National and International Benchmarking - CREDIT Report 5.

Huovila, Pekka; Porkka, Janne; Bertelsen, Niels Haldor; Hansson, Bengt; Haugbølle, Kim; Hietanen, Päivi; Karud, Ole Jørgen; Widén, Kristian

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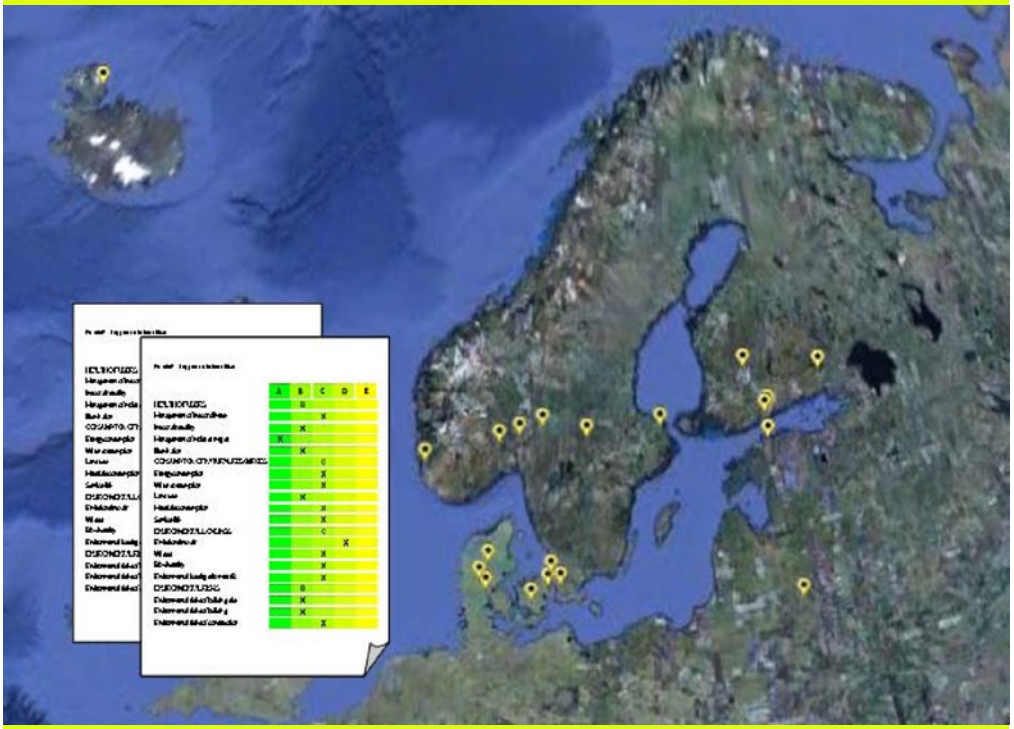

Danish Building Research Institute
AALBORG UNIVERSITY

National and International Benchmarking

CREDIT Report 5

Pekka Huovila
Janne Porkka
Niels Haldor Bertelsen,
Bengt Hansson
Kim Haugbølle
Päivi Hietanen
Ole Jørgen Karud
Kristian Widén

SINTEF VTT LUND UNIVERSITY Danish Building Research Institute AALBORG UNIVERSITY

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Contents

Preface

This report summarises the results from the work undertaken in sixth Workpackage on "National and International Benchmarking" as part of the Nordic/Baltic CREDIT project *(Construction and Real Estate – Developing Indicators for Transparency, 2007-2010)*. Altogether, these cases represent an interesting cross-section from building types - offices, housing, schools and nursery and shopping centres - from Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania.

CREDIT includes the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi/AAU (Denmark), VTT (Finland), SINTEF (Norway) and Lund University (Sweden). Moreover, three associated partners joined CREDIT for the Norwegian part of the project. The three associated partners are The Icelandic Center for Innovation (Iceland), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

The project has been managed by a steering committee consisting of the following persons representing the four main partners:
– Kim Haugbølle, SBi/AAU (project owner), Denmark.
– Niels Haldor Bertelsen, SBi/AAU (project coordinator), Denmark.
– Pekka Huovila, VTT, Finland.
– Päivi Hietanen, Senate Properties, Finland.
– Ole Jørgen Karud, SINTEF, Norway.
– Magnus Hvam, SKANSKA, Norway.
– Bengt Hansson, Lund University, Sweden.
– Kristian Widén, Lund University, Sweden.

The steering committee wishes to thank our industrial partners and all the contributors to the CREDIT project. In particular, the steering committee wishes to thank the four Nordic funding agencies that sponsored the project as part of the ERABUILD collaborative research funding scheme: The Danish Enterprise and Construction Authority (Erhvervs- og Byggestyrelsen) in Denmark (funding SBi), TEKES in Finland (funding VTT), The Nordic Innovation Centre (NICe) (funding SINTEF) and FORMAS in Sweden (funding Lund University).

Danish Building Research Institute, Aalborg University
Department of Construction and Health
August 2010

Niels-Jørgen Aagaard
Research director

Summary

This report summarizes findings and recommendations from 24 case studies from seven participating countries addressing performance indicator benchmarking at a sectoral, national or international scale. Their distribution in scope is:

- benchmarking systems and indicators (4 case studies)
- offices (7 case studies)
- housing (6 case studies)
- school and nursery (4 case studies)
- shopping centres (3 case studies).

In addition, actual performance benchmarking was done between six Finnish and Norwegian office buildings using CREDIT Key Performance Indicators and a web-based benchmarking tool, developed in CREDIT for that purpose.

Some good benchmarking practices exist already at a national and international level. They focus on process issues, investment aspects and environmental properties. These existing schemes contribute to the CREDIT framework, but don't cover well the performance dimension.

There isn't yet any commonly agreed European Key Performance Indicator system, or building and real estate performance indicator standard. CREDIT made a contribution to their development from the Nordic/Baltic perspective. It also provided valuable input from the performance and social sustainability point of view to existing economic and environmental oriented schemes that are continuously updated and amended.

CREDIT made progress in performance indicator framework and actual performance indicators and tools, some of which were already tested in the case studies. Understanding on existing benchmarking schemes is also improved.

The results of CREDIT WP6 performance indicator benchmarking at a sectoral, national or international scale can be exploited in number of ways, such as

- the front runner companies adopt the core performance indicators in their practices and influence in forming their use a sector based practice
- further development of standardization, tool development (IFCs), benchmarking schemes and rating systems makes use of the results.

1 Introduction and objective

This chapter describes the objectives, organisation and work packages of the CREDIT project as well as the deliverables including the reports published by CREDIT. The chapter is an introduction to the following chapters where an improved understanding of end user needs, performance indicators and user satisfaction in Nordic and Baltic countries is given. The report is based on collaboration that gives a solid and evidence-based transparent ground for communicating results in order to improve the competitiveness of construction and real estate business.

1.1 The objectives and the project programme of CREDIT

Sir Winston Churchill once said, “We shape our buildings, afterwards our buildings shape us” (28 October 1943). This quotation underlines how strongly a building can influence its occupier or user. It is not without complications to provide complex public facilities for example for hospitals, schools, universities and libraries able to meet both the internal and external stakeholders’ needs and experience. The aims and demands of different stakeholders within a project may sometimes conflict with other stakeholders’ interest. Understanding the needs and experience of the stakeholders is essential to stay competitive in today’s market. A client who pays attention to the needs of the end-users will be rewarded with a high-performance property. Concurrently, this shift seeks to solve many ills associated with inadequate building conditions that result in poor building function.

The amount of both public and private money that are invested in delivering public and private facilities calls for decisive measures to be adopted. Collaboration with the relevant stakeholders helps building owners to identify performance indicators required for creating high-performance facilities. The project aims to define a model for the implementation of performance requirements that ensures fulfilment of various types of users’ and stakeholders’ needs and demands. The model should also allow for the continuous measurement of the effectiveness of the applied requirements and the model as such, so that it can be improved as more knowledge and experience of it is gained.

Adhering closely to the themes laid down in Erabuild, the aim of CREDIT is to improve transparency of value creation in construction and real estate. Thus, the objectives of CREDIT are:

– To capture end-user needs and experience in order to identify and quantify – where possible – value creation in the constructions and real estate sectors,
– To develop compliance assessment and verification methods,
– To define and develop benchmarking methods and building performance indicators for the construction and real estate,
– To propose recommendations for international benchmarking of key performance indicators of buildings.

Consequently, the deliverables of CREDIT are:

1. The establishment of a network of Nordic and Baltic researchers of benchmarking and performance indicators by frequent interaction in workshops across the Nordic and Baltic countries.
2. A State-of-the-Art report to identify and critically examine a number of existing tools, databases, mandatory reports, approaches and bench-

marking schemes to capture and measure end-user needs, client demands and public requirements to performance and value creation.
3. A strategic management and decision-making tool to guide the definition and development of benchmarking methods and building performance indicators in different business cases.
4. A comprehensive performance assessment and management tool with associated key performance indicators to capture end-user needs and experience and to continuously measure and verify the compliance of performance throughout the life cycle of an actual building project linked to building information models.
5. Recommendations of how sector and national indices of performance indicators can be designed in order to promote international benchmarking of construction and real estate.
6. Dissemination of the lessons learned and tools developed through news articles, press releases and workshops with actors from the construction and real estate sector.

The expected impact of CREDIT on the construction and real estate sector at national and European levels are as follows:
– Improved understanding of end-user needs and client's demands to performance requirements and level of satisfaction.
– New and improved tools to make the costs/value ratio of products and services more transparent throughout their life cycles.
– A more solid and evidence-based background for launching new public policies to improve the competitiveness of construction and real estate business.
– Improved opportunities for more accurate comparisons with neighbouring countries via improved methods.

More information about the background is given in the CREDIT project programme (CREDIT, 2007).

1.2 Main partners in the CREDIT project

The CREDIT project was a cooperative research project including four Nordic research institutes:
– Danish Building Research Institute (SBi), Aalborg University, Denmark – funded by The Danish Enterprise and Construction Authority (DECA) (Erhvervs- og Byggestyrelsen).
– VTT, Technical Research Centre of Finland, Finland – funded by TEKES
– SINTEF Byggforsk, Norway – funded by The Nordic Innovation Centre (NICe)
– Lund University, Construction Management, Sweden – funded by FORMAS.

Another three associated partners joined CREDIT for the Norwegian part of the project:
– The Icelandic Center for Innovation, Iceland.
– Tallinn University of Technology, Estonia.
– Vilnius Gediminas Technical University, Lithuania.

The Danish Building Research Institute (SBi) was project owner and project coordinator of the project as well as legally responsible according to ERABUILD on behalf of the four main partners. SBi, VTT, SINTEF and Lund University were the national coordinators for the project in Denmark, Finland, Norway and Sweden respectively, and moreover SINTEF was responsible for the coordination with the three associated partners.

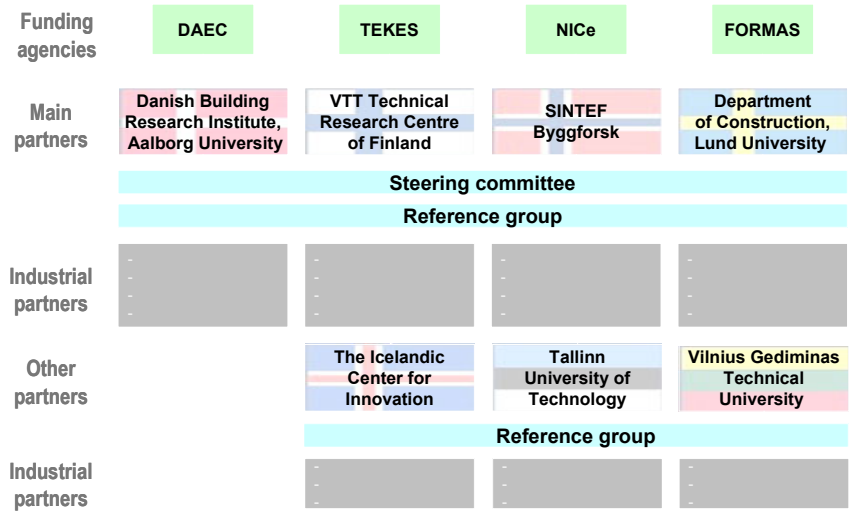
The project was managed by a steering committee chaired by the project owner, the project coordinator was secretary and each of the four main partners had two seats. The steering committee saw to the overall coordination and operation of the project, and was responsible for making the decisions necessary in this regard. The following persons represented the four main partners in the steering committee:

– Kim Haugbølle, SBi (project owner), Denmark.
– Niels Haldor Bertelsen, SBi (project coordinator and DK project manager), Denmark.
– Pekka Huovila, VTT (FI project manager), Finland.
– Päivi Hietanen, Senate Properties, Finland.
– Ole Jørgen Karud, SINTEF (NO, IC, ES and LT project manager), Norway.
– Magnus Hvam, SKANSKA, Norway.
– Bengt Hansson, Lund University (SE project manager), Sweden.
– Kristian Widén, Lund University, Sweden.

In relation to national activities, different partners from the construction and real estate sectors were involved in the case studies and the discussions of the findings. All these national contacts and cooperative partners were referred to as national reference group members. They represented different users of performance data and benchmarking systems in the Nordic and Baltic countries and are therefore the target group for the CREDIT results. Together with policy makers, funding agencies and researchers they constituted the Nordic Baltic Reference Group.

More information about the organisation is given in the CREDIT cooperation agreement (CREDIT, 2008).

Figure 1. The main partners and funding agencies in CREDIT



1.3 CREDIT work packages and meetings

Through seven work packages (WPs), the national research groups studied international experiences and examined a number of existing and new methods, tools and systems for performance assessment and international benchmarking. WP1 and WP7 dealt with the general project management and dissemination of results from CREDIT. WP2, WP3, WP4, WP5 and WP6 represented different steps of the research activities from a general study of the state-of-the-art in WP3 through the performance model in WP2, project assessment in WP4, national case studies in WP5 and international benchmarking in WP6 and returning with the final conclusions and recommendations to

WP2. Coordination of the specific research in WP4, WP5 and WP6 were also handled by WP2, and WP2 therefore had the following three tasks:

1. To formulate the research model and coordinate the research in CREDIT.
2. To classify performance indicators in the CREDIT benchmarking model.
3. To summarise the CREDIT reports including national recommendations.

WP3 studied literature and general national practice as background for the specific research in WP2, WP4, WP5 and WP6, and this resulted in a formulation of more specific tasks and objectives for the four other WPs. WP4 studied different project assessment methods and tools and how the different enterprises worked with indicators, assessment and benchmarking. WP5 studied 28 different case studies in the Nordic and Baltic countries, which were grouped and compared within different building segments. WP6 surveyed sector, national and international benchmarking systems of key performance indicators and experience from front–runners in the construction and real estate sector.

According to the CREDIT project programme (CREDIT, 2007), a number of deliverables (D) were agreed for each of the seven WPs. A final list of the specific deliverables (D) is given in Appendix A, and an overview is given below of each of the seven WPs:

– WP1: CREDIT project management. (Responsible: SBi/DK)
  Deliverables: Steering committee (SC) and SC Meetings (D1), CREDIT project meetings (D2) and Progress reports and accounts (D3).
– WP2: Performance models. (Responsible: SBi/DK)
  Deliverables: Stimulus paper, draft report and final report (D4a) on performance indicator and a draft and final summary report (D4b). D4b is an extra deliverable according to the project programme. CREDIT Report 3 and 6.
– WP3: State-of-the-Art. (Responsible: SINTEF/NO)
  Deliverables: Stimulus paper, draft report and final report (D5) on State-of-the-Art. CREDIT Report 1.
– WP4: Project assessments and tools. (Responsible: Lund University/SE)
  Deliverables: Stimulus paper, draft report and final report (D6) on project assessments and enterprises. CREDIT Report 4.
– WP5: National case studies. (Responsible: VTT/FI)
  Deliverables: Stimulus paper, draft report and final report (D7) on case studies and buildings. CREDIT Report 2.
– WP6: International benchmarking. (Responsible: VTT/FI)
  Deliverables: Stimulus paper, draft report and final report (D8) on sector, national and international benchmarking. CREDIT Report 5.
– WP7: CREDIT dissemination. (Responsible: SBi/DK)
  Deliverables: CREDIT project web (SINTEF eRoom) (D9), reference group and user workshops (D10), press releases (D11), news articles in trade journals (D11) and research articles (D12).

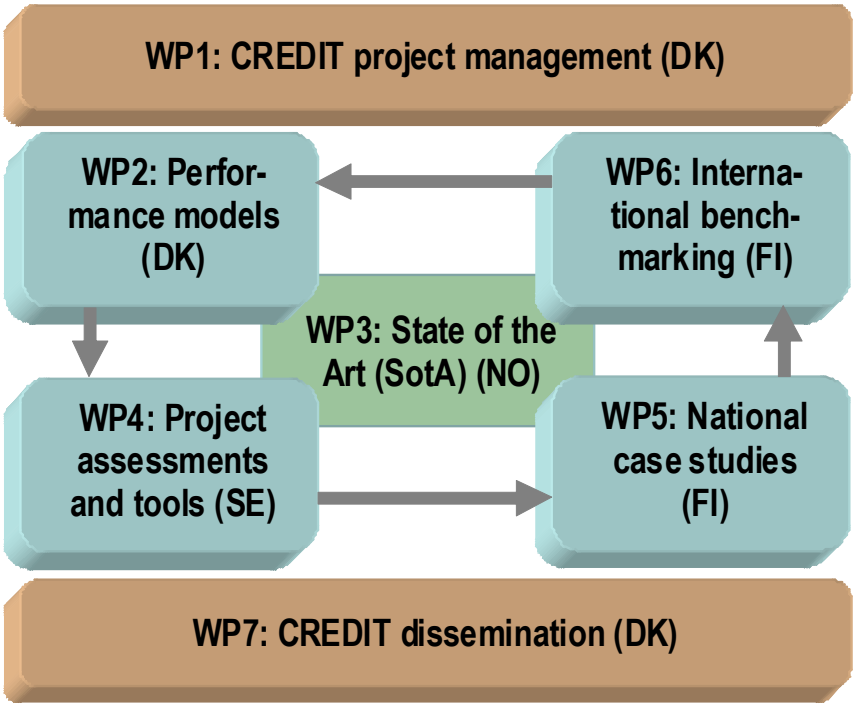
Seven two-day meeting packages (MPs) were held in 2008, 2009 and 2010 in the different countries to strengthen the innovative cooperation between the researchers and the national reference groups comprising the main players in planning, construction, real estate, benchmarking and the responsible authorities. Each meeting package (MP) focused on a specific work package (WP) and consisted of a one-day project meeting, a half-day user workshop, a reference group meeting and a steering committee meeting.

The seven CREDIT meeting packages alternated between the participating countries:

1 Helsinki, Finland, 24-25 January 2008: Kick off and end-user values.
2 Oslo, Norway, 29-30 May 2008: WP2 Performance models and WP3 State-of-the-Art.
3 Lund, Sweden. 8-9 October 2008: WP4 Project assessment methods and tools.
4 Vilnius, Lithuania, 19-20 January 2009: WP5 National case studies.
5 Reykjavik, Iceland, 8-9 June 2009: WP6 International benchmarking.
6 Tallinn, Estonia, 26-27 October 2009: Discussing the final CREDIT Reports 1, 2, 3, 4, 5 and 6. An extra meeting according to the project programme.
7 Copenhagen, Denmark, 25-26 January 2010: Final reports and closing of CREDIT.

The CREDIT project plan (CREDIT, 2007) outlines the relations between work packages (WPs), meeting packages (MPs) and deliverables (D). Every six months a project status was prepared and a progress report sent to Erabuild at the Danish Enterprise and Construction Authority, and in February 2009 it was extended to a 'CREDIT Progress and Mid-term Report' of 36 pages (CREDIT, 2009). A final version of the project and meeting plan is given in Appendix A.

Figure 2. The seven work packages (WPs) in CREDIT with the responsible countries (DK, FI, NO or SE) in bracket. WP2-WP6 are the main research WPs, and WP1 and WP7 include the project management and dissemination of results of CREDIT respectively.



1.4 CREDIT reports, deliverables and eRoom

The work of each of the main work packages (WP3, WP5, WP2, WP4 and WP6) were documented in five reports - CREDIT Reports 1, 2, 3, 4 and 5 - and in various scientific articles and news articles. For example Report 1 describes the state-of-the-art as a result of the work of 'WP3 State-of-the-Art'.

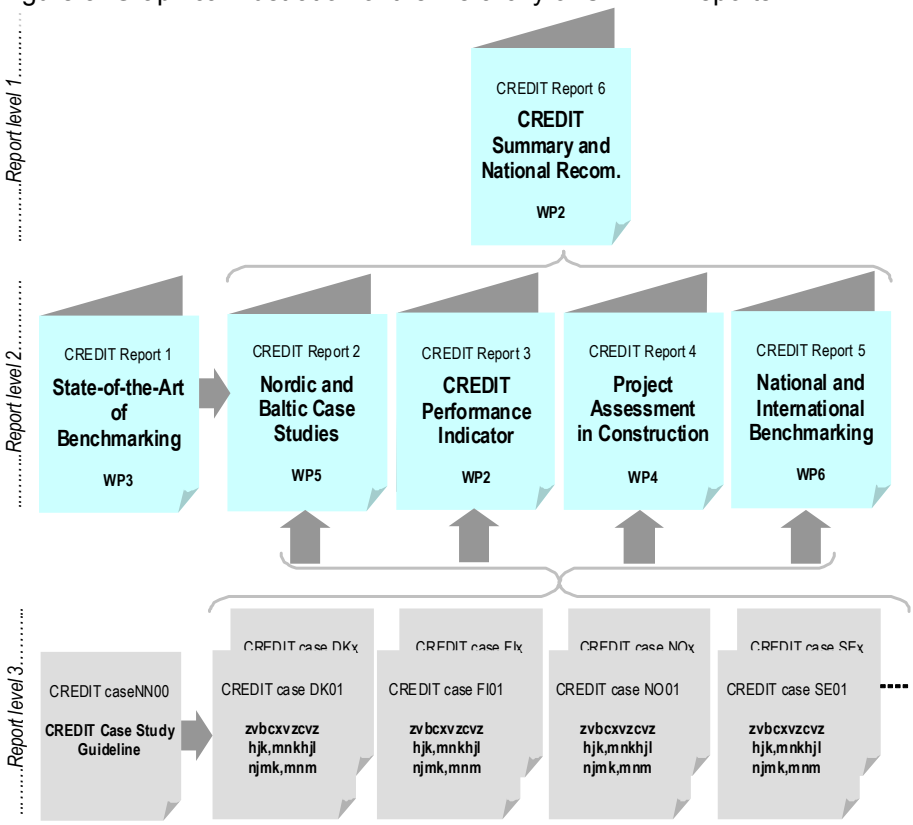
The work of 'WP5 National case studies' resulted in 28 Nordic and Baltic case studies with focus on performance indicators, assessment tools and benchmarking in front-runner building projects, enterprises and benchmarking organisation and reported in CREDIT Report 2. Each case study is described in accordance with a common guideline and together with results from the state-of-the-art report they form the background for the research and proposals for future improvements presented in CREDIT Reports 3, 4 and 5.

CREDIT Report 3 describes the CREDIT performance indicator framework as a result of 'WP2 Performance models', and the indicators are relation to national regulations; international standards and research; and:
– Report 4: Project Assessment in Construction and Real Estate.
– Report 5: Internal, National and International Benchmarking.

The results of the five CREDIT reports are summarised in this CREDIT Report 6 together with recommendations on how to implement the results nationally in the Nordic and Baltic countries.

In Figure 3 a graphical illustration is given of the three levels of the hierarchy of CREDIT reports, and after Chapter 8 all CREDIT reports are listed. Through the research all deliverables were filed in the common CREDIT project web in eRoom in SINTEF, Norway, and a complete list can be seen in the minutes of the CREDIT Steering Committee Meeting 8 (CREDIT, 2010).

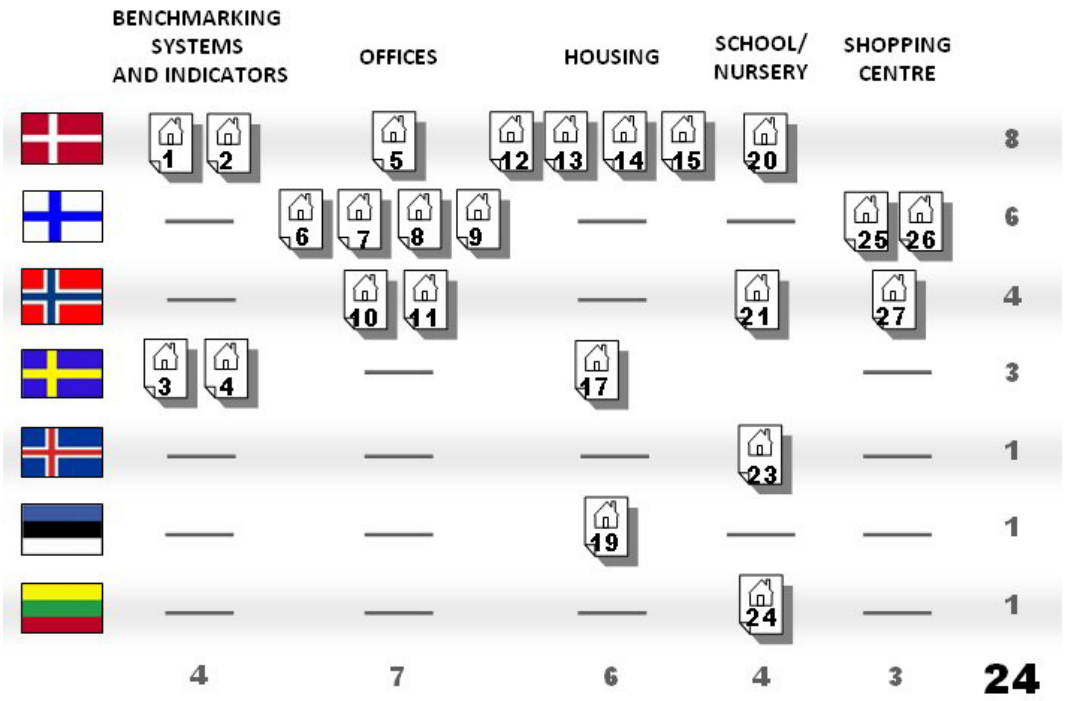
Figure 3. Graphical illustration of the hierarchy of CREDIT reports.



2 Summaries of Case Reports

This Chapter shortly summarizes the scope and findings of 24 Case Studies (out of 28) from the seven participating countries that contained indicator and benchmarking information at a national level. Their distribution to four different building types is shown in the figure below.

Figure 4. 24 Case Studies addressing indicators and benchmarking at a national level.



2.1 22 student housing estates DK01

Stakeholder evaluation of user satisfaction, housing quality, economy and building process

The target for the evaluation in this case was to measure whether the political goals with a specific initiative were met. The initiative was taken to increase the number of dwellings in the private housing sector for students.

The evaluation focused on the following chosen four themes: quality in the finished buildings, the building process, economy for the society, client and user together with user satisfaction.

Basis for the evaluation were similar aspects of non profit housing for student.

2.1.1 The actual benchmarking organisation and its purpose

The evaluation has been executed by a group of private companies in accordance with talks with the ministry responsible for the initiative, Ministry of Interior and Social Affairs.

The results and recommendations were aiming at the governmental initiative and to get an insight into quality, building process, economics and user sat-

isfaction of the finished estates. Basis for the evaluation were similar aspects of non profit housing for student.

2.1.2 Assessment applied in the benchmarking organisation

The evaluation is primarily based on registration of the quality of the finished buildings, questionnaires and interviews with all clients and persons responsible for economics in the execution of the estates, interviews with local authorities, questionnaires to students, questionnaires and interviews with persons responsible for the operation of the estates and interviews with members of the judging committee.

The indicators were tailored to this evaluation. They were used after the estates have been taken into use and the users have moved in.

The theme quality contained three main topics: architecture, standard and fulfilment of the demand from the ministry. The evaluation was divided into "levels" and started with the outer appearance and the individual apartments and continued with the inner rooms and components.

The theme building process focused on the more general level with the interplay between the main actors: the ministry, the client, the companies and the local authority.

The theme economics looked at the costs for construction, operation and life cycle use. Furthermore whether there has been a competition between the companies.

The theme user satisfaction focused on the users own evaluation of their apartment. They were also asked about use of common areas and social interaction. Furthermore were student movements and the use of the estate evaluated.

The four themes were as mentioned evaluated when the buildings were finished and students have moved in.

2.1.3 Cost and performance indicators applied in benchmarking

The indicators were used after the estates have been taken into use and the users have moved in. The results and recommendation were aiming at the governmental initiative and to get an insight into quality, building process, economics and user satisfaction of the finished estates.

There were three goals for the evaluation:
– an evaluation of the use of the governmental initiative
– an evaluation of the quality of the finished apartments and
– an evaluation and comparison between non profit student housing and private built student housing.

The ministry decided that the evaluation should be concentrated on indicators within the following four themes: quality, building process, economics and user satisfaction. The same themes were used for all estates.

"Good quality" was here in accordance with the ministry defined as whether the buildings and apartments met the requirements from the ministry which were similar to traditional student housing, had a sound economy and the users were satisfied.

On a general basis the quality was evaluated on the basis of three parameters of quality: architectural, functional and technical quality.

Basis for the evaluation concerning the quality was an agreement between the ministry and a client/developer with some demands concerning five main topics. On level one, two and three the topics were: the development plan, the building in general, common facilities (as kitchen, toilet, common area and laundry), on level four and five the apartments and the rooms in the apartment (as entrance, kitchen, bathroom, room and depot).

In the evaluation a grading with six marks was used – with 1 as worst and 6 best.

Focus for the quality was the user's opinion of access to their apartment, the apartments, common rooms, facilities as kitchen and toilet.

The technical quality - for example of surfaces, the climate façade and quality of chosen components - has been evaluated by a registration and an evaluation by an architect and a civil engineer. There were three sub criteria: the execution, the condition and the constancy.

The evaluation started with a registration of all the finished estates in accordance with the mentioned division in levels. Here it was noted whether the demands were met.

A further division of indicators were used to describe the different aspects of quality as for example the layout of the building and sorting of waste and garbage.

In the quality evaluation entered also answers from the questionnaires.

The main indicators belong to Indicator 3 Building performance and indoor environment. But there are also indicators belonging to Indicator 1 concerning cost, 4 concerning building parts and 6 concerning process.

The other main themes, as the building process, the economy and user satisfaction were handled mainly on the basis of questionnaires and calculations.

2.1.4 Relation to enterprises, building project and real estate

The indicators were used after the estates have been taken into use and the users have moved in. The results and recommendation were aiming at the governmental initiative and to get an insight into quality, building process, economics and user satisfaction of he finished estates

The individual client/company has only besides information of the client's/company's own building got the general report. As far it is known nobody of the clients and companies have taken initiative to specific assessments of the building and the process they have worked with.

2.1.5 Visions and innovations for future improvements

The indicators and the chosen tools yielded a good insight in the results of the political initiative. The results aimed primarily at the agreed overall framework and not at the individual case under planning and construction.

The single estate was evaluated and the results were summarized to make an evaluation of the private student housing as a group and a comparison with the non profit housing also as a group.

In the case a new initiative is taken there are conclusions which also could influence the single building quality, process, economy and user satisfaction.

It was decided from the start that the initiative should be evaluated. Meanwhile the evaluation was not specified in a programme with the needed data beforehand. Therefore and due to confidence concerning some data it turned out to be difficult to evaluate some indicators, especially concerning economy. Also the short period for evaluation gave problems concerning evaluation of the operation of finished buildings.

The results of the evaluation are experiences concerning the mentioned themes and conclusions to alterations. Meanwhile there is no political interest as mentioned for further initiatives of similar character for the moment.

But in the case a new initiative is taken there are conclusions which also could influence the single building quality, process, economy and user satisfaction. And the chosen topics could be a platform for a systematic evaluation of student housing.

2.1.6 Lessons learned and recommendations

The evaluation was tailored to the actual situation – an evaluation of a specific political initiative to increase the number of dwellings in the private housing sector for students.

Therefore the indicators were chosen in accordance with the framework for the initiative which was created on the basis of the political intensions in the Ministry of Interior and Social Affairs in a dialogue with organizations within the building industry.

Basis was the quality of student dwellings within the non profit housing.

The single estate was evaluated and the results were summarized to make an evaluation of the private student housing as a group and a comparison with the non profit housing also as a group.

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But in the case a new initiative is taken there are conclusions which also could influence the single building quality, process, economics and user satisfaction. And the chosen indicators could be a platform for a systematic evaluation of student housing.

2.2 Benchmark Centre for the Danish Construction Sector DK02

Applying and improving Key Performance Indicators (KPI) in the Danish construction sector

2.2.1 The actual benchmarking organisation and its purpose

The Benchmark Centre for the Danish Construction Centre (BEC) was established by the organizations in the building sector with participation from the Danish Ministry's Agency for Enterprise and Construction.

The establishment was a result of a task force report looking into the state of affair in the building sector. The report found that the Danish building industry was lacking behind other countries in productivity and quality in an international comparison.

It is compulsory for clients responsible for state projects and from 1st October 2009 for non profit housing projects to ask for KPIs when they are looking for potential contractors to execute new buildings and it also compulsory to get new building projects evaluated with the aim to calculate KPIs.

About 30 % of the evaluations executed of BEC are due to the demand from the state meanwhile 70 % are from private clients or local authorities.

The system and the indicators are used for different types of buildings – from offices and museums to all sorts of housing projects.

Since 1st July 2005 construction companies have had to present KPIs for previous projects, if they wish to undertake new construction projects for the Danish state. BEC refers here also to the company's "grade book" when the construction company has collected KPIs from at least three projects.

From 1st October 2009 it is likewise compulsory for non profit housing clients with new projects to ask for KPI's from potential contractor interested in executing the project.

Up to now BEC has executed 1.460 evaluations and 115 companies have got a grade book. Furthermore 640 contractors either have got or are in the process with getting KPIs.

For the moment BEC covers about 3 % of the total market – buildings for private, regional, local authority, non profit housing and state clients.

2.2.2 Assessment applied in the benchmarking organisation

In practice the demand is part of the contract between the client and the construction company concerning a new project and it is up to the company to make an arrangement with an independent evaluator to make the registrations. In principle it can be other organizations than BEC.

2.2.3 Cost and performance indicators applied in benchmarking

The contractor has to deliver data concerning the progress in the execution of the building to establish the basis for calculation of the following KPIs which are delivered to the client after the construction:

– actual construction time in relation to planned construction time
– actual construction time incl. remediation of defects in relation to planned construction time
– remediation of defects during the first year after handing over

– number of defects recorded in the handing-over protocol, classified according to degree of severity
– accident frequency per billion DKK
– work intensity, man hours per m^2
– labor productivity
– changes in project price during the construction phase
– square meter price
– customer satisfaction with the construction process.

KPIs which are delivered after construction to the contractor:
– actual construction time in relation to planned construction time
– actual construction time incl. remediation of defects in relation to planned construction time
– remediation of defects during the first year after handing over
– number of defects recorded in the handing-over protocol, classified according to degree of severity
– accident frequency per billion DKK
– customer satisfaction with the construction process.

The collection of data has been digitalized.

The system and the indicators are used for different types of buildings – from offices and museums to all sorts of housing projects.

2.2.4 Relation to enterprises, building projects and real estate

The KPIs are used at the company level and as a presentation of a company in connection with prequalification and the client's selection of companies to take part in a tendering procedure.

Furthermore they give clients information about the process at the building site in concrete projects when the building is finally delivered after one year.

2.2.5 Visions and innovations for future improvements

From 1st May 2008 the system was simplified and digital reporting was introduced. The simplifications included costs and leaving out man hours from the contractors and subcontractors from reporting. This means that information about effectiveness; work intensity and labour productivity are not calculated in the new system.

From 1st May 2009 the system has been further simplified as the grouping of information about building defects at handing over has been changed and two groups combined. Possible defects will be evaluated in accordance with the costs for remediation and inconvenience for the users of the building. There are three now grades of seriousness of defects plus information about number of defects to be investigated further.

By using an average rate for costs per man hour it is possible to convert the new information to the former method and in this way to maintain continuity.

For the question concerning the clients satisfaction there were 11 questions to be answered. These have been reduced to 8. A new KPI is a question about client loyalty.

This simplification also implies that it will be up to the clients to report the necessary data for calculation of KPIs but the contractor still has to confirm the data.

2.2.6 Lessons learned and recommendations

The government has decided that it is compulsory for clients working with state building projects and clients for non profit housing to use the system. The same clients have to demand key performance indicators from potential contractor interested in new projects.

Since the system was introduced in 2004 it has been through some evaluations from clients and companies which have resulted in alterations. A main feature has been to simplify the system and especially reduce the scope of work for the companies. Furthermore the collection of data has been digitalized.

Two of the main partners behind the system representing clients, the Agency of Enterprise and Construction and the Ministry of Interior and Social Affairs, have emphasized simplifications in order to secure the highest usefulness and the lowest use of resources in creating the KPIs. Therefore the efforts were concentrated about a reduction of indicators and the effectiveness of the system.

The target with alterations has been continuously to use objective as well as subjective KPIs and to maintain the continuity so it is possible to use KPIs already collected in a long time perspective.

From 1st May 2008 the system was simplified and digital reporting was introduced. The simplifications included costs and leaving out man hours from the contractors and subcontractors from reporting. This means that information about effectiveness; work intensity and labour productivity are not calculated in the new system.

From 1st May 2009 the system has been further simplified as the grouping of information about building defects at handing over has been changed and two groups combined. Possible defects will be evaluated in accordance with the costs for remediation and inconvenience for the users of the building. There are three now grades of seriousness of defects plus information about number of defects to be investigated further.

By using an average rate for costs per man hour it is possible to convert the new information to the former method and in this way to maintain continuity.

For the question concerning the clients satisfaction there were 11 questions to be answered. These have been reduced to 8. A new KPI is a question about client loyalty.

This simplification also implies that it will be up to the clients to report the necessary data for calculation of KPIs but the contractor still has to confirm the data.

It is the opinion that the simplification will not give the clients and the companies' poorer information than before but there is still some doubts about how KPI's will be included in the project and enterprise management systems and how the performance will be improved in the future.

2.3 Public housing DK03

User needs and benchmarking of economy

This chapter focuses on the organisation, assessment methods and applied indicators of BOSSINF, a public benchmarking system monitoring the costs of public housing.

2.3.1 The actual benchmarking organisation and its purpose

The BOSSINF system is an electronic reporting, management and information system for the administration of public funded housing. BOSSINF started in 1992 in order to establish a consistent foundation for reviewing and handling applications for public financial support to built public housing by the local authorities in Denmark. The establishment of BOSSINF was a part of the decentralisation of the handling of the funding applications in relation to public housing. Today it is still the local authority that handles the applications, on a consistent foundation defined by the Ministry of interior and social affairs.

The purpose of the system is to manage the funding of public housing, monitor the acquisition and building costs and the projects compliance with the legal requirements.

BOSSINF covers only public housing: youth housing and housing for elderly. The public housing in Denmark includes 541.500 dwellings. On average 5.000 new dwellings in public housing has been built every year since 2000.

It is mandatory to deliver data to the system in order to get public support to a public housing project; the application for public support is at the same time input to the system. Therefore the system covers all public housing, and public supported youth housing and housing for elderly.

The Ministry of interior and social affairs is the administrator of the system, KMD, an IT enterprise, takes care of the daily operation and administration of the system.

2.3.2 Assessment applied in the benchmarking organisation

The data to the system is collected by the local authorities. The housing organisation (client) submits the data as a part of the application to get public support to a housing project and building permission from the local authority.

The data is delivered from the client three times:

– The first time application form A is delivered before the tendering of the housing project (before or during the design phase in the CREDIT carpenter model). The data in application form A is based on the estimate made by the consultants on the project. If the client gets acceptance from the local authority, the project for the housing can be put out to tender. When the tendering process is ended and the contractors chosen, the client delivers application form B to the local authority with figures based on the bid from the tender (after the design phase in the CREDIT carpenter model). These figures are calculated by the contractor based on prize lists or databases.
– When the building process is ended the client delivers form C with accounting figures from the different costs (after construction in CREDIT carpenter model) based on the client's accountancy of the project.

The procedure is digital. Either the data is entered directly in a digital application form by the client, or it is entered by the local authority with data from a paper application form.

2.3.3 Cost and performance indicators applied in benchmarking

The key figures related directly to the indicators in the application as the average (plus upper and lower quartile) acquisition costs distributed on site costs, construction costs, and expenses and differentiated between 4 different building types.

The spaces for entering data in the application and the key figures are parallel to CREDIT Indicator classification 1.1 - capital, investment, construction and commissioning costs, 2.2 – Plot opportunities, 3.1 – Category of building, quantity, size and area, 4.1 – Building parts, quantity, size and area, 7.1 – Resource use.

After 2006 the publishing of these key figures have stopped. The reason is probably that there since 2004 have been a fixed maximum amount allowed for the cost per m² for public housing. Therefore, the figures on the acquisition costs per m² will be equal to the maximum amount per m².

2.3.4 Relation to enterprises, building project and real estate

BOSSINF is a governmentally initiated system established to ensure a consistent foundation for the local authorities when handling the applications for public financial support to public housing.

Interest groups such as The National Association of Local Authorities in Denmark and the Danish Construction Association, use the BOSSINF key figures for their political work.

2.3.5 Visions and innovations for future improvements

Currently there are plans for simplifying and modernizing the system:
– In the future it will be required that the client/ housing organisation enters data digitally.
– The spaces in the application form will be simplified. The specification of the different construction cost will be made less detailed, because it is inappropriate in its current form.
– The application form will include more data on life cycle costs with more detailed specifications based charts of account from the operation of the building.

The accounts for public housing follow a standardized chart of accounts and the accounts are submitted to the Ministry of the interior and social affairs. On the basis of these accounts the Ministry of the interior and social affairs publishes key figures for the facility management costs for public housing specified in 5 categories:
– net capital costs
– water and sewers
– cleaning
– net maintenance
– remaining costs.

In 2007 key figures on contractors' were introduced in relation to public housing and 2008 key figures on consultants' performance were introduced. The client evaluates both the contractor's and the consultant's performance on a building project. The key figures for consultants relate only to the design phase, whereas the key figures for contractors are based on data from

both the construction phase and data from an inspection of the finished building. On the basis of these data a mark for the performance is calculated (see CREDIT DK case 02). These key figures will be published on the Danish Building Defect Fund's web site.

The data in BOSSINF reflects what is needed in the management of the application for funding for public housing and secure the projects compliance to the legal requirement. Therefore, the focus is on acquisitions costs, and the management and tendering in project. But there is a growing wish to know more about the users/dwellers experience of the quality of the same buildings.

2.3.6 Lessons learned and recommendations

The BOSSINF system has a very high coverage in the field of public housing because the application from the housing organisations for public financial support is at the same time input data to the system. The system is initially intended for that management of the applications and not as a benchmarking system. The benchmarking part is a spinoff of the application management. The connection between delivering input to the system in order to receive support seems to be a very reliable way to secure input data to a system.

Data is submitted three times, in relation to the CREDIT Carpenter model after briefing, design and construction. The BOSSINF system relates only to the acquisition costs and project management and therefore only to the construction bubble in the Don Ward model.

The indicators relates to CREDIT Indicator Classification 1.1 - capital, investment, construction and commissioning costs, 2.2 – Plot opportunities, 3.1 – Category of building, quantity, size and area, 4.1 – Building parts, quantity, size and area, 7.1 – Resource use.

BOSSINF is a governmentally initiated system, and the submission of data is mandatory therefore it belongs to the mode lll - the public non profit benchmarking systems in the benchmarking typology.

The system is only intended for control of economy and compliance with legal requirements, therefore it influences only the conduct in the public housing projects in that respect. Over the years different focus areas such as life cycle costing, accessibility or quality management has been advanced linking the allotment of public funding with requirements of including these focus areas in the project.

After 2006 the key figures on acquisition cost distributed on different entries has ceased to exist apparently because of the fixed maximum for the costs per m². This fixation means that the costs per m² always will equal the maximum amount.

Nevertheless, the way the costs are distributed on the different expenses must vary form project to project as well as from one part of the country to another despite the fixed price per m². Such information could be as interesting as the former output form BOSSINF.

Besides, it's high coverage of the field and the broad range of input data from different stages in the process points at the possibilities to let a system like this have a greater impact on the conduct in projects by including a broader range of input.

2.4 University buildings and energy labelling DK04

Directives for and benchmarking of energy demand

This chapter focuses on the organisation, assessment method and tools and indicators of the Energy labelling system EMO, a national mandatory labelling system. In its current form EMO has been functioning in three years, but it is built on former versions, that with many revisions go back to 1979.

2.4.1 The actual benchmarking organisation and its purpose

EMO is administered by the common secretariat for inspection and labelling systems (FEM-sekretariatet) placed at the Danish technological institute. FEM secretariat educates the energy consultants that perform the labelling, When the labelling end report is executed FEM secretariat control that the consultant and his firm is authorized, and that the data about the building in question are in accordance with the BBR register.

It is the owners of the buildings that pay the authorized energy consultant to make the assessment and suggestions for improvements that the label consists of. The consultants come typically from architectural or engineering firms.

2.4.2 Assessments applied in the benchmarking organisation

The data for the EMO label and report is collected and calculated by authorized energy consultants, educated for the task by FEM – secretariat.

The data is collected from:
- the BBR (building and housing register)
- the owner or organisation that houses the building
- registrations of consume of energy, water and operational conditions of energy consuming installations
- the drawing material and specifications on the building, building parts and materials
- an inspection of the house made on site.

2.4.3 Cost and performance indicators applied in benchmarking

The indicators in the energy efficiency labelling system EMO concern:
- contributions to the energy demand (heating, electricity for running the building, temperatures that exceed the limit for the temperature)
- the net energy demand (heating the space, warm water, cooling)
- selected electricity demands (lighting, heating the space, heating warm water, heating pump, ventilators, pumps, cooling)
- loss of heating in the installation (heating the space, warm water)
- output from special sources (solar heat, heat pump, solar cells).

The EMO indicators relate to 3.1- Category of building, 4.1- Category of building parts, 4.4 -Thermal quality, and 7.1 – resource use in the CREDIT indicator classification.

These indicators (input data) are summed up in a label, a general indicator (output data) for the energy demand for the specific building. A building can get a label on a scale that ranges from A1 to G.

The label A1 is given to the building with a very high level of energy efficiency that conforms to the strictest requirements (office buildings and institution 50 kWh per m² + 1.100 kWh divided with m² heated area, for dwellings 35 kWh per m² + 1.100 divided kWh with m² heated area), label A2 for the

second best (offices and institutions 70 kWh per m² + 1.600 kWh divided with m² heated area, dwellings 50 kWh per m² + 1.600 kWh divided with m² heated area). Label B is given to the building that conforms to the general requirements in the Danish building regulations (offices and institutions 95 kWh per m² + 2.200 kWh divided with m² heated area, dwellings 70 kWh per m² + 2.200 kWh divided with m² heated area). The label G is the purest level of energy efficiency (offices and institutions 265 kWh per m² + 6.500 kWh divided with m² heated area, dwellings 240 kWh per m² + 6.500 kWh divided with m² heated area).

2.4.4 Relation to enterprises, building projects and real estate

The EMO label and report is an assessment of the individual building and is meant as a tool to get an overview of the energy efficiency of the building for the owner or enterprise that is responsible for operating and maintaining the building. Besides the calculation of the current energy demand of the building, the report gives specific suggestions for improvements and calculates the profitability of these improvements. This input about improvements can be used in the strategic pre-project phase or as general considerations in the maintenance.

EMO is governmentally initiated, and a mandatory system. Likewise are the developed assessment methods and tools governmental initiatives.

2.4.5 Visions and innovations for future improvements

The objective with EMO is to establish increased attention on the energy consumption and thereby initiate energy saving improvements and renovations.

By the end of 2008 an evaluation of all the Danish energy saving initiatives was published in a report, among these the Energy labelling system EMO.

The report concludes that EMO is not cost efficient in its current form:
- Though it is mandatory for all buildings with an area that exceed 60 m², more than half of the buildings that ought to be labelled, are not. There are no sanctions for not labelling one's building.
- The evaluation assesses the system as expensive because the label is based on a consultant's analysis of every building on the basis of an inspection of the building and building drawings and specifications rather than on data that can be extracted from meters and other registrations.
- A survey done in 2002 (by AKF, to be published in 2008) among single-family houses showed that there was no difference between houses with an energy label and house without regarding the energy consumption and the number of energy renovations.
- Among the 1.546 large buildings that had been labelled from 2006 to 2008, 837 (54 %) had got the same label as their last label. This means that the suggestions for improvements have not been followed, or that the suggestions have not been significant enough to change the energy label form one level to another.

The evaluation points out the meeting of obligation, data collection and the quality of the energy saving suggestions as weaknesses of the system that ought to be looked at in a revision of the system.

The Danish Energy Agency has planned a series of improvements of EMO on the basis of this evaluation. These include among other things:
The labels will be made public for free including the data that forms the basis for the giving the label and active information about the label will be given to

target group (building owners, craftsmen, contractors, consultants and finance institutions).

The labelling will be differentiated; with a more thorough inspection of old building where the potential energy savings will be bigger, and a less thorough inspection of new buildings.

Also the interval between the labelling will be differentiated; the label given to an energy efficient building will last longer than the label given to a building that is not energy efficient.

The task of the common secretariat for inspection and labelling systems (FEM-sekretariatet) will become more focused on quality management of the work done by the energy consultants as well as play a more facilitating role in relations to the energy consultants' work.

2.4.6 Lessons learned and recommendations

The EMO label system is a revised version of former systems (ELO, EM) and is intended for the individual building owner or administrator as a tool for the planning of renovation and maintenance.

The calculation and assessment methods are well incorporated in the sector because the calculation tools (Be06) are the same that since the last version of the Danish building regulations came out in 2008 has been used in the planning phases to certain that the planned building comply to the requirements of the Danish building regulations. The indicators (input data) sed in EMO relates to 3.1- Category of building, 4.1- Category of building parts, 4.4 -Thermal quality, and 7.1 – resource use in the CREDIT indicator classification. Output data - the label is a letter (A1 – G) that is linked to the level of resource consume as kWh per m².

Initiative to establish EMO labelling system was governmental and it is a mandatory public non-profit system (in relation to CREDIT benchmarking typology) though the actual task of calculating/giving the labels is done by privately paid consultants.

An evaluation of all the Danish energy saving initiatives was published in a report among these EMO, questions whether the system is cost efficient. The evaluation points out three weaknesses of the system that ought to be looked at in a revision of the system:

– the owners meeting of obligation (only half of the building that are covered by EMO do actually have a label)
– the comprehensive data collection and analysis (based on the consultants inspection of the building as well as drawings and specifications of the building and building parts)
– the quality of the suggestions that is part of the label of the system (many buildings get the same label again after 5 years, which indicates that the suggestions are not significant enough).

In relation to CREDIT this case shows:

– that there are well established indicators on energy demand and consumption in the sector that are applicable in relation to benchmarking
– points at the problematic in having a mandatory system without sanctions when building owners do not meet their obligations
– the weaknesses in having a system that is based on the incentive the owner gets from the labelling report of his building, if the profitability of the suggestions in these reports is not significant.

2.5 Benchmarking private housing DK05

Search engines at estate agents

This chapter focuses on national search engines for private homes, which can be used to benchmark private homes. In this chapter, we will take a take the website www.boligsiden.dk as our starting point, since this has been a very prominent search engine for private homes.

2.5.1 The actual benchmarking organisation and its purpose

Financing

Until recently (2008), the operation of the site has been financed by contributions from the association of estate agents and the chains of estate agents. When the company was formally and physically dissociated from the association, a new financing scheme came into existence. Besides the income from issuing shares to the shareholders, the website now also gain income from selling various banner commercials.

Coverage of building types

The search engine covers both existing buildings and new building (typically project development). The following types of buildings are included:

- single-family house/detached house
- semi-detached house
- dwelling
- dwelling in small detached house
- summer cottage
- farm house
- vacant building site for summer cottage
- site for all-year housing
- tenants-owner housing.

Market share

The search engine includes only private homes for sale from professional estate agents and not from private individuals. Although some private homes are sold by private individuals, the overwhelming majority is sold with the assistance of professional estate agents. At present (April 2009), some 75.000 homes are for sale.

Despite hardly any marketing of the website, the search engine quickly generated a very significant traffic after its start. According to counts made by FDIM as of April 2009, www.boligsiden.dk is one of the top 50 Danish websites with more than 400.000 unique users each month.

2.5.2 Assessment applied in the benchmarking organisation

Data for www.boligsiden.dk is collected and delivered by the estate agencies. Data stems from the sheet of information.

Updating of data can take place whenever the estate agencies want to. Automatic updates are installed by most estate agencies. Most estate agencies choose to have several daily updates. Only a few choose to have one daily update typically by night.

Whether incoming data is correct or not, is not checked by the administration of the website. Rather, this is the responsibility of the individual estate agencies as part of their normal duties as estate agents.

2.5.3 Cost and performance indicators applied in benchmarking

In the first 10 year life time, the search engine and portal was only changed slightly. The content of the portal (as of November 2008) is divided in three focus areas:

– search for housing: data on all houses for sale in Denmark in order to give a comprehensive overview of the housing market
– the ABC of housing: information on the sale process step-by-step including guidelines, tools and documents
– housing statistics: the recent update of the site includes various statistics on the housing market in general and with search options for your specific neighbourhood.

The search results are shown in the Figure that follows.

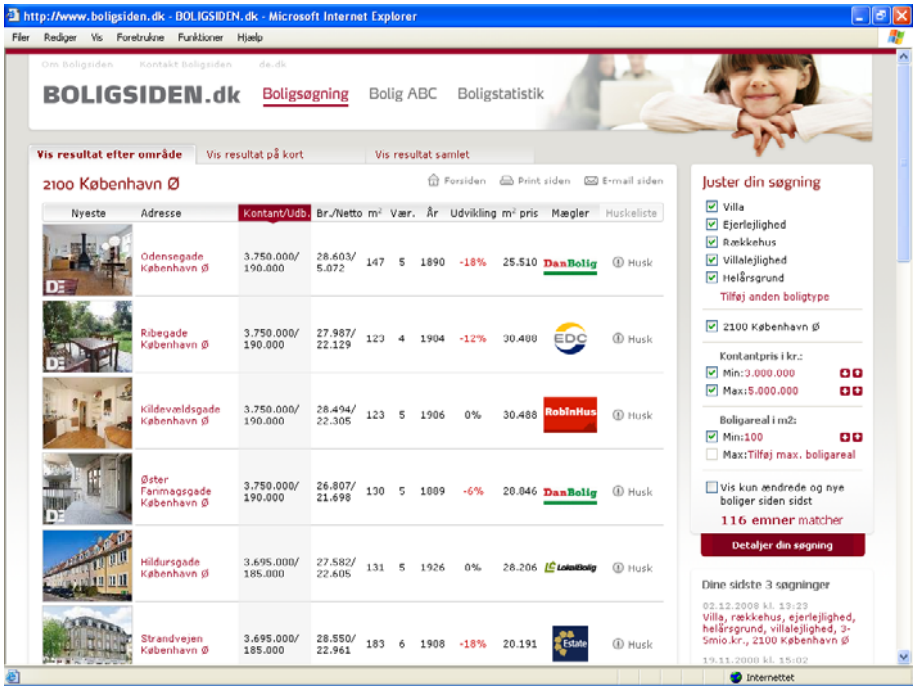

Figure 5. Search results.

The search results will be displayed with a number of key indicators:

– a picture of the house
– the address
– price/down payment
– gross/net payment/price per month
– size in m^2
– number of rooms
– building year
– change in price in % since first advertised
– price per m^2
– real estate agent: logo
– add/create your own list.

2.5.4 Relation to enterprises, building project and real estate

One of the contested features of the search engines has precisely been the transparency, since a search engine makes it possible not only to display and market your own product, but also your competitors. Thus, the search engines gives the estate agents an opportunity to closely *monitor your competitors'* way of marketing, market shares, valuations etc. Consequently, some of the estate agents have been reluctant towards the search engines.

2.5.5 Innovation and visions for future improvements

Until 2007, Boligsiden A/S hardly did any innovation or development of the website. The rationale was to keep activities at a minimum in order to comply with public regulation and nothing more. The management of the website was located at the Danish Association of Chartered Estate Agents, where one person took care of the website as a minor part of his job. The activities primarily included support, which was outsourced to an ICT firm.

This situation changed quite dramatically in the beginning of 2007, when another website www.boliga.dk was launched. Inspired by Google and their previous job experiences from other search engines and portals like Jubii, the three founders of Boliga insisted on a different approach to search engines for private homes. Boliga did two things very differently from Boligsiden. First, location-location-location is a mantra among estate agents, still the search facilities in Boligsiden was linked to addresses, internal reference numbers or similar. Instead Boliga decided to implement interactive maps or rather aerial photos as the prime search facility. Second, being independent of the estate agencies Boliga took the buyers' perspective as the starting point. Thus, historical data on price reductions/rise and duration of the waiting time/selling period was included in the search facilities. These facilities quickly generated massive traffic on the website.

The emergence and immediate success of Boliga put pressure on Boligsiden. While Boligsiden obtained data from the estate agencies through a predetermined and fixed database structures and reporting routines, Boliga obtained data by simply web-crawling the sites of the estate agents to harvest data typically at night. This was considered intrusive by the estate chains and the association of estate agents, and the chains decided collectively to block for assess by the search robot of Boliga. This was done by blocking the IP addresses identified as belonging to Boliga. This made feelings run high in the media. Consequently, the competition authorities became involved. After about two weeks of blockade, the estate chains and the association of estate agents were subjected to open access to the sites again. The swift action was possible since a similar case involving Ofir and the association had been taken to court some time earlier. This case was lost by the estate agents. Shortly after, a redesigned version of Boligsiden was launched. This redesign was, however, already underway according to Boligsiden itself.

But the pressure had two other significant impacts. First, Boligsiden was effectively transferred to a commercial company owned by the shareholders constituted primarily by the estate agents and with only a small amount of shares to the association. With the transfer a new innovation strategy was deployed. The secretariat has been expanded to 3-4 full time employees although technical support and development is still outsourced. But being less tied to the association has opened up for a more commercial road ahead, which include selling banner commercials and deploying more extensive user analysis through web questionnaires and search profiles than previous. Second, along with transfer of Boligsiden an agreement was settled between the chains of estate agents to do cross-referencing of items on sale, thus effectively creating 6-7 national search engines.

2.5.6 Lessons learned and recommendations

On a national level, the assessment methods and tools applied in the marketing and sales process include the two national search engines for private homes:

– www.boligsiden.dk.
– www.boliga.dk.

The lessons learned on usability of the two national search engines can be summarised in four conclusions.

The first question to answer is if the search engines are being used at all. The two search engines are effectively being visited by some 3-400.00 unique users every month. Both search engines are ranked among the top 50 websites in Denmark judged by their number of visitors according to FDIM (www.fdim.dk) – the Danish association of interactive internet media.

The second question of usability is about the purposes for which the search engines can or are being used. As illustrated previously, the search engines serve various purposes. These purposes include e.g. compliance with public regulation in particular regarding www.boligsiden.dk, marketing, market transparency and ease of comparisons in the search and selection process of buyers. Ironically, the search engines are apparently also being used by criminals to select the most appropriate house to break into.

The third question is whether the results of the assessments are reliable and valid. Since the base data stems from the estate agencies, the reliability and validity is basically dealt with at the real estate agencies. The question is rather if it is the most appropriate and relevant data being presented at the search engines. The rapid success of and the controversies surrounding www.boliga.dk illustrates that at least buyers are evidently looking for other types of information than originally provided by www.boligsiden.dk, most notably on price alterations and the sales period along with the interactive map search features.

The fourth question is whether the search engines are worth the effort. Two facts point at the value of the search engines. First, the accessibility to information has been greatly improved, which benefits the buyers in particular in their search and selection process. Second, the competition between the major chains of estate agents and the two national search engines – in particular the harsh attacks on www.boliga.dk from the association of real estate agents – emphasise the commercial value of search engines seen from the perspective of estate agents and mortgage institutions.

Our recommendations on benchmarking system level can be summarised as:

– the core indicators are building type, map based location, economy and size
– given the diverse and very different requirements set by the individual user, it may be more appropriate to skip the idea of having a star-rating system as indicated in the CREDIT application, and instead establish search options that can be individually optimised by the users to serve different purposes
– an intelligent interplay between public regulation and market forces can potentially create a very powerful benchmarking-like system
– unhindered accessibility of basic data is crucial.

Summing up, the study concludes that search engines include a number of indicators, assessments and search facilities that can be applicable in CREDIT. Further, search engines represent a highly valuable approach to setting up an international benchmarking system that is dynamic in nature, user-oriented and cost-effective.

2.6 Benchmarking commercial property DK06

Retail, office, residential and industrial buildings

This chapter focuses on the systemic qualities of the Investment Property Databank's 'IPD Denmark Annual Property Index'. Systemic qualities refer to the operation, organisation, management and institutionalisation of this benchmark system in a Danish context.

2.6.1 The actual benchmarking organisation and its purpose

The IPD Denmark Annual Property Index is financed through membership to the Danish Property Federation. An arrangement initiated and sanctioned by the members of the federation. An estimated 48 % (measured in total capital value) of the professional investment market is covered by the IPD Danish Annual Property Index.

2.6.2 Assessment applied in the benchmarking organisation

The IPD databases hold records of properties owned by investors and managed by portfolio managers. Validation of data is, regardless of which country index is being constructed, conducted centrally from the IPD headquarters in London. This is done in order to ensure that the IPD system can be considered consistent across country borders.

Table 1. Data on properties recorded in the IPD database.

Indicator	Description
Location	Address, postcode, type of location.
Investment interest	Type of investment, owner occupied status, tenure, ownership share.
Direct property type	Predominant current use, percentage use mix.
Physical/historical data	Building condition, listed building or conservation area status, construction date.
Purchase data	Method of acquisition, purchase date, gross and net purchase price, purchase costs: stamp duty, legal fees, agents fees, other fees.
Sale data	Sale date, gross and net sale price, sale costs: legal fees, agents' fees, other fees. Sales are dated to the end of the month.
Valuation data	Valuation date, managing agent, valuer (company name), open market capital value, open market rental value, rent passing, net lettable area, current gross, net, equivalent yields and cap rates, method of valuation.
Lease and headlease details	Tenant name, tenant use, lease start and expiry dates, rent review dates, whether upward only, step dates and amount, rent review frequency, lease status, gearing information, net lettable floor space, date and type of break clause, rent passing, open market rental value.
Vacancies	Start and end dates of last vacancy, days vacant, anticipated letting date.
Capital expenditure and receipts	Development expenditure, on-going capital expenditure, transaction costs, part purchases and sales, other capital receipts.
Revenue expenditure	Ground or head rents, property management costs (base management fees, rent review fees, lease renewal fees), other irrecoverable revenue costs including expenditure on vacancies and bad debt write-offs.
Rents and income	Rent passing, contracted rent, rent receivable, other income, net income receivable. Income is recorded in daily amounts.

2.6.3 Cost and performance indicators applied in benchmarking

Each directly held asset (building) that attracts a separate open market capital valuation is individually recorded in the IPD database according to the indicators shown in Table 1.

2.6.4 Relation to enterprises, building project and real estate

IPD measures total returns to directly held standing property investments and thus covers part of the process of building operation. Further in relation to the use of the IPD indices and benchmark in enterprises, the data is used in sales and procurement decisions.

The Danish Property Federation maintains the so-called Property Statistics Database (Ejendomsstatistikken), which is a collection of data within nine different areas based on information from a series of different sources – public authorities as well as private players in the property market. From this database a total of 105 different output charts can be created, 11 of which stems from the IPD Denmark Property Index.

2.6.5 Innovation and visions for future improvements

IPD utilises valuation data as the core information source for their performance measurement indices.

Concerning visions for the future and the innovation strategy of the IPD Denmark Annual Property Index, it can be argued that a two-stringed strategy is followed:
– First, there is the *demand-pull* from members and national associations.
– Second, there is the *technology-push* from IPD to the members.

Demand-pull

The Danish Property Federation also conducts a series of conferences and member meetings, where feed-back on the use and content of the system is gathered. Moreover, and in addition to the more informal feedback gathered this way, a formal member satisfaction survey is conducted each year.

Technology-push

Recent years, several specific issues have been addressed within the Danish IPD system when dealing with possible changes. Most notably concerning the frequency of data reporting (on the input-side), but also indicators for sustainability has been considered for inclusion in the system (e.g. pertaining to energy consumption and the like). According to the Danish Property Federation, these indicators have not yet been implemented in Denmark; however IPD will be able to provide the indicators – are the members willing to pay the cost.

2.6.6 Lessons learned and recommendations

On the systemic level this is a case of a voluntary international benchmark system promoted by the 'parent' organisation as a means of creating transparency in the market and adopted by companies in order to compare their investments to those of the market, and thus promote their own investment portfolios *vis-à-vis* those of the rest of the market.

We concur with the statement that the system brings transparency to the market, as it is immediately possible to attain information on the financial performance within various segments of the market across different geographical locations.

The system is institutionally anchored at an umbrella organisation that collects data and coordinates between the different users of the system. This seems to be a pre-requisite for the operation of the system, and hence for the fulfilment of the purposes of transparency in the market, as it ensures that uniform standards, measures and methods are used.

The market can therefore rely on the accuracy of the data (for comparative purposes) given that they accept the premises of the system – including the use of valuations rather than sales prices. This however should not pose a problem in that all the premises for the operation of the system are readily available for scrutiny.

Conclusions on the system

Looking into the technicalities of the IPD system, it is possible to draw attention to some of the features of the applied methods that can account for usability concerns. From this perspective, the usability of the assessment methods and tools can be summarised as follows:

Use of existing data: IPD to great extent relies on pre-existing data from auditing reports, tax authorities, external valuators and external accountants. Following a reduction in the amount of data to be delivered to the system initiated a few years ago, the system has become simpler to use in terms of the time consumption required in the data input process.

Automated validation process: An important system feature is the attempt to eliminate human errors in the reporting of data, by flagging possible data errors, including responses outside specified ranges, missing data in essential fields, missing financial records, and exceptional growth/performance numbers. This contributes to the credibility of the system.

Uniform inputs and results: Every country in the system input the same type of data and is given the same output in order to facilitate comparative purposes.

CREDIT information model – decision making as focus

In relation to the CREDIT information model the main feature of the IPD system *from the point of the users* (i.e. the property investors) is that IPD Denmark Annual Property Index is seen as a tool for making decisions about future investments and rationalisations. Focus is placed on presenting output data for use in decision processes rather than on rigidity of input data.

In the terminology of the CREDIT benchmarking typology model, the IPD arrangement can be seen as a cross-over of a business model and an association model. Part of the success of the model can be explained from the fact, that the IPD benchmarking system is not a stand-alone solution offered to the market.

In a Danish context, IPD is part of a larger 'package' of paid services that the different enterprises (i.e. property investors and owners) pay for through their membership of the Danish Property Federation. As such the system is institutionally anchored at an association, which the members acknowledge serves their specific interests. At the same time, members are provided by the IPD with the tools necessary to conduct benchmark of own portfolios in relation to the rest of the market. An important element in actually realising this objective is the *historicity* of the system. IPD's long track-record and consistency in data input and output formats can be considered part of the reasons for its success.

It is recommended that the wider organisational and institutional embedding and anchorage of a CREDIT benchmarking system is considered in the further deliberations in the CREDIT work groups.

2.7 Operation of an office building DK07

Danish Facilities Management benchmarking

The chapter describes the organization of DFM-benchmarking and the co-operation among the property owners in the network which is the organizational framework for the work. Furthermore the procedures and the use of the resulting KPI's are described.

2.7.1 The actual benchmarking organisation and its purpose

The background to DFM benchmarking was a wish and a will from a group of clients to voluntarily strengthen the operation of a building concerning costs as well as quality. Furthermore they also saw a need for a better tool for budgeting operation and for comparing the actual operation with the work in similar buildings.

Some KPIs are published in the press and for example used for considerations concerning the costs of operation of a single building or of buildings at a local area.

All professional owners of properties can become members of DFM-benchmarking. They have to pay 10.000 DDK and it is obligatory to participate in the yearly gathering and delivering of data to form KPI's

The driving force or the incentive is the wish from the responsible manager on a voluntary basis to reduce the costs of the operation of a building or strengthen the quality.

DFM-benchmarking cooperates independently and through DFM with similar organizations in other countries. The organization was established in 1996 and has now 50 members mainly from bigger property owners, among these public authorities as municipalities.

2.7.2 Assessment applied in the benchmarking organisation

It is up to the client and the manager of operation of the mentioned building to collect data concerning the different operational activities.

The secretariat in DFM-benchmarking rewrites the data from members of the organization to Key Performance Indicators (KPIs) which are published only for members. They form the basis for systematically comparisons and exchange of experiences at workshops and yearly reports.

2.7.3 Cost and performance indicators applied in benchmarking

The described data – and KPI's – belongs mainly to CREDIT indicators concerning group "5. Facility performance in operation and use" but they are also of interest for the groups 3 and 7. They are on level two and three.

Buildings are divided in groups as schools, kindergartens, and offices. The indicators are the same.

2.7.4 Relation to enterprises, building projects and real estate

The DFM-benchmarking secretariat works out statistics concerning operation of buildings for the members of the organization and take initiative to seminars where results are presented. The seminars give members possibility to exchange experiences and to evaluate their results.

The handling of data has been digitalized. Data collection occurs in the FM management function of each company – member of DFM benchmarking, see Annex

The resulting KPI's are mainly used of the members in their individually work and as the basis for seminars and workshops where the participating members of the network exchange experiences and get information to reduce costs or increase the quality of the operation.

2.7.5 Visions and innovations for future improvements

Lessons learned from many years of data collection, analysis and comments from users have led to a revision into a simplified and improved version of the web-based analysis system which now has been taken into use.

There are no plans for the moment to further alterations in indicators or organization

2.7.6 Lessons learned and recommendations

The described data – and KPI's – belongs mainly to CREDIT indicators concerning group "5. Facility performance in operation and use" but they are also of interest for the groups 3 and 7. They are on level two and three.

Data from the actual building and the KPIs from DFM-benchmarking secretariat are used as a basis for budgeting the costs and key data for the coming year. At the same time they give a platform for monitoring the actual operation.

The system has shown to be a good tool for such a monitoring of the operation of a building and as a starting point for exchange of information at seminars and workshops.

It is also possible to compare actual costs with costs from former years and from other buildings. In this way it is possible to evaluate the consequences of initiatives to reduce costs or to increase quality of services.

Lessons learned from many years of data collection, analysis and comments from users have led to a revision into a simplified and improved version of the web-based analysis system which now has been taken into use.

There are no plans for the moment to further alterations in indicators or the organization.

The case shows how it has been possible on a voluntary basis to establish a benchmarking system and get a group of property owners to participate in the organization. The numbers of buildings in square meter covers meanwhile only a minor part - about 1-2 % - of the total number of buildings in Denmark.

In an international perspective the experiences up to now have shown that a condition for a further effective cooperation with other countries depends on whether it is possible to get into contact with similar organizations and there are international standards.

It is recommended that the Danish experiences concerning motivation and driving forces of a voluntary benchmarking system – as wish and will for effectiveness and quality – are channelled into considerations for future work with benchmarking.

2.8 Defects in housing, Musikbyen DK08

Danish Building Defects Fund (BSF)

On the basis of one year and five year inspections the Fund has developed an extensive statistic about defects in housing which is disseminated to the industry and clients. The statistic is organized in accordance with the classification of indicators and companies involved in the actual project.

In this way it is also possible for clients and other interested persons and companies to see the results of a concrete project concerning defects related to different parts of the building, the client and the companies involved in the project.

The Fund also publishes warnings about specific methods, components or materials.

2.8.1 The actual benchmarking organization and its purpose

The Danish Building Defects Fund is the primary source of information on the building quality of Danish subsided housing. The Fund is an independent institution, which was established by law in 1986 as part of a quality and liability reform the same year. Further information can be found on www.byggeskadefonden.dk.

Since 1986 it has been obligatory for all housing projects with public support to register at the Fund and pay 1 % of the building costs including site to the Fund. Private housing projects can not register.

The Fund covers up to 95% of the expenditures for damage repairs that are claimed at the latest 20 years after hand over have taken place. After acknowledgement of a building damage, the Fund make liability claims to the responsible builder, consultants, contractors and suppliers as far as possible.

The deficiencies can be due to the design process as well as the work on the building site and the used components. Deficiencies will in few cases lead to a damage which gives breakage, leakage, deformation or deterioration and thereby reduces the use of the building. The Fund will pay the expenses for repairing damages.

All housing projects with public subsides have to register at the Fund and the Fund executes two inspections.

The results from the two inspections, one year and five years after hand over, are published on a homepage and used in publications.

2.8.2 Assessment applied in the benchmarking organization

Approximately 250 independent firms, consultants (architects and engineers) and other (i.e. contractors) carry out one year and five year inspections through out the country.

2.8.3 Cost and performance indicators applied in benchmarking

The inspections are executed in accordance with a general classification of the different parts of a building, which are used for types of public subsidised housing. They are the indicators.

The building inspection company register for all the parts of the building, which are essential for the lifetime of the building, whether the actual building part is in accordance with laws, regulations and likely, or if there is defect or damage.

Typically all building parts concerning the climate protection are registered, while for instance indoor equipment are not registered, because it has no influence on the lifetime of the building.

A *deficiency* means that the building materials, structures or building elements are in absence of properties, which should have been present. A *building damage* means a deficiency, which leads to breakage, leakage, deformations, impairment or deterioration in the building. Both deficiencies and damages must be caused by the building of the house.

Defects and damages must in details be described and photographed in the digital report that the independent firm carries out as a result of the inspection.

The Fund has furthermore established a classification for the seriousness of a deficiency or a building damage.

2.8.4 Relation to enterprises, building projects and real estate

The indicators are used, as described, when an independent company execute an inspection after hand over. In this way they are not used in the planning or construction of the actual project. But they are used in eventually repair work and in the operation of the actual building. And due to the dissemination of information and the rules for quality assurance they are part of the planning and execution of coming new projects.

2.8.5 Visions and innovation for future improvements

The Fund has recently decided to investigate, whether it is possible to change the law and the regulations for the Fund, so that in the future there will be no five year inspections.

The change is under consideration due to new rules for liability and because the five year inspections the latest years only registered very few new defect. The costs to carry out the inspections are very high compared with the costs to repair the few defects that are registered under year-five inspections.

Instead of that there will be an independent examination of the project before the design work is finished and tenders are invited and the work on the building site is started.

The examinations are supposed to be carried out by private firms like the one year and five year inspections have been carried out so far and so that the experiences can be used in future projects of planning, supervision and execution of non profit housing.

The examinations of the projects will be executed in accordance with a general classification of the different parts of a building – probably the same classification as the year one inspections. When a deficiency is observed, it is therefore also marked.

In this way it will be possible to target messages to the clients and industry and make warnings about defects and damages towards constructions and materials which often show defects in the examinations of projects.

The costs of examinations of projects are supposed to be approximately the same as for five-year inspections so far.

If this new arrangement is established, it will only have impact for projects, where the decision on public subsidising is taken after the law about the new arrangement is passed in the parliament.

2.8.6 Lessons learned and recommendations

On the basis of the inspections it has been possible for the Fund to develop an extensive statistic about defects in housing which is disseminated to the industry and clients. The statistic is organized in accordance with different aspects as clients (with concrete name), building parts after the classification and seriousness and involved companies (with concrete names).

If necessary the Fund also publishes warnings about specific methods, components or materials. Some examples are problems with stability of buildings, use of specific bricks and cement slates and roofs with light underroofing.

It is estimated that dissemination of information has reduced repair costs by at least 100 millions DDK per year. The number of estates with defects has been reduced from about 30 % to about 4 %.

It can also be mentioned that the Danish Parliament in 2008 issued a law concerning private housing. In accordance with this law it is obligatory for a developer or contractor to sign an insurance concerning possible defects in new private dwellings. The law is based on experiences from the Fund.

The Fund has recently decided to investigate, whether it is possible to change the law for the Fund and the regulations of the Fund, so that in the future the five year inspections will be cancelled.

The change is under consideration due to new rules for liability and because the five year inspections in the latest years only have registered very few new defect. The costs to carry out the inspections are very high compared with the costs to repair the few defects that are registered after five year inspections.

Instead of that there will be an independent examination of the actual project before the design work is finished and tenders are invited.

The examinations are supposed to be carried out by private firms like the one year and five year inspections have been carried out so far and so that the experiences can be used in future projects of planning, supervision and execution of non profit housing

BSF has been established for a specific group of clients and the clients have to pay to the Fund in accordance with a demand from the state. For an international exchange of experiences it has appeared to be important with similar methods and organizations with identical definitions of buildings defects.

It is recommended to organize benchmarking in accordance with a well defined target group and establish incentives for this group to participate. Furthermore it is important to have a well defined system for data with procedures for input and output. Last but not least it is essential with a framework for active participation from interested clients and companies in the use of the results.

2.9 Tulli Business Park FI01

2.9.1 The actual benchmarking organisation and it's purpose

In Finland KTI Institute for Real Estate Economics updates real estate indicators and related data. They update real estate index and several economical factors are included. Large real estate owners and consulting organisations publish also real estate indicator data mostly related to market information.

RAKLI ry and Rakennustieto Oy have published some years ago the national environmental rating sceme PromisE. KTI and real estate consulting companies provide benchmarking services. Universities and VTT make also some real estate benchmarking relating mostly with research projects.

2.9.2 Assessment applied in the benchmarking organisation

Different organisations have their own internal indicators applied for benchmarking. Cost related indicators are more or less the same in different organisations. Performance and qualitative indicators vary between different organisations and also the purpose of their use. Environmental rating system PromisE is used in some enterprises. So is VTT's EcoProP tool that can be used for setting and managing performance objectives.

2.9.3 Cost and performance indicators applied in benchmarking

Real estate index is used to follow success of real estate portfolio and to support investment and sales decisions. KTI's real estate index include following factors:

- yield from a property, %
- value change yield, %
- net yield rate, %
- market value, €/m²
- rent value, €/m²/month
- net yield requirement, %
- contract rent, €/m²/month
- over/under rent, €/m^2/month
- vacation rate, %
- gross yield, €/m²/month
- costs, €/m²/month
- net yield, €/m²/month
- capitalization, €/m²/month
- market value, € or %-share
- real estate sales contract numbers.

The above economical factors and indicators are generally used in real estate assessments and benchmarking. Rent value is divided into capital rent and maintenance rent (running costs). Generally used performance indicators are energy kWh/year and water consumption m^3.

2.9.4 Relation to enterprises, building project and real estate

Enterprises can freely use any indicators or indicator system they see beneficial. Building regulations set a minimum level for some indicators like energy consumption. Building owners' requirements can push developers and contractors to use some specific indicator or rating system and verify that buildings meet the requirements. There are couple of possibilities for such a system. For example in Finland some owners and developers, such as Pöyry, one of the leading consultants in Finland, are committed to LEED rating, while others in the industry see BREEAM as a better alternative.

LEED (Leadership in Energy and Environmental Design) rating provides a comprehensive sustainability report for a building. The rating encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. LEED certifications are available to s a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings.

BREEAM (BRE Environmental Assessment Method) instead is used for evaluating a building's environmental impact. It addresses wide-ranging environmental and sustainability issues and enables developers and designers to prove the environmental credentials of their buildings to planners and clients. Assessment system is used by trained assessors.

2.9.5 Visions and innovations for future improvements

It's possible to forecast that importance of benchmarking is growing in the future. One reason is new rising environmental and energy requirements as well as energy price risks. Differences between new buildings and old buildings are growing. It means at the same time that differences of market values will be bigger between new and old buildings.

Most of the indicators are needed in more than one phase during a life cycle of a building or even in all main phases. We can benchmark performance requirements, design criteria and performance in use. During construction process and handing over clear performance indicators and criteria are needed for verification. In the future need to find clear sustainability indicators, such as in LEED and BREEAM systems, is growing.

2.9.6 Lessons learned and recommendations

Benchmarking was based on official building regulations and different assessment and benchmarking methods. The main goal in assessments has been earlier to find out market value of a real estate "Finnish real estate assessment handbook (1991)". The most important factors which was represented to influence on market value of a real estate were size of a town, location, access to pedestrian, parking, plot solution, size of a building and space solutions, modifiability, condition, rent contracts, plot ownership, opportunity of a plot, unused permitted building volume and neighbourhood. These factors are still essential in real estate assessments and benchmarking.

Nowadays and in the future performance, usability, ecological and energy aspects will be much more highlighted in national benchmarking. Enterprises and organisations can use different indicator systems and assessment methods.

2.10 Baltic Sea House FI02

2.10.1 The actual benchmarking organisation and its purpose

Some most important real estate benchmarking organizations acting in Finland are Catella Oyj, KTI Kiinteistötieto Oy, Newsec Oy, Statistics Finland and VTT.

2.10.2 Assessment applied in the benchmarking organisation

Every organization has their own internal benchmarking systems.

2.10.3 Cost and performance indicators applied in benchmarking

Sponda Oyj uses wide range of cost and performance indicators in its daily operations. Cost and energy consumption indicators applied by Sponda Oyj are listed in the following table. Sponda Oyj utilizes various key performance indicators produced by FIMX maintenance system and condition surveys and assessments.

Table 2. Cost and energy consumption indicators applied by Sponda Oyj.

Administration	€/m^2, month
Operation & Maintenance	€/m^2, month
Maintenance of outdoor areas	€/m^2, month**
Cleaning	€/m^2, month*
Heating & Cooling	€/m^2, month
Water & Waste water	€/m^2, month
Electricity & Gas	€/m^2, month
Waste management	€/m^2, month
Insurances	€/m^2, month
Site lease	€/m^2, month
Taxes	€/m^2, month
Other running costs	€/m^2, month
Repairs	€/m^2, month
Heat Consumption	kWh/heated m^3/month
Water Consumption	m^3/net floor area/year
Electricity Consumption	kWh/m^3/year

* m^2: cleaning area

** m^2: oudoor area under maintain

In this case study three occupier organizations were also interviewed in order to find out their opinions of some performance indicators and on what level the performance of the building and premises was. The interviewees were asked the importance of each indicator and how they found the actual performance. The importance was asked by scale 1 to 5 where 1 was not at all important and 5 was very important. The results of the importance of each performance indicator/item are shown in the following table. The tenant organizations found all the indicators at least important (lowest average value 4,0).

Table 3. The average importance of the performance items according to three tenant organization interviews in Baltic Sea House.

Performance item / indicator	Importance of the item / indicator (Scale 1 to 5)
Rent	
- general information of the rent level in the area	4,0
- detailed composition of the rent	5,0
Quality of the building and indoor environment	
- brand and reputation of the building	4,0
- security and safety	5,0
- usability, flexibility and adjustability	4,0
- thermal comfort	5,0
- indoor air quality and healthiness	5,0
- cleanliness	5,0
- acoustics	4,7
- esthetics and visual signals	4,7
- feelings & sensations	5,0
Operation and maintenance	
- technical O&M	5,0
- caretaking of outdoor area	5,0
- waste management	5,0
- long term maintenance	4,3
User services	
- reception services	4,7
- catering	4,7
- meeting rooms	5,0
- car parking	4,3
- additional services available in neighbourhood	4,3
TOTAL	**4,7**

2.10.4 Relation to enterprises, building project and real estate

The benchmarking organizations mentioned above offer their services to any real estate owner/management/occupier. The scopes of services and types of contracts vary a lot case by case.

2.10.5 Visions and innovations for future improvements

Every organization has their own strategic goals and visions. The future improvement needs are based on these and it is not public information.

2.10.6 Lessons learned and recommendations

For benchmarking purposes it is essential that the indicators are exactly defined, uniform and easy to generate. This requires better and deeper cooperation from the actors.

The sophisticated management tools and systems of today produce huge amount of data. However this data is not fully utilized in practice. Refining this data could give a lot of added value to building owners, managers and occupiers.

2.11 Lappeenranta Tax Office FI03

2.11.1 The actual benchmarking organisation and its purpose

There are no commonly agreed or standardized global or European Key Performance Indicators.

2.11.2 Assessment applied in the benchmarking organisation

Benchmarking systems, such as the British OGC and GSA from United States, have been tested at Senate Properties.

2.11.3 Cost and performance indicators applied in benchmarking

The British OGC (Office of Government Commerce) has introduced a standardised framework to enable departments to measure and manage their own estate performance. It defines efficiency and effectiveness consistently for use by all departments and has been tested the performance framework on 130 buildings from four departments on following indicators:

- cost /m^2
- m^2/workstation
- workplace productivity including functional suitability, workplace environment and downtime
- environmental sustainability including kWh/m^2/year, Solid waste recycled, m^3/water
- operability including condition and health and safety.

GSA (General Services Administration) is the largest facility owner in the United States. It evaluates following characteristics from facilities:

- total square feet 759.000.000 rsf (office)
- cost per square feet owned $4.95 per rentable square foot
- vacancy rate 3.9 percent
- cost per person $14,200
- customer satisfaction 89 percent
- sustainability (LEED) 53 percent.

Further, GSA has also described characteristics of good work places, such as:

- workplace to meet the functional needs of the users
- a clean, healthy building environment, free of harmful contaminants and excessive noise, with access to air, light and water
- workplace configurations that can be readily restructured to accommodate key functional changes with a minimum of time, effort, and waste
- workplace services, systems, and components that allow occupants to adjust thermal, lighting, acoustic, and furniture systems to meet personal and group comfort levels
- full communication and simultaneous access to data among workers at both on-site and off-site workplaces
- workplaces with efficient, state-of-the-art heating, ventilating, air conditioning, lighting, power, security, and telecommunication systems and with easily maintained equipment with backup capabilities to minimize downtime.

Social aspects are present in Corporate Social Responsibility (CSR) strategies by enterprises that often use triple bottom line (economic, environmental, social) reporting. There are guidelines for CSR, e.g. Sustainability Reporting Guidelines (Global Reporting Initiative) that provide a structure for social aspects that is relevant also to sustainable construction. At present, they don’t directly help in development of standards for user requirements, building performance, or environmental and social impacts.

Social aspects can also be addressed on the building level like for example (ISO 2006b)
– quality of buildings as a place to live and work
– building-related effects on health and safety of users
– barrier-free use of buildings
– access to services needed by users of a building
– user satisfaction
– architectural quality of buildings
– protection of cultural heritage.

Global information about space utilization, normally square meters per worker, are published by DTZ Research (http://www.dtz.com). For example in Finland the space efficiency in offices is approximately 25 square meters per worker which really high compared to other European countries. Sustainability situation of each country and globally may also be checked through Environmental Sustainability Index ESI and Environmental Performance Index EPI.

2.11.4 Relation to enterprises, building project and real estate

Working environment covers all workplaces which are regularly used by working group or team. It has to be noticed that most of people work in many spaces and situations for example during work week, which may be analysed by means of work profile and space use analyses.

Workplace represents the convergence of facilities with spaces, management, user services, information technology and human resources. The responsibilities of facility managers extend beyond operating issues to the more fundamental goals of providing high-performing and sustainable workplaces. Remarkable basis of workplace development is to notice the interaction of user's business actions (workplace strategy) and premises. Perhaps the most remarkable development factor is ICT- and communication technology making it possible to serve clients even better as well as applying flexible ways of working. Place sends messages about corporate and group culture. Workplace process is connected with work psychology and environment psychology. Space efficiency may be measured with so called hard factors, such as:
– total use of spaces m^2
– unit use of spaces: m^2/person, m^2/action
– space cost totally, /person /action
– times of use of spaces
– amount of personalized working points
– cost per change (furniture, removing company, costs per personnel
– amount of waste paper and other wastes.

With regard to workspace structure, there is a general opinion that individual working rooms and individual workstations create satisfaction, while lack of those can be compensated with help of good architectural design and high quality ICT.

Effectiveness concerns self estimation: effects on productivity and client satisfactory as well as amount of sick cases. Expression may be noticed by client interviews; imago and reputation.

The spaces may be described as connective for social work, formal for silent work and reflective for marketing work etc. Everybody has some how different work styles; so working environment should aim at supporting personal productivity and satisfactory based choices at least with following interactions: face to face interaction and communication through internet.

The most important factors that affect productivity of work include:
– the quality of indoor conditions
– workspace structure
– comfort of work spaces
– flexibility
– interaction
– disturbances
– safety.

2.11.5 Visions and innovations for future improvements

Senate Properties has long traditions among workplace process being the leading service provider in Finland. Services cover support for planning process to produce better facilities (customer satisfaction), tool to create strategic relationships with clients (partnership agreements), tool to meet the government needs, and asset in real estate business.

Senate Properties' role in projects is procurement and project management, and it has partnership agreements with 10 workplace consultancies. The levels of workplace changes promoted by Senate Properties are:

Level 1. Improving space efficiency
– Shrinking and increase, utilization rates
– Improving usability and flexibility
– Eliminating workplace obstacles
– Relocation functions

Level 2. Alignment
– Multidisciplinary approach HR, spaces, ICT, services
– Diverse workplace solution supporting different needs and activities
– Knowledge management
– Branding

Level 3. Transformation
– New strategy/vision
– Process development
– Supporting mobile and distributed work
– Radical workplace solutions
– Flexible and diverse workplace and service strategy.

In the 2008 removals VTT’s space efficiency was improved by 20 %, but in average the change costs per person were however relatively high because of lacking well working solutions. Pay back time is over 1 year and real effects on productivity are hard to monitor. Therefore, it should be recognized that changes in cell offices have to be thoroughly considered and planned.

Table 4. Principles and effects of shrinking workers in box office.

Basis	**Solutions**	**Economical effects per person** (Case VTT; shrinking 20 %)
KeyPerformance analysis. Workplace strategy. Work profiles. Use clarification of common spaces.	Communication and motivation plan. Excursions. ICT –store. Furniture plans for different kinds of spaces and supporting furniture store. Increase of flexible ways of working. Interactive setting of teams/personnel. Ensuring lightning enough. Ensuring good inner climate. Office manual.	Change cost +1 800 €/person/time Space cost -1 200 €/person/year *about which* heating cost -200 €/person/year electricity cost -50 €/person/year

Technically the requirements concerning spaces shall be modified to technical definitions for example with following interactions:
– healthiness (HVAC technology, automation, materials)
– safety (structures and building systems and intelligent materials).

Integration of HVAC technology form an important factor of space management. Also new materials and censors change role of traditional physical elements like walls. They may also be reactive to changes in circumstances. Intelligent technology does also change during life time of space. It also may be applied to open source technology to which anyone may later increase some characters.

2.11.6 Lessons learned and recommendations

There are no commonly agreed or standardized global or European Key Performance Indicators. Senate Properties has long traditions among workplace process being the leading service provider in Finland. Currently they have put more focus on work place management to increase customer satisfaction, create strategic relationships with clients (partnership agreements) and to meet the government needs, and asset in real estate business.

Currently Senate Properties is looking for indicator system that could help them to develop performance of the work spaces. However, there is not such an indicator system and existing national indicator systems, such as PromisE, LEED and BREEAM, have been designed from different viewpoint to consider mostly environmental values, sustainability and life-cycle economy.

2.12 Vuorimiehentie 5 office building FI04

2.12.1 The actual benchmarking organisation and its purpose

PromisE is an environmental classification that was developed by a joint effort by Motiva, The Finnish Association of Building Owners and Construction Clients (RAKLI), the Finnish Ministry of Environment and the National Technology Agency of Finland (Tekes). It is a tool for rating the environmental qualities of buildings operating through internet.

2.12.2 Assessment applied in the benchmarking organisation

The PromisE system has been developed for residential buildings, office buildings and retail buildings. The assessment can be made with help of an internet-based tool. The classification is based on several factors relating to the planning, location, maintenance and consumption monitoring which are then graded. Finally, a grade is awarded to describe the combined environmental class of the building.

2.12.3 Cost and performance indicators applied in benchmarking

This case study followed nationally agreed Finnish indicators on cost and performance as follows:

Location and architecture (L)
L1 – L7 Site characteristics
– The plot is rock-bottom area
L 11 Architectural quality
– Old 70's office style
L12 Growing neighbourhood
– Distance from Otaniemi Shopping Centre, post office, bank and library 100 m
– Located to Aalto university area
L13 Public transport
– Distance to railway station 5 km, bus station 3 km, bus stops 100 m
– Distance to Helsinki - Vantaa airport 20 km
L14 Pedestrian and bicycle access
– Distance to bicycle route 50 m, footway: 50 m
L15 Access to services
– All kind of services are available within 300 m
L16 Access to green open spaces
– Distance to Otaniemi park 200 m

Building performance (P)
P1 – P2 Thermal comfort
– Indoor air quality standard: 23-26 summer, 21- 22 C winter
P3 – P4 Air quality
– Indoor condition levels S2
P5 – P7 Lightning
– Low energy fluorescent lightning
P8 – P11 Noise
– Partition walls 35 dB, acoustic ceilings
P12 Design flexibility
– Open offices
– Easy modification possibility, movable electric and network towers
P16 Meeting current safety regulations
– Fire safety system

Real estate business (B)
B1 Branding

– Entrance and courtyard area have been developed

B6 – B8 Maintenance

– Maintenance services

B9 Facility services

– FM organization

B10 Range of user services

– Restaurant, lobby and office services, conference and meeting room reservation

– Office maintenance and operating services, management services

– ICT services

B11 – B12 Parking

– 300 car parks: 0,6 car parks/employer.

The national PromisE environmental rating has been used in Vuorimiehentie 5 case study. PromisE indicators were set to building before the renovation. Some PromisE indicators an their rating are shown in the following table.

Table 5. PromisE ratings in Vuorimiehentie 5 office building after renovation.

PromisE – Vuorimiehentie 5 office building

	A	B	C	D	E
HEALTH OF USERS			C		
Management of indoor climate			X		
Indoor air quality		X			
Management of moist damages				X	
Illumination			X		
CONSUMPTION OF NATURAL RESOURCES				D	
Energy consumption				X	
Water consumption					X
Land use	X				
Materials consumption				X	
Service life			X		
ENVIRONMENTAL LOADINGS			C		
Emissions into air				X	
Wastes				X	
Bio-diversity	X				
Environmental loadings from traffic		X			
ENVIRONMENTAL RISKS				D	
Environmental risks of building site				X	
Environmental risks of building				X	
Environmental risks of construction				X	

TOTAL = C

In PromisE each indicator is valued in five level scale (A, B, C, D, E), ranging from E-level representing normal level, to the A-level that promotes excellent solution. The indicators and categories have been weighted and the excellence of the building can be expressed in terms of one class. According to PromisE rating, the building level environmental class of Vuorimiehentie 5 is C.

2.12.4 Relation to enterprises, building project and real estate

PromisE was developed by a joint effort by Motiva, The Finnish Association of Building Owners and Construction Clients (RAKLI), the Finnish Ministry of Environment and the National Technology Agency of Finland (Tekes). It has been used by large number of companies in the Finnish construction and

real estate cluster ranging from Senate Properties, the largest building owner in Finland, to largest construction companies.

2.12.5 Visions and innovations for future improvements

The classification can be used to identify the environmental features of existing buildings to verify the environmental character of the maintenance of existing buildings, and to set targets in order to improve the environmental aspects of a building. As a whole the tool is functional and well defined, depending on the latest understanding on sustainability but in broader scale it has rather limited focus not covering all important objectives. Therefore, the classification has been used in parallel with other indicator systems and in this context CREDIT framework is also one potential candidate for further development.

In the future, Senate Properties has target to take in use more LCA based indicator systems that operate in the interface of value creation to end users. They have constantly tested various rating schemes, such as the national PromisE environmental assessment, BREEAM and LEED. At the moment the interest is to find an internationally implemented indicator classification adoptable to local conditions. Regarding CREDIT project, one of the Senate Properties objectives is CREDIT indicator framework and its suitability to be a widely used cross-border benchmarking framework for property portfolio management.

The objective for Senate Properties is to embrace usage of BIMs in all facility projects, both in new buildings and renovations. In the first phase, models will be required in ordinary projects and only for some of the design jobs of the project. The requirement for modelling will apply both to construction and to renovation projects. The obligatory part will be limited to modelling and visualisation of the starting scenario and architectural design as well as to the monitoring of the scope and costs performed on the basis of the models. General description of the BIMs for different parties and their connection to the design process flow is presented in the Figure 6.

ARCHITECTURAL DESIGN	STRUCTURAL DESIGN	MEP DESIGN	INTENDED USE
Requirements model Space program in a table format (Excel), requirements of the client and the end-user	**Requirements model** Space-specific loads and other structural requirements, if any	**Requirements model** MEP requirements for the spaces (indoor climate, lighting, system requirements, etc.)	Documentation of space requirements and possible other requirements in a structured form
Site BIM Site borders, elevations, required joining to the surroundings and to the technical systems			Site use planning Location of the building(s) on the site
Inventory BIM Spaces and building elements of the existing building(s)	Inventory BIM Load-bearing structures	Inventory BIM MEP systems to the extent regarded applicable	Documentation of the starting situation for renovation construction
Spatial Group BIM Building masses and principal spatial groups as space objects			Investigation and visualization of the building's massing as well as comparison between alternatives Investment calculation based on scope and massing Rough energy simulation if applicable

ARCHITECTURAL DESIGN	STRUCTURAL DESIGN	MEP DESIGN	INTENDED USE
Spatial BIM Spaces as space objects, building envelope	Spatial Reservation BIM Suggestion for structural system, suggestion for basic structure	Spatial Reservation BIM MEP system service areas, main ducts and flues, as well as pipework, cable racks and other technical systems and spaces presenting significant space requirements	Design and visualization of alternative spatial design solutions Scope management Investment calculation Energy simulation and, if required, simulation of ambient conditions (determining the dimensioning bases for systems) Examining MEP system alternatives and determining service areas Examining structural system alternatives Agreements concerning spatial requirements for structures and systems
Preliminary Building Element BIM (PBE BIM) Spaces, preliminary building elements	PBE BIM Frame structures (measures, locations and dimensions of the vertical and horizontal frame), agreed BIM details, foundations	Preliminary System BIM Service areas of MEP systems, main ducts, pipework and central units	Definition of building elements, comparison of building element and structural alternatives Management of quantity information Investment calculation Energy simulation and, if required, simulation of ambient conditions (further specification of the dimensioning bases for systems) Preliminary dimensioning of structures Building permit
Building Element BIM (BE BIM) – quantity take-off phase Spaces, building elements with type information	BE BIM/Penetration and Reservation BIM – quantity take-off phase Frame structures (measures, locations and dimensions of the vertical and horizontal frame, example elements, type structures and joints, foundations), joinings to foundations, penetrations and reservations	System BIM/Penetration and Reservation BIM – quantity take-off phase Service areas of MEP systems, central units, ducts, pipework, terminal devices, switchboards, cable routes (lead and cable-throughs and grates), lighting fixtures, penetrations and reservations	Dimensioning of structures to the precision required in the calls for tenders Definition of MEP systems Quantity take-off Investment calculation Energy simulation Use of models as appendices to tenders Use of models to support penetration and reservation design

ARCHITECTURAL DESIGN	STRUCTURAL DESIGN	MEP DESIGN	INTENDED USE
BE BIM – construction phase BIM with a level of precision similar to that of the previous stage, updated to correspond with the implementation	BE BIM/ Penetration and Reservation BIM – construction phase Frame structures and joints, input information to prefabricated element design, placements and reinforcements of cast-in-situ structures, foundations, joinings to foundations, details, penetrations and reservations	System BIM/ Penetration and Reservation BIM – construction phase Service areas of MEP systems, central units, ducts, pipework, terminal devices, switchboards, cable routes (lead and cable-throughs and grates), lighting fixtures, penetrations and reservations	Detailed design Information for prefabricated element design and production planning
As-built model BIM with a level of precision similar to that of the previous stage, updated to correspond with the final implementation	As built model BIM with a level of precision similar to that of the previous stage, updated to correspond with the final implementation	As built model BIM with a level of precision similar to that of the previous stage, updated to correspond with the final implementation	Information to maintenance and repairs, space and occupancy management and to the planning of later use and renovation of the building

Figure 6. General description of the BIMs for different parties; mandatory tasks in bold, other tasks decided on project basis. Fields marked with gray are generally not included but serve the design process and are performed according to a separate assignment.

2.12.6 Lessons learned and recommendations

Senate Properties applies the Common Finnish environmental rating (PromisE) approach, which is also applied in this case building. The classification can be used to identify the environmental features of existing buildings, to verify the environmental character of the maintenance of existing buildings, and to set targets in order to improve the environmental aspects of a building. As a whole the tool is functional and well defined, depending on the latest understanding on sustainability but in broader scale it has rather limited focus not covering all important objectives. Therefore, the classification has been used in parallel with other indicator systems and in this context the CREDIT framework is also one potential candidate for further development.

2.13 Shopping Centres FI05, FI06

This chapter describes the findings from two shopping centre cases in Finland. Because they are very similar of their nature, the two are merged into the same chapter.

2.13.1 The actual benchmarking organisation and its purpose

Dealing with shopping centres there are general information available but a specific analyze between various shopping centres has not been publish. The existing information could be collected and organized from various sources – in most cases the key figures are not public, depending on the owner (e.g. retail chains keeps their figures confidential).

2.13.2 Assessment applied in the benchmarking organisation

There is number of software available which could be possible used to analyze different shopping centres. The data from the shopping centres should be gathered up and organized; it means that there should be e.g. an interactive internet-based spreadsheet where the participants could send their information. This would be relatively easy to realize inside an enterprise. Problems may be between the enterprises. There are examples (printing houses, wellness and spa hotels etc) that benchmarking and facility management tools over an industrial branch can work. There must be a service provider who takes care to run the system.

2.13.3 Cost and performance indicators applied in benchmarking

Cost and performance indicators can be divided into two parts: General indicators which are regardless of the branch and then business specific indicators. Dealing with the shopping malls, this study showed that such concepts need further studies inside the business area. Individual shopping centres or real estate owner's can use their own existing system, but dealing with technical performance, there are lot of "black holes" being due to inefficient use of building automation systems and deficiencies in reporting. The systems are designed for the daily operation but not on the point of view of facility and energy management or set requirements.

2.13.4 Relation to enterprises, building project and real estate

Referring the results and items discussed in the previous chapters, there would be possible to create a data file, by which the business could compare the facility costs – within the limitations of trade secrets and competitive positions. MOTIVA (National Agency of Energy Savings) has information based on energy audits of the shopping centres. Inside the branch there are company-specific studies, which may be not public. Also the owner's requirements may change, depending on the type of business. There are various tools available, which could be used in benchmarking and analyzing of the shopping centres, but at the moment (excluding general requirements) there is no such generally accepted indicator or list of factors which could be used, but common interest is obvious.

2.13.5 Visions and innovations for future improvements

In Finland the most building projects are based on life-cycle evaluation and costs. Shopping centres are facilities, which can change the use with time, and have several renovations during the lifetime. The location of shopping centre is very essential, and also they could be totally rebuilt if the overall conditions will change. For the owner, the flexibility and usability and space management are very important factors, which will set up some limitations and boundary conditions for planning. The performance – technical perform-

ance and space performance – and the position of the building on life-cycle curve should be determined in all the stages, which mean that the monitoring system must be good enough to give relevant information to the facility manager and owner. It includes both proper installation of sensor and meters, monitoring system and finally up-to-date reporting system.

Each business branch should have concepts which will include also the branch-specific indicators. These indicators depend on the needs and goals of the owners. Because the conditions in Scandinavian countries are relatively similar, the benchmarking concept could be common to cover these countries.

2.13.6 Lessons learned and recommendations

There is a need for generally accepted procedure for benchmarking shopping centres. The business branch has the key role in developing such concept. Besides technical performance, there are many other factors which may be more important from the owner's point of view. Technical performance includes also other factors than energy efficiency and indoor conditions (use of space, maintenance costs etc). Without a proper monitoring system there is no possibility to go into the details and distribution of the consumptions.

2.14 Statistics Norway, Kongsvinger NO01

Statsbygg reports both to NFB – The Network key number for Benchmarking and to NfN – Norwegian Facility Management Network. These two organisations are described in more details below.

NBEF / NFB

The Norwegian Society of Facility Management NBEF (http://www.nbef.no) consists of former Byggherreforeningen, The Network Key number for Benchmarking (NFB - http://www.nfb.no) and Network Facility Management. NBEF is a non-profit organization for companies and persons working in Facilities or property management.

The purpose of NBEF is to create a common communication and development platform for property owners, institutions / corporations, users / tenants and other individuals who have property-, building- and service management as their prime professions.

Accounting and property data has been collected since 1999. This means that you can see the evolution over time.

The database structure has been criticised because of the use of building categories. The majority of buildings are categorized as owned buildings, and the main report is essentially devoted to these. On the other hand, state buildings are categorized as leased buildings. There are relatively few cases in this group, which means that the benchmarking often has limited value for Statsbygg.

NfN

Norwegian Facility Management Network – NfN (http://www.nfn-fm.no) was established in 1992, and has since 1993 conducted annual benchmarking processes amongst the members. Initially the processes covered mainly Corporate Real Estate - CRE management but are now extended to include a broader span of Facility Management - FM.

The NfN highlights a number of professional networking groups where the practitioners can exchange experiences in work processes and dig deeper into their key figures. Members of these groups can facilitate bilateral benchmarking and enhance the development of internal benchmarking routines within the member corporations.

NfN is a member of EuroFM and has an ambition to contribute actively to the development of closer European relations particularly with the Nordic members in EuroFM. NfN is also member of a Nordic FM project which was initiated in 2003.

Nordic FM priorities were from the start given to the following objectives:
- Development of a common Nordic framework for standardization within FM.
- Benchmarking activities between participants in the Nordic.
- Facility Management professional environment and marketplace.
- Development of a framework and structure for education and qualification within FM on Bachelor and Master Level.

This network consists essentially of large private owners of offices. About 20 companies contribute data every year. Most members of the network have only reported data for management, operation and maintenance from few cases. This means that the work has less value in a benchmarking context,

since the selection is so small. Energy consumption is one of the key indicators that are benchmarked in this cooperation. Benchmarking on energy consumptions can be shown both in kWh and the cost.

2.14.1 Assessment applied in the benchmarking organisation

Statsbygg reports the data on key performance indicators from Statistics Norway to the Norwegian Facility Management Network – NfN. NfN uses a standardized excel- file to collect the data. All participants also receive definitions, information of use, results and descriptions of the key performance indicators used.

NfN's own experiences:
- Choice of indicators: These have been changed somewhat from year to year to capture the fact that some of the participants have changed roles from owners into tenants, and some have outsourced the FM services.
- Quality control: If unusual values are encountered, they are double checked.
- All data providers are invited to a yearly meeting in order to discuss the results. The participants find this meeting to be useful for their understanding of the results.

2.14.2 Cost and performance indicators applied in benchmarking

The tables below shows the actual Key indicators collected in NFN and how the network secures that the data are collected in a proper manner by giving out definitions and describing in detail which numbers to collect and how to understand the definitions.

2.14.3 Relation to enterprises, building project and real estate

NfN is concerned with property management. Statsbygg has not been very active in using numbers from NfN in its planning of new buildings nor in its management of its existing ones.

2.14.4 Visions and innovations for future improvements

When it comes to the choice of indicators, NfN has added rental cost in the newest version and they are considering adding quality indicators. Further developments of the template for key indicators are being considered. They consider also a web-based solution and cooperation with other networks.

2.14.5 Lessons learned and recommendations

Statsbygg participates in both the national benchmarking networks (NBEF and NfN) as a result of a policy decision. When it comes to using data for benchmarking purposes, Statsbygg uses its own internal data as comparison points. One reason why Statsbygg chooses to rely on its own data, is that some of the data from other participants in the networks might not be comparable. Some have for example different ambitions for the long term level of maintenance.

Statsbygg believes that it is important to keep focus on the physical usage of energy rather than energy costs. The reason is that fluctuating energy prices might distort the benchmarking.

2.15 University of Stavanger NO02

2.15.1 The actual benchmarking organisation and its purpose

Statsbygg reports both to NFB and to NfN that were described in the previous chapter.

2.15.2 Assessment applied in the benchmarking organisation

Statsbygg is member of the NFB Network. The members use a web-based system to collect and distribute the evaluation afterwards. Members can enter their own data and read and order reports and statistics. They can also get updates from news and other professional activities and communicate with the system administrator via the Internet and mail.

Statsbygg also reports the data on key performance indicators to the Norwegian Facility Management Network – NfN. NfN uses a standardized excel-file to collect the data. All participants also receive definitions, information of use, results and descriptions of the key performance indicators used.

NfN's own experiences:
- Choice of indicators: These have been changed somewhat from year to year to capture the fact that some of the participants have changed roles from owners into tenants, and some have outsourced the FM services.
- Quality control: If unusual values are encountered, they are double checked.
- All data providers are invited to a yearly meeting in order to discuss the results. The participants find this meeting to be useful for their understanding of the results.

2.15.3 Cost and performance indicators applied in benchmarking

The key numbers are in three main categories:
- key numbers related to costs, as management, operation, maintenance (MOM) costs per m^2 or per working space. The cost categories are from NS3454
- key numbers related to area, as m^2 pr working space in office building or per pupil in school
- key numbers related to consumptions, as energy consumption per m^2, water use and waste.

The key numbers are actual numbers, not theoretical numbers. The key numbers express the consequences of activities.

2.15.4 Relation to enterprises, building project and real estate

The purpose of the key numbers is description of actual use, giving an overview for benchmarking and improvement. The key numbers can be used as input information in early stage life cycle costing. Aspects from life cycle costing may also be used as indicators, for instance to compare between building or to compare results from one year to another.

2.15.5 Visions and innovations for future improvements

Statsbygg has as goal to use the national database as a learning tool.

2.15.6 Lessons learned and recommendations

The new building at the University of Stavanger is not completed, and lessons are still being learned. On interesting aspect is how simple it will be to use information stored in the BIM to semi-automatically generate the information required to report to the national benchmarking networks.

2.16 Stortorvet Kjøpesenter, Kongsberg NO03

2.16.1 Assessment applied in the benchmarking organisation

Skanska does not currently take part in any national benchmarking activities.

2.16.2 Cost and performance indicators applied in benchmarking

In the productivity benchmarking project mentioned in subchapter 4.2 two kinds of data were gathered: (1) Data on production volume such as areas, quality, etc. and (2) explanatory data such as size of the teams, technologies used, environmental standards, priorities by the project manager etc.

These data points were analyzed using the DEA method (Data Envelopment analysis, DEA – a non-parametric method often used to benchmark productive efficiency). Based on these calculations a single number, the efficiency of the building project was constructed. This number, the efficiency (between 0 and 100 percent) was the main indicator.

2.16.3 Relation to enterprises, building project and real estate

Skanska does not currently take part in any national benchmarking activities.

2.16.4 Visions and innovations for future improvements

The Falk system would be ideal for internal and external benchmarking of Skanska at different levels. As a large organisation, Skanska could get valuable results purely based on internal data and cross-project/region benchmarking.

2.16.5 Lessons learned and recommendations

The Falk system is a great example of the benefits large enterprises can get when using a common data gathering/reporting system for its internal (benchmarking, analysis) and external (reporting) needs.

2.17 Skattens hus, Oslo NO04

This chapter focuses on sector, national and international benchmarking in related to the assessment and application of indicators in building in Chapter 2 and in enterprises in Chapter 3 and how benchmarking is organised, managed and rooted in the sector and what indicators are assessed in the system.

2.17.1 The actual benchmarking organisation and its purpose

Skanska's main participation in national benchmarking has been that it contributed data to a productivity benchmarking project ("Efficiency in Construction") financed by the Research Council of Norway and the construction industry. SINTEF Byggforsk was the research organisation that analyzed the data.

The main goal of the benchmarking project was to compare the productive efficiency in the production of blocks-of-flats using the DEA method (Data Envelopment Analysis). As part of the analysis the efficiency of Norwegian building construction firms were also calculated based on data from Statistics Norway (see below):

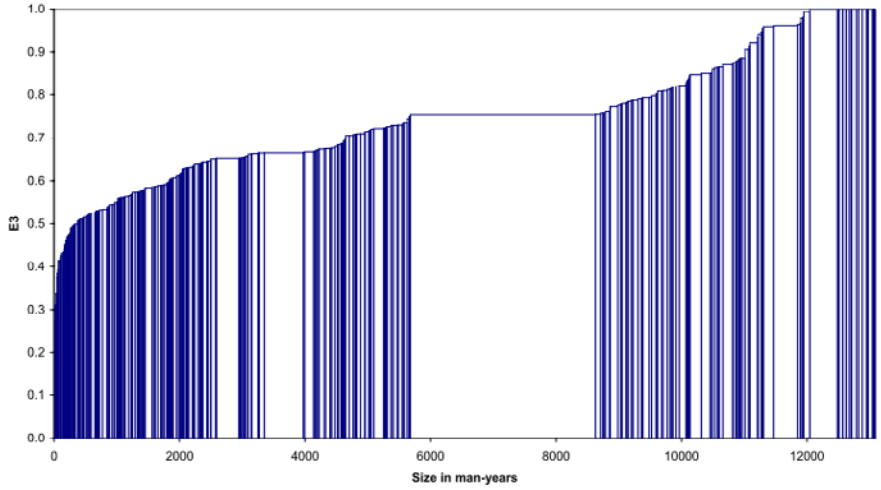

Figure 7. Efficiency of Norwegian building construction firms.

In the figure above each bar represents a construction firm. The width of the bar represents the size of the firm (measures in man-years), while the height of the bar is its relative productivity. For instance, 50% means that it could create the same production volume with half the resource usage -- compared with the units that are fully efficient (100% in the graph).

2.17.2 Assessment applied in the benchmarking organisation

Skanska does not currently take part in any national benchmarking activities.

2.17.3 Cost and performance indicators applied in benchmarking

In the productivity benchmarking project mentioned in subchapter 4.2 two kinds of data were gathered: (1) Data on production volume such as areas, quality, etc. and (2) explanatory data such as size of the teams, technologies used, environmental standards, priorities by the project manager etc.

These data points were analyzed using the DEA method (Data Envelopment analysis).

2.17.4 Relation to enterprises, building project and real estate

Skanska does not currently take part in any national benchmarking activities.

2.17.5 Visions and innovations for future improvements

The Falk system would be ideal for internal and external benchmarking of Skanska at different levels. As a large organisation, Skanska could get valuable results purely based on internal data and cross-project/region benchmarking.

2.17.6 Lessons learned and recommendations

The Falk system is a great example of the benefits large enterprises can get when using a common data gathering/reporting system for its internal (benchmarking, analysis) and external (reporting) needs.

2.18 System for evaluating the construction process SE03

Every measuring an enterprise is doing is generating data to an index data base. In the index data base it is possible to compare for example the efficiency to similar projects. The thought is to be able to compare to best practices in the sector. The suppliers of the system are planning to premiere the best results or having some kind of competition. The benchmarking can give a base to some kind of standardization. The suppliers consider the possibility to comparing by measuring in a similar way, to be one value of the system. Another value is the increased capacity of goal setting at all.

2.18.1 The national benchmarking and purpose of the organisation

The background of the tool is to improve the efficiency of the construction process by improving the leadership, co-workers, organisation and processes and the ability of setting relevant project and effect goals. The purpose is to create a spiral of continuously improvement. The improvement will mainly be on learning, communication skills and management in construction process. The tool is monitoring between the four main phases; programming/briefing, designing, construction and occupancy as well as within every single phase. The tool is directed to the whole construction sectors. The tool will be taken in action in April 2009. The collection of the information is made on a voluntary basis.

2.18.2 Applied assessments and tools in national benchmarking

The project members and the enterprises are addressing the information to the system. Data is collected by questionnaires and raw data inserted by the different leading units.

2.18.3 Cost and performance indicators applied in benchmarking

Exactly what indicators that will be inserted is not clearly set at the moment. The first challenge was to make the system measurable. The supplier of the system would like to research more before setting every indicator.

2.18.4 Relation to enterprises, building projects and real estate

The main thought is that the participant in the project can learn and correct their ways of working during the process by a number of different kinds of evaluations.

2.18.5 Discussion and conclusions

The purpose of the study was to:
- to map out how this system is attempt to work and the purpose behind it and further development strategies
- to understand how users are involved and what benefits they get from it.

Though the system is no in use it is hard to evaluate the benefits of it in use. The system is very ambitious and it will be interesting to see how/if the participants in every phase will embrace it. The end user are involved in the system of they are participating in workshops, meetings in the different phases. They should be involved when setting the effect goals the end users organisation wants to achieve in the beginning and be able to express their opinions about the goal fulfilment in the end.

The thought of the softer indicators are to be collected in a national bank but not the project and effect goals measurement depending on their flexible nature.

2.19 Managing tenants in a housing company SE04

The housing company is participating in a national benchmarking system furnish by SABO (Sweden of public utility housing companies). The focus is mainly on economical and resource use aspects.

2.19.1 The national benchmarking and purpose of the organisation

The measuring is focusing on economic and resource use aspects. The purpose, for the company, to use the benchmark system is to be able to compare towards the competitors. To see how well they perform. The housing company has always been in the top section. The problem with the system is that you can never tell what areas the others have calculated on. The company does not consider it very easy to learn from the benchmarking system.

2.19.2 Applied assessments and tools in national benchmarking

The company is collecting the information by themselves and then sends it to SABO. SABO is then putting it together.

2.19.3 Cost and performance indicators applied in benchmarking

The company is measuring economical (almost every parameter in the statement of income) and resource use aspects, the unit of the indicators are SEK/m^2. The company does not separate the dwelling information from the habitats.

2.19.4 Relation to enterprises, building projects and real estate

The obtained report shows the development of the company over the years. A comparison is made towards real estate companies in the same size and towards the country as a whole. If you are a member of the benchmarking system you have access to the data from every company involved in the benchmarking system.

2.19.5 Visions and innovations for future improvements

It is concerned hard to know if the different companies have been calculating on the same areas. The focus is on economical aspects, maybe a SCI would have been interesting to compare as well. But that requires that the same questions are asked by every company. The company has not any further need for more benchmarking exercises.

Discussions and conclusions

This study has been investigating how a real estate company manages their present and future tenants. This section is discussing the findings, on a company and a national benchmarking level. The purpose is to answer the objectives of the study

- the management of existing and future end-users requirements and the body of knowledge of end-users requirements in the company
- the use of indicators and benchmarking activities.

2.19.6 Lessons learned and recommendations

The real estate company is participating in a national benchmarking system provided by SABO. The focus is on economical parameters from the statement of income. The company experience that, one weakness with the benchmarking, is to know if the participating companies are measuring the same areas. The dwelling areas are not separated from the habitats areas which can be regarded as a weak point as well.

2.20 FIA SE06

Different initiatives to improve the construction industries competitiveness have been introduced in a number of European countries, for example Constructing Excellence (the UK), PSI Bouw (Holland) and Utmärkt Samhällsbyggande (Sweden). In Sweden, apart from the larger Utmärkt Samhällsbyggande a more focused program aimed at improving the competitiveness of the civil engineering part of construction, FIA (Renewal within the civil engineering sector), was launched in December 2003.

2.20.1 The actual benchmarking organisation and its purpose

The aim of FIA is that the year 2010 their vision should be fulfilled, the vision states:

> *"The civil engineering part of construction is and is perceived as, an important and respected society provider, whom, together, in an innovative and learning process and in a cost efficient manner develops the road and rail infrastructure to fulfil the demands of society and end-customers. The industry has compared with today's situation substantially increased their efficiency and lowered the frequency of faults." (Free translation from Swedish)*

To achieve this five aims have been defined:
- increased efficiency delivering increased quality at lower cost with increased profit margins (efficiency)
- better teamwork and increased cooperation between the parties of the industry (cooperation)
- better incentives for R&D and development of competencies (R&D)
- more efficient dissemination of existing knowledge and competence (knowledge transfer)
- recruitment of new personnel made easier by the more positive image of the industry (image).

From this aims several different research and development projects has been and will be initiated by FIA to achieve these aims. FIA saw a need to monitor how the civil engineering sector develops, in order to effectively plan and implement development projects.

2.20.2 Assessment applied in the benchmarking organisation

The Division of Construction Management, Lund University was commissioned by FIA to develop the survey, manage the data gathering and to do the analysis. The survey consists of factual questions about the projects and questions where the respondents shall grade assertions about the project on a 10 graded scale from very bad to very good. The assertions and how they relate to the five goals (very strong, strong, weak or none). There was also an open question added that addressed the issue of key factors for the outcome of the project. This question gives a qualitative explanation of aspects covered in other questions. The measurements constructed from the factual questions will be adapted to the five goals laid out by FIA to evaluate how the Swedish civil engineering sector will develop in accordance to these goals.

2.20.3 Cost and performance indicators applied in benchmarking

The main focus in this assessment is on efficiency. It has not yet been decided exactly which ones will be used. The concept of efficiency can generally be described as input versus output, how many units of something that can be produced in relation to the input of resources. For a manufacturing

industry this concept is quite clear. If the production of units increases with maintained or smaller input of resources the efficiency is increasing. However, for a civil engineering project there are many external factors (e.g. circumstances in the ground, ground levels, and existing facilities to consider) that will affect the potential amount of the finished product in relation to the input of resources. Consequently, to measure the quantity of the finished product, for example kilometre of road or railroad, is not a relevant measure in order to evaluate the efficiency of civil engineering projects.

For a civil engineering project it is better to measure the output in terms of the project value. In this survey the project value is measured both as the contract sum and as actual cost. The total length of the project is also measured, in terms of both the planned timescale and the real final length of the project. If the final outcome is different from the budgeted or planned outcome, the respondents are asked to answer why this deviation occurred. The input is measured in terms of the number of days of work conducted for one man (man days).

From these measures it will possible to evaluate the efficiency from, for example, the following relations:
– actual cost (SEK) / the total number of man days (days)
– (actual cost (SEK) – contract sum (SEK)) / contact sum (SEK)
– the final length of the project (days) / the total number of man days (days)
– (the final length of the project (days) – contracted length of the project (days)) / contracted length of the project (days).

In addition to these the efficiency can be evaluated from a number of soft parameters. The explanations of why the project has increased the costs or been delayed shows if this is due to a decreased efficiency or as a result of other reasons. The form of payment (e.g. fixed price, running prices and incentives) in relation to increased costs or delays can give indications if one form of payment is more efficient than another. The amount of changes in the contract and the number errors at final inspection can give indications to the quality of the contracting documents and the quality of the performed contracting work, which indirectly will affect the efficiency of the work conducted.

2.20.4 Relation to enterprises, building project and real estate

The main question in the survey relating to the issues of cooperation between the different actors in the project process (e.g. Client, main contractor, sub-contractors, designers), are if any forms of systematic cooperation has been adopted beyond conventional practice? Depending on what form cooperation that have been adopted it can be graded on scale from 0-5, where 0 is conventional practice and 5 is a long term strategic cooperation between for example client and contractor.

In addition the following questions relates to cooperation:
– have soft parameters been evaluated in the tendering process?
– was price the deciding factor in choice of contractor?
– have new productions methods or products been that have not been used before by client or main contractor?
– what kind of contract (e.g. standard approach, design and build) has been adopted in the project?
– what kind of reimbursement form has been adopted in the project?

These questions are by themselves of limited interest. However, the correlation between these and other questions can give insights of how different

levels and forms of cooperation will affect for example the different aspect of efficiency as stated above.

The main question that relates to R&D is if any new production methods or products have been used that have not been used before by client or main contractor. The following questions can also indirectly be related to the topic of research and development:
– have any forms of systematic cooperation been adopted beyond conventional practice?
– have alternative solutions for the production been given from the contractor in the tendering process?

In the survey there are no direct factual questions relating to knowledge transfer. In the questionnaire design the formulation of one clear question that could not be misinterpreted was almost impossible. However, nearly all other questions in the questionnaire can indirectly be related to this topic, which gives ample opportunity to indirectly evaluate the consequence of an existing, or non-existing, transfer of knowledge. The main questions that relates to this topic are the following:
– have any forms of systematic cooperation been adopted beyond conventional practice?
– have common goal been established between the actors in the project?
– amount of changes in the contracted works during construction on site.
– amount of errors at final inspection.

2.20.5 Visions and innovations for future improvements

There has been an interest in the development of indicators on productivity. The issue has not been solved yet, as it has been found to be rather difficult to find comparable measure across the infrastructure sector. It is now leaning towards the use of a number of indicators, indirectly measuring productivity and those measures used together as indication on the trend of productivity in the sector.

2.20.6 Lessons learned and recommendations

Two main issues are of importance in regard to the CREDIT objectives.
1. The difficulty of getting in the data – although this assessment has been initiated, approved and sponsored by the very top management of the two largest infrastructure clients and even though it is written in the procurement guidelines for both of these organisations that the survey should be carried out jointly, between the client and the supplier (consultant or contractor), it has been extremely difficult to get the survey sent in. Now, both of these two organisations have designated personnel to track down projects and make them fill it out, according to guidelines, and send it in.
2. The main performance the parties in the sector are interested to measure and to keep track of is efficiency and productivity. They are largely uninterested of measuring the performance of the product and/or how it affects the end-users. Similar tendencies has been seen in other national initiatives on housing in Sweden. This is to some extent in large contrast to the views and aim of the CREDIT project.

2.21 Nursery schools - Reykjanesbær IS01

This chapter focuses on sector and national benchmarking and how this is interrelated to assessment and application of indicators in the building industry.

2.21.1 The actual benchmarking organisation and its purpose

The term “benchmarking”, in its limited use in Iceland, is sometimes used for two different aspects:

a- a comparison of values for different objects in the scope of studying what can be done better and thus aiming for improvement in performance

b- following-up of eventual changes in performance, e.g. comparison between objects, or inter-comparison of each object, to find out changes to better or the worse (mainly as indicators of faults).

Based on discussions with actors on the market it may be stated that benchmarking in the first mentioned aspect is so far very little used in Iceland. There are though some examples of this use in pilot projects- in these studies no specific models or methods are used; the data is gathered the hard way from the companies and so far there is no automatic registration of “interesting” data.

- “Félagsbústaðir”, a housing company owned by Reykjavík municipality; a study of maintenance cost for eleven houses of different building periods over a five years period. The distribution of the cost on different aspects is considerable, but the period studied so far to limited to show if there is a systematic difference between houses.

- “Fasteign” a housing company owned by some municipalities and financial companies; A comparative study of various performance aspects of five “kinder gartens”. In the study the operational cost of five childrens day-care homes is studied over a two years time period. The staff of the homes was also asked to evaluate different performance aspects of the homes. The study shows some clear differences between homes, both in operational cost and satisfaction of staff and other users. This pilot study has shown some interesting results and it seems to be the case that at least two systematic design faults have been found.

- A case study of owner satisfaction of homes in two municipalities; Reykjavík and Akureyri. The study shows that performance satisfaction regarding function of homes and environment is partly dependent on age of the homes but location is also important. It is also very clear that older homes have usually been refurbished to a some extent, which may explain the general satisfaction of owners.

Information that can be used in comparison of buildings, benchmarking, is located in various databases, which may or may not be accessed by the researcher or even the general public. Generally it can be stated that the best databases of interest are regarding energy use of buildings, but in practice this data is not always accessible for studies as it is considered as a violation of personal integrity to give information on use of e.g. heating energy for a specific building (if privately owned).

Comparison, or inter-comparison of objects is rather frequent in evaluation of energy use of distribution nets (in whole or parts) to estimate changes in energy losses (e.g. in Reykjavik municipality) and also in evaluation of energy performances of buildings (e.g. the above mentioned “Félagsbústaðir”).

Following is a list of the more interesting actors and database owners:

Orkustofnun (The Energy Authority, http://www.orkustofnun.is)
This is a government institute responsible to the Ministry of Industry. Orkustofnun is the official specialist on energy production and imports and make estimates of energy use in future. On their home page information about energy production in Iceland can be found and estimates of future needs for energy in various fields.

Orkusetur **(**http://www.orkusetur.is**)**
Orkusetur is an information center for energy application and use, linked to the governmental institute; Orkustofnun. Information regarding changes the last 15 years in use of electricity, hot water and oil per capita is easily accessible.

They also give information that can be used to estimate the energy requirements for heating of a home, given location and size.

Hagstofan (Statistics Iceland, http://www.hagstofa.is/)
Statistics Iceland is the National Statistical Institute of Iceland and was founded in 1914. Statistics Iceland collects information regarding both economical and social statistics, and yearly. The information on buildings is though limited to homes (not service or public buildings) and consists of yearly built amount (number of apartments, total amount in m3, apartment size statistics; number of rooms). Statistics Iceland also publishes every three months a New Building Cost Index which is based on calculation models for very well defined types of buildings and actual market cost for labour and materials.

Fasteignamat ríkisins (Icelandic Property Registry,
http://www.fasteignamat.is)
All buildings and homes have a specific registration number. Estimated building cost and current tax value for any building in Iceland can be accessed from this home page (official information that can be accessed by anyone). Based on these figures an annual Selling Cost Index of buildings is calculated, based on location of buildings.

2.21.2 Assessment applied in the benchmarking organisation

Many actors on the market collect data, but the kind of data varies. Very little efforts are done to compare data between instances, and therefore the systematic in data gathering has not been type standardized.

2.21.3 Cost and performance indicators applied in benchmarking

Most enterprises collect cost data from own enterprise, usually this data is only for own use but two firms publish data for use as reference values.

2.21.4 Visions and innovations for future improvements

The facility owner “Fasteign” has shown interest in the case study reported, but it is not clear how or if they will continue the work themselves.

2.21.5 Lessons learned and recommendations

Benchmarking should be of considerable use in improving building quality and reduce the overall cost (LCC). This will require definitions of performance indicators that are not in use today in the enterprise discussed nor nationally.

2.22 Paldiski road EE01

2.22.1 The actual benchmarking organisation and it's purpose

On the national level in Estonia the most advanced scheme for benchmarking is based on assessing energy efficiency. As the energy prices have been increased dramatically and will continue to increase so there is the most direct incentive for any owner of the property to reduce costs for energy, primarily costs for heating. Similar is the incentive for the users – high energy costs will become reasonable burden for them and create the preconditions to influence these parties in the construction and property sector, who in fact are responsible for improvements of the housing facilities.

2.22.2 Assessment applied in the benchmarking organisation

The objectives for the Estonian housing sector for the years 2008-2013 are:
– to create access to housing for all inhabitants of Estonia
– to improve high quality, energy efficient and sustainable housing stock
– to ensure diversified residential areas in a balanced and sustainable manner.

Clearly, when introducing any schemes for benchmarking in the sector the KPI should depict listed above aim and sub-aims.

The main objectives as for the dwelling stock arise from the need to extend the life-time of the existing dwellings. For this primarily, by not allowing the apartment buildings to fall into disrepair because of poor maintenance and repairs, to increase the energy efficiency of dwellings, to improve the quality of the living environment, to raise residents' awareness about housing maintenance and to broaden the financing possibilities of social target groups for housing.

Following the above presented statement one will see the necessity of compiling a list of criteria that will depict the current status and the changes that will take place during the agreed time-lag.

Sustainable development (as defined in the national housing sector related documents) is a concept for development that meets the needs and aspirations of the present generation without compromising the ability of future generations to meet their own needs. In Estonia the following elements comprise sustainable development:
– enhanced quality of life, to be achieved through preserving the Estonian cultural space
– significantly increasing coherence of the society
– maintaining ecological balance.

The main problem areas for the housing sector:
– ***Housing is not accessible to every resident in Estonia***. Problems related to accessibility of housing have become more topical year-by-year. They concern mostly new households with lower incomes about to enter the housing market. Less competitive groups also face difficulties in accessing housing in the market due to lower income. Purchase prices and rents on the private housing market are not affordable for the majority of such persons and the public sector offers only a very limited number of dwellings.
– ***Limited number of apartments adapted for person with special needs***. Almost one-third of the disabled require adapted accommodation units for independent coping. Given that disabled persons often belong to lower income groups they need public sector support for the modification of their dwellings.

– ***Deterioration and decreasing quality of the housing stock***. Residential construction volumes of the past decade are considerably lower than the average in 1950-1989 and the houses built half a century ago are gradually reaching the end of their life-time, as prescribed by the applicable standards. Although, there is no direct danger of falling into disrepair the apartment buildings still are in need of reconstruction. Any delay in commencing reconstruction will allow the situation to deteriorate further and result in higher costs in the future.
– ***High energy costs of housing stock***. The issue of energy conservation of the housing stock has come to the limelight with the transposition of the EU directive on the energy performance of buildings. The average energy consumption per square meter is higher in Estonian residential buildings in comparison with the other EU member states (in Estonia ca 250 kWh/m^2; in Finland and Sweden this number is below 150 kWh/m^2).
– ***Inefficient planning of built environment***. Estonia is currently lacking a comprehensive and established plan on how to combine the technical, social, environmental and economic aspects when designing the living environment and urban space. This has led to chaotic development and has not always been the most efficient.
– ***Problems with awareness among the residents***. The majority of management and maintenance tasks have been placed on the owners of the buildings but they are lacking the required knowledge and professional skills to carry out such tasks. As a result decisions are taken that may not be the best ones for improving the residential buildings and ensuring its sustainability; often materials of poor quality and workers with no professional skills are used.

2.22.3 Cost and performance indicators applied in benchmarking

Given the problems of the Estonian housing sector and in line with the mission and vision of the housing policy the objectives and measures are the following ones.

ACCESSIBILITY OF HOUSING
Objective: To make housing accessible to every resident in Estonia
Measures:
1. Improving access to dwellings
2. Improving possibilities for acquisition of housing
3. Improving housing conditions
4. Ensuring compensation of housing costs to persons with coping difficulties
5. Improving the legal environment and increasing administrative capacity.

HOUSING STOCK
Description of the current situation
Objective: To achieve high quality and sustainable housing stock
Measures:
1. Increasing the quality and energy efficiency of the housing stock
2. Increasing awareness to improve the housing stock
3. Mapping the condition of the housing stock
4. Improving the legal environment and increasing administrative capacity.

LIVING ENVIRONMENT
Description of the current situation
Objective: to ensure diversity, and balanced and sustainable development of residential areas.
Measures:
1. Improving the quality of the living environment
2. Tidying up apartment building areas
3. Developing urban areas

4. Valuing milieu valuable residential areas
5. Shaping a secure living environment
6. Improving the legal environment and increasing administrative capacity.

National objective is to achieve high quality and sustainable housing stock. The following benchmarks have been set up on the national level.

Criteria/measure	result
The average expected life-time of the housing stock (especially as to the apartment buildings) has increased by	30%
The share of apartment buildings falling into the highest energy efficiency category will be	10%
The number of apartment buildings renovated with the help of renovation support	8.000 (increase)
The share of residential buildings that have undergone energy audits, implemented the recommended measures and reduced their energy consumption	20%
Technical condition of the different types of apartment buildings has been mapped nationally	95%
The percentage of expert analyses conducted in the apartment buildings of the target group	50%
The percentage of energy audits conducted in apartment buildings	30%

2.22.4 Relation to enterprises, building project and real estate

The listed above KPIs are for national level, but may be used also for municipal level assessments. Currently there are more than 9.000 Home Owners' Associations founded in Estonia. Though not all of them are active and have initiated any reconstruction projects it can be still expected that reasonable number of them will be involved in the national campaign to improve energy efficiency at least 30, but also possibly 40 percentages.

2.22.5 Visions and innovations for future improvements

The energy efficiency level based motivation system is currently mainly based on voluntary drivers, rather than compulsory. Though energy efficiency is the national priority, considerable improvements here require reasonable investments from the owners of the dwellings, e.g. households.

2.22.6 Lessons learned and recommendations

Quality of buildings and business activities are always driven by different objective and subjective drivers – the owners of the buildings may like their property (incl. dwellings) to be more prestigious and attractive to have certain tangible preferences in the market place. At the same time the drivers may be related also to ambitions of certain individuals or group of people to show their role and advanced competence.

For the national housing sector it is rather questionable to introduce a compulsory system of KPIs for the accommodation units. All the improvements that will be needed to keep up the buildings to meet the current standards (e.g. benchmarking system set goals) require reasonable investments to be done by the responsible individuals, in our case by the common households.

Introducing the energy-label system may become a reasonable driving force in the society when principles of voluntary acceptance will be balanced by the public interest and pressure.

2.23 VGTU Laboratory building LT01

2.23.1 The actual benchmarking organisation and it's purpose

On the background of evaluation of energy efficiency, multivariant design and multiple criteria analysis of the renovation of VGTU Laboratory Building and quality of life analysis it has been possible for VGTU to develop recommendations for the efficiency increasing of the building refurbishment and improving quality of life which are disseminated to the stakeholders in construction and real estate during distance and lifelong learning, conferences, newspapers.

The statistic and information are collected in accordance with different aspects on the building and quality of life. In this way it is also possible for stakeholders to see the results of the efficiency of renovation of VGTU Laboratory Building and quality of life. If necessary VGTU will also publish recommendations about efficiency increasing of renovation and rising of quality of life by using multivariant design and multiple criteria analysis methods and intelligent systems. Currently Lithuania did not have a benchmarking system for construction and real estate sector.

2.23.2 Assessment applied in the benchmarking organisation

Lithuania still did not have a national benchmarking system. Only some individual organisations carry out inspections.

2.23.3 Cost and performance indicators applied in benchmarking

Therefore, we can analyse only VGTU experience in carrying out inspections. The building inspections register for main parts (windows, walls, roof, doors, ventilation) of the building, which are essential for the energy saving and quality of life. A system of energy saving (U-value (W/m²K), heating energy consumption (kWh/m²)), quality of life (particle pollution, electromagnetic pollution, illumination, volume flow, air velocity, air temperature, relative humidity, dew point temperature, vibration impulse amplitudes) and other indicators have been analysed.

The energy efficiency, quality of life and other indicators can be used in the planning or construction and refurbishment. And due to the dissemination of information they can be as part of the planning and execution of coming projects.

2.23.4 Relation to enterprises, building project and real estate

The energy efficiency, quality of life and other indicators are used in eventually repair work and in the operation of the building. And due to the dissemination of information they can be as part of the planning and execution of coming projects.

The information concerning energy efficiency and quality of life is presenting for responsible persons in VGTU. The responsible persons in VGTU evaluate the energy efficiency and quality of life situation and take some practical solutions.

In addition to the mentioned activities VGTU researchers and professors takes initiative to considerable exchange of the results via bachelor and master degree courses, lifelong learning, distance learning and articles.

2.23.5 Visions and innovations for future improvements

European citizens spend over 90 % of their time in closed space. In over 40 % of the closed spaces people complain of their health and comfort. Outside air pollution has many defects. Thus creation of healthy environment and improvement of the quality of life in closed spaces for Lithuanian residents is very important to ensure quality of life in premises would improve productivity and reduce morbidity and health care expenditures.

We have plans for improvement the e-assessment methods and e-tools, including all steps in e-assessment process, for analysis of particle and electromagnetic pollution. Currently, the Embedded Particle and Electromagnetic Pollution Recommender Systems is under development.

2.23.6 Lessons learned and recommendations

On background of the multivariant design and multiple criteria analysis of the renovation of VGTU Laboratory Building and quality of life analysis it has been possible for VGTU to develop recommendations for the efficiency increasing of the building refurbishment and improving quality of life which are disseminated to the stakeholders in construction and real estate during distance and lifelong learning, conferences, newspapers.

3 Web-based benchmarking tool

This chapter describes the web-based benchmarking tool that has been implemented to collect information from building case studies. The benchmarking system provides tools for indicator storage, management, benchmarking and analyses. Further, it provides reporting functions considering the cross-section of the building stock or appearing trends in the building stock.

3.1 General description

A system for indicator storage, management, benchmarking and analyses has been piloted in the project. VTT is responsible for the implementation of the system at http://credit.vtt.fi. Usernames and passwords, which have been delivered to project participants, are required to enter the site. A screenshot from the portal is shown in the following figure.

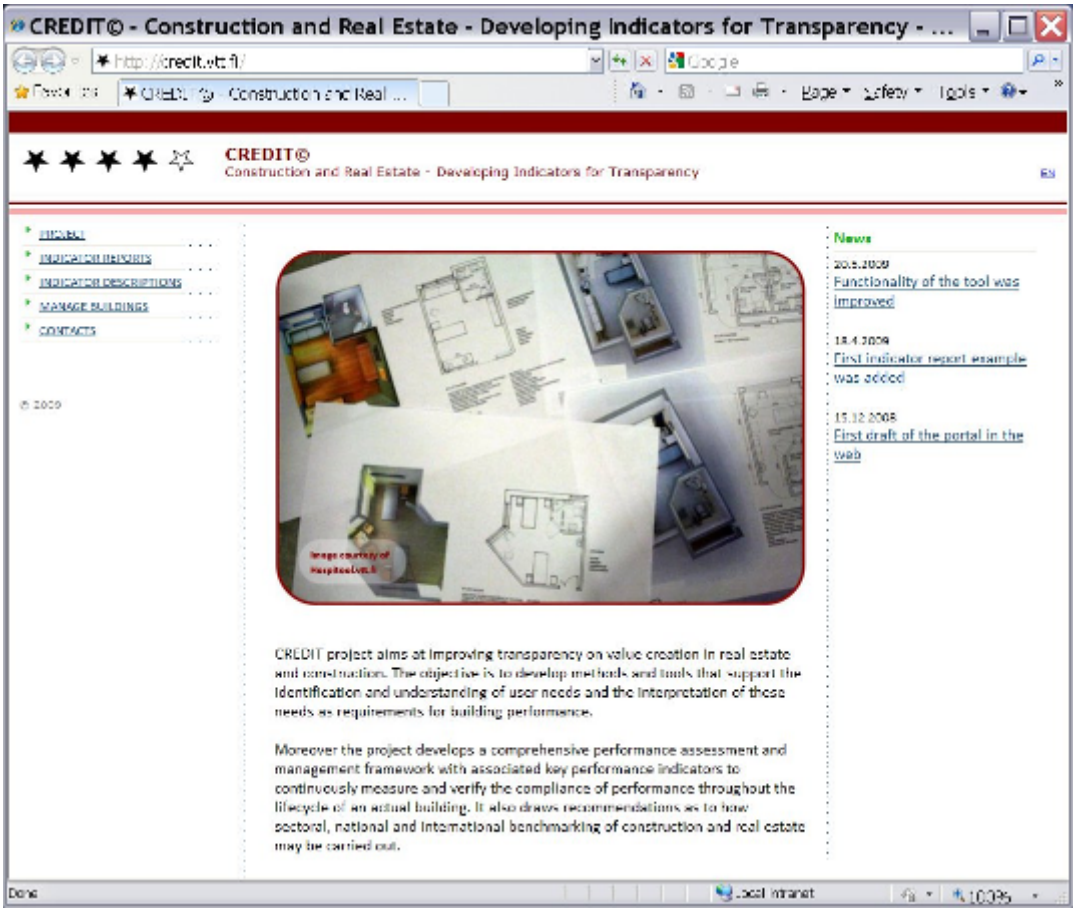

Figure 8. Screenshot from Credit portal.

The indicator reporting system is currently placed under *Indicator reports* and *Manage buildings* titles. The other menu items lead to general information about the project and its results. The indicator reporting system is based on Information Builders' business intelligence tool WebFOCUS (Information Builders 2009), which provides advanced reporting and analyses features and very good connectivity to various databases and systems. Currently the portal contains only a few simple sample reports and an example of form, which could be used to add new building to the database.

3.2 Application to case studies

The application of the benchmarking web tool proceeds through templates, which include relevant building information. Steps in adding new building to system are as follows:

– fill in the basic information and values to indicators that are defined in the case study (see Figure 9)
– check the reports to verify that given indicator values are correct
– fix the incorrect values
– check the reports (see Figure 10).

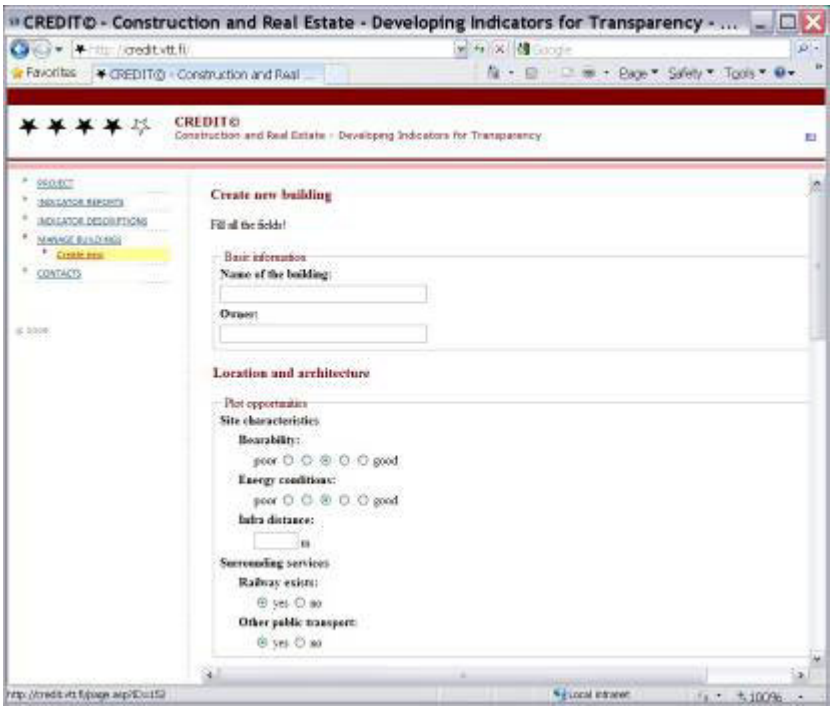

Figure 9. Filling basic information and indicator values for new case in Credit portal.

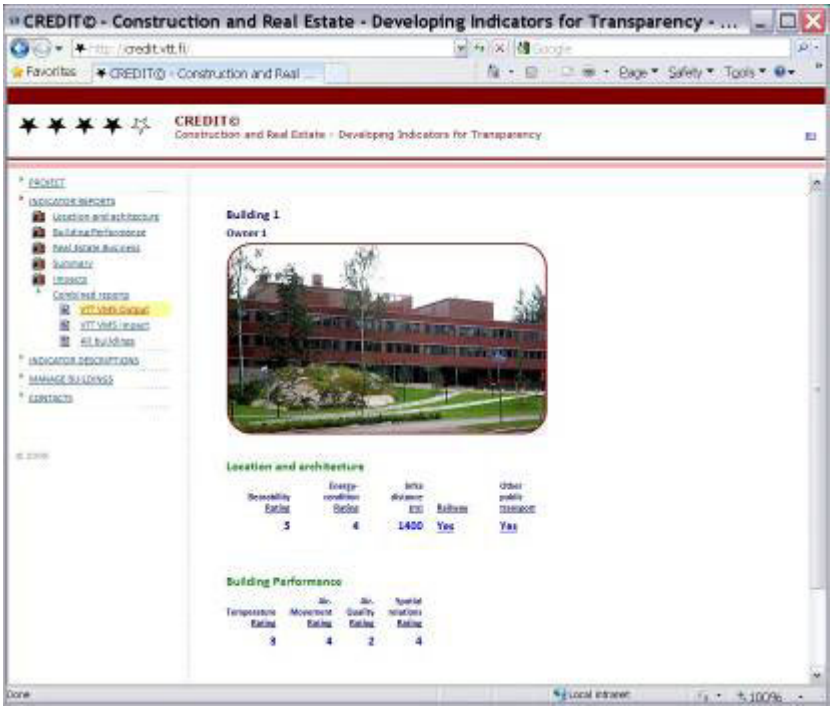

Figure 10. Sample case from Finland, Vuorimiehentie 5 office building, in Credit portal.

3.3 Recommendations for the future

VTT is currently adding new functionalities to the benchmarking platform. Next steps in the development work are as follows:

– select the indicators to be used in cross-border benchmarking
– create management interface and functions to allow building owners to add, update and modify indicator data
– provide basic reports for given indicators.

During the implementation of the benchmarking system to CREDIT and value adding indicators we have perceived that the user interface is very important. When the basic reporting is ready, we put more effort to developing additional value with advanced features. In the CREDIT project, some discussions have been raised on adding map user interface to the benchmarking platform. One screenshot from this kind of system is included in Figure 11, where the user may select the buildings from the map and get an e-book of their characteristics to the screen. Further, the system provides an opportunity to see the cross-section of the building stock or consider trends in the building stock.

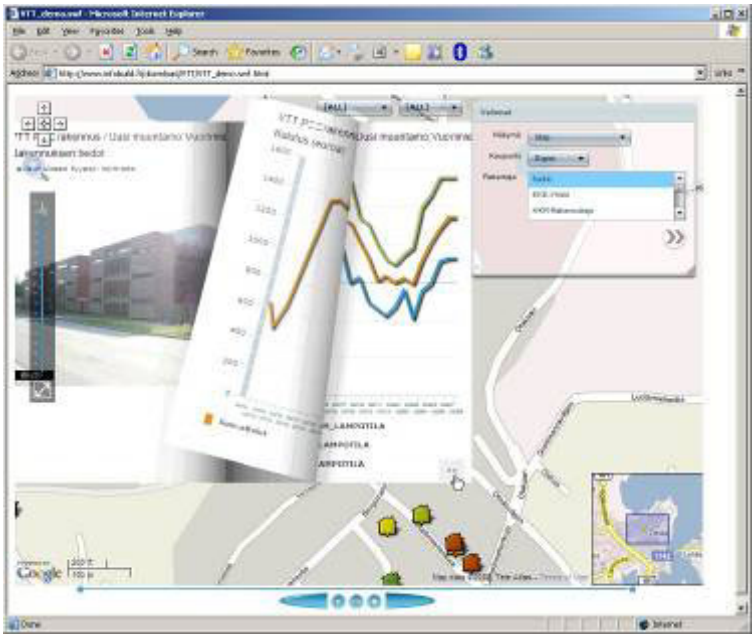

Figure 11: WebFocus demo by the Infobuild Oy.

4 The CREDIT indicator and benchmarking model

4.1 The model

The CREDIT project covered housing, office buildings, schools and nurseries, universities, hospitals and shopping centres. The performance of the whole building and internal spaces and rooms are of special interest for the end-user, the owner and the surrounding society. Contrary to that the construction companies and producers normally are more interested in the construction of building parts. The performance of the building and assessment methods will also depend on the actual location of the building. The CREDIT case studies have been executed in all seven participating countries: Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania

An important part of the project was the development of a model. We see that the design of building concerns two interlinked designs; internal space and rooms with different functions, and building parts as an envelope for the rooms and an external climate protection for the activities in the building. The product model in CREDIT looks primarily at the following three physical segments in the product model; the building parts and components, the building and internal spaces and rooms, and the location of building site, city, region and country. We analyse them from inside out as well as from outside as shown in the following figure.

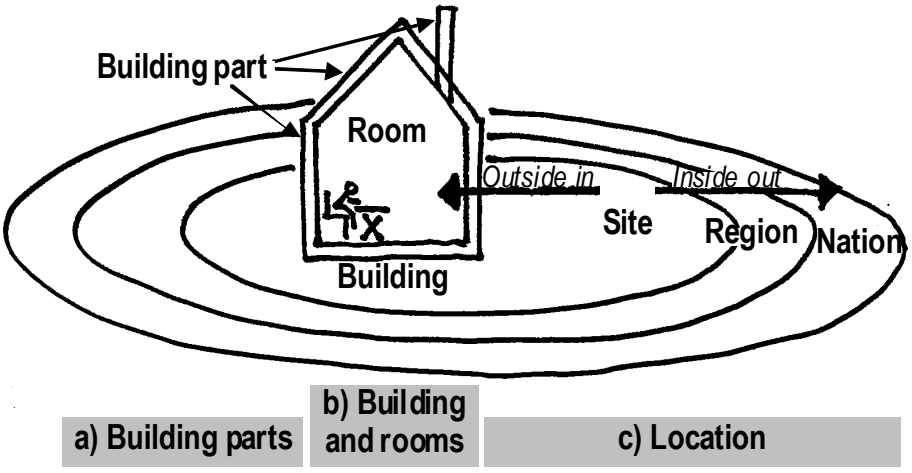

Figure 12. The CREDIT model showing linkage between different segments.

4.2 Performance indicator classification

The performance classification framework developed in a 'gross' inventory of indicators relevant in relation to the building and real estate sector in the seven Nordic and Baltic countries: Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania. The content is based on the findings from 28 case studies in the project as well as on the input from national building regulations, different national or international standards and research studies. The performance indicator framework has been developed as an iterative process in parallel to the case studies, experiences from assessing methods and tools, and collecting feedback from enterprises on the application of benchmarking in their organization.

These promising results have been comprised to a structure of performance indicators in seven independent categories (Bertelsen et al, 2010a). The first category is on costs and price through the life cycle of the building, while the next five categories address performance from various perspectives: location, buildings, building parts, facility management and the design and construction process. They all include both an objective for measurable performance indicators and indicators addressing less measurable properties such as end-user experiences. The last category deals with impact of the building on external environment, social life and economy. Each of the seven main categories is divided to groups that contain an increasing level of detailing ending up with about 200 indicators (see the following table).

Each indicator is titled and described shortly, see Bertelsen et al (2010a) for details. In addition to that the unit of how the indicator is measured is also described, and when possible also predefined values that the indicator may have are described based on standards and national regulations. In relation to earlier, the common target for performance indicator definitions is grades in 5 levels e.g. class A, B, C, D and E, where class A is the best.

Table 6. CREDIT performance indicator classification framework, seven main categories and groups beneath.

1. Cost, price and life cycle economy (LCE)	
11 Capital, investment, construction, commissioning and decommissioning cost	13 Business services related the activities in the building (not building related)
12 Building services related to operation, maintenance and development	
2. Location, site, plot, region and country	
21 Location and address	24 Spatial solution and site aesthetics
22 Social-cultural context	25 Surrounding services
23 Plot opportunities	26 User experiences and sensation
3. Building performance and indoor environment	
31 Category of building, quantity, size and area	36 Lighting conditions
32 Safety and security	37 Acoustic climate
33 Usability and adaptability	38 Aesthetics quality of building and indoor spaces
34 Thermal climate	39 User experiences and sensations
35 Air quality	
4. Building parts and component performance	
41 Category of building part, quantity, size and area	46 Lighting quality
42 Safety and durability	47 Acoustic quality
43 Usability	48 Aesthetic quality of building part
44 Thermal quality	49 User experiences and sensations
45 Impact on air quality	
5. Facility performance in operation and use	
51 Category of tenancy and operation and area of space	54 Business services related the activities in the building (not building related)
52 Applicability of the facility	55 Social performance and user experiences
53 Building services related to operation, maintenance and development	
6. Process performance in design and construction	
61 Category of process, supplier and organisation	64 Quality management
62 Resource control and project management	65 Participants or involved parties experiences
63 Health and safety and work environment	
7. Impact on environment, social live and economy	
71 Site	74 Waste to disposal
72 Emissions	75 Social and economical impact on the local community
73 Resources	

An example of indicator assessment is the Danish energy labelling system. Data on what the building consists of, how well it is insulated and the convective properties of the building components are collected by inspections of the building and the drawing material. This data forms the basis for the calculation of the buildings energy consumption. Output data is the calculation presented as classes ranging form A – G.

We see that the developed performance indicator classification framework can work as a tool to improve performance of buildings as well as to support the cooperation between the parties in the construction and real estate sector. Further, it is also important to get a better understanding on how the built environment can create value for the end-users and enhance activities in the building. End-user's experience and sensations are considered in five of the seven categories.

4.3 Selection of key performance indicators

The case studies revealed that there are only a few performance indicators that turn up in all cases or therefore may be selected as Key Performance Indicators (KPIs). In the case studies focusing on existing benchmarking systems we also noticed that there are certain general measures used as a baseline for other indicators, such as location, building type, size/area and price/costs. However, the values of indicators are also changing greatly between the different building types.

We have tested the applicability of these indicators in a CREDIT cross-border benchmarking pilot. The pilot tested a short list of 36 indicators to compare six office buildings in Norway and Finland. From the building owner and client perspective a set of 10 KPIs is proposed in the following table (Bertelsen et al., 2010a). Other proposals may be prepared in the future as alternatives and for other purposes to accommodate for different needs and wishes for benchmarking.

Table 7. A set of 10 Key Performance Indicators selected from CREDIT performance indicator classification framework for cross-border benchmarking pilot.

Core 1:	**1. Cost, price and life cycle economy (LCE)**
	2. Location, site, plot, region and country
Core 2:	23 Plot opportunities
Core 3:	252 Distance to public transport
	3. Building performance and indoor environment
Core 4:	331 Adaptability to needs (now and over time)
Core 5:	34 Thermal comfort
Core 6:	352 Pollutants in indoor air
	4. Building part and product performance
	5. Facility performance in operation and use
Core 7:	521 Rental agreement
	6. Process performance in design and construction
Core 8:	622 Working plan and time consumption
	7. Environmental impact
Core 9:	721 Climate change (CO2)
Core10:	731 Energy efficiency

5 Cross-border benchmarking pilot in Nordic countries

During the last quarter of the CREDIT project a cross-border benchmarking exercise was carried out in six offices in Norway and Finland. The Norwegian part was implemented by SINTEF at Skattens Hus (Skanska as main contractor) and Statistics Norway (Statsbygg), while the Finnish projects were collected by VTT at Lappeenranta and Vuorimiehentie 5 office buildings (Senate Properties), Tulli Business Park (NCC Finland) and Baltic Sea House (Sponda/Ovenia). Besides these six cases, Senate Properties in Finland wanted to test indicators also in one of their recent projects – the office building at Hakaniemenranta 6. That was a very challenging project, some years back the building was voted as the ugliest building in Helsinki. Multiple methods and tools were used during the development project; Building Information Models (BIMs) and workplace management to mention few of those.

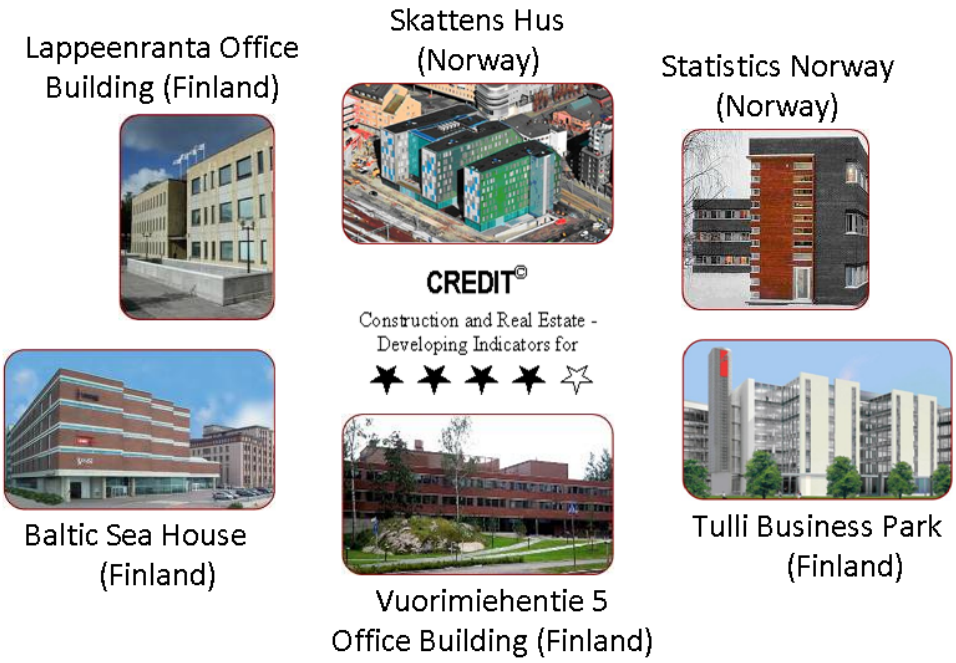

Figure 13: Six office buildings from Norway and Finland used in cross-border benchmarking pilot.

The indicator set that was assessed comprised ten KPIs, which were selected based on case experiences and other relevant indicators. Altogether, these indicators gave a great overview and included enough challenges that had to be solved in developing an indicator system. On the other hand this pilot also pointed out that it's not an easy task to develop an indicator system that is applicable for international use. We managed the cross-border benchmarking data with web-based benchmarking tool. The benchmarking system provides tools for indicator storage, management, benchmarking and analyses. Further, it also provides reporting functions for the building stock or trends in the building stock. When the data from cases was added to the system, we perceived that the user interface is very important and has influences the motivation of users. Therefore, VTT added map-user interface to the tool. The system also enables users to see the cross-section of the building stock and consider trends.

It is also hard to capture and formalise end-user needs and experiences, and soft values are often easier to collect in interviews and satisfaction surveys. We used professionals to judge rather many indicators comparing usability, adaptability, and architectural quality. One of these cases promoted flexible design solution. In Finland, Tulli Business Park is a solution that takes people to centre stage and enhances job satisfaction by minimizing negative stimuli in the working environment. The design concept is flexible to built open space, cell offices or mixed office solutions. Recently also indoor environment and conditions have gained much attention. We collected indoor climate indicators in measurements and evaluated also technical systems.

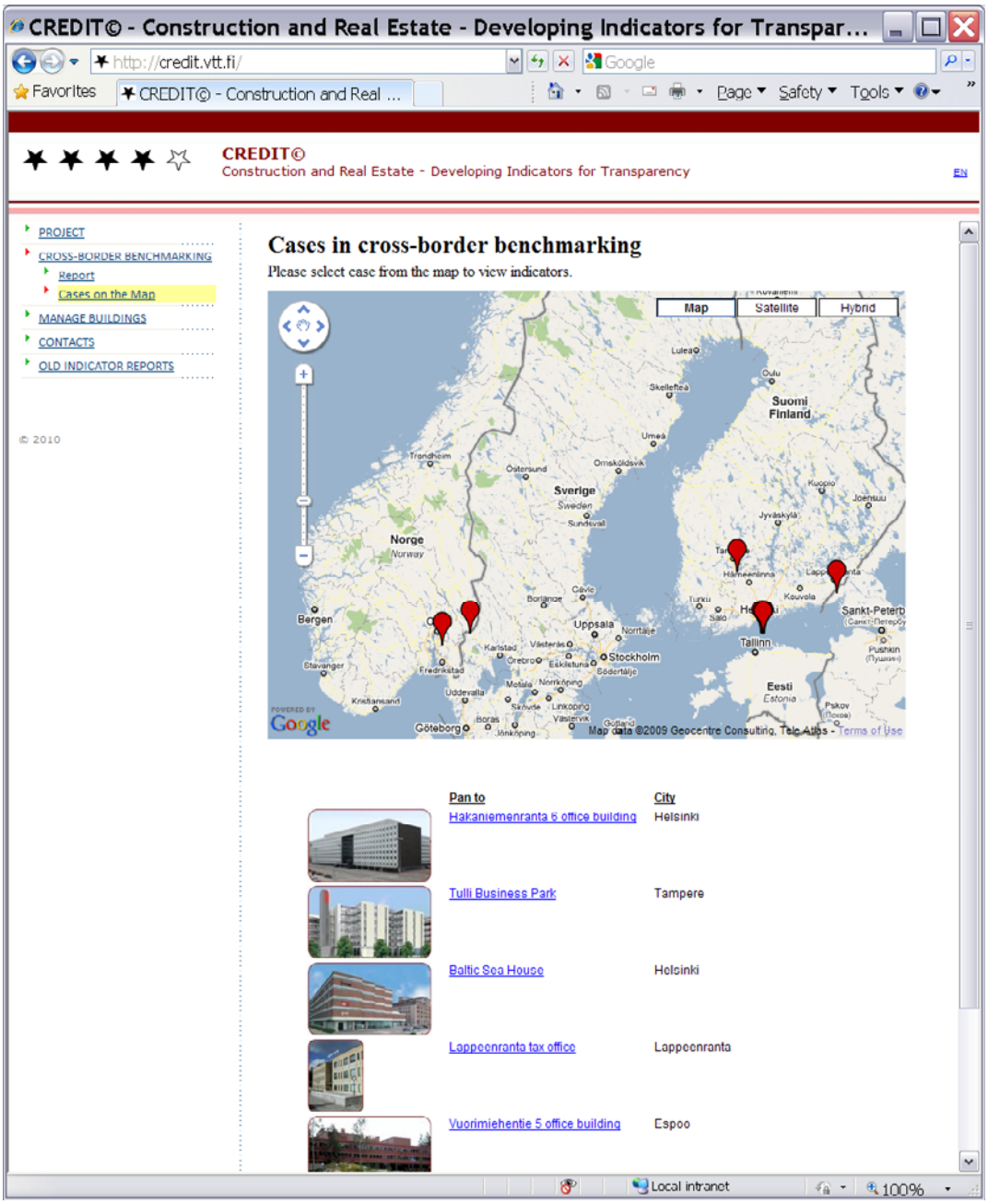

Figure 14. Screenshot from web based cross-border benchmarking tool.

During the benchmarking pilot, we perceived challenges of achieving true value metrics and to do successful cross border benchmarking. We noticed that some indicators may result in incomparable values. For example the plot opportunities that address size of the site, building efficiency and density, and quality of outdoor spaces were hard to evaluate. Two rather similar buildings in town milieu may actually be totally different. How we rate those, depends greatly on do we judge areas with high or low density.

The following figures illustrate the content of those pilots using the web-based benchmarking tool as described in Chapter 3.

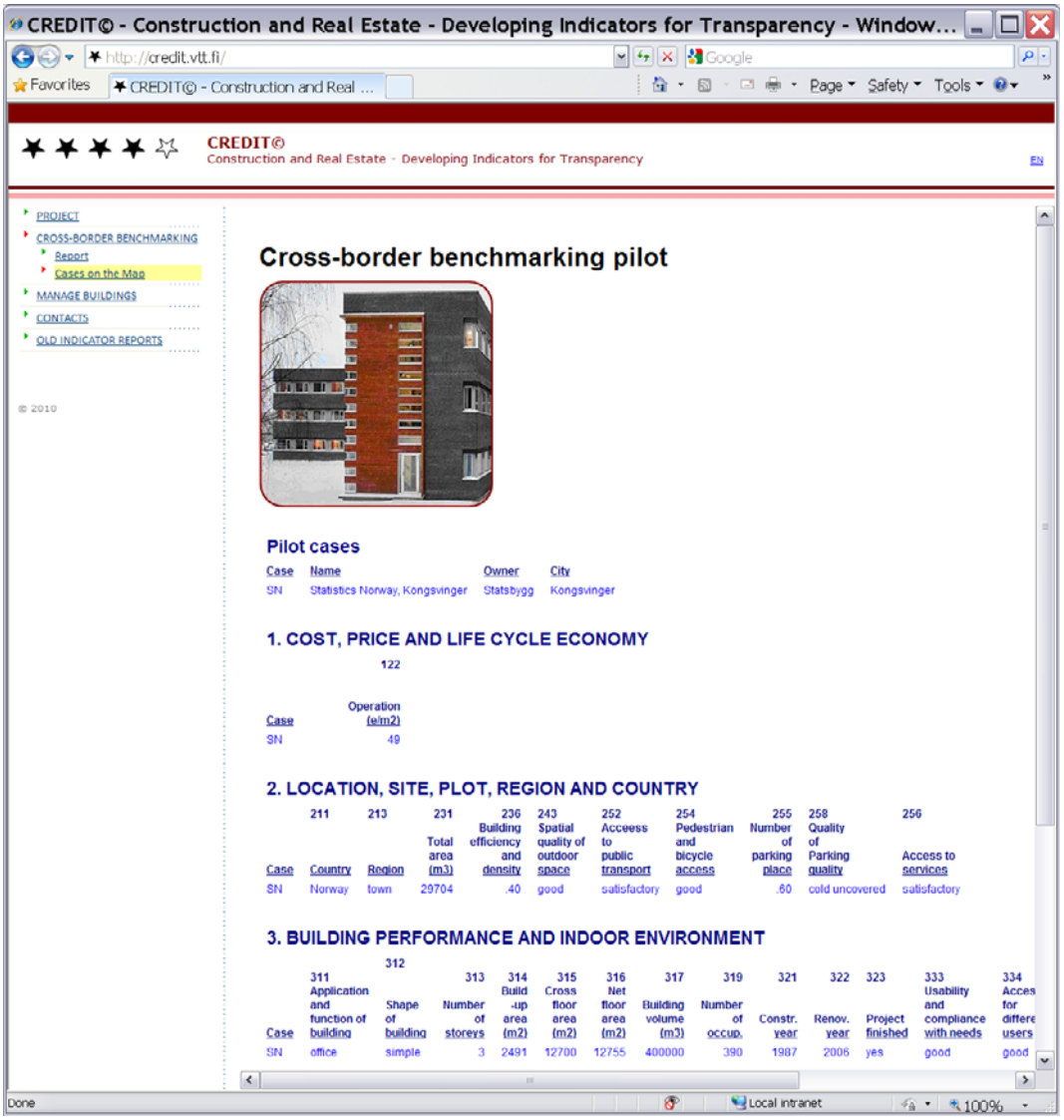

Figure 15. Kongsvinger Statistic Norway.

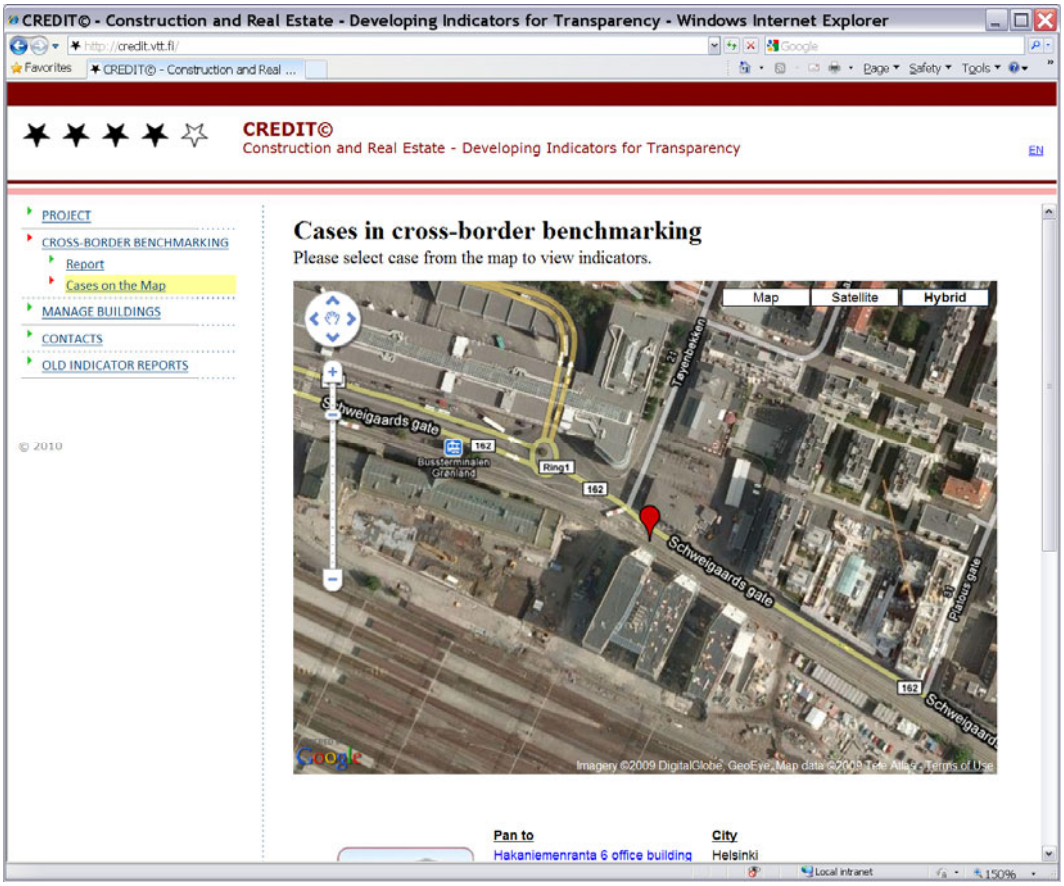

Figure 16. Skattens Hus.

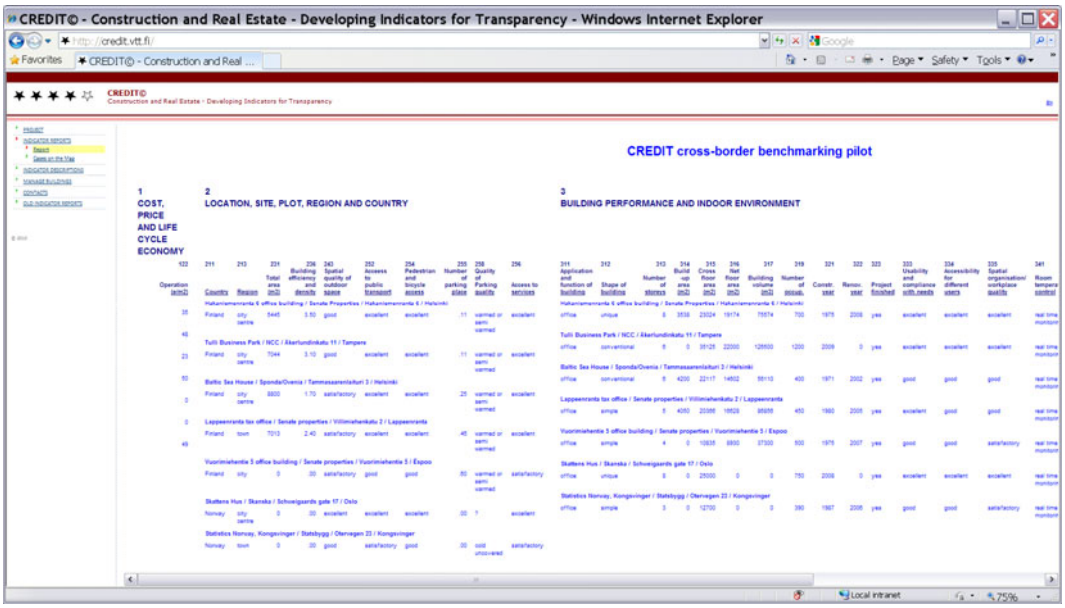

Figure 17. CREDIT Indicators benchmarked.

The conclusions from the three primary core indicators

(2) Plot opportunities

– architectural quality, cultural heritage, community acceptance
– zoning requirements, changing use, supplementary construction
– location, brand, upside

(4) Usability and adaptability

– easiness of use, flexibility, diversity, support to clients' strategies
– workplace management indicators and tools: more research needed!

(10) Carbon Footprint

– CO2, GHG, CF – facilities + travelling + equipment
– inevitable future direction
– how to measure virtual space or multi-locational workplaces?

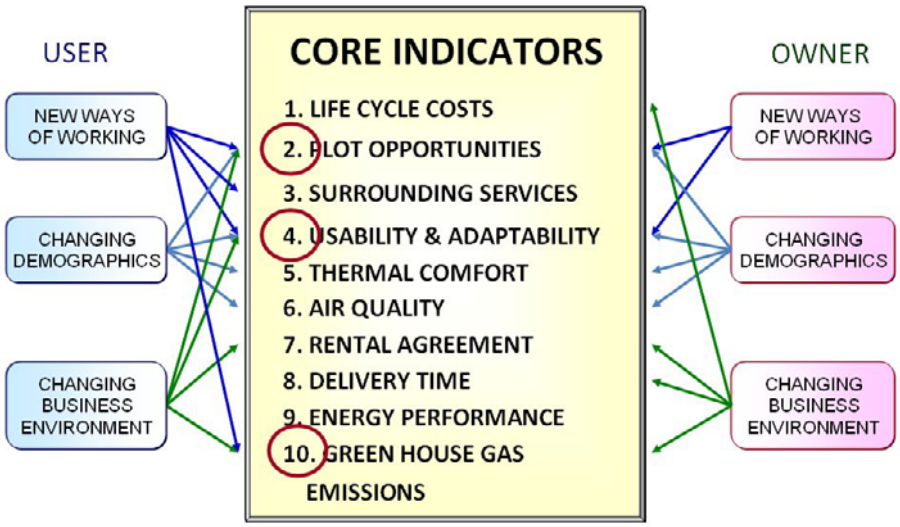

Figure 18. CREDIT Indicators benchmarked.

The conclusions from the seven secondary core indicators
(1) Life cycle costs – developing towards life cycle economy
(3) Surrounding services – relates with plot opportunities
(5, 6) Indoor conditions – must be in order, critical!
in addition to thermal comfort and air quality, also lighting and acoustics are important: quantifiable metrics?
(7) Rental agreements
applicability to client´s and owner's strategies
length/rental costs/net income, relation with valuation and LCE
(8) Delivery time
very tight schedules are risks to defects, quality, performance?
impacts of delays to core businesses
(9) Energy performance
kWh as an intermediate measure towards Carbon Footprint

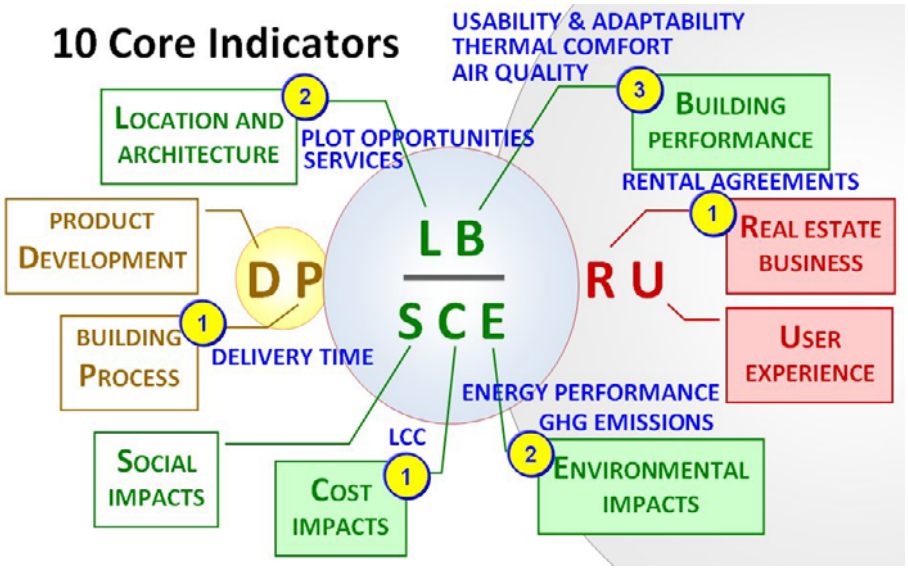

Figure 19. CREDIT Indicators benchmarked.

6 Discussion and conclusion

The purpose of Workpackage 6 was to explore and discuss how project-related measurements can be linked to sectoral, national and/or international indexes for performance indicators in order to continuously monitor and manage the performance of the construction and real estate cluster.

This report summarizes findings and recommendations from 24 case studies from seven participating countries addressing performance indicator benchmarking at a sectoral, national or international scale. The distribution of the case studies to different building types is summarized below and illustrated in the figure that follows:

- benchmarking systems and indicators (4 case studies)
- offices (7 case studies)
- housing (6 case studies)
- school and nursery (4 case studies)
- shopping centres (3 case studies).

CREDIT CASE STUDIES

1 Benchmarking systems and indicators			
1	DK02	Denmark	Applying and improving Key Performance Indicators (KPI) in the Danish construction sector (BEC)
2	DK06	Denmark	Benchmarking commercial property - Retail, office, residential and industrial buildings (Denmark)
3	SE03	Sweden	System for evaluating the construction process (Sweden)
4	SE06	Sweden	FIA (Sweden)
2 Offices			
5	DK07	Denmark	Operation of an office building (Danish Facilities Management benchmarking)
6	FI01	Finland	Tulli business park (NCC, Finland)
7	FI02	Finland	Baltic Sea House (Sponda/Ovenia, Finland)
8	FI03	Finland	Lappeenranta tax office (Senate Properties, Finland)
9	FI04	Finland	Vuorimiehentie 5 office building (Senate properties, Finland)
10	NO04	Norway	Skattens Hus (Skanska, Norway)
11	NO01	Norway	Statistics Norway, Kongsvinger (Statsbygg, Norway)
3 Housing			
12	DK08	Denmark	Defects in housing, Musikbyen (Danish Building Defects Fund
13	DK05	Denmark	Benchmarking private housing – search engines at estate agents (Denmark)
14	DK01	Denmark	22 student housing estates - Stakeholder evaluation of user satisfaction, housing quality, economy and building process
15	DK03	Denmark	Public housing - User needs and benchmarking of economy
17	SE04	Sweden	Managing tenants in housing company (Sweden)
19	EE01	Estonia	Paldiski road (Tallinna Majaehituskombinaat, Estonia)
4 School and nursery			
20	DK04	Denmark	Energy labelling system in University Buildings (University and Property Agency, Denmark)
21	NO02	Norway	University of Stavanger (Statsbygg, Norway)
23	IS01	Iceland	Nursery Schools, Reykjanes (Reykjavik municipality, Iceland)
24	LT01	Lithuania	VGTU Laboratory Building (VGTU, Lithuania)
5 Shopping centres			
25	FI05	Finland	Shopping centre 1 (Citycon, Finland)
26	FI06	Finland	Shopping centre 2 (Citycon, Finland)
27	NO03	Norway	Stortovet shopping centre (Skanska, Norway)

Figure 18. 24 cases studies of Report 4, classified according to building types with piloting countries mentioned.

In addition to individual case studies, a web-based benchmarking tool was developed, and used to some extent in cross-border benchmarking between Norwegian and Finnish office buildings.

CREDIT WP6 case studies encompass a range of pilots of different characteristics and flavour. The Danish case studies focused on analyzing the existing benchmarking systems, the Finnish case studies emphasised CREDIT key performance indicators and their assessment and benchmarking. The Swedish case studies studied methods for capturing end-user needs whereas the focus in Norway was at the enterprise level tool implementation. Each approach is valid complementing well the general view.

Some good practices exist already for benchmarking indicators at a national level, such as process indicators by the Danish Benchmarking Centre (BEC) or environmental indicators by the Finnish PromisE. Examples of existing international benchmarking systems can be taken from economic indicators by the Investment Property Databank (IPD) or environmental indicators of BREEAM or LEED that are gaining popularity amongst international investors and actors. All of these existing schemes contribute to the CREDIT framework, but don't cover it's performance scope.

Each indicator system has been developed from its own point of view: production process, environmental sustainability, economy. Some of them have been extended to cover additional aspects, like environmental and social sustainability, but the performance in use dimension has not been the driver. The positive aspect of the existing systems is that they have already an established infrastructure, they can provide comparability through benchmarks and some of them can even support branding. The challenges with these systems may lie in the coverage of the value related performance content (usability, adaptability, serviceability, indoor conditions etc.) and on the other hand with the applicability (local adaptation) of an international system to meet the local, even regional conditions.

The front runner companies have their own key performance indicators, sometimes even several indicator systems used by different organizational units in different process phases. There seems to be a demand for a uniform indicator system that could be applied by different stakeholders. CREDIT provides a framework towards such a system. It also provides list of potential performance indicators that could be included in such a system, and even a proposition of ten core indicators that could be started with.

The small cross-border benchmarking exercise gave an opportunity to validate those core indicators in real buildings. It was possible to test the accessibility to the indicator data, the reliability and comparability of the indicator values. It showed the differences between cases and countries, and emphasized the importance of integrating those indicators with the applied methods and tools. If formal applications are available to produce needed data, to retrieve it, to assess it, to use it for simulation or reporting, it will make the benchmarking considerably less time consuming.

Performance indicator benchmarking also identified the need for further development of some indicators that were found important (e.g. plot opportunities, usability and adaptability), but could not be easily quantified. The need for more precise metrics, like calculation of Carbon Footprint instead of using some indirect indicators was also identified.

Since there isn't yet any commonly agreed European Key Performance Indicator framework, or performance indicator standard, CREDIT made a contribution to their development from the Nordic/Baltic perspective. It also pro-

vided valuable input from the performance and social sustainability point of view to existing economic and environmental oriented schemes that are continuously updated and amended. It was also on interesting collaboration effort between seven countries, having congruent objectives but sometimes distinct priorities and constraints.

The important building and real estate performance benchmarking area didn't become completed, but the prerequisites to make steps forward within the sector by the front runner companies have been improved. Amelioration to existing national or international benchmarking systems can be made based on CREDIT outcome, and other ongoing activities (dissemination, education, research and development) may exploit these results.

CREDIT reports

CREDIT reports and CREDIT case study reports are published by Danish Building Research Institute (SBi), Aalborg University, Copenhagen, and all reports are available free of charge in http://www.sbi.dk/byggeprocessen/evaluering/credit-construction-and-real-estate-developing-indicators-for-transparency-1/?searchterm=None.

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Construction and Real Estate -
Developing Indicators for Transparency

This report summarises the results from work in sixth work package on ”International benchmarking” as part of the Nordic project Construction and Real Estate – Developing Indicators for Transparency (CREDIT). It discusses how projectrelated measurements can be linked to sectoral, national and/or international indexes for performance indicators in order to continuously monitor and manage the performance of the construction and real estate cluster. These results have been reached in active cooperation between the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi (Denmark), VTT (Finland), SINTEF (Norway) and Lund University (Sweden), and partners from Iceland (The Icelandic Center for Innovation), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

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