

BIM4Ren

TRAINING

Collaborate with BIM: the BIM4Ren workflow, a result of current needs and best practices

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This project has received funding from the H2020 programme under Grant Agreement No. 820773

- B1. Needs and requirements for using BIM in renovation
- B2. Methodology KPI4Ren for assessment the impact of BIM in renovation
- B3. BIM based renovation workflows
- B4. BIM4Ren workflows
- B5. BIMQ : Knowledge base about renovation processes



Needs and requirements for using BIM in renovation



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Methodology for the analysis of needs and requirements



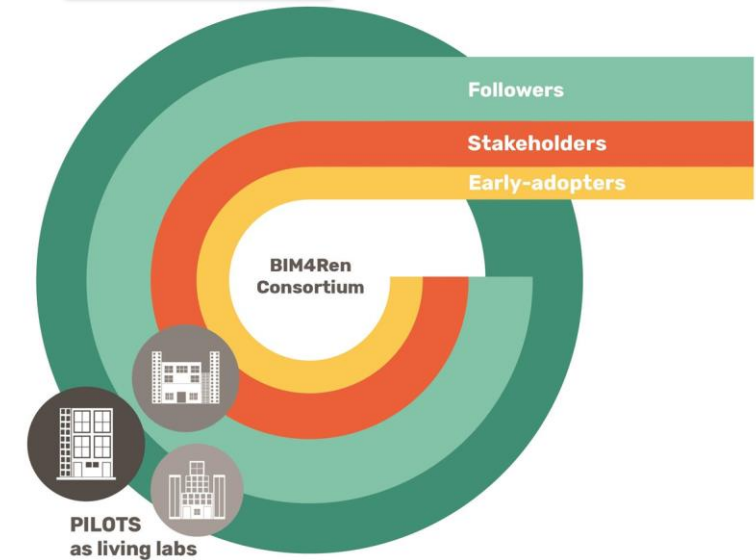
WHAT?

Analysis of critical **barriers** of the renovation process

Potential for digitalisation to overcome them through **BIM methodology**

Needs and requirements for using BIM in renovation

WHO?



HOW

STAKEHOLDERS' ELICITATION BASED ON **LIVING LABS METHODOLOGY**:

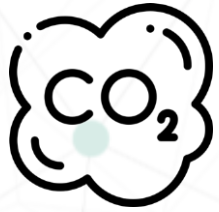
Project pilots are used as a **user-centered, open innovation** ecosystem with **co-creation, exploration, experimentation and evaluation** of the deployed tools.

Through 3 instruments of data collection:

- **On-line questionnaire** addressed to the whole value chain of construction process in Europe
- **Interviews** with key stakeholders of the renovation process
- **Local workshops** to check and validate the results through direct dialogue with closest stakeholders around the pilots



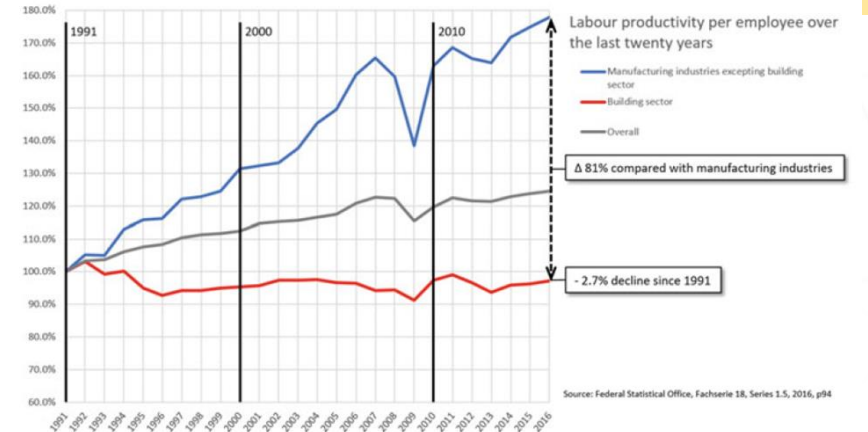
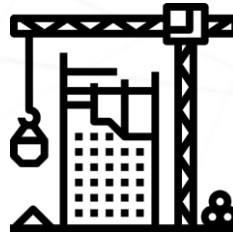
Construction sector landscape



Existing buildings are responsible for 40% of the total energy consumption and 38% of GHG emissions

We need to increase the renovation level of the existing building stock from 1% to 3% !

The construction sector has one of the poorest productivity of the industrial sectors, with minor use of digital tools



99.9% of the sector is made up of SMEs with less than 10 employees

60% of the sector production is done by SME (less than 50 employees) while employing 70% of the sector working population (Eurostat 2011)

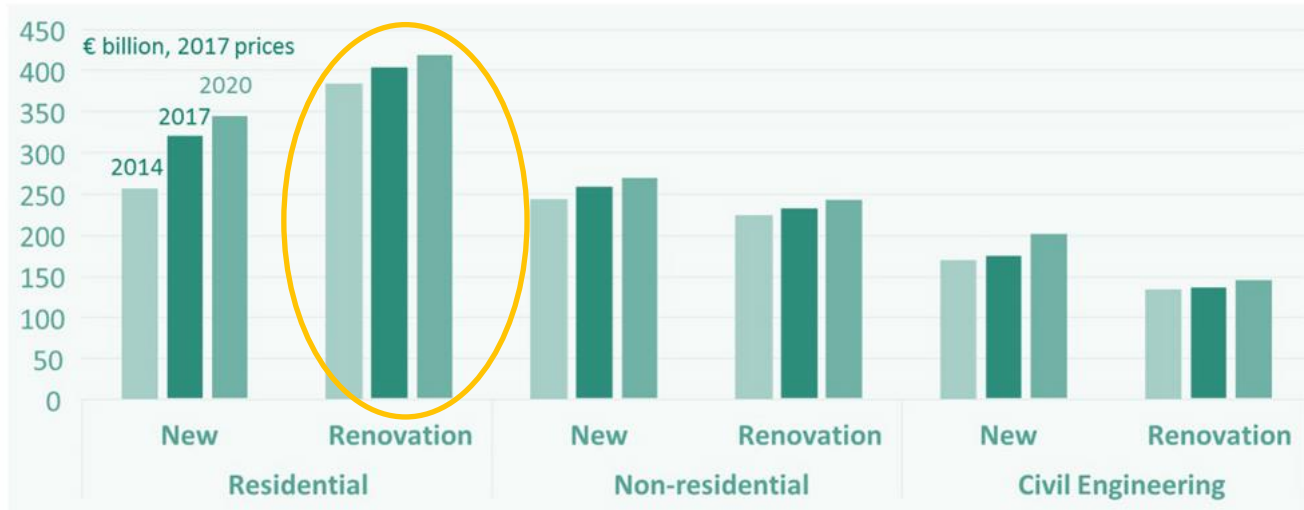
Digital Transformation is not easily accessible to SMEs and handcrafters.



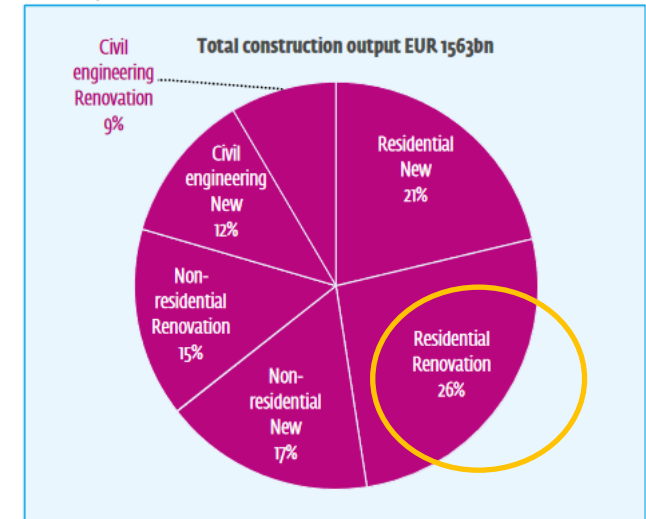
We need to put adapted tools in the hands of every kind of construction actor.

Landing in renovation sector

European (EC-19) Construction value by sectors in 2014, 2017 and 2020



Construction market by subsectors (EC-19, 2018)
share in %, 2018



Source: EUROCONSTRUCT, November 2018

Residential renovation is the more growing construction field in the last years (*i.e 26% of the sector de la construcción and 410.000 M€ output in UE in 2018*)

Big room for **productivity improvement** since it is a traditional sector with minor technological innovations

**BUSINESS
OPPORTUNITY FOR
DIGITALISATION OF
RENOVATION**



Characterization of the renovation process

Basis for the use cases workflows definition:

STAKEHOLDERS

- **Designer** (Architect, Project manager, Engineer).
- **Contractor** (key staff: site Manager, cost controller, quality controller, security manager...).
- **Sub-contractor** responsible for functions, such as HVAC, structure, foundations, electricity, plumbing, or painting. In a renovation project, subcontractors can provide survey and data gathering, materials characterization, inspections etc..
- **Resident or Building owners** (according to the property: public or private), (according to dependencies: owners, social housing, tenants, facility managers..)
- **Supplier/ manufacturer**
- **External consultant**, such as software developer or BIM consultants.
- **External certification. administration as regulator entity**
- **Financial entities**, or funders.

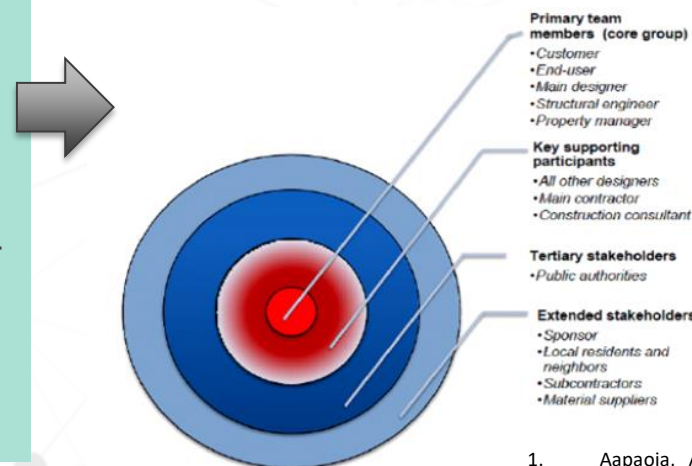
PHASES

- **Strategic Definition**
- **Information gathering and survey**
- **Diagnosis**
- **Renovation Conceptual Design**
- **Renovation Technical Project**
- **Construction**
- **Handover and close out**
- **In use**

RENOVATION TYPOLOGIES

- **Maintenance and inspection works**
- **Internal refurbishment** (painting, floor/wall tiling, partition and internal space remodeling, or wet room refurbishment)
- **Renovation in the envelope**, including framing and glazing replacement, façade retrofitting and roof retrofitting
- **Structural intervention**
- **Service improvement** including HVAC, RES, electricity, plumbing sewage, fire security...
- **Accessibility improvements** with measures such as elevators or adaptation of main access to buildings (ramps).
- **Deep renovation** leading to high energy performance buildings, including most of the aforementioned renovation works

Stakeholders classification in the renovation project [1].



1. Aapaoja, A., & Haapasalo, H. (2014). A Framework for Stakeholder Identification and Classification in Construction Projects. *Open Journal of Business and Management*, 02(01), 43-55. doi:10.4236/ojbm.2014.21007

Main barriers of the renovation process:

(Identified through the stakeholders elicitations achieved from questionnaires, interviews and workshops ⁽¹⁾):

- Lack or inaccurate information collected used and exchanged during the renovation process
- Low level of digital information exchange
- Barriers due to the cultural approach to work in the renovation sector
- Involvement of different stakeholders in different stages of the renovation process
- Legal constraints
- Interaction between stakeholders
- Exploitation of the information generated after the renovation works

(1) Source: BIM4REN project. Public Deliverable D1-1 Stakeholders requirements and Constrains. Available online <https://bim4ren.eu/download/d1-1-stakeholders-requirements-and-constrains/>)

Inefficiencies and Barriers of the renovation process



BARRIER	CATEGORY
Lack or unaccurate information collected used and exchanged during the renovation process	<ul style="list-style-type: none">• Inconsistencies and lack of information in the measurements of current and new components on the building• Difficult to obtain enough and accurate information about the existing elements (materials, structure...)• During the preliminary and design phases the errors can often be cumulative and need to be solved during the construction phase• Lack of traceability and common information (budget, drawings...) to be shared between different stakeholders• Ddifficulty to conveniently update 2D plans during the execution of the works• Lack of information about the progress of the works to the owners
Barriers due to the cultural approach to work in the renovation sector	<ul style="list-style-type: none">• Culture of working on site to solve problems• Unforeseen works appear due to the new requirements or unexpected situation requiring quick answers. The human factor affects this decision-making process.• Many companies use old fashion way of design and are reluctant to use BIM methodology• Public funding guiding current energy renovation works influences the decisions adopted and the overall technical assessment is not sufficiently developed



Inefficiencies and Barriers of the renovation process



Identified through the stakeholders elicitations achieved from questionnaires, interviews and workshops (1)

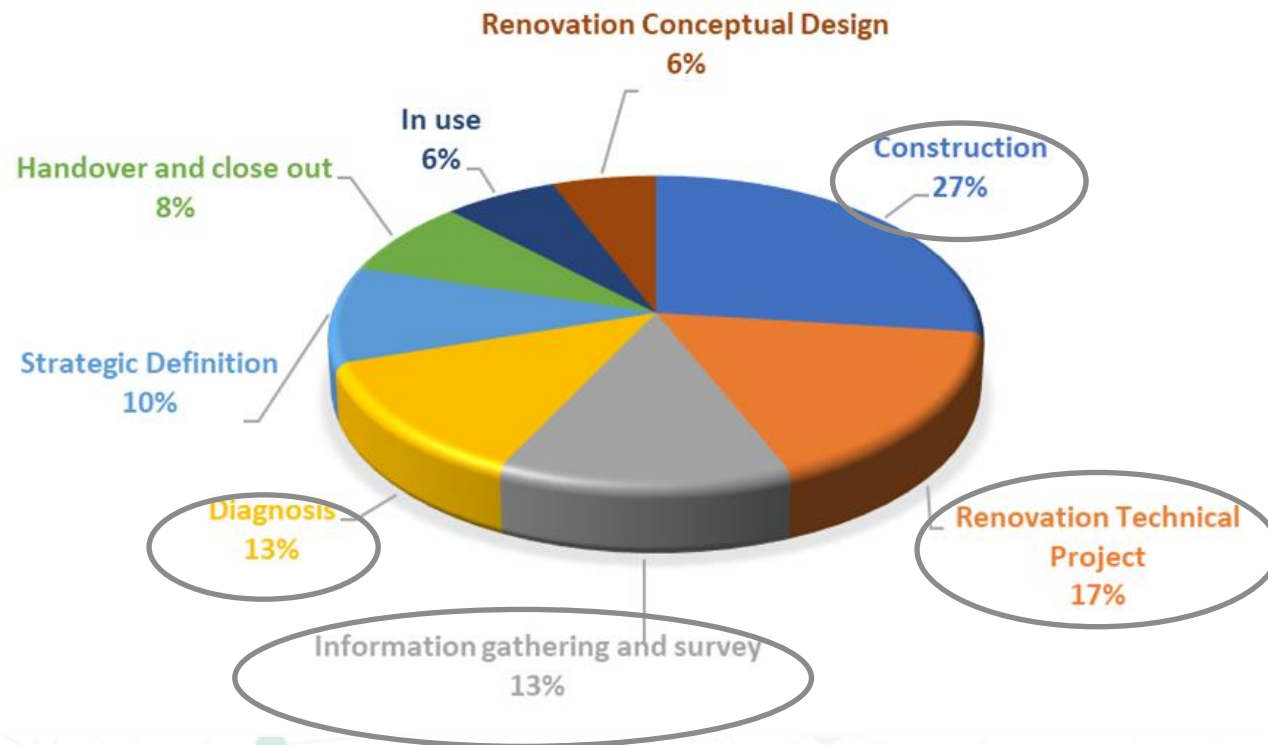
BARRIER	CATEGORY
Involvement of different stakeholders in different stages of the renovation process	<ul style="list-style-type: none">• Different price quotations depending on the phase (design, construction...)• Systems/products are often requested in the construction phase, without having been consulted in the design phase
Legal constraints	<ul style="list-style-type: none">• Legal issues to solve about responsibilities of each stakeholder in the project• Distrust about a joint participation of the Architect and Contractor in public tenders
Interaction between stakeholders	<ul style="list-style-type: none">• Lack of confidence among stakeholders• Many designers/technicians involved in renovation processes making communication and information exchange complex
Exploitation of the information generated after the renovation works	<ul style="list-style-type: none">• The technical project is not delivered to the owner• Preventive facility management of the building after renovation is not common in residential buildings
Low level of digital information exchange	<ul style="list-style-type: none">• Manual data gathering in initial phases, using topographic instruments that needs to be transformed into digital data• Use of different formats (pdf, xls...) that doubles the work as they need to be transferred to another format for other software



Inefficiencies and Barriers of the renovation process

Outcomes from the questionnaire “*Survey about the BIM implementation in renovation processes*” launched to European AEC sector in the BIM4Ren framework (311 respondents over Europe) (1)

PHASES OF THE RENOVATION PROCESS CAUSING INEFFICIENCIES



The **critical phases** in renovation are the **Construction, Technical Project Diagnosis, and Information gathering**, which reveals

- the challenge of the onsite construction phase in renovation,
- the technical difficulties in the retrofitting design due to design and
- the need of knowledge about the existing building

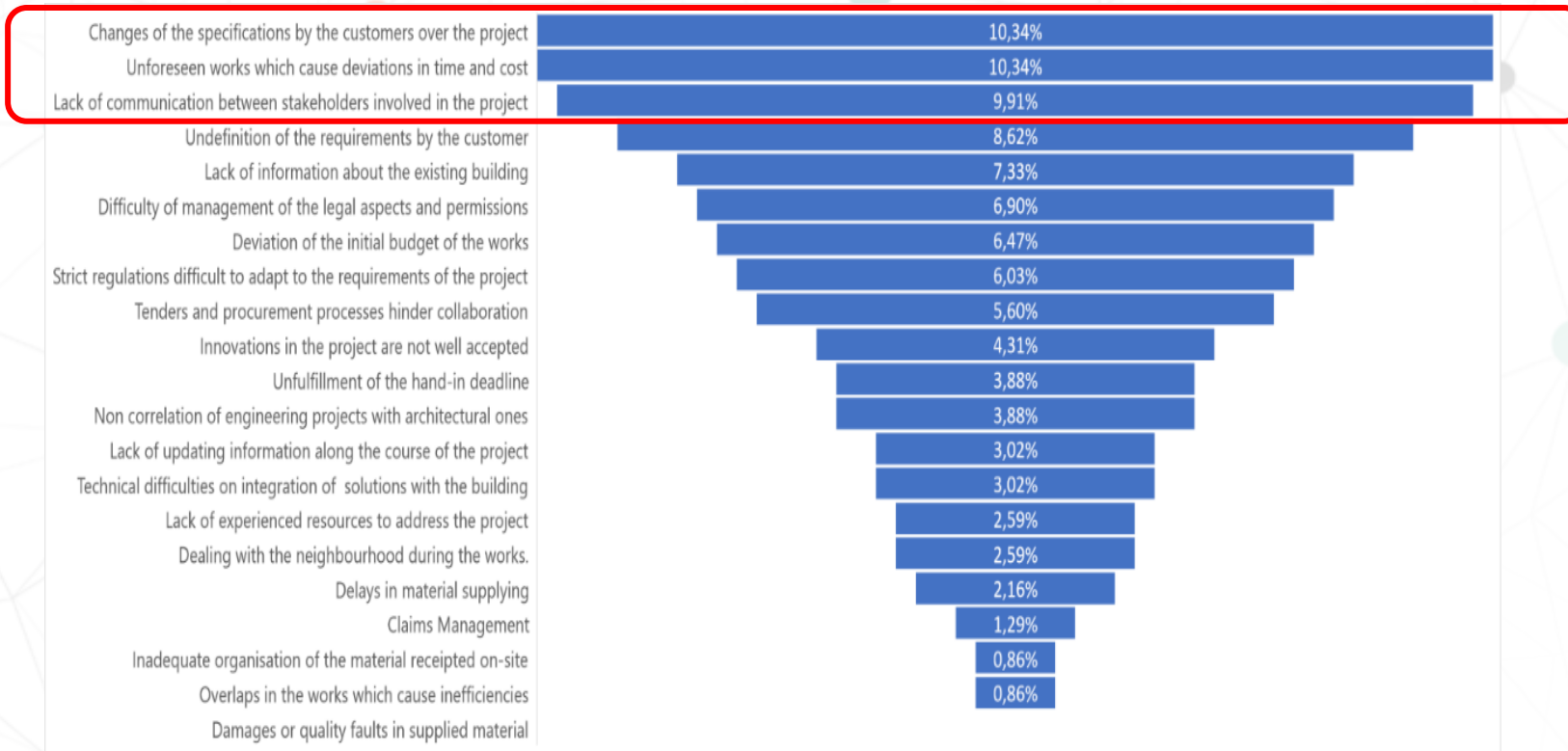
(1) Source: BIM4REN project. Public Deliverable D1-1 Stakeholders requirements and Constrains. Available online <https://bim4ren.eu/download/d1-1-stakeholders-requirements-and-cobstrains/>

Inefficiencies and Barriers of the renovation process



Outcomes from the questionnaire “*Survey about the BIM implementation in renovation processes*” launched to European AEC sector in the BIM4Ren framework (311 respondents over Europe) (1)

PRIORITIZATION OF THE INEFFICIENCIES OF A RENOVATION PROJECT ACCORDING TO THE BUSINESS’

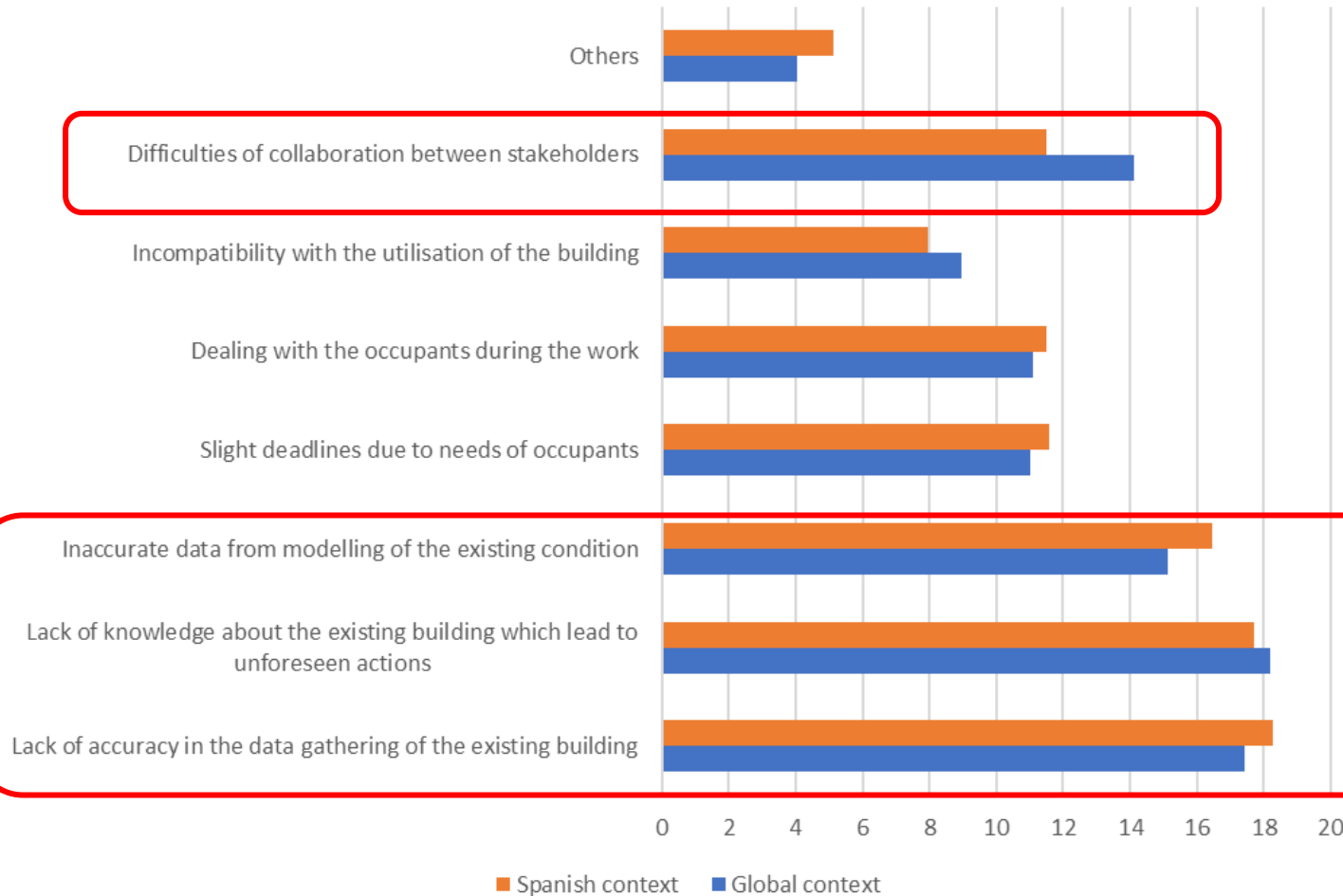


The **changes of the specifications**, the **unforeseen events**, together with the **lack of communication** are the critical issues specific for the renovation and the main causes for time and cost losses



Inefficiencies and Barriers of the renovation process

IMPACT OF THE PROBLEMS IN RENOVATION : GLOBAL RESULTS AND SPANISH RESULTS OF THE QUESTIONNAIRE

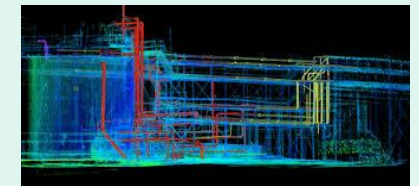


MAIN BARRIERS TO OVERCOME IN RENOVATION:

Collaboration!!



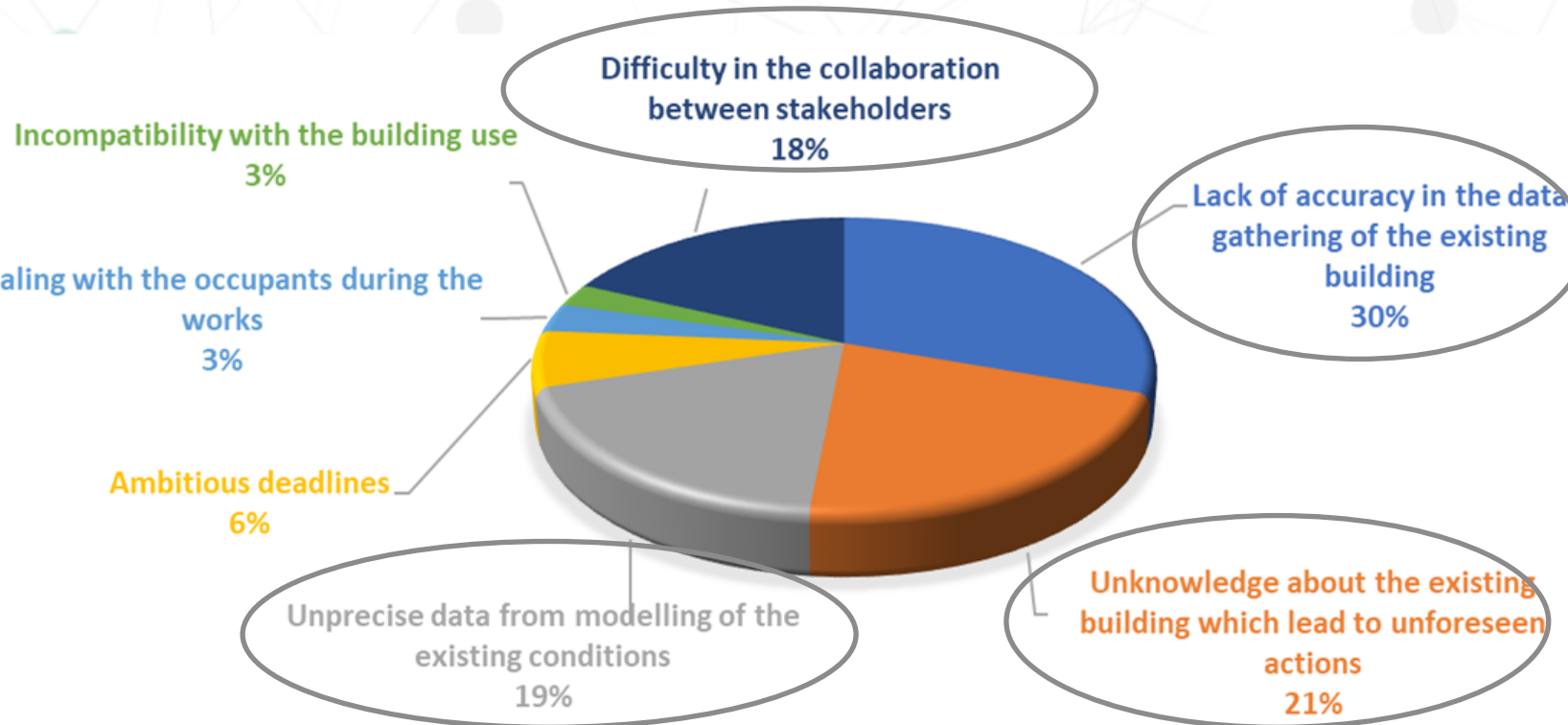
Need of knowledge about the building!!



OPPORTUNITY FOR
DIGITALISATION AND BIM!!!!

Potential of BIM for overcoming the barriers

BARRIERS OF THE RENOVATION PROJECT THAT CAN BE OVERCOME WITH BIM



The main expected **value of BIM** is related to:

- **Accuracy** of existing building information
- **Ease of visualisation** of the solution
- **Time reduction**: project development and execution
- **Cost reduction**
- **Organisation** of documentation

BIM is set to transform the sector and optimise the renovation process

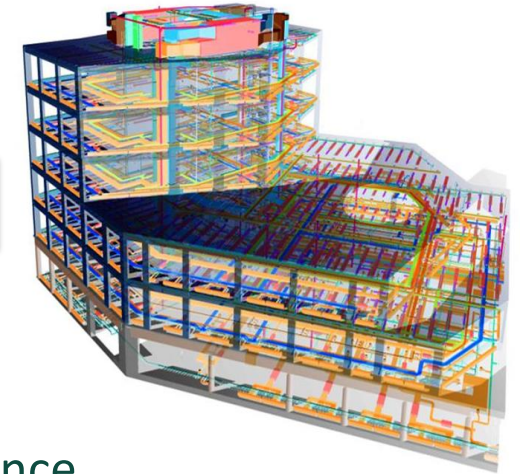
Needs and requirements for using BIM in renovation



From the barriers that can be overcome by BIM

Definition of the **end user requirements** for the use of BIM in renovation (1):

- Availability of a **digital platform to share information** between stakeholders.
- Integration of **end-user needs** throughout the process.
- **Interlink between phases** to enable continuity in the process and optimise performance.
- Provides a **common database of the existing building** available to all stakeholders at any time
- Need of a **standardized renovation process**
- Integration between **cloud exchange platforms and BIM information tools**.
- Combined use of **new technology for data acquisition** and easy **conversion into a format readable** by design or evaluation tools.
- Specifically for **building owners and administration**, particular requirements needed to boost the implementation of BIM, i.e. integration into administrative processes, training, updating hardware, etc.



1) Source: BIM4REN project. Public Deliverable D1-1 Stakeholders requirements and Constrains. Available online <https://bim4ren.eu/download/d1-1-stakeholders-requirements-and-constrains/>





Methodology KPI4Ren for assessment the impact of BIM in renovation



This project has received funding from the H2020 programme under Grant Agreement No. 820773

DEFINITION OF KPI

A Key Performance Indicator (KPI) is a **quantifiable measurement of the performance** of either the **process** during renovation or the **building** under renovation.

KPIs may relate to the building or to one or more of its parts, systems, components or individual elements

HOW TO MEASURE THEM

- Defining the measurement units
- Defining the measurement and validation (M&V) protocol (who, how, where, when to measure)
- Comparing the achieved values with the threshold values of the KPIs

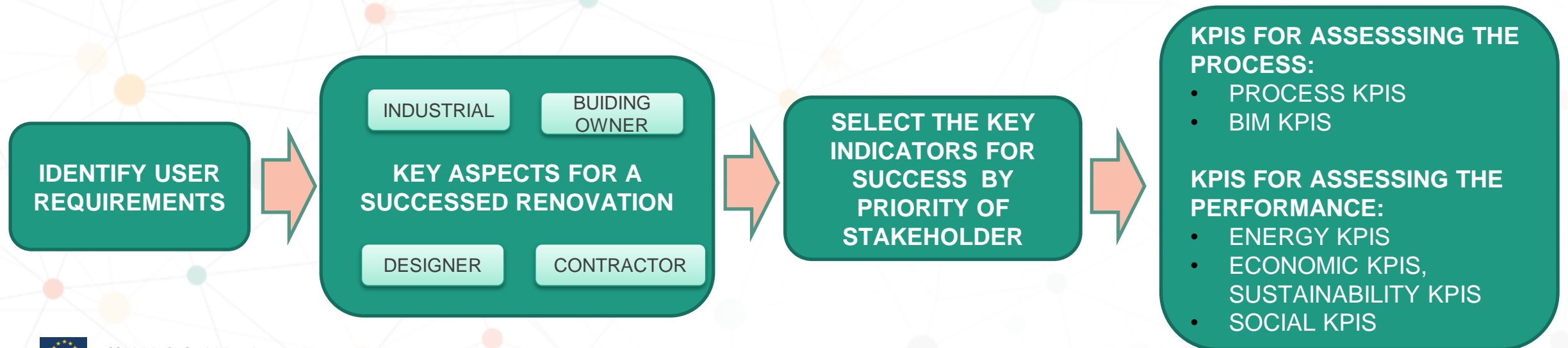
Methodology KPI4Ren for assessment the impact of BIM in renovation



STARTING FROM THE **USER REQUIREMENTS** => DEFINITION OF **INDICATORS** FOR RENOVATION PROCESS

The **indicators** allow to **measure the success of the renovation process** according to different criteria and relevance by stakeholder

PROCESS FOLLOWED IN BIM4REN FOR DEFINING THE KPIS



Methodology KPI4Ren for assessment the impact of BIM in renovation



Key aspects for the success of a renovation process	Relevance for			
	Designer	Contractor& Subcontr.	Building owner	Industry
Accuracy of the data gathering of the existing building	***	***		*
Easy visualisation of the solution	***	***		**
Reduction of delivery time	***			***
Organisation of the documentation	***	**		**
Cost reduction	***	***	***	***
Improvement of the company's reputation	**	**		*
Validation of the standards compliance	**	**		*
Justification of the Decision Making	**	**		
Easy replication	**	**		
Easy collaboration with the client	**	**		
Integration of requests from residents	*			
Reduction of the visits to site	*	*		
Complaint management	*	*		**

Key aspects for the success of a renovation process	Relevance for			
	Designer	Contractor& Subcontr.	Building owners	Industry
Access to financial subsidies			**	
Maintenance cost reduction			***	
Energy savings			***	
Resident's comfort improvement			***	
CO2 and other pollutant emissions reduction			**	
Support to the control quality		**		
Longer building lifetime			***	
Aesthetic improvement of the building			**	
No need for the resident to leave the building			*	
Reduction of accidents on site		**		
Reduction of unforeseen events on site		***		
Reduction of execution works time		***		*
Easy interaction with the designer		***		***
Integration of requests from residents		*		***
Increase in the building value			*	
Organisation of the material onsite				***



KEY ASPECTS OF THE RENOVATION PROCESS BY STAKEHOLDERS WHICH LEAD TO THE KPIS IDENTIFICATION

- **For designers:**

Aspects such as accuracy, easy visualisation, data management, time and cost reduction in renovation are key for designers, while the integration with residents as well as reduction of site visits are less relevant.

- **For Contractors&Subcontractors:**

Aspects such as accuracy, easy visualisation, time and cost reduction , easy interaction with architect, and unforeseen events reduction in renovation are key for Contractor and Subcontractors.

- **For Building owners:**

Aspects such as cost reduction, comfort improvement, maintenance cost reduction and energy savings and longer lifetime are their main priorities for owners. However they do not value the increasing of building value or avoiding to leave their homes while the construction works

- **For Industrials (Suppliers and Manufacturers):**

Aspects such as reduction of delivery time , cost reduction, easy interaction with the architect, attention to the residents' requests and organization of the on site material are their main concerns.

KPIs defined in BIM4ren for assessing the renovation **PROCESS**:

Process KPIS:

- Time Savings
- Processes repeated
- Cost Savings
- Waste Generated
- Disturbances
- Level of Digitalization of the process
- Resources Consumed

BIM KPIS:

- Interoperability between tools
- Integration of stakeholders requirements
- Investment / training required for BIM
- BIM trained workers
- Level of Involvement of stakeholders in phases
- Communication between stakeholders

KPIs for assessing the **PERFORMANCE** of the renovated building

Energy KPIs

- Final energy demand
- Heating & cooling demand
- DHW demand
- Final energy Consumption
- Energy Savings
- RES production

Economic KPIS:

- Investment
- Payback period
- Accessibility to financing

Sustainability KPIS:

- Recycled material content
- Carbon Footprint
- Water Consumption
- Waste generated
- CO2 emmissions
- Sustainability Labelling

Social KPIS:

- Thermal comfort
- Average Temperature
- Average Humidity
- Air Quality
- Fresh air
- Daylighting

Methodology KPI4Ren for assessment the impact of BIM in renovation



Example KPI: PROJECT COST PREDICTABILITY

	CODE	PR1.4	UNIT	%
GOAL	Improve project cost predictability.			
DESCRIPTION	It allows monitoring the project cost predictability in order to lower risks. This KPI compares the tendered cost of the process to the actual cost, measuring the accuracy of the prediction.			
UNIT	%.			
MEASUREMENT & VALIDATION				
COMMENTS	When the cost predictability is high ,the risk of tendering cost is low. One of the biggest issues of the building industry is the lack of accuracy when predicting cost, which generates budget overruns and economic losses. Literature asserts that BIM methodology benefits project cost tendering. The model's accuracy is higher and predictability should get benefit from it.			





BIM based renovation workflows



This project has received funding from the H2020 programme under Grant Agreement No. 820773

MOTIVATION:

- The huge amount of typologies, activities and stakeholders involved in renovation, together with the lack of standardization lead to a **high inefficiency in the process**.
- Traditional workflows in construction are **not structured enough for automation**
- The **stakeholder's requirements** and roles need to be included in the process through a **collaborative platform** serving a quicker, collaborative and most efficient process for renovation.
- Given the fact of the concurrence of multiple actors in renovation, with various skills, knowledge, tools, applications, and software, the **organization of the information** generated, adapted, exchanged, and interpreted becomes crucial.
- Although BIM arise to obtain a common framework to work together by means of conceiving digital-based models, the **standardization of the process** is needed for a BIM-based digital workflow



The integration of stakeholders, requirements, and technologies in workflows as a first precondition to automate the process

CHALLENGES

- The **standardization of digital-ready workflows** will allow to reach higher rates of application of the BIM methodology in the renovation sector. The digital workflows represent the renovation process and information requirements in a **structured framework**, according to the involvement of different stakeholders
- The collaborative workflows for renovation play a crucial role in the **integration of the phases and stakeholders** around the digital model. Only suitable **harmonization of terms and roles** will allow one to set the basis for a common understanding, which leads to a collaborative environment for the necessary optimization of the process. A standard classification for typologies, phases, and stakeholders involved in a renovation process facilitates the design of renovation workflows
- The BIM methodology relies on **interoperability** as the way to reduce the barriers that hinder the exchange of information, as a result of the use of **open standards**, such as IFC (ISO 16739) and related standards which are being promoted by buildingSMART
- In the case of BIM4Ren, the digital workflows support the definition of the **software system architecture and associated tools** developed in the project. The workflows will help to digitally implement the renovation project, guiding the use of the software platform or tools, with the ability to support or execute the linked tasks to cover the whole renovation process.

BIM based renovation workflows

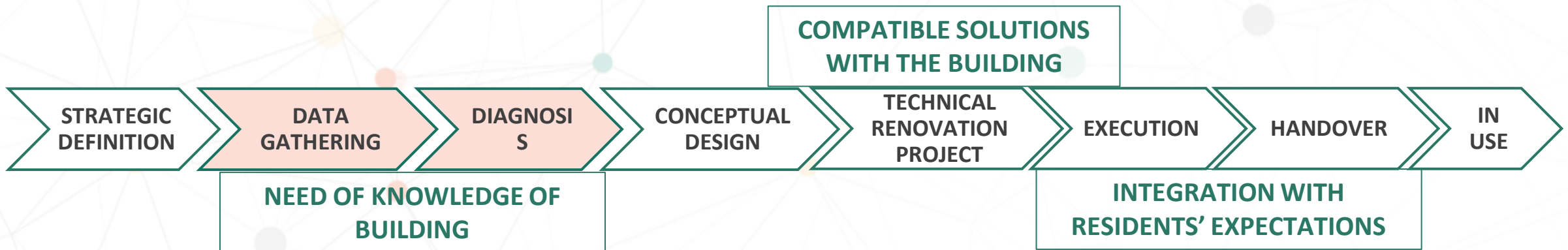


NEW CONSTRUCTION WORKFLOW VS RENOVATION WORKFLOW: New challenges in renovation

General workflow of the construction process



General workflow of the renovation process: new challenges



New challenges arise in the retrofitting process that BIM can address through **higher data accuracy**, **collaborative working** and the ability to implement **more technically demanding solutions**.

BIM based renovation workflows

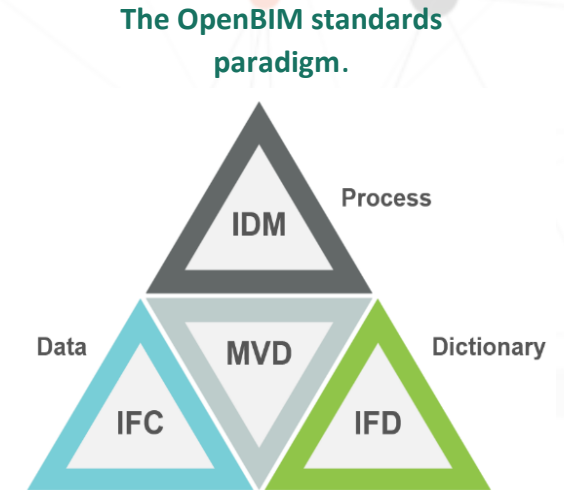


Methodology for defining the renovation workflow:

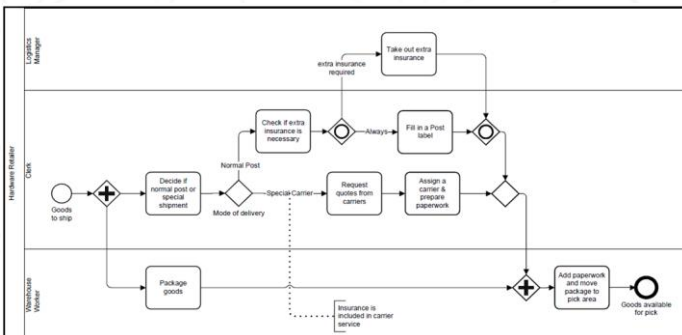
OBJECT: to transform the implicit knowledge from the stakeholders involved in the building renovation process, not structured enough for automation, into an OpenBIM digital process based on the BIM standards

RESULTS: OpenBIM ready workflows that represent the renovation process and information requirements according to the involvement of different stakeholders. Those workflows are the basis for the future development of specific products and tools for boosting digitalization and interoperability in the renovation process.

The methodology relies on several **standards promoted by BuildingSMART International (BSI)** such as **IFC** (Industry Foundation Classes) , **IDM** (Information Delivery Manual) , usually complemented by the graphic language **BPMN** (Business Process Modelling Notation), and **MVD** (Model View Definition) and **IFD** (International Framework for Dictionaries).



Example of a Business Process Model and Notations



Graphic language BPMN provides an interoperable and standard representation to understand and represent the communication and data exchanges between participants and activities.

The BPMN models are comprised of diagrams built from a limited set of graphical elements, which simplify the understanding of business activities and processes for both business users and technical users, since it provides a structured way to graphically share processes.

BIM based renovation workflows

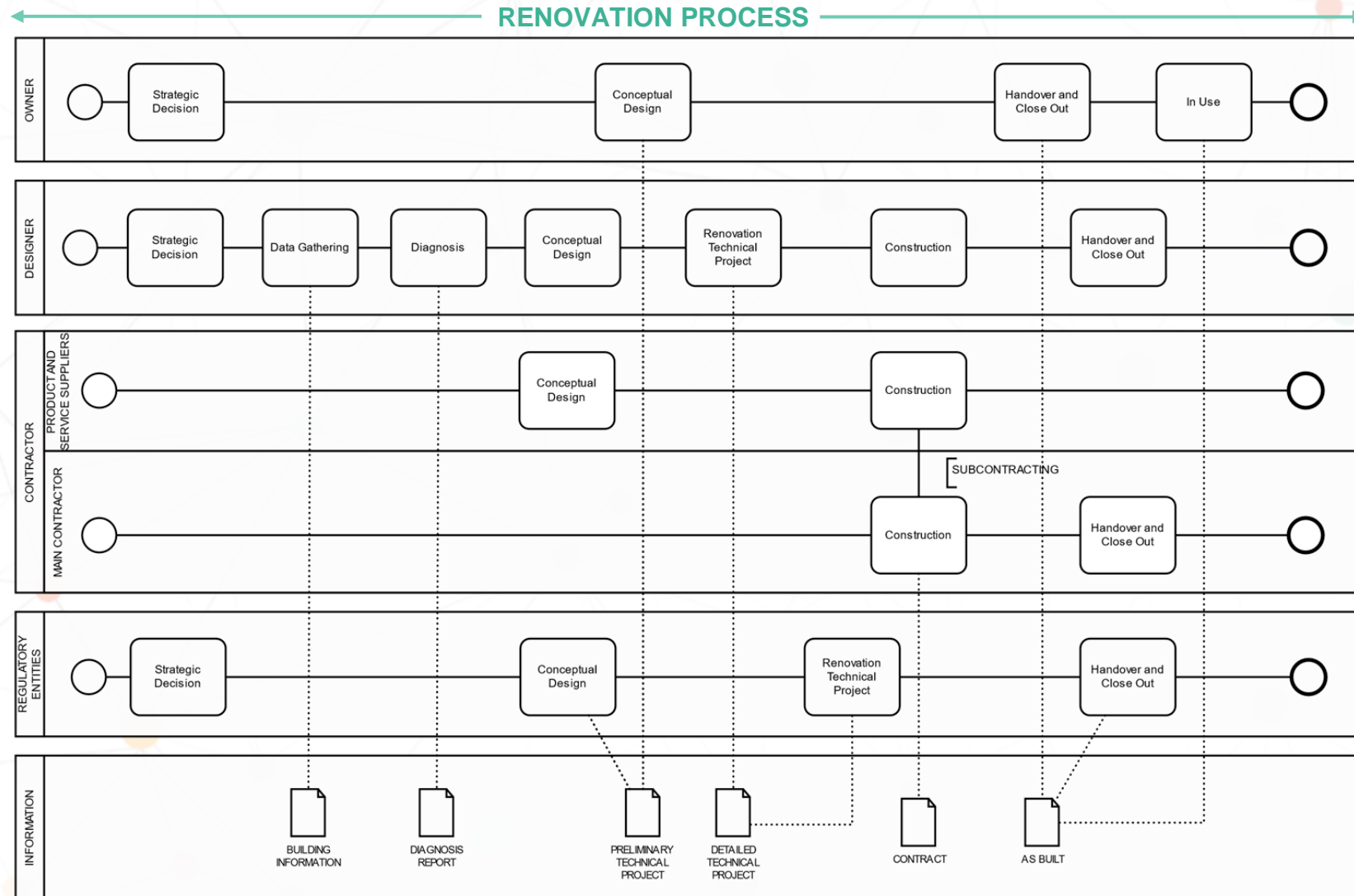


Generic renovation process represented in a BPMN diagram

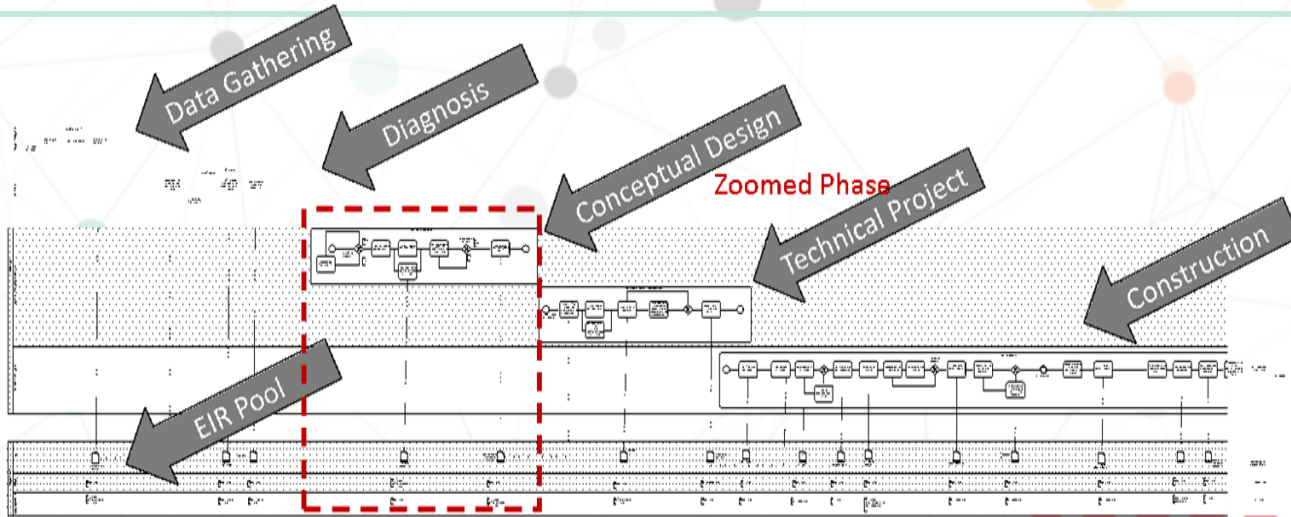
PHASES/
ACTIVITIES

STAKEHOLDERS

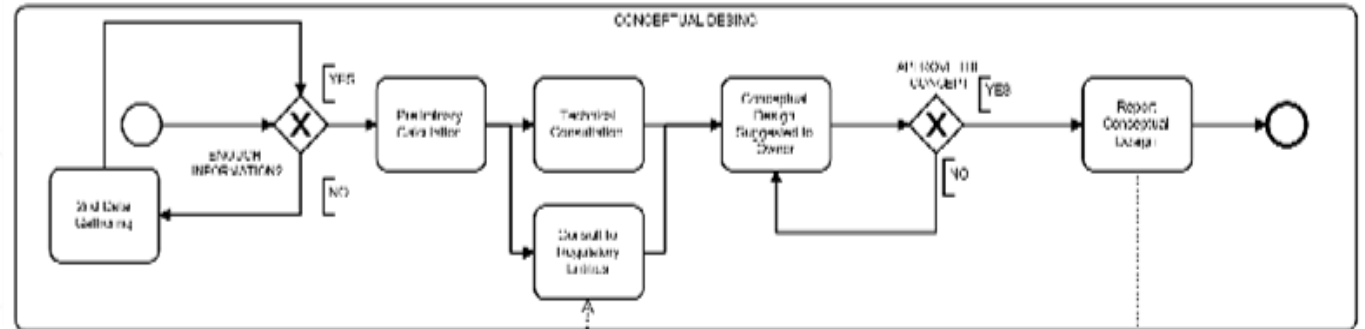
EXCHANGED
INFORMATION



BIM based renovation workflows



Specific façade renovation BPMN diagram.
(Zoom of the design phase as an example)





BIM4Ren workflows



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BIM4ren Approach for set-up of Renovation Workflows



CHALLENGES AND GOALS:

- There is an **increasing amount of options** to configure design workflows.
- Use of BIM will foster and accelerate development of new tools.
- Use of **building simulation is key to optimize renovation**. They provide necessary input to KPI-based design decisions.
- Simulation can be done with **different levels of accuracy**, depending on used simulation methods.
- Simulation methods and provided results typically correlate with:
 - Accuracy, type and amount of input data
 - Required skills and experiences of the domain expert
 - Effort and time to run the simulation and provide requested results

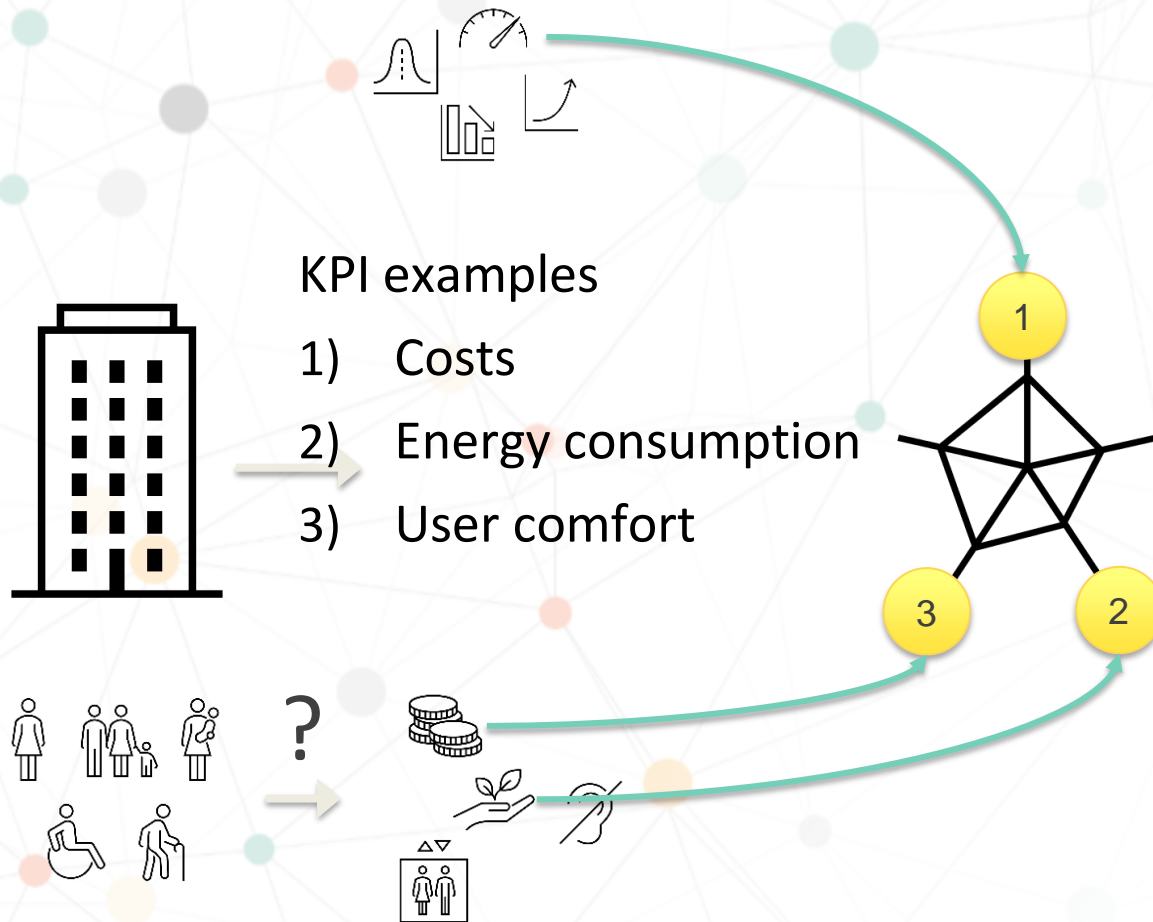


Main goal is to collect and generalize information about renovation workflows and to use that knowledge to set-up project-specific workflows.

BIM4ren Approach for set-up of Renovation Workflows



Main steps: 1) Select KPIs and specify target values by owner and users



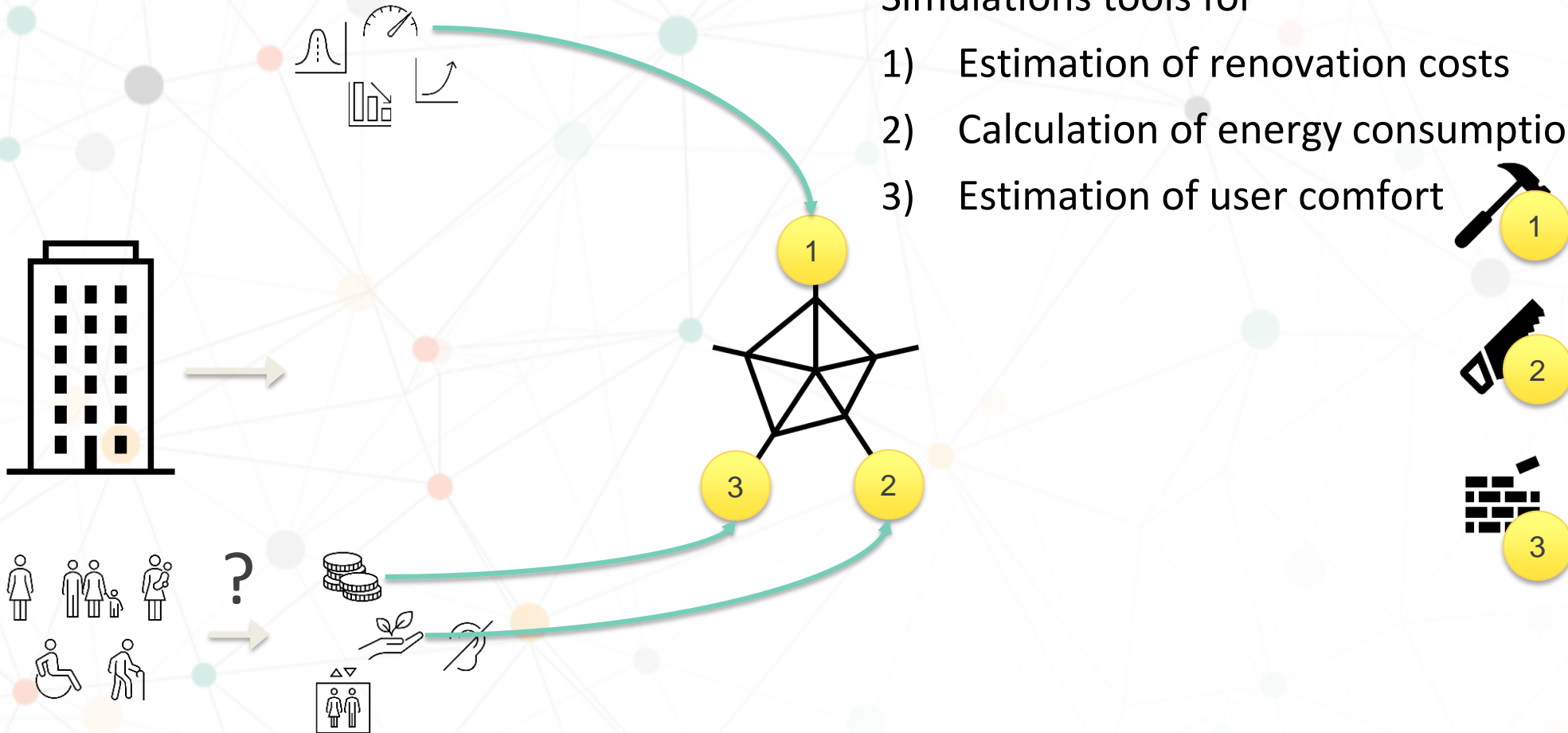
BIM4ren Approach for set-up of Renovation Workflows



Main steps: 2) Identify tools that can generate requested KPIs for a given design

Simulations tools for

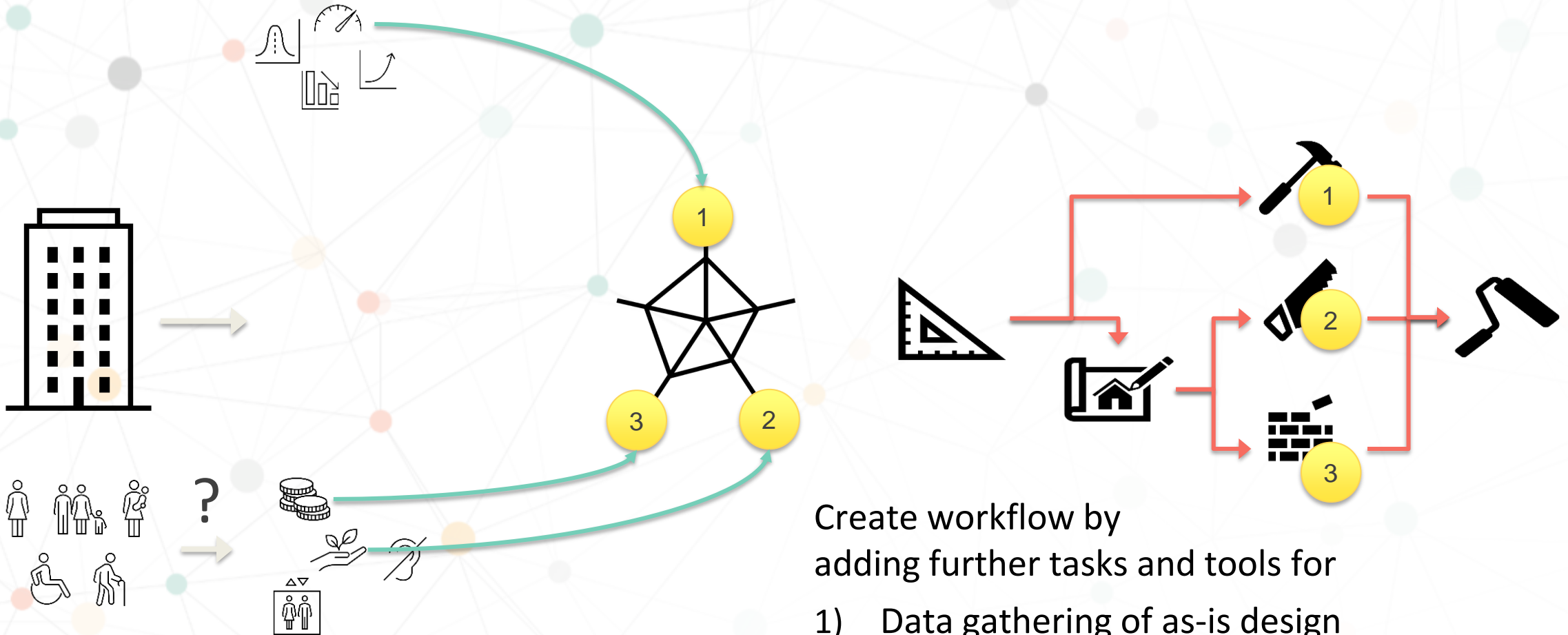
- 1) Estimation of renovation costs
- 2) Calculation of energy consumption
- 3) Estimation of user comfort



BIM4ren Approach for set-up of Renovation Workflows



Main steps: 3) Derive workflow proposal from generalized, configurable BIM4ren workflow



- Create workflow by adding further tasks and tools for
- 1) Data gathering of as-is design
 - 2) Design tools for to-be design



BIM4ren reference workflow



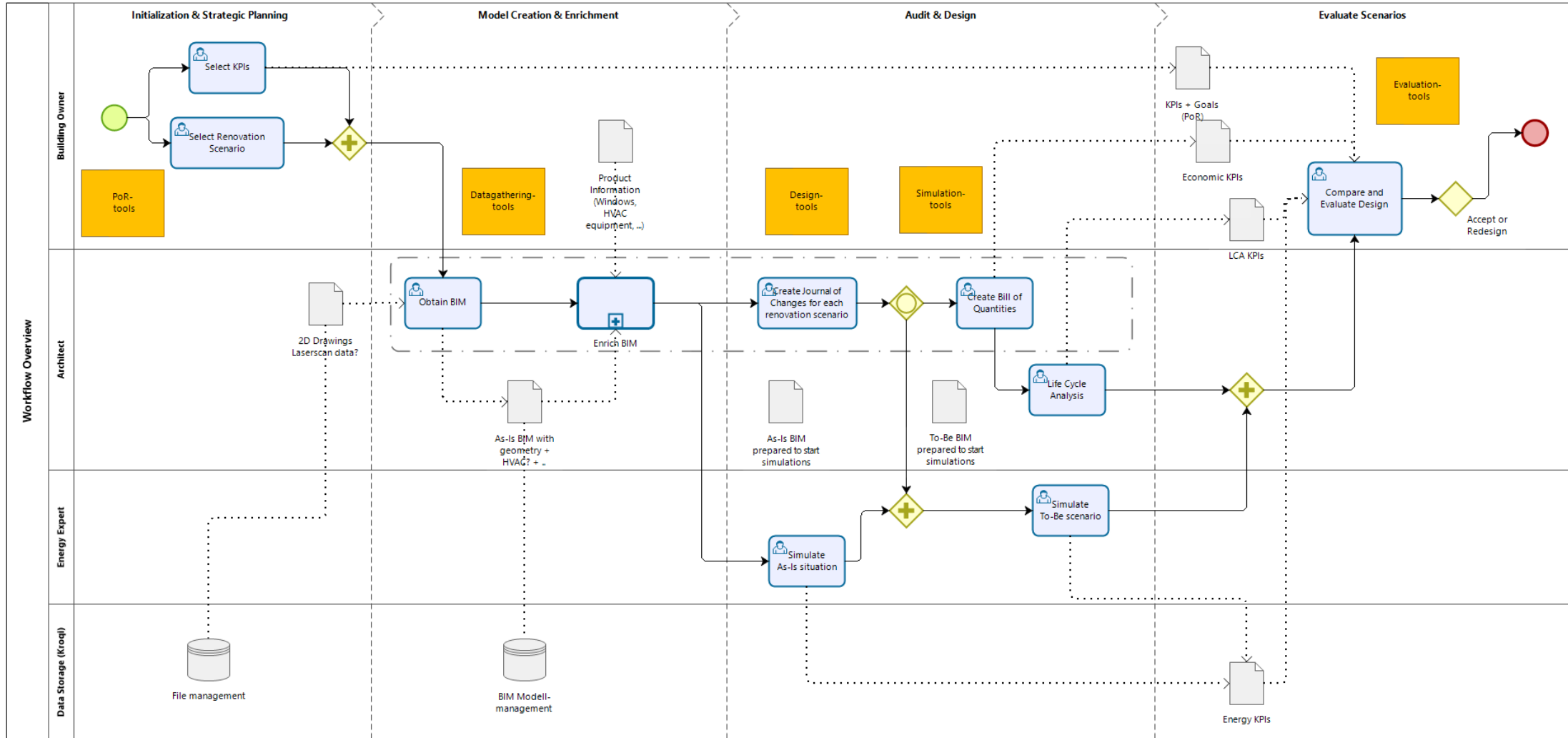
OVERVIEW:

- Modelled in Business Process Modelling Notation (BPMN), mainly for documentation purposes
- Identify main tasks and its dependencies
- Being configurable:
 - including alternatives, e.g. on-site vs. off-site data gathering
 - having generic tasks like building simulation being further specified by its export requirements
- Focus on early phases with:
 - project set-up (Intialization & Strategic Planning)
 - data gathering (Model Creation & Enrichment)
 - design simulation based on design proposals (Audit & Design)
 - design evaluation (Evaluate Scenarios)

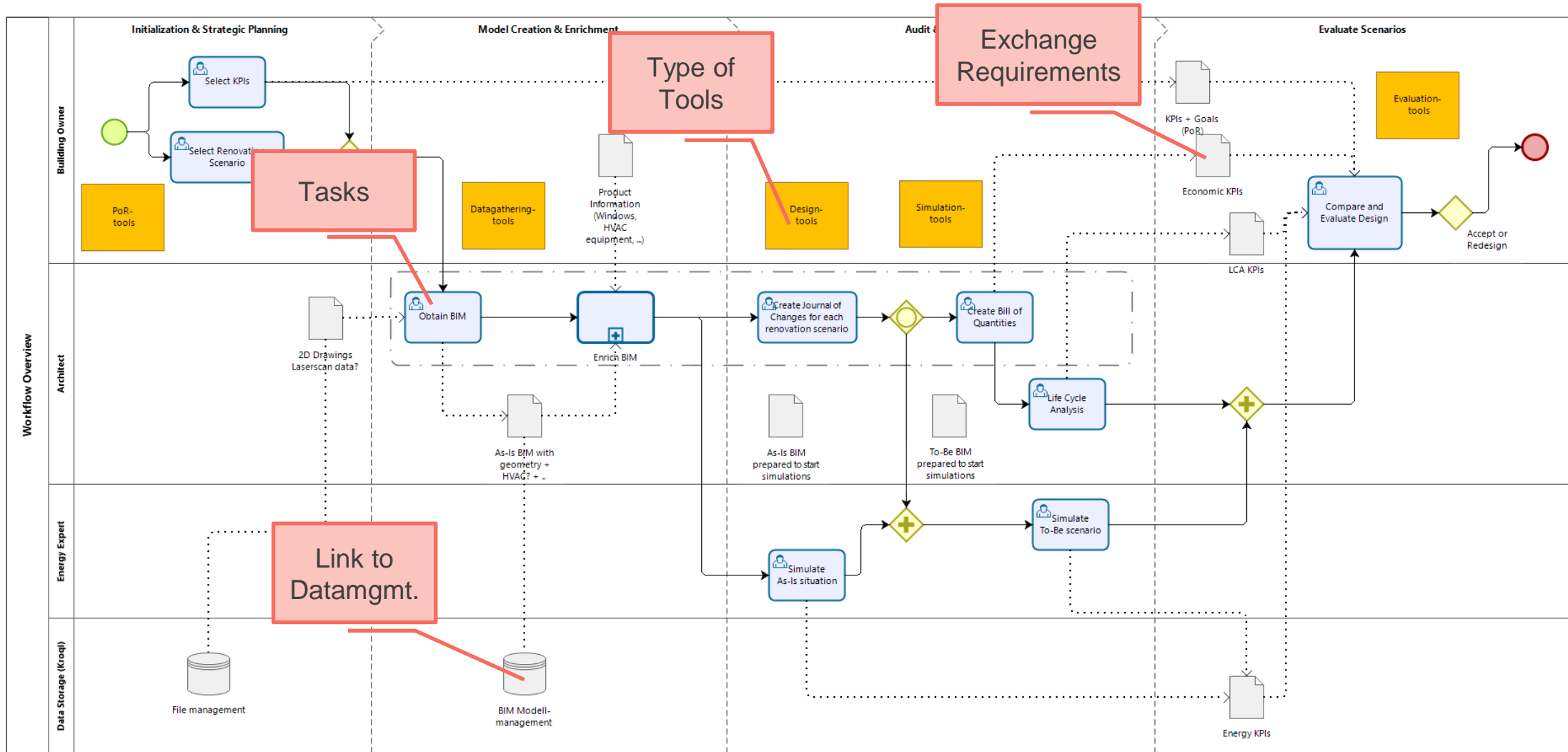


BIM4ren reference workflow is part of the knowledge base and covers various types of renovation.

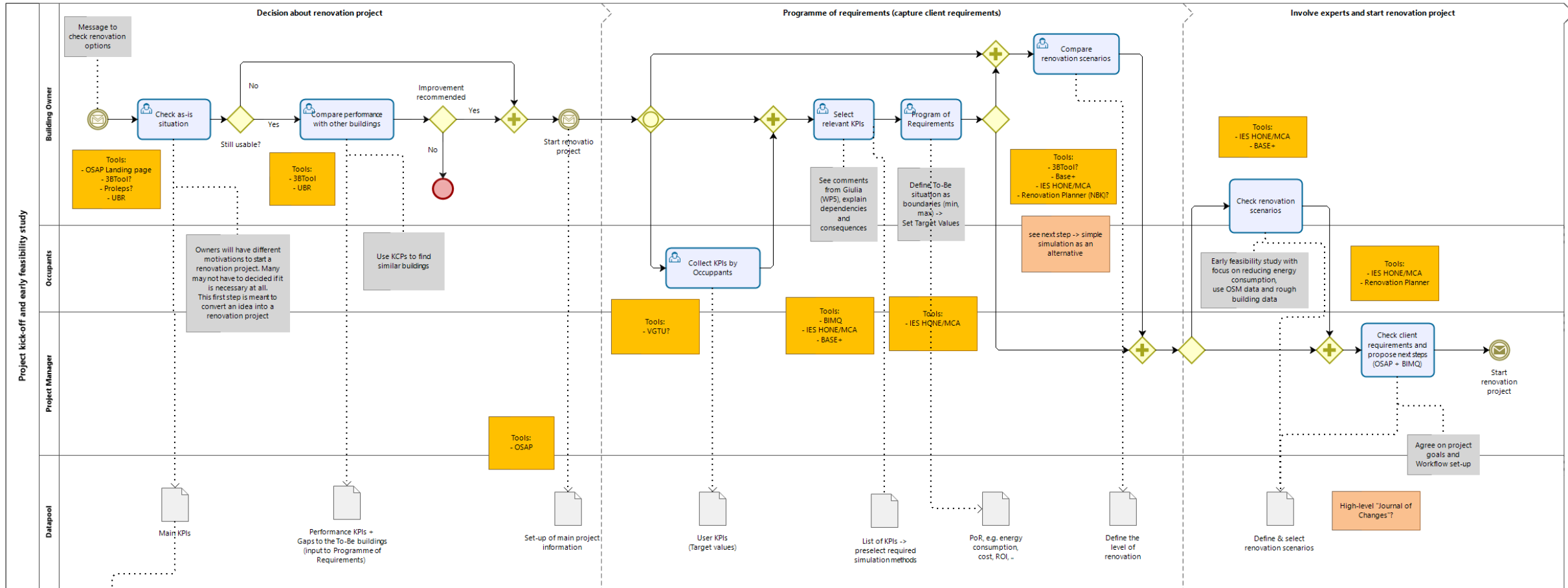
BIM4ren reference workflow - Overview



BIM4ren reference workflow - Overview

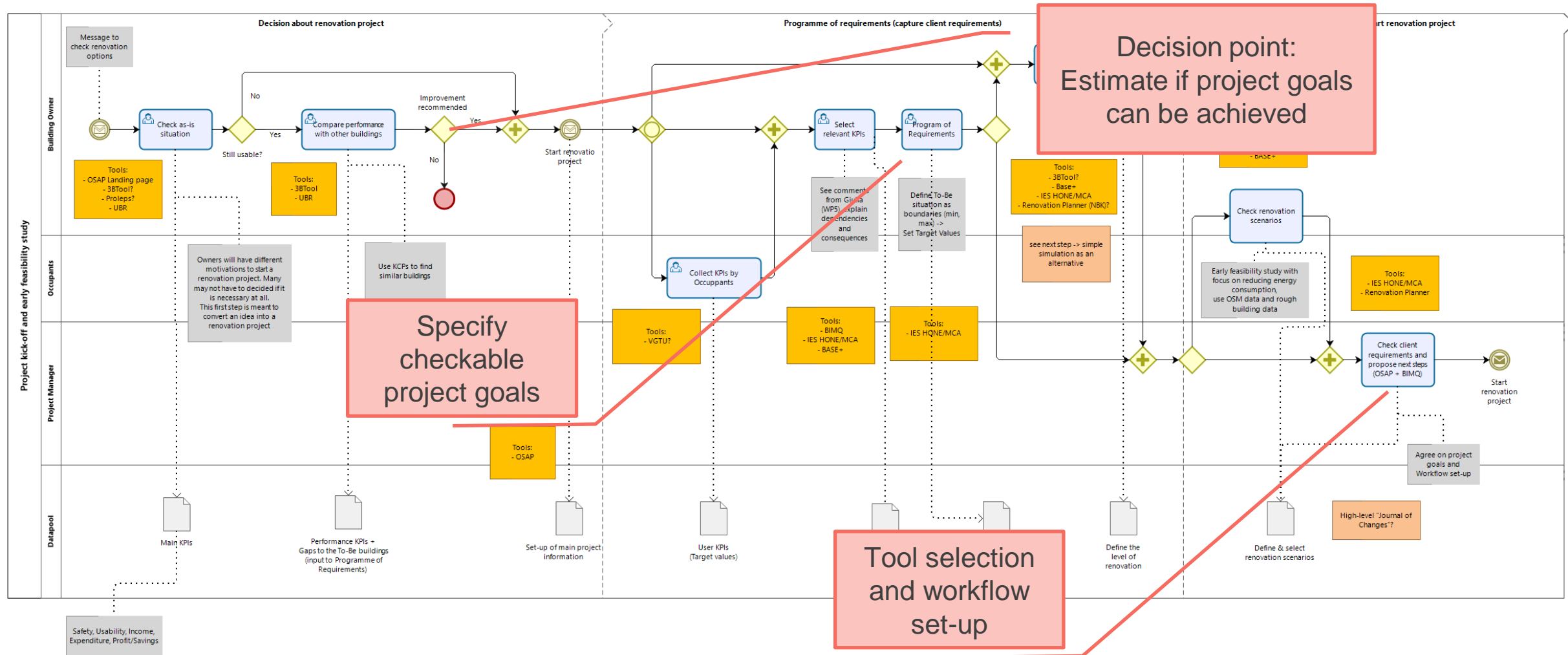


BIM4ren reference workflow – Project set-up

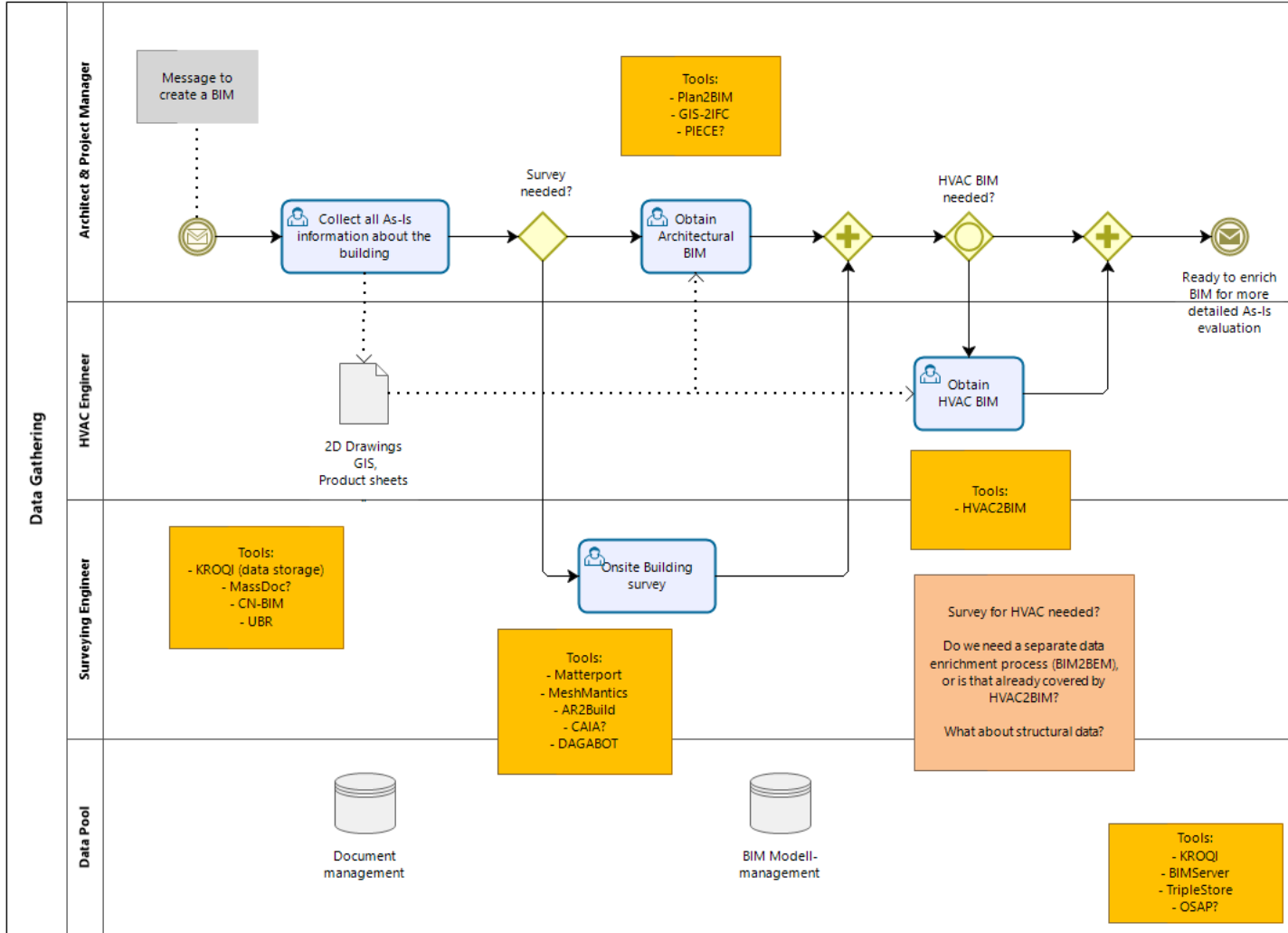


Safety, Usability, Income, Expenditure, Profit/Savings

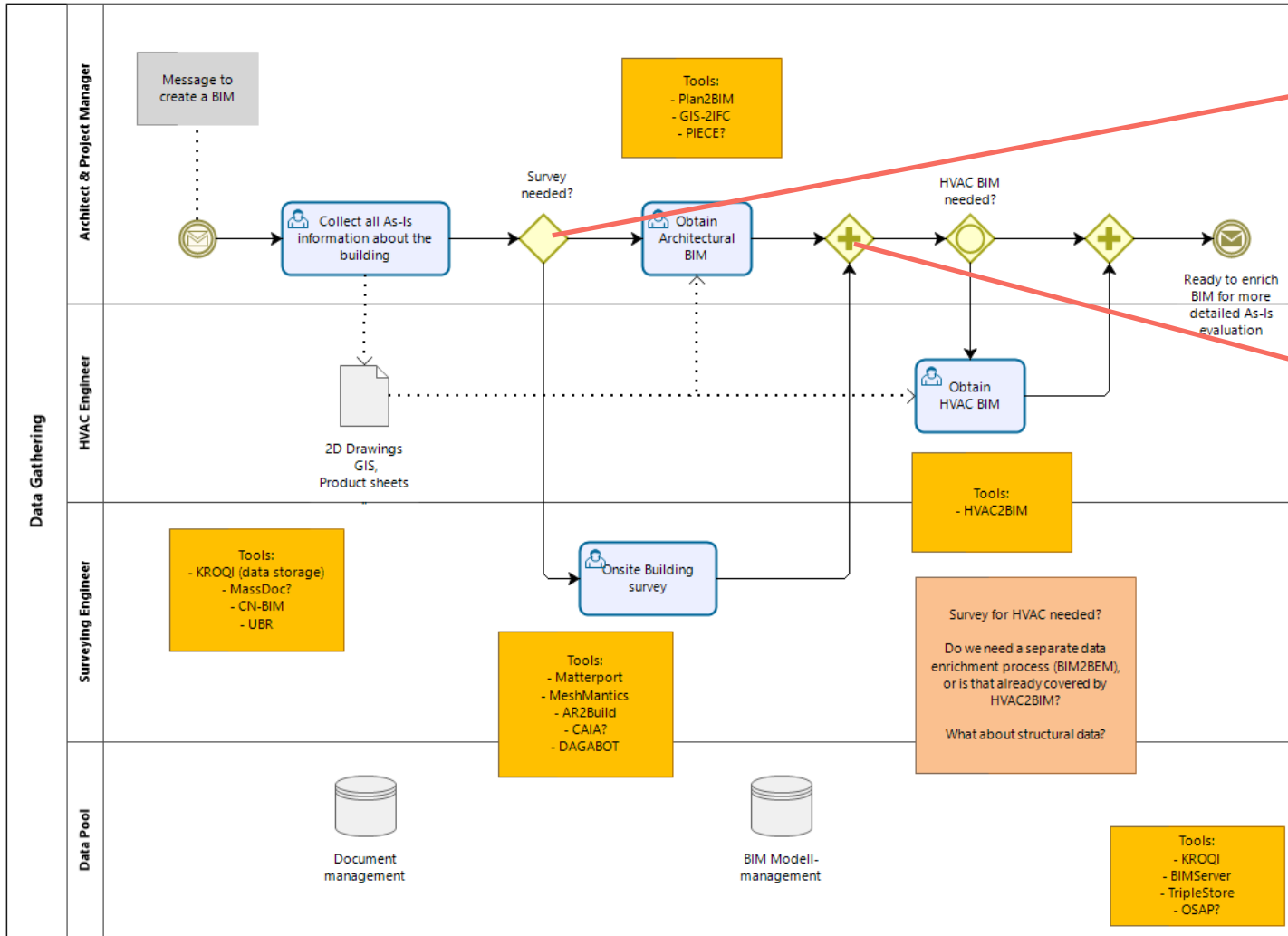
BIM4ren reference workflow – Project set-up



BIM4ren reference workflow - Data Gathering



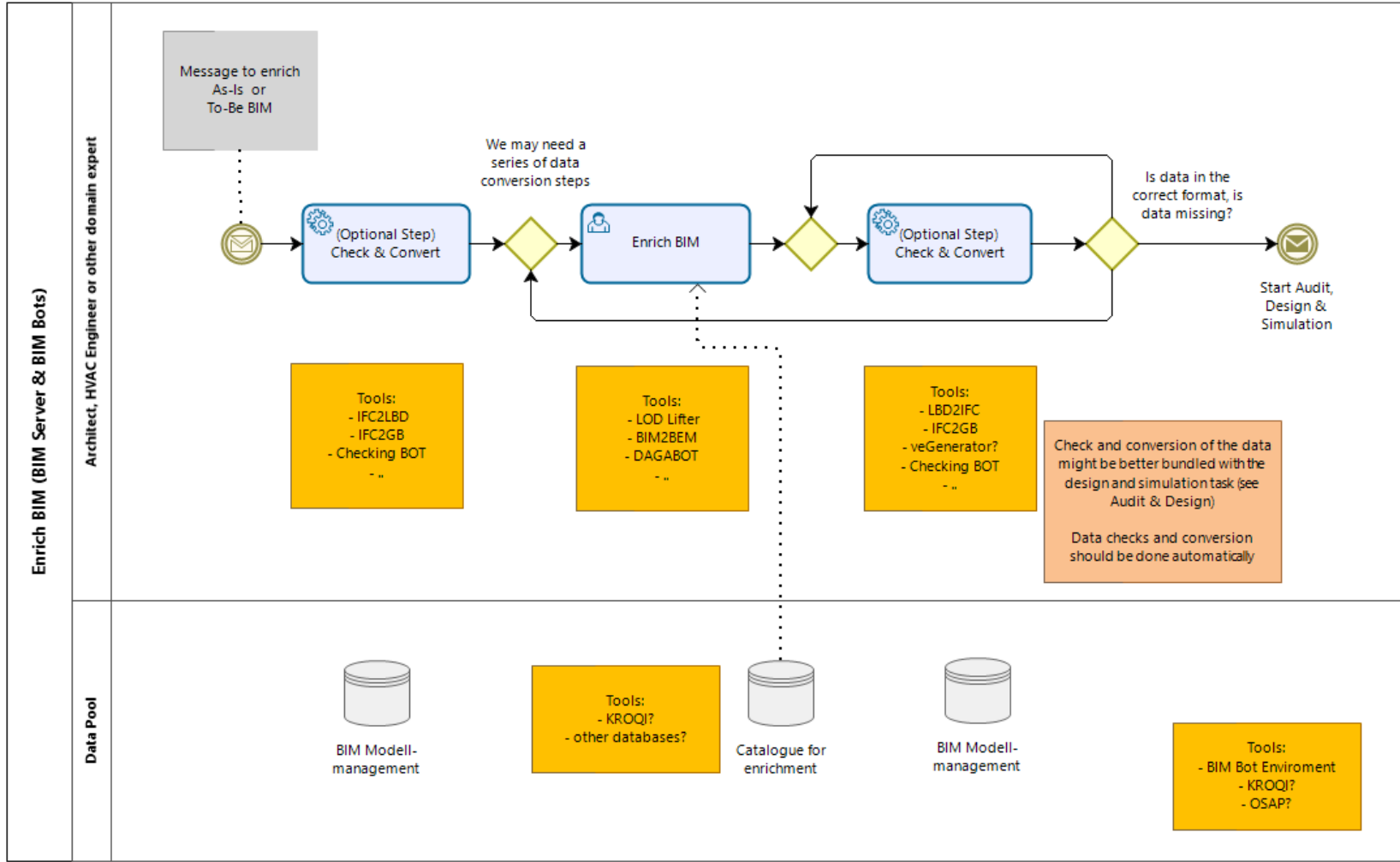
BIM4ren reference workflow - Data Gathering



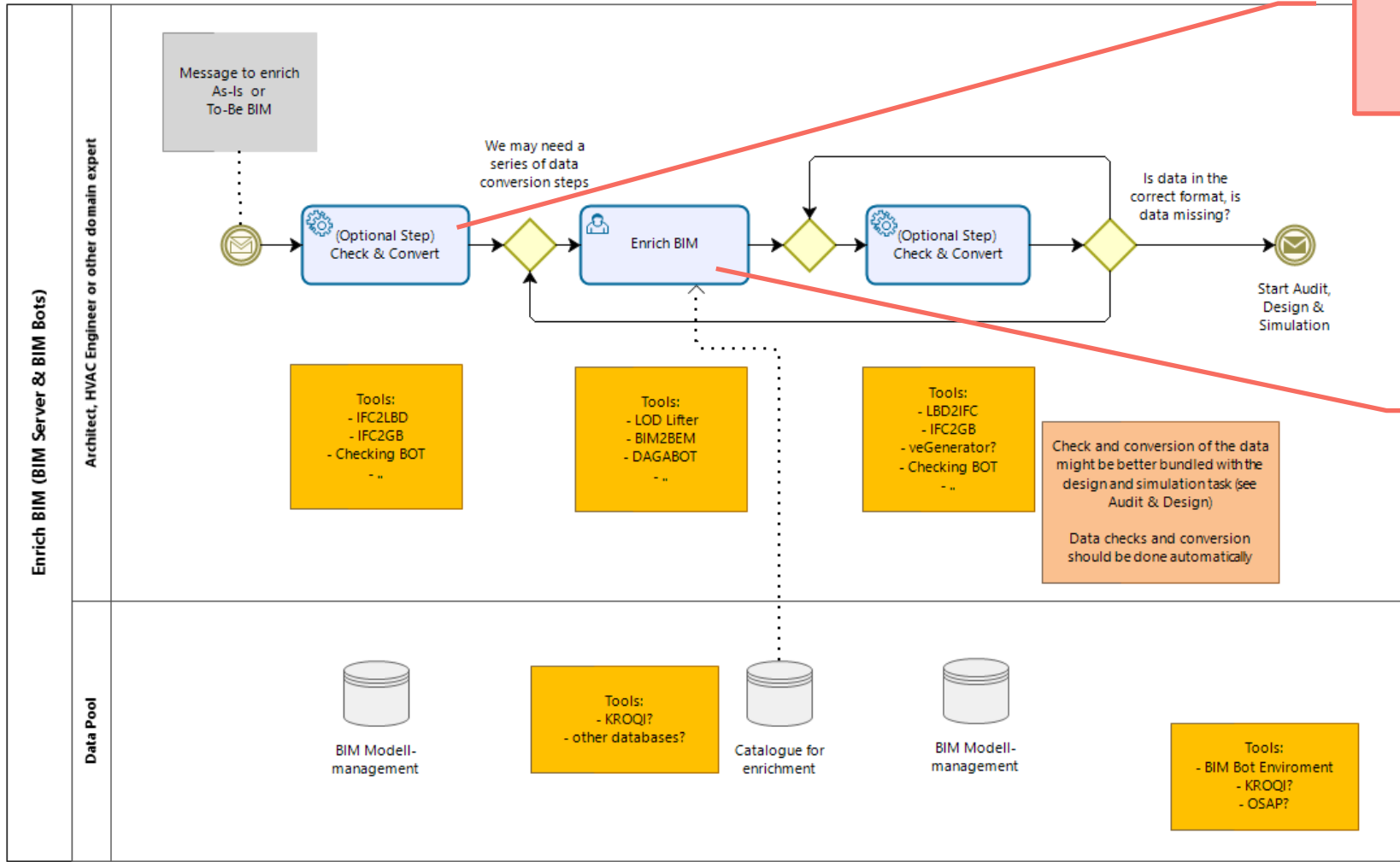
Decision point:
Onsite survey vs. data extraction from drawing

Merge results if data extraction from drawings and survey was used.

BIM4ren reference workflow - Data Enrichment



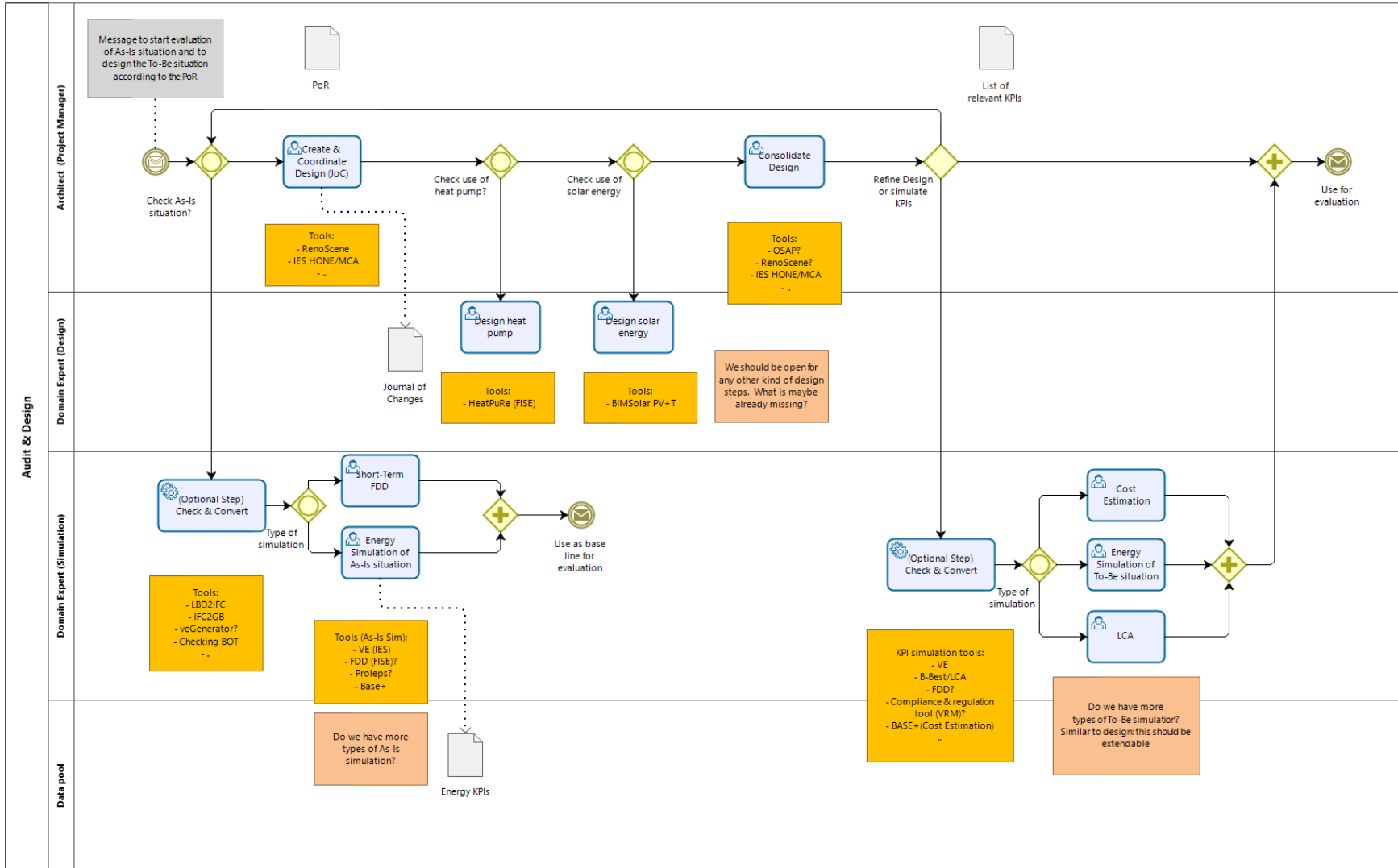
BIM4ren reference workflow - Data Enrichment



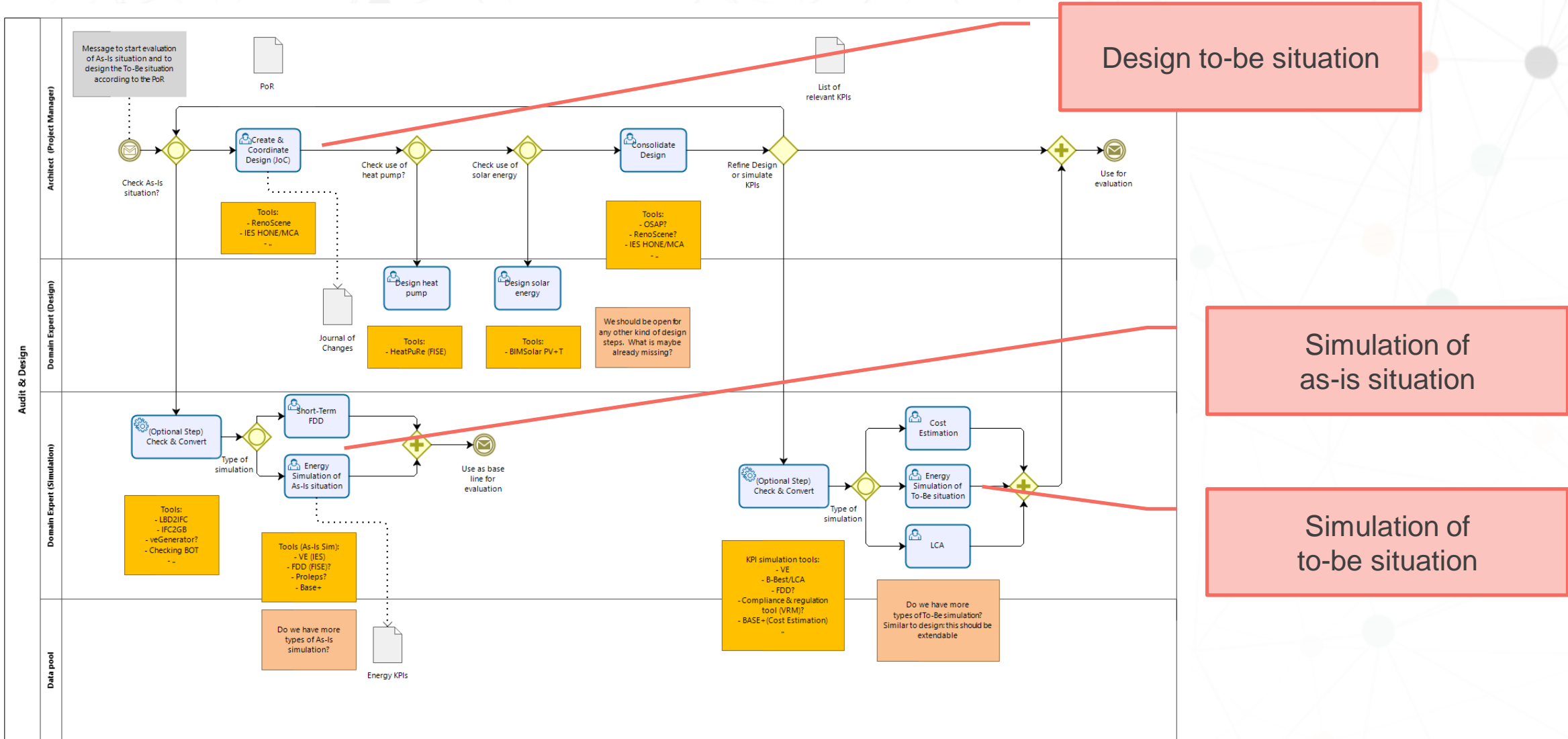
Quality ensurance and data conversion

Add missing information for further simulation

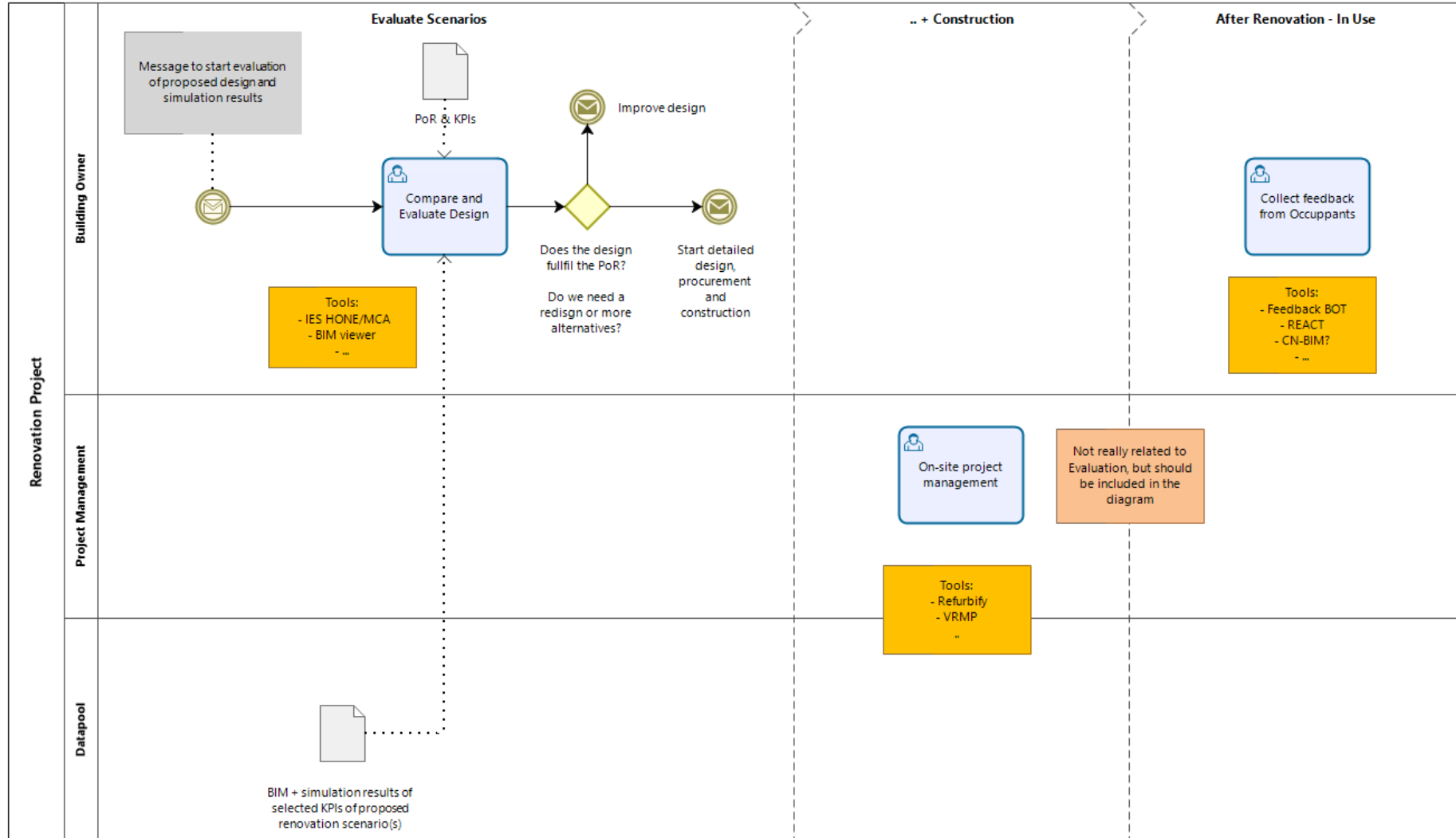
BIM4ren reference workflow - Design and Simulation



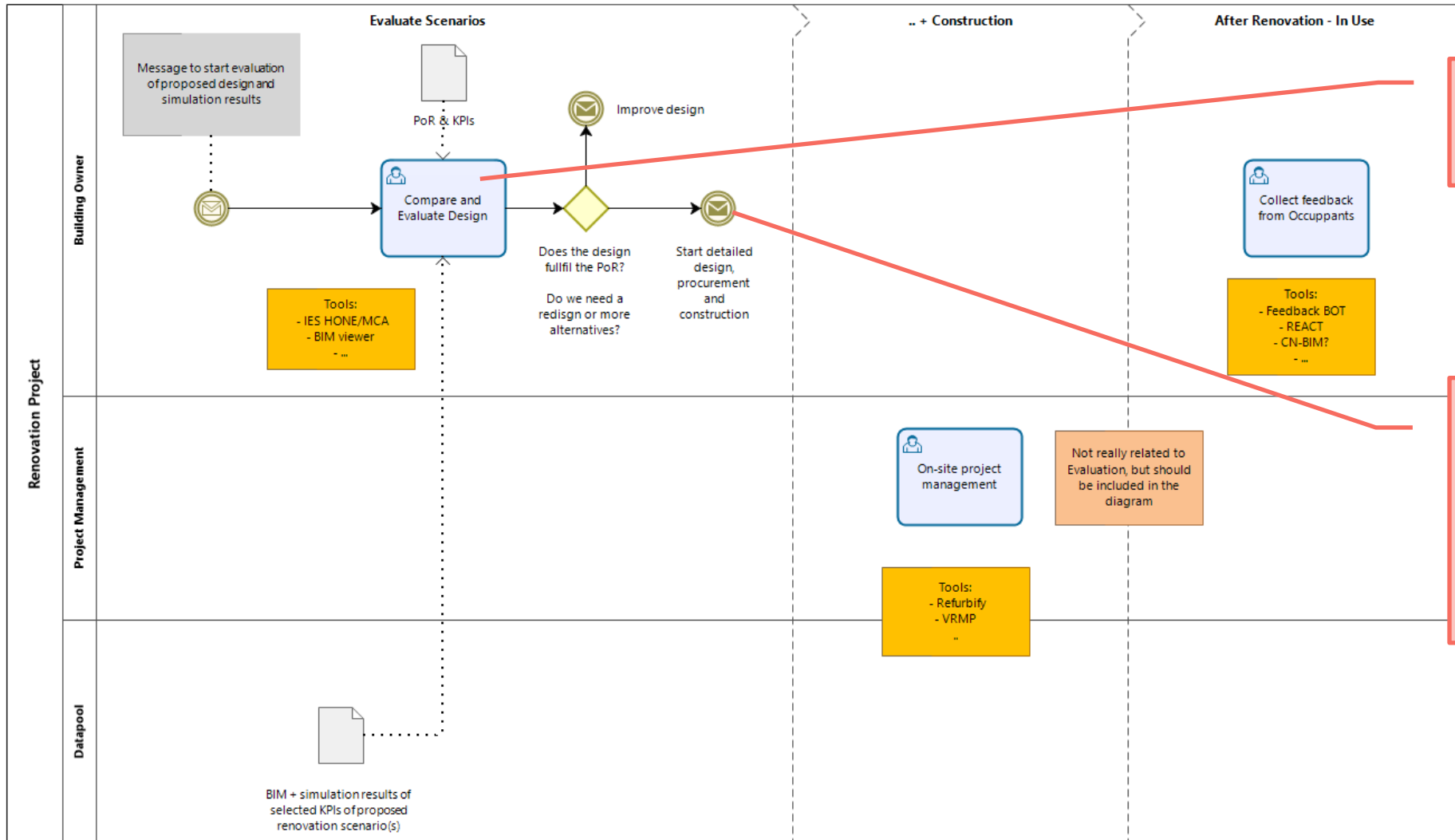
BIM4ren reference workflow - Design and Simulation



BIM4ren reference workflow - Evaluation



BIM4ren reference workflow - Evaluation



Compare as-is with various to-be alternatives

Later phases:


- Detailed design
- procurement
- construction/refurbishment
- hand-over
- in-use

BIM4ren - task tool card



Identify potential tools by task selection


Tools/Tasks	Check as-is situation	Compare performance with other buildings	Collect KPIs by Occupants	Select relevant KPIs	Program of Requirements	Compare renovation scenarios	Check renovation scenarios	Check client requirements and propose next steps	Collect all As-is information about the building	Obtain Architectural BIM	Onsite Building survey	Obtain HVAC BIM	Check & Convert	Enrich BIM	Create & Coordinate Design (CoC)	Short-term FDD	Energy simulation of As-is situation	Design heat pump	Design solar energy	Consolidate design	Cost estimation	Energy simulation of To-be situation	Life Cycle Analysis	Compare and Evaluate Design	Onsite project management	Collect feedback from Occupants
PROLEPS	X																X									
3Btool	X	X																								
CAIA (Context Aware Image Acquisition)																										
UBR?																										
GIS2FC																										
Plan2BIM																										
PIECE																										
MassDoc																										
Short-Term FDD																										
HVAC2BIM																										
REACT																										
AR2Build																										
Matterport																										
MeshMantics																										
BIMsolar PV+T																										
SMART																										
HeatPure																										
VE2018																										
B-BEST																										
IES HONE?																										
MCA Tool																										
Base+																										
Compliance & Regulation Tool																										
LoD Lifter + Catalogue Editor																										
MaestroBot																										
BAR Open Catalogues - (Object standardized open catalogues)																										
Feedback BOT																										
Open BIM services environment (BIM storage, checkers and converters)																										
KROQI																										
BIM2BEM																										
CN-BIM																										
OSAP																										
BIMQ																										
VRMP																										
BIMServer and BIM Bots																										
Refurbify																										
Dagobot??																										
Renovation Planner																										




BEM Expert

VE/IES:


Energy Simulation of AS-IS Situation




BEM, gbXML



BEM, veXML



Energy consumption, Energy costs



Further details for each task tool combination



Identify potential tools by task selection

Tools/Tasks	Check as-is situation	Compare performance with other buildings	Collect KPIs by Occupants	Select relevant KPIs	Program of Requirements	Compare manifests scenarios	Life Cycle Analysis	Compare and Evaluate Design	Onsite project management	Collect feedback from Occupants
PROLEPS	X				X					
3Btool	X	X								
CAIA (Context Aware Image Acquisition)										
UBR?										
GIS2FC										
Plan2BIM										
PIECE										
MassDoc										
Short-Term FDD										
HVAC2BIM										
REACT										
AR2Build										
Matterport										
MeshMantics										
BIMsolar PV+T										
SMART										
HeatPure										
VE2018										
B-BEST										
IES HONE?										
MCA Tool										
Base+										
Compliance & Regulation Tool										
LoD Lifter + Catalogue Editor										
MaestroBot										
BAR Open Catalogues - (Object standardized open catalogues)										
Feedback BOT										
Open BIM services environment (BIM storage, checkers and converters)										
KROQI										
BIM2BEM										
CN-BIM										
OSAP										
BIMQ										
VRMP										
BIMServer and BIM Bots										
Refurbibly										
Dagobot??										
Renovation Planner										

Data requirements:
Input
(high-level categorization)

Data requirements:
Output
(high-level categorization)

VE/IES:
Energy Simulation of AS-IS Situation

BEM, gbXML

BEM, veXML

Energy consumption, Energy costs

Data requirements:
KPI-Output
(detail specification)

BIM4ren - task tool card



Identify potential tools by task selection

Domain and level of expertise

Tools/Tasks	Check as-is situation	Compare performance with other buildings	Collect KPIs by Occupants	Select relevant KPIs	Program of Requirements	Compare renovation scenarios	Check renovation scenarios	Check client requirements and propose next steps	Collect all As-is information about the building	Obtain Architectural BIM	Onsite Building survey	Obtain HVAC BIM	Check & Convert	Enrich BIM	Create & Coordinate Design (B+C)	Short-term FDD	Energy simulation of As-is situation	Design heat pump	Design solar energy	Consolidate design	Cost estimation	Energy simulation of To-be situation	Life Cycle Analysis	Compare and Evaluate Design	Onsite project management	Collect feedback from Occupants	
PROLEPS	X				X												X									2	
3Btool	X	X																									3
CAIA (Context Aware Image Acquisition)																											1
UBR?											X																0
GIS2FC												X															1
Plan2BIM													X														1
PIECE														X													1
MassDoc																											1
Short-Term FDD										X																	1
HVAC2BIM												X															1
REACT																											1
AR2Build													X														1
Matterport														X													1
MeshMantics														X													1
BIMsolar PV+T																											1
SMART																											0
HeatPure																											1
VE2018																											2
B-BEST																											2
IES HONE?																											0
MCA Tool					X	X	X	X	X																		7
Base+							X																				8
Compliance & Regulation Tool																											1
LoD Lifter + Catalogue Editor																								X			1
MaestroBot																											0
BAR Open Catalogues - (Object standardized open catalogues)																											0
Feedback BOT																											1
Open BIM services environment (BIM storage, checkers and converters)																											1
KROQI											X																1
BIM2BEM																									X		1
CN-BIM																											1
OSAP																											1
BIMQ		X																									2
VRMP						X																					2
BIMServer and BIM Bots																									X		2
Refurbly																											3
Dagobot??																											3
Renovation Planner																											3

VE/IES:
Energy Simulation of AS-IS Situation

BEM Expert (Graduation caps icon)

BEM, gbXML (House icons)

BEM, veXML (House icons)

Energy consumption, Energy costs (Lightbulb and coins icons)

Effort/Duration



BIM4ren workflow in pilot projects



Workflow + tools selection for:

- French pilot
- Italian pilot
- Spanish pilot





BIMQ

Knowledge base about renovation processes



This project has received funding from the H2020 programme under Grant Agreement No. 820773

BIMQ - capture data requirements for tasks



OVERVIEW:

- Based on IDM/MVD methodology from buildingSMART
- Focus on definition of Exchange Requirements including the mapping to IFC and other data structures (e.g. gbXML)
- Basic setup for link to process specification (IDM and BPMN diagram):
 - Differentiate between responsibilities (actor roles) and project deliveries (types of BIM models)
 - Specify project phases with all relevant use cases (tasks)
- Specify resources like classes and properties (may splitted into KPI, design parameters, ..)
- Link properties to classes and tasks (input and output)



BIMQ – basic set-up (actor roles)



BIM4REN - Specification of Tools and Workflows

Add Actor Template Import Excel Import/Export

Actor Code +

Actor Code Description

Q Search...

Actor	Code	Description	
BIM Coordinator	-	-	🗑
Building Administration	-	-	🗑
Construction Company	-	-	🗑
Control Desk	-	-	🗑
Cost Controller	-	-	🗑
External Certification	-	-	🗑
Financial (funders ...)	-	-	🗑
Lifecycle Engineer	-	-	🗑
Local Authorities	-	-	🗑
Maintenance	-	-	🗑
Occupants	-	-	🗑
Product Manufacturers	-	-	🗑
Urban Planner	-	-	🗑
Waste Management and Disposal	-	-	🗑
Structural Engineer	02	-	🗑
MEP Engineer	03	-	🗑

BIMQ – basic set-up (phases)



BIM4REN - Specification of Tools and Workflows

Add Phase Template Import Excel Import/Export

Phase Code

Phase Code Description

Phase	Code	Description	
Strategic Definition	Ph01	Phase for establishing the project vision and means to satisfy the client's business or public service requirement, including site selection, planning considerations, e...	<input type="button" value="🗑"/>
Data gathering and survey	Ph02	-	<input type="button" value="🗑"/>
Diagnosis	Ph03	-	<input type="button" value="🗑"/>
Renovation Conceptual Design	Ph04	-	<input type="button" value="🗑"/>
Renovation Technical Project	Ph05	-	<input type="button" value="🗑"/>
Tendering and Construction	Ph06	-	<input type="button" value="🗑"/>
Handover and close out	Ph07	-	<input type="button" value="🗑"/>
In Use and Maintenance	Ph08	Phase in which owner or a designated agent occupies, uses, and manages and maintains a facility, which may also include partial or whole facility renovation, repair...	<input type="button" value="🗑"/>

Showing 1 to 8 of 8 entries

BIMQ – basic set-up (use cases/tasks)



BIM4REN - Specification of Tools and Workflows

Add Use Case **Template Import** Excel Import/Export

Select template from my projects ▾

Identify method

Name & Code
 Name

Merge strategy

Keep existing content
 Replace by imported element

Use Case | Code | Description

Use Case	Code	Description	
3BTool	3B-IN	Input for Benchmarking of Building Performance and Best Practices	
3BTool	3B-OUT	Output for Benchmarking of Building Performance and Best Practices	
Base+	Base+IN	Input for Building Simple Assessment through Energy+	
Base+	Base+OUT	Output for Building Simple Assessment through Energy+	
BIMServer and BIM Bots	BBB-IN	Input for IFctoLBD - Maestro Bot – Model Checker	
BIMServer and BIM Bots	BBB-OUT	Output for IFctoLBD - Maestro Bot – Model Checker	
BIMSolar PV+T	BSolar-IN	Input for Early PVT technical and economic analysis	
BIMSolar PV+T	BSolar-OUT	Output for Early PVT technical and economic analysis	
Compliance & regulation tool	CRT-IN	Input for Compliance checking	
Compliance & regulation tool	CRT-OUT	Output for Compliance checking	
Short-Term FDD	FDD-IN	Input for HVAC degradation assessment through (FDD)	
Short-Term FDD	FDD-OUT	Output for HVAC degradation assessment through (FDD)	
HeatPuRe	HeatPR-IN	Input for Potential Analysis for Installation of HP for Renovation	
HeatPuRe	HeatPR-OUT	Output for Potential Analysis for Installation of HP for Renovation	
IES HONE	HONE-IN	Input for Multicriteria analysis and decision helping tool	
IES HONF	HONF-OUT	Output for Multicriteria analysis and decision helping tool	

BIMQ - specify resources (domains, classes, properties, ..)



BIM4REN - Specification of Tools and Workflows

[Components Table](#)
[Search & Filter](#)
[Mass Assignment](#)
[Template Import](#)
[Excel Import/Export](#)

[Show Columns](#)
[Software](#)
[Interface Format](#)



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Hits per Page



All Component Templates	Code	Description	Type	Unit	Used	BIM4REN	gbXML	IFC 4 Add2
▶ Discipline Models	00	-	Group		⊖	-	-	Discipline Models
▶ Elements	01	-	Group		⊖	-	-	Elements
▶ Properties	02.1	-	Group		⊖	-	-	Properties
▶ BIM4REN KPIs	02.2	-	Group		⊖	-	-	BIM4REN KPIs
▶ DIAGNOSIS	01	-	Group		⊖	-	-	DIAGNOSIS
▶ PROCESS	02	-	Group		⊖	-	-	PROCESS
▶ PERFORMANCE	03	-	Group		⊖	-	-	PERFORMANCE
▶ Energy KPIs	PE1	-	Group		⊕	-	-	BIM4REN_EnergyKPIs
▶ Primary Energy Demand and Consum	PE1.1	The primary energy demand/consumption refers to the energy required to meet the c	Property	Energy	⊕	-	-	#.Primary Energy Demand and Consumption
▶ Energy savings	PE1.2	Decrease of the energy consumption after retrofitting in order to reach the same req	Property	Energy	⊕	-	-	#.Energy savings
▶ Degree of energetic self-supply by R	PE1.3	This parameter is the ratio of locally produced energy from renewable energy sources	Property	Ratio	⊕	-	-	#.Degree of energetic self-supply by RES
▶ Thermal transmittance	PE1.4	Heat transfer through building ´s fabric. It shows how effective the envelope is at tra	Property	Thermal Transmittance	⊕	-	-	#.Thermal transmittance
▶ Economic KPIs	PE2	-	Group		⊕	-	-	Economic KPIs
▶ Investment	PE2.1	It measures the investment over total square meters. It is closely connected with the	Property	Monetary	⊕	-	-	#.Investment
▶ Payback	PE2.2	It measures the time it takes to cover investment costs. Time is measured between t	Property	Time	⊕	-	-	#.Payback
▶ Accessibility to financing	PE2.3	% of the budget financed by public administration.	Property	Ratio	⊕	-	-	#.Accessibility to financing
▶ Sustainability KPIs	PE3	-	Group		⊕	-	-	Sustainability KPIs
▶ Recycled material content	PE3.1	KPI to measure the amount of materials that are obtained from natural, renewable sc	Property	Ratio	⊕	-	-	#.Recycled material content
▶ Carbon footprint	PE3.2	This KPI tracks the amount of greenhouse gas emissions caused by the renovated bui	Property	-	⊕	-	-	#.Carbon footprint
▶ Water consumption	PE3.3	The water consumption KPI may measure the performance of water usage taking intc	Property	-	⊕	-	-	#.Water consumption

BIMQ – basic configuration (link properties to classes)



BIM4REN - Specification of Tools and Workflows

Assignments

► Display



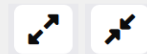
Templates



Q Search

- 00 Discipline Models
- 01 Elements
- 02.1 Properties
- 02.2 BIM4REN KPIs
 - 01 DIAGNOSIS
 - 02 PROCESS
 - 03 PERFORMANCE
 - PE1 Energy KPIs
 - PE1.1 Primary Energy Demand and Consumption
 - PE1.2 Energy savings
 - PE1.3 Degree of energetic self-supply by RES
 - PE1.4 Thermal transmittance
 - PE2 Economic KPIs
 - PE2.1 Investment
 - PE2.2 Payback
 - PE2.3 Accessibility to financing
 - PE3 Sustainability KPIs
 - PE3.1 Recycled material content
 - PE3.2 Carbon footprint
 - PE3.3 Water consumption

Project Requirements



Q Search

- 00 As-Is Model
 - Building
 - PE1 Energy KPIs
 - PE1.1 Primary Energy Demand and Consumption
 - PE1.2 Energy savings
 - PE1.3 Degree of energetic self-supply by RES
 - PE1.4 Thermal transmittance
 - PE2 Economic KPIs
 - PE4 Social KPIs
 - 00 Drawing
 - 11 3BTool
 - 13 Plans2BIM
 - 19 LoDLifter
 - 27 Base+
 - Building
 - PE1 Energy KPIs
 - PE1.1 Primary Energy Demand and Consumption
 - PE1.2 Energy savings
 - PE1.3 Degree of energetic self-supply by RES
 - PE1.4 Thermal transmittance

BIMQ - ER specification (set requirements per task)



BIM4REN - Specification of Tools and Workflows

Requirements Table Search & Filter Mass Assignment Excel Import/Export

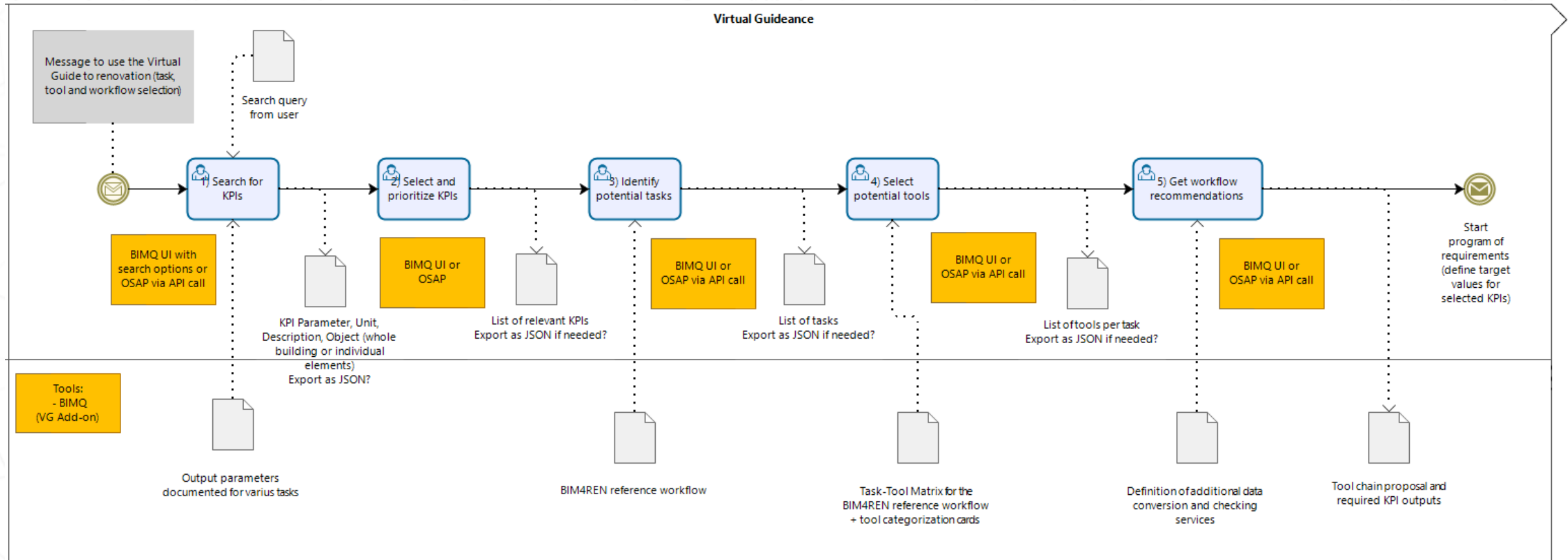
► Show Columns ► Software ► Interface Format ► Milestones and use cases

15 Hits per Page



Base+ (Architect)	Code	Description	Type	Ph02-Base+OUT	Ph02-LoDL-IN	Ph02-LoDL-OUT
✦ Building	-	-	Object	<input checked="" type="checkbox"/>		
✦ Energy KPIs	PE1	-	Group	<input checked="" type="checkbox"/>		
<input checked="" type="checkbox"/> Primary Energy Demand and Consumption	PE1.1	The primary energy demand/consumption refers to the energy required to meet the operation parameters. All energy consumed	Property	<input checked="" type="checkbox"/>	-	-
<input type="checkbox"/> Energy savings	PE1.2	Decrease of the energy consumption after retrofitting in order to reach the same requirements. Energy consumption from the re	Property	<input checked="" type="checkbox"/>	-	-
<input type="checkbox"/> Degree of energetic self-supply by RES	PE1.3	This parameter is the ratio of locally produced energy from renewable energy sources throughout a time period.	Property	-	-	-
<input type="checkbox"/> Thermal transmittance	PE1.4	Heat transfer through building's fabric. It shows how effective the envelope is at transmitting heat between inside and outside.	Property	-	-	-
✦ Economic KPIs	PE2	-	Group	<input checked="" type="checkbox"/>		
<input type="checkbox"/> Investment	PE2.1	It measures the investment over total square meters. It is closely connected with the next KPI that measures the payback perio	Property	-	-	-
<input type="checkbox"/> Payback	PE2.2	It measures the time it takes to cover investment costs. Time is measured between the investment and the time at which saving	Property	<input checked="" type="checkbox"/>	-	-
<input type="checkbox"/> Accessibility to financing	PE2.3	% of the budget financed by public administration.	Property	-	-	-
✦ Sustainability KPIs	PE3	-	Group	<input checked="" type="checkbox"/>		
<input type="checkbox"/> Recycled material content	PE3.1	KPI to measure the amount of materials that are obtained from natural, renewable sources that have been managed and harves	Property	-	-	-
<input type="checkbox"/> Carbon footprint	PE3.2	This KPI tracks the amount of greenhouse gas emissions caused by the renovated building's facilities (scope one). The type of c	Property	-	-	-
<input type="checkbox"/> Water consumption	PE3.3	The water consumption KPI may measure the performance of water usage taking into account annual water consumption and ni	Property	-	-	-
<input type="checkbox"/> Waste generated	PE3.4	The waste generation ratio defines the amount of waste generated during the renovation process.	Property	-	-	-
<input type="checkbox"/> Waste recovery	PE3.5	The waste recovery percentage defines the amount of waste recovered during the renovation process.	Property	-	-	-
<input type="checkbox"/> CO2 emissions	PE3.6	It may provide the measurement of how much carbon dioxide is created and it is closely related to the energy usage of building	Property	<input checked="" type="checkbox"/>	-	-
<input type="checkbox"/> Life cost analysis	PE3.7	It is useful to estimate the overall costs of project alternatives and to select the design that ensures the facility will provide the l	Property	-	-	-
✦ Social KPIs	PE4	-	Group			
<input type="checkbox"/> Indoor Operative Temperature	PE4.1	The average of radiant and dry-bulb air temperature. The setpoints criteria to be specified seasonally.	Property	-	-	-

BIMQ - Knowledge for further guidance and project set-up



BIM4Ren

TRAINING

Thank you for
your attention



This project has received funding from the H2020 programme under Grant Agreement No. 820773

<http://bim4ren.eu/>



[@bim4ren](https://twitter.com/bim4ren)