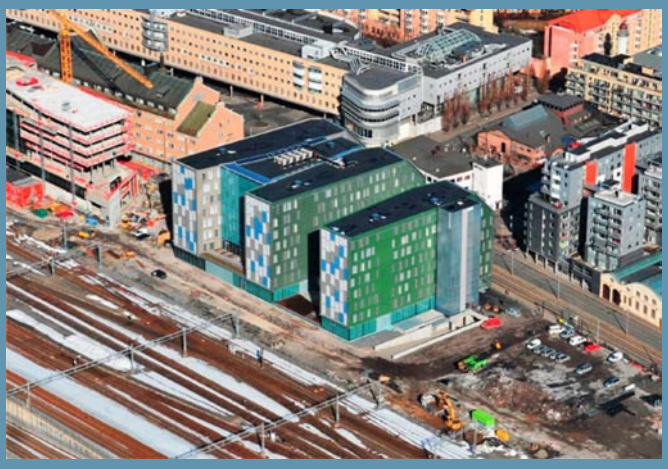
SBi 2010:37

# Skattens Hus, Oslo

## CREDIT Case NO04



Danish Building Research Institute
AALBORG UNIVERSITY

CREDIT©

Construction and Real Estate -
Developing Indicators for Transparency

# Skattens Hus, Oslo

CREDIT Case NO04

Dag Fjeld Edvardsen
Ole Jørgen Karud

SBi 2010:37
Danish Building Research Institute, Aalborg University · 2010

SINTEF

| | |
|---|---|
| Title | Skattens Hus, Oslo |
| Subtitle | CREDIT Case NO04 |
| Serial title | SBi 2010:37 |
| Edition | 1 edition |
| Year | 2010 |
| Authors | Dag Fjeld Edvardsen, Ole Jørgen Karud |
| Language | English |
| Pages | 21 |
| Key words | Skattens Hus, Oslo, building, enterprises, benchmarking |
| ISBN | 978-87-563-1449-7 |
| Photos | Skanska |
| Cover | Skanska |
| Publisher | Statens Byggeforskningsinstitut<br>Danish Building Research Institute, Aalborg University<br>Dr. Neergaards Vej 15, DK-2970 Hørsholm<br>E-mail sbi@sbi.dk<br>www.sbi.dk |

Extracts may be reproduced but only with reference to source: *Edvardsen, D. F & Karud, O. J. (2010). Skattens Hus, Oslo. CREDIT Case NO04 (SBi 2010:37). Hørsholm: Danish Building Research Institute, Aalborg University.*

# Contents

# Preface

This report describes the results of a case study undertaken as part of the Nordic/Baltic project *CREDIT: Construction and Real Estate – Developing Indicators for Transparency*. The case study is part of the work in work package 4-6 with respect to project assessment tools, application in firms and national benchmarking systems.

CREDIT includes the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi/AAU (Denmark), VTT (Finland), Lund University (Sweden) and SINTEF (Norway). Further, three associated partners have joined CREDIT. 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:
- Kim Haugbølle, SBi/AAU (project owner).
- Niels Haldor Bertelsen, SBi/AAU (project coordinator).
- Päivi Hietanen, Senate Properties (chair of Finnish steering committee).
- Pekka Huovila, VTT.
- Ole Jørgen Karud, SINTEF.
- Magnus Hvam, SKANSKA.
- Bengt Hansson, Lund University.
- Kristian Widén, Lund University.

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

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

*Niels-Jørgen Aagaard*
Research director

# Summary

This report describes the case study of the usage of key indicators in relation to the Skattens Hus in Oslo. The study was undertaken as part of the Nordic and Baltic project CREDIT: Construction and Real Estate – Developing Indicators for Transparency.

The analysis aims at three levels: the project or building, the firm and the national benchmarking system.

*Buildings (WP4)*
"Skattens Hus" is located in the centre of Oslo and is the new head quarter for the Tax authorities in Oslo.

A questionnaire to evaluate the CREDIT indicators is shown in Chapter 5. The values here show the importance the project manager puts on the different indicator.

*Enterprises (WP5)*
All Skanska projects use the Falk management system (see chapter 4).This is a very useful tool, both for collecting data and continuous assessments. Falk has different access levels. In addition to the Falk system, projects always makes a final project report which describes its process, experiences and special conditions. The reporting into the Falk system is Skanska internal. Different kinds of information are reported with different frequencies.

*National Benchmarking (WP6)*
Skanska does not currently take part in any national benchmarking activities.

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

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

# 1. Introduction and objectives

This chapter describes the objectives of the CREDIT project, the background, scope and purpose of the case study of search engines for private homes, and the research design of the study.

## 1.1 Objectives and work packages of CREDIT

Sir Winston Churchill once said, “We shape our buildings, afterwards our buildings shape us” (28th Oct 1943). This quotation underlines how strong a building can influence an occupier or a user. Providing complex public facilities for example hospitals, schools, universities and libraries that are able to 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 remain competitive in today’s market. A client that pays attention to the needs of the end-users will be rewarded with a high-performance property. Simultaneously, this shift seeks to solve many ills associated with inadequate building conditions and resulting in poor building function.

Due to the amount of both public and private money being invested in delivering public and private facilities, strong actions must be adopted. Collaboration with the relevant stakeholders will help building owners in identifying the required performance indicators to create high-performance facilities. The project aims to define a model for the implementation of performance requirements, which ensure the fulfilment of the various types of users’ and stakeholders’ needs and demands. The model shall also allow for the continuous measuring of the effectiveness of the used requirements and the model as such so that it may be improved as more knowledge and experience of it is achieved.

Following the themes of the ERABUILD call closely, the aim of CREDIT is to improve transparency on value creation in real estate and construction. Thus, the objectives of CREDIT are:

– To capture end user needs and requirements in order to identify and quantify – where possible – value creation in real estate and construction.
– To develop compliance assessment and verification methods.
– To define and develop benchmarking methods and building performance indicators in real estate and construction.
– To set out recommendations for benchmarking internationally key building performance indicators.

Consequently, the deliverables of CREDIT are:

– 1. The establishment of a network of Nordic and Baltic researchers for benchmarking and performance indicators through frequent interactions in workshops across the Nordic and Baltic countries.
– 2. A State-of-the-Art report, that will identify and critically examine a number of existing tools, databases, mandatory reporting, approaches and benchmarking schemes to capture and measure end-user needs, client and public requirements on 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 requirements and to continuously measure and verify the compliance of performance throughout the lifecycle of an actual building project and linked to building information models.
– 5. Recommendations as to how sectoral and/or national indexes for performance indicators can be designed in order to allow for international benchmarking of construction and real estate.
– 6. Dissemination of the lessons learned and tools developed through news articles, press releases, workshops with actors in the real estate and construction cluster etc.

## 1.2 Background, purpose and focus of the case study

This office building case from Skanska has been chosen, because it describes typical assessment methods used in Skanska. Compared to the other Skanska case: ”Stortorvet Shopping Centre”, it also shows that Skanska manages to keep on a common data collection and KPI-reporting system more or less independent of types of projects.

Skanska wants to establish a common performance management-system in the Nordics across the country borders and from land purchase to handover. That means that Skanska wants to link development-project with construction and define common KPIs in the whole value chain. In this context it is important to identify the right master-data.

## 1.3 Research design and methods applied in the case study

This case study has been carried out in collaboration between Skanska and SINTEF.

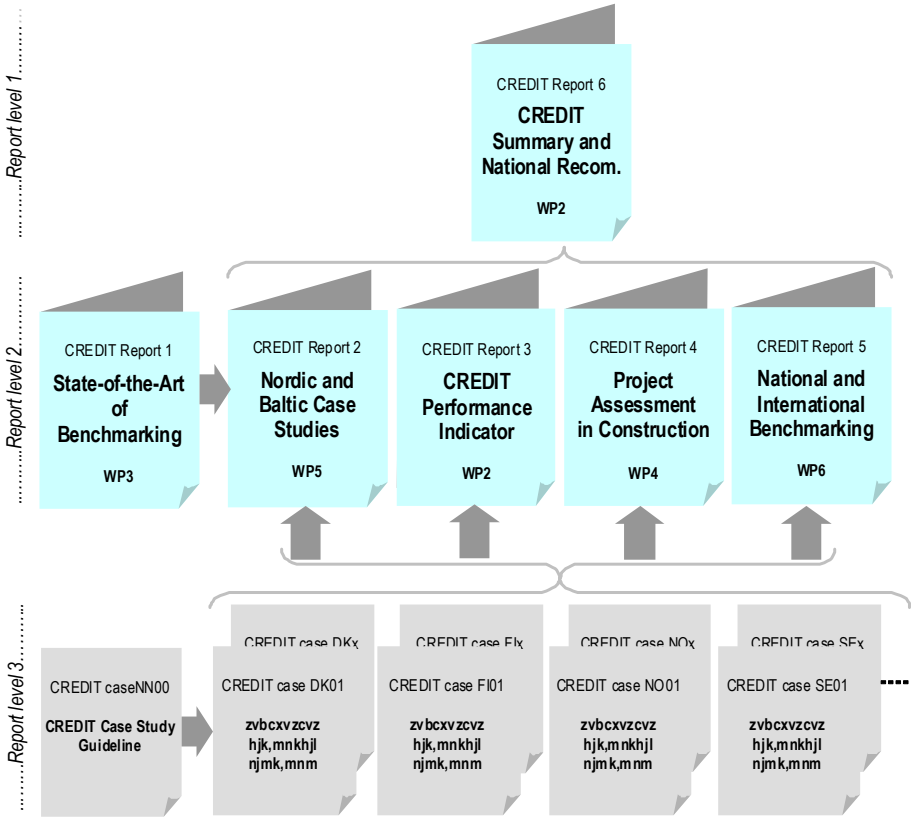
Information about the project, the Skanska Management System and the use of indicators, both in general and in this project, is based on interviews with chief controller, project controller and the project leader.

## 1.4 Reading instruction

This report summarises the case study of search engines as input to work package 4-6 of the CREDIT project. Chapter 2 in this report addresses issues relevant to WP4 on assessments at project level. Chapter 3 addresses issues relevant to WP5 on the application of assessments in firms. Chapter 4 addresses issues relevant to WP6 on sectoral, national or international benchmarking systems. Chapter 5 discusses and concludes on the lessons learned with respect to the three levels of projects, firms and systems.

The work of each work package (WP) is documented in various other reports, articles etc. Below, a graphical illustration of the hierarchy and linkages between the individual reports is given.

Figure 1. Graphical illustration of the hierarchy of the CREDIT reports.



# 2. Buildings – assessments in construction or real estate processes

This chapter is particularly relevant for WP4 and CREDIT Report 2 and focuses on the KPIs relevant for FM of a specific office building. It addresses questions related to how data and information about the building is collected, managed, evaluated and used.

## 2.1 The actual building, building parts and processes

Skattens Hus is located in the centre of Oslo and is the new head quarter for the Tax authorities in Oslo.

Some facts about the building and actors:

- Owner: ROM Eiendom
- End user: Tax authorities, Oslo
- Main contractor: Skanska
- Contract Value: 366 MNOK
- Size: 25 000 m2 gross area
- Type of contract: Design build
- Type of customer procurement: Tender / negotiated
- Building period: February 2007 – October 2008
- Project leader: Realutvikling
- Architect: Narud Stokke Wiig
- Consultants: Fredriksen, Hjellnes Cowi, ÅF Consult, NGI

Office Building is a distinctive office building with eight floors. The three blocks are developed with good flexibility. It is largely used prefabricated elements in the building.

The biggest challenge in this part of the town for Skanska and the rest of the project team was the ground conditions. It was soft clay almost 70 meter down to solid rock.

Figure 2. Skattens Hus, Oslo.


## 2.2 The applied assessment methods and tools in the processes

All Skanska projects use the same Falk management system; see chapter 4. This is a very useful tool, both for collecting data and continuous assessments. Falk has different access levels.

In addition to the Falk system, the project always makes a final project report which describes the process, experiences and special conditions.

The reporting into the Falk system is Skanska internal. Different kinds of information are reported with different frequencies:

- Economic progress is reported per month.
- Health, Environment and safety incidents are continuously reported.
- The client fills out a standardised template form when the project is finalized.
- The final project report is used as a guideline for new projects, but is not meant to be used as something to be carbon copied.
- The Falk system uses filters that information can be shown according to context/perspective (enterprise, project management, type of building).
- Falk is used by management, geographical regions, and country.
- However, information to the project management is provided from the accounting system.
- Benchmarking is done in relation to progress and quantitative measures of technical drawings.
- The client wants to measure Skanska based on physical aspects of the building actually delivered (for instance air flow through ventilation channels).

## 2.3 Cost and performance indicators applied in the assessments

Skanska has supplied information in a separate questionnaire (see appendix). Looking at the information provided for “Skattens hus” the following are used as the preferred indicators when it comes to measures during the building process:

- Category of building parts, quantity size, area
- Category of process, supplier and organisation
- Health, safety and work environment

In relation to measures when the project is finalized the preferred indicators are:

- Safety
- Thermal quality
- Impact on air quality
- Lightning quality
- Acoustic quality
- Resource control and project management
- Health, safety and work environment
- Environmental impact (emissions).

When finishing building projects in Skanska, they always make a final internal project report, which describes project facts, building process, results and experiences about:

- Short project description
- Project organisation
- Goal achievement (economy, quality, health/environment/safety, waste)
- Subcontractors and important suppliers
- Changes
- Deviations
- Important observations
- Experience figures from the production
- Building owners evaluation

The impression is that the most important indicators for the clients are related to no accidents and the environment.

The calculation department in Skanska is concerned with hours used per square meter. This is used then updating the cost calculations for future projects.

Skanska has several indicators related to Human Resources, for instance TPI (Team Performance Index) and GBI (Great Boss Index).

## 2.4 Relation to different enterprises and national benchmarking

The Falk system is used to simplify the communication with and reporting when it comes to a lot of the information that is required to send to governmental databases

Skanska’s main contribution to national benchmarking has been it’s participation in the Norwegian research project “Benchmarking in Construction 2” (see chapter 4). However, this research project took place before the Falk

system was operational (2001-2006) and had its main concern with blocks-of-flats.

## 2.5 Visions and innovation for future improvements

Today, the advantages with the Falk system are mostly for the management level. The project manager contributes a lot of data to the system, but does not currently use it for his/her own needs.

It is expected that the clients in the future will demand more detailed and frequent information when it comes to safety and environmental aspects.

Some information is still reported outside of Falk, but the ambition is that over time almost everything is reported inside of the system.

# 3. Enterprises – assessments and indicators internally applied

This chapter focuses on how Skanska use the Falk Management System throughout the organisation in Norway, how they report, assess the results and use indicators internally in their organisation to control and improve their business.

## 3.1 The actual enterprise, company and firm

Skanska is one of the worlds leading contractors with expertise in construction, commercial premises, housing and public-private partnerships (PPP).

Skanska's products and services in Norway cover:

- Infrastructure
- Private homes
- Public and private premises
- Surveying
- Technical contracts
- Prefabricated houses
- Steel products
- Public-private-partnerships (PPP)
- Project development.

Skanska Norway which is based in Oslo and the company builds on more than a hundred years of experience. The sales for Norwegian operations in 2007 were 11 billion NOK and the company employed about 4700 people.

The Skanska Group has globally about 60,000 employees in selected home markets in Europe, in the US and Latin America. Headquartered is in Stockholm.

In Skanska every business unit govern its own business. Skanska has different management and key indicator systems in all the Nordic countries, but there is a pan-Nordic initiative going on, because Skanska wants to:

- Connect the dots between the construction units in Finland, Sweden and Norway with Residential development Nordic.
- Get a better overview over knowledge and spread best practices.
- Minimize errors.
- Take advantage of the size in the market.

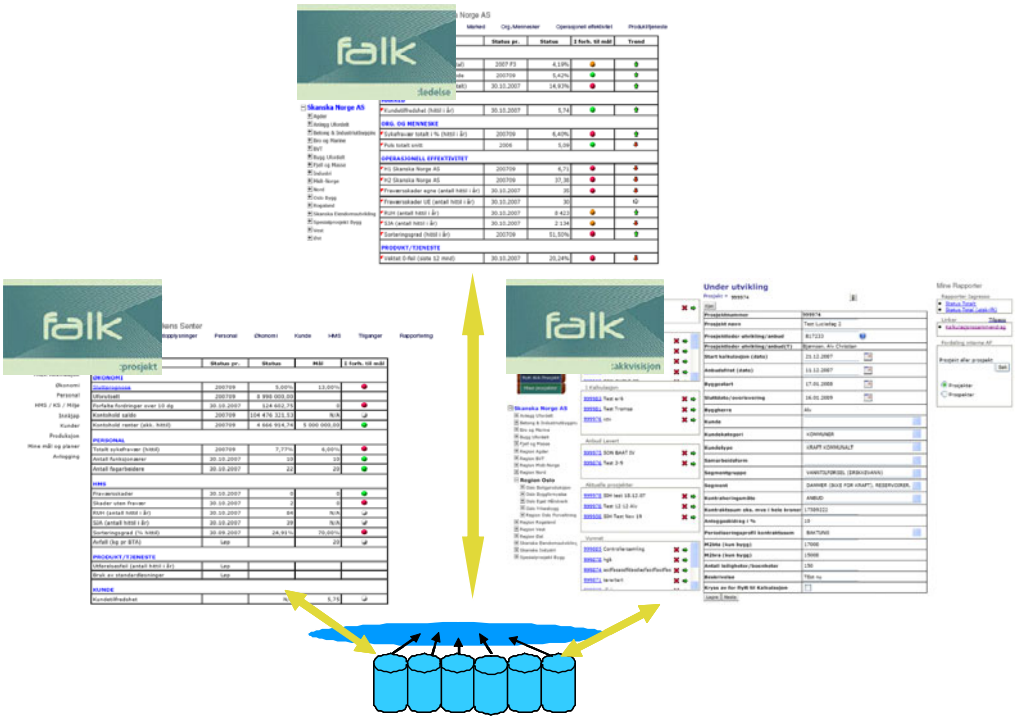
## 3.2 Assessment methods and tools applied in the enterprise

Skanska's management information system in Norway is called FALK. The purpose of this system is:

- All "relevant" management information and KPI's are gathered one place for all organizational levels.
- Consistence in all information and KPIs through the possibility to drill down to the project for all numbers.

- Effective input- and reporting-process through the setup of the system. All reporting on all levels in the organization have to report through FALK. Input is punched one place once.

Figure 3. Falk Management System.




The background and incitement for the Falk management information system was that the information was spread with low accessibility in many subsystems. Skanska felt for making a common way of doing business more effectively with more common key performance indicators and with a higher degree of consistency in master data from the different projects and parts of the company.

The work with a new management system began in 2004 and the goals were:

- All input and relevant management information gathered one place for all levels in the organization with full drilldown to underlying levels.
- Less time consumed to find status. That means more time to focus on the future and analyze trends. More easy to look for early warnings.

The effect of the Falk system will result in significantly fewer manual operations and formats. The leaders and controllers will have direct access to data through input/output at one place, which will give huge savings in time and motivation and full control over important aspects in the company. They will also see the same data in real-time.

On other effect will be possibility to execute corrective action based on deviations and trends.

The system will avoids distribution of reports etc via mail, fax and personal presence and time-consuming communication. It will be easy to just drill down in the system, to benchmark regions/districts, and sharing knowledge between parts of Skanska.

## 3.3 Costs and performance indicators applied in the enterprise

Skanska has objectives and main key numbers at both a company level and a project level.

The company level has main objectives and key indicators in these categories:

- Economy
    - EBIT
    - Not paid receivables
    - Cash flow situation
    - Profitability
    - Order reserve (12 months)
- Market
    - Customer satisfaction
- Organisation and employees
    - Total sick leave
    - Internal HR-survey
- Operation effectiveness and health / environment / safety
    - Injuries with absence (two different categories)
    - Waste sorting (%)
- Production and services

The project level has objects and key indicators in these categories:

- Economy
    - Final prediction
    - Unforeseen
    - Not paid receivables
    - Balance
- Staff
    - Total absence
    - Numbers of administrative staff
    - Number of specialized workers / craftsmen
- Health / environment / safety
    - Injuries with absence
    - Injuries without absence
    - Reports about unwanted occurrences / incidents
    - Safe job analysis
    - waste sorting (%)
- Production and services
    - Loyalty using Startbank (common supplier register for serious actors in the construction industry)
    - Zero defects
- Customers
    - Customer satisfaction

Skanska in Norway is mostly a large contractor, but sometimes it also has the role of being a client (Skanska Residential Development Nordic).

Skanska has contributed in the Credit project with filling out two forms describing which indicators they see as most important – depending on which role it is in (contractor or client).

Both as a contractor and as a client Skanska is concerned with:

- Cost and Price
- Building performance and indoor environment
- Process performance in design and construction
- Environmental impact

As a client Skanska is concerned about location, site, region etc.

As expected the contractor part of Skanska is more strongly concerned than the client with measures during the building process.

## 3.4 Relation to building cases and benchmarking organisations

Falk is built to gather and report all information that Skanska Norway is required to deliver in relation to its construction projects.

## 3.5 Visions and innovation for future improvements

In the near future the project part will be further developed, and the KPI's will be compared within project types (today the comparison is independent of project type).

Adding more historic information into the system is desirable.

It could be beneficial to measure customer satisfaction more than one time during the project.

Skanska Norway wants better measuring of team processes, sub-contractors (not measured today) and more information relevant for early warnings.

# 4. National benchmarking – indicators, assessment and organisation

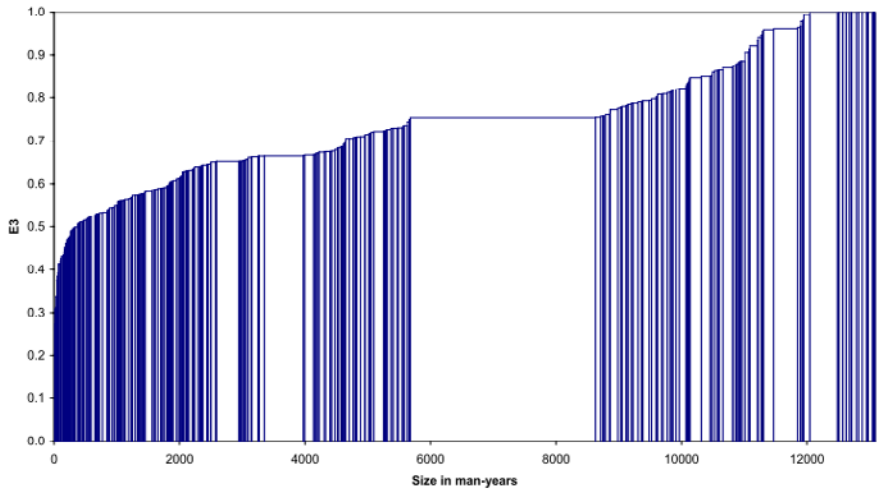
This chapter focuses on sector, national and international benchmarking in related to the assessment and application of indicators in building in Chapter 2 and in enterprises in Chapter 3 and how benchmarking is organised, managed and rooted in the sector and what indicators are assessed in the system.

## 4.1 The actual benchmarking organisation and its purpose

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

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

Figure 4. Efficiency of Norwegian building construction firms.




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

## 4.2 Assessment applied in the benchmarking organisation

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

## 4.3 Cost and performance indicators applied in benchmarking

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

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

## 4.4 Relation to enterprises, building project and real estate

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

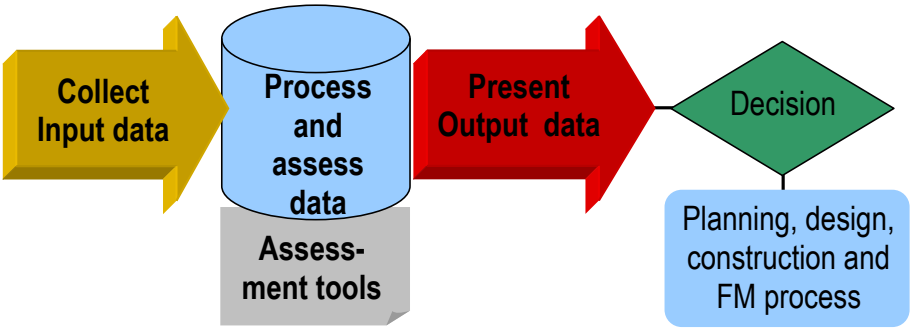
## 4.5 Visions and innovations for future improvements

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

# 5. Discussions and conclusions

This chapter discusses the lessons learned from Skanska's experiences with benchmarking in general and in relation to the shopping centre in this case.

Figure 5. CREDIT information model in relation to decisions in the planning, design, construction and facility management processes.




## 5.1 Buildings - lessons learned and recommendations

The effect of the Falk system has been significantly fewer manual operations and formats. The leaders and controllers have direct access to data through input/output at one place, which give huge savings in time and motivation and full control over important aspects in the company. They will also see the same data in real-time.

One other effect is the possibility to execute corrective action based on deviations and trends.

The system avoids distribution of reports etc via mail, fax and personal presence and time-consuming communication. It is easy to just drill down in the system, to benchmark regions/districts, and share knowledge between parts of Skanska.

## 5.2 Enterprises - lessons learned and recommendations

Skanska Norway uses Falk as its Information Management system. The cost of data gathering has decreased, and the information is more readily available.

One very important effect of introducing Falk was ”Mass-execution” of manual operations and formats, and direct access to data through input/output one place principle. There was a huge saving in time and at the same time improvement in motivation. The system provides full control over important aspects in the company, and a possibility to execute corrective action based on deviations and trends.

It is also important that everyone see the same information in real time. It is essential to avoid distribution of the reporting process via mail, fax and per-

sonal presence. Time-consuming communication was reduced, and it is easier to drill down in the system.

The system makes it possible to drill-down all the way. For instance it is possible to start with the aggregated expense numbers and drill down to a single invoice.

For the most important indicators goals are defined and projects/regions are compared against these. Performance relative to these goals are flagged as red (good), yellow (should be better), and red (lower performance than desired).

The purpose is that all ”relevant” management information and KPI’s are gathered one place for all organizational levels. This provides consistence in all information and KPIs, and it is possibility to drill down to the project for all numbers.

Another important aspect is effective input- and reporting-process through the setup of the system. All reporting on all levels in the organization have to report through FALK. Input is punched one place once.

## 5.3 National benchmarking - lessons learned and recommendations

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

**CREDIT Indicator Classification**

Company: Skanska Norway

Role: Contractor

Project: Skattens hus Country: Norway

Date: 07092009 Sign: I.V.

***To which degree are the following indicators preferred?***

Please use the following scale when answering:

2 Always - strategic and very important

1 Sometimes, depends upon the project

0 Not at all, unimportant

Table 1: Questionnaire to evaluate CREDIT Indicator Classification.

| Cost and performance indicators | Public demands | Internal project demands | Measures during building process | Measures when finished project | During facility management | Comments and other indicators recommended |
|---|---|---|---|---|---|---|
| 1. Cost, price and life cycle economy (LCE) | | | | | | |
| 11 Capital, investment, construction, commissioning cost | | | | | | |
| 12 Building services related to operation and maintenance | | | | | | |
| 13 Business services related the activities in the building | | | | | | |
| 2. Location, site, plot, region and country | | | | | | |
| 21 Location and address | | | 1 | | | |
| 22 Plot opportunities | | | | | | |
| 23 Spatial solution and property aesthetics | | | | | | |
| 24 Surrounding services | | | | | | |
| 25 Social values | | | | | | |
| 3. Building performance and indoor environment | | | | | | |
| 31 Category of building, quantity, size and area | | | | | | |
| 32 Safety and security of burglary | | | | | | |
| 33 Usability and adjustability | | | | | | |
| 34 Thermal comfort | | | | | | |
| 35 Air quality and health | | | | | | |
| 36 Visual climate | | | | | | |
| 37 Acoustic climate | | | | | | |
| 38 Aesthetics of building and indoor spaces | | | | | | |
| 39 Feelings and sensations | | | | 0 | | |
| 4. Building part and product performance | | | | | | |
| 41 Category of building parts, quantity, size and area | | | 2 | | | |
| 42 Safety | | | | 1 | | |
| 43 Durability | | | | 0 | | |
| 44 Thermal quality | | | | 2 | | |
| 45 Impact on air quality | | | | 1 | | |
| 46 Lighting quality | | | | 2 | | |
| 47 Acoustic quality | | | | 2 | | |
| 48 Aesthetic quality as form, surface, colour and details | | | 0 | | | |
| 49 Feelings and sensations | | | 0 | | | |
| 5. Facility performance in operation and use | | | | | | |
| 51 Category of tenancy and operation and area of space | | | | | | |
| 52 Applicability of the facility | | | | | | |
| 53 Operation | | | | | | |
| 54 Services | | | | | | |
| 55 Social performance | | | | | | |
| 6. Process performance in design and construction | | | | | | |
| 61 Category of process, supplier and organisation | | | 2 | | | |
| 62 Resource control and project management | | | | 2 | | |
| 63 Health and safety and work environment | | | 2 | 2 | | |
| 64 Quality management | | | | | | |
| 65 User involvement and cooperation | | | | | | |
| 7. Environmental impact | | | | | | |
| 71 Resource use | | | | | | |
| 72 Emissions | | | | 1 | | |
| 73 Biodiversity | | | | | | |

CREDIT©

Construction and Real Estate -
Developing Indicators for Transparency

This report describes the results a case study of Skattens hus. The study was undertaken as part of the Nordic and Baltic project CREDIT: Construction and Real Estate – Developing Indicators for Transparency.

The analysis is aiming at three levels: the project or building, the firm and the national benchmarking system.

The case study describes the usage of key indicators in relation to the Skattens hus in Oslo.

1st edition, 2010
ISBN 978-87-563-1449-7

SINTEF VTT LUND UNIVERSITY SBi Danish Building Research Institute AALBORG UNIVERSITY