

SBi 2010:35

University of Stavanger, Building 302

CREDIT Case NO02



Danish Building Research Institute
AALBORG UNIVERSITY

CREDIT[©]

Construction and Real Estate -
Developing Indicators for Transparency



University of Stavanger, Building 302

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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 one new building at the University of Stavanger in Norway. This case has been chosen because Statsbygg as building owner has focus on use of Building Information Model (BIM).

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)

Statsbygg has made the strategic decision to require usage of BIM for the new building at the University of Stavanger. In principal everything will be stored in the BIM. All relevant numbers can be found in the same place. One of the interesting aspects in this project is to examine how the data inserted into the BIM can be used for benchmarking. One key indicator that will be studied is net / gross area in different phases of the building process. Today there are some parallel processes that can be eliminated. The idea is not to create a data warehouse, but a system that collects data as needed from subsystems.

A questionnaire to evaluate CREDIT Indicator Classification is shown in chapter 5. The values here show the importance Statsbygg put on different indicator for both public and internal project demands. The most focused classification groups are 'Cost / price / life cycle economy' and 'Process performance in design and construction', but there are many other important internal indicators too.

Enterprises (WP5)

At the firm level, the analysis focuses on Statsbygg's usage of the indicators. In order to perform Life Cycle Costing analysis, Statsbygg's collects data on a number of cost and performance indicators. The data from individual buildings are processed and compared with different building categories and between different types of costs.

From 2010 Statsbygg will require the use of BIM in all their building projects. This is an important signal to the building industry both in Norway and abroad. Information stored in the BIM is important as basic information. It can potentially be used when calculating rents, for the maintenance strategy, and for internal analysis. The information can also be used as input for changes in work processes for Facility Management.

National Benchmarking (WP6)

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

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

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

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

Statsbygg acts on behalf of the Norwegian government as property manager and advisor in construction and property affairs. Statsbygg offers governmental organisations premises suited to their needs, either in new or existing buildings.

Statsbygg has decided that all their substantial building projects have to use Building Information Models (BIM) from 2010. Statsbygg has issued a statement of intention to BIMs based on open standards.

This particular building project (UIS 302) has been chosen as a case study because:

- First BIM project in Statsbygg in ordinary production.
- Uses IFC for information exchange, see below.
- Shows benchmarking potential in BIM.
- Opportunity to benchmark procedures and implementation strategies when introducing new technology.
- Valuable experiences concerning implementing BIM, both internally in Statsbygg and in construction industry.

IFC is an acronym for "Industry Foundation Classes", and can be explained as an object oriented file format with a data model developed by IAI (International Alliance for interoperability, now buildingSMART international). The purpose is better collaboration and frictionless communication in the construction industry. The format is typically used to define and exchange building information models ("BIM"). The most important aspect with IFC is that it is open, neutral and freely available. It is also important that the file format itself is designed to be read and understood by humans. This makes it easier to implement and quality assure than if the format had been binary.

1.3 Research design and methods applied in the case study

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

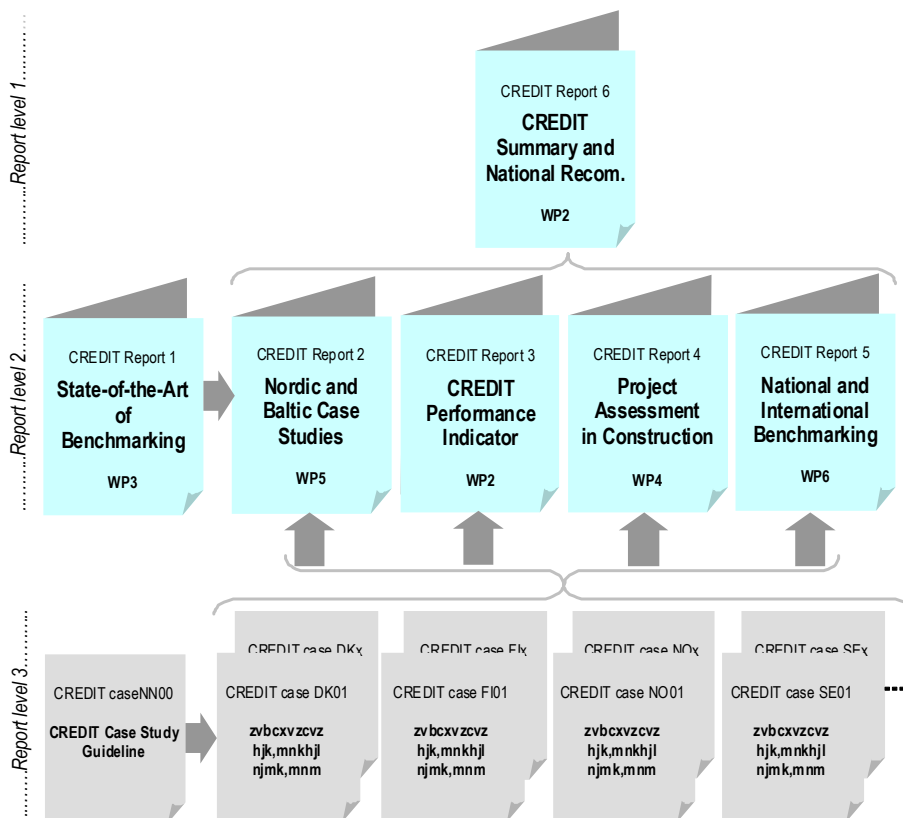
Information about the building project and the use of BIM technology are based on interviews with the project manager for BIM in Statsbygg, Diderik Haug and the building project manager for UIS 302, Brit Helene Øygard. Statsbygg's information systems have been examined regarding their strategy and implementation of BIM, and for specific information about UIS 302.

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 KPIs from a Building Information Model perspective. It addresses questions related to how data and information about the building is collected, managed, evaluated and used. The chapter also shows how Building Information Models can contribute to collections of actual data.

2.1 The actual building, building parts and processes

This case is concerned with a new building at the University of Stavanger. It will contain the Faculty of social science (“Building 302”). The size of the building will be 3 600 m², with room for 100 employees and 140 students. It will be owned by Statsbygg.

The location will be Ullandshaug in Stavanger. The time horizon for the project is as follows:

- Programming phase: 2008 - 2009
- Construction: 2009 - 2010
- Handover: 2010 / 2011

The architect is Link Signatur and the consulting engineer is Multiconsult.

Figure2. Rendered illustration of the new building at the University of Stavanger.

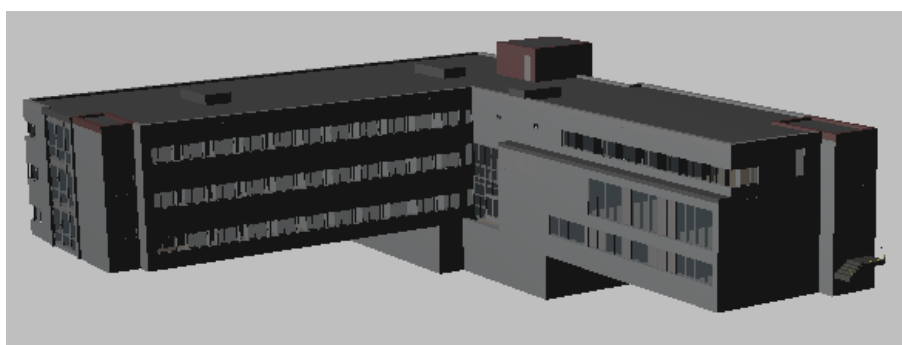


Figure 3. Building 302, with ARK-BIM at the left and the VVS-BIM at the right.

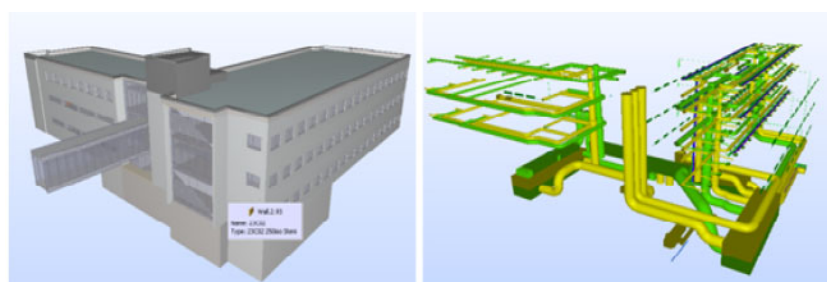


Figure 4. Photo of the area.



2.2 The applied assessment methods and tools in the processes

One of the criteria of the competition was that a Building Information Model (BIM) should be delivered. Currently (Summer 2009) the project is in the programming phase. A digital room and building program is being designed. Requirements that the building has to meet are being defined. The planning of activities was finalized 15th of June.

Some indicators stand out as being most relevant: Gross/net efficiency of the constructed area:

- in the requirement-BIM
- in the planning / sketch phase
- as built

It will be important to keep track of the original requirements and the final product as built.

In principal everything will be stored in the BIM. All the relevant numbers can be found in the same place.

2.3 Cost and performance indicators applied in the assessments

An important example of relevant indicators is gross/net area efficiency. Information about the building from the BIM can be analyzed together with cost information from other sources.

In the current phase of the building project the main focus is on the performance of the building. The approach is to compare with the original requirements.

2.4 Relation to different enterprises and national benchmarking

When facility managers in Statsbygg do their benchmarking, they compare with other buildings in Statsbygg's portfolio, not with the numbers from the national benchmarking networks.

In each geographical region the facility managers meet twice a year. In these meetings the key indicators are used as “discussion points”. A challenge with national benchmarking is the “apple and pears” problem. A major problem is that there are substantial differences when it comes to level of maintenance. Statsbygg believes that their buildings have a relatively equal level of maintenance. If attention is not paid to this matter benchmarking can result in misleading recommendations. Buildings with too low historical maintenance expenses can become best practice when maintenance level is not taken into account.

Another problem is that different definitions seem to be used when it comes to separating between value preserving maintenance and value increasing development.

In the Network Key Number for Benchmarking (NFB) buildings are characterized by the standard NS 3457 (containing a table for different building types). In addition they are categorized as owned, rented in or rented out. The cost data are categorized according to the standard NS 3454 (Cost Data for LCC).

2.5 Visions and innovation for future improvements

Statsbygg has stated the intention to use BIMs in all its significant projects. In addition it has a clear ambition of making the data gathering simple and efficient (“Platform 2012”). An important aspect is to get the systems to communicate seamlessly, Using BIMs based on open, international standards is an important piece of this.

Today there are some parallel processes that can be eliminated. The idea is not to create a data warehouse, but a system that collects data as needed from subsystems.

The vision is to use fewer resources to collect data, and more resources on analyzing them.

3. Enterprises – assessments and indicators internally applied

This chapter focuses on how Statsbygg applies the assessments and indicators internally in their organisation to control and improve their business. Since the new building at the University of Stavanger is planned using a BIM (building information model) new challenges and opportunities arise. Using BIMs is a central point in Statsbygg's strategy.

3.1 The actual enterprise, company and firm

Statsbygg acts on behalf of the Norwegian government as property manager and advisor in construction and property affairs. Statsbygg offers governmental organisations premises suited to their needs, either in new or existing buildings.

Statsbygg is an administrative body, responsible to the Ministry of Government Administration and Reform, and operates in accordance with standard business principles. However, achievements in accordance with Government objectives take precedence over Statsbygg's own business interests.

Statsbygg manages approx. 2.6 million m² of floor space, in Norway and abroad. The property portfolio consists of government and cultural buildings, colleges and public administration buildings, royal properties, embassies and diplomatic residences abroad.

Statsbygg is responsible for organising, planning and completing building projects within set frameworks for budgets, time limits and quality. The buildings must meet quality requirements pertaining to architecture, functionality and environmental concerns. In total Statsbygg's annual building budget is approx. NOK 3 billion.

Statsbygg offers consultancy and assistance in civil engineering and technical matters to ministries and other governmental organisations. Statsbygg also cooperates with the public administration, and advises on assessing property needs, planning and acquiring property.

A new task for Statsbygg in the future will be to develop vacated state-owned premises for alternative public or commercialised utilisation. The objective is to create attractive areas, emphasising local interests, efficient use of resources and sound environmental solutions.

As responsible for the construction, management and development of state owned property, Statsbygg has co-ownership in the environmental challenges of our country.

Statsbygg as an organisation consists of the head office in Oslo and five regional offices. 300 of the 750 employees are based at the head office; more than 350 are engaged in the operation and maintenance of Statsbygg's properties and the rest work at the regional offices.

Statsbygg was one of the parties making the following BIM-statement, together with GSA, Senate and DECA:

Washington, DC
January 17, 2008

Public Statement

**STATEMENT OF INTENTION TO
SUPPORT BUILDING INFORMATION MODELING
WITH OPEN STANDARDS**

Background

Government clients of the AEC/FM (Architecture, Engineering, Construction, and Facilities Management) sector have an interest in the continuous advancement of productivity, efficiency, and quality in the AEC/FM industry, leading to a better built environment for end users, clients, and stakeholders.

We believe that sharing AEC/FM-related information throughout the life cycle (scoping, planning, design, tendering, procurement, construction, operation, maintenance, refurbishment, and disposal) of capital facilities globally and across all disciplines and technical applications, is key to achieving this goal.

The document continues to state that: "We will support the use of IFC-related BIM solutions in public construction works within the legal boundaries of local, national, and relevant multilateral competition law".

One of Statsbygg's objectives is to be the most professional principals in the business and play a leading role in development and use of digital Building Information Models (BIM), based on open standards. The aim is to increase value creation throughout the value chain related to siting, planning, building, administration, running and maintenance of buildings.

The statement – "Statsbygg goes for BIM" was put on the web in 2007:



STATSBYGG

[Kontakt](#)

[Jobb](#)

[Presserom](#)

[Sidekart](#)

[English](#)

Hovedmeny

Aktuelt

Nyhetsabonnement
W4 2007
Tema
Postjournal
Anbud. Konkurranser
Åpninger av bygg
Ledige stillinger
Åpent Rom
Eiendom
Prosjekter
Veiledning
Miljø
Arkitektur
Kulturminnevern
Om Statsbygg
Presserom
Publikasjoner

Statsbygg goes for BIM

The Norwegian Directorate of Public Construction and Property - Statsbygg - has decided to use digital Building Information Models (BIM) based on open international standards. The final goal is to use BIM for all Statsbygg's buildings, throughout their entire lifespan. At least five projects will apply BIM during 2007.
(15.05.2007)

As the main rule, BIM will be in use in all of Statsbygg's projects and building processes during 2010. [15.05.07]

Statsbygg's goal to increase the use of BIM is a decision that can influence the entire Norwegian AEC/FM industry.

- BIM will improve efficiency for all building processes. BIM will make it possible to carry out our assignments better, with fewer errors.

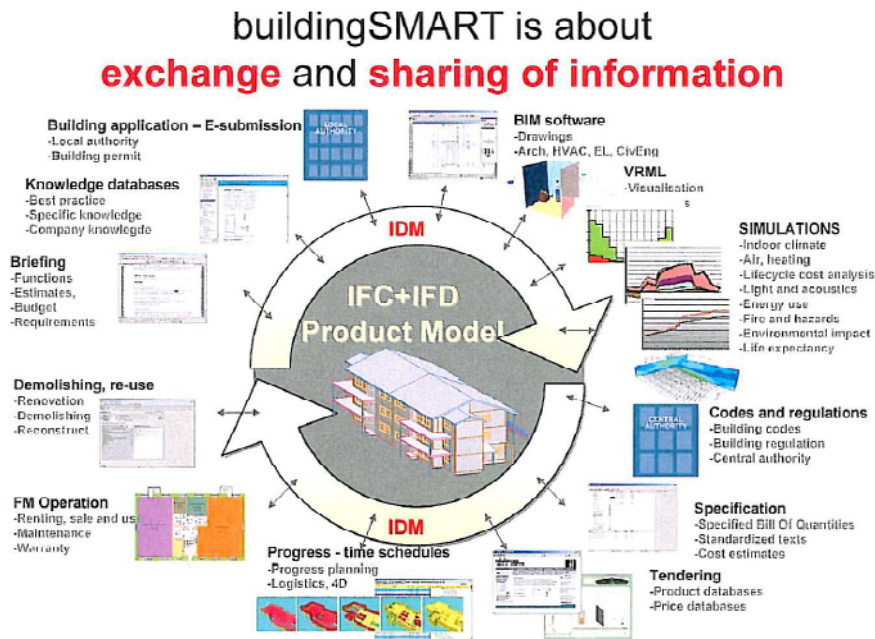
"The benefits are apparent. Buildings will be erected more efficiently, and they will be less expensive to design and construct," says the Director of Development at Statsbygg, May Balkøy.

Coordinated models

The use of digital information models (BIM) leads to digitalization of planning, building, and facility management processes, allowing the data and information of a project to be processed more efficiently. BIM changes

Statsbygg will contribute to better, more effective interaction and information exchange between the parties in the building process, via simplification and improvement of such processes, see figure below.

Figure 5. An illustration of buildingSMART and how use of open international standards will contribute to better collaboration. Illustrations: Lars Bjørkhaug Norwegian Building Research Institute, Olof Granlund, NBLN University of California, Stanford University.



From 2010 Statsbygg will require the use of BIM (Building Information Modeling) in all their building projects. This is an important signal to the building industry both in Norway and abroad. “Open standards, greater efficiency and enhanced environmental awareness are essential components in the development of technology,” says Minister of Government Administration and Reform, Heidi Grande Røys. She believes that the technology stems from the strong international commitment demonstrated by the Norwegian building industry, and that it represents an excellent example of innovative thinking in Norwegian trade and industry today.

3.2 Assessment methods and tools applied in the enterprise

A standardized data gathering form is used to collect data on some key indicators. This form is based on NFN’s (Norwegian Facility Management Network). Statsbygg has reported data to NFN since 2003.

In addition Statsbygg has its own energy and cleaning statistics. Statsbygg collects both cleaning cost and energy consumption. NFN, however, only collect energy costs.

The motivation for collecting the data in Statsbygg is:

- Local assessment of the effect of local measures
- Planning of activities
- Reporting upwards in the system: Property, region, headquarters
- Ministry of Government Administration and Reform
- Basis for Statsbygg’s analysis and reporting
- Benchmarking against similar buildings
- Improving work processes
- A basis for condition assessment
- Energy consumption has special attention

The system is an integrated part of Statsbygg's operation and management of properties. The procedure is described on Statsbygg's intranet.

3.3 Costs and performance indicators applied in the enterprise

Energy indicators are used to compare buildings within categories (office, education, etc.). The other numbers are compared independent of building category.

The real estate indicators are used to manage the existing buildings in a more efficient way, but as of today they are not used in the planning / design of new buildings. The transfer of knowledge from existing buildings to new buildings is not taking place in a large degree.

The area where largest progress has been made is energy performance. In addition the indicators are used when creating cost budgets and calculating rent. Statsbygg has created its own LCC-calculator ("LC-profit"), and they use it to do life cycle costing.

The main focus is better management of existing buildings. Statsbygg owns 2 300 buildings, but creates only about 20 -30 new ones each year.

Statsbygg collects a large amount of data for each of its buildings. The figure below shows a screenshot of some of the information as presented in MS Excel.

Table 1. Example of the key indicators gathered by Statsbygg. The numbers for UiS can not be shown at this time since it is under construction.

Sum nøkkeltall

Revisjon:	0	Referans år:	År
Eier:	Eiers adr.:	Bygn.adr.:	
Statsbygg		Kommune:	Kongsvinger

Basis for nøkkeltallene

	Brutto areal (kvm)	Sum Arb.pl. (stk)
Ekvivalent basis for nøkkeltall		
(Data for den bygning som er grunnlaget for nøkkeltallene)		

Økonomiske nøkkeltall for kontor- og eiendomsvirksomhet

	Totalt	Kostnader	
	(KNOK)	pr. kvm (NOK/kvm)	pr. Arb.pl. (NOK/Arb.pl.)
EIENDOM			
SUM FORVALTNING			
SUM DRIFT OG VEDLIKEHOLD			
SUM UTVIKLING			
SUM Eiendom = FDVU			
KONTOR / SERVICE TJENESTER			
SUM ADM. + KONTORLEDELSE			
SUM FLYTTING + ROKKERING			
SUM KONTORMØBLERING			
SUM REKVISITA			
SUM PRINT OG KOPIERING			
SUM VAKTHOLD / SIKRING			
SUM SENTRALBORD OG RESEPSJON			
SUM POST- OG BUDTJENESTER			
SUM KANTINETJENESTER			
SUM Kontor			
SUM Kontor- og eiendomsvirksomhet			

Nøkkeltall

Side 1 av 2

År

Eiendom	Areal	Antall	Kostnader					
	(BTA)	arb.pl.	Totalt	pr. kvm	pr. Arb.pl.			
	(kvm)	(stk)	(NOK)	(NOK/kvm)	(NOK/Arb.pl.)			
FORVALTNING								
Skatter og avgifter								
Forsikring								
Administrasjon egne ansatte								
Øvrige administrasjonskostnader								
SUM FORVALTNING								
DRIFT OG VEDLIKEHOLD								
Personellkostn. DV-ansatte								
Renhold, sum								
- herav innvendig								
- herav utvendig								
Energi, sum						Energi i kwh	Kwh/kvm	Kr per kwh
- herav el-kræft								
- herav olje								
- herav fjernvarme/kulde								
Renovasjon/avfallshånd.								
Vann og avløp								
Teknisk sikring (alarmer, etc.)								
Utendørs								
Alternativ 1: for de som ikke skiller ut vedlikeholds kostnaden. Spørsmål? Ring 90882601								
Bygning								
VVS-installasjoner								
El-installasjoner								
Alternativ 2 for de som skiller ut vedlikehold.								
VEDLIKEHOLD								
Planlagt vedlikehold								
Utskiftinger								
Utendørs								
SUM VEDLIKEHOLD								
SUM DRIFT OG VEDLIKEHOLD								
UTVIKLING								
Løpende ombygging								
Offentlige krav/pålegg								
Oppgradering								
SUM UTVIKLING								

Nøkkeltall

Side 2 av 2

År

Kontortjenester	Areal	Antall	Kostnader					
	(BTA)	arb.pl.	Totalt	pr. kvm	pr. Arb.pl.			
	(kvm)	(stk)	(NOK)	(NOK/kvm)	(NOK/Arb.pl.)			
ADM. + KONTORLEDELSE								
Personellkostn. ansatte								
Kjøpte eksterne tjenester								
SUM ADM. + KONTORLEDELSE								
FLYTTING, ROKKERING ARB.PL.								
Personellkostn. ansatte								
Kjøpte eksterne tjenester								
SUM FLYTTING + ROKKERING								
KONTORMØBLERING								
Kjøp av inventar og møbler								
Eksterne personellkostnader								
Personellkostn. ansatte								
SUM KONTORMØBLERING								
REKVISITA								
Kontor, datarekvisita, papir								
Eksterne personellkostnader								
Personellkostn. egne ansatte								
SUM REKVISITA								
PRINT OG KOPIERING								
Avskrivning, leie, service, klikkavg.								
Personellkostn. ansatte								
SUM PRINT OG KOPIERING								
VAKTHOLD / SIKRING								
Adgangskortprod. m/kort+kamera								
Personellkostn. ansatte								
Kjøpte eksterne tjenester								
SUM VAKTHOLD / SIKRING								
SENTRALBORD / RESEPSJON								
Kjøpte eksterne tjenester								
Personellkostn. ansatte								
SUM SENTRALBORD / RESEPSJON								
POST- OG BUDTJENESTER								
Porto, varer, maskiner								
Kjøp av eksterne tjenester								
Personellkostn. ansatte								
SUM POST- OG BUDTJENESTER								
KANTINETJENESTER								
Kjøp av varer								
Personellkostn. ansatte								
Personellkostn. innleide								
Cateringkontrakt								
Salg i kantinen (trekkes fra)								
SUM KANTINETJENESTER								

Figure 6. Comparing some important indicators between different buildings. The figure above shows how indicators can be compared between different buildings in Statsbygg's portfolio.

Reg E.nr.	Eiendomsnavn	Areal m ²	Fastkraft kWh	Oppvarming kWh	Vann m ³	Totalt kWh	Totalt gdk. kWh	Spes.gdk. kWh/m ²	Driftstid tim/uke	Spes.dtn. kWh/m ²
EØ 60/101	Regjeringskvartalet G-Blokk	17 100	2 571 197	64 246	14 716	2 635 443	2 826 527	165,3	70 (58)	151,1
EØ 00074	Regjeringskvartalet Grubbegate 1	8 000	603 794	596 819	1 695	1 200 613	1 287 664	161,0	58 (58)	161,0
EØ 60/102	Regjeringskvartalet H-Blokk	19 222	2 847 494	1 770 107	7 132	4 617 602	4 952 403	257,6	70 (58)	235,6
EØ 60/105	Regjeringskvartalet Møllergate 19	3 962	615 142	0	1 030	615 142	659 743	166,5	58 (58)	166,5
EØ 60/107	Regjeringskvartalet R4 og M17	25 898	2 402 537	1 314 199	15 339	3 716 735	3 986 219	153,9	58 (58)	153,9
EØ 60/108	Regjeringskvartalet R5	48 774	5 378 226	2 782 600	11 926	8 160 826	8 752 530	179,5	70 (58)	164,1
EØ 60/104	Regjeringskvartalet S-Blokk	14 796	2 432 357	55 391	3 817	2 487 748	2 668 123	180,3	58 (58)	180,3
EØ 60/109	Regjeringskvartalet Utendørsanlegg*	0	0	0	0	0	0	0,0	(58)	0,0
EØ 60/103	Regjeringskvartalet Y-Blokk	21 805	1 297 417	1 562 599	3 289	2 860 016	3 067 383	140,7	70 (58)	128,6
EØ 00602	Statistisk sentralbyrå	12 755	2 354 447	0	3 568	2 354 447	2 517 770	197,4	58 (58)	197,4
EØ 00061	Victoria terrasse	40 703	3 234 169	1 904 927	8 265	5 139 096	5 511 709	135,4	52 (58)	143,2
51 eiendommer i denne kategorien.		479 491	MWh	MWh	m³	MWh	MWh	kWh/m²	Snitt tim	kWh/m²
46 er med i statistikken.		468 287	49 648	30 880	171 009	82 879	88 374	189	78	169,4

3.4 Relation to building cases and benchmarking organisations

When facility managers in Statsbygg do their benchmarking they compare with other buildings in Statsbygg's portfolio, not with the numbers from the national benchmarking networks.

Statsbygg's intranet contains both statistics and procedures. The indicators are discussed locally among facility managers, and are used to create analysis and reports for different purposes.

When it comes to national statistics, Statsbygg is sharing data with NFN. Their statistic for facility management is also shared, while their energy statistics is not shared externally.

Statsbygg is required by the government to publish the specific energy consumption for its buildings.

3.5 Visions and innovation for future improvements

Statsbygg wants to digitize all the requirements in their projects by creating requirement-BIMs. The requirements are put into a database containing the rooms. A software package named «dRofus» is central.

When different disciplines contribute to the BIM, conflicts can occur. Software will be used to detect these conflicts. Some important issues are:

- It is desirable that all the existing information is put into the BIM, but this is not current practice.
- Numbers should be stored in one central location.
- Why should basic numbers be stored when they can be (re)generated? In that way numbers don't expire their «best before» date.
- International and open standards should be used.
- There are different data sources. The Oracle system contains a lot of cost information.

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.

This chapter describes in more detail the two organisations NFB and NfN, but neither of them, nor any other organisation on the national level, use the information stored in BIMs for benchmarking purposes - so far.

4.1 The actual benchmarking organisation and its purpose

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

NBEF / NFB

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

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

The NFB goal is to focus on activities that contribute to more efficient use of resources in the facility management, and hence using the key number (Key Performance Indicators) as support tools.

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

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

NfN

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

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

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

Nordic FM priorities were from the start given to the following objectives:

- Development of a common Nordic framework for standardization within FM.
- Benchmarking activities between participants in the Nordic.
- Facility Management professional environment and marketplace.
- Development of a framework and structure for education and qualification within FM on Bachelor and Master Level.

This network consists essentially of large private owners of offices. About 20 companies contribute data every year. Most members of the network have only reported data for management, operation and maintenance from few cases. This means that the work has less value in a benchmarking context, since the selection is so small. Energy consumption is one of the key indicators that are benchmarked in this cooperation. Benchmarking on energy consumptions can be shown both in kWh and the cost.

4.2 Assessment applied in the benchmarking organisation

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

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

NfN's own experiences;

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

4.3 Cost and performance indicators applied in benchmarking

The key numbers are in three main categories:

- Key numbers related to costs, as management, operation, maintenance (MOM) costs per m² or per working space. The cost categories are from NS3454.
- Key numbers related to area, as m² pr working space in office building or per pupil in school.
- Key numbers related to consumptions, as energy consumption per m², water use and waste.

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

4.4 Relation to enterprises, building project and real estate

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

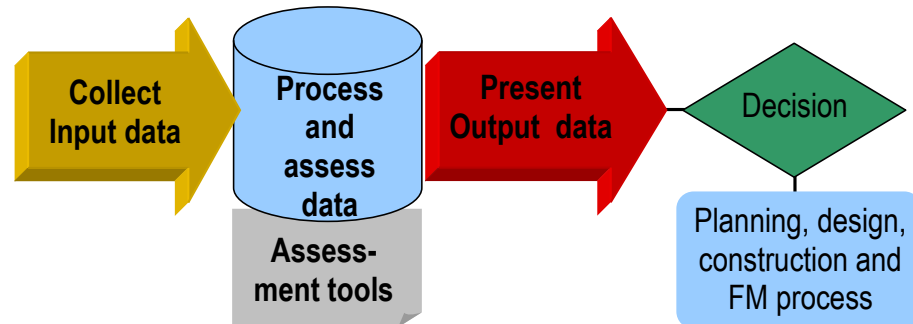
4.5 Visions and innovations for future improvements

Statsbygg has as goal to use the national database as a learning tool. See also 3.5.

5. Discussions and conclusions

The new building at the University of Stavanger is not completed, and lessons are still being learned. Collaborating in the building process using a BIM provides new possibilities for benchmarking.

Figure 7. CREDIT information model in relation to decisions in the planning, design, construction and facility management processes.



5.1 Buildings - lessons learned and recommendations

Statsbygg has made the strategic decision to require usage of BIM for the new building at the University of Stavanger. One of the interesting aspects in this project is to examine how the data inserted into the BIM can be used for benchmarking. One key indicator that will be studied is net / gross area in different phases of the building process.

5.2 Enterprises - lessons learned and recommendations

Information stored in the BIM is important as basic information. It can potentially be used when calculating rents, for the maintenance strategy, and for internal analysis. It is also being used for creating reports to the owner. In addition the information can be used as input for changes in work processes for Facility Management.

5.3 National benchmarking - lessons learned and recommendations

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

CREDIT Indicator Classification

Company: Statsbygg
 Role: Construction
 Project: UIS 302 Country: Norway
 Date: 07072009 Sign: Morten Dybesland

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 2. Questionnaire to evaluate CREDIT Indicator Classification.	Public demands	Internal project demands	Measures during building process	Measures when finished project	During facility management	Comments and other indicators recommended
Cost and performance indicators						
1. Cost, price and life cycle economy (LCE)						
11 Capital, investment, construction, commissioning cost	2	2				
12 Building services related to operation and maintenance		2				In Property management
13 Business services related the activities in the building		2				In Property management
2. Location, site, plot, region and country						
21 Location and address	2	2				
22 Plot opportunities		2				
23 Spatial solution and property aesthetics						Important, but no KPI
24 Surrounding services						Important, but no KPI
25 Social values						Important, but no KPI
3. Building performance and indoor environment						
31 Category of building, quantity, size and area		2				
32 Safety and security of burglary		2				
33 Usability and adjustability		1				
34 Thermal comfort						Important, but no KPI
35 Air quality and health						Important, but no KPI
36 Visual climate						Important, but no KPI
37 Acoustic climate		1				
38 Aesthetics of building and indoor spaces						
39 Feelings and sensations						
4. Building part and product performance						
41 Category of building parts, quantity, size and area		2				
42 Safety		2				
43 Durability						Important, but no KPI
44 Thermal quality						Important, but no KPI
45 Impact on air quality						
46 Lighting quality						
47 Acoustic quality						
48 Aesthetic quality as form, surface, colour and details						Important, but no KPI
49 Feelings and sensations						
5. Facility performance in operation and use						See FM case
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	2				
62 Resource control and project management	2	2				
63 Health and safety and work environment	2	2				
64 Quality management		2				
65 User involvement and cooperation		2				
7. Environmental impact						
71 Resource use		2				
72 Emissions		2				
73 Biodiversity						Important, but no KPI



This report describes the results a case study of University of Stavanger. 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 one new building at the University of Stavanger in Norway. This case has been chosen because Statsbygg as building owner has focus on use of Building Information Model (BIM).

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