CREDIT Summary and National Recommendations

Indicators and benchmarking framework for transparency in construction and real estate in the Nordic and Baltic countries. CREDIT Report 6

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CREDIT Report 6

Danish Building Research Institute
AALBORG UNIVERSITY

CREDIT©

Construction and Real Estate -
Developing Indicators for Transparency

CREDIT Summary and National Recommendations

Indicators and benchmarking framework for transparency in construction and real estate in the Nordic and Baltic countries

CREDIT Report 6

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Preface

This report summarises the work undertaken in CREDIT and proposals for how to implement CREDIT; it is the final part of the Nordic/Baltic project *CREDIT: Construction and Real Estate – Developing Indicators for Transparency*. The report presents the objectives and the research model for CREDIT followed by a summary of the results of CREDIT Reports 2, 3, 4 and 5. The conclusive part of the report presents national recommendations of how to implement CREDIT in the Nordic/Baltic countries 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

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1 Introduction and objectives

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 summarises first the main CREDIT reports and followed by national recommendations of how to implement CREDIT and the conclusion.

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 benchmarking

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.

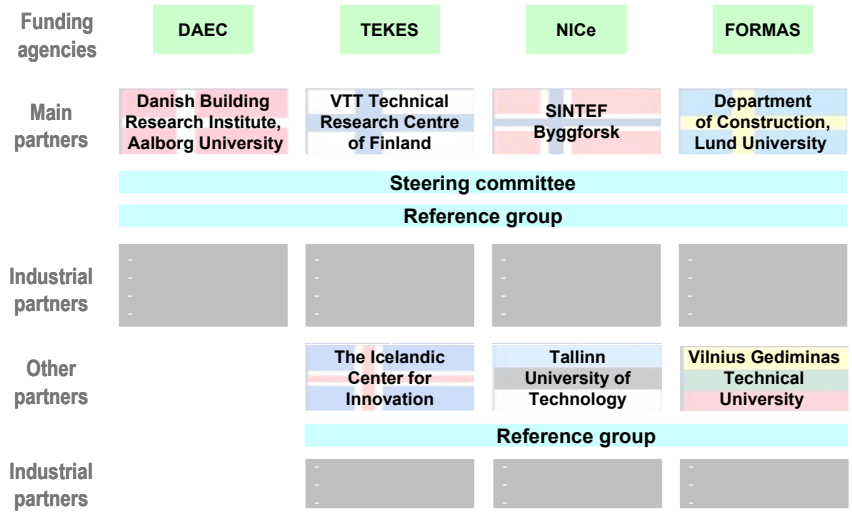
The project was managed by a steering committee chaired by the project owner, the project coordinator was secretary and each of the four main partners had two seats. The steering committee saw to the overall coordination and operation of the project, and was responsible for making the decisions necessary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

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).

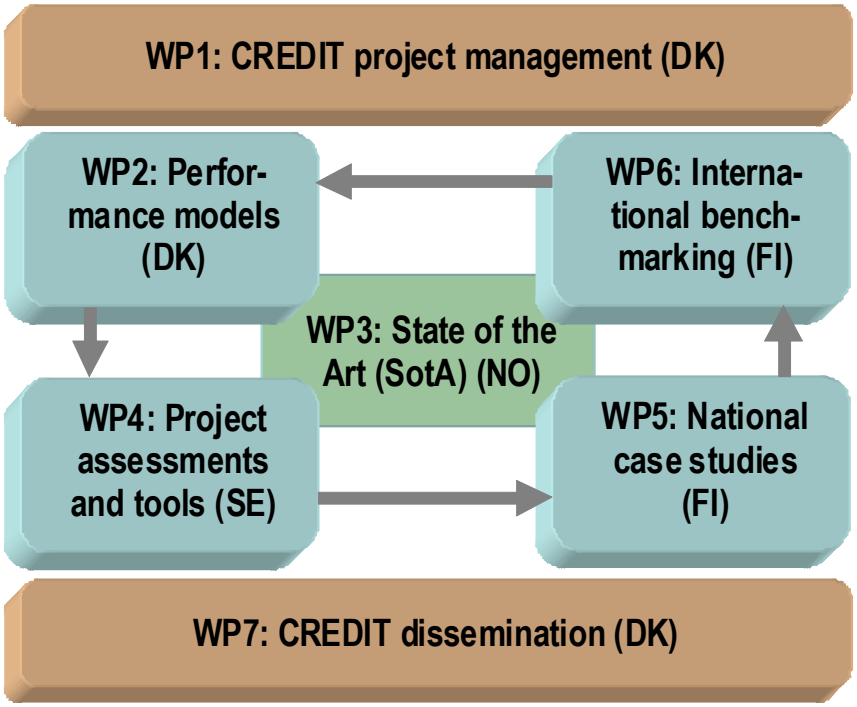
Seven two-day meeting packages (MPs) were held in 2008, 2009 and 2010 in the different countries to strengthen the innovative cooperation between the researchers and the national reference groups comprising the main players in planning, construction, real estate, benchmarking and the responsible authorities. 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'.

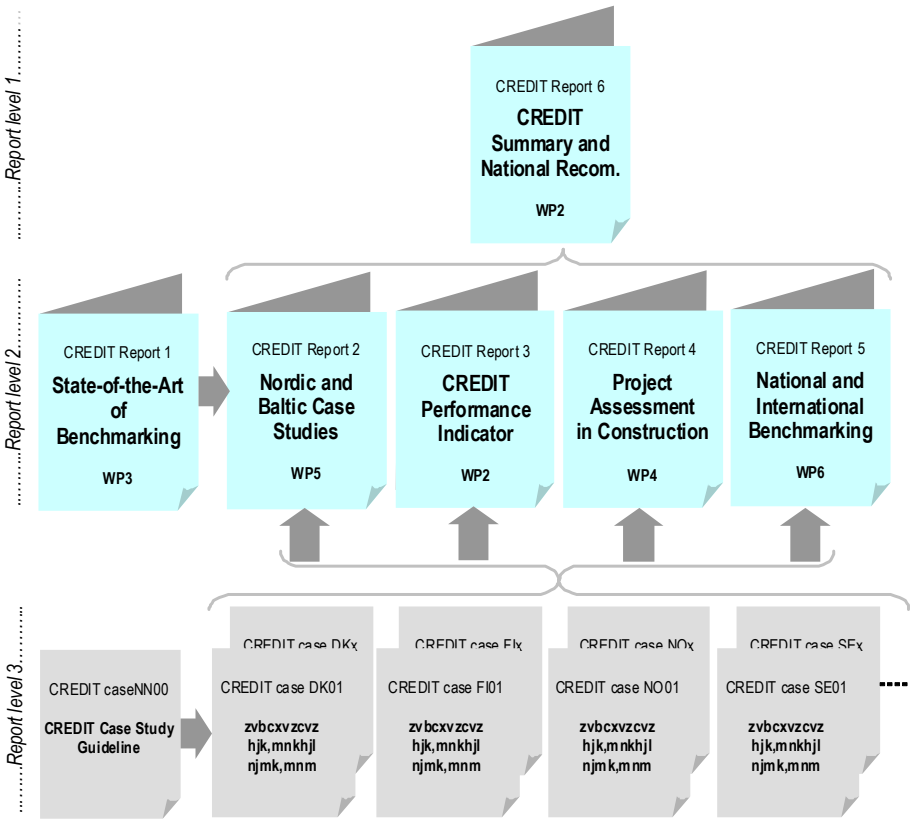
The work of 'WP5 National case studies' resulted in 28 Nordic and Baltic case studies with focus on performance indicators, assessment tools and benchmarking in front-runner building projects, enterprises and benchmarking organisation and reported in CREDIT Report 2. Each case study is described in accordance 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 The CREDIT research model

This chapter presents the CREDIT research model on indicators, assessment and benchmarking. First substantial segments are described with their locations, buildings, processes and actors that were pivotal points for the CREDIT study. Secondly the CREDIT performance information model are described and how it are related to important segments in the product and process models and different enterprises, building projects and benchmarking organisations. Thirdly is described how the analyses in CREDIT are carried out stepwise in ten topics from case studies, through the different CREDIT reports to the final conclusion in this report.

2.1 Segments of locations, buildings, processes and actors

The analyses in CREDIT were performed for selected segments in the CREDIT product and process model. In the discussion and conclusion we endeavour to generalise from them to the entire construction and real estate sectors. The main focus point with regard to the performance study of CREDIT was the building, and it varied depending on its function, design, location, and the construction and facility management process.

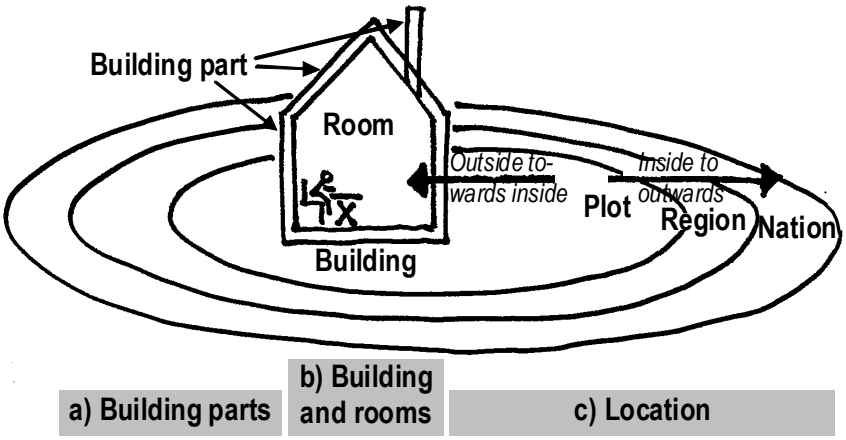
The CREDIT product model – Location, building and building parts
A building has different functions and in CREDIT we focused both on housing, office buildings, schools, universities, hospitals and shopping centres. We deal with two interlinked designs of buildings:
– Design of internal space and rooms with different functions.
– Design of building parts and components as an envelope for rooms and an external climate protection for the activities in the building.

The performance of the whole building as well as internal spaces and rooms are of special interest for the end-user, the owner and society. In contrast, the construction companies and producers are normally more interested in the construction of building parts (external walls, roofs, heating and ventilation systems) and the manufacturing of components (bricks, concrete, insulation materials, pipes, wires, radiators and fittings).

The performance of the building and the assessment methods also depend on the actual location of the building. To substantiate this, the study was carried out in all seven CREDIT countries: Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania. Through the analyses we also examined variations between different regions and climate zones and buildings located in small or large cities or in the city centre.

In CREDIT we therefore primary looked at the following three substantial physical segments in the product model, and we analysed buildings from the inside and outwards as well as from the outside towards the inside, see Figure 4:
a. Building parts, components and products.
b. Building and internal spaces and rooms.
c. Location including building plot, city, region to country.

Figure 4. The CREDIT product model is a physical linkage between: Materials, components, systems, building parts, rooms, building and its location in cities, regions and countries. CREDIT looks at the following three selected segments: a) Building parts; b) Building and rooms; and c) Location.



The CREDIT process model – Life cycle phases, actors and activities

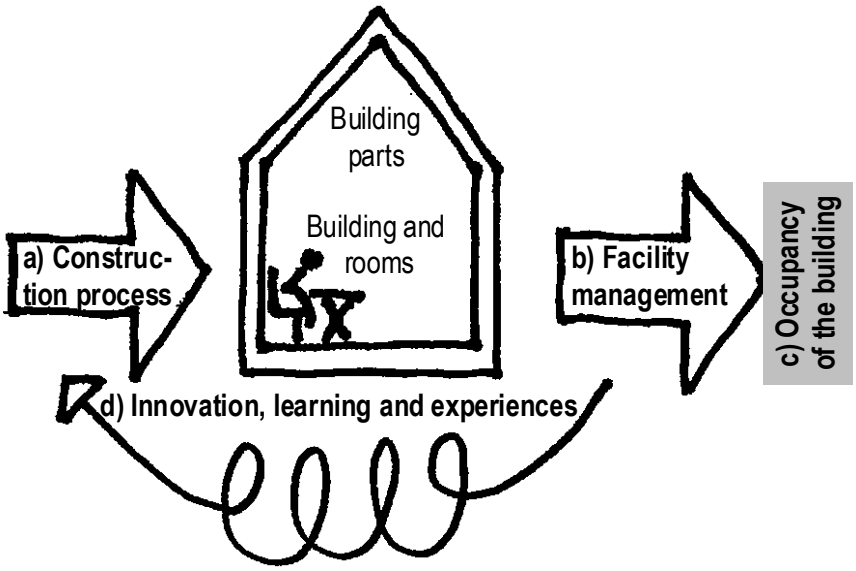
The CREDIT process model is linked to the CREDIT product model. On one hand it describes the building design and construction; on the other hand the CREDIT process model includes facility management and the use of the building. The last part in the CREDIT process model is lessons learnt on one building project or enterprise and their transformation for use on another project to improve the quality, efficiency and economy of construction and real estate. In the analyses in CREDIT we included the following four substantial parts of the CREDIT process model:

a. Design and construction process.
b. Facility management process.
c. Business, housing and other activities of the building.
d. Innovation and learning process.

The CREDIT process model also included the actors in the processes, and how they perform in the individual activities and in the internal cooperation in the different life cycle phases of the building. In CREDIT we worked with the following five substantial segments of actors in relation to performance indicators, assessment and benchmarking, where the first three were the main actors in the supply chain and the two last segments were main partners in the supporting system:

– End-users, tenants of the building, neighbour and society.
– Client, owner and facility manager.
– Consultants, contractors, manufacturers and other suppliers.
– Authorities and assessment and benchmarking organisations
– Researchers, developers and teachers.

Figure 5. The CREDIT process model is linked to the CREDIT product model, and CREDIT examines four selected process segments. The design and construction processes on the left hand side of the building in the sketch. The operation of facilities and the use and occupancy of the building on the right hand side of the building in the sketch. The last of the four processes is innovation and learning, and they link the three other processes together.



2.2 The CREDIT performance information model

The CREDIT performance information model is a framework for improving transparency of value creation in the construction and real estate sectors. It is a tool for exchanging performance information between end-users, enterprises, building projects and benchmarking organisations. The CREDIT performance information model is composed of the three interlinked topics:

1. CREDIT performance indicator classification.
2. Assessment methods and tools including capturing end-users needs.
3. Internal, national and international benchmarking.

The performance indicators are the subjects of the assessment and benchmarking process. These information processes provide documentation for the decisions made in the construction and real estate sectors as well as proposals of how buildings and processes are improved through innovation. A total overview of the CREDIT performance information model is given in Figure 8.

The CREDIT performance indicators classification

The indicators to be dealt with in CREDIT are organised primarily from the end-users', the owners' and tenants' point of view and secondarily from the suppliers' point of view. Lowest priority is given to the impact on neighbours, society, the national economy and the global environment.

End-user, owners and tenants are primarily looking at the following three performance indicators in a descending order of priority: The economy; the location of the building; and the standard and quality of the building and the internal spaces and rooms as a whole. Normally end-users, owners and tenants have a minor interest in the design and construction processes or the facility management process, and only few users are interested in how the building affects their neighbours, society, the national economy or the global environment. When they are confronted with such issues, they expect the authorities to have included the impact on society and the global environment in building

regulations and other public requirements to the building and the construction process.

The suppliers' primary interest is how to manufacture products and how to design, construct and operate the building. Obviously the professional suppliers know the importance of understanding and satisfying the end-user and the client's needs and demands. But still the majority of enterprises in the construction and real estate sectors are production-oriented rather than client-oriented. To inspire and motivate them to participate in improving the construction and real estate sectors, it is therefore important that parts of the performance indicators are also relevant for them. This could for example be expressed through performance indicators on building parts and components as well as through indicators on the construction and real estate processes.

In CREDIT we therefore dealt with seven substantial facets of performance indicators reflecting different subjects according to the arguments above. The seven performance facets are given in Figure 6. More details and clarified conclusions of CREDIT Report 3 *CREDIT Performance Indicator Framework* are given in Chapter 4.

Figure 6. The seven main facets of CREDIT performance indicators

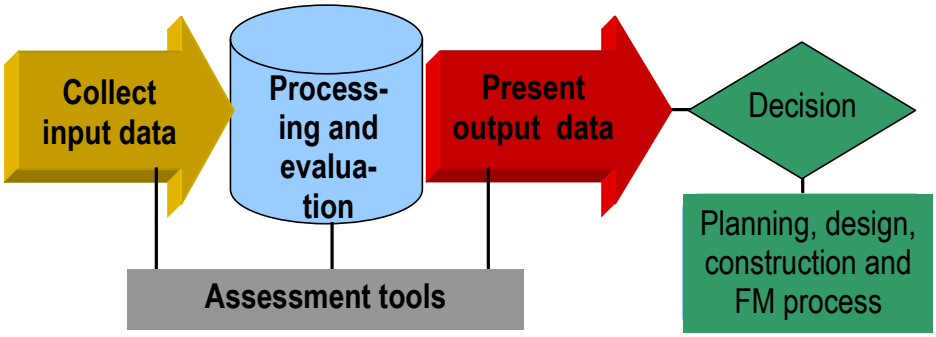
Main facets of CREDIT performance indicators
1. Costs, price and life cycle economy (LCE)
2. Location, plot, region and country
3. Building performance and indoor environment
4. Building part and product performance
5. Facility performance in operation and use
6. Process performance in design and construction
7. Impact environmentally, socially and economically

Assessment methods and tools

The assessment process was divided into the following three activities that were supported by various assessment tools from manual calculations to digital programs for 3D live presentation of information:

– How to collect and file input data and general information including how to capture end-users needs and experience.
– How to calculate and evaluate information and compare with other data.
– How to present and report output data and information ready for decision.

Figure 8. The three main activities of the CREDIT framework of assessment as background for decisions and supported by different assessment tools.



In CREDIT assessment methods and tools were analysed according to the model in Figure 7. In Chapter 5 the assessment status of different segments is discussed together with proposals for improvements. For example it is discussed when and where new or changed assessment tools might appear in the future to support improvement in national and international benchmarking. And how the assessment will differentiate according to the purpose and needs of different actors. It is for example also discussed how the needs of performance information of a professional supplier in the supply chain will differ from the needs that of a non-professional end-user.

Benchmarking internationally, nationally and internally

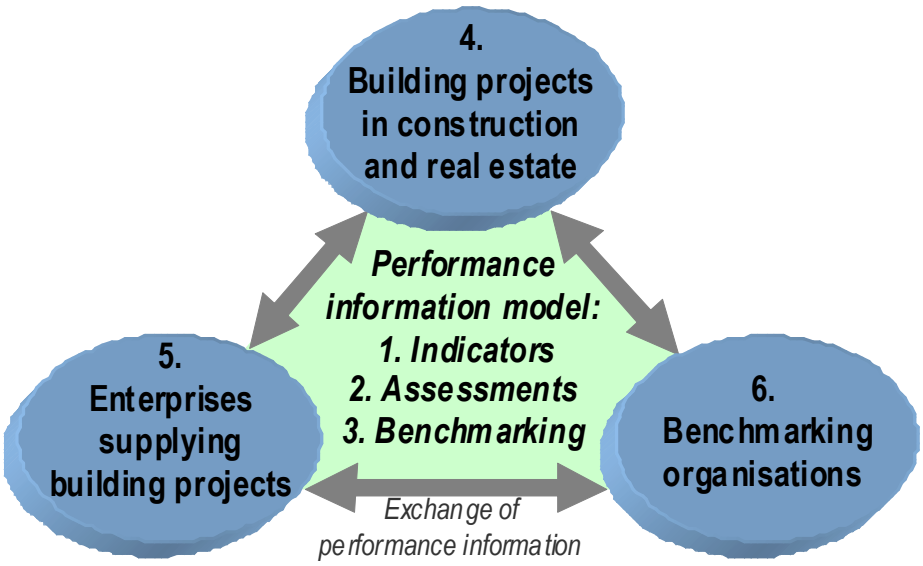
The third topic in the CREDIT performance information model was how benchmarking was applied in assessments internally in enterprises and building projects. It also included how measures and experience of different indicators were exchanged with benchmarking organisations, and how internal, national and international benchmarking interacts and could be improved. In this context the following subjects were studied in CREDIT and further discussed in Chapter 6 according to a detailled description in CREDIT Report 5:

- How will benchmarking of performance indicators in 'young' and 'mature' benchmarking organisations differ?
- How will the interaction between building projects, the individual enterprises and national or international benchmarking organisations be completed in different segments?
- How will the benchmarking measures and information be presented in interaction with different user groups and applied to improve the buildings and the enterprises?

The CREDIT study also included the following categories of benchmarking organisations and how to handle benchmarking measures and information:

- Open or closed organisations.
- Publicly demanded or voluntary organisations.
- Public or private owned organisations.
- 'Young' and 'mature' organisations.
- Manual or digital handling of measures and information for example how to apply the Internet and 3D visualisation.

Figure 8. The CREDIT performance information model includes indicators, assessment and benchmarking (topics 1, 2 and 3), and the practise in the construction and real estate sectors was analysed in different building projects, enterprises and benchmarking organisations (topics 4, 5 and 6).



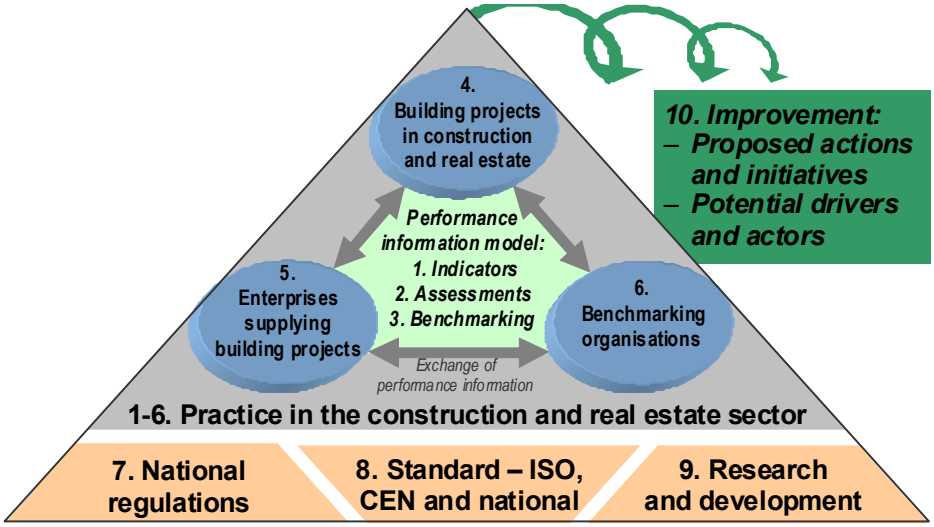
2.3 How was information analysed and concluded in CREDIT

In CREDIT we analysed the performance information practice and potential for improvement of value creation in the construction and real estate sectors in the Nordic and Baltic region. We analysed selected segments according to the CREDIT performance information model described in the previous sections in this chapter. As background we studied practice and opportunities of improvements in 28 CREDIT case studies of front-runner enterprises, building projects and benchmarking organisations. The lessons learnt from these case studies were for example discussed in relation to national regulations and international standards and research (Figure 9: Topic 7, topic 8, and topic 9).

The discussions of the ten different topics according to Figure 9 are presented in the following chapters, and the discussions were carried out according to the following steps:

– First one of the three topics in the CREDIT performance information model (Figure 9: Topic 1, topic 2, and topic 3) was discussed and how it interacts with the other two topics.
– Secondly one of the three different actors in the exchange of performance information – building projects, enterprises and benchmarking organisations (Figure 9: Topic 4, topic 5, and topic 6) was discussed and how it interacts with the other two topics according to the exchange of performance information (Figure 9: Topic 1, topic 2, and topic 3).
– Thirdly the selection of improvement initiatives was discussed, and what and whom were the potential drivers and front-runner actors of future innovation processes in the individual segments in the Nordic and Baltic countries.

Figure 9. In the CREDIT project the performance information practice (topics 1-6) and potential for improvement (topic 10) was analysed according to this model of ten topics.



The different results are presented in Chapters 3-6 as a summary of CREDIT Reports 2-5 concerning: CREDIT case studies; CREDIT performance indicator framework; project assessment; and benchmarking. Each report is described according to the three steps outlined above, and we have endeavoured to answer the following questions in relation to the model in Figure 9:

1. What are the important categories of indicators, assessment methods and tools, as well as benchmarking methods, and how are they applied now and in the coming years in the different segments?

2. How are the different parts of the performance information model described generally, and how can we distinguish between 'young' and 'mature' ones?
3. How will different segments in the CREDIT product and process model apply the CREDIT performance information model in the future, and how will they improve to reach a higher maturity level?
4. What essential activities, initiatives, drivers and front-runners would improve the effect of the performance information and international benchmarking?

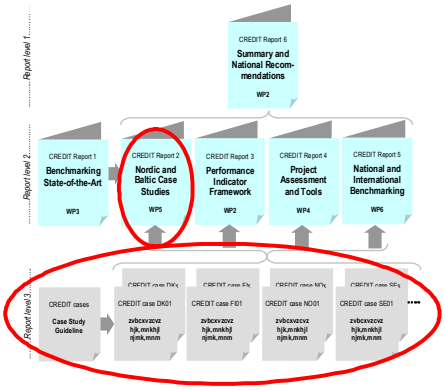
Based on the discussions in Chapters 3-6 each of the seven countries participating in the CREDIT project have put forward their national recommendations and priorities the implementation of CREDIT in Chapter 7. The last chapter – Chapter 8 - presents the overall and final conclusions of CREDIT and it is presented according to the objectives in Chapter 1 and the CREDIT models in this chapter illustrated in Figure 9.

To evolve the final conclusion we have step by step extracted the conclusions in still more narrow spirals in the following steps according to the ten topics in Figure 9:

1. The main chapters of Reports 2-5.
2. The discussions and conclusions of Reports 2-5.
3. The summaries of Reports 2-5. In this report Chapters 3-6.
4. The national recommendations. In this report Chapter 7.
5. The overall and final conclusions of CREDIT. In this report Chapter 8.

3 Nordic and Baltic case study

The case study was carried out in Work Package 5 and reported in CREDIT Report 2. The purpose for Work Package 5 was to test assessment methods and tools and CREDIT key performance indicators as well as international benchmarking in front-running case studies in Nordic and Baltic countries. This chapter summarises the CREDIT Report 2 included a total of 28 case studies individual reported in 28 CREDIT case reports according to report level 3 in Figure 3. Different angles of information are further treated and discussed in CREDIT Reports 3, 4 and 5 and summarised in the three next chapters.



3.1 The 28 CREDIT case studies

All 28 case study reports are prepared according to a common CREDIT case study guideline and can be read individually referring to a common introduction and objectives alike the introduction in this report. In the next three chapters is described the actual building project, the involved enterprises and related benchmarking if it is relevant. Each of the three chapters are prepared by the same five sections:

- The actual building project, involved enterprises or benchmarking
- Assessment applied
- Performance indicator applied
- Relation to the other two items (project, enterprises or benchmarking)
- Visions and innovations for future improvements.

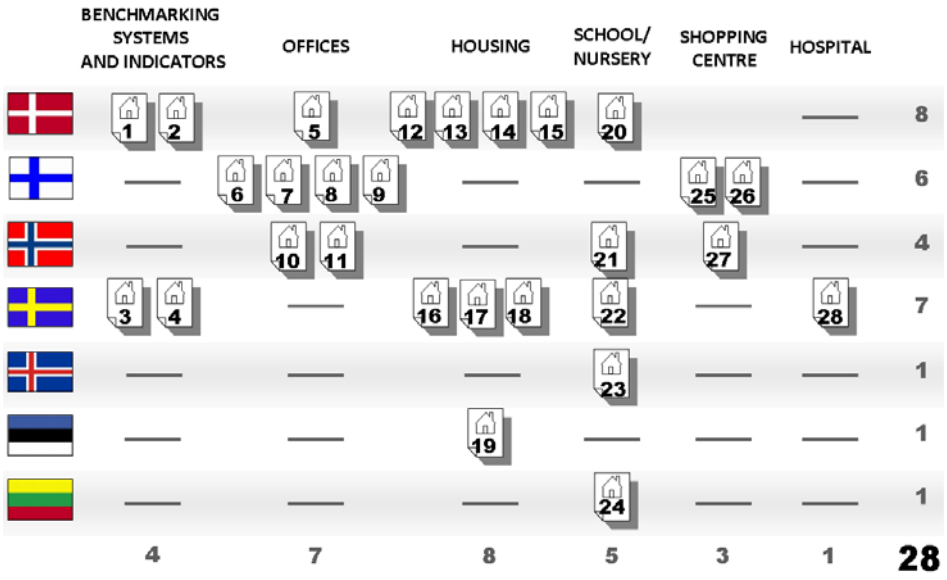
In the last chapter the lessons learned are discussed and individual recommendations are given on three previous chapters on building projects, involved enterprises and benchmarking.

The 28 cases address the common interest in indicators, assessments and benchmarking and show the following distribution on different building types:

- Benchmarking systems and indicators (4 case studies)
- Offices (7 case studies)
- Housing (8 case studies)
- School and nursery (5 case studies)
- Shopping centres (3 case studies)
- Hospital (1 case study)

The focuses of the case studies in Denmark, Norway, Sweden, Finland, Iceland, Estonia and Lithuania turned out to be slightly different. Finnish cases concentrated on measuring key performance indicators in enterprises and on testing multiple rating systems. Swedish cases emphasised methods for capturing end-user needs. Benchmarking systems were the focus of Danish cases, and tool implementations at enterprise level was the focus of Norwegian case studies.

Figure 10. Cases included in Report 2, structured according to countries and building types. A total list of all CREDIT case studies is shown after Chapter 8.



3.2 Benchmarking and benchmarking organisations

There are already some good practices for benchmarking on a large scale. Danish Benchmarking Centre (BEC) provides a web tool for addressing process indicators, such as time, accidents, productivity, and customer satisfaction with process. On the other hand, the Investment Property Databank (IPD) publishes annual indices focused on investments and use of buildings collected from thousands of buildings, but building performance indicators are not included yet.

In these case studies, front-runner enterprises recognise the potential of benchmarking for business purposes. If a building is rated to belong to the best class, the interest increases especially for the investor's and the building owner's perspective. There are also national and international environmental rating systems in the market; for example PromisE classification is used by large building owners in Finland.

During the past five years, the number of rated buildings has grown fast, and it seems that BREEAM and LEED are strong candidates for international investors. These systems are typically developed for a specific market, and are highlighting specifically defined perspectives such as environmental values and sustainability. The leading solutions for benchmarking are now getting stronger than ever and motivation for using those is also growing. One of the enterprises in the case study, NCC - one of the largest contractors in the Nordic Countries - has chosen BREEAM as their rating scheme.

3.3 Project involvement

Signals from the market indicate a paradigm shift towards more active end-user involvement in projects. For example, non-profit housing in Denmark involves tenants more actively in project development. Experience shows that it is important to listen to the tenants, but it is also important to agree on systematic methods for involving end-users and making continuous monitoring of their satisfaction. Post Occupancy Evaluation (POE) helps to capture user perceptions in existing buildings.

In Sweden, one promising method used for monitoring annual tenant satisfaction is the Satisfied Customer Index (SCI). When end–users are committed to the project, they need help in order to be able to contribute to the value adding throughout the project implementation. A few cases built bridges between designer and end-user by arranging study tours and by changing the way site meetings were organised. Lessons learned from joint ambition development are also very promising.

Workplace management enhances office design by tailoring spaces to suit end-user needs. The basic question is how to develop spaces to meet organisational needs for the business in the building in use. This may often culminate in a question of whether the space layout follows a cell–office layout or open-plan layout, or whether it is uses a mixture of both. Senate Properties in Finland is developing services for customers who want to develop their use of space; for example if they need to improve space efficiency, or make organisational change and they wish to do it strategically where spaces are an important asset. Promising results from this were shown in Lappeenranta office building.

3.4 Internal benchmarking

National and international indicator systems do not cover all important business matters, and therefore, companies are developing their own systems. Skanska, one of largest construction companies in Norway, has been developing the FALK system to help them to assess progress with measuring e.g. safety, resource use, quality and environmental impacts.

Citycon, a market leader for shopping centres in Finland, is also using their own system, and they are also operating in the other Nordic and Baltic countries. Their strong interest lies in monitoring indoor conditions and providing better indoor environment. Yet this monitoring information about the indoor environment is not available. In the future, building automation systems could provide real-time possibility for monitoring performance indicators and parameters continuously throughout the lifecycle of a real estate and contribute performance changes automatically. The indoor environment is important in shopping centres, and the performance level for spaces is an opportunity for the owner to hasten cash flow through rental agreements.

3.5 Performance indicators

There is no commonly agreed or standardised global or European key performance indicator framework, but some national and international rating schemes are available. Altogether, it seems that systematic procedures are needed for evaluating performance and compliance with needs in the end result. When doing so, the set of indicators collected, should not be too large.

Some of the front-runner building owners are already interested in using range of costs and performance indicators in daily operations. Senate Properties in Finland and Statsbygg in Norway are addressing costs, energy efficiency and investment process with indicators throughout all their projects. Interestingly, indicators offer a way to improve property portfolio management.

According to the case studies, organisations are looking for an indicator system that could help them to measure and enhance the performance of buildings. Apparently some indicators are more important than others. In many countries regulations for accessibility have also become tighter. Location is

still the key driver for offices and shopping centres, but the owners' interest is also growing towards operations and reducing annual consumptions, like heating, water, electricity, maintenance costs.

However, based on findings in the CREDIT case studies, it is hard to balance the trade-off between building performance, process development, and better usability. As previously mentioned, better indoor conditions require a better automation system which in turn increases the electricity consumption. There is a great potential for improving energy efficiency of buildings, especially in renovation projects, and in schools and nurseries. In Denmark this is furthered by a currently mandatory energy label required for university buildings.

3.6 Project assessment and benchmarking enterprises

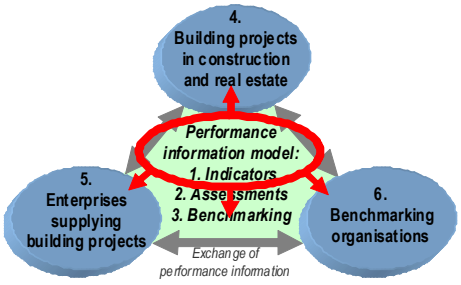
Indicator systems should be implemented in tools so as to encourage their use in projects. According to the experiences from the cases, the process of assessing indicators is mostly manual. This problem was addressed in the Norwegian and Finnish cases, emphasising the use of Building Information Models (BIMs) as a tool for managing indicators and building data in a more automated way. For example, the building gross floor areas of spaces may be used as a reference for indicators utilising that information.

Based on findings in the CREDIT case study, offices and shopping centres were found to be the most attractive building types in terms of benchmarking. The bigger and more complicated a case is, the more potential there is for benchmarking. However, the growing size and increasing complexity also bring challenges. Benchmarking of enterprises takes place to some extent, but a systematic and common used process has not yet been developed. Industry also needs a uniform indicator system that considers building performance and value creation as well.

The CREDIT project has made a contribution to this and increased understanding of indicators and transparency by testing performance and a value-driven CREDIT performance indicator framework. Now the first steps towards cross-border benchmarking have been taken, and the construction and real estate sectors need more research on this matter.

4 CREDIT performance indicator framework

This chapter is based on the discussion and conclusions of CREDIT Report 3 *CREDIT Performance Indicator Framework*. First the research focus is discussed and how performance indicators are presented in seven independent facets and expanded to two levels of sub-facets comprising a total of around 187 individual indicators - all according to topic 1 in Figure 8. Next the CREDIT performance indicators are discussed in relation different segments and the other topics. The chapter is completed by a proposal on how to implement performance indicators in different segments.



4.1 Research objectives, methods and focus

From the general aim and the specific objectives in the project description and the additional recommendations in the state-of-the-art report (CREDIT Report 1 State-of-the-Art) we extract that the CREDIT performance indicator classification must:

- Improve transparent value creation in both construction and real estate.
- Develop an international performance classification framework focusing on the first step needed by the Nordic and Baltic countries.
- Provide recommendations for international key indicators for buildings.
- Focus on performance demands and requirements to buildings to satisfy the end-user needs and functions of the building rather than to follow a prescriptive approach.
- Distinguish between the demand and the supply perspective in the construction and facility management process.
- Secure that the needed performance information is available throughout the life cycle of the building.

The performance indicator classification developed in CREDIT is a 'gross' inventory of indicators relevant in relation to the construction and real estate sectors in the seven Nordic and Baltic countries: Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania. The content of CREDIT Report 3 is based on the findings of the 28 CREDIT case studies as well as on input from national building regulations and different standards and research topics. The performance indicator framework was developed concurrently with the case study and the study of assessment methods and tools and international benchmarking presented in CREDIT Reports 2, 4 and 5 respectively.

4.2 Performance indicators in seven independent facets

A simple and understandable structure of performance indicators in seven independent facets was developed by CREDIT. The first facet reflected costs and price through the life cycle of the building. The five next facets addressed performance of location, buildings, building parts, facility management and the design and construction processes. They all included both objective measur-

able performance indicators and indicators that addressed less measurable properties as well as the end-users' experience and feelings. The final facet was the impact of the building on the external environment, social life and economy.

Figure 11. The seven main facets and the first level of sub-facets of the CREDIT performance indicator framework.

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

Figure 12. Number of performance indicators at the three levels of facets.

Main facets of performance indicators		Sub-facet 1	Sub-facet 2
1. Costs, price and life cycle economy (LCE)	1	3	24
2. Location, plot, region and country	1	6	30
3. Building performance and indoor environment	1	9	36
4. Building part and product performance	1	9	25
5. Facility performance in operation and use	1	5	29
6. Process performance in design and construction	1	5	22
7. Impact environmentally, socially and economically	1	5	21
Number of indicators at each level:	7	42	187

Figure 13. Example from CREDIT Report 3 of how an indicator is described in a facet or sub-facet by title, definition and how to measure the indicator and classify the results

Main facet – Title:	3. Building performance and indoor environment
Sub-facet 1 – Title:	36 Lighting conditions
Sub-facet 2 – Title:	361 Daylight access
Definition:	Indicator expressing whether there is access to daylight in the room/building and the window area relative to the floor area.
Measure:	Glass area / floor area ratio in % and the daylight factor in classes from A – E. See Report 3 Appendix A for definition of the classes.

Each of the seven main facets in the CREDIT performance indicator framework was divided into two levels of sub-facets with an increasing level of detailing ending with 187 indicators at sub-facet level 2. Each indicator at the three levels of facets was given a one-line title and a brief description of a few lines. In addition, the unit by which the indicator was measured is also described. When possible, the definitions of units and classes of measures were taken from standards and national regulations, or otherwise CREDIT proposed a common scale of measures in 5 steps e.g. classes A, B, C, D and E, where class A was the best.

Because of its all-encompassing character, the CREDIT performance indicator framework served as a tool to improve the performance of buildings as well as to support the cooperation between the parties in the construction and real estate sectors.

End-user's experiences and feelings are important and they were included in five of the seven facets: Location, building performance, building parts performance, facility management, and process performance. This was done with the intention of focusing on values as well as end-user needs and expectations more than on price, costs and standard of execution, and equipment seen from the suppliers' point of view.

It was also important to get a better understanding of how the built environment could create value for the end-users and increase outcome of activities housed in the building. One focus was the assessing of indicators that were directly linked to the building or the perception of it, which was the main focus. A second focus was the assessing of indicators that could link the productivity of the enterprises involved with the different processes in construction and real estate, which is the primary focus in the building sector today. The third focus could be to change the focus of the building as an expense to it being a

social and economic advantage for the business and the activities in the building in use. This might be a way forward towards in the future.

4.3 Indicators in international standards and national regulations

The CREDIT performance indication framework was linked to both international standards and national regulations. The success of improving transparency of value creation depends on the synergy and the coherence between them.

CREDIT performance indicators and international standards

Selected areas of international standards and research fields were analysed as background for the specification of the CREDIT performance indicator framework. Included were important standards and research experience of the following fields:

- Life cycle economy
- Facility management
- Environmental impact
- Quality management
- Energy consumption
- Indoor climate
- Architectural design and evaluation.

The analyses showed that standards and research included a lot of detailed information in each field. Normally they included one or more of the seven CREDIT indicator facets at the same time, and it was difficult to compress the enormous amount of information into the common and transparent CREDIT performance indicator framework. From the perspective of the different research fields they have difficulties to see the relation to other research fields and to 'accept' the necessity to translate their expert knowledge to a simple CREDIT classification that targeted the end-user, enterprises, building projects in construction, facility management as well as real estate.

On the other hand, international standards and knowledge in the different research fields is one of the primary foundations for an international indicator classification. In the future it will therefore be important constantly to coordinate and eventually adjust the CREDIT performance indicator framework according to new experience gained by research and international standards. At the same time it is also vital that there must be at constant pressure on research and international standards to be transparent and coherence according to the CREDIT proposals.

CREDIT performance indicators and national regulations

The building regulations in five of the seven CREDIT countries were compared to discover inconsistencies between the CREDIT performance indicator framework and the national regulations. All the national building regulations are based on performance-based requirements with a few exceptions. By and large, the indicator classification corresponds to the national regulations. But there are facets of the performance indicators that are not included in the national regulations.

Generally facility management is not addressed in the regulations except for requirements for parking facilities. Nor is process performance and process management addressed except for requirements for commissioning processes in the Norwegian regulations. All the regulations except the Icelandic have requirements for energy consumption and classes ranging from A (A1 in DK) to G for energy efficiency that follow the European directive. The minimum requirement for energy efficiency in new buildings is energy class B in

Denmark and C in Norway. In Denmark and Norway there is only one climate zone in relation to the assessment of energy efficiency whereas Sweden operates with two climate zones.

The Norwegian building regulations have applied the concept of 'Universal design', whereas the other countries operate with the concept of 'accessibility' for ensuring access for disabled persons. These two concepts imply two different approaches to the design of the building and the extent of 'accessibility'.

Besides these differences in the regulations, the size of the five countries and the density of the populations in the individual countries constitute different backgrounds for the assessment of some of the indicators. For example the assessment of distance must be relative to the density of the area. It would not make sense to assess distance with the same measure in the north of Sweden as in the suburbs of Stockholm, of course depending on the purpose with the assessment. Likewise the climate constitutes a basis that differs regarding e.g. load bearing capacity of the construction due to snow, resistance to wind and, as we can see in the regulations, achievement of energy efficiency.

If indicators in national regulations will be more transparent and support international benchmarking better in the future, they should have an unambiguous relation to the CREDIT performance indicator framework and international standards. A possibility might be to expand the numbers of facets and CREDIT indicators to be included in the national regulations or to make an adjustment according to the CREDIT performance indicator framework. The background for such a decision could for example be a more detailed analysis of the inconsistencies in national regulations and norms compared with CREDIT indicators for example used in Appendix B in CREDIT Report 3 - *CREDIT Performance Indicator Framework*.

4.4 Indicators in relation to assessments and benchmarking

According to the CREDIT research model in Figure 9 the CREDIT performance indictor framework is also discussed in relation to the two other topics in the CREDIT performance information model:
– Assessment methods, tools and decisions (Figure 9: Topic 2).
– National and international benchmarking (Figure 9: Topic 3).

Indicators in relation to assessment methods, tools and decisions
We see five groups of patterns in the relation between specific indicator and the applied assessment methods, tools and decisions:

1. End-user needs, experiences and feelings are included in five facets of performance: Location, building and building part, facility management and process management. They are captured through interviews and surveys and assessed with calculations of different satisfaction level.
2. Usability, adaptability, spatial and aesthetic quality are registered and assessed by professionals through observation, analysis of the actual building and drawing material.
3. Input on indoor climate, environmental impact, construction safety, bearing load etc. are gathered with measurements. These are compared either directly or after a calculation with recommended values or threshold values.
4. Information on the meeting of deadlines, compliance with standards, keeping of budget etc. are gathered from contracts, time schedules, budgets, and potential deviations are registered and calculated.
5. Input on economy is gathered from accounts and costs and price per unit is calculated.

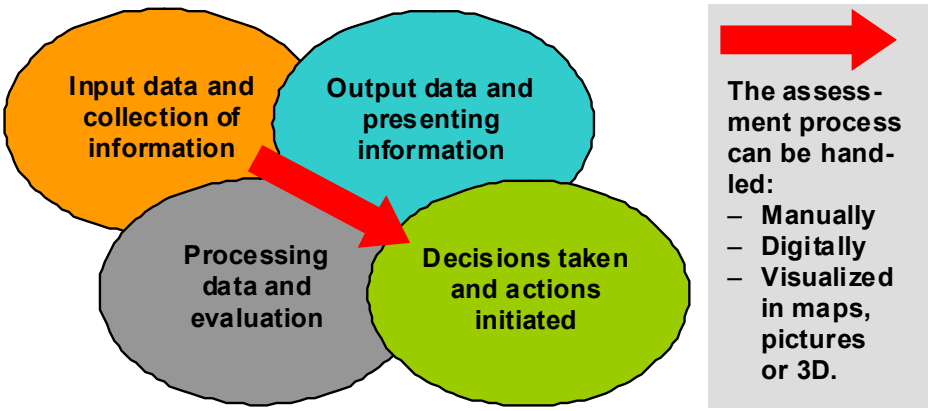
In some instances the three parts of the assessment (collect input data; processing and evaluation; present and output data in Figure 7) are separate phases or actions, perhaps even made by different persons. In other instances they overlap and are difficult to separate.

An example of a classic assessment that clearly fits into the three phases of assessment could be 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 inspecting the building and the drawing material. These data form the basis for the calculation (processing and evaluation in Figure 7) of the buildings energy consumption. Output data are the calculation presented as classes ranging form A – G.

In other instances the collection of data and the processing and evaluation of them can be made almost simultaneously. For example the expert in building construction or accessibility etc. compares the measurements with the predefined standards or recommended dimensions. Dimensions he has at hand or in his head. Therefore, he is able to class the building and space or construction immediately while inspecting the building or the drawing material.

The presentation of information and the final decision of how to act can take place simultaneously as well. A user that needs to decide which building to buy or lease for his expanding firm in relation to access to services and infrastructure can use a map as a simple tool. With a map in his hands that indicate the building in question as well as the nearest public transportation, motorway exit, shopping mall etc., he can without any calculation make an immediate decision on the advantages of the building's location.

Figure 14. The assessment of indicators from the input of data to presentation and decision, as described in the model in Figure 7, can be treated individually or overlapping in an assessment process that can be handled manually, digitally and visualised in maps, pictures and 3D.



Indicators in relation to national and international benchmarking

When looking at the level of national benchmarking, it appears that the distribution pattern of indicators between the public mandatory benchmarking framework focus on the performance aspects (experienced and professionally measured spatial quality, quality of execution, process performance and energy performance). In this group of benchmarking frameworks there is only one exception, where the focus is on economy, life cycle costing and energy consumption costs.

In the private and semiprivate systems, economy is the prime focus, either alone or in combination with FM or location. The search engine for real estate,

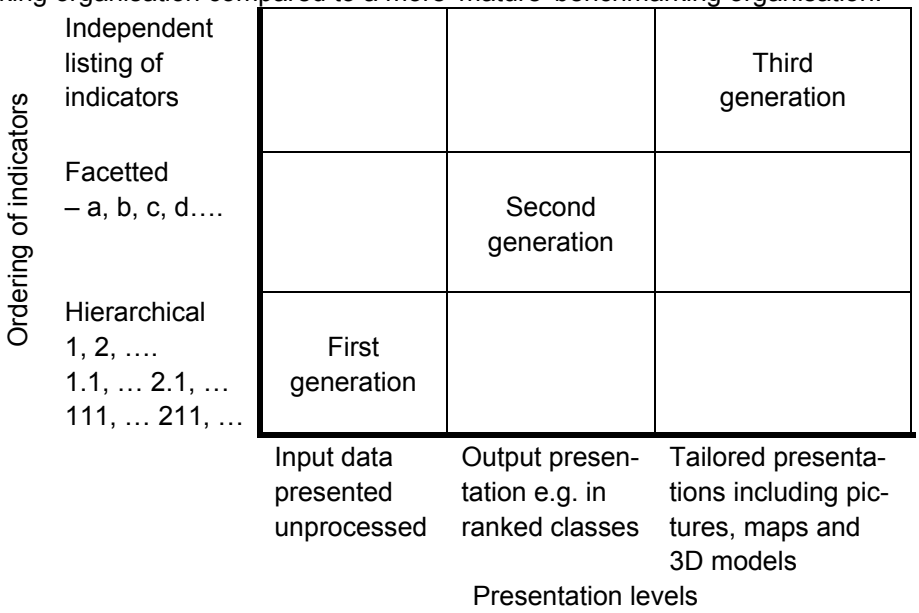
for example seen in the Danish "Boligsiden" (in English: The Housing page), covers all indicator facets with the priority set by the user and the potential buyer. But still the basic indicators or search criteria are location, price and size.

The CREDIT case study also indicates a tendency of change in the presentation of output depending on whether it is a first generation or 'young' benchmarking organisation or it has been revised a few or several times and is a more 'mature' benchmarking organisation.

In the 'young' organisation the output is characterised by being a documentation and presentation of "unprocessed" input data typically of a technical kind that is only comprehensible for persons with insight in the area. It was for example seen in the first versions of indicators, when The Benchmark Centre for the Danish Construction Sector was introduced in 2002. In the second generation organisations the output is input data that e.g. have been calculated and translated into a class in a ranking. It is for example seen in the European energy certification system. Output in the third generation organisations is user-defined through filters so the user only gets the information relevant for his purpose.

The output can be a mixture of assessments that rely on expert knowledge and make a specialised knowledge available for the common user in a simple form such as classes. It can also be data such as maps with an indication of the location of the building, a plan or 3D model put in relation to other data making the user able to assess the data himself. An example of this kind of presentation of information is the Danish Home search engine, where you can insert filters in your search that are relevant for your wishes such as vicinity to nursery or kindergarten.

Figure 15. The indicators are presentated differently in a 'young' benchmarking organisation compared to a more 'mature' benchmarking organisation.



The changes in the presentations are parallel to another tendency in the development of the classification of entries or indicators in the systems. Regarding the classifications, there is a movement away from a hierarchical classification of data as something that cannot be added from data at lower levels like we cannot add apples and pears. And there are even examples of sys-

tems with a completely flat and linear listing of indicators that are totally searchable as seen for example on the Internet.

CREDIT performance indicator framework is a facetted classification with output presentation in classes in a ranking, but it can also include a more visualized presentation system fit for the end-users needs as in a third generation system according to Figure 15.

4.5 Indicators in relation to product and process segments

According to the CREDIT product and process models and selected segments described in Chapter 2, the performance indicator classification is discussed in relation to the following essential segments:
– Different building categories.
– Processes in the life cycle of the building.
– Enterprises supplying the construction and real estate sector.

Indicators in relation to different building categories

Non-profit housing is where most types of assessments and indicators are applied ranging from location of the building, building performance, facility management, process performance as well as costs and aspects of environmental impact. Furthermore, it is in relation to public housing that the end-users' experiences and feelings play an important role in the assessments. The assessments of the other building categories are limited to one or two indicators only apart from private dwellings, and they are all primarily based on measurements and calculations.

It is not possible on the basis of the case studies to link certain indicators to specific building categories. Non-profit housing and private dwellings seem to be the building categories where a broad range of indicators are addressed. Despite this, it cannot be argued that user experiences and the technical standard of the building are more important in relation to housing and dwellings than to university or office buildings. Probably, the differences of how to apply indicators more extensively reflect that the users of the assessment differ (building client, consultant, facility manager, potential buyer or investor) as well as the purpose of the assessment. Besides, it tells us more about where the focus is right now in the management of the various building categories and enterprises.

Indicators in relation to processes in the life cycle of the building

The indicators have three different purposes depending on where and when in the building process they are addressed. In the initial phases, they serve as specifications or requirements in the briefing and programming phase. During the design and construction phase they serve as guidelines for the design and how to compare qualities and specifications of building and components in order to meet the requirements. After completion, they serve as tools for assessing the performance and the economic potential of the finished building, and as a delivery to facility management and the users of the building.

The Danish cases show for example that all main indicator facets (not all indicators) are assessed after completion of the construction phases, either in connection with the commissioning or during the FM and use phase (costs, location, performance of building and building part, FM, process and environmental impact). The only indicators in the cases that are assessed or addressed early and late in the building process are acquisition costs (estimated and actual) in connection with size and location, social context, end-user needs and energy efficiency (estimated). Energy efficiency and acquisition costs are

assessed after every phase (briefing, design, construction and FM), whereas the focus on end-user needs seems to fade as the building process advances.

Many other indicators are of course addressed during design and construction in order to comply with the general requirements in the brief of the building or the building regulations, but as an integrated part of the design and construction process with no impartial assessor involved. The building permit from the local authority is a professional assessment of whether the designed building complies with the building regulations.

Indicators in relation to enterprises in construction and real estate

The building clients and owners in the CREDIT cases address primarily qualitative performance indicators of location, buildings, components and process. The indicators in focus are e.g. end-user experiences and feelings; building parts and components insulating qualities; durability and defects; and facility performance.

The assessment of facility and operation performance focuses primarily on the costs of facility management in order to compare the expenses of one facility with another. Whereas building, rooms and building parts performance are not addressed in operation of facilities. The consultant addresses primarily the end-users' experiences and feelings of location and building performance as a tool for developing a brief that comprises the end-users' wishes.

When we looked at enterprises that facilitate sale or invest in real estate their prime focus on costs, price and income and total return, and the indicators are relation to the category of building and its use, size and location.

Besides the basic indicators on location, building categories, size and price there are no indicators that turn up in many cases and thus could be obvious options for common key indicators in the future. On the contrary, importance and relevance of specific indicators seem to be linked to the purpose of the assessment as well as the type of enterprise.

4.6 Implementing CREDIT performance indicators framework

The CREDIT performance indicator framework is an overall framework for classification as part of the CREDIT performance information model. At this first stage the focus of implementation in the CREDIT project was on the construction and real estate sectors in the Nordic and Baltic countries. To implement and disseminate the application of the CREDIT performance indicator framework, the following initiatives are essential:

1. Informing and presenting the indicator framework broadly in the Nordic and Baltic countries including preparing easy-to-read presentation material.
2. Forming a Nordic and Baltic expert group with related reference groups representative of the important segments and users of the CREDIT performance information model to implement and adjust the model according to new experience.
3. National regulations and international standards and research (topics 7-9 in Figure 9) have to be coordinated in interaction with the indicator framework.
4. The indicator framework has to be applied in analyses and improvements of existing benchmarking schemes in various cross-border segments according to topics 1-6 in Figure 9.
5. Selection of a few key performance indicators for everyday use according to the following proposal.

6. Improving the maturity level for important performance indicators according to the following proposal.

Selection of a few key performance indicators for everyday use

In a CREDIT context key performance indicators could be the seven main facets of indicators that reflect seven important characteristics of building and real estate that the CREDIT indicator classification comprises. Or it could be more specific or detailed indicators at sub-facet level 2 reflecting a specific building type as well as a specific user or purpose. Or it could be ten important indicators common for all uses and purposes.

Figure 16. A proposal of 10 key indicators reflecting the needs of a building owners or the facility manager.

Key	Main facets	1st sub-facets	2nd sub-facets
Key 1:	1. Costs, price and life cycle economy (LCE)		
	2. Location, plot, region and country		
Key 2:		23 Plot opportunities	
Key 3:			252 Access to public transport
	3. Building performance and indoor environment		
Key 4:			331 Adaptability to needs (now and over time)
Key 5:		34 Thermal climate	
Key 6:			352 Pollutants in indoor air
	4. Building part and product performance		
	5. Facility performance in operation and use		
Key 7:			521 Tenancy agreement
	6. Process performance in design and construction		
Key 8:			622 Working plan and time consumption
	7. Impact environmentally, socially and economically		
Key 9:			721 Climate change (CO2)
Key10:			731 Energy efficiency

The case studies show that there are only a few performance indicators that turn up in all cases or in relation to all building categories and therefore could be selected as common key performance indicators in CREDIT. These few common key performance indicators are of a basic character namely: Location, building type, size/area and price/costs. Otherwise the indicators vary primarily depending on the purpose of the assessment and on the user or recipient of the assessment. There does not seem to be a strong linkage between particular indicators and specific building categories.

Therefore CREDIT proposes that several groups of key performance indicators are defined, reflecting the needs of specific users/recipients (end-user, client, authorities, contractors, consultants) of the assessments and benchmarking as well as the needs linked to particular phases in the life cycle of the building.

With the interests and needs of the building owner/client in mind, a set of 10 key performance indicators is proposed with indicators from all facets of the classification and on various levels of facets, see Figure 16. Other proposals could be prepared in the future as alternatives and for other purposes.

Improving the maturity level for important indicators

The various indicators described in the CREDIT performance indicator framework are at very different stages concerning their readiness for inclusion in national or cross-boarder benchmarking. Some of the indicators are already be-

ing applied in national benchmarking and international certification schemes in many or all the CREDIT countries and they are covered by international standards. This includes many but not all the indicators on indoor climate, energy efficiency, environmental impact and facility management. To use these indicators in cross-boarder benchmarking requires translation and harmonisation.

For example, in Denmark, Norway and Finland there are certification systems for indoor climate, but the definitions of the classes are not identical. Another example is the indicators on environmental impact. There are international certification schemes (BREEAM, LEEDS, The Nordic Eco-label (The Swan) and The European Eco-label (The Flower)) where many of these indicators are already being assessed. Even though some of these certification systems operate with different classes of certificate, the indicators included have to be translated from a system of weighting in the certification to CREDIT's five classes for each indicator.

Figure 17. Examples of indicators at different stages of development in relation to international benchmarking and standards.

Maturity levels of indicators	**Relevant indicator**
5. Indicators applied in cross boarder international benchmarking	
4. Indicators assessed nationally in the CREDIT countries based on international standards.	– Indoor climate in facets 3 and 4 – Facility performance in operation and use in facet 5 – Impact on the environment, social life and economy in facet 7 – Energy in facets 3, 4, 5 and 7
3. Indicators defined in international standards including what is measured, method and classes.	– Costs, price and life cycle economy in facet 1 – Process performance in design and construction in facet 6 – End-user experience in facets 2, 3, 4, 5 and 6.
2. Indicators defined in international standards including what is measured, but not method and classes	– Safety in facet 3 – Accessibility in facet 3
1. Indicators that are not defined in international standards and indicators of relative character	– Aesthetic quality in facets 2, 3 and 4 – Cultural heritage in facet 2

Other groups of indicator are not quite as readily applicable in cross-boarder benchmarking. This includes areas like process performance and life cycle costing both covered by international standards. In these areas the barrier is the differences in accounting procedures and to determine the amounts and sizes both on the national as well as the international level.

Another group consists of indicators that are only possible to separate into in two classes: Compliance with building regulations or not. This group includes areas such as accessibility, construction safety and fire safety. The reason differs as to why they are not applicable right now.

Accessibility is described in national and international standards, but the required level of accessibility is not the same in the seven CREDIT countries. Does Norway for example implement Universal design as a standard? At the moment it is only possible to describe whether it complies with the building

regulations, while measuring the compliance with requirements in classes is not yet possible.

Construction safety and fire safety are very well covered by international standards with national annexes. These require compliance with the standards and building regulations and do not define classes of quality but instead classes of risk, thus reflecting the impact of a potential accident depending on the use of the building.

Yet another group consists of indicators of a relative character. This includes indicators addressing usability, architectural or aesthetic quality and cultural heritage. Some of these indicators are included in international standards, but are not defined or recognising that they either depends on building function or on cultural or national values.

Whether it is possible to assess such indicators nationally or internationally is open to discussion. It will probably be possible to address indicators such as usability and adaptability within a foreseeable future and likewise cultural heritage, whereas aesthetic and architectural qualities are areas that it is much more difficult to agree upon how to assess.

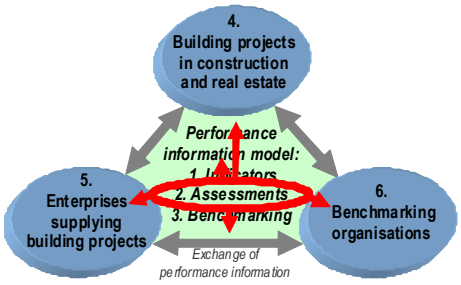
Figure 18 gives a first proposal of how many years it will take for specific indicators to be ready for international benchmarking based on international standards - if the Nordic and Baltic countries decide to do it.

Figure 18. CREDIT proposal of the years of development for selected indicators ready for international benchmarking in relation to internationally agreed classes and standards.

Years of development		
5 years	10 years	20 years
5. Indicators applied in cross-boarder international benchmarking:		
– Indoor climate in facets 3 and 4 – Performance in operation and use in facet 5 – Impact on the environment, social life and economy in facet 7 – Energy in facets 3, 4, 5 and 7 – End-user experiences in facets 2, 3, 4, 5 and 6	– Costs, price and life cycle economy in facet 1 – Process performance in design and construction in facet 6 – Accessibility in facet 3 – Cultural heritage in facet 2	
4. Indicators assessed nationally in CREDIT countries based on international standards:		
		– Aesthetic quality in facets 2, 3 and 4

5 Project assessments, methods and tools

This chapter is a summary of CREDIT Report 4 *Project Assessments in Construction and Real Estate* evaluating project assessments in relation to different methods, tools and BIM according to item 2 in Figure 8. The carpenter model was developed in CREDIT and describes the main process parts and actors in the construction and real estate process in relation to project assessments on different performance indicators. The project assessments were evaluated according to national differences, different performance indicators of building and facility management and functions of buildings based on 28 CREDIT case studies.



5.1 CREDIT carpenter model and related actors

A generic model called the CREDIT carpenter model was developed to support a better understanding and execution of how to capture end-user needs and assess requirements and results in the process. The carpenter model describes the main phases and milestones throughout the life cycle process of the building, and the main actors and their activities and internal cooperation related to it.

The main phases in the carpenter model

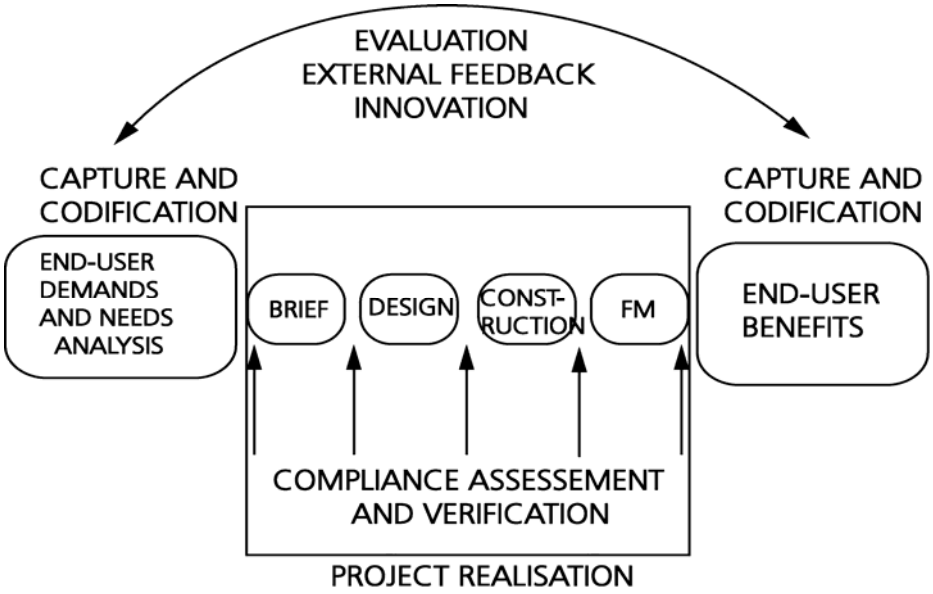
The construction industry revolves around a never ending supply of projects. These projects were traditionally arranged according to industry practice in a number of phases in, more or less, a sequential order, often described as a relay race. These phases were typically brief, design, construction and facility management (FM). Compared with traditional project management literature, brief, design and construction fit well with the definition of projects, i.e. initiate, plan and execute. The rationale for incorporating FM into the project framework was that FM directly affects the results of the earlier construction phases. On the other hand, FM was part of the occupancy and use of real estate, where the values of the construction phases will be judged.

The CREDIT carpenter model included these four phases, and before and after each of the four phases, an assessment and verification of the results were carried out in the model to ensure compliance with goals and requirements. These transitions are often referred to as stage gates, milestones, phase gates etc. To illustrate the limits of the actual building project and also depicture the multitude of organisations involved in the construction and FM process, a square is drawn around the four phases in the carpenter model. See Figure 19.

Any project needs to have a clear scope of what the project should result in. In construction the scope is defined by the requirements that the finished construction is supposed to meet. Identifying and setting the price, performance and the quality of the product is obviously a matter for the professionals in construction and FM, but the end-users should also be involved in one way or

another. Their needs and demands should be captured to be able to find solutions that fit them as well as create benefits for the client, the owner, the stakeholders and the occupancy of the building in use. Their needs along with the demands of the client and authorities should be to be codified into project language by the professional project members according to the carpenter model so that they could act on them.

Figure 19. CREDIT carpenter model is named after the sketch, which look like the head of a carpenter with ear protector.



At the realisation of the project, the information is according to the carpenter model a feed-forward process and it is processed during every step of the process: brief, design, construction, facilities management and occupancy phases. At the end of the project the end-users' benefits and experience of the professional actors should be captured and codified. This allowed for evaluation, learning and improvement of the management of end-users as well as individual processes and the final result of the building, so that values could be better created in future projects in relations to demands of the end-user.

Related to the carpenter model it is an important issue to continuously improve performance in the actual project as well as in future projects. Apart from just assessing to what extent the needs and demands have been achieved, it is also important to assess the process of accomplishing the desired result. This way it is possible to learn what worked well and what did not.

The actors and stakeholders in the carpenter model

There are other general issues that are also important to deal with in relation to the carpenter model. The end-users and the professionals in the project organisation often work in two different value chains. This meant that they might not share a common understanding of the processes and goals of the project. This should be dealt with accordingly. As the construction and facility process involved a great number of professionals there is also a risk of misinterpretation of the information in the process of transferring it. In the analyses of the assessment methods and tools we therefore discussed the cooperation and communication problems internally and between the following five segments of actors in the construction and real estate process:

A. End-users, tenants of the building, neighbours and society
B. Client, owner and facility manager
C. Consultants, contractors, manufacturers and other suppliers

D. Authorities and assessment and benchmarking organisations
E. Researchers, developers and teachers.

In accordance with the carpenter model the different actors played different roles and they act and cooperate in different constellations throughout the life cycle process of the building. These different roles influence the project assessment process and the applied assessment methods and tools because it had to fit the needs of the individual actors. At the same time it deteriorated the opportunities of linking the individual activities and assessments together as well as the opportunities for meeting the shared project goals.

Another important problem is how individual projects are linked to the strategies and goals of the different enterprises involved in the construction and real estate process. In the CREDIT study it lead to a deviation of brief in:
– Functional brief and programming in the actual projects,
– Strategic brief common for several projects as part of the long-term strategic planning in the individual enterprises and client organisations.

Related to the carpenter model in Figure 19 and these clarifications, the carpenter model included the following seven main phases or process parts:
– Common for several projects:
  1. Innovation, learning, evaluation and external feedback process of projects and buildings in use to improve building and process performance in general
  2. Strategic brief, analyses and planning in enterprises and client organisations including several projects and real estate portfolios
– Individual construction projects:
  3. Functional brief and programming in a construction project
  4. Design and planning process in a construction project
  5. Construction and execution process in a construction project
– FM and occupancy of individual buildings in use:
  6. Facility management of a building in use
  7. Occupancy of and business in a building in use.

5.2 Project assessments and dependencies

As stated in CREDIT Report 1 *State-of-the-Art of Benchmarking in Construction and Real Estate,* the literature review showed that there were a number of different methods for managing end-users' needs that could be used for parts of the processes; but that there were very few that seek to cover the whole process. Most methods existed for the early or late phases. The methods that sought to cover the whole process were not very well tested in real life.

Commonalities of the methods and tools:
- Seek to increase the communication gap between the stakeholders
- Build on quite complex systems of data gathering and analysing systems
- Improve the understanding of the end-users' real needs and demands.

Differences of the assessment methods and tools:
- The process was regarded either as a dynamic or a static process
- The focus should be on the individual needs and experience of the building or it should be on an organisational level.

What was being assessed and how it was being assessed varied somewhat depending on the type of building. Assessments of housing were more inclined to focus on softer aspects, for example perception. In the other cases there was, generally, a more technical perspective. It could be an effect of how knowledgeable users were. In the case of housing, the users might have

less experience of construction and communicating their needs than in the case of offices etc.

There was also a notable difference in the different countries in approaches and interest in what to assess. Sweden had a much softer approach and an ambition to get as many as possible to understand what was being assessed and for what reasons, while Finland had a much more technical and measurable approach.

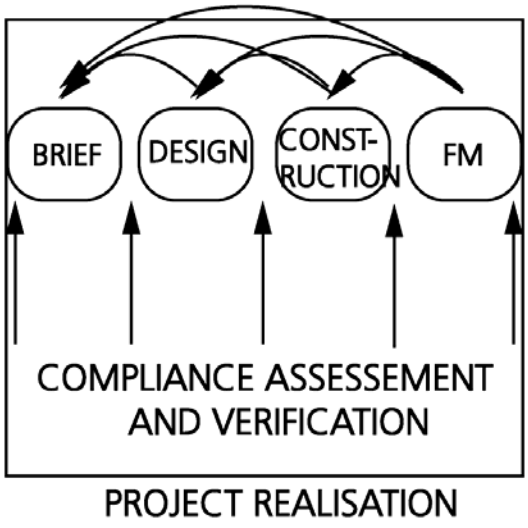
5.3 The role of the actors and the lack of feedback

Clients, naturally, played a big role in the construction process, also when it came to capturing and transferring the needs and demands of the end-users. Maybe more surprisingly, they did perform a lot of the work themselves as well. Designers played an important role in knowing the end-users' needs and in translating demands to requirements and specifications.

During a project it was mainly the client that initiates assessments, and the actors of the project process like for example designers and producers normally performed the assessments. Evaluating the degree of compliance with the needs and demands as well as the learning from assessing the process was also mainly a client action as regards initiating and performing the assessment. The rest of the actors do not engage to any larger degree.

The processes from the beginning of the functional brief to the end of construction had well-developed routines as a part of the project management system. These routines were sufficient to conclude the studied project successfully and the control of the process in order to get internal efficiency in the short-run perspective. But there was almost no case that showed any assessment tool that supported internal feedback in and between the different phases. It includes also the knowledge development and the innovation process which was important in the long-run innovation perspective. The lacking feedbacks were marked in the carpenter model Figure 20, and according to the carpenter model they are an important part of the general innovation, learning and evaluation process to improve the overall performance of projects.

Figure 20. The lacking internal feedbacks in and between the different phases in the construction and facility management process in the CREDIT carpenter model.



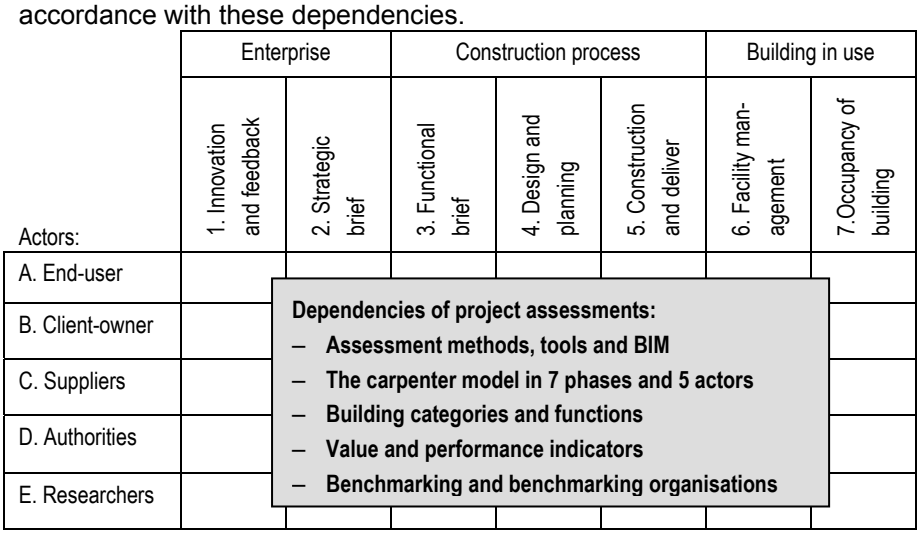
In the study there were two examples of tools that together could to some extent overrule this practice. Building Information Models (BIM) has the potential to act as an information carrier within a project and to store all types of information needed for assessing a number of different aspects. However, the main issue was to get the right information and to present it in a way suitable for the target group. This was done for example in the case of the Falk system in Skanska in Norway (CREDIT case NO03 and NO04), which is a system to gather and present a multitude of KPIs (Key Performance Indicators) in an easy and understandable layout according to the carpenter model.

5.4 The concept of value in project assessments

Value is multidimensional and as a consequence a number of definitions of the concept exist. The concept is often considered to have a subjective nature as it:
– Is influenced by the contexture of the individual's experience and the current situation,
– Can be a relation between subjective and economic parameters,
– Includes both tangible and intangible aspects.

The judgment of value depends on who is making the judgment and for whom the value is created. A project can for example generate value to customers, enterprise, suppliers/subcontractors and community and be judged from a social, economic and environmental perspective. Though, a single-minded perspective of value is most often used when trying to understand the value of an organisation. The most commonly used perspective is an industrial perspective of economical parameters (for example return on investment). But not everything can be explained in monetary terms. In these study five different perspectives on value dominated:
– Economic value, for example tax value, market value, project cost etc.
– Social value – although not clearly defined.
– Measurable values (quantitative) – values that can be measured objectively – often this is related to indoor climate, environmental impact etc.
– Client value.
– Customer value.

Figure 21. The CREDIT evaluation of project assessments was discussed in accordance with these dependencies.

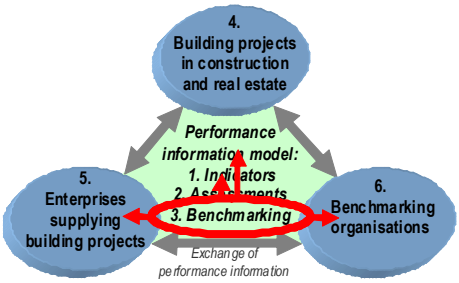


Both the two last ones seemed to be something that was taken for granted and something that should be achieved, but not clearly defined what it was. In many of the case studies they were not even mentioned.

When discussing value, it is very important to understand that, as value is multidimensional and may be interpreted differently, value means different things to different people and organisations.

6 National and international benchmarking

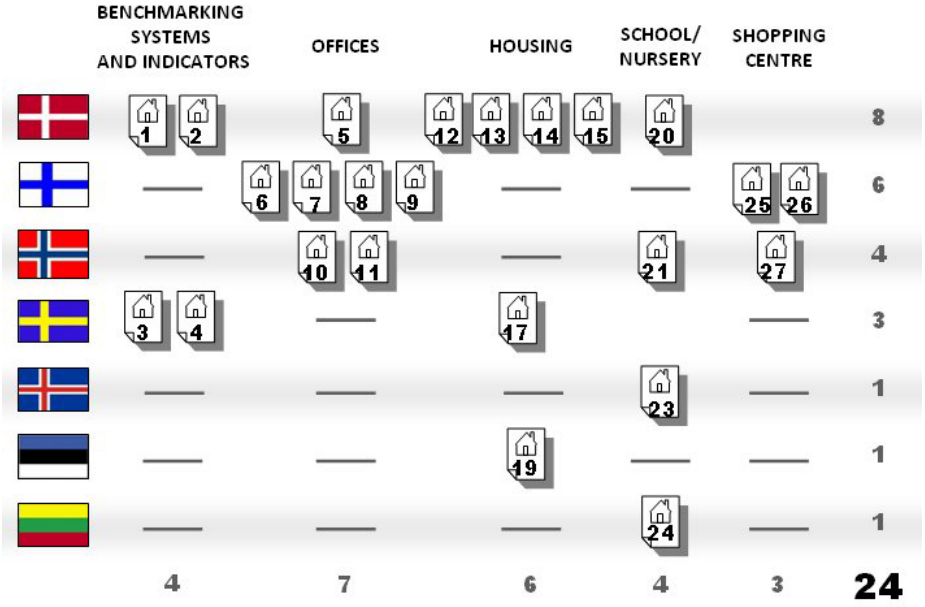
This chapter summarises the CREDIT Report 5 *Internal*, *National and International Benchmarking* and the results of the study of national and international benchmarking made by Work Package 6. The purpose of the study was to explore and discuss how project-related measurements can be linked to sector, national and international benchmarking of performance indicators. The results are discussed according to topic 3 in Figure 8 emphasising experience gained from the case studies, a web-based benchmarking platform, and a pilot cross-border benchmarking.



6.1 Case studies on benchmarking

The benchmarking study was based on findings and recommendations from 24 of the 28 CREDIT case studies from the participating countries. Four case studies did not include information on benchmarking. We addressed performance indicator benchmarking both at a sector, national and international scale, and we discussed how benchmarking could support management of the performance and monitoring processes in the construction and real estate sectors.

Figure 22. 24 CREDIT case studies were included in the study of national and international benchmarking and they were classified according to the following building types with piloting countries mentioned.



The distribution of the case studies on different building types are summarised below and illustrated in Figure 22:

– Benchmarking systems and indicators (4 case studies)

– Offices (7 case studies)
– Housing (6 case studies)
– Schools and nurseries (4 case studies)
– Shopping centers (3 case studies).

The CREDIT case studies encompassed a range of pilot benchmarking of different characteristics and features in the relation to the benchmarking study. The Danish case studies focused on analysing the existing benchmarking systems, the Finnish case studies emphasised CREDIT key performance indicators and their assessment and benchmarking. The Swedish case studies investigated methods for capturing end-user needs, whereas the focus in Norway was on implementation of the enterprise level tool. Each approach was valid and complemented the general view well.

6.2 Performance indicators in the benchmarking study

Some good practices already exist 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, which are gaining popularity amongst international investors and actors. All of these existing schemes contributed to the CREDIT framework, but did cover its performance scope.

Each indicator system was developed from its own point of view: production process, environmental sustainability or economy. Some of them were extended to cover additional aspects like environmental and social sustainability, but the performance was not the driver in the use of the building. The positive aspect of the existing systems is that they already have an established infrastructure that they can provide comparability through benchmarks and some of them can even support branding. The challenges of these systems might lie in the coverage of the value-related performance content (usability, adaptability, serviceability, indoor conditions etc.) and on the other hand in 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 organisational 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 for such a system. It also provides a list of potential performance indicators that could be included in such a system, and even a proposition of ten key indicators that could be used for starting.

6.3 Web-based benchmarking platform developed by VTT

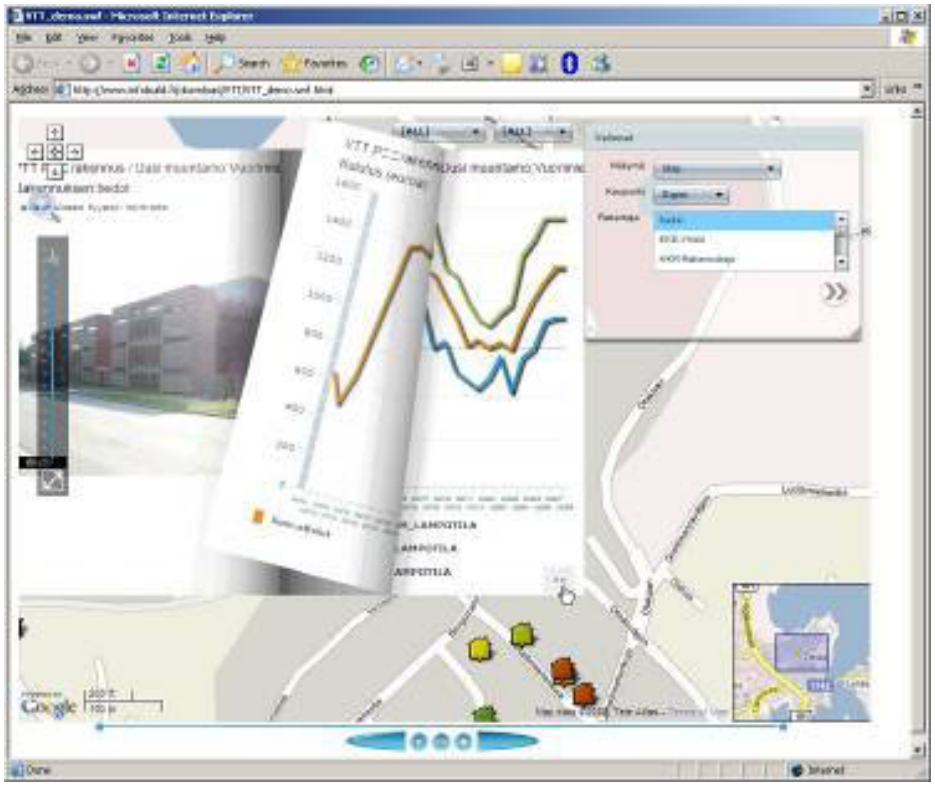
In addition to the individual case studies, a web-based benchmarking platform was developed by VTT, Finland, and used to some extent in a pilot cross-border benchmarking between Norwegian and Finnish on office buildings. The benchmarking platform provided tools for indicator storage, management, benchmarking and analyses. Further, it provided reporting functions that considered the cross-section of the building stock or appearing trends in the building stock. The platform was tested in the project, and VTT was responsible for the implementation of the platform at www.credit.vtt.fi. A screenshot of the portal is shown in Figure 23. Passwords were required to enter the site.

The indicator reporting system was based on the Information Builders' business intelligence tool, WebFOCUS www.informationbuilders.com, which provides advanced reporting, analyses features and very good connectivity to various databases and systems. The system enabled users to see the cross-section of the building stock and consider trends. Currently the portal contains only a few simple sample reports and an example of a form that can be used for adding new building to the database.

VTT is currently adding new functionalities to the benchmarking platform and the next steps in the development work should be:
– To select the indicators to be used in cross-border benchmarking
– To create management interface and functions to allow building owners to add, update and modify indicator data
– To provide basic reports for given indicators.

During the implementation of the benchmarking platform in CREDIT, we perceived that the user interface was very important, and some discussions were raised on adding map-user interface to the benchmarking platform. When the basic reporting is ready, VTT will put more effort into developing additional value with advanced features.

Figure 23. Screenshot of the VTT web-based benchmarking platform on WebFocus-demo by the Infobuild Oy.



6.4 Pilot cross-border benchmarking on office buildings

During the last quarter of the CREDIT project, a cross-border benchmarking exercise was carried out in six office buildings in Norway and Finland. The Norwegian part was implemented by SINTEF at Statistics Norway (CREDIT case NO01) and Skattens Hus (CREDIT case NO04), while the Finnish projects were collected by VTT at Tulli Business Park (CREDIT case FI01), Baltic Sea House (CREDIT case FI02), Lappeenranta Office Building (CREDIT case

FI03) and Vuorimiehentie 5 Office Building (CREDIT case FI04). 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.

The assessed indicator set comprised ten KPIs (Key Performance Indicator) that were selected based on case experience and other relevant indicators:
Primary KPIs
– Plot opportunities
– Usability and adaptability
– Carbon Footprint
Secondary KPIs
– Life cycle costs – developing towards life cycle economy
– Surrounding services – related to plot opportunities
– Thermal comfort
– Indoor air quality
– Rental agreements
– Delivery time
– Energy performance - an intermediate measure towards Carbon Footprint.

Figure 24. Six office buildings from Norway and Finland used in pilot cross-border benchmarking.

This small cross-border benchmarking exercise provided an opportunity for validating the KPIs in real buildings. It was possible to test the accessibility to the indicator data, the reliability and comparability of the indicator values, and it showed the differences between cases and countries. Altogether, these KPIs provided a great overview and included enough challenges that had to be solved when developing an indicator system. On the other hand this pilot benchmarking also suggested that it was not an easy task to develop an indicator system that should be applicable for international use. It also emphasised the importance of integrating those indicators with the applied methods and tools, and that benchmarking would be considerably less time consuming if formal applications were available to produce needed data, to retrieve it, to assess it, to use it for simulation or reporting.

6.5 Lessons learned from the benchmarking study

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

Since there is no commonly agreed European Key Performance Indicator framework or performance indicator standard yet, CREDIT made a contribution to the development from the Nordic/Baltic perspective. It also provided valuable input from the performance and social sustainability point of view to existing economic and environmentally oriented schemes that were continuously updated and amended. It was also an interesting collaboration effort between the seven countries in CREDIT with congruent objectives and sometimes also distinct priorities and constraints.

The important area of building and real estate performance benchmarking was not completed, but the prerequisites were improved so that the front-runner companies can take steps forward within the sector. Improvement 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.

An important lesson learnt from the case study of the front-runner benchmarking organisations was that they differed a lot in the way they were organised with regard to ownership, business profile, purposes and background. Some of them were privately owned and others were publicly owned or owned by associations. Some of them were non-profitable governmental organisations and others were businesses organised to earn the owners a profit. Examples of the different models are given in Figure 25, but other categories could also be mentioned.

Figure 25. Different models for the benchmarking organisation.

		Ownership	
		Private	Public
Economy	Profit	Business model	Service model
	Non-profit	Association model	Government model

Based on these few case studies, it was not possible to get a clear picture of what kind of benchmarking organisations would have the greatest potential for becoming an effective, market leading and international organisation. But the following lines of approach were regarded as important in the future analysis of strengths, weaknesses, opportunities and threats (SWOT) of benchmarking organisations with options to become international market leaders:

1 Benchmarking product: The market segment in which the organisation operates should be clearly delimited and its benchmarking products should be well defined and accepted in the marked both by suppliers, clients and authorities.
2 Benchmarking process: Data gathering, processing and reporting should be effective and the organisation should be reusing as much information as possible. Web-based benchmarking and management tools should be

applied and integrated in building information models (BIM) and linked to the important decision processes in construction and real estate.

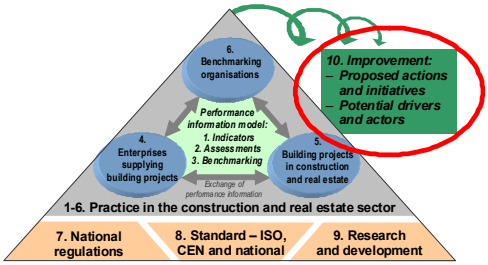
3 Economy robustness: The income and costs of the organisation should be in balance and robust over time with a profit margin to finance improvements.

4 Market coverage: To what degree does the organisation cover the local, national and international market segment defined in item 1?

5 Innovation strategy: How well is the innovation strategy of the benchmarking organisation functioning and supporting the constant improvement of the organisation and benchmarking process to fulfill the needs and demands of the market?

7 National recommendations and implementation of CREDIT

In this chapter national recommendations are described by the national representatives in CREDIT according to topic 10 in Figure 9. The authors of the seven national recommendations are listed directly after the heading. However, the national proposals do not necessarily reflect the opinions of individual members in the national project or reference group members. Appendix B provides a guideline for preparing national recommendations along with two examples of long versions of the national recommendations by Denmark and Sweden in the local language. The chapter finishes with a summary of the national recommendations, the first version of which were discussed at a final CREDIT workshop and a reference group meeting in Copenhagen in January 2010.



7.1 Danish national recommendations

Niels Haldor Bertelsen & Kim Haugbølle, SBi/AAU – Danish Building Research Institute/Aalborg University

Consultation process

This proposal was drafted by the Danish Building Research Institute, Aalborg University; the Institute was the Danish representative at CREDIT and coordinated the whole project.

The main statements of the first version of the proposal were presented and debated at the Danish reference group meeting in November 2009. The Danish reference group included representatives of relevant organisations, clients, contractors, consultants and policy makers. The proposal was subsequently revised, incorporating the comments made at the meeting, and distributed to the reference group for comments.

A concerted effort was made to accommodate all comments, which are presented in a five-page version in Danish, see Appendix C. However, the final version, including the recommendations in the two last sections, are proposals by SBi and therefore do not necessarily reflect the opinions of individual reference group members. The two last sections of Appendix C are translated into English and presented in the next two sections.

Proposed actions and initiatives

Based on the experience gained from the CREDIT project, SBi proposes that Denmark prioritises the following efforts and initiatives which can contribute to the realisation of the intentions of CREDIT to promote international benchmarking and to develop and improve the construction and real estate sectors:

– To (further) develop indicators of user satisfaction for well-defined areas in connection with the new initiatives – nationally as well as internationally.

For example dwellings, educational buildings, hospitals and maintenance. Different types of actors in construction will in general have different needs.

– To develop purpose-specific indicators in accordance with the CREDIT framework. For example regarding the future work of the Green Building Council on indicators of sustainability.
– To analyse how indicators can support the development of digital construction and vice versa, how the use of assessments, indicators and benchmarking schemes can be promoted in connection with digital construction.
– To discuss the internationalisation of assessments and indicators and benchmarking with major internationally operating enterprises, also operating in Denmark. For example NCC, Skanska, Rambøll, Cowi, other consultants and contractors as well as real estate companies.
– To make the use of indicators more visible for clients and enterprises as well as the positive results that it would entail. An important issue for the further development is how assessments and benchmarking can contribute to changed behaviour. For example by applying data from own construction projects and facility management and the projects of others.
– To expand existing benchmarking organisations in a number of ways in accordance with the benchmarking framework proposed in CREDIT so that they become cross-national instead of establishing new organisations.

Potential drivers and actors

It does not seem very likely that any actor will push hard for the implementation of an all-embracing cross-national benchmarking organisation and system in the short term. The benefits are too uncertain and the investment and running costs are probably quite high. However, within certain areas like sustainability some political pressure and market pull may be expected, e.g. in relation to the International Property Index or the establishment of a Green Building Council in Denmark.

In other areas like the OIS/BBR systems (the Public Real Estate Server www.ois.dk - Building and Dwelling Register www.bbr.dk) changes will most likely only be pursued in case there is a political pressure for change.

A broad cooperation is needed between front-runner actors and interested parties in order to improve international benchmarking and ensure cohesive solutions.

SBi suggests that an outline of work tasks might look like this:

Danish Enterprise and Construction Authority and the Ministry of Social Affairs establish the framework for legislation and development of the utilisation of indicators based on the results of CREDIT. The framework would for example be utilised by public and non-profit clients, in private innovation partnerships concerning development projects, cooperation between front-runner enterprises and executed and documented in pilot building projects.

Organisations of the construction industry launch (new) initiatives to further expansion, professionalization and internationalisation of (partial) benchmarking that follow up on the CREDIT framework.

Development institutions investigate, in continuance of CREDIT and in cooperation with the Danish reference group, how clients and enterprises apply benchmarking schemes and to what extent and how partners could increase their utilisation.

Enterprises present their needs on potential topics at for example a SBi seminar including the possibility of contributing to data collection, presentation and benchmarking and preferred form of organisation.

Benchmarking organisations can analyse the experience of performance, to visualise and to apply lessons learnt of how end-users, clients and suppliers change the attitude and behaviour.

Users, the main target group being e.g. the Danish Association of Construction Clients, Local Government Denmark, Danish Regions and other public clients as well as the Danish Association of Housing Associations, followed up by broad information on CREDIT and further development of the advantages for clients, users and enterprises of using indicators, new assessments tools and international benchmarking.

7.2 Finnish national recommendations

Pekka Huovila, VTT with contributions from the members of the Finnish CREDIT team

Consultation process

This proposal is based on the international work on performance classification and benchmarking that forms the background of the Finnish CREDIT work. The project was carried out in a close collaboration with the end-users Citycon, NCC, Senate Properties, Tampere Vuores, and VVO together with VTT, supported by Tekes. These Finnish CREDIT partners have had a special interest in the following building types: shopping centres (Citycon and Tampere Vuores), office buildings (NCC, Senate Properties and VTT) and housing (VVO).

The final outcome was mainly discussed with the chair of our national Steering Committee, Senate Properties, with national reference group members from the Ministry of the Environment, and within VTT. A follow-up meeting was held after the final CREDIT workshop and reference group meeting in Copenhagen with participants from the Finnish Ministry of Environment, Tekes, Senate Properties and Aalto University to further discuss these recommendations.

Proposed actions and initiatives

The CREDIT project delivered

- a systematic framework for performance indicators, addressing the value creation for owners and users of buildings,
- a long list of performance indicators, out of which ten core indicators were proposed jointly with other CREDIT countries,
- case studies where the tools and indicators were tested with the end-users in their pilots projects,
- a cross-border benchmarking exercise between Norwegian and Finnish office buildings,
- an internet platform, linked with a map interface, where the benchmarking information can be easily uploaded, managed, monitored and reported,
- an internet application for user preference inquiry, including visual and textual content,
- technology surveys (Second Life etc.) supporting the use of performance indicators and other queries, like analysis of the reasons why companies move.

Based on these achievements, it is recommended that all CREDIT partners implement these results in their activities with their stakeholders, and

- the information of these achievements be widely disseminated so that
  - the front-runner organisations may develop their current performance indicators further, structure them interoperable with the CREDIT framework and integrate the core indicators in their practices, and
  - the follower organisations may adopt the core indicators and develop their performance measurement and benchmarking procedures accordingly,
- development of tools, especially with BIM, so that the core indicators and their assessment can be implemented in an intelligent way,
- continue the international collaboration and standardisation work so that the performance indicators can be unambiguously communicated,
- the important indicators (e.g. adaptability and usability) are developed further towards a small and representative set of quantifiable indicators,
- the link between and the assessment of performance and value will be further elaborated.

Potential drivers and actors

Legislation is undoubtedly the strongest driver. CREDIT performance indicators are, however, not seen to be implemented through that route in the short term in Finland. Market-driven voluntary approaches are primarily searched. At present, building owners, developers and users are increasingly interested in environmental rating schemes (LEED, BREEAM or PromisE). Even though these assessments do not necessarily provide a solid framework, transparent indicators or interoperable tools, they seem to generate great interest through branding and also to manage risks in the asset portfolio. Thus, such indicators are voluntarily collected and reported even with additional costs.

The following routes for implementation were found to be explored concurrently

- input to improvement of the rating schemes
  - a structured framework for sustainability assessment (building performance and environmental impacts, linked with economic issues)
  - starting with the core indicators - not the full system
- tool development
  - links with the IFCs should be built to avoid additional work when collecting, assessing and reporting data
  - an internet platform can be adopted for increased ease of use
  - real-time monitoring of core indicators may increase the motivation and commitment of users, and thus create a bigger impact from the user behaviour viewpoint.

The following actors are seen in the focus of development:

front-runner owners: structuring and extending indicator sets that they already use, communicating through performance indicators with their suppliers

public actors: further development of performance-based procurement guidelines, the market-leader approach, standardisation

professional associations: providing benchmarking services

demanding clients: selecting spaces based on performance indicators, linking metrics with company policies, corporate social responsibility reporting or external commitments.

7.3 Norwegian national recommendations

Dag Fjeld Edvardsen and Ole Jørgen Karud, SINTEF Building and Infrastructure

Consultation process

The national implementation proposal was developed in cooperation with the research group at SINTEF and the two most active industry partners in CREDIT - Statsbygg and Skanska. There has not been a large reference group for the Norwegian part of the CREDIT project, partly because the interest in benchmarking by companies in the construction industry is relatively low at the current point in time. On the other hand, we see an increasing focus on relevant indicators within the companies, and between their own projects.

The discussions leading to the national recommendations took place in different arenas. Skanska's and Statsbygg's input are based on internal processes in their organisations, and there has also been joint meetings for the Norwegian partners. The final information exchange took place electronically.

Proposed actions and initiatives

SINTEF proposes the following actions and initiatives based on the research and conclusions of the CREDIT research project:

- Introduce the CREDIT performance indicator classification framework to governmental organisations as well as building and construction companies and associations.
- Cooperate with the national standardisation organisation; Standards Norway. There is currently works being done related to benchmarking for Facility Management. The project group (prEN-15221-7) is connected to CEN/TC348 and plans to present a standard for benchmarking by spring 2011. CREDIT should introduce its results to this working group.
- Inform national benchmarking networks (“nfb”/”NfN”) about the results of CREDIT.
- Inform international public real estate networks about the results of CREDIT (task: Statsbygg)
- Inform NKS (Nordisk Kontakt om Statsbyggeri) and PuRE-net (Public Real Estate Network), (task: Statsbygg).
- Further explore the potential for using BIMs (Building Information Model) in benchmarking in order to increase precision and reduce costs and time consumption for data gathering and processing. Many of the KPIs (Key Performance Indicator) will probably be available “for free” in the BIM.

Potential drivers and actors

In order for the CREDIT performance indicator classification framework to be used in practice by a significant number of organisations and companies, there has to be significant interest and pressure in the market, and a sufficient force of actors have to support the acceptance of the framework. In the following, possible drivers are listed:

- General pressure on lower costs and productivity increases. Benchmarking in order to know how good we are at different areas, and in which area we have to improve the most.
- Political pressure for increased environmental sustainability in the sector. By benchmarking and showing improvement in a credible way it can be shown that new regulation might not be necessary; the industry’s own ini-

tiatives are sufficient. In order to do this it is necessary to measure improvement.

- End-users desire transparent markets – they want to know about what they plan to buy from each supplier – and how this offer compares with the alternatives.
- Increased pressure on the public organisations in the sector to show that they are efficient by simulating market competition with benchmarking.
- There is a tendency to increasingly automate data gathering and reporting. One example of this is the Norwegian “Alt inn” system www.altinn.no – a common internet portal for public reporting in Norway, encompassing more than 20 Norwegian government agencies.
- Increased interest in standardised Building Information Models (BIM) is a data carrier well suited for benchmarking between projects and processes.

The following actors should support the implementation of benchmarking:

- Public sector. Financing infrastructure, contribute data, as a large buyer / owner suggest the direction.
- Large professional buyers / owners. Suggest direction, contribute data.
- Existing benchmarking organisations. These have incentives to implement the CREDIT performance indicator classification framework in order to support internationally recommended classifications.

7.4 Swedish national recommendations

Bengt Hansson, Kristian Widén & Sofia Pemsel Lund University

Consultation process

Consultation process in the autumn of 2007, when the Nordic research project CREDIT started; there was no interest in Sweden for indicators or benchmarking. As a consequence the Swedish contribution to the project was a modest one compared with that of the remaining Nordic countries.

However, in spring 2008 a change of interest appeared at reference meetings among the participants: the interest of indicators and benchmarking had grown. On behalf of FIA (Renewal of the Civil Engineering Sector; in Swedish 'Förnyelse I Anläggningssektorn'), the division of Construction Management, Lund University performs continuous studies of the development in the infrastructure part of the construction sector and BQR (Council for Construction Excellence; in Swedish 'Rådet för Byggkkvalitet') has recently started a program for development of the construction process.

In Sweden a few systems exist with narrow purposes, which could be regarded as benchmarking systems for example organised by SABO (Swedish Association of Municipal Housing Companies; in Swedish 'Sveriges Allmänyttiga Bostadsföretag') and REPAB (a company running and renovating built facilities as supplier for real estate companies).

The following implementation suggestions were developed at the division of Construction Management, Lund University (the Swedish representative of the CREDIT project) and they are based on the experience gained in the CREDIT project and the 28 case studies included in the project. The experience was developed during the discussions of the reference meetings with the industrial partners from housing, schools/offices and hospital businesses.

Appendix D gives a Swedish version of the recommendations for Sweden.

Proposed actions and initiatives

According to the results of the project CREDIT, the following suggestions of developments are formulated in order to support the development of the construction sector of an international benchmarking system:

– To develop indicators that aims at improving customer satisfaction, in well defined areas and contexts, with new initiatives – national and international, for example housing companies, hospitals, schools and maintenance. Most commonly has different actors have different needs and moreover they formulate the needs differently.

– To develop indicators in accordance with the CREDIT framework: directed towards specific buildings and constructions. For example the upcoming activity of development of indicators related to sustainability in order to meet the Green Building Council recommendations.

– To analyse how indicators could support the development of BIM respectively how the application of evaluation systems, indicators and benchmarking could develop the use of BIM.

– To discuss internationalisation of evaluations and indicators with major internationally acting companies like NCC, Skanska, Rambøll, Sweco, WSP, Atkins and other consulting firms, contractors and real estate companies.

– To increase visibility of the actual use of indicators among clients and corporations and the positive outcomes that the use of indicators could bring. One important issue that needs to be further analysed is how the evaluation and benchmarking could affect the execution of the construction process. For example, by using information from internally filed or other performed construction schemes or property management. Of importance is to design the benchmarking system that integrates an existing system instead of continuously creating new ones. As mentioned before, this can be performed in a number of ways.

– To increase the knowledge of the management of end-users and their needs among the partners. Much knowledge of how to manage the end-users and their needs in the construction process is possessed by individuals but not efficiently shared. Of interest to further study is how the knowledge sharing could be improved between parties, for example through a system or by improved communication, in order to improve project efficiency and the quality of the outcome.

The need for a broad collaboration

To solve the tasks and secure the connections between solutions, there is a need for an inclusive collaboration between potential driving forces and stakeholders. Experience gained in the CREDIT project show that the following activities are of interest:

– Public clients need to further develop and include the use of indicators and benchmarking systems, based on the CREDIT result, in their organisation's routines and activities.

– The organisations of the construction sector including the clients are recommended to initiate the development of transforming the conceptual system, developed by CREDIT, into a professional and international system.

– A survey directed towards the use of a conceptual system should be initiated in collaboration with the remaining Nordic research institutions. Of interest would be to study how the clients and organisations are using benchmarking and indicators and what factors that affect their use.

– A seminar/conference, arranged by Construction Management, Lund University, with participating industrial partners, in which the partners will discuss and describe their needs of benchmarking and possibilities of contributing with necessary information and how the benchmarking organisation should be organised in practice.
– The users should, through BQR and The Clients Association Sweden (Byggherrarna), initiate dissemination of the information of the outcomes from the CREDIT project and the benefits for the clients and users in using the indicators and benchmarking.
– The connection between the indicators and the users' requirements needs to be further studied.

Potential drivers and actors

Until now there have been no drivers for a benchmarking system including the necessary indicators. The newly started project *Bygginnovation* supported by Vinnova and with involvement by some key actors in the construction industry has a project idea that could include the development of the CREDIT benchmarking framework in Sweden.

7.5 Icelandic national recommendations

Björn Marteinsson, Innovation Center Iceland and University of Iceland – faculty of civil and environmental engineering

Consultation process

The national implementation proposal and recommendation is based on discussions at two meetings (spring and autumn 2009) held by FSR (Government Construction Contracting Agency) concerning benchmarking, and with various actors on the building market. Nearly 40 persons participated in the meetings but those who voiced their opinion were much fewer. The interest in benchmarking is new in Iceland and the work still in a very early stage.

Proposed actions and initiatives

Based on discussions and the research and conclusions of the CREDIT research project, the following actions and initiatives are proposed:

– At this point in time there is interest in using the BREEAM classification system as this system already exists. The English system does not meet Icelandic requirements in some major aspects and there are wishes for considering a Nordic framework.
– It is necessary to introduce the CREDIT performance indicator classification framework to governmental organisations, as well as building and construction companies and associations.
– Inform national benchmarking networks ("Fasti") about the results of CREDIT.
– Further explore the potential for using BIMs (Building Information Model) in benchmarking in order to increase precision and reduce costs and time consumption for data gathering and processing.

Potential drivers and actors

In order for the CREDIT performance indicator classification framework to be used in practice, there has to be interest and willingness to implement the methodology in the market. This may take some time to build up, but in the beginning public facility owners may be expected to take the leading position as drivers.

7.6 Estonian national recommendations

Roode Liias, Tallinn University of Technology, Estonia

Consultation process

Currently there is no existing system for benchmarking the buildings in Estonia. In fact there is a list of technical parameters that are used to describe certain aspects of any building mainly for the purpose of statistical analyses. This system and the parameters listed have nationally no practical output especially for managing the construction and real estate sectors. The major problem is related to the issue that the single parameters are not clearly defined and the national building registrar guarantees neither the reliability of input nor of output data.

In Estonia there are no initiatives on benchmarking in the national construction and real estate sectors or research institution, so the major role is played by Tallinn University of Technology (TUT) and its subdivisions. Therefore the role of the Department of Building Production is to promote the topics and recommendations discussed and highlighted during the CREDIT project.

Proposed actions and initiatives

Based on the cooperation and discussions in the CREDIT project, TUT has in mind the following strategies for potential activities:

– Start using the CREDIT framework of indicators in everyday practice when describing the buildings for Society.

– Review the existing practice of using building measurements when assessing the performance of facility and area.

– Introduce the CREDIT project proposed framework of indicators for the academic research to get reliable database for further analyses to be carried out on an international scale.

– Compile a report for the national authorities about the experience of benchmarking of buildings in the Nordic countries.

– Relate the current national priorities – especially related to energy efficiency – to the benchmarking framework when assessing the buildings.

– Carry out a study amongst the current reconstruction strategies to answer the question how common preferences are reflected through the CREDIT benchmarking framework.

Potential drivers and actors

For Estonia, energy efficiency has currently become the major driving force in any either of the sectors, especially for construction and specifically for housing.

The majority of buildings in Estonia date back to the Soviet era, but there are also older buildings. All these buildings lack long-term maintenance and renovation strategies, but they do not meet the contemporary standards for built environment either. Quite clearly, all the relevant activities to improve the quality of the built environment are dependant on investments and the incentives of the actors.

In Estonia there have traditionally been different national development plans compiled; e.g. development plan for housing. National authorities should play the leading role when initiating relevant priorities and activities to improve the quality of built environment.

The framework of indicators proposed in CREDIT includes a list of parameters not always clearly understood by non-professional people, e.g. by the users of the buildings. Therefore any benchmarking framework has its output for professionals, but also for everyday users. For the latter, a 'handy' framework of indicators has to be proposed to assure its wide implementation and dissemination.

The major role can be played by different professional institutions and TUT.

7.7 Lithuanian national recommendations

Arturas Kaklauskas, Vilnius Gediminas Technical University (VGTU)

Consultation process

Currently a benchmarking system does not exist in Lithuania. The proposed actions and initiatives are developed at the Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, and are based on the experience of the CREDIT project and our 20 years' research experience.

Proposed actions and initiatives

According to the experience gained from the CREDIT project, the following suggestions of developments are formulated in order to promote international benchmarking and to develop and improve the construction and real estate sector:

- Additional development of quantitative and qualitative criteria of interested parties (clients, users, designers, economists, contractors, maintenance engineers, building material manufacturers, suppliers, contractors, financing institutions, local government, state and state organisations) satisfaction through the life cycle of housing, industry and public buildings. The life cycle of a building cannot be effectively implemented without the satisfaction of the differing goals of interested parties.
- To expand quantitative and qualitative criteria system in the very low energy buildings.
- To analyse how quantitative and qualitative criteria can support the development of digital, device-based and smart construction.
- To make the use of quantitative and qualitative criteria more visible for interested parties (clients, users, designers, economists, contractors, maintenance engineers, building material manufacturers, suppliers, contractors, financing institutions, local government, state and state organisations).
- To adapt cross-national benchmarking for Lithuania. Of significance is to design the benchmarking organisation so that it can be integrated in existing international framework instead of creating a new one.
- To increase the tacit and explicit knowledge of the management of interested parties and their needs (for example according to Maslow's hierarchy of needs). Of interest to further study is how the tacit and explicit knowledge sharing could be improved between parties, for example through an intelligent library system.

Potential drivers and actors

Until now there have been no drivers for benchmarking including the necessary indicators. The reimbursement is too doubtful and the life cycle costs are too high. The development of a benchmarking organisation will most likely only be pursued in case there is a political pressure for change.

7.8 Summary of the national recommendations

When planning the project, the four main partners in CREDIT believed that benchmarking was widely accepted in the construction and real estate sectors and that cross-border benchmarking could be implemented at the course of a few years. That opinion was changed through the project, and in the national recommendations it was stated that the support for international benchmarking in the seven countries as a whole was much lower than we had expected in the beginning. It is for example stated in the Norwegian and Estonian recommendations that *"The interest in benchmarking is relatively low at the current point in time"* and *"in Estonia there are no initiatives on benchmarking in the sector or in research institutions"*. But in the past few years we also saw a change taking place concurrently with the CREDIT project as stated for example in the Swedish and Norwegian recommendations: *"In spring 2008 a change of interest appeared at reference meetings among the participants"* and *"we have seen an increasing focus on relevant indicators within the companies and between their own projects"*.

The proposed actions and initiatives for implementing indicators, assessments and benchmarking nationally in projects and enterprises and for international comparisons were gathered in the following four groups:

1. Communication of the results of CREDIT to different parties
2. Development of different categories of performance indicators
3. Analyses and tools linking indicators, assessment and benchmarking
4. Drivers in development and implementation of benchmarking.

In the following sections are given a summary of the national recommendations according to these four groups, and in Figure 26 are given an overview of 18 different proposed actions and initiatives recommended by the seven countries in Section 7.1-7.7 and how the recommendations differ from country to country.

Figure 26. Overview of proposed actions and initiatives in the national recommendations from Denmark (DK), Finland (FI), Norway (NO), Sweden (SE), Iceland (IS), Estonia (EE) and Lithuania (LT).

Item	Proposed actions and initiatives in the national recommendations	DK	FI	NO	SE	IS	EE	LT
1	**Communicate the results of CREDIT to different parties**							
11	To publish national memorandum of CREDIT and inform national authorities			X		X	X	
12	To organise conferences/seminars/workshops/meetings about CREDIT	X			X		X	
13	To inform national front-runner enterprises and their organisations	X	X		X	X		
14	To inform national benchmarking organisations and networks			X		X		
15	To inform international organisations and enterprises				X			
2	**Develop different categories of performance indicators**							
21	To make result and use of indicators more visible for clients and non-professionals	X	X		X		X	X
22	To develop purpose-specific and important indicators and rating schemes	X	X	X	X		X	X
23	To develop indicators of end-user satisfaction for well-defined building functions	X		X	X			
24	To develop automatic data gathering and reporting in database for international research	X		X				
3	**Analyses and tools linking indicators, assessment and benchmarking**							
31	To analyse how indicators can support digital construction and vice versa.	X		X	X		X	
32	To implement tools in BIM for intelligent implementation of indicators and assessment		X	X		X		X
33	To elaborate the link between assessment of performance in difference phases	X	X					
34	To increase management of end-users needs and assessment among the partners	X			X			X
4	**Drivers in development and implementation of CREDIT**							
41	To transform the CREDIT framework targeting internationally operating enterprises	X			X			
42	To expand existing benchmarking organisations to cross-border benchmarking	X	X	X	X	X		X
43	To continue international collaboration and CREDIT partners implementing results	X	X		X		X	
44	To encourage front-runner actors, client and enterprises to pull the sector	X	X	X	X	X		
45	Authorities and standard organisations are pointed out as the important supporters	X	X	X			X	X

The presented recommendations are obviously an up-to-the-minute account, and other national representatives or times for presenting recommendations may give other national results than stated in Figure 26.

Communication of the results of CREDIT to different parties

The countries propose that the overall information of the CREDIT results were to be compiled in brief national memorandums and distributed nationally to authorities, associations, and important enterprises and benchmarking organisations in the construction and real estate sectors.

The countries propose that specific needs and opportunities of national front-running enterprises and benchmarking organisations should be discussed in national conferences, seminars, workshops or meetings arranged by the CREDIT participants. It was further proposed that national research groups could also be involved in this and together with the other parties select important national topics for development and implementation.

The countries propose important target groups for the future information. Specific national benchmarking organisations and networks were pointed out as important target groups for the communication and future development. Also specific international or Nordic organisations and enterprises related to the national benchmarking as well as standard organisations were pointed out as target groups for the CREDIT communication. But all recommendations pointed to that the national authorities and government as the most important parties to be informed of the CREDIT results.

Development of different categories of performance indicators

The counties propose that the CREDIT performance indicator framework was developed to target groups of front-runner actors, enterprises and organisation in the construction and real estate sectors. If the motivation and commitment were to increase and have an impact on the client and end-users' behaviour, it was important to make the indicator monitor real time and more visible for them. We could for example start using the performance indicators in everyday practice, and we could analyse how well understood performance is by non-professionals.

The countries propose to develop purpose-specific and important performance indicators. It could for example be indicators on sustainability, energy efficiency, building performance, performance of specific categories of buildings, construction process performance, usability, productivity, costs and the impact on economy. The indicators must be developed according to the needs and specific purposes of the individual parties in the construction and real estate sectors. The indicator must be developed towards a small and representative set of quantifiable indicators, starting with a few key indicators and not a full system.

The counties propose to develop indicators of end-user satisfaction for well-defined areas, and dwellings, educational buildings, hospitals and maintenance are of special interest for the implementation. End-users desired a transparent market and they wanted to know what they buy from each supplier. It is therefore proposed to analyse how different end-users formulate their needs in different ways and to include it in the future development.

The counties pointed out that there will be an increase in automated data gathering and reporting and using common internet portals for public reporting supported by national government agencies. Implementation could therefore also include the development of reliable databases for further analyses and academic research on an international scale.

Analyses and tools linking indicators, assessment and benchmarking

The countries pointed out the important to analyse how indicators can support the development of building information model in digital construction and real estate and vice versa. It is further proposed to press the public organisations to show that they are efficient by simulating market competition with benchmarking and to review the existing practice of using building measurements and benchmarking when assessing the performance of facility and area.

The countries propose development of tools in building information models (BIM) and to implement indicators and assessment in a more intelligent way by adopting internet platforms to heighten easy use in practise. It is further proposed to explore the potential for using BIM in benchmarking and as a data carrier in order to increase precision and reduce costs and time consumption for data gathering, processing and reporting. It is also proposed to analyse how indicators, assessment and benchmarking can be promoted in connection with BIM, and how links can be elaborated between assessments of performance in the different phases though the life cycle of the building.

The countries propose that benchmarking organisations analyse experiences and lessons learnt of how end-users, clients and suppliers change attitude and behaviour when applying benchmarking in practise. It is further proposed to analyse how knowledge sharing could be improved between parties, and increase the tacit and explicit knowledge of the management of interested parties and their needs for example through an intelligent library system.

Drivers in development and implementation of benchmarking

In the national recommendations the following drivers are proposed to develop and implement the CREDIT framework in the Nordic and Baltic countries:

- Internationally operating enterprises
- Existing national benchmarking organisations
- International collaboration between CREDIT partners to continue implementation
- Front-runner actors, clients and enterprises in construction and real estate
- Authorities and standard organisations to support development.

The countries propose a discussion internationalisation and how major international operating enterprises transform the CREDIT framework into international operational concepts. Further expansion, professionalisation and internationalisation of cross-border benchmarking could for example be launched in NCC, Skanska, Rambøll, Cowi, Sweco, WSP and Atkins.

The countries agree that it does not seem likely that any actor will push hard for the implementation of an all-embracing cross-national benchmarking organisation in the short term. The benefits are too uncertain and the investment and the running costs are probably quite high. However, within certain areas like sustainability some political pressure and market pull can by expected. In the short term it is instead proposed to expand existing national benchmarking organisations in accordance with the CREDIT framework and to strengthen the cross-border cooperation between national benchmarking organisations.

This was found to be a better alternative than to establish new organisations. BREEAM, LEED and PromisE were pointed out as examples of existing international organisations to be implemented in the Nordic and Baltic countries, but in some major aspects they do not meet the national requirements. Some of the countries have no national benchmarking organisations and go directly for the international level. It is also emphasised how important it is to build international benchmarking on internally benchmarking in enterprises and to build on internationally founded standards.

The countries propose to continue the international collaboration in CREDIT and the national implementation through the national reference groups so the results could be widely communicated. A survey of the use of a conceptual system could be initiated in collaboration with other Nordic and Baltic research institutes. The CREDIT partners may play an important role in the implementation of the CREDIT results e.g. in cooperation with national stakeholders.

There is a need for a broad cooperation between front-runner actors, interested parties and organisations in order to improve international benchmarking and ensure cohesive solutions. They can integrate key indicators in their practices and communicate through performance indicators to their suppliers and clients. Demanding clients can select different standard of buildings and rooms based on performance indicators and link measures with company policies and external commitments for social responsibility. Large professional buyers and owners suggest direction for development and contribute data to ensure the connection between solutions and stakeholders' needs. Some of the countries indicate that till now there have been no drivers for international benchmarking and important indicators, but concurrently with the CREDIT project interest is growing.

In specific areas the changes will most likely be pursued only in cases where there is a political pressure for change. Specific government agencies are mentioned as important drivers of international benchmarking through legislations and public client requirements. Cooperation with national standard organisations are needed and the current national and international work being done in different standardisation groups could be in integrated into in the improvement of the CREDIT framework.

8 CREDIT summary and conclusions

The CREDIT project was launched in November 2007 as a cooperative research project by seven Nordic and Baltic research institutes:
– Danish Building Research Institute (SBi), Aalborg University, Denmark
– VTT, Technical Research Centre of Finland, Finland – funded by TEKES
– SINTEF Byggforsk, Norway
– Lund University, Construction Management, Sweden
– The Icelandic Center for Innovation, Iceland.
– Tallinn University of Technology, Estonia.
– Vilnius Gediminas Technical University, Lithuania.

The work was completed in seven work packages (WP1-WP7) and seven two-day CREDIT meeting packages alternated between the participating countries. The project was concluded in April 2010 and the results were published in 28 CREDIT case-study reports and 5 main CREDIT reports all summarised and concluded in this final report CREDIT Report 6.

The results was also presented in scientific articles at the 5th Nordic Conference in Reykjavik, Iceland, June 2009 (Pemsel, S.; et al., 2009), SB10 Regional Conference in Espoo, Finland. Sep. 2010 (Frandsen, A. K.; et al., 2010; Haugbølle, K.; et al., 2010) and CIB 2010 World Building Congress in Salford, England, May 2010 (Porkka, J.; et al., 2010).

The CREDIT research model and evolvement of the conclusions

The analyses in the CREDIT project were performed for selected segments of processes, actors, building parts, buildings and locations. The CREDIT performance information model for improving transparencies of value creation in the construction and real estate sectors were developed as a core model for the research in CREDIT. It was intended as a tool for exchanging performance information between end-users, building projects, enterprises and benchmarking organisations and consisted of three interlinked topics:
1. CREDIT performance indicator classification
2. Assessment methods and tools including the capturing of end-users needs
3. Internal, national and international benchmarking.

Performance indicators were the subjects of an assessment and benchmarking process. These processes provided documentation for the decisions made in the construction and real estate sectors as well as proposals for how buildings and processes should be improved through innovation.

In the CREDIT project we analysed the performance information practice and potential for improvement of value creation in the construction and real estate sectors in the Nordic and Baltic regions. We studied practices and opportunities for improvements in 28 CREDIT case studies of front-runner building projects, enterprises and benchmarking organisations, and in three steps we analysed selected segments according to the ten topics in the CREDIT performance information model.

Based on the discussions in the five main CREDIT reports, each of the seven countries participating in the CREDIT project put forward their national recommendations and priorities for the implementation of the CREDIT frame-

work. The evolvement of the final CREDIT conclusions was extracted step by step in ever narrowing spirals as follows:
– The experience from the state-of-the-art report and the 28 case studies
– The results, discussions and conclusions of the five main reports
– The summary of the main reports in Chapters 1-6 in this summary report
– The national recommendations in Chapter 7 in this summary report
– The final conclusions of CREDIT in this chapter.

CREDIT performance indicator framework in a Nordic/Baltic perspective

As no commonly agreed European Key Performance Indicator framework exists CREDIT has made a contribution from the Nordic/Baltic perspective. We have developed a simple and understandable structure of performance indicators in seven independent facets with a direct relation to national regulations and international standards and research.

The first facet reflected costs and price through the life cycle of the building. The five next facets addressed the performance of location, buildings, building parts, facility management and the design and construction processes. They all included both objective measurable performance indicators and indicators that addressed less measurable properties, as well as the end-users' experience and feelings. The final facet was the impact of the building on the external environment, social life and economy. The seven facets in the CREDIT performance indicators framework:
1. Costs, price and life cycle economy (LCE)
2. Location, site, plot, region and country
3. Performance of building and indoor environment
4. Performance of building parts and components
5. Facility performance in operation and use
6. Process performance during design and construction
7. Impact on the environment, social life and economy.

Each of the seven main facets were divided into two levels of sub-facets with increasing levels of detailing, ending with 42 indicators at sub-facet level 1 and 187 indicators at sub-facet level 2. Each indicator at the three levels of facets was given a one-line title and a brief description of a few lines. In addition, the unit by which the indicator was measured was also described. When possible, the definitions of units and classes of measures were taken from standards and national regulations. Otherwise CREDIT proposed a common scale of measures in 5 steps e.g. classes A, B, C, D and E, where class A was the best.

The CREDIT performance indicator framework was tested against both international standards and national regulations. The success of improving transparency of value creation depended on the synergy and the coherence between them. The analyses showed that standards and research included a lot of detailed information in each field, and it was difficult to compress the enormous amount of information into the common and transparent CREDIT performance indicator framework. On the other hand, international standards and research were two of the primary foundations for an international indicator classification. In the future, it will therefore be important constantly to coordinate and perhaps adjust the CREDIT performance indicator framework according to new experience gained by research and international standards.

Building regulations in five of the seven CREDIT countries were also compared in order to discover inconsistencies between the CREDIT performance indicator framework and the national regulations. By and large, the indicator classification corresponded to the national regulations, but there were facets that were not included in the national regulations and the same indicator were found to be defined and used in different ways. If indicators in national regula-

tions become more transparent and support international benchmarking better in the future, they should have an unambiguous relation to the CREDIT performance indicator framework and international standards. A more detailed analysis of the inconsistencies in national regulations and norms compared with the CREDIT framework are therefore proposed according to the methods outlined in CREDIT Report 3.

The focus in this first stage of development has been on the construction and real estate sectors in the Nordic and Baltic countries. The following initiatives are essential for the future implementation and dissemination of the CREDIT performance indicator framework:

1. To prepare easy-to-read information material and present the framework widely
2. To form a Nordic/Baltic expert group with related reference groups
3. To implement the framework in interaction with international standards and the necessary adjustments in the national regulations
4. To apply the framework in existing benchmarking organisations and expand them for use in cross-boarder benchmarking
5. To select a few key performance indicators for everyday use
6. To improve the maturity level of important performance indicators.

Project assessments and benchmarking in an international perspective

A generic model called the carpenter model was developed to support a better understanding and execution of how to capture end-user needs and assess requirements in the process. The model included the following seven phases and five main groups of actors.

– The seven main phases along the life cycle of the building:
    1. Innovation, learning and evaluation and feedback process of projects
    2. Strategic brief and strategic analyses and planning in enterprises
    3. Functional brief and programming in a construction project
    4. Design and planning process in a construction project
    5. Construction and execution process in a construction project
    6. Facility management of a building in use
    7. Occupancy of and business in a building in use
– The related five main actors in the construction and real estate process:
    A. End-users, tenants of the building, neighbours and society
    B. Client, owner and facility manager
    C. Consultants, contractors, manufacturers and other suppliers
    D. Authorities and assessment and benchmarking organisations
    E. Researchers, developers and teachers.

The literature review showed that existing assessment methods mostly cover the early or late phases. Methods that seek to cover the whole process are not very well tested in real life. Assessments vary somewhat depending on type of building, performance indicator, country and interest in what to assess. Clients play an important role in the construction process and surprisingly, they perform a lot of the work themselves as well. Designers play an important role in translating demands to requirements and specifications, but the rest of the actors do not engage to any larger degree.

In the construction process there are well-developed routines as a part of the project management system, but there is almost no case that shows any assessment tool that supports feedback and innovation in the long run. The Building Information Models (BIM) and the Falk system in Skanska are examples of potential carriers of digital information within a project and of how to store all types of information needed for assessing a number of different aspects.

Many international and front-runner enterprises have their own benchmarking system and key performance indicators, sometimes even several used by different organisational units in different process phases. It is important that national as well as international benchmarking should be built on efficient internal benchmarking in enterprises and that professional project assessment methods and BIM are integrated. In addition it will also be important to have a web-based benchmarking platform to process the cross-border benchmarking information. VTT, Finland had developed a benchmarking platform in CREDIT, and it was tested in a small cross-border benchmarking exercise on six office buildings. Ten performance indicators were evaluated, and we saw that the user interface was very important, if in the future we want to improve how to process information. On the other hand this exercise also suggests that it would not be an easy task to develop a benchmarking system that will be applicable for international use.

An important lesson learnt from the case study of the front-runner benchmarking organisations was that they differed a lot in the way they were organised compared with ownership, business profile, purposes and background. It was also an interesting collaboration effort between seven countries with congruent objectives but sometimes distinct priorities and constraints in the research.

Based on the case studies, it was not possible to get a clear picture of what kind of benchmarking organisation that would have the greatest potential for becoming an effective, market leading and international one. But the following lines of approach were regarded as important for the future analysis of strengths, weaknesses, opportunities and threats (SWOT) of benchmarking organisations with potential for becoming international market leaders:

– The marked segment in which the organisation operates should be clearly delimited and its benchmarking products should be well defined and accepted.
– Data gathering, processing and reporting should be effective and web-based benchmarking tools should be integrated in building information models (BIM).
– The income and costs of the organisation should be robust over time with a profit margin to finance improvements.
– The organisation should cover the main part of the market segment of building, enterprises and indicators that they focus on.
– The innovation strategy of the organisation should be effective and support constant improvement to fulfill the demands of the market.

National recommendations for implementation of CREDIT nationally

The national representatives from Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania presented national recommendations for potential drivers and initiatives to implement CREDIT proposals nationally. In the national recommendations, the following drivers were proposed to develop and implement the CREDIT framework in the Nordic and Baltic countries:

– International operating enterprises
– Existing national benchmarking organisations
– International network of CREDIT partners
– Front-runner actors, clients and enterprises in construction and real estate
– Authorities and standard organisations supporting implementation.

To implement the CREDIT framework on indicators, assessments and benchmarking nationally in projects and enterprises for international comparisons the seven countries recommend the following actions and initiatives:

– Communicate the results of CREDIT nationally in national memoranda and seminars and inform national authorities, front-runners, existing benchmarking organisations and international working enterprises directly.

- Develop different categories of performance indicators e.g. purpose-specific indicators, rating schemes and end-user satisfaction, and make indicator results more visible for clients and non-professionals.
- Analyse methods and tools linking indicators, assessment and benchmarking in an integrated performance information model including management of end-users needs; assessment of different process parts; analyse and develop related digital tools in BIM (Building Information Models).

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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.

Extracts from the reports may be reproduced but only with reference to source as this example: Bertelsen, N.H. et al. (2010). CREDIT Summary and National Recommendations. Indicators and benchmarking framework for transparency in construction and real estate in the Nordic and Baltic countries. CREDIT Report 6 (SBi 2010:19). Hørsholm: Danish Building Research Institute (SBi), Aalborg University.

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Appendix A: CREDIT project and meeting plan

CREDIT project plan – April 2010

Year:	2007	2008				2009					2010			
Quarter:	IV	I	II	III	IV	I	I	II	III	IV	I	I		
Milestones:		M1	M2		M3	M4		M5		M6				
Work packages (WP) and deliverables (D) e=extra	Nov	Feb	May	Aug	Oct	Jan	Mar	Jun	Aug	Oct	Jan	Feb		CREDIT report
WP1: CREDIT project management (DK)														
Steering committee and SC meetings	D1.1	D1.2	D1.3		D1.4	D1.5	D1.6	D1.7		D1.8e	D1.9e			
Project meetings		D2.1	D2.2		D2.3	D2.4		D2.5		D2.6				
Progress reports and accounts		D3.1		D3.2		D3.3			D3.4			D3.5		
WP2: Performance models (DK)														
a) Stimulus paper, draft & final Summary report		D4.1	D4.2								D4.3			**Rep6**
b) Draft and final report of CREDIT indicators						D4.4e		D4.5e		D4.6e				**Rep3**
WP3: State-of-the-art (NO)														
Stimulus paper, draft report and final report		D5.1	D5.2							D5.3				**Rep1**
WP4: Project assessments and tools (SE)														
Stimulus paper, draft report and final report		D6.1			D6.2					D6.3				**Rep4**
WP5: National case studies (FI)														
Stimulus paper, draft report and final report		D7.1				D7.2				D7.3				**Rep2**
WP6: International benchmarking (FI)														
Stimulus paper, draft report and final report		D8.1						D8.2		D8.3				**Rep5**
WP7: CREDIT dissemination (DK)														
CREDIT project web (SINTEF eRoom)*		D9.1												
Reference group meetings and User workshops		D10.1	D10.2		D10.3	D10.4		D10.5				D10.6		
Press releases		D11.1									D11.2			
News articles in trade journals		D12.1				D12.2					D12.3			
Research articles						D13.1		D13.2		D13.3		D13.4		

** SINTEF Byggforsk eRoom: https://project.sintef.no/eRoom/byggforsk/ErabuildCREDIT. Responsible: ole.jorgen.karud@sintef.dk*

CREDIT meeting plan – April 2010

Meeting packages	Main objectives	a) Project meeting	b) User workshop	c) Reference group meeting	d) Steering committee meeting
1. Helsinki, FI* 24-25 Jan 2008	Kick of and end-user values	1st day 10-15 2nd day 9-13	2nd day 13-16		1st day 15-17
2. Oslo, NO* 29-30 May 2008	WP2: Performance models WP3: State-of-the-art	1st day 10-16	2nd day 9-12		2nd day 13-15
3. Lund, SE* 8-9 Oct 2008	WP4: Project assessment	1st day 10-17	2nd day 9-13	2nd day 13-15	1st day 17-18 2nd day 15-16
4. Vilnius, LT*/ES/FI/DK 19-20 Jan 2009	WP5: National case studies	1st day 9-12 2nd day 9-15	1st day 13-16		2nd day 15-16
5. Reykjavik, IS* 8-9 Jun 2009	WP6: International benchmarking	1st day 8:30-12 2nd day 9-16	1st day 13:15-16:30		2nd day 16-18:45
6. Tallinn, ES*/FI/DK 26-27 Oct 2009 extra	Final version of CREDIT Reports 1, 2, 3, 4 and 5	1st day 9:30-17 2nd day 9-14:15			2nd day 14:45-16:15
7. Copenhagen, DK* 25-26 Jan 2010	Presenting CREDIT Report 6 *Summary report* and closing		1st day 10-17	2nd day 9:30-15:00	2nd day 15-17

** The host is responsible for planning, writing the agenda and inviting the different members to a), b) and c), and he is also chairman and writes the minutes for a), b) and c). The project owner is chairman and the project coordinator writes the agenda and the minutes for d).*

Appendix B: Guideline for preparing national recommendations

Authors name, Institutional affiliation

Consultation process

Please describe what kind of consultation process (if any) has been carried out in order to set up these recommendations.

– Who has been involved in the proposal?
– How was the process undertaken (reference group meetings, public hearing, private conversations etc.)?

Proposed actions and initiatives

Please describe specific initiatives and steps to be taken in order to implement a benchmarking system for international comparisons as well as indicators, internal company benchmarking and web-presentations as the Home example.

– Where do we want to go – in the short term, medium term and long term?
– How will we get there?

Potential drivers and actors

What are the potential drivers, and who are the actors supporting the establishment of a new benchmarking system or the elaboration of an existing benchmarking system in your country?

– What kind of political pressure and motivating support can be expected to implement and improve existing national benchmarking system, performance indications and digital assessment methods and tools?
– What kind of market trends and technical solutions and web systems can be expected to foster the implementation of a national benchmarking system, performance indicators and digital assessment methods and tools?
– What kind of incentives (if any) is in place for potential users to use and implement a benchmarking system in your country?
– Which actors are likely to support the implementation or re-shaping of a benchmarking system?
– How can learning and education support the implementation of CREDIT?

Appendix C: SBi proposals for Denmark – in Danish

Forslaget er udarbejdet med baggrund i resultaterne fra det nordisk/baltiske forskningsprojekt CREDIT (Construction and Real Estate Developing of Indicators for Transparency), hvor Statens Byggeforskningsinstitut (SBi), Aalborg Universitet har været ansvarligt for den fælles koordinering og det danske arbejde i netværket.

I et samarbejde med bygningsejere og byggeparter er der i CREDIT udviklet rammerne til et nyt evalueringssystem, hvor man kan bedømme og sammenligne bygningers kvalitet på en lang række punkter, hvor brugernes bedømmelse indgår med særlig vægt.

CREDIT har fokus på brugen af bygninger

Bygninger spiller en afgørende rolle for mange funktioner i samfundet. Det gælder som bolig, i arbejdslivet, ved uddannelse, i kulturen, i hospitaler og på en række andre områder. Derfor er det vigtigt, at bygninger udføres og drives på grundlag af brugernes, ejernes og det omgivende samfunds behov og værdier.

For byggesektorens virksomheder bliver det af voksende betydning for konkurrenceevnen, at der er værktøjer og metoder til at få indsigt i brugernes situation, og hvorledes værdier kan omsættes til krav til bygningernes ydeevne. Det gælder også som led i den internationale konkurrence.

Med basis i det toårigt nordisk/baltisk forskningsarbejde, CREDIT, er udviklet et rammesystem med indikatorer, der skaber større gennemsigtighed for såvel brugere som virksomheder om brugernes værdier. Projektet giver også gennem en række cases eksempler på, hvordan indikatorerne er brugt i nybygning, drift, vedligehold og ombygning samt i benchmarkingsystemer.

Resultatet af CREDIT kan yde et bidrag til udviklingen af byggeriet og brugernes rolle ved at pege på behovet og mulighederne for en stærkere brug af evalueringer, hvor brugernes og ejernes tilfredshed er i fokus. Det gælder eksempelvis i boliger, ved undervisning, i kulturinstitutioner og på hospitaler samt også for kontorer, butikker og produktion. Evalueringer kan antage mange former, men indikatorerne er et centralt omdrejningspunkt.

Denne åbning mod brugerne skal ses i sammenhæng med, at andre grupper i byggeprocessen - som bygherrer, myndigheder og virksomheder - samtidig får bedre mulighed for at evaluere deres eget arbejde.

I CREDIT arbejdes med evalueringer af såvel selve bygningen og driften i bygningens levetid som med processerne ved udførelse og drift. Resultatet vil således også kunne være nyttigt som drivkraft i udviklingen af bygning, drift, processer og miljøet.

Dansk referencegruppe og baggrund for forslaget

Dette forslag er udarbejdet af Statens Byggeforskningsinstitut (SBi), Aalborg Universitet, som er den danske repræsentant i CREDIT og koordinator for hele projektet.

Forslagets hovedpunkter blev fremlagt og debatteret i en første udgave for den danske referencegruppe, der består af repræsentanter fra de vigtigste organisationer, bygherrer og byggeparter på området, ved et møde i november 2009. Det blev efterfølgende revideret efter kommentarer fra mødet, og referencegruppen har kommenteret forslaget i en skriftlig høring.

Alle kommentarer er søgt imødekommet, men den endelige beskrivelse, herunder anbefalingerne i de to sidste afsnit, er SBi's forslag, og derfor ikke nødvendigvis dækkende for de enkelte deltageres opfattelse.

Indikatorer et omdrejningspunkt

Grundlaget for evalueringer i CREDIT udgøres af et omfattende system af indikatorer. Systemet, der er opdelt i syv hovedgrupper kaldet facetter, dækker forskellige dele af en bygning og byggeprocessens faser. Systemet udgør en ramme for en fælles forståelse af brugen af indikatorer – og for et helhedssyn på byggeri, drift, processer og påvirkning af det ydre miljø.

En afgørende inspirationskilde og kvalitetssikring har været beskrivelse af 28 cases fra byggerier og driftsopgaver i de nordiske/baltiske lande, der afspejler de vigtigste kategorier af bygninger og initiativrige brugergrupper. Sideløbende er indikatorerne sammenholdt med bygningsreglementer i de nævnte lande, internationale standarder og forskningsrapporter. Der er konstateret en god overensstemmelse mellem disse kilder og det foreslåede system. Systemet bør viderebearbejdes og operationaliseres, især bør brugersiden i et videre udviklingsarbejde udbygges.

På baggrund af de 28 cases er det erfaret, at brugen af indikatorer vil være bestemt af den aktuelle situation, ligesom indikatorerne vil blive valgt af de parter, der agerer i situationen. Eksempler på faktorer, der vil påvirke parternes konkrete valg af indikatorer, er: Formål med evaluering, bygningstype, bygherre, brugere, virksomheder, organisation og faser i byggeprocessen eller driften.

Det samlede system af indikatorer understøtter udviklingen mod en voksende brugerindflydelse og større vægt på bygningens bidrag til ”livet og virksomheden i bygningen”. Så vidt vides er det første gang, at forskellige vinkler på byggeri – fra traditionelle kvaliteter og nye miljømæssige emner til drift og selve byggeprocessen – er samlet i ét bruttosystem af indikatorer.

I en international målestok vil de vigtigste mål i det videre arbejde derfor være:
- at udbygge og udvikle de væsentligste indikatorer og målemetoder
- at udbygge og udvikle eksisterende og nye benchmarkingsystemer
- at harmonisere disse på afgrænsede områder på tværs af regioner og grænser
- at forankre benchmarkingen i virksomhederne og byggerierne
- at bidrage til en stærk udvikling og forbedring af byggeriet
- at det nordisk/baltiske system af indikatorer på længere sigt kan bidrage til et større internationalt samarbejde om brugertilfredshed med byggerier.

Benchmarking vejen til dialog og udvikling

I de udarbejdede cases er flere eksempler på benchmarkingsystemer. De er etableret til bestemte formål, og hvert enkelt system har sin særlige baggrund, opgave og arbejdsform. Eksempelvis varierer målgruppe, incitament, lovgivning, organisation, registrering af data, brug af resultater og offentlighed.

Det er også konstateret, at det er vigtigt med incitamenter for at fremme deltagelse i systemet og aflevere og bruge data – også i de tilfælde, hvor der er tale om krav fra lovgivning. Ligeledes bør såvel ind-data som ud-data være lette at skaffe, præsentere og bruge.

Den vigtigste drivkraft ved etableringen af benchmarkingsystemer synes at være konkrete problemer som byggeskader, uhensigtsmæssige processer og mere rationel drift. Derefter er der foregået en udvikling, hvor såvel indsamling af data som brug af resultater og synlighed er udviklet.

Nogle systemer har givet markante resultater i form af ændret adfærd, som færre byggeskader i det danske almene boligbyggeri. Et gennemgående træk synes dog også at være, at der er behov for større viden om brugen af resultaterne. Eksempelvis ved en større gennemsigtighed om bygherrers og virksomheders interne brug af systemerne og deres indbyrdes kommunikation fra byggesagens start til brugernes anvendelse af bygningen.

Generelt vil udbygning af benchmarkingsystemer – nationalt og internationalt – kunne ske på en række måder. Eksempelvis ved et tættere samarbejde for at sikre fælles definitioner. Det kan også ske ved udbygning af eksisterende former for registrering af data i benchmarkingsystemer indenfor afgrænsede områder som energimærkning og facilities management. Det kan også ske ved videreudvikling af eksisterende systemer som Den Offentlige InformationsServer (OIS) www.ois.dk og Bygnings- og Boligregistret (BBR) www.bbr.dk med brugerdata og udvikling af nye systemer baseret på erfaringerne fra ejendomsområdet med brugerinterface.

Der kan være mange vanskeligheder ved at etablere et internationalt samarbejde baseret på eksisterende systemer, da det vil kræve en harmonisering af indikatorerne i benchmarkingsystemerne og en koordinering mellem de aktuelle systemers 'infrastruktur'. Det dansk-norske samarbejde på området drift af bygninger viser, at det er muligt at løse problemerne. Tilsvarende gælder tilløbet til dialog mellem Danmark og Norge på området byggeskader. En tredje mulighed for en åbning mod international benchmarking er, at internationalt arbejdende virksomheder går i spidsen for evaluering på tværs af grænserne ved at åbne deres egne systemer.

Målemetoder danner grundlaget

Der er i CREDIT registreret mange meget forskellige metoder til at måle den aktuelle værdi af en indikator. For nogle indikatorer er der nøje specificerede kvantitative metoder, for andre 'karakterskalaer' i meget forskellig udformning – og for en stor del ingen metoder. Bortset fra de metoder, der er beskrevet i internationale standarder eller harmoniseret på anden måde, er der også store variationer i målemetoder fra land til land.

Den internationale udvikling vil for en række indikatorer, hvor der ikke foreligger aftalte målemetoder, formentlig i første omgang kunne dreje sig om at skabe enighed om de oplysninger, der bør foreligge. Et eksempel er her ejendomsområdet, hvor der er etableret en systematik for de data, der karakteriserer en ejendom, og derfor er vigtige ved en handel.

Målemetoder kan bruges i driftssituationer til at registrere brugernes opfattelse af brugen af bygningen. Eksempelvis akustik, indeklima og energibesparelse. Erfaringerne kan bruges til handlingsplaner, der kan afhjælpe generne og bruges fremadrettet til forbedring af nyt og renoveret byggeri.

Brugerne kan få en stærkere stilling

Ved at indarbejde indikatorerne i den praktiske planlægning, udførelse og drift af byggeri kan der skabes grundlag for større synlighed om resultater og bedre muligheder for gennem benchmarking at sammenligne byggekvaliteter nationalt og internationalt. Det vil give brugerne en stærkere stilling.

For at udnytte denne mulighed er der imidlertid behov for åbenhed, retningslinjer om offentlighed og kvalitetssikring af de målte værdier for indikatorer.

Denne udvikling har allerede været i gang. Eksempelvis i Danmark på områder som byggeskader og nøgletal for byggeprocessen.

Det bør også overvejes om, der kan etableres en større anvendelse af eksisterende benchmarkingsystemer. Eksempelvis ved at skabe en bedre forbindelse mellem driftsdata og planlægning af nybygning og store fornyelser.

På længere sigt er det et spørgsmål, om der kan etableres sammenhæng mellem forskellige benchmarkingsystemer. Her vil CREDIT systemet af indikatorer kunne tjene som vejledning for udviklingen af internationale (del-) benchmarkingsystemer målrettet forskellige specifikke formål.

Det videre arbejde

På baggrund af erfaringer fra CREDIT vil SBi foreslå, at Danmark satser på følgende bestræbelser og initiativer, som kan realisere intentionerne med CREDIT om fremme af international benchmarking til udvikling og forbedring af byggeriet:

- At (videre) udvikle indikatorer for brugertilfredshed på veldefinerede områder og i sammenhæng med nye initiativer – nationalt som internationalt. Eksempelvis boliger, uddannelsesbyggeri, hospitaler og drift. Generelt vil byggeriets forskellige aktører have forskellige behov.
- At udvikle formålsbestemte indikatorer i overensstemmelse med CREDIT systemet. Det gælder eksempelvis det kommende arbejde med indikatorer vedrørende bæredygtighed i Green Building Council.
- At analysere hvorledes indikatorer kan understøtte udviklingen af det digitale byggeri og modsat, hvorledes brug af evalueringer og indikatorer, og evt. benchmarkingsystemer, kan fremmes i forbindelse med det digitale byggeri.
- At drøfte internationalisering af evalueringer og indikatorer med større internationalt arbejdende virksomheder, der arbejder i Danmark. Eksempelvis NCC, Skanska, Rambøll, Cowi, andre rådgivere og entreprenører og ejendomsselskaber.
- At skabe større synlighed om brugen af indikatorer hos bygherrer og driftsherre virksomheder, og de positive resultater, det kan give. Et vigtigt spørgsmål for den videre udvikling er, hvordan evalueringer og benchmarking kan bidrage til ændret adfærd. Eksempelvis ved brugen af data fra egne eller andres byggerier og driftsopgaver.
- At udbygge eksisterende benchmarkingsystemer så de bliver grænseoverskridende frem for at etablere nye systemer. Det kan ske på en række måder som nævnt ovenfor under benchmarkingsystemer.

Behov for et bredt samarbejde

For at løse disse opgaver og sikre sammenhængen mellem løsningerne er der behov for et bredt samarbejde mellem potentielle drivkræfter og interessenter.

SBi finder, at en mulig arbejdsdeling kunne være:

- *Erhvervs- og Byggestyrelsen* og *Indenrigs- og Socialministeriet* opstiller lovgivnings- og udviklingsmæssige rammer for brug af indikatorer og evaluering, der er baseret på resultaterne af CREDIT. Rammerne vil for eksempel kunne komme i spil hos statslige og almene bygherrer, ved brug af offentlige private innovationspartnerskaber om udviklingsopgaver og ved gennemførelse af spydspidsbyggerier.

– *Byggeriets organisationer* tager (nye) initiativer til videreudbygning, professionalisering og internationalisering af (del) benchmarkingsystemer, der følger op på CREDIT systemet.
– *Udviklingsinstitutioner* undersøger i fortsættelse af CREDIT og i et samarbejde med den danske referencegruppe, hvordan bygherrer og virksomheder udnytter benchmarkingsystemer og i relevant omfang, hvordan partnerne kunne øge udnyttelsen.
– *Virksomhederne* spiller ved et SBi seminar ud med deres behov indenfor potentielle indsatsområder, muligheder for at bidrage til indsamling og præsentation af data og foretrukne form for organisering.
– De etablerede *benchmarkingsystemer* analyserer præsentationen, synligheden og brugen af deres ud-data, og hvorledes de ændrer adfærd hos modtagerne, jf. ovenfor om udviklingsinstitutioner.
– *Brugerne* med Bygherreforeningen, Kommunernes Landsforening, Danske Regioner og andre offentlige bygherrer samt Boligselskabernes Landsforening i centrum følger op med en bred information om CREDIT og en videreudvikling af bygherrers og brugeres fordele ved anvendelse af indikatorer og benchmarking.

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Appendix D: LTH proposals for Sweden - in Swedish

Bygg- och anläggningssektorn spelar en väsentlig och ofta avgörande roll för samhällsutvecklingen. Företagsetableringar, byggande av bostäder, skolor, kontor och vårdinrättningar är några av de områden som är starkt beroende av utvecklingen inom bygg- och anläggningssektorn. Därför är det viktigt att de byggnader och anläggningar som uppförs och drivs uppfyller brukarnas, ägarnas och samhällets behov. Svenskägda företag verksamma i byggsektorn konkurrerar i ökad grad på en internationell marknad och beställarna i Sverige riktar sig allt oftare till internationella entreprenörer. Konkurrensförmågan hos byggsektorns företag är starkt beroende av det finns analysmetoder som kan appliceras då företagen skall utveckla sin verksamhet. Då är särskilt viktig att skaffa sig kunskap om brukarnas behov och hur värde skapas för brukarna genom den byggda miljön.

Då forskningsprojektet CREDIT startades hösten 2007 var intresset i Sverige för indikatorer och benchmarking- system mycket begränsat. Den svenska insatsen beviljades mot bakgrund av detta ett lägre belopp än övriga nordiska länder. Engagemanget vid de referensgruppsmöten som genomfördes under våren 2008 hade dock förändrats och det fanns hos de flesta av dem som deltog i referensgruppsmöten ett påtagligt engagemang för indikatorer och benchmarking. På uppdrag av FIA genomför LTH kontinuerligt en studie av förändringen inom anläggningssektorn och BQR har initierat ett nyligen startat program för utveckling av byggprocessen. Några system med speciella syften förekommer i Sverige som kan betraktas som benchmarking-system (organiserade exempelvis av SABO och REPAB).

Inom ramen för ett nordisk/baltiskt forskningsprojekt, CREDIT, har utvecklats ett system med indikatorer som skapar större transparens för såväl brukare som företag. Projektet ger genom en rad av exempel på hur indikatorerna har används i nyproduktion, drift, underhåll, ombyggnad samt i några benchmarking system.

Resultatet av det mer än 2–åriga forskningsprojektet CREDIT bidrar till utvecklingen av byggande av brukarens roll o byggandet genom att visa på möjligheterna med vanligare användning av utvärdering och erfarenhetsåterföring där brukarnas och ägarnas behovs tillfredställelse sätts i fokus. Det gäller bostäder, sjukhus, skolor, kontor och produktion i allmänhet. Utvärderingarna kan utföras på många sätt men indikatorerna är en förändringspunkt. Öppningen mot brukarnas skall ses i sammanhang med andra aktörer i byggprocessen såsom beställare (byggherrar), myndigheter och företag samtidigt får bättre möjlighet att utvärdera sitt eget arbete.

Med CREDIT-konceptet kan utvärderas såväl själva byggnaden som processen för byggande och förvaltning dvs hela livslängden. Resultatet kommer att vara bidra till utvecklingen av byggnaden och processerna (byggande och förvaltning).

Bakgrund till förslaget

Detta förslag är utarbetat vid Construction management, Lunds Universitet, den svenska representanten i CREDIT- projektet, och baserat på erfarenheterna från CREDIT- projektet och de däri redovisades 28

fallstudierna. Erfarenheter som kommit fram vid referensgruppsmöten som genomförts med representanter för bostäder, skolor/kontor samt sjukhus utgör en annan viktig utgångspunkt.

Indikatorer utgör en förändringspunkt

Utgångspunkten för utvärderingar enligt CREDIT- koncept utgörs av ett omfattande system av indikatorer. *Systemet av indikatorer är uppdelat i sju huvudgrupper som täcker skilda delar av byggnaden och byggprocessen.* Det ger en ram för samsyn av användningen av indikatorer och en helhetssyn på byggande och förvaltning.

En viktig inspirationskälla och kvalitetssäkring av arbetet har de 28 fallstudierna av byggande och förvaltning i de nordiska/baltiska länderna utgjort. De avspeglar de viktigaste kategorierna av byggnader och initiativrika användargrupper. Parallellt är indikatorerna sammanhållna av byggregler i respektive land, internationella standarder och forskningsrapporter. Det har konstaterats en god överensstämmelse mellan dessa källor och det föreslagna systemet. Systemet behöver vidareutvecklas och operationaliseras, särskilt bör brukarmedverkan bearbetas ytterligare.

Mot bakgrund av de 28 fallstudierna har erfarits att nyttjandet av indikatorer bestäms av den aktuella situationen och de parter som agerar i situationen. Exempel på faktorer som kan förväntas påverka aktörernas konkreta nyttjande av indikatorer är följande: Syfte med utvärdering, byggnadskategori, beställare, brukare, företag organisation och olika skeden av bygg- och förvaltningsprocessen.

Det samlade systemet af indikatorer understödjer utvecklingen mot ett större brukarinflytande och att större vikt läggs på utveckla byggnadens bidrag till verksamheten i byggnaden. Så vitt vi vet är det första gången olika aspekter på byggnad och byggprocess är samlat i ett system av indikatorer.

I ett internationellt perspektiv kommer det viktigaste målet för det vidare arbetet att vara följande:

– Att komplettera och utveckla de väsentligaste indikatorerna och mätmetoderna.
– Att bygga ut och utveckla existerande nya benchmarking system.
– Att harmonisera dessa på avgränsande område på över regionala och nationella gränser.
– Att förankra benchmarkingen i företag och byggande.
– Att bidra till en stark utveckling och förbättring av byggandet
– Att det nordisk/baltiske system av indikatorer på längre sikt kan bidrag till ett större internationalt samarbete om brukartillfredsställelse vid byggande.

Benchmarking vägen till dialog och utveckling

I de studerade fallen finns fler exempel på benchmarking system. De är etablerade med bestämda syfte och har var och en specifik bakgrund, uppgift och syfte. Exempelvis varierar målgrupp, incitament, tillståndsgivning, organisation, registrering af data, användning av resultat och offentlig af resultat och offentligt.

Det har även konstaterats att det är viktigt att det finns incitament för att delta i systemet såsom att lämna och hämta information. På samma sätt bör såväl indata som utdata vara lätta att skaffa och använda.

Den viktigare drivkraften vid etablering av benchmarking system synes att vare konkrete problem som byggskador, ineffektiva processer och behov av mer rationell drift. Vidare har det varit en utveckling där såväl insamling av information som användning av information och synlighet har utvecklats.

Några system har givet markanta resultat i form av ändrad utformning och färre byggskador i processen (exempelvis i Danmarks bostadsbyggande) och ändrad process. Ett genomgående drag tycks vara att behov en större kunskap om användningen av resultatet. Exempelvis vid en större transparens om beställarens och verksamheten användning internt av system och deras inbördes kommunikation från idé till brukarnas användning av byggnaden.

Generellt kan utbyggnaden av benchmarking system – nationellt och internationellt – kunna ske på en många olika sätt. Exempelvis vid ett tätare samarbete för att säkra gemensamma definitioner, utbyggnad av existerande former för registrering av information till benchmarking

Det är naturligtvis förenat med stora svårigheter att etablera ett internationellt samarbete baserat på befintliga system och det skulle kräva omfattande harmonisering av indikatorerna i benchmarking systemen och en koordinering mellan de aktuelle systemens struktur. Ett dansk- norskt samarbete inom området drift av byggnader och byggskador visar att det är möjligt att lösa problemen. En tredje möjlighet för öppning med en internationell benchmarking är, att internationellt arbetande företag som går i spetsen för utvärdering över gränserna och öppna företagens egna system.

Mätmetoder

I CREDIT- projektet har många olika metoder att mäta aktuell värde av för en indikator iakttagits. För några indikatorer är väl specificerade kvantitativa metoder , för andra finns karaktärsskalor i mycket varierande utformning för en stor del inga metoder. Bortsett från de metoder som är beskrivna i internationella standarder eller harmoniserade på annat sätt finns det även stora skillnader i mätmetoder från land till land.

Den internationale utvecklingen kommer för en rad av indikatorer för vilka det inte föreligger avtalade mätmetoder i första omgången röra sig om att skapa enighet om den information som bör föreligga. Ett exempel på fastighetsområdet där det finns en etablerade systematik gällande den information som karaktäriserar en fastighet och som är viktiga för att handel med fastigheten skall kunna genomföras.

Mätmetoder kan användas i driftssituationer till at registrera brukarnas uppfattning av byggnadens användning.. Exempelvis akustik, inneklimat och energibesparning. Erfarenheterna kan användas till handlingsplaner som kan bidra till bättre nytt byggande.

Brukarna kan ges en starkare ställning

Genom att inarbeta indikatorer i den praktiska projektering, byggande och förvaltning skapas förutsättning för större synlighet om resultatet och bättre möjlighet för genom benchmarking att jämföra byggstandarder nationellt och internationellt Det kommer att ge brukarna en starkare ställning.

För att utnyttja denna möjlighet finns det emellertid behov av öppenhet, riktlinjer och kvalitetssäkring av uppmätta värden för indikatorer. Denne utveckling är i viss omfattning redan igång i Norden. Exempelvis inom området byggskador i Danmark och nyckeltal för byggprocessen.

Det bör även övervägas om det kan etableras en större avvändning av existerande benchmarking system. Exempelvis genom att skapa en bättre koppling mellan driftsdata och projektering av byggnader.

På lång sikt är det fråga om det kan etableras kopplingen mellan skilda benchmarking system. Här vill CREDIT-konceptet av indikatorer kunna tjäna som vägledning för utvecklingen av internationella benchmarking system inriktat på skilda specifika syfte

Fortsatt arbete

Mot bakgrund av det genomförda projektet CREDIT föreslås följande utvecklingsinsatser i syfte att främja byggsektorns utveckling med hjälp av ett internationell benchmarking system:

– Att vidareutveckla indikatorer för brukaretillfredställelse på väl definierade områden och i sammanhang med nye initiativ – nationellt som internationellt. Exempelvis bostäder, skolor, sjukhus och drift. Generellt har olika aktörerna olika behov och formulerar de dessutom olika.

– Att utveckla indikatorer i överensstämmelse med CREDIT systemet inriktade på specifika byggnader och anläggningar. Det gäller exempelvis det kommande arbetet med indikatorer rörande hållbarhet i Green Building Council.

– Att analysera hur indikatorer kan stödja utvecklingen av BIM respektive hur tillämpningen av utvärderingssystem och indikatorer och benchmarking kan utveckla användningen av BIM.

– Att diskutera internationalisering av utvärderingar och indikatorer med större internationellt arbetande företag NCC, Skanska, Rambøll, Sweco, WSP, Atkins och andra konsulter och entreprenörer och fastighetsbolag.

– Att skapa större synlighet om användning av indikatorer hos byggherrar och företag och de positiva resultat detta kan ge En viktig frågeställning som bör vidareutvecklas är hur utvärdering och benchmarking kan bidra till ändrat genomförande. Exempelvis genom att använda av information från egna eller andra byggen eller förvaltningar. Att bygga existerande benchmarking system så de blir gränsöverskridande I stället för att etablera helt nya system. Det kan som tidigare nämnts ske på en rad olika sätt.

– Att bygga upp kunskap om brukarnas behov och hur brukarnas behov kan fångas.

Behov av brett samarbete

För att löse uppgifterna och säkra sammankopplingen mellan lösningarna finns det ett behov av ett brett samarbete mellan potentiella drivkrafter och intressenter. Mot bakgrund av erfarenheterna från CREDIT är aktiviteter aktuella:

– Offentliga beställare ges i uppdrag att vidareutveckla och rutinmässigt använda indikatorer och benchmarking system baserat på resultatet av CREDIT.

– *Byggbranschens organisationer med Byggherrarna rekommenderas ta initiativ till utveckling av*, professionalisering och internationalisering av benchmarking system som följer upp CREDIT konceptsystemet.

– *En undersökning inriktad på studie av användning av CREDIT påbörjas i samarbete övriga nordiska forsknings-institutioner. Då bör studeras hur byggherrar och företag utnyttjar benchmarking och indikatorer och vilka faktorer som påverkar omfattningen av utnyttjandet.*

– *Medverkan av företagen i ett seminarium/konferens arrangerat av Construction Management där företag beskriver sina behov av*

benchmarking system och möjligheterna att bidra till insamling av nödvändig information och hur användning av benchmarking-system skall organiseras.

– *Brukarna genom BQR och Byggherrarna tar initiativ till* en bred information om CREDIT och en vidareutveckling av byggherrars och brukarens fördel med användningen av indikatorer och benchmarking.
– Kopplingen mellan indikatorer och brukarnas krav bör studeras.

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Construction and Real Estate -
Developing Indicators for Transparency

This report summarises the work undertaken in the CREDIT project and proposals for how to implement the CREDIT framework. It is the final part of the Nordic/Baltic project CREDIT: Construction and Real Estate – Developing Indicators for Transparency. The report presents the objectives and the research model for CREDIT followed by a summary of the results of CREDIT Reports 2, 3, 4 and 5. The conclusive part of the report presents national recommendations of how to implement the CREDIT framework in the Nordic/Baltic countries Denmark, Finland, Norway, Sweden, Iceland, Estonia and Lithuania.

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