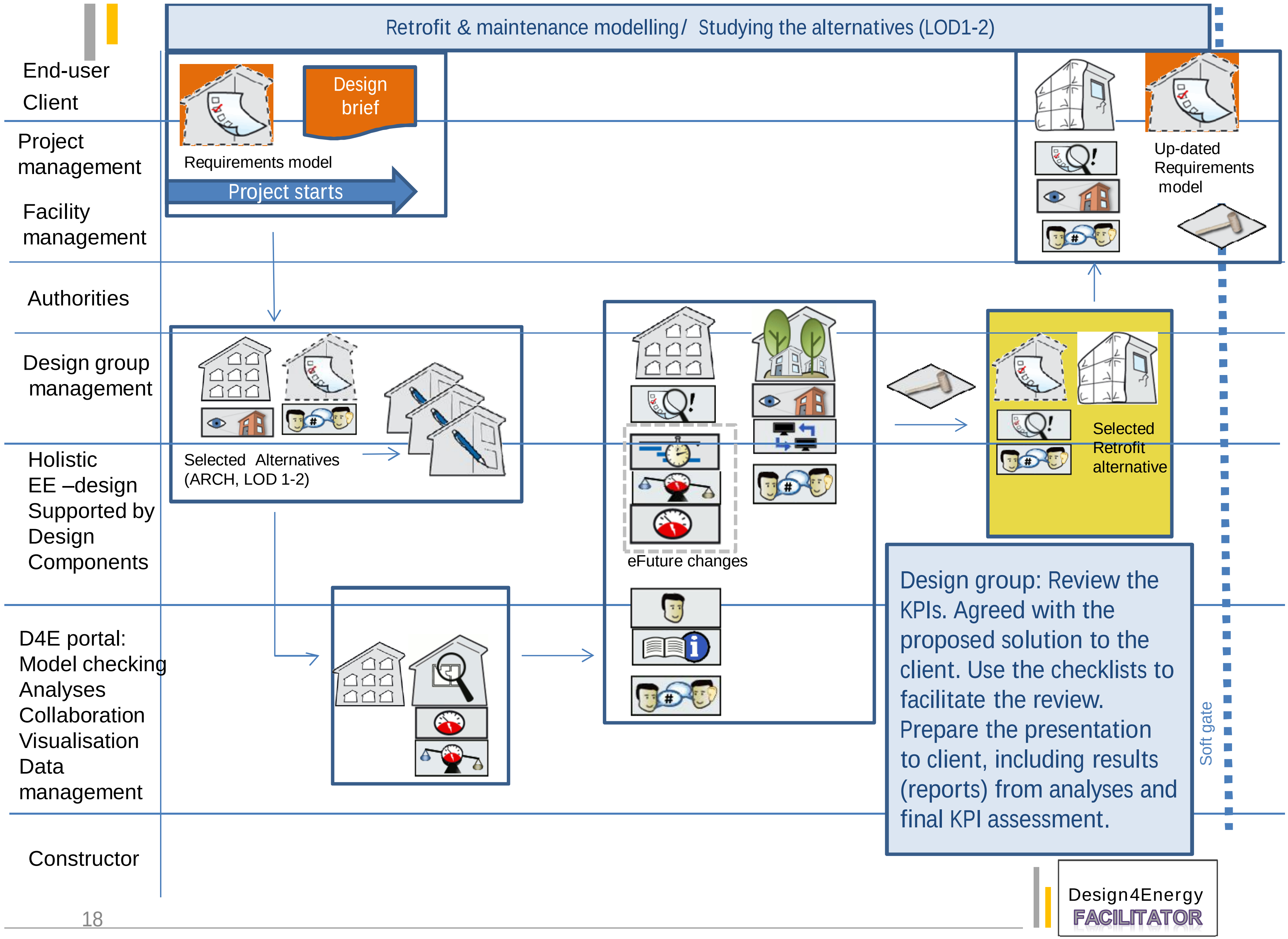
Retrofit & maintenance modelling/ Studying the alternatives (LOD1-2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Design brief
Requirements model
Project starts
Client: Produce retrofit or maintenance brief. Define KPIs. Upload the brief to D4E portal.
Selected Alternatives (ARCH, LOD 1-2)
eFuture changes
Selected Retrofit alternative
Up-dated Requirements model
Soft gate
Design4Energy
FACILITATOR

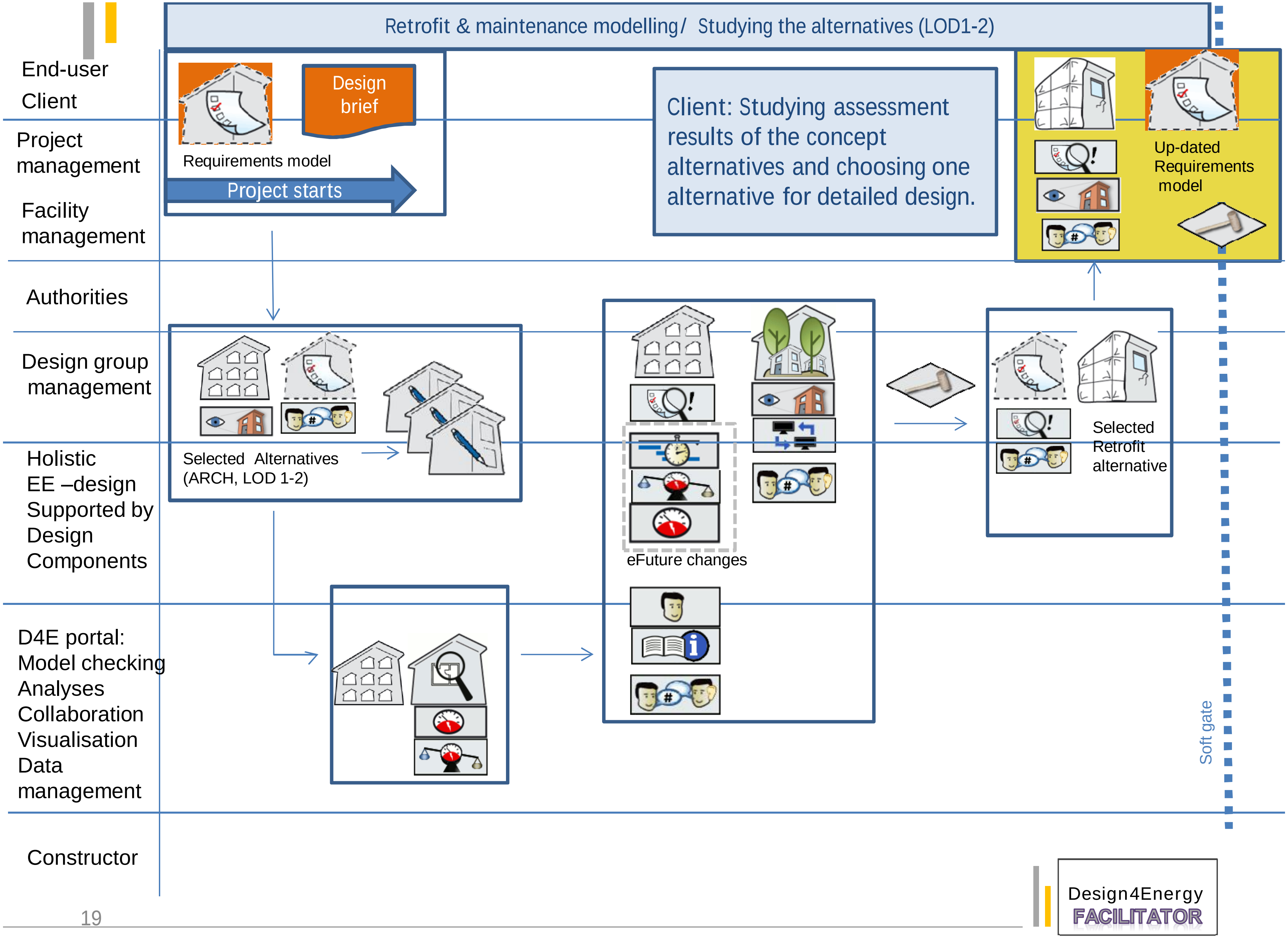


Design4Energy FACILITATOR



Retrofit & maintenance modelling/ Studying the alternatives (LOD1-2)
End-user
Client
Project
management
Facility
management
Authorities
Design group
management
Holistic
EE –design
Supported by
Design
Components
D4E portal:
Model checking
Analyses
Collaboration
Visualisation
Data
management
Constructor
Design
brief
Requirements model
Project starts
Selected Alternatives
(ARCH, LOD 1-2)
eFuture changes
Up-dated
Requirements
model
Selected
Retrofit
alternative
Soft gate
Chief designer /expert
designers Run EE-
simulations and energy
matching for each
alternative
Design group:
Review neighbourhood
implications.
Review adaptability
(evolutionary aspect)
See
checklist for
design
review
Design4Energy
FACILITATOR

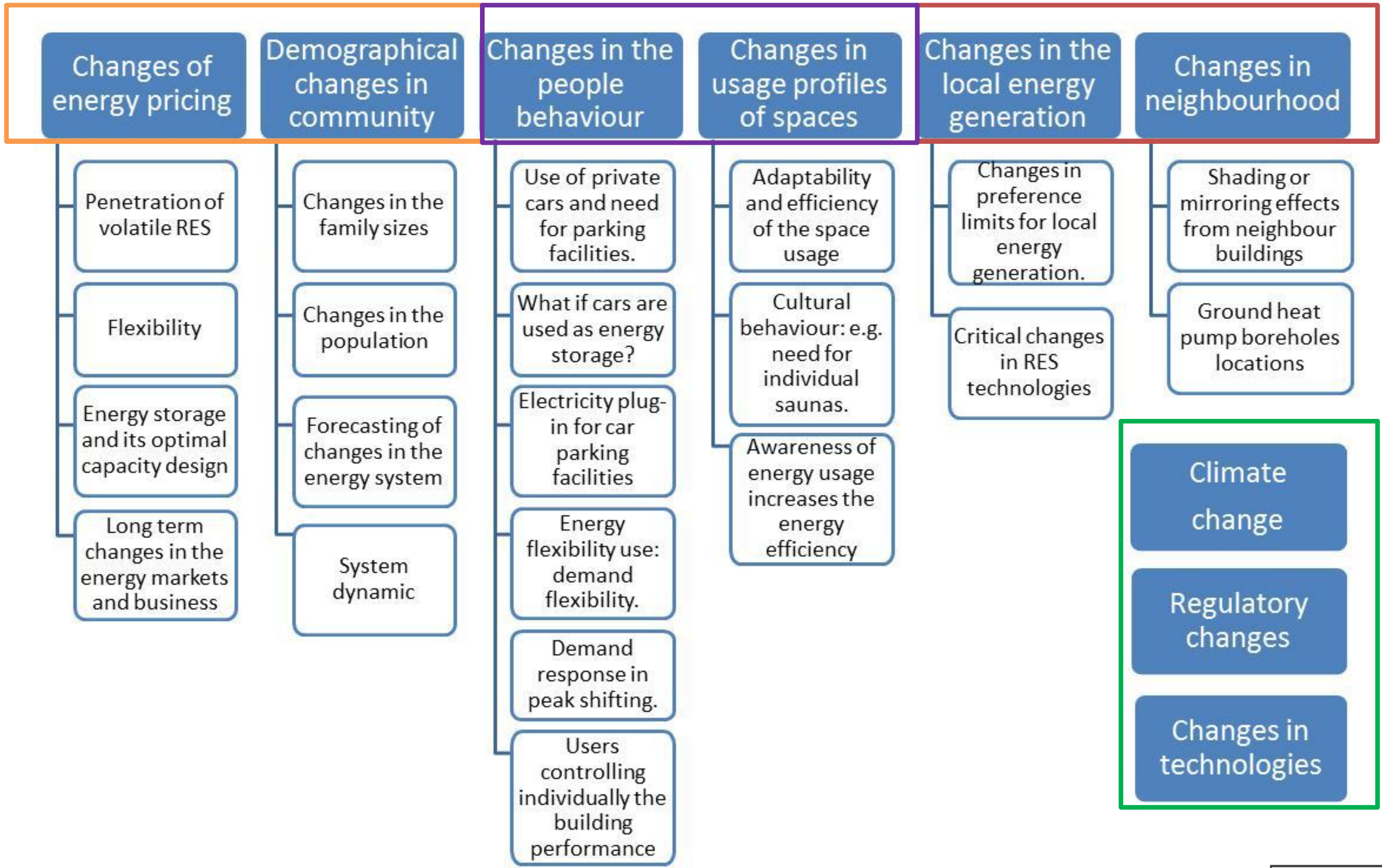

Retrofit & maintenance modelling/ Studying the alternatives (LOD1-2)
End-user
Client
Project
management
Facility
management
Authorities
Design group
management
Holistic
EE –design
Supported by
Design
Components
D4E portal:
Model checking
Analyses
Collaboration
Visualisation
Data
management
Constructor
Design
brief
Requirements model
Project starts
Selected Alternatives
(ARCH, LOD 1-2)
eFuture changes
Selected
Retrofit
alternative
Up-dated
Requirements
model
Design group: Review the KPIs. Agreed with the proposed solution to the client. Use the checklists to facilitate the review. Prepare the presentation to client, including results (reports) from analyses and final KPI assessment.
Soft gate
Design4Energy
FACILITATOR



Retrofit & maintenance modelling/ Studying the alternatives (LOD1-2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Design brief
Requirements model
Project starts
Client: Studying assessment results of the concept alternatives and choosing one alternative for detailed design.
Up-dated Requirements model
Selected Alternatives (ARCH, LOD 1-2)
eFuture changes
Selected Retrofit alternative
Soft gate
Design4Energy
FACILITATOR

Design Advisory

The design team identify what could be the potential future changes and their possible outcomes and effects to the building energy design.
If there are many possible solutions to adapt to change situations, their performance should be assessed and the best alternative selected.



Design Advisory

The design team should together identify what could be the potential future changes and their possible outcomes and effects to the building energy design. If there are many possible solutions to adapt to change situations, their performance should be assessed and the best alternative selected. The checklists for some typical future changes that could be considered in the design process in the scope of D4E are the following:

1. Consider changes of energy pricing:

- Price of energy increases or decreases: is the overall energy solution still profitable and costs on an acceptable level? For example, if the energy price is 20% higher, how does the energy system reflect to the changed circumstances?
- Flexibility in energy demand: consider e.g.:

What energy loads could be adapted according to the price of energy?

Would it be possible to shift energy loads to other times if profitable?

- Can the Building Energy Management System adapt the energy demand in a flexible manner? How easy/difficult it would be, can it be automatized?

How easily the electrical equipment can be automatically managed?

- Would it be possible to add energy storage? It could be one future strategy to cope with increasingly fluctuating real-time energy prices (avoiding of expensive peak hours). More fluctuation in electricity pricing (among others due to increasing the share of RES), which can cause significant fluctuation in the real time electricity pricing and cause more often expensive electricity price tariffs at some times.
- Long term future changes (over 50 years) in the energy markets and business can affect radically to the needed technical building services and building structure changes.

2. Consider demographical changes in community:

- Changes in the family sizes, e.g. increasing demand for smaller apartments.
- Changes in the population, which can be forecasted with:

urban planning tools and service network analysis, forecasting of district energy system changes, forecasting the need for public service spaces (e.g. schools, day care centres), system dynamic method.

- What if: the neighbourhood is under development within the next 20 years – what would be optimal layout and size of apartments in a building in order to maximise the profit?

Design Advisory

The design team should together identify what could be the potential future changes and their possible outcomes and effects to the building energy design. If there are many possible solutions to adapt to change situations, their performance should be assessed and the best alternative selected. The checklists for some typical future changes that could be considered in the design process in the scope of D4E are the following:

3. Consider changes in the people behaviour:

- Changes in the people behavior:

e.g. ownership of cars: how many people need private car parking facilities. Transportation and use of private cars influences the need of parking facilities, which are often expensive.

Effects to the space demand of the bicycle storages.

- What if cars are increasingly used as energy storage in the future? Already now e.g. electricity plug-ins are available often in Nordic private car parking places.
- How to increase the flexibility of energy demand?
- Could demand response in peak load shifting be used in the building?
- Increasing demand for individual control of users to adjust the building performance, e.g. temperature, ventilation, and cooling.

4. Consider changes in the usage profiles of spaces: possibilities to adapt the space usage e.g. from office to residential building:

- Adaptability is achieved by design strategies, such as flexible routes of HVAC systems, spatial buffers and/or space allocation.
- Changes in cultural behavior: e.g. in Finland one common sauna in an apartment building instead of private saunas in each apartment.
- Different user preferences concerning flexibility: e.g. early adapters.
- Awareness of energy usage among residents can increase the efficiency of energy use, e.g. through the comparison of individual residents' consumption to the average energy consumption in the same or similar building, district and city; and showing of real-time energy usage. This could reduce the energy demand.
- What space usage mix could provide the best energy matching option (especially in large building complexes and in relation to the neighbourhood)?
- How building space use efficiency could be improved?

Design Advisory

The design team should together identify what could be the potential future changes and their possible outcomes and effects to the building energy design. If there are many possible solutions to adapt to change situations, their performance should be assessed and the best alternative selected. The checklists for some typical future changes that could be considered in the design process in the scope of D4E are the following:

5. Consider changes in the local energy production

- Changes in the surplus production amount.
- Changes in preference limits for local energy generation. Energy tariff strategies can be either dynamic or fixed price level.
- Critical changes in local RES technologies with significantly reduced costs can change the local energy markets and supply.

6. Consider changes in neighbourhood

- Other building types in the neighbourhood: how could they affect?
- What if there will be new buildings (or other shading), which reduces on-site solar production in the existing building?
- Shading or mirroring effects from neighbouring buildings, e.g. mirroring effect from the nearby building can increase the need for cooling in an office building.
- If new ground heat pump boreholes will be put nearby existing heat pumps' boreholes, potential temperature changes to the existing system, and hence, the co-efficiency of the performance of the heat pumps can reduce.

The design team should together identify what could be the potential future changes and their possible outcomes and effects to the building energy design. If there are many possible solutions to adapt to change situations, their performance should be assessed and the best alternative selected. The checklists for some typical future changes that could be considered in the design process in the scope of D4E are the following:

7. Climate change

- What kind of effects could be caused from changes there could be on the local weather and climate? What are the risks?
- How can the building to be designed, or its site, protect local environment to suffer risks of climate change?
- How can the building to be designed adapt or be highly resilient for the changes caused by the climate?

Extreme climate events: rains, floods, winds, variation of cold and warm temperature, drought.

8. Regulatory changes

- Potential new requirements for the energy performance of the building.
- We know the EU-strategy for nearly zero energy buildings.

This means that the target should be set there're, as the new regulations are already on place when the next renovation cycle occurs (30 years cycle).

There is also a need for using local renewable energy sources because the target level is not reachable otherwise, at least in Nordic countries.

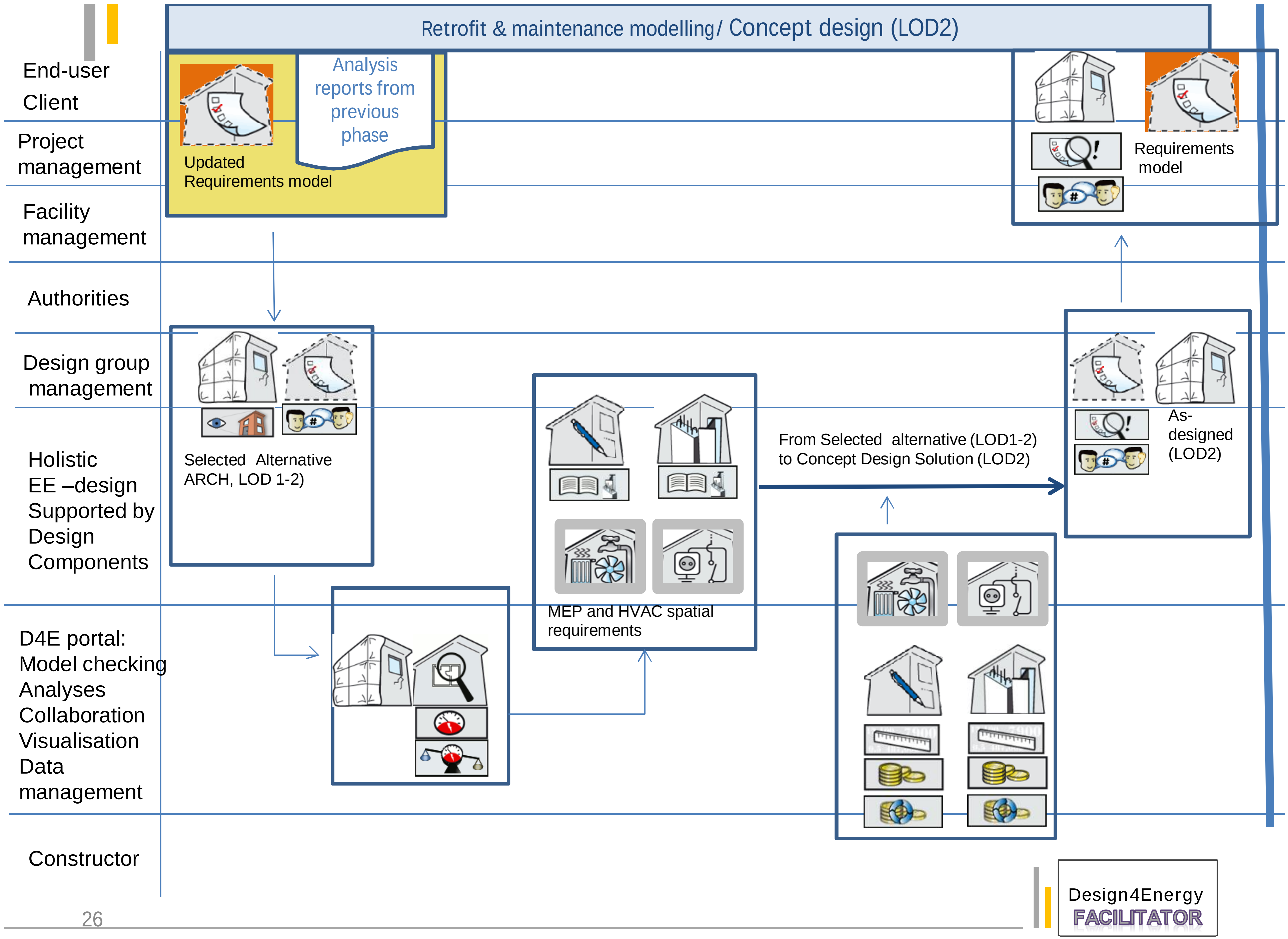
9. Changes in technologies

- What if cars are increasingly used as energy storage in the future? Already now e.g. electricity plug-ins are available often in Nordic private car parking places.
- Would it be possible to add energy storage? It could be one future strategy to cope with increasingly fluctuating real-time energy prices (avoiding of expensive peak hours). More fluctuation in electricity pricing (among others due to increasing the share of RES), which can cause significant fluctuation in the real time electricity pricing and cause more often expensive electricity price tariffs at some times.
- What kind of improvements could be coming to smarter and more efficient, more automatized building energy management systems? Solutions for improved energy matching of demand and production on site, optimisation of energy costs, etc.

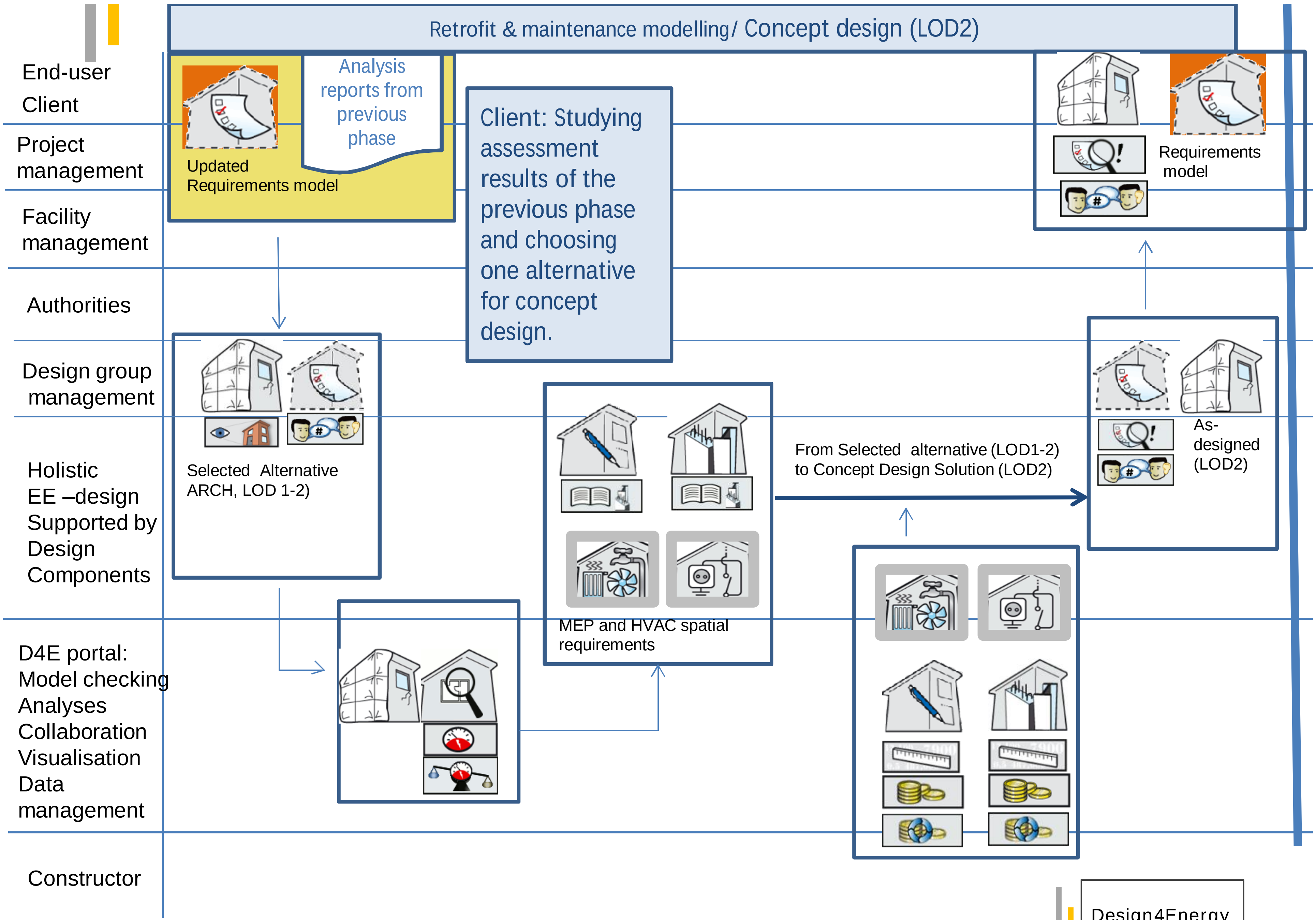
Retrofit & maintenance modelling

Phase consists of

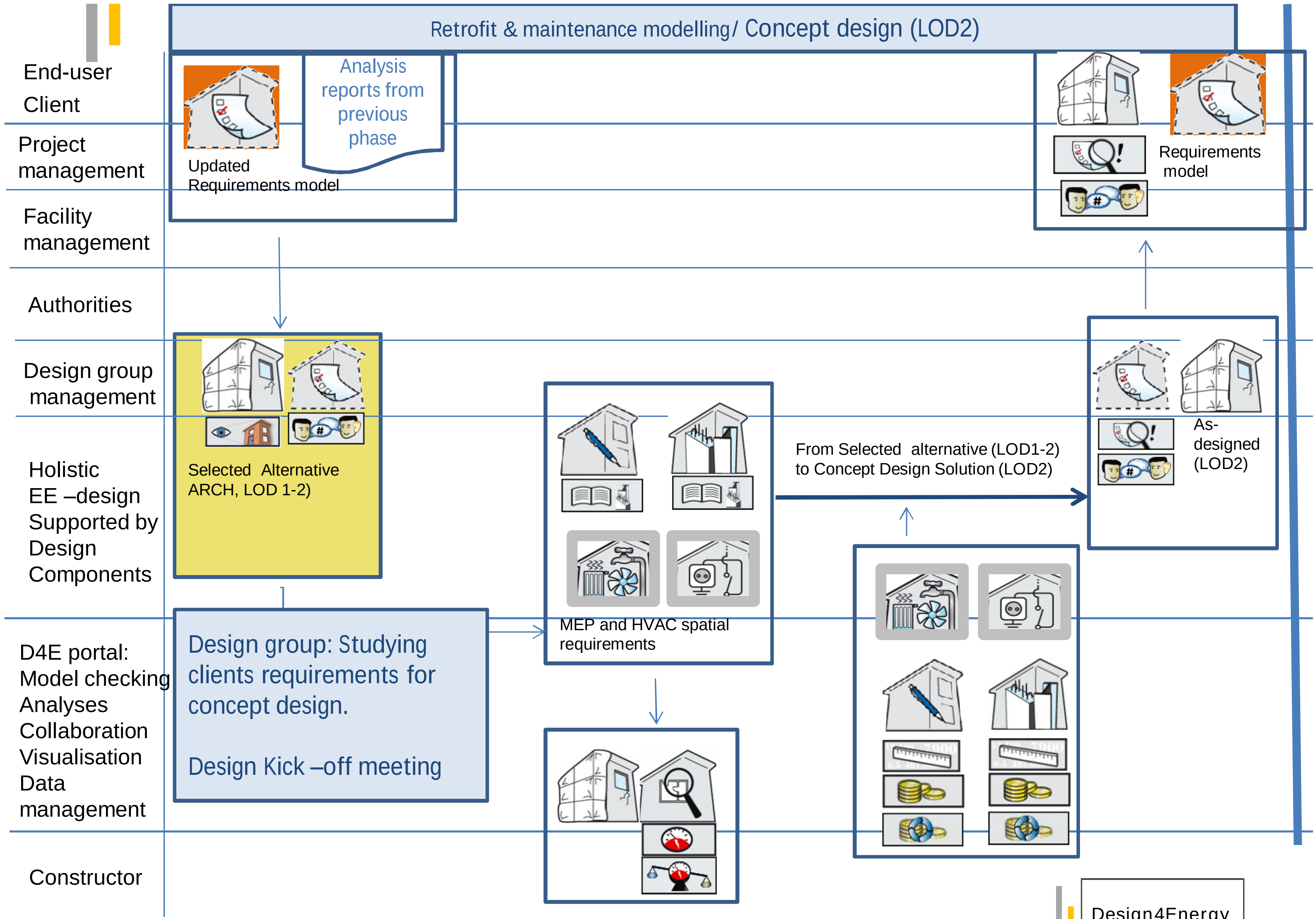
- Design with developing BIM model from LOD2 to LOD4 with help of analyses and collaborative reviews
  - From Selected Alternative to Concept design solution (2/2)
  - From Concept design (LOD2) to Final Design solution (LOD 4)
- Final performance assessment to support client's decision making.



Retrofit & maintenance modelling/ Concept design (LOD2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Analysis reports from previous phase
Updated Requirements model
Requirements model
Selected Alternative ARCH, LOD 1-2)
MEP and HVAC spatial requirements
From Selected alternative (LOD1-2) to Concept Design Solution (LOD2)
As-designed (LOD2)
Design4Energy
FACILITATOR



Design4Energy FACILITATOR



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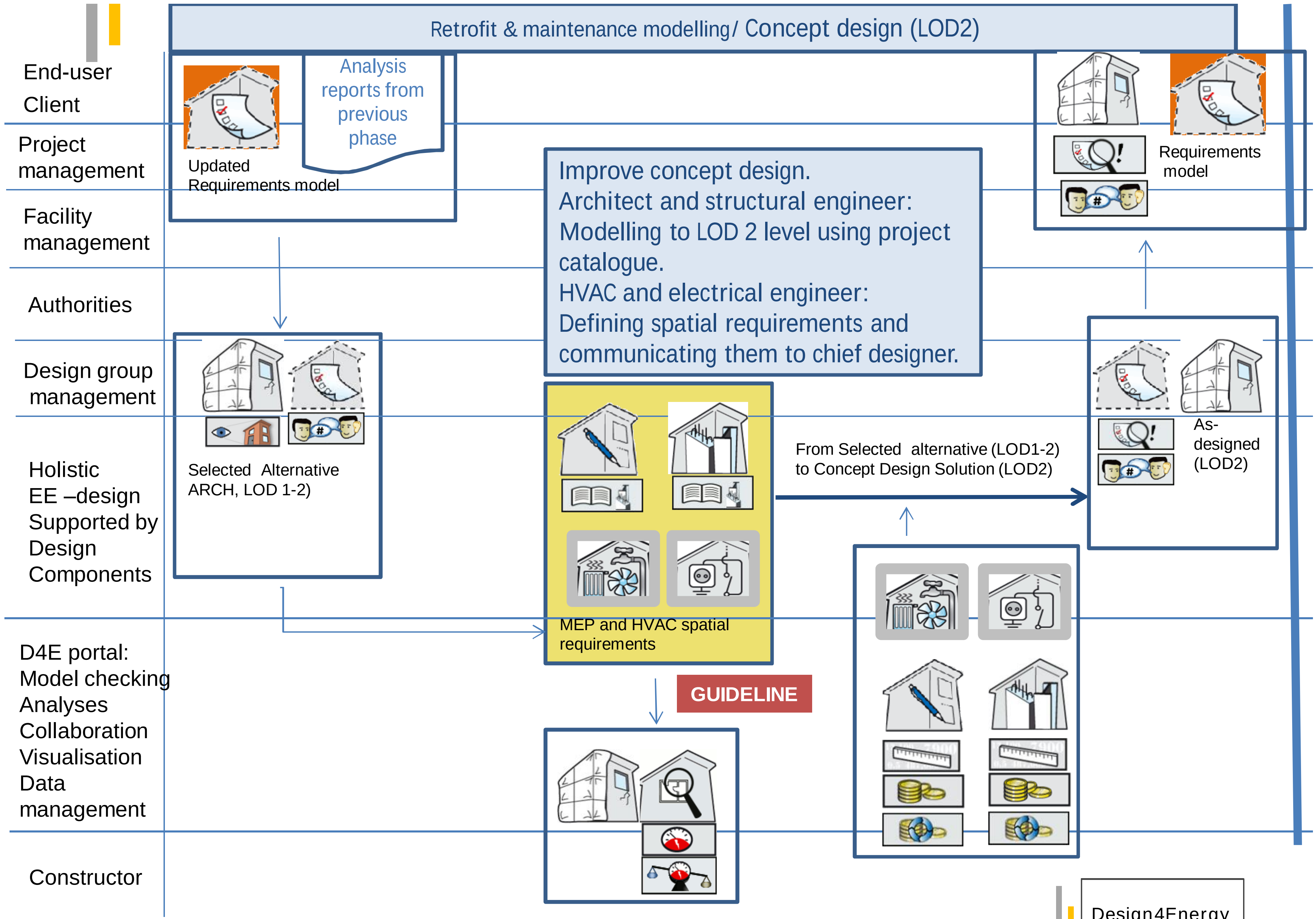

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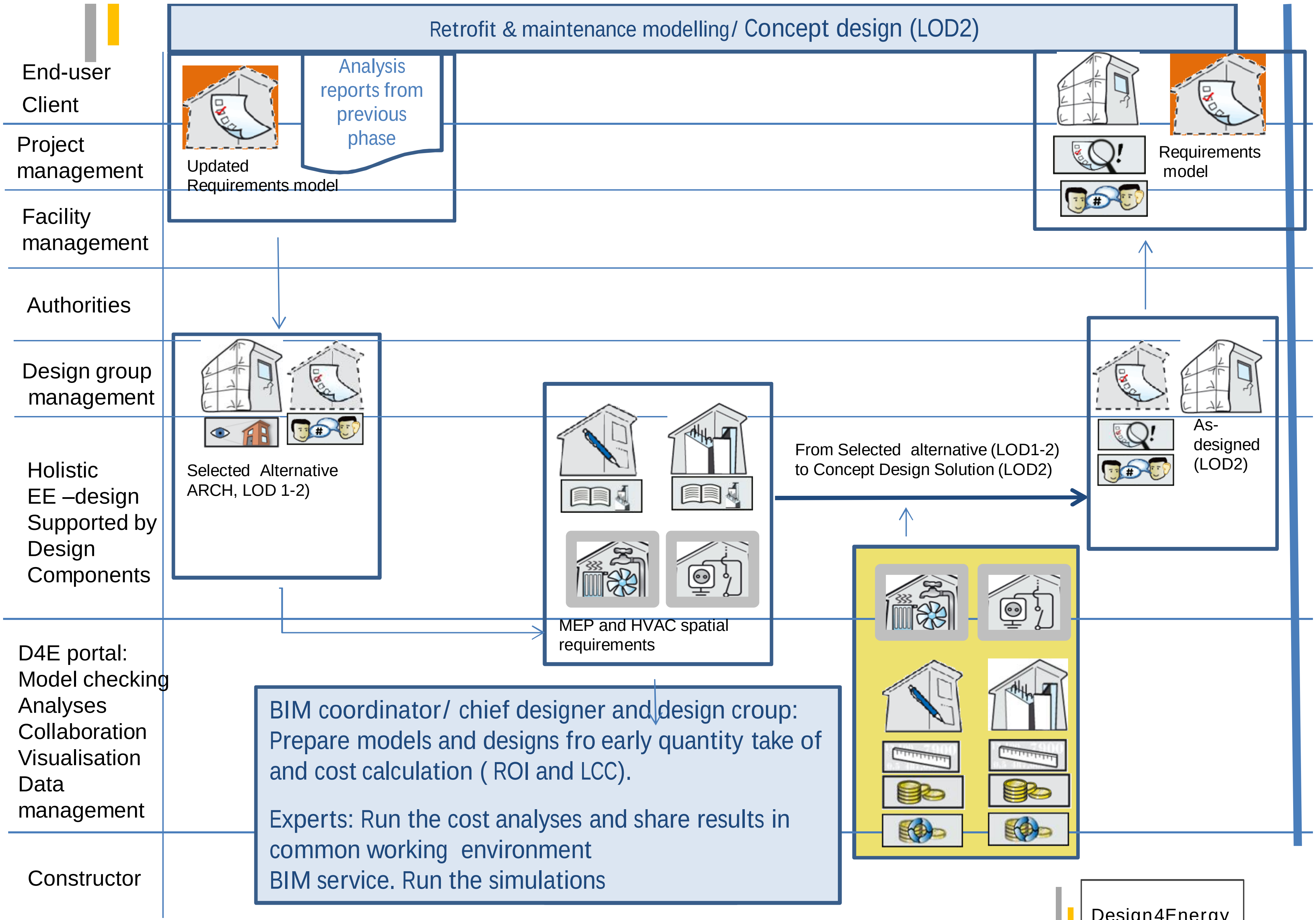

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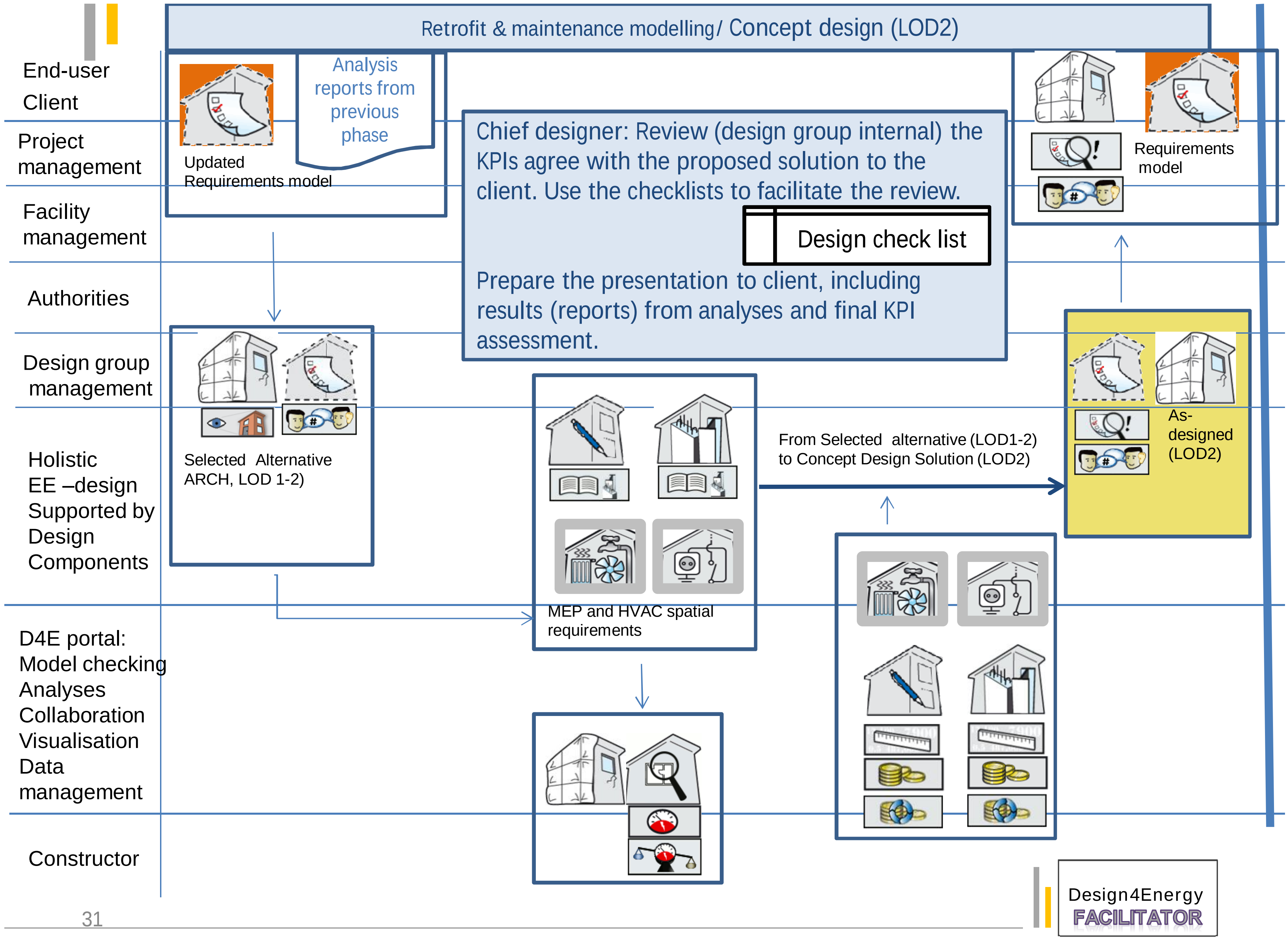
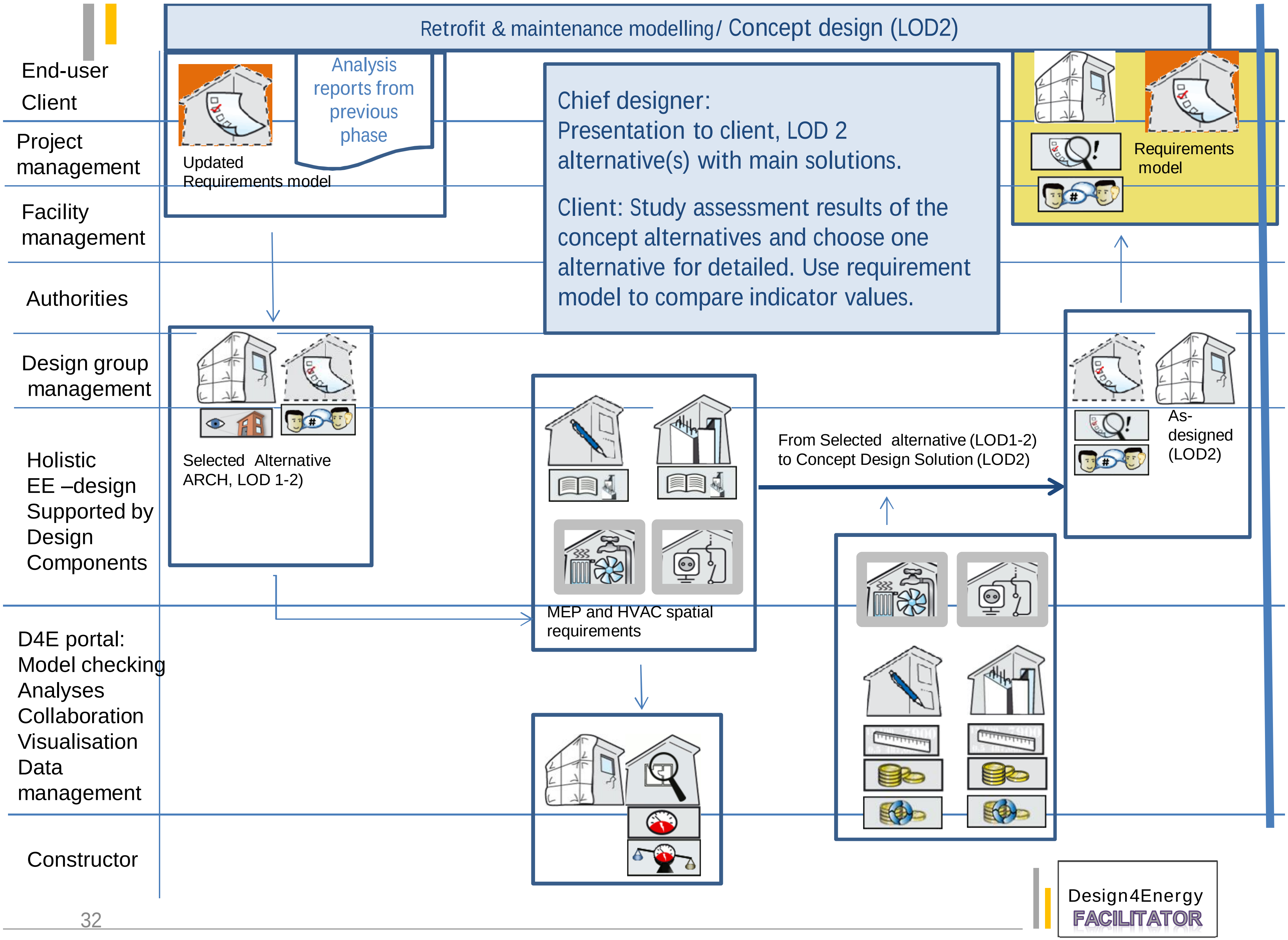


Retrofit & maintenance modelling/ Concept design (LOD2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Analysis reports from previous phase
Updated Requirements model
Chief designer: Review (design group internal) the KPIs agree with the proposed solution to the client. Use the checklists to facilitate the review.
Design check list
Prepare the presentation to client, including results (reports) from analyses and final KPI assessment.
Requirements model
Selected Alternative ARCH, LOD 1-2)
MEP and HVAC spatial requirements
From Selected alternative (LOD1-2) to Concept Design Solution (LOD2)
As-designed (LOD2)
Design4Energy FACILITATOR

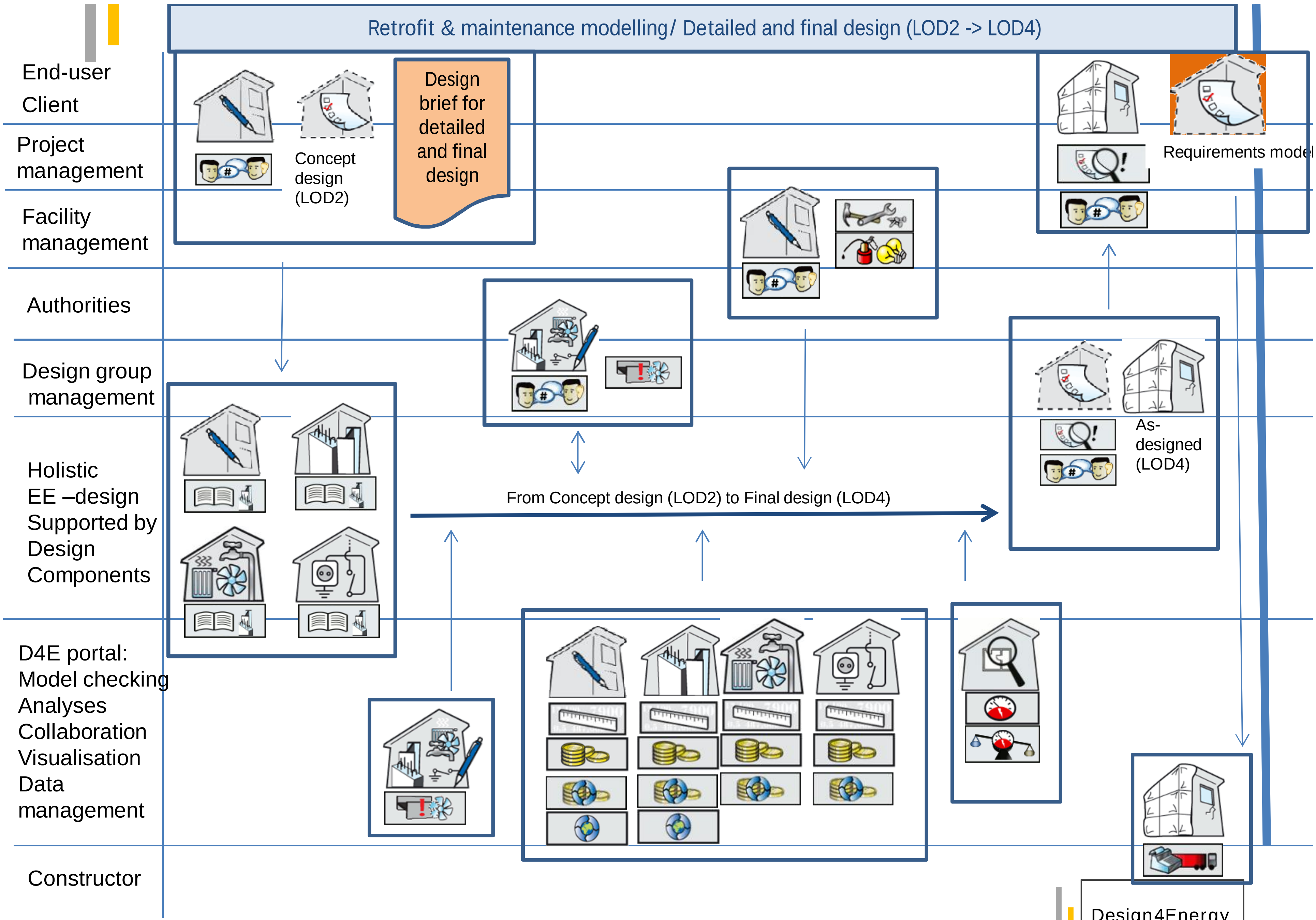


Retrofit & maintenance modelling/ Concept design (LOD2)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Updated Requirements model
Analysis reports from previous phase
Chief designer:
Presentation to client, LOD 2 alternative(s) with main solutions.
Client: Study assessment results of the concept alternatives and choose one alternative for detailed. Use requirement model to compare indicator values.
Requirements model
Selected Alternative ARCH, LOD 1-2)
MEP and HVAC spatial requirements
From Selected alternative (LOD1-2) to Concept Design Solution (LOD2)
As-designed (LOD2)
Design4Energy
FACILITATOR

Retrofit & maintenance modelling

Phase consists of

- Design with developing BIM model from LOD2 to LOD4 with help of analyses and collaborative reviews
  - From Selected Alternative to Concept design solution
  - From Concept design (LOD2) to Final Design solution (LOD 4)
- Final performance assessment to support client's decision making.



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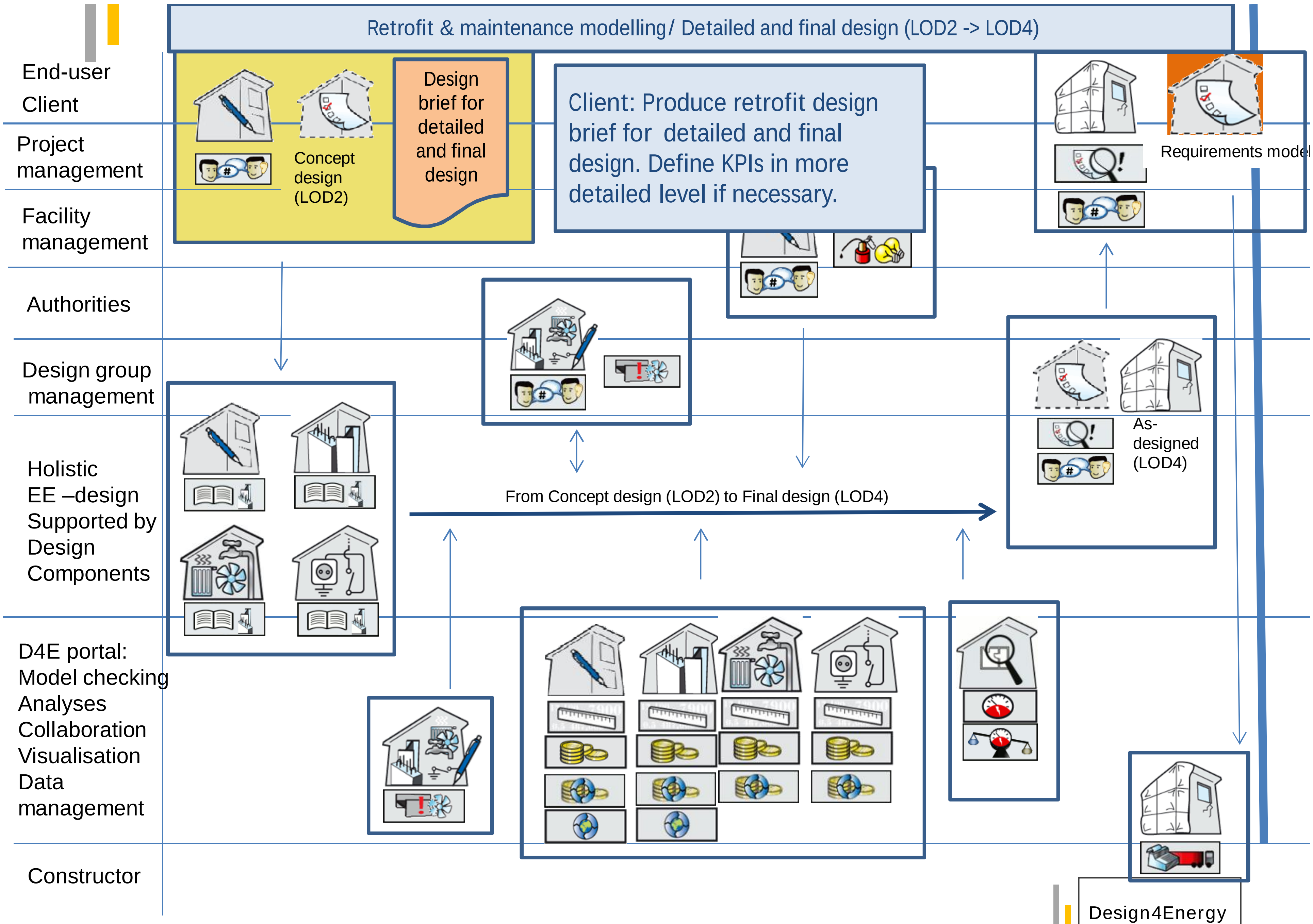

Design4Energy
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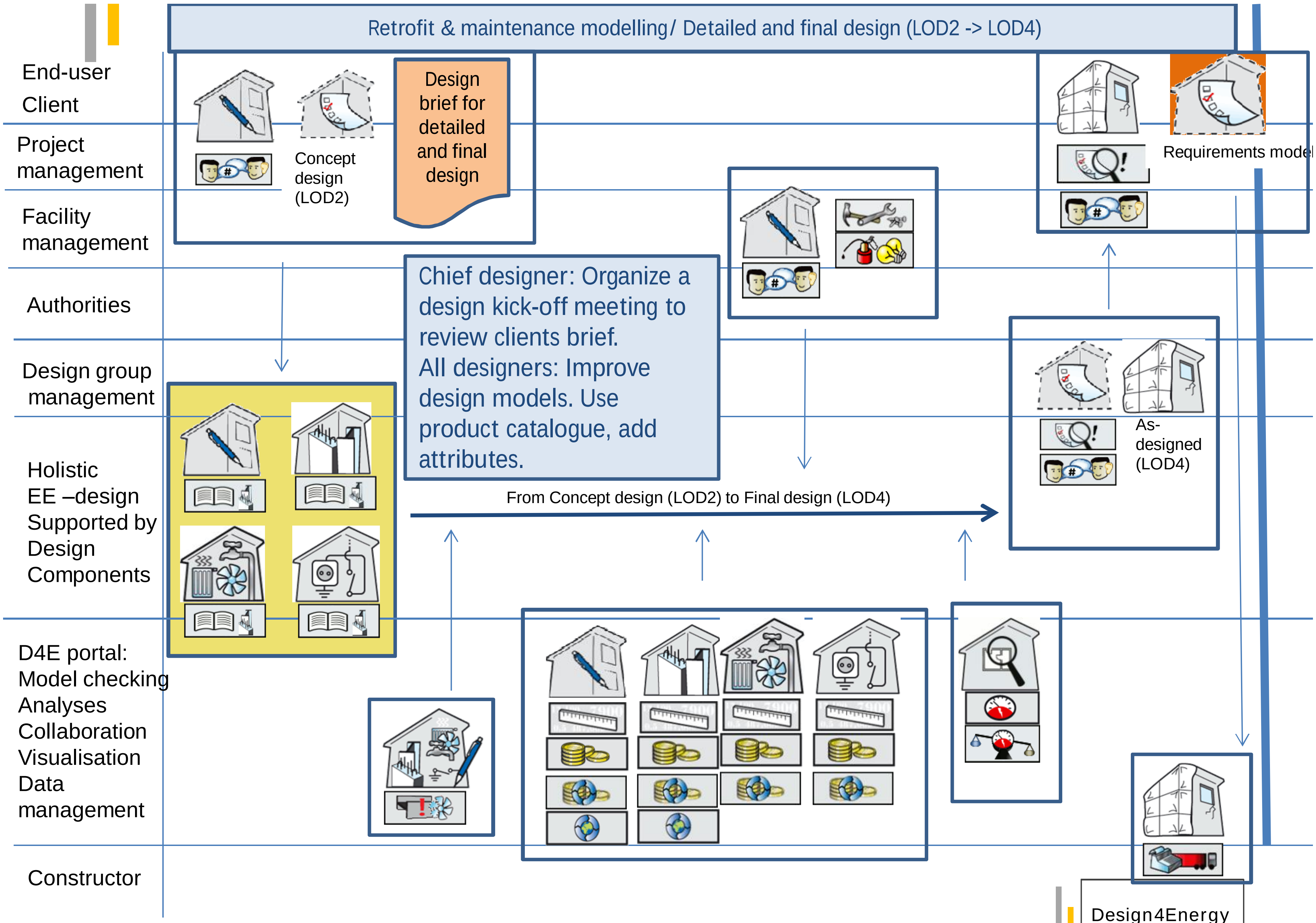

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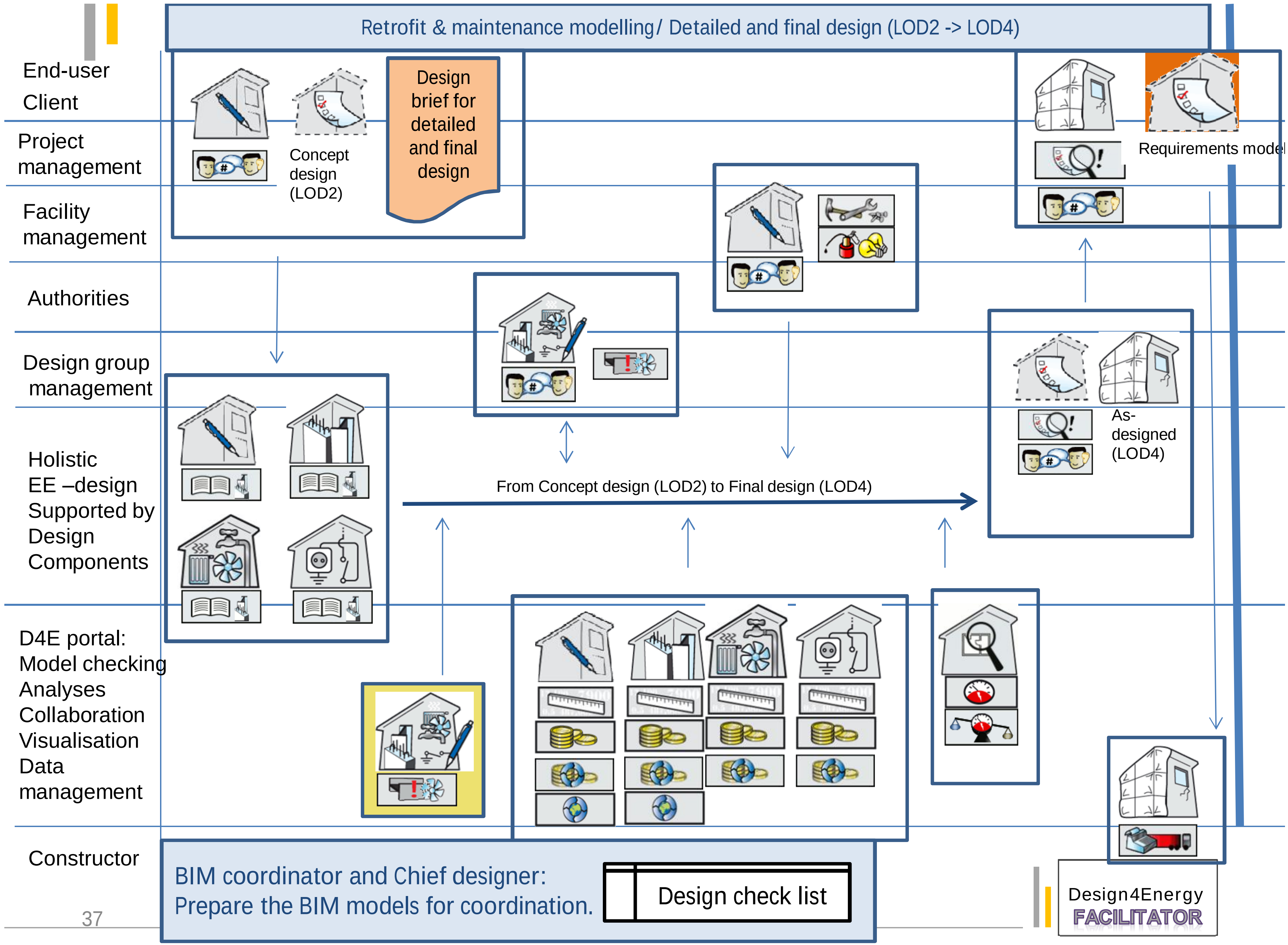
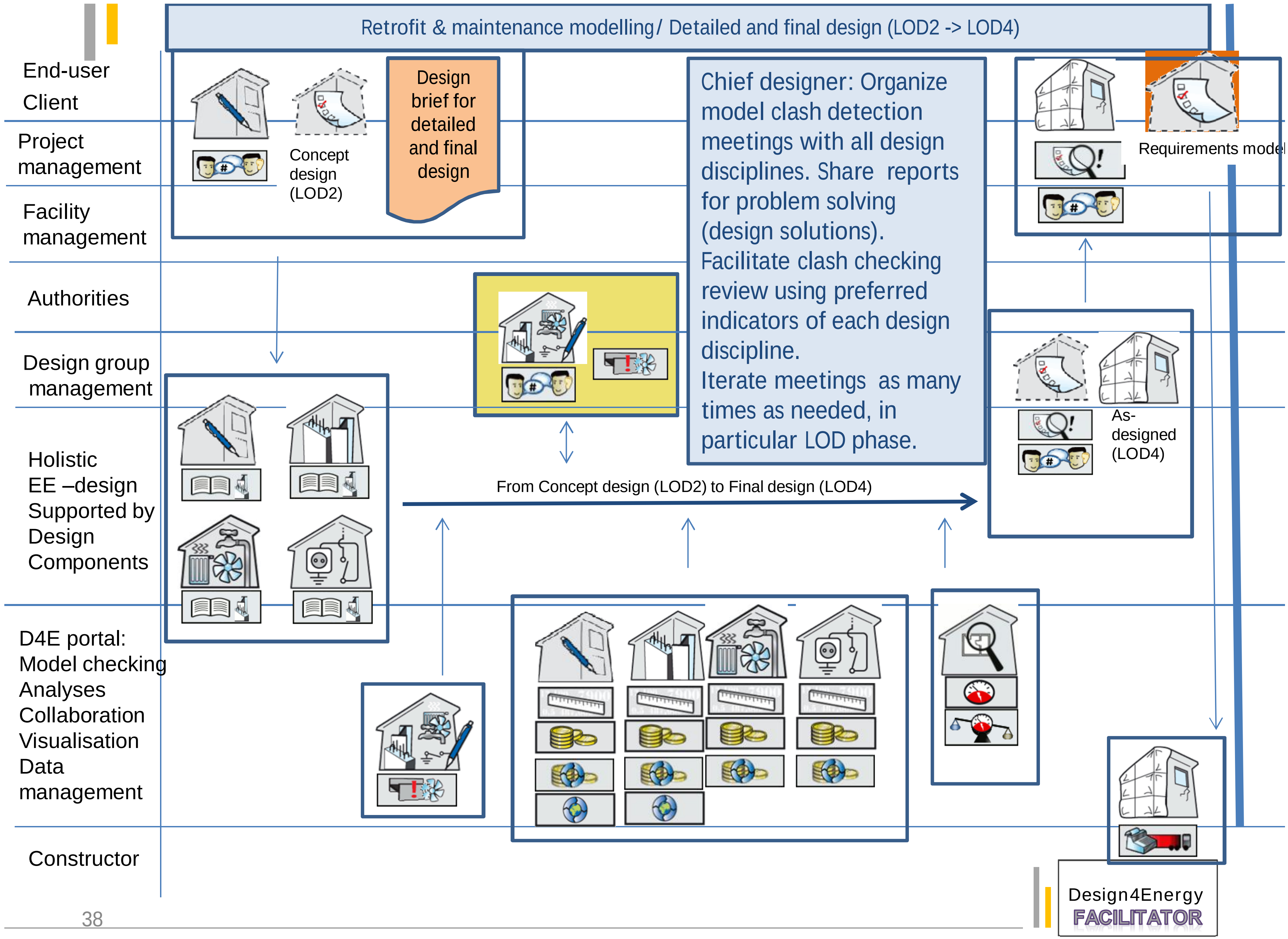
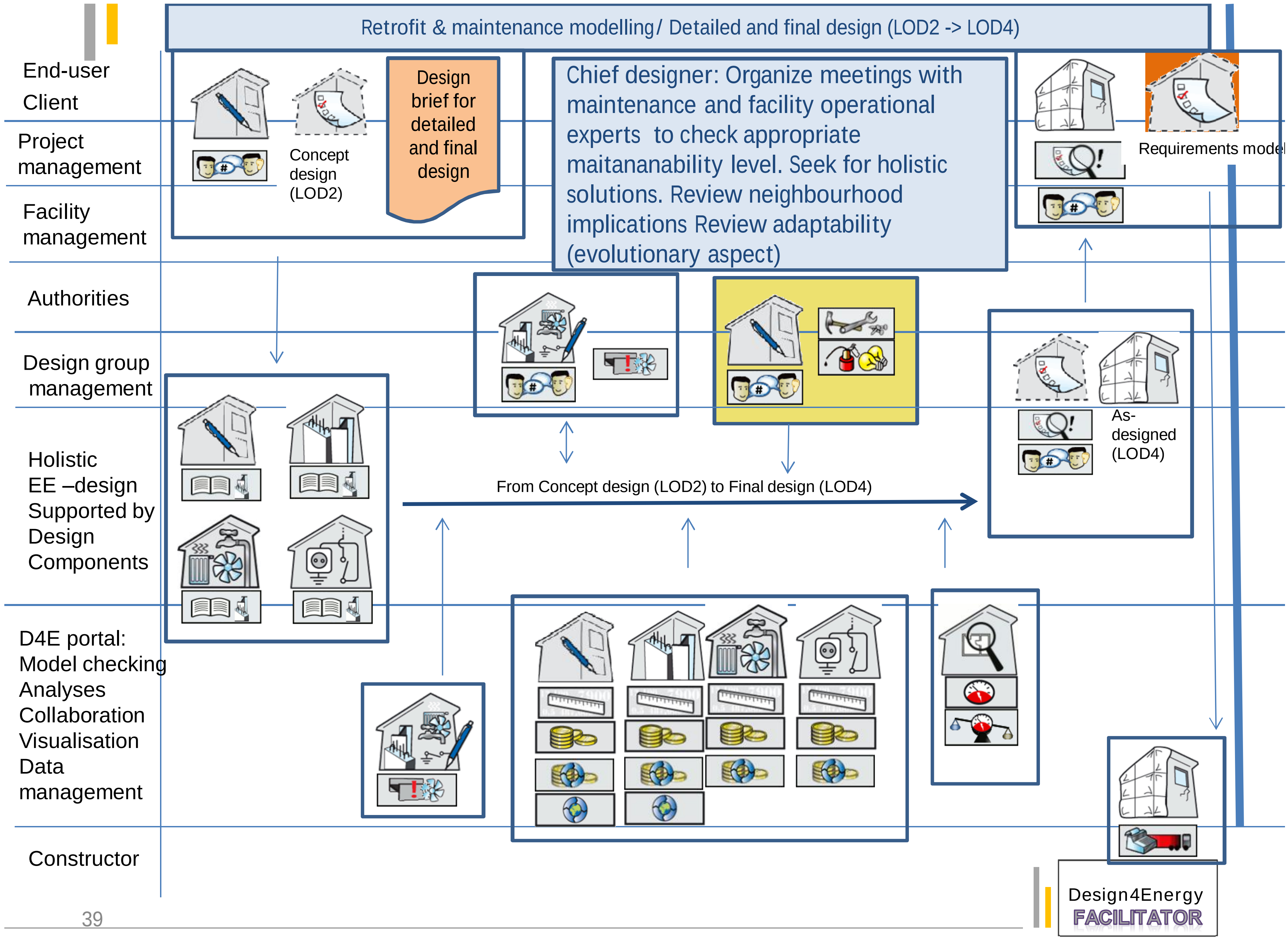
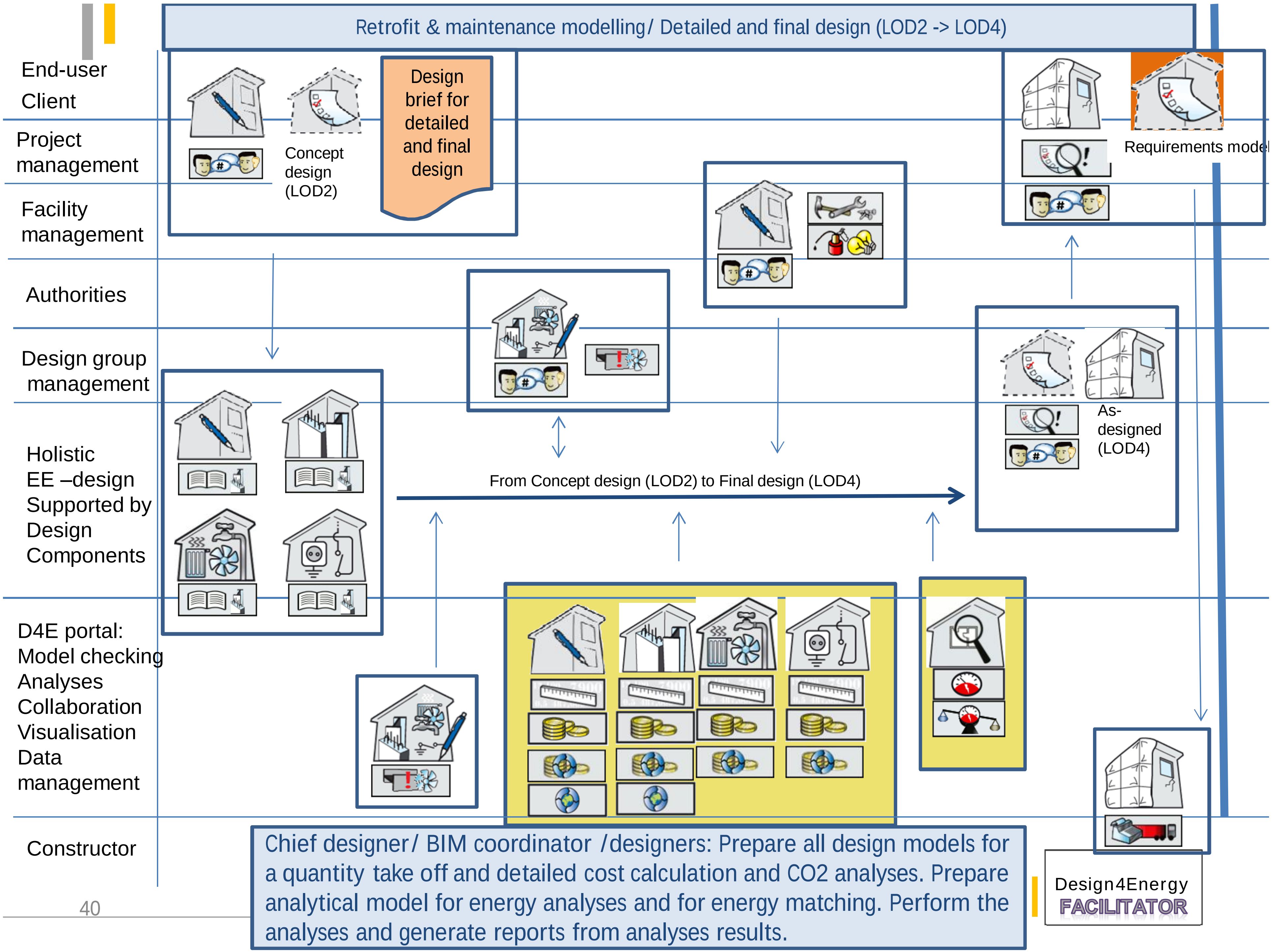


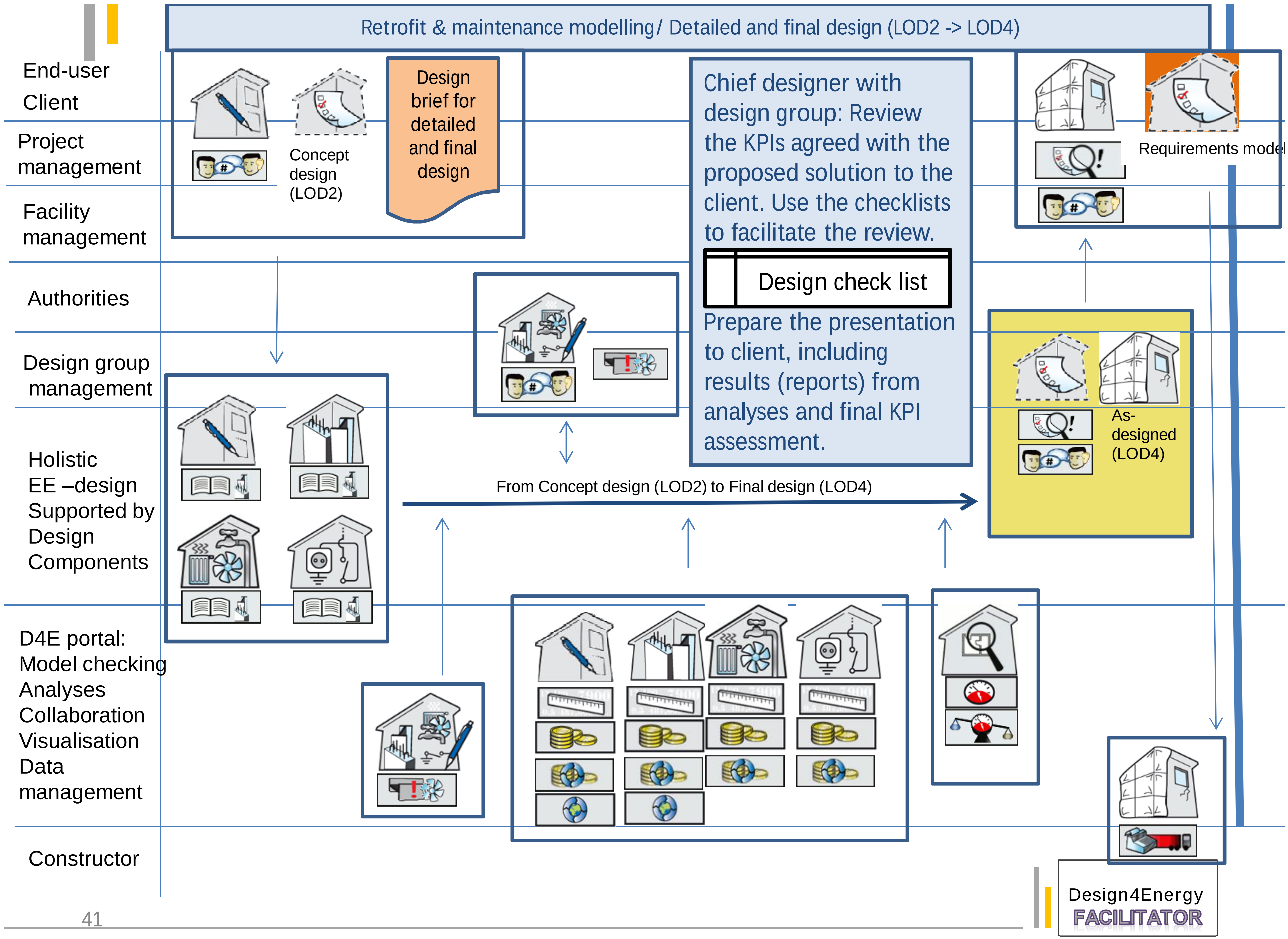
Retrofit & maintenance modelling/ Detailed and final design (LOD2 -> LOD4)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Concept design (LOD2)
Design brief for detailed and final design
Requirements model
As-designed (LOD4)
From Concept design (LOD2) to Final design (LOD4)
BIM coordinator and Chief designer:
Prepare the BIM models for coordination.
Design check list
Design4Energy
FACILITATOR


Retrofit & maintenance modelling/ Detailed and final design (LOD2 -> LOD4)
End-user
Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Concept design (LOD2)
Design brief for detailed and final design
Chief designer: Organize model clash detection meetings with all design disciplines. Share reports for problem solving (design solutions). Facilitate clash checking review using preferred indicators of each design discipline. Iterate meetings as many times as needed, in particular LOD phase.
Requirements model
As-designed (LOD4)
From Concept design (LOD2) to Final design (LOD4)
Design4Energy
FACILITATOR



Design4Energy FACILITATOR


Retrofit & maintenance modelling/ Detailed and final design (LOD2 -> LOD4)
End-user Client
Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Concept design (LOD2)
Design brief for detailed and final design
Requirements model
As-designed (LOD4)
From Concept design (LOD2) to Final design (LOD4)
Chief designer/ BIM coordinator /designers: Prepare all design models for a quantity take off and detailed cost calculation and CO2 analyses. Prepare analytical model for energy analyses and for energy matching. Perform the analyses and generate reports from analyses results.
Design4Energy
FACILITATOR



Retrofit & maintenance modelling/ Detailed and final design (LOD2 -> LOD4)
End-user
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Project management
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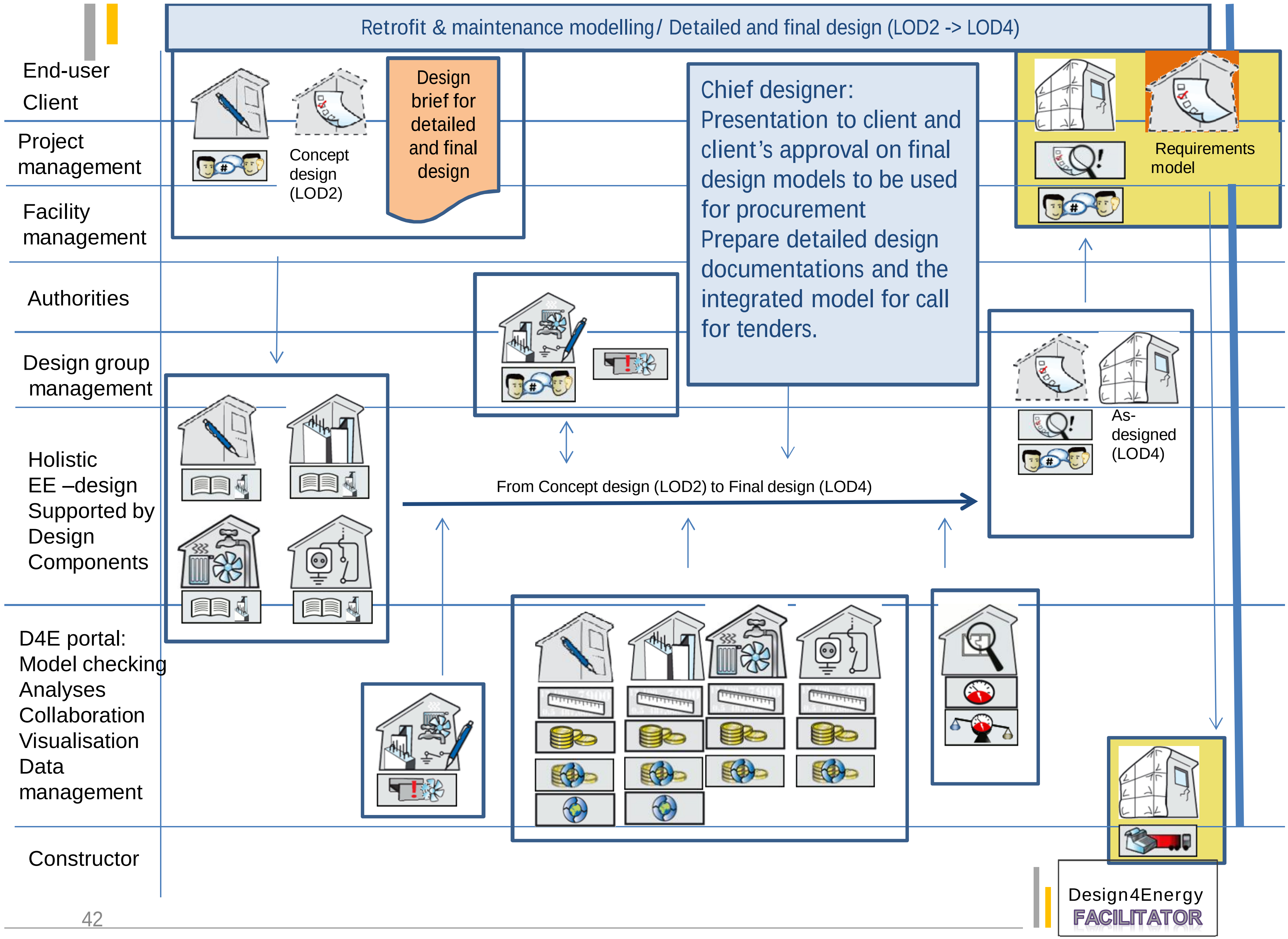
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Concept design (LOD2)
Design brief for detailed and final design
Chief designer with design group: Review the KPIs agreed with the proposed solution to the client. Use the checklists to facilitate the review.
Design check list
Prepare the presentation to client, including results (reports) from analyses and final KPI assessment.
Requirements model
As-designed (LOD4)
From Concept design (LOD2) to Final design (LOD4)
Design4Energy
FACILITATOR


Retrofit & maintenance modelling/ Detailed and final design (LOD2 -> LOD4)
End-user
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Project management
Facility management
Authorities
Design group management
Holistic EE –design Supported by Design Components
D4E portal: Model checking Analyses Collaboration Visualisation Data management
Constructor
Concept design (LOD2)
Design brief for detailed and final design
Chief designer: Presentation to client and client's approval on final design models to be used for procurement
Prepare detailed design documentations and the integrated model for call for tenders.
Requirements model
As-designed (LOD4)
From Concept design (LOD2) to Final design (LOD4)
Design4Energy FACILITATOR

GUIDELINE

Handover from architectural design model to analytical model for EE simulation.
Modelling guideline for architect (using Revit software)

Number	Guideline
1	Turn on the 'Areas and Volumes' option in Architecture > Room and Area (panel)
2	Go to coarse view and press TL for thin lines. This ensures that multiple layers can be identified more easily. Resolve multiple layers (e.g. ceilings and slabs)
3	Make columns non-room-bounding
4	Run interference checks (in the Collaborate tab) and resolve any warnings about overlapping building elements when possible
5	Change function of external walls and ground floors to 'exterior'
6	Make half-height internal walls non room bounding
7	Replace bay windows with windows directly on the main wall
8	Use the 'Automatically Embed' option to place curtain glazing within walls instead of making holes in the wall's profile
9	Assign spaces to all areas, including lifts, risers, and voids
10	Assign space to roof so that it can be extracted from Revit, otherwise it is ignored
11	Ensure space limits are sufficient for each space to have a bounding element or another space at the top and bottom
12	Ensure spaces are set to Unoccupied by unticking the Occupiable selection and Unconditioned where/when required
13	Add zones and assign spaces
14	Add separate zone to unoccupied spaces
15	In Analyze > Energy Settings > Energy Model – Building Services set appropriate settings
16	Occupancy, lighting and equipment settings can be addressed in each space individually. The relevant schedules are linked to the Building Type option during gbXML export and can be viewed in Manage > MEP Settings > Building/Space Type Settings
17	Infiltration can be set by selecting the Zone and managing the Energy Analysis options or by following point 16 above.
18	Heating system can be set following point 16 above but is not transferred in gbXML. Only the designHeatT and designCoolT are exported in gbXML.
19	In the gbXML export options ensure that appropriate settings are defined for the building. The Export Category needs to be set to Spaces. The export Complexity needs to be set to Simple or Simple with shading. The Building Construction needs to be selected and the None should be clicked to ensure that the actual constructions and thermal properties of the elements are not overridden by defaults.
20	Export gbXML and check on a viewer (e.g. SketchUp's OpenStudio Plugin)

Check list for internal design group review for ee-design

Overall Design Advisory

- The overall energy efficiency and sustainability of a building composes of various design decisions related to energy efficiency and used energy sources. Accordingly, holistic energy solutions are required when targeting to the best possible buildings' energy design.
- The holistic energy design of buildings should primarily target to minimise the energy demand without compromising the good quality of using the building. In addition, holistic energy design should include the optimal use of renewable energy sources, as well as minimising the CO_2 emissions and optimising the energy costs.
- In the target setting phase, the target values are set for the energy demand, renewable energy sources use, CO_2 emissions and energy costs. As continuation in the concept design phase, potential and available energy design options are identified and the main concept for the building energy solution is drafted according to the targets. In practise, this can mean e.g. minimising the energy demand with passive design solutions, giving priority to local and on-site renewable energy sources (solar energy, biomass based heat production, heat pumps etc.). At the same time, energy costs should be considered against set targets and planning how to manage the energy demand and selling of excess energy (if available). In many cases, the focus is to minimise the costs of heating, cooling and electricity demands and production among others through energy matching with the entire neighbourhood. In the detailed design, the detailed design decisions are done, while the overall energy system should be still kept in mind.

See checklist for energy designer

See checklist for structural designer

See checklist for HVAC designer

See checklist for architectural design (EE passive design)

See checklist for design group review (arch, HVAC, structural)

Check list for design reviews. ARCHITECT Energy efficient building design (“ passive mode ”):

Location and Site selection:

- Appropriate use of passive solar energy in winter Orientation of the building
- Passive cooling, e.g. natural shading for reduced summer time cooling demand ‘
- Consider shadow effects (buildings around and tall trees)
- Consider general climate parameters

Building volume

- Consider efficient form (Volume factor <1)
- Look for usable lay-outs/ considering functionality
- Efficient massing and lay out considering low energy demand.
- Avoid unnecessary corners/ windows/ bay window in the principal massing, as they increase thermal losses of the envelope.
- Use rectangular volumes as principal massing concept.
- Use entry locks.

Openings

- Primary function is focusing on natural lighting and views out through openings.
- Secondary Passive solar utilisation during heating season.
- Optimize with appropriate shadings for good summer thermal comfort (avoid overheating).

Micro climate

- Check that reflecting sun of neighbouring buildings and its impact to the indoor climate.
- Check that local winds are supporting usability
- Consider vegetation as shading to support comfort
- Orientation of building block to best directions considering use of renewable energy sources

Massive walls

- Use for sun harvesting with internal massive structural elements between heating and cooling season (spring and autumn). Be careful with overheating.
- Use for balancing heat gains to minimize cooling peak during summer time.

Shadings against sun (external and internal)

- Use shading elements to block the sun (heat load). Do not spoil your design concept of natural lighting and views out.
- Use supplementary building parts and elements of the facade to create sufficient shading.

Co-design with energy expert and HVAC for technical spaces

- Locations and size of energy production and storage equipment
- Spatial needs for systems and equipment

Efficient renewable energy production on-site:

- Preliminary identification of possible placing of renewable energy production equipment (e.g. solar panels and heat collectors on roof surfaces, heat pump (pumping station at the building and location of bore holes in the yard).
- Efficient use of roof for active solar systems by adequate roof pitch

FACILITATOR

Check list for internal design group review

ARCHITECT together with STRUCTURAL and HVAC DESIGNERS

Aim for as simple as possible solutions to increase the reliability of the solutions.

- Compactness of the house for reduced heat losses.
  - In detailed design: use HVAC and building components from D4E library
- Window design for passive solar energy utilisation.

- Spatial needs and lay-outs
  - Routing needs and technical room in dwelling unit design.
  - Placing of kitchen appliances, heating equipment, water heaters etc. for utilization of internal heat loads.

- Thermal and moisture technical design and analyses
  - Thermal insulation of building surfaces.
  - Minimize thermal bridging or use exterior insulation systems to reduce thermal losses.
  - Consider the need of all structural components; they may influence on thermal properties and cost efficiency.
  - Use modular dimensions, e.g., 600 mm for frame walls and windows.
  - Consider moisture dry-out from thick structures; avoid double vapour barriers in wet rooms.

Indoor climate
  - Design for air barrier. Installations inside air barrier for air tightness.
  - Design for wind barrier.
  - Consider ways and means to seal all components leading through a structure.

- Ventilation
  - Space allocation for routing of ventilation duct work.
  - Terminal inlets and directness of ventilations duct work in spatial planning.

- Quality
  - Consider the order of site work already in design.

Check list for design reviews.
ENERGY EXPERT

Use of renewable energy sources

- Identify local available renewable energy sources (solar, wind, geoenergy, bio fuels) and their maximum potential for utilisation.
- Check the availability of the space and the preliminary plans for on-site renewable energy production from architect and from structural designer (e.g. space for a mounting of solar panels, heat collectors or a wind mill).

Energy concept

- Preliminary design of energy production needed for the energy demand (district heating, cooling, gas, boiling, etc.) and inform HVAC planner about this energy concept.
- Respond to energy demand with dimensioning of energy mix using as much renewable energy sources as possible
  - Geothermal
  - Sun power
  - Wind
  - Biofuels

Analyses and collaboration

- Analysing of energy matching and neighbourhood impacts with the indicators from the target setting.
  - Optimising of energy parameters and cost with Energy simulations and Energy matching analyse and cost estimation (LCC).
  - Decisions based on KPIs
- Sizing /dimensioning
  - Sizing of the local energy grid connection (for heating, cooling, gas, electricity)
- Co-design with architect and HVAC for technical spaces
  - Locations and size of energy production and storage equipment
  - Spatial needs for systems and equipment
- Preliminary and detailed design of energy storages if required.

Check list for design reviews.
STRUCTURAL DESIGN

Spatial needs

- Consider space requirements for HVAC installations

Indoor climate

- Minimize thermal bridging or use exterior insulation systems to reduce their effects.
  - Design for air barriers for through-holes of technical installations.
  - Design joints with air barriers. Consider ways and means to seal all components leading through a structure.
  - Design for wind barrier
  - Use modular dimensions, e.g., 600 mm for frame walls and windows, in order to minimise thermal bridges

Energy concept

- Massive walls
  - Use for sun harvesting with internal massive structural elements between heating and cooling season (spring and autumn). Be careful with overheating.
  - Use for balancing heat gains to minimize cooling peak during summer time.
- Consider the need of all structural components; they may influence on thermal properties and cost efficiency.

Quality

- Consider the order of site work already in design.
- Consider moisture dry-out from thick structures; avoid double vapour barriers in wet rooms.

Check list for design reviews.
HVAC DESIGNER

Design level KPIs are communicated these metrics as starting points for concept design phase:

- Thermal loss parameters of envelope components
  - U-value and G-value of windows
- Occupancy
- Hot water consumption, Hot water heat recovery
- Internal energy loads according to purpose use
- Lighting profiles according to purpose use

Management of EE key performance indicators

- Technical system selection and sizing: heating, cooling, ventilation, electricity and automation.
  - Choosing systems, equipment and building objects from component catalogue based on performance
  - Decisions based on KPIs

Consider space requirements for HVAC installations and renewable energy production.

- Check Routings together with architect and structural designer

- Facade
  - Draught control and window size
  - Solar control
- Control
  - Thermal mass assessment
- Dimensioning
  - Ventilation heat recovery
  - Ventilation air flow and schedules
  - Minimum ventilation rate and control
- Indoor climate
  - Ventilation Inlet terminal placing
    - place and mixing strategy
  - Draught control
  - Lighting levels
  - Overheating and simulations
  - Noise control
- Comfort
  - Wet room heating
- Energy calculation

Check list for review of integrated model (model checking). Internal meeting of the design group

A short checklist to support the preparation for model integrations

Each designer individually:

- Check domain BIM model that it is technically solid and contains the right information content (level of development) in right details (level of details, also in attribute data)
- Publish and upload you model to the D4E portal

Chief designer:

- Prepare the agenda fro model checking
  - Plan the proper order the domain models will be merged with each other (for example HVAC with STRUCT, then STRUCT with ARCH, then HVAC with ARCH)
  - List the key design issue to be discussed in the review
  - Invite experts if needed for design content evaluation (for instance: constructability and maintainability)
- Distribute agenda
- Facilitate the design review meeting and prepare report

BIM coordinator:

  - Run testing round with merging of the domain models
  - Communicate any technical issues with chief design and domain designers

Check list for internal design group review for running KPI assessment

A short checklist to support the preparation for main KPI assessment (before each hard gate).

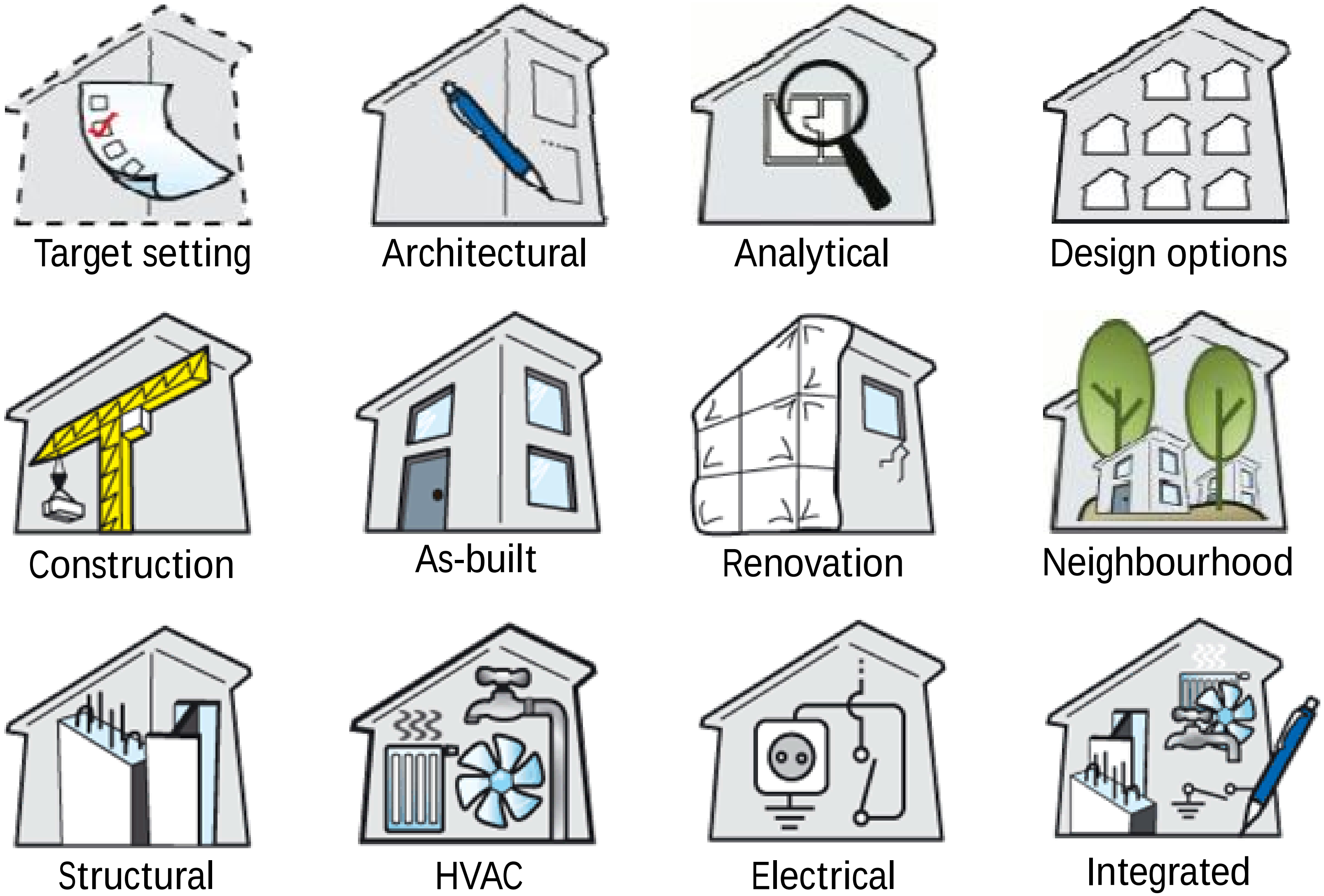
- Calculate each strategic indicator with appropriate method (all results are based on energy simulation and energy matching analysis).
- Run multi-criteria calculation in the assessment tool.
- Assessment results are visualised in the virtual working space. Study each indicator.
- Compare design value and indicator specific scores to the target value levels.

- Seek for design solutions (with a component library), which reach the target values.
- Consider neighbourhood aspects through each design level (holistic design).
- Consider flexibility for future changes (evolutionary design).
- Collaborate with the design team to find most balanced design solution. Use integrated BIM to support discussion.

Explanation of the symbols used in Facilitator

SYMBOLS

Models



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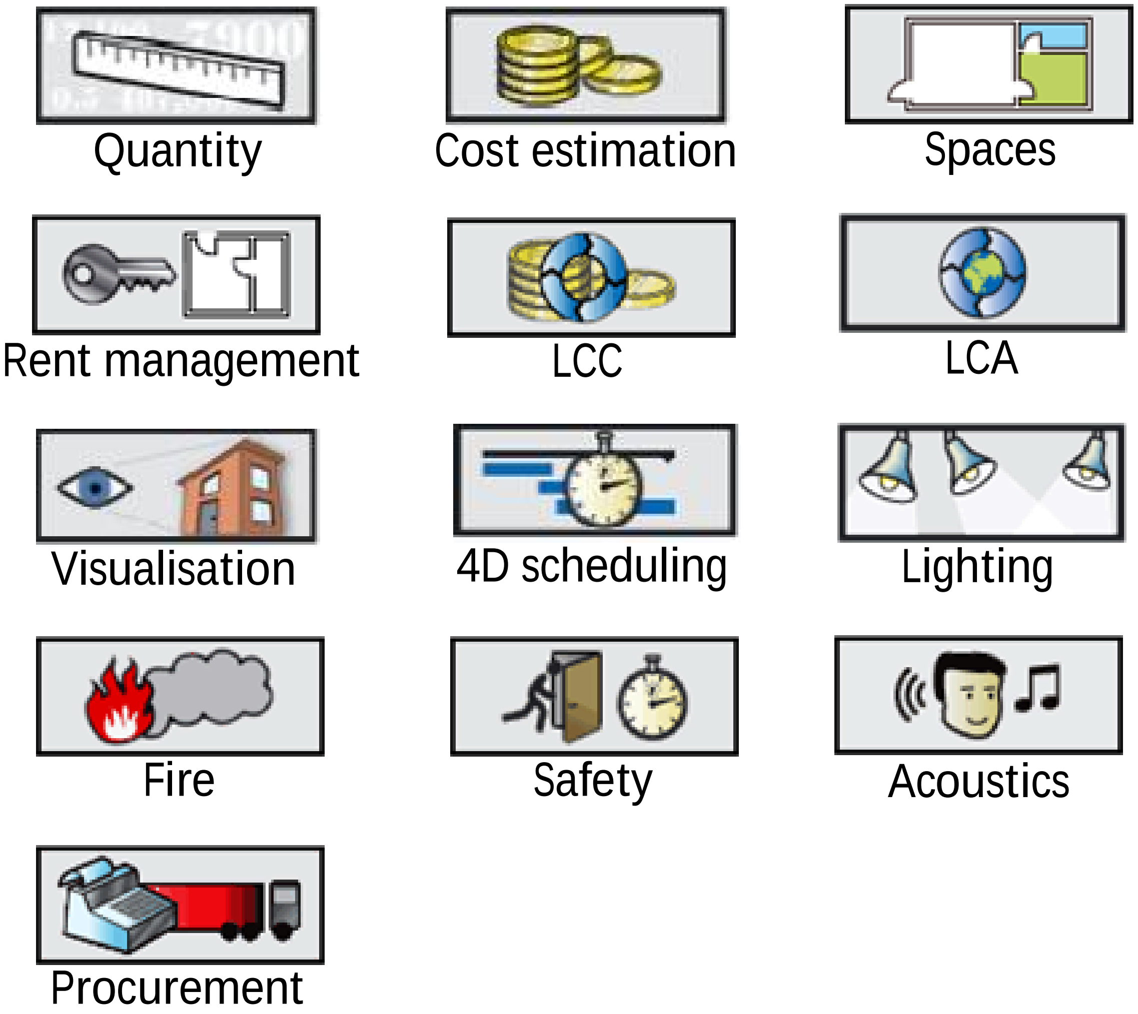
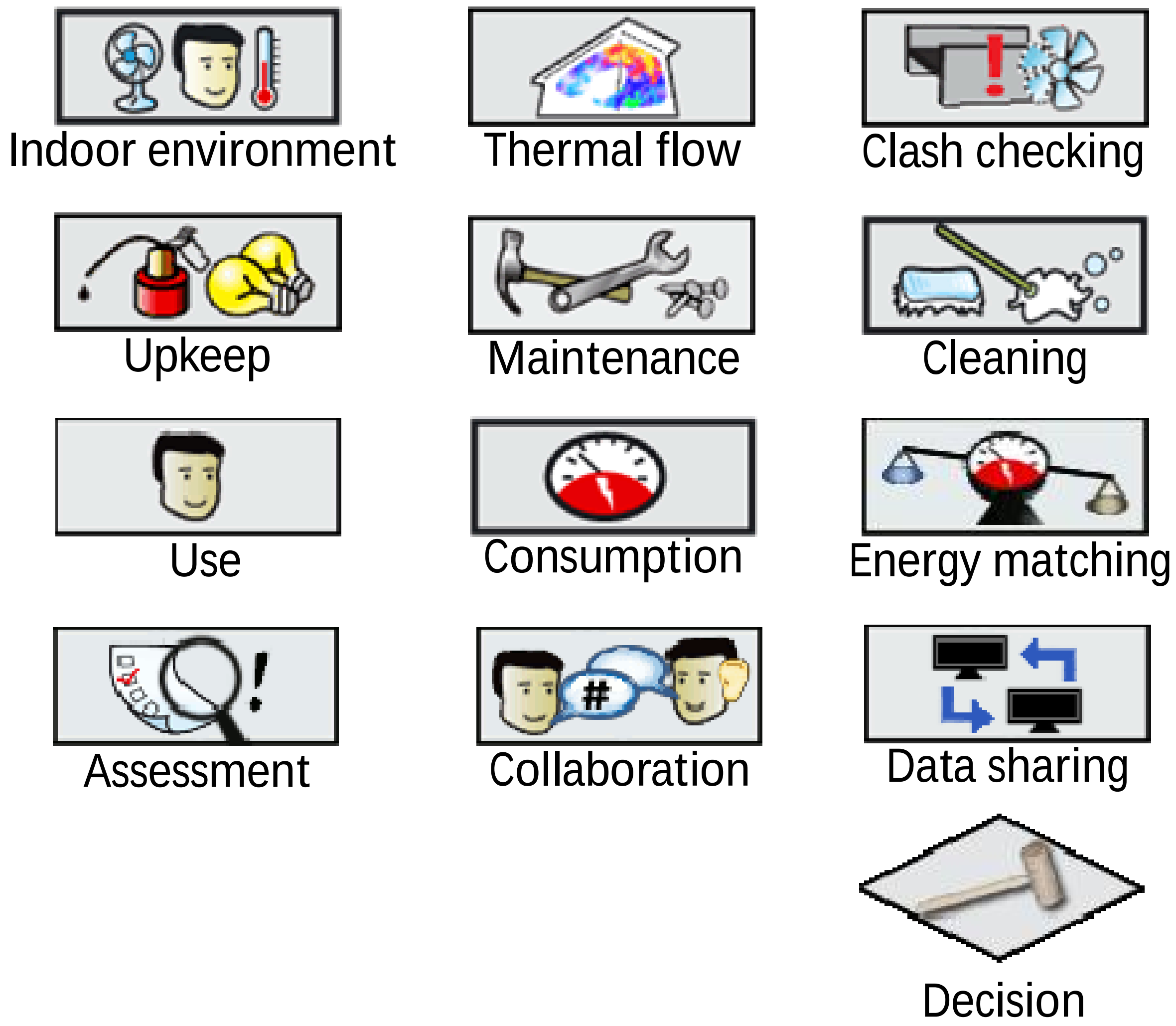
Analysis 1/2

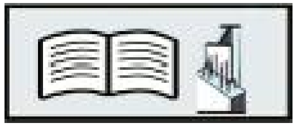

Quantity
Cost estimation
Spaces
Rent management
LCC
LCA
Visualisation
4D scheduling
Lighting
Fire
Safety
Acoustics
Procurement

Analysis 2/2

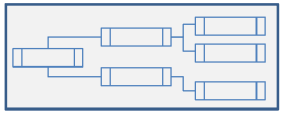

Indoor environment
Thermal flow
Clash checking
Upkeep
Maintenance
Cleaning
Use
Consumption
Energy matching
Assessment
Collaboration
Data sharing
Decision

Model based on...

Registers



Component catalogue data



Attribute level data

For further information please contact

tarja.makelainen@vtt.fi

Presentations (power point slides with hyperlinks) are shared on request.

Open source development efforts for any testing of the Facilitator (or part of it) is highly appreciated.

When using or showing any of the slides please refer to the source: VTT, 2017