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Vuorimiehentie 5 Office Building

CREDIT Case FI04

Danish Building Research Institute
AALBORG UNIVERSITY

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Construction and Real Estate -
Developing Indicators for Transparency

Vuorimiehentie 5 Office Building

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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).
- Pekka Huovila, VTT.
- Päivi Hietanen, Senate Properties.
- Ole Jørgen Karud, SINTEF.
- Magnus Hvam, SKANSKA.
- Bengt Hansson, Lund University.
- Kristian Widén, Lund University.

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

Niels-Jørgen Aagaard
Research director

Summary

Senate Properties studied two cases in the CREDIT project. Vuorimiehentie 5 office building describes indicators, following nationally agreed CREDIT indicators from Finland. The building is a small renovation project and facilitates working spaces for VTT in Southern Finland,.

Buildings (WP4) summary

In this case study, the building owner has implemented multiple indicator systems. First, the CREDIT indicators on cost and performance indicators were implemented. Second, the ratings for national environmental classification PromisE were implemented. Finally, testing of Building Information Models (BIMs) for renovation project were implemented. Considering CREDIT indicators, this case study follows nationally agreed Finnish indicators on cost and performance. Before the renovation, a national environmental classification for the building was made based on the PromisE classification framework. The total PromisE class of the building is C. The case has also been a demonstration of Senate Properties in using Building Information Models in renovation project.

Enterprises (WP5) summary

Senate Properties is the largest building owner in Finland and uses internal investment indicators called SeneKPI in all facility projects. Altogether Senate Properties has an objective to harmonize all indicator systems. Currently they are seeking an international indicator scheme that is locally adoptable. At the moment, Senate Properties applies the following approaches related with CREDIT: Investment decision support and benchmarking (SeneKPI), and Common Finnish environmental rating (PromisE). Other objective in Senate Properties is to embrace usage of BIMs in all facility projects, both in new buildings and renovations.

National benchmarking (WP6) summary

PromisE is a Common Finnish environmental rating system for residential buildings, office buildings and retail buildings. The PromisE indicators are divided to four main categories; health of users, consumption of natural resources, environmental loadings and environmental risks. Each indicator is valued in five level scale (A, B, C, D, E), ranging from E-level representing normal level, to the A-level that promotes excellent solution. According to PromisE rating, the building level environmental class of Vuorimiehentie 5 is C.

1. Introduction and objectives

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 case study describes indicators for Vuorimiehentie 5 office building, following nationally agreed CREDIT indicators from Finland. The building is small renovation project and facilitates working spaces for VTT in Southern Finland. Before the renovation, an environmental evaluation was made based on the national environmental classification framework called PromisE. In the process, owner of the building, Senate Properties, tested the use of Building Information Models for design phase.

1.3 Research design and methods applied in the case study

This case study has been conducted as an action research by researchers and members of a client organisation seeking to improve their situation (Greenwood and Levin, 1998). We have gathered data in this case study from multiple sources to enhance reliability and trustworthiness of the results (Robson, 2002). Documents, direct observations, interviews, questionnaires and to some extent also standardised tests have been methods for data collection. Research setting is exposed to changes, and because of this quantitative method has been used in collecting indicator and process data. Then qualitative analysis has been employed to the results.

1.4 Reading instruction

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.

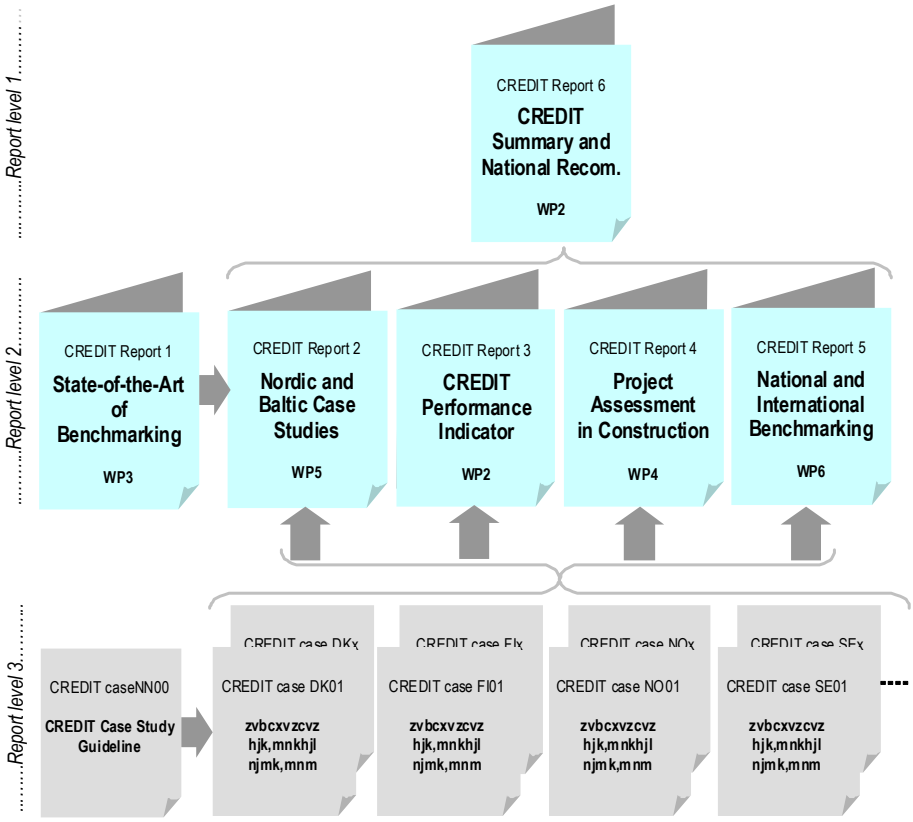

Figure 1. Graphical illustration of the hierarchy of the CREDIT reports.

2. Buildings – assessments in construction or real estate processes

Vuorimiehentie 5 is a renovated office building built for the use of VTT research and development. The building project included the renovation and alterations work of office premises, and new air-conditioning plant and room. In the Finnish CREDIT case studies, we have tried to apply same core indicators. Before the renovation, a national environmental classification for the building was made based on the PromisE classification framework. The PromisE target class is indicated in this chapter, we discuss about PromisE classification more thoroughly in chapter 4 on national benchmarking systems. Further, the case has also been a demonstration of Senate Properties in using Building Information Models in renovation project. These experiences considered in chapter 3 on Enterprises.

2.1 The actual building, building parts and processes

The building represents the office style from 1970's and pictures before and after the renovation are introduced in Figure 2. The renovation has major impacts on work place management and space efficiency because cell offices were transformed into open offices.

Figure 2: VTT office building before (2005) and after (2007) renovation.

General information:
– Region: Southern Finland
– Location: Espoo
– Gross area: 10.835 m2
– Office floor area: 8.930 m2
– Volume: 37.300 m3
– About 500 jobs
– About 300 car parks
– Age of real estate: 34 years (construction 1975) and renovation 2007
– Indoor climate standard S2 (the Finnish classification of indoor climate)
– Ventilation system: mechanical balanced ventilation + heat recovery, chilled beams in office spaces
– Heating system: water convectors, air supply units
– Cooling system: water-cooling units serve: ventilation cooling network, chilled beams, fan coil units
– Fire safety: alarm system, mechanical heat and smoke venting
– Electricity distribution: flexible electricity networks in spaces

– Automated continuous monitoring: Reports on energy, costs and operations are transmitted directly to property owners and managers via an internet portal

Available services are as follows
– Conference and meeting rooms
– Lobby and office services
– Office maintenance and operating services
– Security services
– IT services

The office is located to Otaniemi Espoo, less than ten kilometres from the city centre Helsinki – the capital city of Finland. Map is presented in Figure 3.

Figure 3. Location of Vuorimiehentie 5 office building in Espoo.

2.2 The applied assessment methods and tools in the processes

In this case study, the building owner has implemented multiple indicator systems. First the CREDIT indicators are presented in chapter 2.3 on cost and performance indicators and then we continue by presenting the ratings for national environmental classification PromisE. Finally we conclude the process with testing of Building Information Models (BIMs) for renovation project. Senate Properties uses BIMs in all projects that ate over two million Euros.

The information modelling in the case follows the Senate Properties BIM guidelines from year 2007. The modelling work began at May 2006. The first as-planned models were made for the machine room, auditorium, and en-

trance hall, continuing to modelling of other building parts. The information model has not been used for architectural design or producing the documentation such as work plans. It has been mainly prepared by using the completed final 3-dimensional as-built drawings and plans. From the entrance hall and auditorium, there has been made some interior perspective pictures to support the decisions on details such as decoration. In addition, the model has been partly used for simulation of lightning conditions.

The model has been mainly constructed from final drawings, The emphasis towards complete as-built model in model creating has shofted the objective from maintenance. Currently the model is being updated for facility management use in order to use models also in connection with maintenance databases.

2.3 Cost and performance indicators applied in the assessments

Primary objective in CREDIT WP2 is to present a list of key indicators applicable in the life cycle of buildings and setting a new international standard widely accepted in the Nordic and Baltic countries. The end result of this work, the CREDIT indicator classification, is developed upon the experiences from the best buildings and enterprises and on detailed international standard and research knowledge to promote value generation. This case study follows nationally agreed Finnish indicators on cost and performance because the CREDIT indicator framework was not finished when this case study has been implemented.

Location and architecture (L)

L1 – L7 Site characteristics
– The plot is rock-bottom area.

L 11 Architectural quality
– Old 70's office style

L12 Growing neighbourhood
– Distance from Otaniemi Shopping Centre, post office, bank and library 100 m
– Located to Aalto university area

L13 Public transport
– Distance to railway station 5 km, bus station 3 km, bus stops 100 m
– Distance to Helsinki - Vantaa airport 20 km

L14 Pedestrian and bicycle access
– Distance to bicycle route 50 m, footway: 50 m

L15 Access to services
– All kind of services are available within 300 m

L16 Access to green open spaces
– Distance to Otaniemi Park 200 m

Building performance (P)

P1 – P2 Thermal comfort
– Indoor air quality standard: 23-26 summer, 21- 22 C winter

P3 – P4 Air quality
– Indoor condition levels S2

P5 – P7 Lightning
– Low energy fluorescent lightning

P8 – P11 Noise
– Partition walls 35 dB, acoustic ceilings

P12 Design flexibility
– Open offices
– Easy modification possibility, movable electric and network towers

P16 Meeting current safety regulations
– Fire safety system

Real estate business (B)

B1 Branding

– Entrance and courtyard area have been developed

B6 – B8 Maintenance

– Maintenance services

B9 Facility services

– FM organization

B10 Range of user services

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

– Office maintenance and operating services, management services

– ICT services

B11 – B12 Parking

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

PromisE environmental rating has been used in Vuorimiehentie 5 case study. More details on the PromisE classification is written in National Benchmarking chapter 5. PromisE indicators were set to building before the renovation. In the following paragraphs, some of the PromisE indicators are described followed by indicators and total PromisE class of the building in Table 1.

Table 1: PromisE ratings in Vuorimiehentie 5 office building after renovation.

PromisE – Vuorimiehentie 5 office building

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

TOTAL = C

Descriptive indicators

– Location: suburban

– Services in the neighbourhood: shopping mall, post office, bank, library, university campus (Promise class B)

– Service life: no target lifetime (Promise class E)

– Public transportation: (Promise class A)

– Bicycle and pedestrian traffic: (Promise class C)

User oriented indicators/satisfaction

– Indoor condition levels for temperature and relative humidity: S2 as a general level, S1 for meeting rooms, and S3 for storage rooms (the Finnish classification of indoor climate). Indoor climate rated values for chilled beams and fan coil units: temperature 24 C, relative humidity 45 %.
– Modifiability of spaces: highly flexible office spaces (Promise class B)
– ICT services: VTT's ICT support process
– Acoustics: 33 / 38 dB(A) in office spaces (C1 Sound insulation and noise abatement in building Regulations and guidelines)
– Lighting: working space lighting level 500 lx (Promise class C)

Eco/energy indicators, annual consumptions

– Heating energy consumption kWh/year: calculated estimate after renovation 88,8 kWh/htm2 (before renovation 140 kWh/htm2) (Promise class D)
– Electricity consumption kWh/year: calculated estimate after renovation 58,2 kWh/htm2 (before renovation 140 kWh/htm2) (Promise class D)
– Fresh water consumption m3/year: water consumption level corresponds to typical office building usage (Promise class E)
– Recycling level %: the building has target levels for recycling (Promise class D)
– Waste amount /year: separation of wastes (Promise class D)

Energy indicators are becoming more and more important in Finland. From the 1990s Finland has employed a voluntary agreement scheme to promote energy efficiency. Practical means have been energy audits, analyses and certain energy efficiency investments subsidised by the government. Energy agreements have proved to be effective,
The energy efficiency agreements are mainly made for energy intensive industry sectors. Currently in force are the ones for the industries, municipal, oil, goods transport & logistics and public transport. The housing sector property sector has an older energy conservation agreement. The agreements consist of framework agreement and action plans. A company joining the agreement makes the commitment to implementing them. (Motiva 2009)

One of the actions used in energy agreements is the energy audit. Energy audits are used to evaluate building energy consumption and identify energy saving measures. Energy audit procedure consists of start-up meeting, basic data collecting, field work, data analysis, reporting and implementation of saving measures.

Finland's Energy Audit Programme (the EAP) is one of the oldest national energy efficiency grant schemes in place. The EAP was, in practice, launched in January 1994 and has been a clean-cut and full-scale programme since then. The EAP is run by Motiva Oy, a state owned company. The MEE´s Energy Department is the Administrator, responsible for all official decisions. Consulting companies form the major part of the energy auditors and the clients are industry, service and energy sectors. The EAP is a voluntary programme, but promoted by a 40 to 50 % subsidy by the Ministry of Employment and the Economy (the MEE). Cumulative energy consumption from pre-EAP actions in 1992 to year 2006 has been nearly 10 TWH and 335 million €.

Currently the construction sector doesn't have an energy efficiency agreement in force. The previous one ended in 2007 seven and the new one is currently under consideration. Apparently the new agreement will require more demanding activities to respond to the demands that come from the EU and from the Finnish Ministry of the Environment. The Minister of Housing Jan Vapaavuori from Ministry of the Environment has said that energy performance requirements for renovated buildings will be brought to building regulations in 2012. Currently there are practically no requirements for existing buildings.

Even though there is no obligation to make energy performance actions now, it is definitely wise to prepare for the future and improve current energy management.

The energy management is a permanent process to assure energy efficient operation of the building. In practice this means most often reducing the current consumption by changes in operation and maintenance or by investments. Good energy management starts from an understanding how a building uses energy. In the next phase inefficiencies must be identified and based on that saving actions can be planned. The actions mentioned need commitment of the whole organisation, clear targets and ongoing monitoring to get the basic data for analysis. Energy management has usually short and long term perspectives:

- In short term the existing building and its systems and equipments should be used as efficiently as possible to get out the most of done investments
- In long term the technical and functional performance must be improved to match the changing user requirements and increasing social-economic demands

Actions taken to improve efficiency can vary. Some cost nothing, others are low cost and some require greater investment. Some use technology, other focus on people. However, good energy management will normally deliver savings through a combination of methods.
The idea of energy management is shown in Figure 4.

Figure 4. Energy Management (EPA & DoE 2009)

Vuorimiehentie 5 office building is connected to automation systems and detailed measurements of the heating energy, electricity and water consumptions are available through Epeportal. Figures 5-9 describe these measurement graphs.

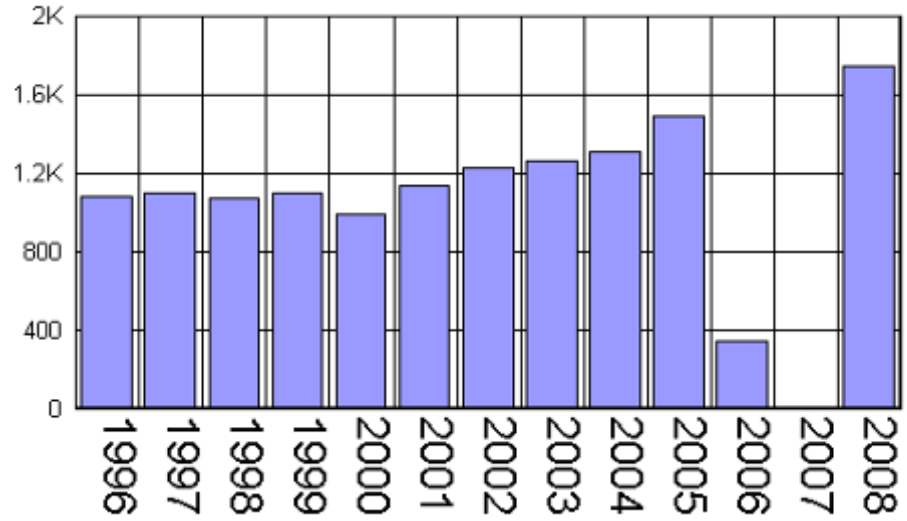

Figure 5: Measured heating energy consumption (MWh / year), source: epeportal.vtt.fi

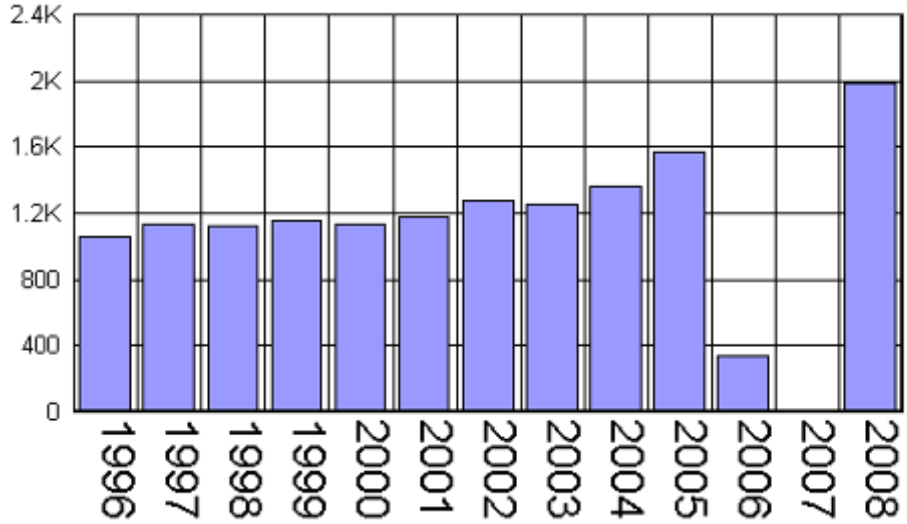

Figure 6: Weather corrected heating energy consumption (MWh / year), source: epeportal.vtt.fi

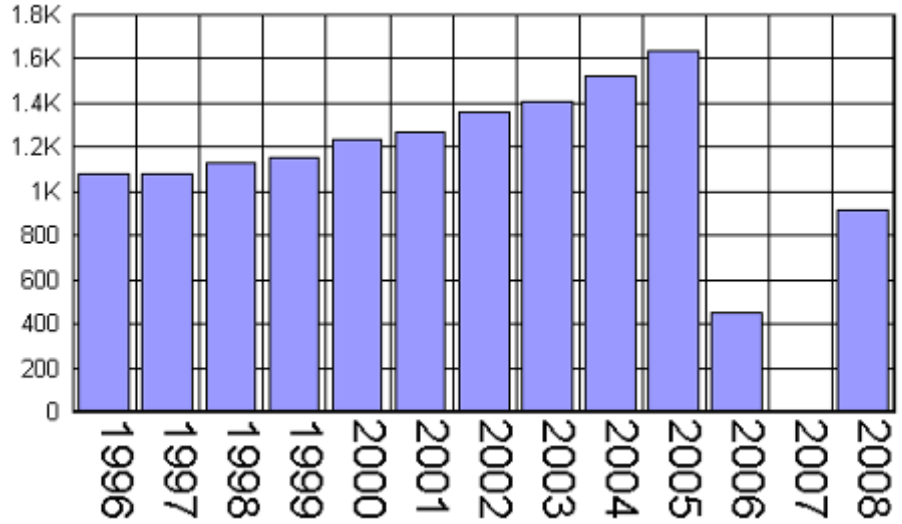

Figure 7: Electricity consumption (MWh / year), source: epeportal.vtt.fi

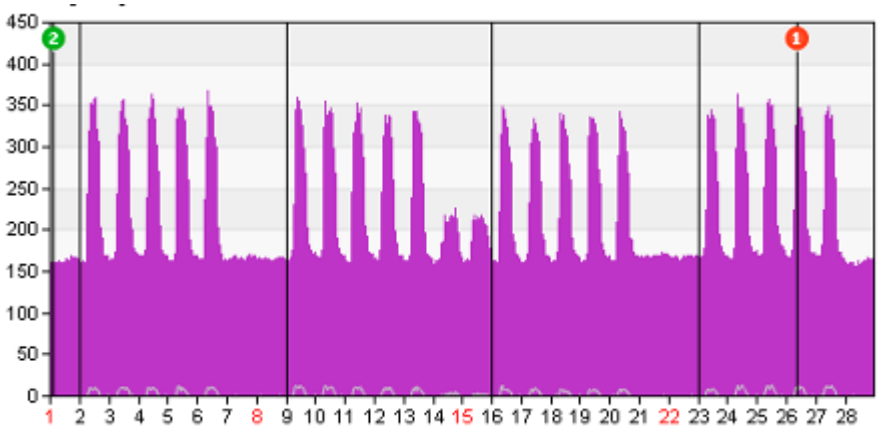

Figure 8: Electricity consumption in February 2009 (kWh), maximum power 1 is 374 kW and minimum power 2 is 157 kW, the violet area presents active power/energy and the grey line is reactive power, source: www.enerkey.com

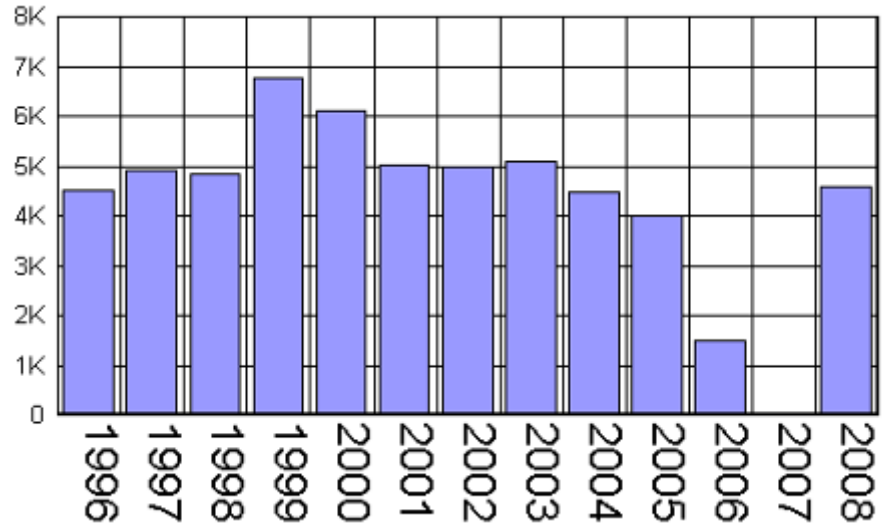

Figure 9: Water consumption (m^3 / year), source: epeportal.vtt.fi

2.4 Relation to different enterprises and national benchmarking

At the moment Senate Properties has difference indicator systems for different phases of the project. The objective is to harmonize the use of multiple indicator systems. Senate Properties has tested multiple indicator systems.

2.5 Visions and innovation for future improvements

The building has been in use for year and half, and therefore, further investigation is needed on heating energy and electricity consumption. The annual heating energy consumption during the first operation year after renovation has risen, while the electricity consumption has gone down. At the moment, the results are only indicative, and more re-liable conclusions can be made after building being occupied for two more years.

We also have to acknowledge the fact that the use of building has definitely changed – some functions in the building are different. The change in work places towards more efficient space use has been challenging. Experiences from first years have revealed that research and development organisation is highly dependent on individuals. The removes in 2008, one of these was Vuorimiehentie 5 office building the space efficiency was developed by 20 %, but change costs per person were however relatively high because of lack of very well working solutions. Therefore, it is also challenging to esti-

mate the payback time of making more space efficient solutions. So the changes in cell offices should be very thoroughly considered and planned before making work environment changes.

In relation to earlier, it is not also complicated to evaluate the influence on energy, electricity and water consumptions. Besides, the renovation also realised indoor environment changes, particularly in indoor air quality. The higher target level in indoor environment may also cause alterations because of extra ventilation periods.

The issues described earlier could be studied in e.g. an energy audit or in an inspection for energy performance certification and it could be clarified how energy efficient the building really is and is there some potential for energy efficiency or indoor environment improvements. The understanding of energy consumption behaviour is very important in long run, and may help to detect faults in building systems before large damage exists.

3. Enterprises – assessments and indicators internally applied

3.1 The actual enterprise, company and firm

The building owner, Senate Properties, is a government owned enterprise under the aegis of the Finnish Ministry of Finance and is responsible for managing the Finnish state`s property assets and for letting premises. Senate Properties provides services related to premises, primarily to customers which form part of the state administration. The services include leasing premises, investments, and the administration and development of the property portfolio. As a business enterprise, Senate Properties finances its own operations and is not dependent on the state budget. The building stock comprises university, office, research, cultural and other buildings.

Senate Properties in brief
- 11 200 buildings, 8.2 million m2
- Turnover EURO 645,8 million
- Property assets valued at EURO 5.6 billion
- 3,900 leases
- 276 property professionals
- Five divisions: Ministries and Culture, Defence and Security, Universities and Research, Offices as well as Development and Regional Properties.

The end user of building, VTT - Technical Research Centre of Finland, is the biggest multitechnological applied research organisation in Northern Europe. VTT provides high-end technology solutions and innovation services.From its wide knowledge base, VTT can combine different technologies, create new innovations and a substantial range of world class technologies and applied research services thus improving its clients' competitiveness and competence. Through its international scientific and technology network, VTT can produce information, upgrade technology knowledge, create business intelligence and value added to its stakeholders.

VTT is a part of the Finnish innovation system under the domain of the Ministry of Employment and the Economy. VTT is a non-profit-making research organisation. VTT has ISO9001:2000 certificate.

VTT operates in VTT Group structure starting January 1, 2010. The new structure strengthens VTT’s position in domestic and international research markets and improves the efficiency and effectiveness of VTT operations. VTT Group consists of VTT research and development, business solutions, strategic research, and IP business, and VTT Group companies VTT Expert Services Ltd, VTT International Ltd and VTT Ventures Ltd. The companies offer expert, testing, certification and product approval services, services for boosting VTT's international networking and business as well as spin-off activities.

VTT in brief
- Turnover: 245 M€
- Personnel: 2700
- Established: 1942

3.2 Assessment methods and tools applied in the enterprise

Senate Properties is the largest building owner in Finland and uses internal investment indicators called SeneKPI in all facility projects. Altogether Senate Properties has an objective to harmonize all indicator systems. Currently they are seeking an international indicator scheme that is locally adoptable. This indicator classification should cover also internally applied core indicators (SeneKPI) and value creation indicators.

Other objective in Senate Properties is to embrace usage of BIMs in all facility projects, both in new buildings and renovations. In the first phase, models will be required in ordinary projects and only for some of the design jobs of the project. The requirement for modelling will apply both to construction and to renovation projects. The obligatory part will be limited to modelling and visualisation of the starting scenario and architectural design as well as to the monitoring of the scope and costs performed on the basis of the models. In the architectural design, modelling will be applied throughout the process, starting with the presentation of alternatives based on space models and ending with the tender documents for the contracting stage. In the project planning stage, the main emphasis for modelling will be on supporting the investment decision by comparing alternatives' scope, costs and lifecycle attributes. To facilitate cost control, type data in conformity with the room schedule for spaces will be added to the model. The quantity and scope data obtained from the model in the draft stage will be used to support the production of the building element estimate. Efforts will be made to secure the energy budget of properties by simulating the building's energy consumption before major decisions and by harnessing these results in monitoring the energy consumption of the building during its occupation stage. Efforts will be made also to model structural and HEPAC systems in the detail design stage, but the requirement for these models will be decided on a case-by-case basis. The use and data content of the models will be binding requirements in design agreements. General description of the BIM s for different parties and their connection to the design process flow is presented in figure 10.

In CREDIT project, end user of Vuorimiehentie 5 office building was interested to examine employee satisfaction on office spaces. For this purpose, a new application to map user perceptions to office spaces was developed. The baseline for this application was easiness to use, and therefore, combines textual survey to visual approach in a unique way. The method draws from answering first to ten questions and then addressing ten different space types by selecting the image that user prefers most from set of images collected from similar spaces in organizations building portfolio. The approach provides new kind of feedback to top management concerning the user satisfaction.

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

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

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

Figure 10. General description of the BIM s for different parties; mandatory tasks in bold, other tasks decided on project basis. Fields marked with gray are generally not included but serve the design process and are performed according to a separate assignment.

3.3 Costs and performance indicators applied in the enterprise

Senate Properties applies the following approaches related with CREDIT: Investment decision support and benchmarking (SeneKPI), and Common Finnish environmental rating (PromisE). The SeneKPI indicators are applied to all construction projects, including new buildings and renovation projects. KPI and workplace management needs are very similar from viewpoints of commitments by state, Senate Properties as owner and users of spaces. Then sustainability is emphasized for Senate Properties and directly working workplace needs for user. However SeneKPI may be applied from different

points of view as well. See also the other Senate Properties case study FI03 that discusses more deeply the workplace management issues.

The space preferences survey application has been developed in the CREDIT project on top of the open source applications and running on MySQL database. The main interest in the survey is to understand better the work place satisfaction and preferences that users have in their individual and collaborative work at VTT's facilitiesconcerning the current work place. The user fills the information through standard web survey that has more user friendly visual data input through selecting images. The spaces that are evaluated include entrance to building, lobby, corridors, work place, meeting rooms, teamwork spaces, printing and support rooms, coffee rooms, outdoor relaxation area, and temporary work places. Screenshots from space preference application are shown below in Figure 11.

Figure 11. Screenshots from space preferences survey carried out to end users at Vuorimiehentie 5 office building.

During the CREDIT project, small sample of employees answered to survey. This kind of studies may reveal patterns in answers between age groups and genders. In our survey, one of the trends remaining was valuation to cosiness and richness of colours (Figure 12).

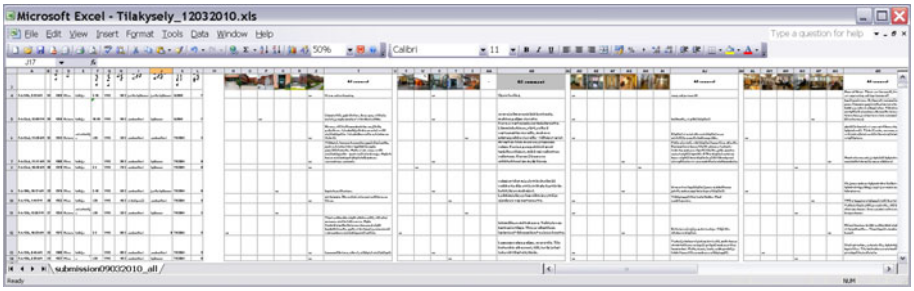

Figure 12. Screenshot from results from small sample of employees that answered to space preferences survey at Vuorimiehentie 5 office building.

3.4 Relation to building cases and benchmarking organisations

Since 2001, Senate Properties has carried out a number of pilot projects to develop and study the use of building information models. Based on feedback from these, Senate Properties has assessed product model technology to be sufficiently ready for putting to use in ordinary project work, and the company has decided to require models meeting the IFC standard in its projects as of 1st October 2007.

3.5 Visions and innovation for future improvements

The level of modelling required from 1st October 2007 is just the first step in going over to the broader use of models. Senate Properties will develop modelling requirements together with property owners in the Nordic countries, the USA and the Netherlands. The aim is to go over to all-embracing, integrated model-based operations in designing, building, and property servicing and maintenance in the next few years.

The results from a small sample of employees in space preferences survey were very promising. The new visual approach was found both, very easy to use by end users and simultaneously very helpful by managers in order to map the satisfaction to work spaces.

4. National benchmarking – indicators, assessment and organisation

4.1 The actual benchmarking organisation and its purpose

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

4.2 Assessment applied in the benchmarking organisation

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

4.3 Cost and performance indicators applied in benchmarking

The PromisE indicators are divided to four main categories; health of users, consumption of natural resources, environmental loadings and environmental risks. Each indicator is valued in five level scale (A, B, C, D, E), ranging from E-level representing normal level, to the A-level that promotes excellent solution. The indicators and categories have been weighted and the excellence of the building can be expressed in terms of one class. Values from PromisE rating in Vuorimiehentie 5 office building renovation are listed in Table 1. According to PromisE rating, the building level environmental class of Vuorimiehentie 5 is C.

4.4 Relation to enterprises, building project and real estate

PromisE was developed by a joint ef-fort by Motiva, The Finnish Association of Building Owners and Construction Clients (RAKLI), the Finnish Ministry of Environment and the National Technology Agency of Finland (Tekes). It has been used by large number of companies in the Finnish construction and real estate cluster ranging from Senate Properties, the largest building owner in Finland, to largest construction companies.

4.5 Visions and innovations for future improvements

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

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

5. Discussions and conclusions

5.1 Buildings - lessons learned and recommendations

In this case study, the building owner has implemented multiple indicator systems as the CREDIT indicators on cost and performance indicators, the ratings for national environmental classification PromisE, and the Building Information Models (BIMs) for renovation project. These practical studies support the Senate Properties future goal to find an internationally implemented indicator classification adoptable to local conditions. Because the CREDIT indicator framework was not finished when this case study has been implemented, this case study follows the nationally agreed Finnish indicators on cost and performance.

5.2 Enterprises - lessons learned and recommendations

One objective in Senate Properties is to embrace usage of BIMs in all facility projects, both in new buildings and renovations. The level of modelling required from 1 October 2007 is just the first step in going over to the broader use of models. Senate Properties will develop modelling requirements together with property owners in the Nordic countries, the USA and the Netherlands. The aim is to go over to all-embracing, integrated model-based operations in designing, building, and property servicing and maintenance in the next few years. In the future, Senate Properties has target to take in use more LCA based indicator systems that operate in the interface of value creation to end user. Therefore, they have constantly tested various LCA based indicator systems, such as national stands like PromisE environmental rating, BREEAM and LEED. At the moment the interest is to find an internationally implemented indicator classification adoptable to local conditions. Regarding CREDIT project, one of the Senate Properties objectives is CREDIT indicator framework and its suitability to be a widely used cross-border benchmarking framework for property portfolio management.

In Vuorimiehentie 5 office building, the end user was interested to map user preferences to office spaces. The new application that combines textual survey to visual approach in a unique way was developed. The results from small sample of employees answering to survey were very promising. The visual approach was found both, very easy to use by end users and simultaneously helpful by managers. Therefore, new more user friendly approaches have much potential for further development.

5.3 National benchmarking - lessons learned and recommendations

Senate Properties applies the Common Finnish environmental rating (PromisE) approach, which is also applied in this case building. The classification can be used to identify the environmental features of existing buildings, to verify the environmental character of the maintenance of existing buildings, and to set targets in order to improve the environmental aspects of a building. As a whole the tool is functional and well defined, depending on the lat-

est understanding on sustainability but in broader scale it has rather limited focus not covering all important objectives. Therefore, the classification has been used in parallel with other indicator systems and in this context CREDIT framework is also one potential candidate for further development.

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Construction and Real Estate -
Developing Indicators for Transparency

This report represents the finding and results from the fourth Finnish case study (FI04) called Vuorimiehentie 5 Office Building. Work belongs to Nordic project Construction and Real Estate – Developing Indicators for Transparency (CREDIT), that represents a sectional view to case studies from varied building types in Nordic and Baltic countries: offices, housing, schools and nursery, shopping centres and hospitals. The work has been undertaken by the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi (Denmark), VTT (Finland), SINTEF (Norway) and Lund University (Sweden), and partners from Icelandic Center for Innovation (Iceland), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

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