SEVENTH FRAMEWORK PROGRAMME OF THE EUROPEAN COMMUNITY
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INTELLIGENT SERVICES FOR ENERGY-EFFICIENT DESIGN AND LIFE CYCLE SIMULATION

Deliverable D8.6.1:

Contributions to eeBDM Harmonisation

(initial report)

Responsible Authors:

Romy Guruz, Ken Baumgärtel, Peter Katranuschkov

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Project of the SEVENTH FRAMEWORK PROGRAMME OF THE EUROPEAN COMMUNITY		
Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
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TABLE OF CONTENTS

Executive Summary

Harmonization is one of the basic goals in the European Community. The first step, achieved in July 1968 was the abolition of all tariffs on trade between Member States. Since then, many attempts of standardisation in distinctive fields of expertise have failed or have not been approved by the authorities. Today, the so-called “new approach” targets mandatory EU-wide common standards, which should help to strengthen basic European requirements. The question is how should this refer to our domain of interest?

To enforce the harmonization of energy efficient Building Data Models (eeBDM) we must do more than merely analyse the resources, invite all known and unknown people in related projects and spend some thought about a practical structuring of the research results. We must also think about comparing all analysed requirements and we have to discuss the developed different solutions for related or similar problems. Sustainable standards should be evaluated against a number of clear criteria: well-defined objectives in the projects, target groups, and actions set out in European strategies. This requires a lot of engagement and networking. Many activities are performed already, especially under Mr Segovia’s leadership, but networking and the exchange of experience and knowledge should be also strengthened between the different projects. To work out a baseline for the realisation of such extended goals is part of this initial harmonisation report of the ISES project.

On the basis of these considerations, we decided to use the already existing **eeSemantics** platform. It is structured in three areas:

- ***the WIKI***
- ***the Forum***
- ***the Library***

In this report, each of these areas is analysed and improvement suggestions are outlined. The report will hopefully allow to speed up future eeBDM discussions and to facilitate early steering in the right direction. In a second step (Deliverable D 8.6.2) specific tasks regarding eeBDM harmonization will be further refined and discussed.

The **reported work** is the result of thorough examination of the current content of the eeSemantics platform and mapping of the ISES project goals to possible contributions to that platform. In this regard, the provided figures in the text should be viewed as illustrative conceptual diagrams and not as actual presentation of concrete ISES findings.

1. Introduction to the eeSemantics Platform

The Energy Efficiency Semantics (eeSemantics) Platform is a Collaboration Space with the purpose:

- to provide visibility the on-going RTD projects on ICT4EE in Buildings with a dedicated space to data models,
- to provide visibility to researchers, the who is who, institutions, and persons,
- to create a Repository of Data Models,
- to support the online discussion on formalization of data models
- to provide the collaboration space for the working out of a harmonized data model.

The platform is structured in 8 main categories:

1. ***Welcome page***
   Content: eeBuilding Data Model Tags and Wiki editorial policy;
2. ***Ontology Engineering***
   Content: Overview about Ontology Languages (12) and Ontology Tools (5), and 1 paper about "Semantic technologies and ontology matching for interoperability inside and across buildings";
3. ***eeB Data Model Contexts***
   Content: 1 paper about "Occupancy and Business Modelling" and 1 table "Building Types"; Overview about Climate (All Regions : Europe WMO) and User types (6),
4. ***eeB Data Models***
   Content: BEMS, BIM, eeB Data Model Standards, Energy and Behavioural Modelling and Simulation for ee-Buildings, Home to Grid, Integration Platforms, Lifecycle Energy Management, Semantic Tools in Urban Planning;
5. ***Subsystems***
   Content: IntUBE, eDiana, HYDRA, ENERsip, ISES and SEMANCO project approach;
6. ***Examples and Implementations***
   Content: ENERsip Modeling Ontology, OSGi Open Services Gateway Initiative, SEEDS modeling ontology, Simantics, SUNtool, The IntUBE Energy Information Integration Platform, TNO Open Source BIM Server (IFC Based), VABI UE;
7. ***Tools***
   Content: Connectivity and Related Standards
8. ***Adapt4EE VoCamps***
   Content: Informations about:
   1st Vocamp - Energy Efficiency in Buildings
   2nd VoCamp around Building Information Models (BIM)

A major objective is the achievement of semantic interoperability of energy efficiency ICT Tools for eeBuildings and beyond. To facilitate an incremental investment of consumers in energy management systems, a strong interoperability, close to the plug and play principle, is seen as needed. (Source: https://webgate.ec.europa.eu/fpfis/wikis/display/eeSemantics/Welcome+page)

From this first overview of the eeSemantics platform, the following ISES task can be derived:

ISES TASK 1: Gaps (in particular regarding parts 2-5 and 7) will be identified and a suggestion for restructuring in line with current European approaches will be done. Data models and functionalities of state-of-the-art tools to be used in ISES (results of WP1) will be integrated in parallel.

2. ISES Ontologies

ISES will develop ontologies in the areas of:

- System Management and Information Logistics (Overarching System Ontology)
- Building Information Modelling (OntoBIM),
- Product catalogues (enabling the interlinking of BIM and other relevant supplier eeData).

The public, non-IPR affected ontologies will be available for the scientific community in the eeBDM collaboration space. They will be uploaded in the site Document Library in any of the commonly accepted semantic formalisations together with their documentation or description. In this regard, ISES will make contributions to the eeBDM knowledge base in several sections of the Wiki as indicated in the following sections.

2.1 Overarching System Ontology - System Management and Information Logistics

The overarching system ontology of ISES is an upper ontology which defines basic concepts for the developed domain ontologies OntoBIM and the Product Catalogues. It defines relationships between these domains and top level concepts with general rules and constraints. Figure 1 presents the high level concept of ISES where the system ontology serves as basis for all services and models. The intelligent access controller and system management controls the input and usage of the ontologies. Models can be loaded and ontology individuals of needed model elements can be created on the fly. While using the system ontology the input data can be validated against the defined constraints. This improves model quality and minimizes model errors.

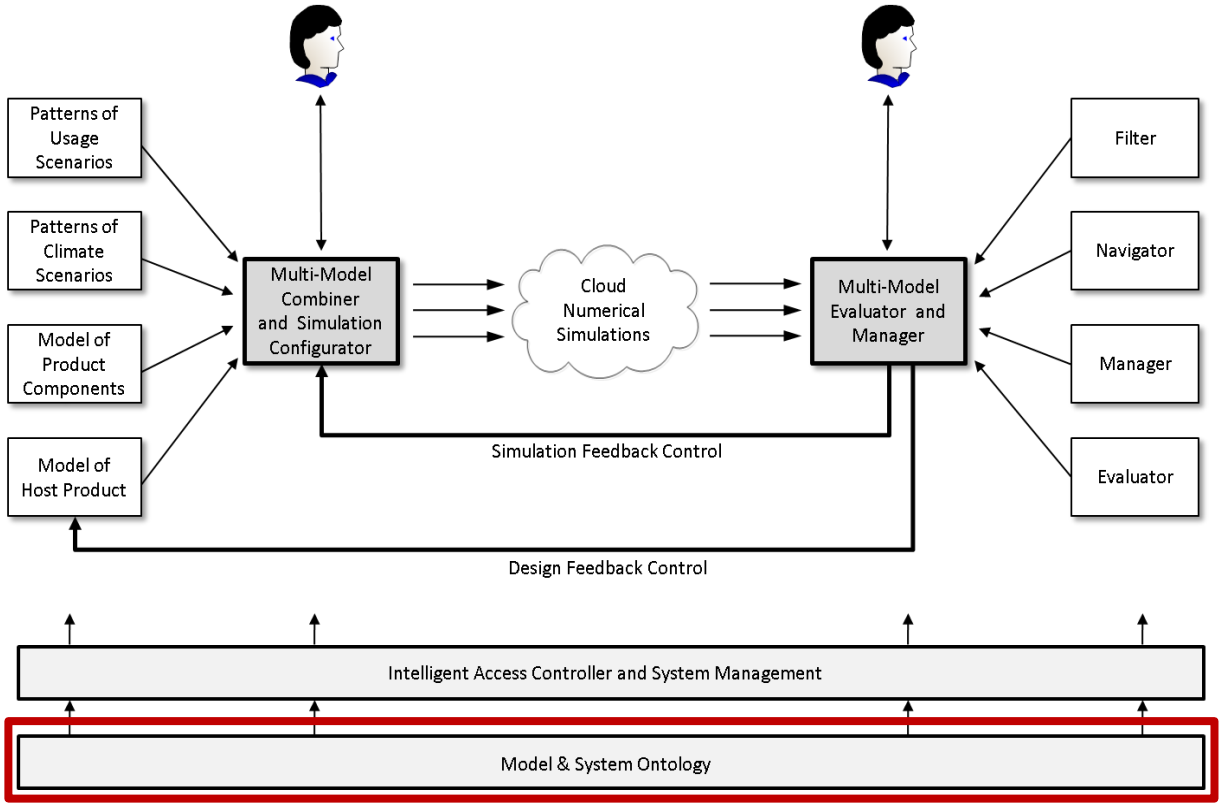

Figure 1: Schematic high level view of ISES and its platform-wide System Ontology concept

The identified ISES task in that regard is as follows:

ISES TASK 2: Overarching System Ontology - Short overview for WIKI.

The concepts will be provided with constraints and rule sets. The whole schema file will be uploaded.

2.2 OntoBIM - Building Information Modelling

The building model in ISES is described via the OntoBIM which is an ontology representation of a subset of IFC entities enhanced by additional energy-related features enabling multi-model interoperability in the targeted building energy performance area. Related energy information regarding IfcBuilding, IfcSpace, IfcBuildingElement, IfcDistributionElement etc. will be used and their relationships with each other will be semantically refined and updated by focusing on energy usage and consumption. The IFC schema will not be extended with new entities but some semantic validation rules will be applied which are necessary for identifying energy consumption. This includes the checking of instances, for example it will be checked if space boundaries relating building elements to spaces are correctly defined. While specifying OntoBIM advantages and gaps of ifcOWL will be analysed and, if necessary, possible improvements suggested.

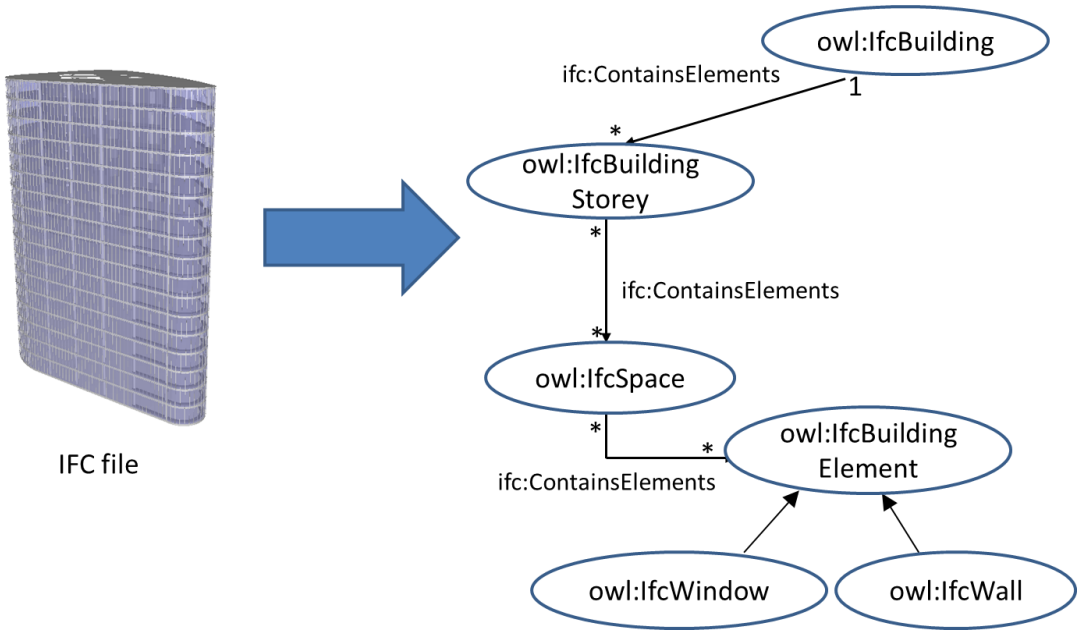

Figure 2: Schematic presentation of the OntoBIM concept

The identified ISES task in that regard is as follows:

ISES TASK 3: OntoBIM - Short overview for WIKI

If ifcOWL is not already used on broader scale, we will provide the definitions of our concepts and properties to the community. Furthermore identified semantic validation constraints which are necessary for energy simulations will be provided.

2.3 Product Catalogues - Interlinking of BIM and other relevant ee data

Beside the building model, ISES will elaborate product catalogues where building and service components are defined and can be related to the elements of OntoBIM. This will be achieved through a product component ontology with predefined elements of ISES end user partners but will be defined as generic as possible so that the ontology can also be used by other suppliers and providers.

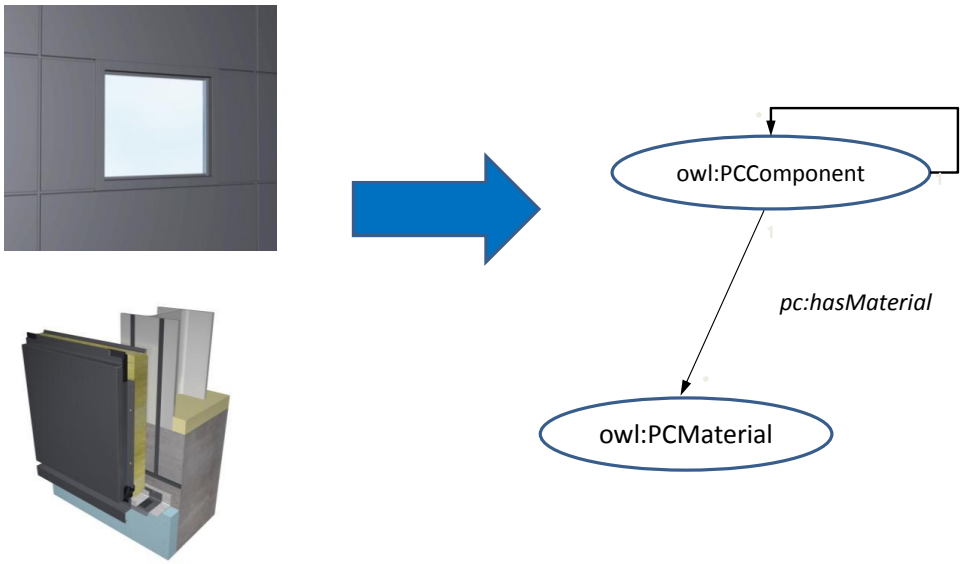

Figure 3: Schematic presentation of the interlinking of BIM and Product Component Data

The identified ISES task in that regard is:

ISES TASK 4: Interlinking of BIM and other relevant eeData - Short overview for WIKI

The product component ontology schema will be provided which can be used to create individuals of specific products. The concepts, properties and examples will be described in the WIKI.

3. Extending the eeBDM Collaboration Space

3.1 Current Version

In order to suggest structural and content improvements, we had first to analyse and categorize the WIKI. The content of the current version includes the sections listed below, whereby colour codes indicate the type of provided content.

< Definitions – Tables – Abstracts – Conference Papers and Proceedings – Other >

1. ***Welcome page***
2. ***Ontology Engineering***
   - Ontology Languages
   - Ontology Tools
   - Semantic technologies and ontology matching for interoperability inside and across buildings
   - W3C Semantic Web
3. ***eeB Data Model Contexts***
   - Occupancy and Business Modelling
   - Building Types
   - Climate
   - User Types
4. ***eeB Data Models***
   - BEMS (view intUBE)
   - BIM (view Adapt4EE)
   - eeB Data Model Standards (view Adapt4EE)
   - Energy and Behavioural Modelling and Simulation for ee-Buildings
   - Home to Grid
   - Integration Platforms (view intUBE)
   - Lifecycle Energy Management (ISES)
   - Semantic Tools in Urban Planning (SEMANCO)
5. ***Subsystems***
   - Displays (view intUBE)
   - Equipment and Appliances (references)
   - Sensor Networks and Cooperating Objects (view eDIANA)
   - Towards a Generic Middleware for Developing Ambient Intelligence Applications (view HYDRA)
   - ENERsip M2M Communications Infrastructure
6. ***Examples and implementations***
   - ENERsip Modeling Ontology
   - OSGi Open Services Gateway Initiative
   - SEEDS modeling ontology
   - Simantics
   - SUNtool
   - The IntUBE Energy Information Integration Platform
   - TNO Open Source BIM Server (IFC Based)
7. ***Tools***
   - Connectivity Standards
   - Related standards
8. ***Adapt4EE VoCamps***
   - 1st VoCamp - Energy Efficiency in Buildings
   - 2nd VoCamp around Building Information Models (BIM)

The result of the content analysis showed that whilst the overall (top level) structure of the eeBDM collaboration space is clearly defined, contributions on the lower (sub)levels are currently not well harmonised and quite varying in type, even at places where such versatility came as a surprise, as e.g. in the sections eeB Data Models and Subsystems.

Apparently, contributors have not always been sure what kind of contribution is expected or spent little time in coordination / harmonisation efforts with colleagues from related projects.

From these observations, the following ISES task is defined:

ISES TASK 5:

Suggest improvements to the WIKI structure using the results of the gap analysis (TASK 1) and the conception for the Library (TASK 10 below). Check the current input and if necessary, revaluate or suggest rearrangement of existing contributions.

3.2 ISES Input for the WIKI

3.2.1 Extension with regard to Related Projects

Currently, a lot of research projects in the area of ***energy efficiency*** are funded by the EC. To understand their individual importance and the positions in this large field of research, and to facilitate collaboration and networking, a special section "Related Projects" is suggested. This new section should feature interconnections between all sub-categories. A generic template has to be developed for the scope and targets of each project and its main topics. This will be helpful for interested users of the WIKI because the main contents and the differences between the projects will be easier to analyse and understand if they are formalized in the same categories/shape. However, the content of this *eeB Semantics Project Template* should be related to the structure of the WIKI, it should not be a general form of project presentation. Furthermore, the template should allow a comparative overview of the related projects, thus providing a further step towards the harmonization of the eeB data models.

At present, some project approaches (mainly in the form of conference papers) are found in the ***Subsystems*** and in the ***Examples*** section. These include: ENERsip, OSGi, SEEDS, Simantics, SUNtool, IntUBE, BIM Server (IFC Based by TNO), VABI UE, eDiana, HYDRA, ENERsip, ISES, HESMOS and SEMANCO. A comprehensive list of current smart buildings projects is provided in the following table.

Compiled List of Current Smart Buildings Projects

Acronym	Project Name	Website
AIM	A novel architecture for modelling, virtualising and managing the energy consumption of household appliances	www.ict-aim.eu
Be Aware	Boosting Energy Awareness	www.energyawareness.eu
BeyWatch	Building EnergY WATCHer	www.beywatch.eu
DEHEMS	Digital Environment Home Energy Management System	www.dehems.eu
E4U	Electronics Enabling Efficient Energy Usage	www.e4efficiency.eu
ENERGY WARDEN	Design and real time energy sourcing decisions in buildings	www.energywarden.net
ENERsip	ENERgy Saving Information Platform for Generation and Consumption Networks	www.enersip-project.eu
EnPROVE	Energy consumption prediction with building usage measurements for software-based decision support	enprove.eu

Acronym	Project Name	Website
EnRiMa	Energy Efficiency and Risk Management in Public Buildings	enrima-project.eu
FIEMSER	Friendly Intelligent Energy Management System for Existing Residential Buildings	www.fiemser.eu
HESMOS	ICT Platform for Holistic Energy Efficiency Simulation and Lifecycle Management Of Public Use Facilities	www.hesmos.eu
ICT4E2B Forum	European stakeholders' forum crossing value and innovation chains to explore needs, challenges and opportunities in further research and integration of ICT systems for Energy Efficiency in Building	www.ict4e2b.eu
IntUBE	Intelligent Use of Buildings' Energy Information	www.intube.eu
ISES	Intelligent Services for Energy-Efficient Design and Lifecycle Simulation	ises.eu-project.info
PEBBLE	Positive-Energy Buildings through better control decisions	www.pebble-fp7.eu
REEB	The European strategic research Roadmap to ICT enabled Energy Efficiency in Buildings and constructions	Reeb fact sheet in Cordis
Revisite	Roadmap Enabling Vision and Strategy for ICT-enabled Energy Efficiency	www.revisite.eu
SEEMPubS	Smart Energy Efficient Middleware for Public Spaces	seempubs.polito.it
SmartCoDe	Smart Control of Demand for Consumption and Supply to enable balanced, energy-positive buildings and neighbourhoods	www.fp7-smartcode.eu
SPORTE2	Intelligent Management System to integrate and control energy generation, consumption and exchange for European Sport and Recreation Buildings	www.sporte2.eu
TIBUCON	Self-Powered Wireless Sensor Network for HVAC System Energy Improvement - Towards Integral Building Connectivity	tibucon.eu
Best Energy	Built Environment Sustainability and Technology in Energy	www.bestenergyproject.eu
HosPilot	Efficient energy efficiency control in hospitals	www.hospilot.eu
LiTES	Led-based intelligent street lighting for energy saving	www.lites-project.eu
Save Energy		www.ict4saveenergy.eu
3-E Houses	Energy Efficient e-Houses	www.3ehouses.eu
e3soho	ICT services for Energy Efficiency in European Social Housing	www.e3soho.eu

Acronym	Project Name	Website
eSESH	Saving Energy in Social Housing with ICT	www.esesh.eu
ICE-WISH	Demonstrating through Intelligent Control (smart metering, wireless technology, cloud computing, and user-oriented display information) Energy and Water wastage reductions in European Social Housing	www.ice-wish.eu
BECA	Balanced European Conservation Approach – ICT services for resource saving in social housing	www.beca-project.eu
EnergyTIC	Technology, Information and Communication services for engaging social housing residents in energy and water efficiency	Factsheet on Europa
SHOWE-IT	Real-life trial in Social Housing, of Water and Energy efficiency ICT services	http://showe-it.eu
SMARTSPACES	Saving Energy in Europe's Public Buildings Using ICT	www.smartspaces.eu
Smart Build	Implementing smart ICT concepts for energy efficiency in public buildings	www.smartbuild.eu
GREEN@Hospital	Web-based enerGy management system foR the optimization of the EnErgy coNsumption in Hospitals	
VERYSchool	Valuable EneRgY for a smart School	www.veryschool.eu

ISES TASK 6:

Suggestion of a generic template with regard to the "eeB Data Models" developed/used in the related projects.
The relevant issues should be part of the eeB Semantics WIKI, to enable linkage within the WIKI and to ensure comparability.

3.2.2 Extension with regard to Energy Models

In the current section of eeB Data Models, under the second level heading (as described in 3.1) a third level is available. The problem is that this third level can only be reached by directly sent (otherwise hidden) links or by expanding the page tree. E.g. by clicking the "BEMS" Link only the intUBE-paper is opened. This part should be made more visible for better understanding of the section. Furthermore, some sub-sections are explained in great detail, whereas some others are empty. To make usable the contents and the knowledge of this section, improvement steps are necessary. A new sub-section of energy models within this section is therefore suggested.

ISES TASK 7:

Energy Models - Detailed suggestion for a new section.

3.2.3 Extension with regard to Energy Use Cases

An extension with regard to ***Energy Use Cases*** is suggested as well. Many projects study different life cycle processes. A pool for the results, structured by themes is seen as very beneficial.

ISES TASK 8:

Energy Use Cases - Detailed suggestion for the pool of use cases.

3.3 Forum and Library for eeB Data Models

3.3.1 User Forum

Expected Users of the Forum are:

- Members of European Commission / Project manager
- Work Package Leaders, Researchers, End Users and other project members.

A task for ISES is seen here as follows:

ISES TASK 9:

Start discussion threads for certain theme groups based on contents of the WIKI.

In this way, broad discussions on a number of further related topics are expected to be fostered.

3.3.2 Planning and managing (idea) of the Library

At present, numerous journal and conference papers are stored in the WIKI. The structuring of these contributions is not optimal and the underlying data volume is huge. A new approach is therefore suggested. It should provide for concise informative description of each contribution in the WIKI, whereas the full paper versions should be stored in the Library. Furthermore, on the project web sites a lot of information and a number of public reports (and/or summaries) are available. All this accumulated knowledge should be stored in the "energy-efficiency" library, thus enabling the possibility for collecting and future use of BIG DATA about eeB.

ISES TASK 10:

Propose a sustainable, low maintenance conception for the Library.

4. Tasks and Workplan for ISES eeB Data Model Harmonisation

The following table synthesises the tasks identified in the preceding chapter and specifies shortly the goals for the upcoming phase (month 18). In the next edition of the report the achieved results will be reported, eventual further refinements will be suggested and the planning for the final phase (month 36) will be laid out.

TASKS Defined in this Deliverable D8.6.1 Month 12	**GOALS** until Month 18 **Intermediate Report D8.6.2**
TASK 1: Gap Analysis. Data models and functionalities of state-of-the-art tools to be used in ISES.	→ Result: redesigned structure with linking concept
TASK 2: Overarching system ontology - Short overview for WIKI.	Contribution in WIKI
TASK 3: OntoBIM - Short overview for WIKI.	Contribution in WIKI
TASK 4: Interlinking of BIM and other relevant eeData - Short overview for WIKI.	Contribution in WIKI
TASK 5: Suggestion of improvements to the WIKI structure using the results of the gap analysis (TASK 1) and the conception for the Library (TASK 10).	→ Result: Redesigned structure with linking concept (further detailing of the result from TASK 1)
TASK 6: Suggestion of a generic template with regard to the "eeB Data Models" developed/used in the related projects. The relevant issues should be part of the eeB Semantics WIKI, to enable linkage within the WIKI and to ensure comparability.	→ Result: Template and project section layout
TASK 7: Energy Models - Detailed suggestion for new section.	→ Result: Concept for new section "Energy Models"
TASK 8: Energy Use Cases - Detailed suggestion for the pool of use cases.	→ Result: Concept for new pool "Energy Use Cases"
TASK 9: Start discussion threads for certain theme groups based on contents of the WIKI.	→ Result: Discussion points for the forum
TASK 10: Propose a sustainable, low maintenance conception for the Library.	→ Result: Concept for the Library

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