

## Developing Indicators for Transparency and International Benchmarking in Construction and Real Estate Industry

Porkka, Janne; Huovila, Pekka; Bertelsen, Niels Haldor; Haugbølle, Kim

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# Developing Indicators for Transparency and International Benchmarking in Construction and Real Estate Industry

Porkka, J.

VTT Technical Research Centre of Finland  
(email: janne.porkka@vtt.fi)

Huovila, P.

VTT Technical Research Centre of Finland  
(email: pekka.huovila@vtt.fi)

Bertelsen, N.H.

Danish Building Institute, Aalborg University  
(email: nhb@sbi.dk)

Haugbølle, K.

Danish Building Institute, Aalborg University  
(email: khh@sbi.dk)

## Abstract

CREDIT (Construction and Real Estate - Developing Indicators for Transparency) was a 27 month research and development project (2008-2010) that aimed at improving transparency on value creation in real estate and construction. Its objective was to develop methods and tools that support the identification and understanding of user needs and the interpretation of these needs as requirements for building performance. CREDIT has developed a comprehensive performance assessment and management framework with Key Performance Indicators (KPIs) to measure and verify the compliance of performance in use throughout the lifecycle of buildings. It also drew recommendations as to how sectoral, national and international benchmarking of construction and real estate may be carried out. This paper describes the CREDIT performance indicator framework, shares findings from implementing different benchmarking schemes and analyses experiences from implementation of CREDIT indicators in pilot projects. The challenges of achieving true value metrics and to do successful cross border benchmarking are discussed.

**Keywords:** key performance indicators, performance, value creation, case studies, cross-border benchmarking

# 1. Introduction

Providing complex public facilities, such as hospitals, schools and universities that meet both the internal and external stakeholders' needs and requirements is not without complications. The aims and demands of different stakeholders within a project can sometimes create conflict with each other's interest. Understanding the needs and requirements of these stakeholders are essential to staying competitive in today's market environment. A client who pays attention to the needs of the end-users can be rewarded with a high-performance property. Simultaneously, this shift seeks to solve many drawbacks associated with inadequate building conditions and resulting in poor building serviceability. Due to the amount of both public and private money being invested in delivering public and private facilities, decisive measures must be adopted. Collaboration with the relevant stakeholders will help building owners in identifying the required performance indicators to create high-performance facilities. (Bertelsen et al, 2010b)

This paper describes the work undertaken in CREDIT project (Construction and Real Estate - Developing Indicators for Transparency) that was finished early 2010. The project developed methods and tools that support the identification and understanding of user needs and the interpretation of these needs as requirements for building performance. The approach also allows continuous measurement of the effectiveness of the applied requirements and the model as such so that it may be improved as more knowledge and experience of it is achieved.

The project was based on collaboration in five Nordic and two Baltic countries giving a solid and evidence-based transparent ground for communicating results and improving the competitiveness of construction and real estate business. These results have been achieved through active cooperation between the most prominent research institutes within benchmarking and performance indicators in construction and real estate SBI (Denmark), VTT (Finland), SINTEF (Norway) and Lund University (Sweden), and partners from Iceland (The Icelandic Center for Innovation), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

We see many impacts of the project for construction and real estate on a national and European level. The work increases understanding of end user needs and satisfaction to client's performance requirements. Further, the methods and tools considered in the research for cost and value enhance transparency of products and services in both national and international level. This transparency may also be used for comparing neighbouring countries. These experiences during the project are also building a more solid and evidence-based ground to launch new public policies to improve the competitiveness of construction and real estate business. (Bertelsen et al, 2010b)

This paper provides a sectoral view to benchmarking from varied building types and is organized as follows. First, the benchmarking model of CREDIT is described. Second, the indicator classification for managing performance indicators to identify end user needs and value creation in real estate and construction is described. Third, we introduce the set of Key Performance Indicators (KPIs) that were selected based on findings from the case studies addressed in the project. Next we also explain our

findings from these 28 case studies. Finally, we draw recommendations for using these KPIs in a cross-border benchmarking pilot to office buildings in Norway and Finland.

## 2. The CREDIT indicator and benchmarking model

### 2.1 The product model

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

An important part of the project was the development of a model. We see that the design of building concerns two interlinked designs; internal space and rooms with different functions, and building parts as an envelope for the rooms and an external climate protection for the activities in the building. The product model in CREDIT looks primarily at the following three physical segments in the product model; the building parts and components, the building and internal spaces and rooms, and the location of building site, city, region and country. We analyse them from inside out as well as from outside as shown in Figure 1.

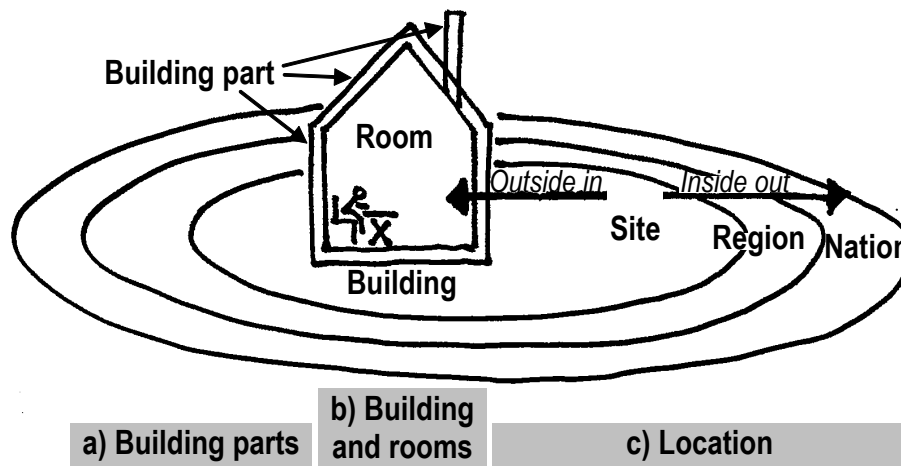


Figure 1: Product model in CREDIT showing linkage between different segments.

### 2.2 Performance indicator classification

The performance classification framework developed in a 'gross' inventory of indicators relevant in relation to the building and real estate sector in the seven Nordic and Baltic countries: Denmark,

Finland, Norway, Sweden, Iceland, Estonia and Lithuania. The content is based on the findings from 28 case studies in the project as well as on the input from national building regulations, different national or international standards and research studies. The performance indicator framework has been developed as an iterative process in parallel to the case studies, experiences from assessing methods and tools, and collecting feedback from enterprises on the application of benchmarking in their organization.

These promising results have been comprised to a structure of performance indicators in seven independent categories (Bertelsen et al, 2010a). The first category is on costs and price through the life cycle of the building, while the next five categories address performance from various perspectives: location, buildings, building parts, facility management and the design and construction process. They all include both an objective for measurable performance indicators and indicators addressing less measurable properties such as end-user experiences. The last category deals with impact of the building on external environment, social life and economy. Each of the seven main categories is divided to groups that contain an increasing level of detailing ending up with about 200 indicators (see Table 1).

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

Table 1: CREDIT performance indicator classification framework, seven main categories and groups beneath.

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

An example of indicator assessment is the Danish energy labelling system. Data on what the building consists of, how well it is insulated and the convective properties of the building components are collected by inspections of the building and the drawing material. This data forms the basis for the calculation (processing and evaluation in Figure 6) of the buildings energy consumption. Output data is the calculation presented as classes ranging form A – G.

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

## 2.3 Selection of key performance indicators

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

We have tested the applicability of these indicators in a CREDIT cross-border benchmarking pilot. The pilot tested a short list of 36 indicators to compare six office buildings in Norway and Finland. From the building owner and client perspective a set of 10 KPIs is proposed in Table 2 (Bertelsen et al., 2010a). Other proposals may be prepared in the future as alternatives and for other purposes to accommodate for different needs and wishes for benchmarking.

*Table 2: A set of 10 Key Performance Indicators selected from CREDIT performance indicator classification framework for cross-border benchmarking pilot.*

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

### **3. Findings from case studies and cross-border benchmarking pilot**

This chapter describes how indicators are assessed and benchmarked in enterprises, building projects and international benchmarking systems. First, we describe findings from 28 case studies from Porkka et al (2010) addressing the common interest for indicators in case studies in Nordic and Baltic countries. The CREDIT case studies are distributed to different building types; 4 benchmarking systems and indicators, 7 office buildings, 8 housing cases, 5 school and nursery buildings, 3 shopping centres, and one hospital building. Then, we also introduce a cross-border benchmarking pilot implemented to office buildings in Finland and Norway. We also discuss about the challenges of achieving true value metrics and to do successful cross border benchmarking.

#### **3.1 Findings from case studies**

There are some good practices for benchmarking in large scale. At the moment, those are addressing mostly process and investment indicators, and do not yet cover performance indicators. Front-runner enterprises are already recognizing the potential of benchmarking, rating to highest class may increase interest from investors and building owners. Otherwise, some national and international rating systems are available in the market.

Few frontline owners are already using cost and performance indicators in daily operations, such as Senate Properties in Finland and Statsbygg in Norway. Their focus is mostly directed to investment, costs, and energy efficiency. Altogether, it seems that systematic procedures are needed in the industry for evaluating performance and compliance to end result to needs.

There is no commonly agreed or standardized global or European Key Performance Indicator system, but some national and international rating schemes are available. During the past five years the number of rated buildings has grown greatly, and motivation for using those is increasing.

Market signals are also showing paradigm shift towards end user involvement, and standardized methods for involving end users and making continuous monitoring of satisfaction should be agreed. When committing end users, they need help in order to be able to contribute in value adding way. Workplace management in office buildings is used for tailoring spaces better to end user needs. Senate Properties in Finland develops services where spaces are a strategic asset that can help to contribute an organizational change.

National and international indicator systems do not cover all important business matters and companies are developing their own systems. Some contractors have been developing national systems for process performance monitoring. Indoor environment is important in shopping centres, and performance level for spaces is an opportunity to owner to enhance cash flow through rental agreements. In the future, building automation systems could provide real-time monitoring of



performance indicators continuously contributing changes automatically to reach desired performance.

Organizations are looking for an indicator system that could help them to measure and enhance performance of buildings. Apparently some indicators are more important than others; regulations for accessibility have become tighter, location is still the core driver, common interest towards operations and reducing annual energy consumptions is growing. There is potential to improve energy efficiency of buildings. Indicator systems should be implemented in tools to encourage usage in projects; those processes are now rather manual. Building Information Models (BIMs) may be suitable tool for managing those more automated way. Based on findings in CREDIT project, offices and shopping centres are most attracting building types in terms of benchmarking.

### 3.2 Cross-border benchmarking pilot in Nordic countries

During the last quarter of the CREDIT project a cross-border benchmarking exercise was carried out in six offices (Figure 2) in Norway and Finland (Huovila et al, 2010). The Norwegian part was implemented by SINTEF at Skattens Hus (Skanska as main contractor) and Statistics Norway (Statsbygg), while the Finnish projects were collected by VTT at Lappeenranta and Vuorimiehentie 5 office buildings (Senate Properties), Tulli Business Park (NCC Finland) and Baltic Sea House (Sponda/Ovenia). Besides these six cases, Senate Properties in Finland wanted to test indicators also in one of their recent projects – the office building at Hakaniemenranta 6. Hakaniemenranta was a very challenging project, some years back the building was voted to the ugliest building in Helsinki. Multiple methods and tools were used during the development project; Building Information Models (BIMs) and workplace management to mention few of those.



Figure 2: Six office buildings from Norway and Finland used in cross-border benchmarking pilot (Huovila et al, 2010)

The indicator set that was assessed comprised ten KPIs, which were selected based on case experiences and other relevant indicators. Altogether, these indicators gave a great overview and included enough challenges that had to be solved in developing an indicator system. On the other hand this pilot also pointed out that it's not an easy task to develop an indicator system that is applicable for international use. We managed the cross-border benchmarking data with web-based benchmarking tool (Huovila et al, 2010). The benchmarking system provides tools for indicator storage, management, benchmarking and analyses. Further, it also provides reporting functions for the building stock or trends in the building stock. When the data from cases was added to the system, we perceived that the user interface is very important and has influences the motivation of users. Therefore, VTT added map-user interface to the tool. One screenshot from tool demonstration is presented in Figure 3, and the user may select the buildings from the map to access the indicator data. The system also enables users to see the cross-section of the building stock and consider trends.

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

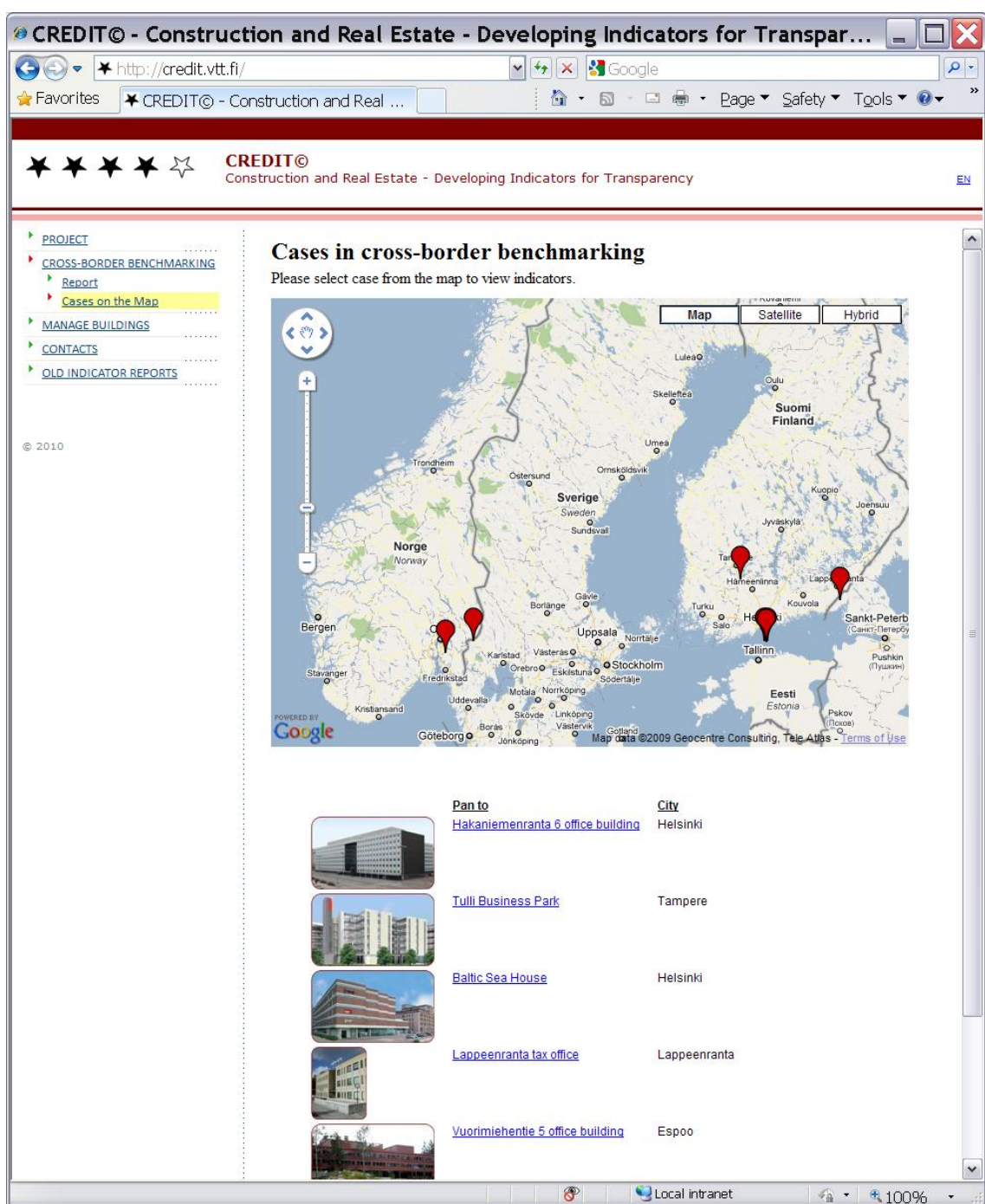


Figure 3: Screenshot from web based cross-border benchmarking tool (Huovila et al, 2010).

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

## **4. Conclusions**

This paper has presented the sectoral view to benchmarking from the CREDIT project. Our goal has been to improve transparency on value creation in construction and real estate industry through methods and tools that support the identification of user needs for building performance.

First, we have explained our research focus on benchmarking from product perspective. Then, based to earlier, the CREDIT performance indicator classification system that builds up from seven independent facets to aggregate about 200 indicators was introduced. The classification was developed in parallel to research in 28 case studies on existing benchmarking systems, ON various types of firms, like clients and contractors, and on different types of buildings like offices, housing, schools and nursery, shopping centres and hospitals.

However, the case studies have also shown that built environment gives value for the end-users, and a lot needs to be changed until the end-users are actively involved in projects. Yet they are rather undervalued stakeholders. Third, we draw conclusions from the case studies and based on the findings, we formulated a set of 36 performance indicators that we tested in the cross-border benchmarking pilot of six office buildings. The results from this exercise were encouraging.

Enterprises are benchmarking indicators to some extent but systematic process has not yet been developed and a uniform indicator system considering also building performance and value creation is missing. We foresee that the work may direct actors to increasingly consider building performance and value creation. Therefore, we propose that actors define several sets of performance indicators based on their specific needs and requirements.

To conclude, we see that the project has improved understanding of end user needs, performance indicators and international benchmarking. It also has created a solid and evidence-based transparent ground for communicating results and improved the competitiveness of the construction and real estate business.

## **Acknowledgement**

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