SEVENTH FRAMEWORK PROGRAMME OF THE EUROPEAN COMMUNITY
(EC GRANT AGREEMENT N° 26088)

# ICT PLATFORM FOR HOLISTIC ENERGY EFFICIENCY SIMULATION AND LIFECYCLE MANAGEMENT OF PUBLIC USE FACILITIES

## Deliverable D10.3.1 (revised)

## Intermediate Public Workshop
## "BIM Based Design and Layout of Energy-Efficient Buildings"

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Obermeyer Planen + Beraten GmbH (OPB) / BAM Deutschland AG (BAM-DE)

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| Project of SEVENTH FRAMEWORK PROGRAMME OF THE EUROPEAN COMMUNITY | | |
|---|---|---|
| **Dissemination Level** | | |
| **PU** | Public | **X** |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | |

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# Executive summary

The **objective** of the First Public Workshop of HESMOS was to validate the results achieved so far by an external audience and to receive feedback and/or raised critical problems.

This **Deliverable D10.3.1** provides an overview of the performed workshop. The agenda, the participants and the general idea are presented. Furthermore, the prepared questionnaire is validated and the main discussion points from the workshop are outlined. In the conclusions, the further objectives from the workshop results are formulated.

The work in **task T10.4** "Project Workshops" of WP10 was set up to bring together interested companies from the building construction, the ICT and the energy sectors, providing them with active insight to the project results and enabling synergies and cross-fertilisation of ideas as well as creation of network effects.

The report of the current results of that work iss structured in the following **four chapters**.

**Chapter 1** presents the **AGENDA** of the workshop.

**Chapter 2** lists the **PARTICIPANTS** and their roles.

**Chapter 3** gives an overview of the prepared **QUESTIONNAIRE**.

**Chapter 4** provides **anevaluation of the questionnaire** and gives an overview of the main **discussion points**.

The following partners contributed task 10.3.1 work in accordance with their knowledge and expertise:

- **OPB** was the main organiser and host of the workshop.
- **BAM** contributed its knowledge for preparing the questionnaire.
- **All partners** were active as presenters and participants.

# 1. Public HESMOS Workshop

The first public workshop of the EU research project Holistic Energy Efficiency Simulation and Lifecycle Management Of Public Use FacilitieS (HESMOS) was carried out in Munich with an audience of practitioners from various companies (designers, facility managers, public administration, and academia). The purpose of this workshop was to present the HESMOS developments and to get feedback from the audience through discussions as well as a questionnaire which is really important for further developments regarding BIM, simulations and monitoring.

## 1.1 Participants

The event was followed by 15 prationers from different end-user groups which represented their requirements to the HESMOS Integrated Virtual Energy Laboratory (IVEL).

- Architects
- Energy Engineers
- Sustainability Consultants
- Facility Managers

| Name | | Institute/Company | Role |
|---|---|---|---|
| Thomas | Liebich | AEC3 Deutschland GmbH | HESMOS Member |
| Bastian | Bort | BAM Deutschland AG, Stuttgart | HESMOS Member |
| Marie-Christine | Geißler | BAM Deutschland AG, Stuttgart | HESMOS Member |
| Michael | Braun | BAM Immobiliendienstleistungen GmbH | End User, Facility Management |
| Andreas | Buchholz | Deutsche Gesellschaft für Nachhaltiges Bauen | End User, Sustainability Consultancy |
| Medin | Verem | Hochschule München | End User, Lecturer, Architect, Energy Advisor |
| Thomas | Hoinka | HOINKA GmbH | End User, Sustainability Consultant |
| Andreas | Colli | INOVIS Ingenieure | End User, Energy Design, Simulations, HVAC-Design |
| Ken | Baumgärtel | Institut für Bauinformatik, TU Dresden | HESMOS Member |
| Romy | Guruz | Institut für Bauinformatik, TU Dresden | HESMOS Member |
| Peter | Katranuschkov | Institut für Bauinformatik, TU Dresden | HESMOS Member |
| Raimar J. | Scherer | Institut für Bauinformatik, TU Dresden | HESMOS Member |
| John | Grunewald | Institut für Bauklimatik, TU Dresden | HESMOS Member |

| | | | |
|---|---|---|---|
| Andreas | Nicolai | Institut für Bauklimatik, TU Dresden | HESMOS Member |
| Joachim | Lepper | J. L. Effiziente Gebäude GmbH | End User, Architect & Energy Consultant |
| Tobias | Mansperger | LAP, Leonhardt Andrä und Partner, Dresden | ISES Member |
| Tobias | Maile | Maile Consulting | End User, Consultant, Berkely Lab |
| Rasso | Steinmann | Nemetschek Allplan Systems GmbH | HESMOS Member |
| Raimund | Zellner | Nemetschek Allplan Systems GmbH | HESMOS Member |
| Robert | Balder | OBERMEYER Planen + Beraten | HESMOS Member |
| Roman | Burhenne | OBERMEYER Planen + Beraten | End User, Institute for building- and energy efficiency, energy - design, simulations, HVAC design |
| Martin | Egger | OBERMEYER Planen + Beraten | HESMOS Member |
| Friedrich | Jonas | OBERMEYER Planen + Beraten | HESMOS Member |
| Burkhard | Junker | OBERMEYER Planen + Beraten | End User, managing director |
| Günther | Liersch | OBERMEYER Planen + Beraten | End User, head of institute for building- and energy efficiency, energy - design, simulations, HVAC design |
| Francisco | Forns-Samso | Granlund Oy | HESMOS Member |
| Robert | Klinc | University of Ljubljana | ISES Member |
| Burkhard | Hensel | Technische Informationssysteme, TU Dresden | HESMOS Member |
| Miha | Kavcic | TRIMO, Ljubljana | ISES Member |
| Ruth | David | Ebert Ingenieure | End User, Energy consultant |
| Magdalena | Zort | Conject AG | End User, Consultant plan management & FM |

## 1.2 Agenda

(as distributed to all participants)

# BIM Based Design and Layout of Energy-Efficient Buildings

## HESMOS Workshop

Integrated Virtual Energy Laboratory

26. October 2012

OBERMEYER PLANEN + BERATEN, Hansastraße 40, Munich

### Introduction

| | |
|---|---|
| **09:00 - 09:15** | Registration & Coffee |
| **09:15 - 10:00** | Welcome, Workshop Overview & Introduction of the Participants<br>Dipl.-Ing. (Arch.) Friedrich Jonas<br>Obermeyer Planen + Beraten, Munich<br>Prof. Dr.-Ing. Raimar J. Scherer<br>Project Coordinator HESMOS,<br>Head, Institut für Bauinformatik,<br>Technische Universität Dresden |

## Virtual Energy Lab (Moderation Prof. R. J. Scherer)

**10:00 - 10:15** Building Energy Management in the Entire Building Life Cycle
Dipl.-Ing. (Arch.) Bastian Bort MBA, BAM Deutschland AG, Stuttgart

**10:15 - 10:45** HESMOS Platform

Overall Concept, Technical Infrastructure, Modules, Services and Tools
Dr.-Ing. Peter Katranuschkov, Institut für Bauinformatik, TU Dresden

Use and Benefits of BIM for the Energy Management
Dr.-Ing. Thomas Liebich AEC3 & buildingSMART e.V., Munich

nD Navigator – Goals, Concepts and Software Design
Dipl.-Ing. Raimund Zellner, Nemetschek, Munich

**10:45 - 11:15** COFFEE BREAK

## Building Energy Simulation (Moderation Prof. J. Grunewald)

**11:15- 11:45** Building Energy Simulation: State of the Art
and New Developments in HESMOS
Prof. J. Grunewald, Institut für Bauklimatik, TU Dresden

**11:45 - 12:00** Simulation Tools in HESMOS
(demonstration of the implemented energy-related processes)
Dr. Andreas Nicolai, Institut für Bauklimatik, TU Dresden

**12:00 - 13.00** LUNCH

 

## Energy Simulations in the Design Phase (Moderation Prof. Grunewald / F. Jonas)

**13:00 - 13:45** Preliminary Design Phase: Workflow, Input Parameters and Templates, Simulation, Post-Processing
(Live Demonstration)
Prof. John Grunewald / Jens Kaiser, Institut für Bauklimatik, TU Dresden
Ken Baumgärtel, Institut für Bauinformatik, TU Dresden
Raimund Zellner / Timo Paulik, Nemetschek

**13:45 - 14:00** Commissioning Phase: Use of Available Data from BIM, Simulation Updates
Prof. John Grunewald / Jens Kaiser, Institut für Bauklimatik, TU Dresden

**14:00 - 14:30** COFFEE BREAK

## Energy Related Monitoring & Facility Management (Moderation Prof. Grunewald / F. Jonas)

**14:30 - 15:00** Operational Phase: Building Energy Monitoring,
Evaluation of Measurement Data and Analysis of Energy Performance
(Live Demonstration)
B. Hensel, Institut für technische Informationssysteme, TU Dresden
Marie-Christine Geißler, BAM Deutschland AG, Stuttgart
Raimund Zellner / Timo Paulik, Nemetschek

**15:00 - 15:30** Energy Optimisation in the Operational Phase,
Energy-Aware Facility Management
(Live Demonstration)
Francisco Forns-Samso, Granlund, Finland

## Invited Guest Presentations

**15:30 - 16.00** 2 x 15 min. presentations (to be announced at the workshop)

## Summary, Outlook and Discussions

**16:00 - 16.20** HESMOS – Further Developments in the Third Project Year,
Enhancements from the more recent EU Project ISES
Prof. R. J. Scherer, Institut für Bauinformatik, TU Dresden

**16:20 - 17.00** Open Discussion:
Practice-Relevant Modelling, Simulation and Monitoring, eeBIM-Roadmap

**ca. 17:00** **END**

## Software Demonstrators

- ALLPLAN BIM Export for Energy Simulations – Nemetschek, Munich, Germany
- HESMOS nD Navigator – Nemetschek, Bratislava, Slovakia
- HESMOS Components - Energy Solver (NANDRAD, THERAKLES) – TU Dresden, Germany
- HESMOS Components - FM & monitoring tools (WebRoomex, RYHTI Metrix, RIUSKA) – Granlund, Finland
- HESMOS Services for the virtual Energy Lab – Nemetschek, Slovakia & TU Dresden, Germany
- Multi-Model-Filtering Framework – TU Dresden, Germany

## HESMOS Portfolio

**European FP7 Project**

**Duration**: 3 years (09/2010 – 08/2013)

**Funding**: 2,7 M€

**Partners**:

- TU Dresden, Germany (Coordinator)
- Nemetschek Slovensko S.R.O., Slovakia
- Granlund OY, Finland
- Royal BAM Group, The Netherlands
- Obermeyer Planen + Beraten GmbH, Germany
- AEC3 Ltd., UK

*Pilot project: Professional School, Pforzheim, Germany*
*PPP Project, BAM Deutschland AG*

HESMOS project team organised the first public workshop in a multi-facetted way, starting with short introduction presentations and proceeding with inter-active software demonstrators.

**Virtual Energy Laboratory & energy simulations (10:00 a.m. -12:00 a.m.)**

The workshop was introduced from end-user point of view by BAM focusing on PPP processes, complex interoperability of involved project partners and the benefits of implementing the HESMOS IVEL. After this end-user oriented presentation, the concept of the HESMOS platform was introduced with minimum technical details, so it is really easy to understand for the end user, but he/she also gets background information, e.g. how necessary data for energy analysis such as climate data, user data and sensor data is linked to the geometry model (multi-model concept, energy-enhanced Building Information Model). Because the audience was really interested in energy simulation capabilities, TUD gave an overview of State of the Art building energy simulations and new developments in HESMOS.

After the break, HESMOS project team wanted to address different disciplines by live demonstration of the IVEL for the identified use case scenarios over the whole life cycle.

**Energy simulations in the design phase (1 p.m.-2 p.m.)**

For design use case the workflow for model-based energy simulation was introduced necessary input parameters were identified and the post-processing regarding the energy-related Key Performance Indicators discussed with the audience.

**Energy-related monitoring & facility management (2:30 p.m. – 3:30 p.m.)**

A short overview of the updating of Building Information Models as well as calibrating these models for simulation, bridge to the operational scenario where the operational team discussed the method of structuring and saving sensor data as well as preffered evaluation functionalities from end-user point of view. The presentation of facility management tool integration, really impressed the audience because in current practise, there are only a few initiatives addressing the integration of sensor data from Building Automation Systems (BAS) with other applications such as BIM or FM tools. Especially, the facility managers saw a great potential in these monitoring functionalities which support the completion of their tasks in an effective and efficient way.

**Invited guest presentations (3:30 p.m. – 4:15 p.m.)**

The invited guest presentations were a great input for further HESMOS developments, e.g. Dr. Tobias Maile showed his research and development activities for evaluating building operation by comparing measured data with calibrated simulation models. He pointed out critical aspects such as the identification and appropriate consideration of measurement assumptions and simulation approximations and in particular, that these limitations can hinder a matching of measured and simulated data and thus need to be considered when comparing performance data.

**Discussion (4:30 p.m. - 6:00 p.m.)**

The afternoon continued with a round table discussion and definition of a road map for the third project year. The HESMOS project team agreed with the end users, that the IVEL should be an open platform based on IFC, where also additional software tools can be connected, regarding the different purposes during the PPP life cycle **(software interfaces).** An interfaces for heat load (EN 12831) and cooling load calculations (VDI 2078) as well as calculations according to the German Energy Saving Ordinance (Energieeinsparverordnung – EnEV), have been requested from audience because these calculations have to be done besides the simulation optimisations. The HESMOS

project team verified that the requirements are full filled to also use the energy-enhanced Building Information Model in IFC capable software solutions such as

- SolarComputer for heat load und cooling load calculation as well as DIN V 18599 calculations
- "DÄMMWERK 2013"
- "Energieberater" (Hottgenroth)
- etc.

The audience realized that new ways of working and processes are related to the implementation of HESMOS IVEL. They see the opportunity to exchange building information via the standardized format "IFC" between the various project participants of life cycle projects. But they also learned that a certain contract language has to be agreed on when you work with external parties that the requirements of data exchange are full filled, e.g. the building model has to be created in a certain way, that it can be used for life cycle optimisations. The responsibilities that the new processes can be adapted were deeply discussed. The responsibilities the audience agreed on are the following:

- **Project coordinator / BIM manager**
  overall structure of the project, contact person for BIM software questions, interface communication, review of available BIM data
- **Architect**
  Design in CAD, decision-making with nD Navigator
- **Energy experts**
  Energy simulations on basis of CAD model > not 1:1 from CAD > idealisation by expert
- **FM consultant**
  Operational concept, operational optimisation, decision-making with nD Navigator, FM tools

The discussion about the usability during **tendering phase** was let by BAM and an architect who is and was often involved in PPP projects. Currently there is not enough time in the tendering phase to simulate the whole building, because for a complex building whole building simulation can take based on data provided about 1 month and there is maximum time of 2 weeks. The audience agreed that HESMOS provide good functionalities such as the templates to run iterative simulations for decision-making. In the tendering phase HVAC design is often not further developed and detailed HVAC simulation in tendering phase causes too much effort. But there is a great opportunity to convincing the client in early stages to optimise the building with simulations to reduce energy consumption and as a result energy-related operational costs. So the HESMOS evaluation functionalities regarding energy-realted Key Performance Indicators in tendering phase were seen as really valuable developments. After contract awarding, detailed simulations can be run based on detailing the former simulation model. So that HVAC equipment load can be optimised and operational costs can be saved. The FM participants in the audience saw these functionalities as a good basis for commissioning & operational phase. The simulation model can be further calibrated as a benchmark for operation, the monitored data can be evaluated in an easy to understand way and because of that inefficiencies can be identified and solved.
The HESMOS project team planned to finnish the meeting at 5 p.m., but the audience was deepend in the discussions and were happy that the HESMOS team gave answers to all of their questions and showed details of the prototype.

# 2. Questionnaire for Participants

It was important for us to have different kinds of feedback:

1 **Group-Discussions**

2 **Personnel assessments**

3 **Collecting Data in a questionnaire -**
for getting a measurable result of understanding and assessment. For this, it was necessary to generate a questionnaire that consists into three parts:
**First**, the understanding of the IVEL should be measured with Dichotomous, where the respondent has two options (YES/NO).
**Second**, the Nominal-polytomous, where the respondent has more than two unordered options, also to measure the understanding of the IVEL.
**Third**, with Continuous, where the respondent is presented with a continuous scale. Here we tried to find out, where the participants imagine possible areas of improvement for the future.

---

**Do you use BIM for your daily work?** yes ☐ no ☐

for which purposes

- Design coordination ☐
- Cost estimation ☐
- Sustainability Certification ☐
- Construction ☐
- Building Management ☐
- Research & Development ☐
- …….. ☐

**What is your main interest in the Integrated Virtual Energy Laboratory?**

- Information / data exchange with the integrated project team ☐
- Energy simulations in design phase ☐
- Decision-making between different alternatives ☐
- Target-performance comparisons in operational phase ☐
- Optimisations in operational phase ☐
- …… ☐
- …… ☐
- …… ☐

**How do you think the Integrated Virtual Energy Laboratory (IVEL) can support your work?**

**Temporal process optimisation**

- Effective communication in the process team +2 | +1 | 0 | -1 | - 2
- Comparison of user requirements, simulation results and measurement values +2 | +1 | 0 | -1 | - 2
- Avoiding duplication of work / manual entry of information +2 | +1 | 0 | -1 | - 2
- Fast iterations with performance prognoses +2 | +1 | 0 | -1 | - 2
- Web-based access to sensor data +2 | +1 | 0 | -1 | - 2
- Graphical processing for energy reporting +2 | +1 | 0 | -1 | - 2

What percentage do you estimate your time savings using the IVEL? …….... %

**Optimisation of process quality**

In General

- Optimisation of interfaces
  - client -> project coordinator +2 | +1 | 0 | -1 | - 2
  - project coordinator -> project team +2 | +1 | 0 | -1 | - 2
  - architect -> HVAC planner +2 | +1 | 0 | -1 | - 2
  - architect -> energy consultant +2 | +1 | 0 | -1 | - 2
  - HVAC planner -> energy consultant +2 | +1 | 0 | -1 | - 2
  - energy consulatant -> FM coordinator +2 | +1 | 0 | -1 | - 2
  - architect -> FM coordinator +2 | +1 | 0 | -1 | - 2
  - HVAC planner -> FM coordinator +2 | +1 | 0 | -1 | - 2
- Optimisation of data exchange +2 | +1 | 0 | -1 | - 2

**Design phase**

- Standard profiles if only functional requirements are available for thermal and energy simulations +2 | +1 | 0 | -1 | - 2
- Comparison of design alternatives processed on a graphical user interface +2 | +1 | 0 | -1 | - 2
- Comparison of impacts of parameters on different key performance indicators (energy, thermal comfort, indoor room quality etc.) +2 | +1 | 0 | -1 | - 2
- Identification of deviations and allocation to rooms and/or zones +2 | +1 | 0 | -1 | - 2

**Operational phase**

- Web-based monitoring +2 | +1 | 0 | -1 | - 2
- Processed graphics for target-performance comparisons +2 | +1 | 0 | -1 | - 2
- Identification of deviations +2 | +1 | 0 | -1 | - 2
- Allocation to rooms and/or zones +2 | +1 | 0 | -1 | - 2
- Identification of influencing factors (climate, user, building, HVAC) +2 | +1 | 0 | -1 | - 2

Where do you see the biggest potential of an Integrated Virtual Energy Laboratory?

- Improvement of information management +2 | +1 | 0 | -1 | - 2
- Process standardisation +2 | +1 | 0 | -1 | - 2
- …… +2 | +1 | 0 | -1 | - 2
- …… +2 | +1 | 0 | -1 | - 2

**Optimisation of the building & HVAC & user behaviour**

Design phase

- Energy and thermal optimisations of the building +2 | +1 | 0 | -1 | - 2
- Energy optimisations of HVAC +2 | +1 | 0 | -1 | - 2

Operational phase

- Optimisation of system control +2 | +1 | 0 | -1 | - 2
- Optimisation of user behaviour +2 | +1 | 0 | -1 | - 2

- What percentage do you estimate the energy optimisation potential because of more iteration with performance prognoses in the design phase? …… %
- What percentage do you estimate the optimisation potential because of optimisations of system control as well as in user behaviour? ……%

**Evaluation matrix**

+2 very strong

+1 strong

0 no change

-1 small

-2 very small

# 3. Results and Discussion Topics

( the most frequent answers are highlighted in black colour for easier reference )

**Do you use BIM for your daily work?** **Yes x2 / no x6**

for which purposes

- Design coordination ☐
- Cost estimation ☐
- Sustainability Certification ☐
- Construction ☐
- Building Management ☐
- Research & Development 1
- Project data amnagement for BIM customers…….. 1

**What is your main interest in the Integrated Virtual Energy Laboratory?**

- **Information / data exchange with the integrated project team** **5**
- **Energy simulations in design phase** **4**
- **Decision-making between different alternatives** **3**
- Target-performance comparisons in operational phase 2
- **Optimisations in operational phase** **4**
- Useability for certification systems 1

……

**How do you think the Integrated Virtual Energy Laboratory (IVEL) can support your work?**

**Temporal process optimisation**

- **Effective communication in the process team** **12/8**
- Comparison of user requirements, simulation results and measurement values 6/7
- Avoiding duplication of work / manual entry of information 5/7
- Fast iterations with performance prognoses 5/7
- **Web-based access to sensor data** **11/8**
- **Graphical processing for energy reporting** **10/8**

What percentage do you estimate your time savings using the IVEL? …10 (1), 15(1) %

**Optimisation of process quality**

In General

- Optimisation of interfaces
- client -> project coordinator 2/7
- **project coordinator -> project team** **10/7**
- **architect -> HVAC planner** **10/7**
- **architect -> energy consultant** **10/7**
- **HVAC planner -> energy consultant** **9/7**
- energy consulatant -> FM coordinator 6/7
- **architect -> FM coordinator** **8/7**
- **HVAC planner -> FM coordinator** **10/7**
- **Optimisation of data exchange** **7/7**

Design phase

- Standard profiles if only functional requirements are available for thermal and energy simulations 8/8
- Comparison of design alternatives processed on a graphical user interface 8/8
- **Comparison of impacts of parameters on different key performance indicators (energy, thermal comfort, indoor room quality etc.)** **12/8**
- Identification of deviations and allocation to rooms and/or zones 7/7

Operational phase

- **Web-based monitoring** **13/8**
- **Processed graphics for target-performance comparisons** **10/8**
- **Identification of deviations** **10/8**
- Allocation to rooms and/or zones 7/7
- Identification of influencing factors (climate, user, building, HVAC) 7/8

Where do you see the biggest potential of an Integrated Virtual Energy Laboratory?

- **Improvement of information management** **11/8**
- Process standardisation 3/6
- Early warning system…….. 1
- Higher graphical 3D output quality…… 1
- Avoid duplicate work…… 1
- Minimize costs…… 1

**Optimisation of the building & HVAC & user behaviour**

Design phase

- **Energy and thermal optimisations of the building** **9/8**
- **Energy optimisations of HVAC** **9/8**

Operational phase

- **Optimisation of system control** **9/8**
- Optimisation of user behaviour 3/8

- What percentage do you estimate the energy optimisation potential because of more iteration with performance prognoses in the design phase? 10(1),15(1),20(2),25(1)%
- What percentage do you estimate the optimisation potential because of optimisations of system control as well as in user behaviour? 10(2),20(1),25(1),35(1)%

 

**Remarks:**

*Evaluation marks:*

+2 very strong
+1 strong
0 no change
-1 small
-2 very small

*Submitted questionnaires:*

8 filled in questionnaires were submitted, 2 more shall be submitted by Joachim Lepper and Tobias Mansperger.

*Appraisal:*

6/7 means 6 points from 7 answers

10(2), 20(1)% means 10% mentioned 2 times and 20% once

# 4. Conclusions

Discussions during the workshop show that there is the need of an open platform where energy-enhanced Building Information Model (eeBIM) data can be used for various evaluation purposes. So that the HESMOS project team focusses on an open standard of data exchange and an open platform which is open for further connections of software tools.

The biggest request was that time and effort to create the model for simulation and evaluation purposes during tendering phase is minimized, so the HESMOS project team focusses on an easy model with link to valuable construction, material and HVAC templates to find the alternative with the best cost-quality ratio. This model can be detailed after contract award for more in depth analysis and used for verification simulations of optimisation measures during operation phase when deviations are identified with HESMOS Facility Management tools (WebROOMEX and RYHTI Metrix).

For figuring out where the audience sees the most benefits in implementing the HESMOS IVEL, we prepared and analysed a questionnaire. They estimate time savings of 10 to 15 % by using the IVEL compared to their current way of working because of effective communication in the process team, web-based access to sensor data and graphical processing for energy reporting. The time savings will be verified by implementing the IVEL and its components on our pilot projects in the third year and compare it to the actual effort for tendering and operation / energy reporting.

Additionally, the audience sees the most improvements in process quality by optimising the information exchange by different partners, the evaluation regarding energy-related Key Performance Indicators (eKPIs), web based monitoring and target performance comparisons for identification of deviations.

As improvement of the buildings and HVAC as such, the audience estimated energy optimisation potential between 10 % and 25 % because of performance prognoses during design. This will be analysed in the third project year on our pilot project Finance Centre Kassel. And they estimated optimisation potential between 10-35 % because of optimisations and system control as well as user behaviour. This will be monitored at our pilot project Alfons-Kern-School in Pforzheim.

 

# Appendix I: Photos

*Figure 1: Room and Participants*

*Figure 2: Invited Guests*

*Figure 3: Snapshot from the Discussion*