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Lappeenranta Tax Office

CREDIT Case FI03

Danish Building Research Institute
AALBORG UNIVERSITY

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Construction and Real Estate -
Developing Indicators for Transparency

Lappeenranta Tax Office

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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. Lappeenranta tax office was totally renewed and simultaneously also workplace efficiency was improved.

Buildings (WP4) summary

Senate Properties uses Key Performance Indicators (KPI) and workplace management in the projects. It highlights sustainability in the workplace development. Multiple indicator systems were tested in the project (SeneKPI, workplace management, POE, PromisE, LEED and VTT ProP®). Project was successful and underlines importance of bringing closer building and facility management concepts.

Enterprises (WP5) summary

Senate Properties is one of the largest real estate managers in the Finnish industry. It uses indicators for investment decision support and benchmarking (SeneKPI) in every project. Currently Senate Properties is also determined to improve workplace management, make end-user satisfaction surveys with POE, and be in the frontline for using Building Information Modelling (BIM) regularly in every investment project over 2 million Euros.

Senate Properties develops indicator systems into tools that user in the projects. At the moment Senate Properties has tested multiple indicator systems, and has an objective to harmonize the use of multiple indicator systems.

National benchmarking (WP6) summary

There are no commonly agreed or standardized global or European Key Performance Indicators. Senate Properties has a focus on work place management to increase customer satisfaction, create strategic relationships with clients (partnership agreements) and to meet the government needs, and asset in real estate business. The existing national indicator systems, such as PromisE and LEED, have been designed to consider mostly environmental values, sustainability and life-cycle economy.

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

Senate Properties has two cases in the CREDIT project. This first case is a renovation project called Lappeenranta tax office. Building was totally renewed in deep co-operation with people of Senate Properties, consult and end-user. In the renovation, main purpose was to develop spaces towards comfort, light and strategic working environment. Senate Properties introduces in this case study multiple approaches; investment decision support and benchmarking (SeneKPI), performance classification (VTT ProP®), environmental rating systems (PromisE and LEED), end-user opinions (POE), work place management, and Building Information Modelling.

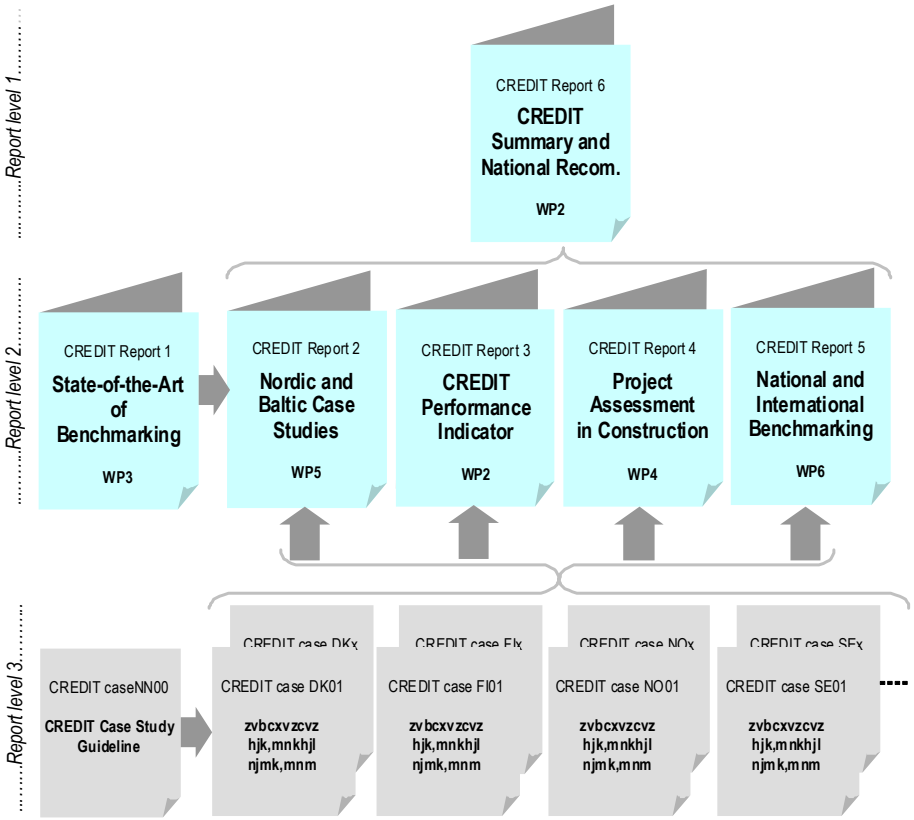
1.3 Research design and methods applied in the case study

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

2.1 The actual building, building parts and processes

Lappeenranta tax office (12 150 brm2) was constructed 1980 and under a thorough renovation from 2003 to 2005 including renovation of moisture damages, structural reparations, renewal of HVAC technology and work-place of taxation department. TH building has totally about 300 working places. In the renovation, the targets were set to comfort environment, better modification, better changes for co-operation and service ability of clients as well as better indoor conditions. Figure 1 shows the building from outdoors, and layout from one floor.

Figure 1: Lappeenranta tax office (Image courtesy of Senate Properties).

2.2 The applied assessment methods and tools in the processes

The building owner, Senate Properties, has studied multiple indicator systems and in Lappeenranta office project. For the CREDIT project, the most interesting ones are investment decision support and benchmarking (SeneKPI), performance classification VTTProP®, environmental rating systems (PromisE and LEED), end user opinions (POE), work place management, and Building Information Modelling.

The renewing process started in May 2004 when first informative occasion to personnel was held and interviews performed. In January 2005, the space solutions ware presented to personnel and more interviews for groups and individuals were made. In the design process environmental ratings were given to facility according to PromisE and LEED systems. After 6 months of building occupancy in May 2006, the first POE round was carried out. The second POE round was collected 18 months after moving. Detailed schedule for case implementation interviews for personnel was as follows

1. May 2004 (before remove)

– One informative occasion to personnel
– Interviews

2. January 2005 (before remove)
– Space solutions have been made and told to personnel
– Group and individual interviews

3. May 2006 (1. POE – Post Occupancy Evaluation)
– About 6 months after remove
– 6 group interviews and a questionnaire to whole personnel

4. April 2007 (2. POE)
– About 18 months after remove
– 3 group interviews and a questionnaire to whole personnel

2.3 Cost and performance indicators applied in the assessments

Multiple indicator systems and approaches have been utilised in Lappeenranta tax office. The first approach used in the case is SeneKPI, used by Senate Properties based on investment indicators that already are used in the enterprise in following phases (Table 1):

- As a description, setting targets and analysing life cycle economy and risks on target setting
- As an iterative analysis of functionality, values and life cycle economy on planning and construction
- As a systematic effectiveness analysis in use

SeneKPI is a help for management of both new and renovation investments and use and maintenance. It also gives information for resale value estimations. It may be used in comparing different the facilities with each other too and increases interest towards life-cycle based indicators too. Senate Properties is interested in to increase productivity of clients but doesn't use other indicators than working environment.

Table 1: SeneKPI summary from Lappeenranta Tax Office.

PROJECT	**Project type:** Renovation **Business area:** Offices **Client:** Central Finland, Offices	**Project name and descriptions:** **Lappeenranta Tax Office** is constructed 1980 and was an object of a thorough renovation 2003…2005 including renovation of moisture damages, structural reparations, renewal of HVAC technology and workplace of taxation department. As targets were set comfort environment, better modification, better changes for co-operation and service ability of clients as well as better indoor conditions. 7 500 htm2 | 12 150 brm2 | 35 000 brm3 | 300 workplaces
FUNCTIONALITY AND VALUES	CLIENTSHIP AND AGGREEMENTS	Permanent client ship. Aggreement time 15 years. Profit target 8,9 %. ***
	LOCATION	Centre of Lappeenranta ***
	ARCHITECTURE AND CULTURAL VALUES	Minor **
	WORKING ENVIRONMENT	The spaces are modifiable, colourful and light. They ensure good possibilities to co-operation. The services of clients have been separated from other spaces. **
	CONDITION AND BUILDING LIFE	After the renovation condition good and building life over 80 years ***
	HEATING ENERGY EFFICIENCY	E → D **
	ELECTRIC ENERGY EFFICIENCY	C → D **
	INNER CLIMATE	S3 → S2/S1 ***
	ENVIRONMENTAL CLASSIFICATION	B **

		Unit	Basis 020105	Project targets 020105	Realized 020107	Use 020108	Use 020111
EFFECTIVINESS	INVESTMENT COST	mill. €		11,3			
	SPACECOST	€/v	0,80	1,10	1,15	1,18	
	RENTS	mill. €/y	1,10	1,50	1,55	1,60	
	PRESENT RESIDUAL VALUE	mill. €	12	21	23	22	
	PROFIT RATE	%	7,2	8,9	8,6	8,8	
	HEATING ENERGY CONSUMPTION	kWh/m2/y	32	25	27	24	
	ELECTRIC ENERGY CONSUMPTION	kWh/m2/y	10	12	13	12	
	CLIMATE CHANGE - emissions CO2 - primary energy	tn/m2/y kWh/m2/y	740 25	725 22	760 23	690 22	
	USE OF WORK PLACES	%	93	98	96	94	
	M2/workplace	m2/wp	32	27	26	26	
	USER SATISFACTION	%	60	75	69	72	
RISKS	RISKS AND POSSIBILITIES	Potential risks concern permanence of client, growth of maintenance costs and possible structural damages.					

The second approach on indicator frameworks tested in Lappeenranta is VTT ProP® building properties classification. VTT ProP® is a building performance classification which can be used for setting the objectives in order to meet client needs.

The Structure of VTT ProP® consists from conformity, performance, life cycle costs and environmental pressure (see Figure 2).

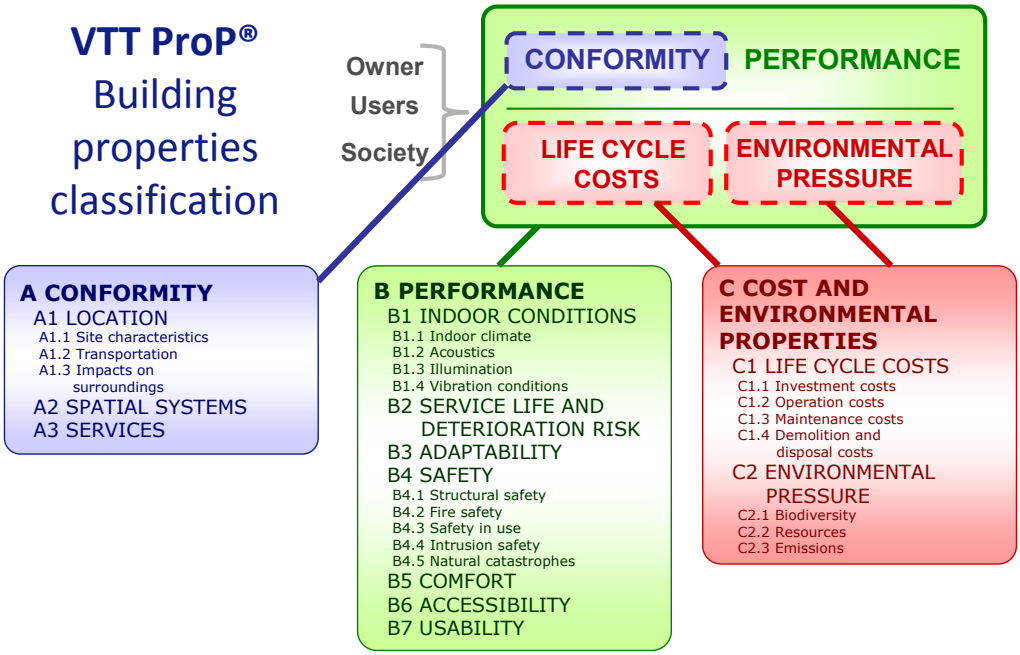


Figure 2: Structure of VTT ProP® building properties classification.

Lappeenranta tax office renovation, indicators from VTT ProP® building properties classification are described below. Summary for the indicators is drawn together after the indicators in Figure 3.

A1. Location: In the centre of Lappeenranta
A2. Space-services: Open Office
B1. Indoor conditions: The indoor climate class has been improved from S2 to S1 as well as acoustics and electricity circumstances from quality class 3 to quality class 2.
B2. Service time and risk for damages: Risk for damages has been decreased and service life remarkably risen (from 20 years to 80 years); altogether from quality class 4 to quality class 2.
B3. Modification rate: The modification rate has been improved from quality class 4 to quality class 2.
B4. Safety: Structural, fire and personal safety has been improved from quality class 3 to quality class 2.
B5.Comfort: Has been improved in spite of direction to from quality class 3 to quality class 2.
B6. Accessibility: Improved from quality class 2 to quality class 1.
B7 Usability. On the whole the usability has been improved from quality class 3 to quality class 2.

Figure 3: Summary from VTTProP® building properties classification.

Third approach on indicator systems is PromisE. It is an environmental assessment system in Finland for office buildings, apartment houses and retail stores in both existing buildings and new buildings. System also constitutes from an assessment tool over the internet.

The framework includes four main categories; health of users, consumption of natural resources, environmental loadings, and environmental risks. All indicators are evaluated in a five-scale rating (A, B, C, D, E), in which the best properties reach the A class. The overall PromisE rating for Lappeenranta Tax Office after renovation is C. Individual indicators are listed more thoroughly in Figure 4.

PromisE – Lappeenranta tax office

	A	B	C	D	E
HEALTH OF USERS		B			
Management of indoor climate			X		
Indoor air quality		X			
Management of moist damages	X				
Illumination		X			
CONSUMPTION OF NATURAL RESOURCES			C		
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		B			
Environmental risks of building site		X			
Environmental risks of building		X			
Environmental risks of construction			X		

Figure 4: PromisE environmental rating from Lappeenranta tax office renovation.

The forth indicator system tested in the case is LEED (Leadership in Energy and Environmental Design) Main principle in LEED is to provide a sustainability report for a building. Therefore, s property gets certain project total points; the highest rating is Platinum (64-85 points), which is followed by Gold (48-63 points), Silver (40-47 points) and Certified (32-39 points). Different rating systems have been developed from LEED to different project types, such as new construction and major renovations (LEED-NC), and existing buildings and operations (LEED-EB). Figure on next page presents contains LEED ratings for the Lappeenranta tax office (Figure 5).

LEED for Existing Buildings v2.0 (year 2008)
Registered Building Checklist

Lappeenranta Tax Office

Yes	?	No			
5			**Sustainable Sites**		**14** Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
Y			Prereq 2	**Age of Building**	Required
1			Credit 1.1	**Plan for Green Site & Building Exterior Management -** 4 specific actions	1
			Credit 1.2	**Plan for Green Site & Building Exterior Management -** 8 specific actions	1
1			Credit 2	**High Development Density Building & Area**	1
1			Credit 3.1	**Alternative Transportation -** Public Transportation Access	1
1			Credit 3.2	**Alternative Transportation -** Bicycle Storage & Changing Rooms	1
			Credit 3.3	**Alternative Transportation -** Alternative Fuel Vehicles	1
			Credit 3.4	**Alternative Transportation -** Car Pooling & Telecommuting	1
1			Credit 4.1	**Reduced Site Disturbance -** Protect or Restore Open Space (50% of site area)	1
			Credit 4.2	**Reduced Site Disturbance -** Protect or Restore Open Space (75% of site area)	1
			Credit 5.1	**Stormwater Management -** 25% Rate and Quantity Reduction	1
			Credit 5.2	**Stormwater Management -** 50% Rate and Quantity Reduction	1
			Credit 6.1	**Heat Island Reduction -** Non-Roof	1
			Credit 6.2	**Heat Island Reduction -** Roof	1
			Credit 7	**Light Pollution Reduction**	1

Yes	?	No			
3			**Water Efficiency**		**5** Points
Y			Prereq 1	**Minimum Water Efficiency**	Required
Y			Prereq 2	**Discharge Water Compliance**	Required
1			Credit 1.1	**Water Efficient Landscaping -** Reduce Potable Water Use by 50%	1
			Credit 1.2	**Water Efficient Landscaping** - Reduce Potable Water Use by 95%	1
			Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction -** 10% Reduction	1
1			Credit 3.2	**Water Use Reduction -** 20% Reduction	1

Yes	?	No			
13			**Energy & Atmosphere**		**23** Points
Y			Prereq 1	**Existing Building Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance** - Energy Star 60	Required
Y			Prereq 3	**Ozone Protection**	Required
6			Credit 1	**Optimize Energy Performance**	1 to 10
				Energy Star Rating - 63	1
				Energy Star Rating - 67	2
				Energy Star Rating - 71	3
				Energy Star Rating - 75	4
				Energy Star Rating - 79	5
			x	Energy Star Rating - 83	6
				Energy Star Rating - 87	7
				Energy Star Rating - 91	8
				Energy Star Rating - 95	9

Figure 5: LEED sustainability report fom Lappeenranta tax office renovation.

End-user feedback was collected as a fifth system because workplaces are foreseeing future changes in organisation and ensured the possibilities, to interactively and positive train of personnel for future changes. This fifth approach of using Post Occupancy Evaluation (POE) revealed following important opinions form personnel after moving to the renovated property:

– Spaces
  - ++ The comfort and functionality have been improved
  - + More light in the spaces
– Work, cooperation
  - ++ Co-operation has become more effective
  - ++ Communication and information management have been developed better
  - + The ability to use and develop work place has improved (space-characteristics)
  - • The possibilities to own basis work have not been improved
– About 25 % are in opinion that they cannot work as effectively in open space-based office as in room-based office

– Client services
    ++ Abilities to client services has improved

On strategic level it was also identified need for workplaces because of foreseen future changes in organisation and ensured the possibilities to interactive and positive train of personnel for future changes. The organisational culture has been undergone to be new and development of current operations. Space cost savings 400 Square meters less space - 5000 Euros rent/month - 60 Euros/year.

2.4 Relation to different enterprises and national benchmarking

The main titles of LEED (The Leadership in Energy and Environmental Design) correspond mostly both PromisE and VTTProP®. More over LEED includes also productivity and user guiding. The classifications don't either exactly correspond with each other when comparing total grades. In PromisE, most of the cases are defined to overall C rating, when in LEED cases tend to get certification with 40% probability.

Table 2: Distribution of results in PromisE and LEED classifications.

PromisE	**A**	**B**	**C**	**D**
Classifications	1…3 %	10…15 %	70…80 %	10…15 %
LEED	**Platinum**	**Gold**	**Silver**	**Certified**
Classifications	5 %	25 %	30 %	40 %

2.5 Visions and innovation for future improvements

The workplace process of new construction as well as in thorough renovation project is strongly dependent on user-organisations strategies aiming at that kind of mixture of spaces will satisfy targets of all interest groups. Then the most significant factors concerning good workplaces are:

– Image of facility and work places
– Good indoor conditions
– Good ICT –environment
– Durability of floors etc.
– Fluency of working
    - Technology supporting (flexible) working
    - Confidential calls and meetings
    - Possible savings in work time
– Possibilities to video conferencing and teleworking
– Promotion of co-operation
– Promotion of flexible work
– Promotion of communication
    - Working communication plan
    - Communication of image
    - Informal communication
– Improving of comfort and ergonomics
    - Colours
    - Furniture
    - Cosiness of common spaces

    - Common use of resources (work spaces, equipment, parking slots…,)
    - Spaces should be generic
    - The court should be "green" and include some water source
- Promotion of ability to use work environment
- Multi-usability
- Ability to client services
- Attitudes towards work place's development
- Sustainable floors

One of the leading development ideas in the work place management is to facilitate spaces for multi-skilled people. Regarding the changes from so called cell offices to open layouts, results must be very well argued and long-influenced in Optimaze.net service. A pay back time for the investment used to be 0,5-2 years even if the increasing space brings remarkable savings in the space costs.

Currently big facility owners and users are also interested in to bring closer building and facility management concepts, which have been optimized by image, economy, sustainability, user satisfaction and ability to serve clients.

3. Enterprises – assessments and indicators internally applied

3.1 The actual enterprise, company and firm

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 2009). 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

As one of the largest real estate managers in the Finnish industry and as such is a trendsetter and forerunner in the business being involved with general future trends in real estate and construction sector in Finland have been described as follows (Figure 6).

- The environmental expertise of the Finnish real estate and construction sector will be internationally renewed
- Lifecycle evaluations shall be part of public sector decision-making
- Sustainable and economic targets are equally important. Units describing environmental burden shall be used along Euros in evaluations
- We have to invest in the implementation of environmental indicators and classification of buildings.

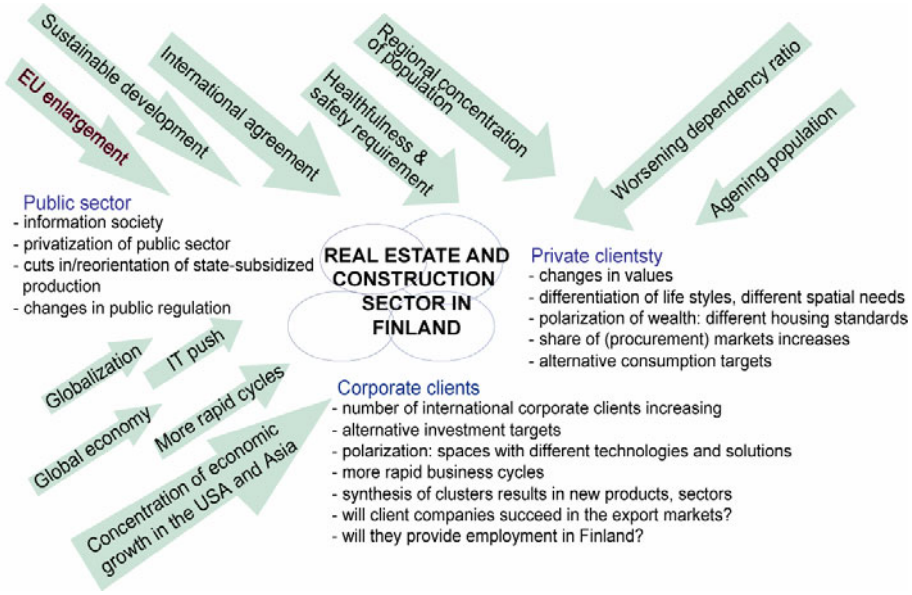


Figure 6: Future trends concerning real estate and construction sector in Finland (RAKLI).

3.2 Assessment methods and tools applied in the enterprise

Senate Properties is committed to state's strategy of premises, which expects to

- Support and improve effectiveness of working effectiveness and productivity
- Support enforcement of the strategies of organisations and achieving long-sighted targets
- Increase efficiency of space-use (m2/person, €/m2, €/y)
- Increase flexibility of spaces as the amount of working point lessons and the working processes change

Needs for the spaces are influenced by the productivity programme of state and increase of e-business and mobile technology. Senate Properties is a member of PureNeT network, The Workplace Network, and the New Ways of Working Network (NewWOW); which share examples and information aiming at increasing a comparability of facility information.

An important integrative approach for Senate Properties is Building Information Modelling (BIM). Senate Properties is very determined to support new paradigm of design. Currently modelling is used in Senate Properties for both new construction and renovation projects with budget over 2 million Euros. Figure 7 demonstrates how model merging is used for cost estimation, scheduling and energy simulations.

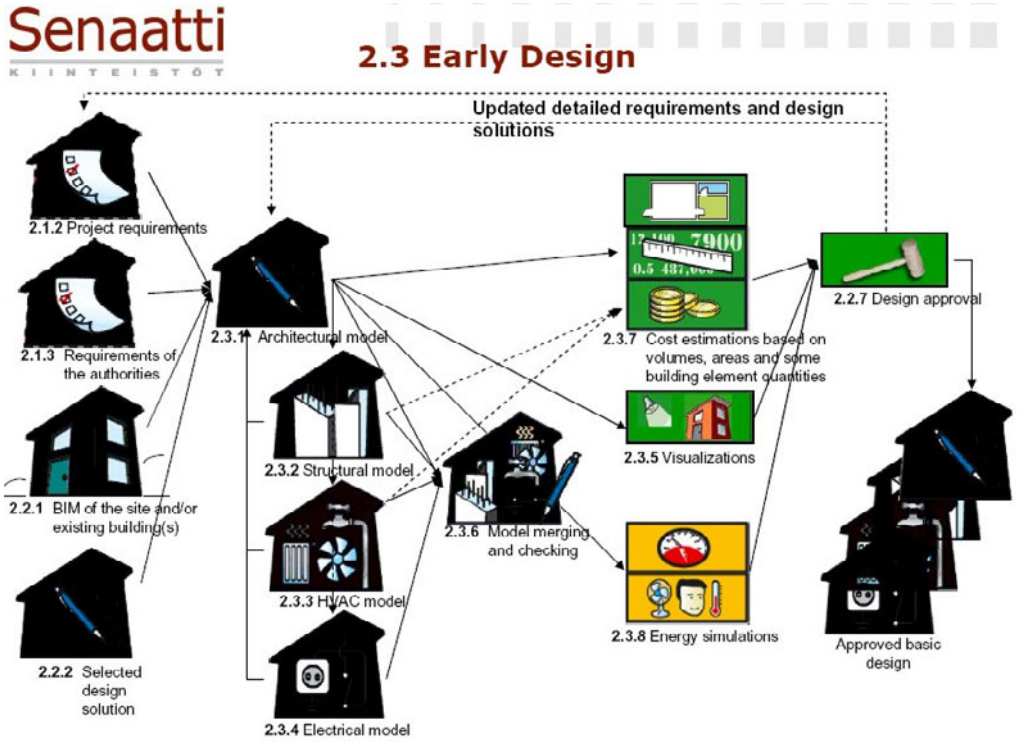


Figure 7: Sustainable Construction and Building Information Models.

3.3 Costs and performance indicators applied in the enterprise

SeneKPI (Figure 8) is an internal tool at Senate Properties for preparing investment decisions. In the investment processes management of time, quality, costs and co-operation are benchmarked as quality indicators. It covers cases of an old and new buildings as well as calculations covering comparisons between an ordinary building and space-effective building. SeneKPI may be applied in the following phases:

– Setting targets for investment decisions in deep cooperation with user and being based on state's strategy of premises
– Planning and benchmarking the performance of the technical solutions in cooperation with user and planners
– Life-cycle commissioning
– Condition assessment, maintenance and primary basis to resale value

In the investment processes management of time, quality, costs and co-operation are benchmarked as quality indicators.

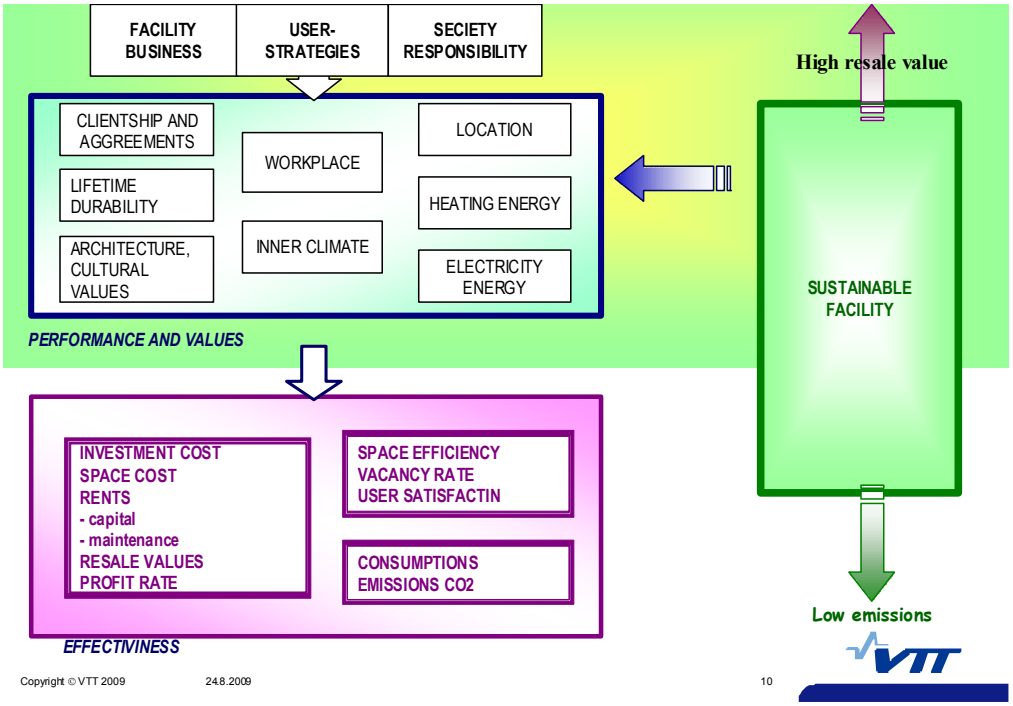


Figure 8: SeneKPI structure.

SeneKPI aims at sustainable facility in a central location providing also flexible working place. Building is aesthetic, healthy and safe, and is economically profitable in terms of maintenance and renovations. In choice of integrated and standardized systems; durability, flexibility, energy economy and waste management are considered and user-satisfaction is expected to remain in good level.

For the end user satisfaction, annual user-satisfaction survey is used at all facilities used by Senate Properties includes following issues

– Services of facility (maintenance, restaurant, security, cleaning)
– Service level of maintenance (service attitude, communication, reparation of faults)
– Indoor climate (air quality, temperature, draughtiness)
– Outside areas (comfort, slipperiness, green areas)
– Common workplace characteristics (location, suitability to work, technical conditions, comfort)
– Condition assessment and maintenance.

The typical resale value indicators in Senate Properties are

– Balanced value of facility (primary) being based on original acquisition cost
– Rent value during rental time
– Market value potential at the end of rental time
– Rent value of the new-coming user
– Tax value (not so reliable).

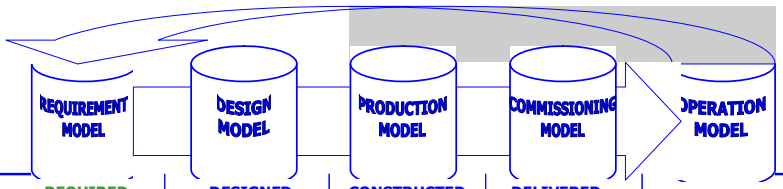
As follows there has been presented SeneKPI's in cases of old and new buildings as well as SeneCost- calculations covering also a comparison between an ordinary building and space-effective building. It is essential to separate user-based indicators because the users use to change in perhaps unpredicted times.

One of principal indicators is energy-economy. Then we have a great challenge in showing life-cycle optimized solutions ensuring also good inner circumstances, good user-satisfactory and good economy. We have to have low-energy and passive building concepts. We cannot only set targets except we must recognize also market-based solutions tested.

3.4 Relation to building cases and benchmarking organisations

Building Information Model (BIM) is applied regularly in investment projects of Senate Properties. It has great potential for value creation during life cycle of buildings at least in the following areas (Figure 9)

– Focus on customer and end-user requirements and sustainability within the building process and life cycle phases
– Increasing transparency in the decision-making process and re-engineering the building process
– Possibilities for cost savings to all actors and better project economy
– Improved possibilities for early stage analysis about: good practice design, construction cost, energy consumptions, environmental impacts, lifecycle cost, performance in use, flexibility, adaptability, indoor climate, usability and maintainability
– A comprehensive and common international knowledge model database with standardized ICT tools, objects and communication rules and available best practices examples.



	REQUIRED	DESIGNED	CONSTRUCTED	DELIVERED	ACHIEVED
PERFORMANCE IN USE	• user requirements • desired performance in use	• designed technical solutions • estimated performance	• constructed building	• validated conformity	• user satisfaction • performance in use
ENVIRONMENTAL IMPACTS	• targeted environmental impacts over the life cycle	• estimated environmental impacts over the life cycle	• environmental impacts during construction	• estimated environmental impacts in use	• environmental impacts of building and its use
ECONOMIC IMPACTS	• targeted whole life costs • targeted business benefits and value of the facility	• estimated life cycle costs	• construction costs	• estimated running costs	• running, maintenance and refurbishment costs, recycling, reuse, demolition and waste disposal costs • value of facility
OTHER	• targeted social, cultural and institutional impacts		• construction safety • construction ethics		• social impacts in the neighbourhood • impacts to the cultural heritage

Figure 9: Innovative and sustainable building information models.

All these areas considered in various project phases are important. Some of these aspects, especially requirements model and design model, are structured into the categories of performance in use, environmental impacts, economic impacts and social, cultural and other impacts. As process indicators Senate Properties uses following

– Existence and quality of Asset Business Plan
– Implementation level of framework agreements and standards regarding suppliers
– Stringency of implementation of Portfolio ratings
– Compliance and success of ISO14001
– Number of non-defective lease per employee.

It is apparent that the diffusion of BIM and linked metadata is strengthened, and there is potential for indicators like the PromisE condition class to gain more attention. Regarding indicators, we need to clarify their usage and then it is possible to mobilise indicators in projects with BIM, because it provides a platform capable to managing e.g. SeneKPI. In the early design modelling is used to making simulation and analysis on the design solution.

3.5 Visions and innovation for future improvements

Lappeenranta Tax Office has been a successful pilot project for Senate Properties, Tax Administration and whole public sector. Benefits for Senate Properties have been

- flexible and diverse solutions
- space efficiency (vs. social responsibility)

In the future, Senate Properties tries to solve following questions related to investment process:

– What kind of tools and indicators should we use to measure productivity; in what cases is it fruitful?
– How much does a poor workplace effect on productivity and do we want to show some warning examples?
– What kind of user-guides should we have?
– What new kind of facility intelligence are we going to be faced to?

4. National benchmarking – indicators, assessment and organisation

4.1 The actual benchmarking organisation and its purpose

There are no commonly agreed or standardized global or European Key Performance Indicators.

4.2 Assessment applied in the benchmarking organisation

Benchmarking systems presented in this chapter, such as the British OGC and GSA from United States, have been tested at Senate Properties.

4.3 Cost and performance indicators applied in benchmarking

The British OGC (Office of Government Commerce) has introduced a standardised framework to enable departments to measure and manage their own estate performance. It defines efficiency and effectiveness consistently for use by all departments and has been tested the performance framework on 130 buildings from four departments on following indicators

- Cost /m2
- m2/Workstation
- Workplace Productivity including functional suitability, workplace environment and downtime
- Environmental Sustainability including kWh/m2/year, Solid waste recycled, m3/water
- Operability inc. condition and health and safety.

GSA (General Services Administration) is the largest facility owner in the United States. It evaluates following characteristics from facilities:

- Total square feet 759,000,000 rsf (office)
- Cost per square feet owned $4.95 per rentable square foot
- Vacancy rate 3.9 percent
- Cost per person $14,200
- Customer satisfaction 89 percent
- Sustainability (LEED) 53 percent.

Further, GSA has also described characteristics of good work places, such as:

- Workplace to meet the functional needs of the users
- A clean, healthy building environment, free of harmful contaminants and excessive noise, with access to air, light and water
- Workplace configurations that can be readily restructured to accommodate key functional changes with a minimum of time, effort, and waste
- Workplace services, systems, and components that allow occupants to adjust thermal, lighting, acoustic, and furniture systems to meet personal and group comfort levels
- Full communication and simultaneous access to data among workers at both on-site and off-site workplaces

– Workplaces with efficient, state-of-the-art heating, ventilating, air conditioning, lighting, power, security, and telecommunication systems and with easily maintained equipment with backup capabilities to minimize downtime.

Social aspects are present in Corporate Social Responsibility (CSR) strategies by enterprises that often use triple bottom line (economic, environmental, social) reporting. There are guidelines for CSR, e.g. Sustainability Reporting Guidelines (Global Reporting Initiative) that provide a structure for social aspects that is relevant also to sustainable construction (GRI, 2004). At present, they don't directly help in development of standards for user requirements, building performance, or environmental and social impacts. Social aspects can also be addressed on the building level like for example (ISO 2006b)

– Quality of buildings as a place to live and work
– Building-related effects on health and safety of users
– Barrier-free use of buildings
– Access to services needed by users of a building
– User satisfaction
– Architectural quality of buildings
– Protection of cultural heritage.

Global information about space utilization, normally square meters per worker, are published by DTZ Research (http://www.dtz.com). For example in Finland the space efficiency in offices is approximately 25 square meters per worker which really high compared to other European countries. Sustainability situation of each country and globally may also be checked through Environmental Sustainability Index ESI and Environmental Performance Index EPI.

4.4 Relation to enterprises, building project and real estate

Working environment covers all workplaces which are regularly used by working group or team. It has to be noticed that most of people work in many spaces and situations for example during work week, which may be analysed by means of work profile and space use analyses.

Workplace represents the convergence of facilities with spaces, management, user services, information technology and human resources. The responsibilities of facility managers extend beyond operating issues to the more fundamental goals of providing high-performing and sustainable workplaces. Remarkable basis of workplace development is to notice the interaction of user's business actions (workplace strategy) and premises. Perhaps the most remarkable development factor is ICT- and communication technology making it possible to serve clients even better as well as applying flexible ways of working. Place sends messages about corporate and group culture. Workplace process is connected with work psychology and environment psychology. Space efficiency may be measured with so called hard factors; for example

– Total use of spaces m2
– Unit use of spaces: m2/person, m2/action
– Space cost totally, /person /action
– Times of use of spaces
– Amount of personalized working points
– Cost per change (furniture, removing company, costs per personnel
– Amount of waste paper and other wastes

With regard to workspace structure, there is a general opinion that individual working rooms and individual workstations create satisfaction, while lack of those can be compensated with help of good architectural design and high quality ICT (Voordt 2004).

Effectiveness concerns self estimation: effects on productivity and client satisfactory as well as amount of sick cases. Expression may be noticed by client interviews; imago and reputation.

The spaces may be described as connective for social work, formal for silent work and reflective for marketing work etc. Everybody has some how different work styles; so working environment should aim at supporting personal productivity and satisfactory –based choices at least with following interactions: face to face interaction and communication through internet.

Facility is usually a customized mixture of strategic-, team and individual based spaces

– Common areas
– Team rooms
– Open working areas
– Negotiation rooms
– Rooms for special actions
– Private rooms

The most important factors that affect productivity of work include

– The quality of indoor conditions
– Workspace structure
– Comfort of work spaces
– Flexibility
– Interaction
– Disturbances
– Safety

Similar aspects affect work satisfaction (Olson 2002, Veitch et al. 2003).

– Possibilities for undisturbed work and spontaneous interaction,
– Comfort,
– Ergonomics, space for storing the needed equipments and documents,
– Possibilities for chatting and
– Good spaces for break;
– Accessibility to needed technology, indoor conditions and possibilities to adjust

Use of spaces and technology should at least be focused as follows

– Optimization of use times of ventilation equipment
– Optimization of use times of servers
– Necessary service time of computers
– Lightning based on presence and utilization of nature light
– Premeditated acquisition and use of office devices (EnergyStar; combinated devices)
– Cleaning of work places
– Electronic information management; deduction of use of paper
– Adequacy of waste fractions

Choice of user services - sustainability, flexibility, client serviceability and total economy. The role of maintenance from workplace point of view is to

– To ensure adjustments ja faultless action of HVAC –systems
– To identify possible changes in inner climate
– Maintenance plans
– Regular verifications of ventilation systems

In case of information work the real use rate of solid working points use to be only 5-10 % during the whole year and 20-25 % without weekends and vacation times. Then the most important efficiency targets of workplace –process

– On society's level better space efficiency and ICT-environment mean lower energy, construction and traffic needs
– On organisational level the targets concern lower space costs and better productivity, cooperation and innovation
– On individual level the wills concern comfort and healthy working environment and adequate choice possibilities for flexible ways of working

The need for customization and optimization in office-buildings is remarkable and difficult to manage. Typical office worker may work in own office, from home and in many kind of third places. However the technology provides currently certain level of freedom for mobile working, but does not yet cover all of typical possible work places. The levels of work place development may be described as follows

– Renewing the work places strategy, flexible ways of working
– Renewing the space as a whole
– Effectiveness of the space use and increase of integrated use of spaces

Workplace strategy includes an analysis and development of the interrelationships of organisation's strategic goals, business processes and facilities and related change management as objective to gain added value to client organisation. It is then also question about new ways of working and total management of resources when trying to change workplace from cost item to productive resource. As the workplace changes mean shrinking the typical phases of approval by personnel may be described as follows

– Stopping, shocking
– Resistance to changes
– Awareness of need for change
– Approval of reality
– Testing new ways
– Internationalisation
– Adoption of new actions

4.5 Visions and innovations for future improvements

Senate Properties has long traditions among workplace process being the leading service provider in Finland. Services cover support for planning process to produce better facilities (customer satisfaction), tool to create strategic relationships with clients (partnership agreements), tool to meet the government needs, and asset in real estate business.

Senate Properties' role in projects is procurement and project management, and it has partnership agreements with 10 workplace consultancies. The levels of workplace changes promoted by Senate Properties are:

<u>Level 1. Improving space efficiency</u>

– Shrinking and increase, utilization rates
– Improving usability and flexibility
– Eliminating workplace obstacles
– Relocation functions

<u>Level 2. Alignment</u>

– Multidisciplinary approach HR, spaces, ICT, services
– Diverse workplace solution supporting different needs and activities
– Knowledge management
– Branding

Level 3. Transformation
– New strategy/vision
– Process development
– Supporting mobile and distributed work
– Radical workplace solutions
– Flexible and diverse workplace and service strategy

Levels 2 or 3 are usually connected to total strategies of user organisation. Then there are number of workplace process phases. The workplace process presented in Table 3 and implementation solutions of space changes in Table 4 are based on guide committed by Senate Properties (Päivi Hietanen) and practises of consults. Consulting from the beginning of 1990's and covering more 10 consults nowadays. In Finland Nokia and Nordea are leading users in private sector and Senate Properties in the public sector.

Table 3: The objects and methods of workplace development on different levels.

Phase	Objects	Methods
1. Strategic functionality analysis of user-organisation	Organisation strategy-based general workplace needs. Wideness and ways of flexible working. Evaluation of change needs Focuse of expression.	Interviews (leaders, key persons, binding groups) Workshops of leaders. Balanced Score Card.
2. Definition of needs of changes to workplace ▪ from hierarchical space allocation to new ways of working ▪ support for innovations and creativity	Analysis of present state. Suitability of current workplace and description of change needs. Description of new ways of workplaces. Setting efficiency targets.	Use clarification of spaces. Work profiles. Netbased interviews. Communications plan.
3. Producing workplace solutions ▪ development of new models and solutions in co'operation with personnel ▪ visual consepts (3D), branding ▪ layout of actions ▪ space and furniture layout ▪ design and construction	Development of workplace ▪ general actions ▪ organisation ▪ team ▪ individual ▪ client service Flexibility Space effectivity	Thematic workshops. • visual concept, branding • space and furnishing plan • furniture inventory • pilot space • performance analysis (SeneKPI) • relocation of personnel • modification • user guide (spaces, ICT, energy, waste management,…) • space programming, Costing
4. Effectiviness • before remove • Post Effectiveness POE	Realization of targets. Repairing actions. User-satisfaction.	Net based interviews. Effectiveness-analysis (SeneKPI).
5. Workplace management	Workplace strategy for long sight	Establishment work place team to commit visions, responsibilities and indicators for management of workplace strategy.

When improving the space efficiency (level 1) in Cell Offices it is important to ensure adequate working conditions and technical support (see Table 4). In

VTT, the space efficiency change was carried out with owner Senate Properties and strategic partners according to followings targets:
– Optimized space use based on tenant strategies (Optimaze.net service)
– Set and speed up innovation processes
– Use spaces as piloting platform

In the 2008 removes VTT's space efficiency was improved by 20 %, but in average the change costs per person were however relatively high because of lacking well working solutions. Pay back time is over 1 year and real effects on productivity are hard to monitor. Therefore, it should be recognized that changes in cell offices have to be thoroughly considered and planned.

Table 4: Principles and effects of shrinking workers in box office.

Basis	**Solutions**	**Economical effects per person** (Case VTT; shrinking 20 %)
KeyPerformance analysis. Workplace strategy. Work profiles. Use clarification of common spaces.	Communication and motivation plan. Excursions. ICT –store. Furniture plans for different kinds of spaces and supporting furniture store. Increase of flexible ways of working. Interactive setting of teams/personnel. Ensuring lightning enough. Ensuring good inner climate. Office manual.	Change cost +1 800 €/person/time Space cost -1 200 €/person/year *about which* heating cost -200 €/person/year electricity cost -50 €/person/year

Technically the requirements concerning spaces shall be modified to technical definitions for example with following interactions:
– healthiness (HVAC technology, automation, materials)
– safety (structures and building systems and intelligent materials)

Integration of HVAC technology form an important factor of space management. Also new materials and censors change role of traditional physical elements like walls. They may also be eractive to changes in circumstancyes. Intelligent technology does also change during life time of space. It also may be applied "open source" technology to which anyone may later increase some characters.

5. Discussions and conclusions

Senate Properties studied two cases in the CREDIT project. The first one, Lappeenranta tax office was totally renewed with new workplace management targets; 300 workers adopting changes to layout, comfort, cooperation possibilities and indoor conditions. This case study describes those processes combined with these approaches.

5.1 Buildings - lessons learned and recommendations

Senate Properties uses Key Performance Indicators (KPI) and workplace management in the projects. It highlights sustainability in the workplace development. In Lappeenranta project, following approaches have been applied:

– Investment decision support and benchmarking (SeneKPI)
  Internal tool to manage investments, use and maintenance
– Workplace management
  Senate properties belongs to multiple networks improving work spaces (PureNeT network, The Workplace Network, and New Ways of Working Network - NewWOW)
– Post Occupancy Evaluation (POE)
  Evaluations revealed that working conditions are better but simultaneously 20% of the respondents experienced productivity decrease.
– Common Finnish environmental rating (PromisE)
  Separate weightings for varied building types in both existing and new buildings, internet based tool
    →Lappeenranta Tax Office = C (3rd level in 5 level rating)
– Sustainability rating (LEED, Leadership in Energy and Environmental Design)
  Sustainability report for the building
    →Lappeenranta Tax Office = Silver certification (2nd level of four certification levels)
– Performance rating (VTT ProP®)
  set objectives for client needs, detailed structure may be defined in projects

KPIs are increasingly connected with sustainability and workplaces, towards the new ways of working - flexible and remote work. The client, taxation administration, wanted to renovate the facilities and carried out also space efficiency improvement in the work environment. Project was successful and underlines importance of bringing closer building and facility management concepts. However, it is hard to evaluate the trade-off between building performance, developed process and work spaces while organizational performance and changes made. It is also challenging to develop indoor conditions and simultaneously have better energy efficiency because the earlier reduces the benefits of the latter. In office environment the better working conditions are produced mostly with electrical energy.

5.2 Enterprises - lessons learned and recommendations

Senate Properties is one of the largest real estate managers in the Finnish industry. In every project it uses indicators for investment decision support and benchmarking (SeneKPI). Currently Senate Properties is also determined to improve workplace management, and it belongs to multiple networks pushing end/user emphasis forward. The outcomes of this work are development to project level for example with POE surveys.

Over the past ten years Senate Properties has also been in the frontline for using Building Information Modelling (BIM) regularly in every investment project over 2 million Euros. This new paradigm has great potential for value creation during life cycle of buildings.

As a whole, Lappeenranta Tax Office has been a successful pilot project for both, the owner and client, the Tax Administration. After its completion a Kaiku award was given to project, and this also encourages to develop working environment in a renovation project. Case also promotes the importance of matching enterprise strategy to spaces and developing flexible and diverse solutions to increase space efficiency and organizational performance. After the renovation a rent level kept in the same level than earlier, which in turn underlines importance of improving the space efficiency in order this being profitable also to the building owner.

Senate Properties is developing indicator systems into tools that user in the projects. Current space management solution (Optimaze.net) has a carbon footprint calculation covering carbon dioxide production from personnel. At the moment Senate Properties has difference indicator systems for different phases of the project. They have tested multiple indicator systems. The objective is to harmonize the use of multiple indicator systems.

5.3 National benchmarking - lessons learned and recommendations

There are no commonly agreed or standardized global or European Key Performance Indicators. Senate Properties has long traditions among workplace process being the leading service provider in Finland. Currently they have put more focus on work place management to increase customer satisfaction, create strategic relationships with clients (partnership agreements) and to meet the government needs, and asset in real estate business.

Currently Senate Properties is looking for indicator system that could help them to develop performance of the work spaces. However, there is not such an indicator system and existing national indicator systems, such as PromisE, LEED and BREEAM, have been designed from different viewpoint to consider mostly environmental values, sustainability and life-cycle economy.

References

Becker, F. (2002). Organisational dilemmas and workplace solutions. Journal of corporate Real Estate. Vol. 4. Iss. 2. pg. 129 – 149.

Charles, K. E. & Veitch, J. A. (2002). Environmental satisfaction in open-plan environments : 2. Effects of workstation size, partition height and windows. National research council Canada. Institute for research in construction. Internal report No. IRC-IUR-845. 39 pp.

DTZ (2008). *Global Office Occupancy Costs* (GOOC). GREEN STAR 2008. Available at: http://www.gbca.org.au/green-star/ (Accessed 08.06. 2010).

Greenwood, D.J. & Levin, M. (1998), *Introduction to action research: social research for social change,* Thousand Oaks, CA: Sage Publications.

Haynes, B. & Price, I. (2004). *Quantifying the complex adaptive workplace.* Facilities. Vol. 22. Pp. 8 – 19.

Heerwagen, J., Kampschroar, K. Powell, K. & Loftness, V. (2004). *Collaborative knowledge work environments.* Building Research & Information. Vol. 32. Number 6. pg. 510 – 528.

Hietanen, P. (2007). *Productive spaces through workplace-process?* Presentation in Kiinko 11.6.2007.

EcoProP, (2009). Web site of requirements management software. Available at: http://cic.vtt.fi/ecoprop/ (Accessed 29.9.2009).

Häkkinen, T., Nuutinen, M., Pulakka, S., Porkka, J., Vares, S., Laitinen, A., Vesikari, E., Pajari, M. (2007). *VTT Digitalo – seeking solutions for sustainable office buildings and modern working environments*. Available at: www.vtt.fi/inf/pdf/tiedotteet/2007/T2366.pdf (Accessed 08.06 2010).

Ilozor, B.D., Love, P.E.D. ja Treloar, G. (2006). *The impact of work settings on organisational performance measures in built facilities*. Facilities. Vol. 20. pg. 61 – 67.

Josephson, P.-E. & Lindström, J. (2007). *Measuring the performance in Construction Projects: The case of the Swedish "Best Practice tool"*. Construction for Development, CIB World Congress. Cape Town, South Africa.

Lee, So Young & Brand, Jay L. (2005). *Effects of control over workspace on perceptions of the work environment and work outcomes*. Journal of environmental psychology. Vol 25. pg. 323 – 333.

Lützkendorf L., Speer T., Szigeti F., Davis G., le Roux P. Kato A. & Tsunekawa K, (2005). *A comparison of international classifications for performance requirements and building performance categories used in evaluation methods.* In proceedings of CIB 2005: Combining forces - Advancing facilites management and construction through innovation. Performance-based building, Helsinki. pp. 108 - 112.

Majchrzak,A. (2004). *Enabling Knowledge Creation in Fr-Flun Teams: Besti Practises for IT Support and Knowledge Sharing*. Journal of Knowledge Management, Vol. 8 No 4. pp 75-88.

Nenonen, S. (2004). *Analysing the intangible benefits of work space*. Facilities. Vol 22. pg. 233 – 239.

Nenonen, S. et al. (2009). *Managing Workplace Resources for Knowledge Work. From workplace cost to productivity*. ProWork Project 2006-2009. Published 2009-10-10, www.proworkproject.com/prowork/final-report

Norros, L. (2004). *Acting under uncertainty. The core-task analysis in ecological study of work.* VTT Publications 546. Espoo: VTT.

Norros, L., Nuutinen, M. (2002). *The concept of the core task and the analysis of working practices.* In: Borehamn, N., Samurcay, R., Ficher, M. (Eds.). Work process knowledge. London: Routledge. Pp. 25–39.

Olson, John, (2002). *Research about office workplace activities important to US businesses - And how to support them*. Journal of Facilities Management, Vol. 1, Number 1, Pp. 31-47.

Ouye, J. *Does Place still matter?* NewWOWNetwork. 207.

PromisE – internet-based database tool for environmental rating of buildings, available at http://www.promise-luokitus.fi (Accessed 25.9.2009).

Rakli (2002). *Vision 2010.* The Finnish Association of Building Owners and Construction Clients (RAKLI). 2002-05-31, Report 2. www.rakli.fi

Richert. E. *Distributed Work Group Practices.* New Way of Working. www.newwow.net

Robson. C., (2002), *Real world research*, 2nd ed., Oxford: Blackwell.

Senate Properties (2009a), *Company introduction,* available at: http://www.senaatti.fi/index.asp?siteID=2 (Accessed 29.9.2009).

Senate Properties (2009b), BIM modelling guidelines, available at: http://www.senaatti.fi/document.asp?siteID=2&docID=517 (Accessed 29.9.2009).

Seppänen, O. (2004). *Productive office 2005*, Final report B77, HUT.Espoo. (in Finnish).

Vartiainen, M. (2007) *Distributed and Mobile Work – Places, People and Technology*. Helsinki University of Technology, BIT Research Center. Otatieto.

Veitch, J. A., Charles, K.E. Newsham, G.R., Marquardt, C.J.G. & Geerts, J. (2003). *Environmental satisfaction in open-plan environments: 5. workstation sand physical condition effects*. National Research Council Canada. Institute for research in construction. Internal report No. IRC-RR-154. 55 pp.

Voordt, Theo J. M. van der, (2004). *Productivity and employee satisfaction in flexible workplaces.* Journal of Corporate Real Estate. Vol.6. Iss.2, pg. 133-148.

Vos, Paul & Voordt, Theo van der. (2001). *Tomorrow's offices through today's eyes: Effects of innovation in the working environment*. Journal of Corporate Real Estate. Vol 4. pg. 48 – 65.

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Construction and Real Estate -
Developing Indicators for Transparency

This report represents the finding and results from the third Finnish case study (FI03) called Lappeenranta tax Office. 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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