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Shopping Centre 2

CREDIT Case FI06

Danish Building Research Institute
AALBORG UNIVERSITY

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Construction and Real Estate -
Developing Indicators for Transparency

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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

Buildings (WP4) summary

The background of the case study was the owner's interest to direct electricity costs by righteous way between the customer shops and to create incentives in optimizing indoor conditions and energy costs. The main topic was to find correlations between the cooling need, indoor air quality and thermal comfort and electricity consumption – the results showed that further studies are needed to show the possible connection because of the same type of defects than in case of SC 1 in ventilation and cooling system and also some new instrumentation are needed. The essential Key Performance Indicators are suggested.

Enterprises (WP5) summary

In the enterprise level it is obvious that existing building automation system should generate information (reports), by means of which one could see the actual situation (indoor conditions, energy consumption). Also in design stage, planning of additional instrumentation and in general the design of instrumentation is very important from the point of view of facility and energy management. The enterprises in this business area should also create KPI`s which are covering and relevant and could be used in internal benchmarking.

National benchmarking (WP6) summary

In national level, there is lack of public information and data available, which partially is caused by competition related things. The business line itself could create characteristics, on the grounds of the industrial branch could monitor and plan energy- and ecologically efficient measures and programs. In fact, there is enterprise-related progress going on.

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 has been conducted as an action research by researchers and members of a client organisation seeking to improve their situation (Greenwood and Levin, 1998) /1/. 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 /2/.

The background of the case study was the owner's interest to direct the incurred expenses (electricity and heating) by proper way and to create incentives for the customer shops in optimizing indoor conditions and energy costs (see also SC 1). The purpose was to find the essential factors, their relations and connections, by which one can control the conditions, especially the share of cooling energy.

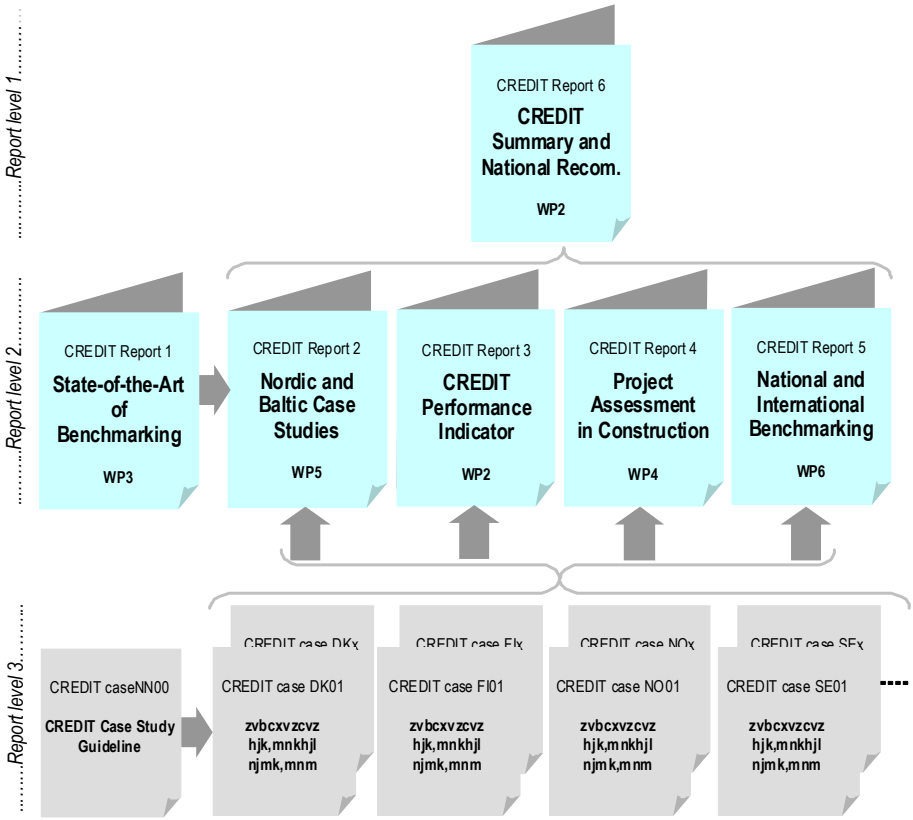
1.3 Research design and methods applied in the case study

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. The studies were carried out by planning two in-situ measurement periods (autumn/winter) completed with concise summer period.

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

Shopping Centre 2 (SC 2) in Vantaa and earlier case study called SC 1, are owned by Citycon that is an active owner and long-term developer of shopping centres. The company takes into account environmental interests and the wellbeing in the areas surrounding its retail properties, and is the market leader in the Finnish shopping centre business. It has 22 shopping centres in Finland, eight in Sweden, two in Estonia and one in Lithuania.

2.1 The actual building, building parts and processes

General characteristics of Shopping Centre 2 are:

- Location: Helsinki Metropolitan area
- Car parks: 1 400 totally, 1 100 indoors
- People living in the area of influence: 93 000
- Yearly buying power in the area of influence: 1,3 billion €
- Year of construction: 1994
- Number of visitors per year: 6 900 000
- Sales per year: 157 200 000 €
- Leasable retail premises: 33 000 m2
- Gross leasable area (GLA): 42 000 m2
- Anchor tenants: A liquor shop, Department Store, Supermarket (national chain), Variety store.

Figure 2: SC 2 in Helsinki metropolitan area.

Table 1. Business mix of SC 2.

Business mix	**Units**	**m^2**
Fashion	16	4 600
Health and beauty	20	1 400
Home and leisure	7	2 100
Furnishing and home supplies	19	2 500
Cafes and restaurants	15	2 700
Grocery stores	4	3 500
Department stores	3	15 500
Speciality retailers	10	700
Commercial and public services	0	0
Total	**94**	**33 000**

Sales per visitor in SC 2 are 22, 78 €, that is above the median value in upper quartile in national scale. When annual sales are compared to leasable area, SC 2 sales embrace 4 764 €/m2.

Three shops were chosen to measurements in the same service area of ventilation system; clothing store for men, shoe shop, and clothing store for women. Two shops have an additional cooling system (including to the electricity bill), and heat load varies because of various lighting power.

Figure 3: Photo of SC 2 indoors.

2.2 The applied assessment methods and tools in the processes

The indoor environment studies will be focused to the business spaces of shopping centres. The term indoor environment includes thermal conditions, the quality of indoor air, acoustic conditions and lighting conditions. The measurements will be mirrored by performance key indicators.

The aim is to manage and control the heat load and energy use is business areas. The correlation between the active heat load and electric power will be determined, and the passive part of heat load by certain measurements, as ventilation measurements. The share of convector net will be also sorted out.

The background was:
1. To address the cooling costs by proper way
2. The own option of the tenants to decrease the costs spaces costs.

The study will be carried out in two shopping centres, both located to Helsinki metropolitan area, where the indoor air conditions will be studied. The objective of the analysis of results is to verify the active heat loads. Results from other case study, SC 1(shopping centre 1), are defined in Finnish case study report FI05. The main goal was the same than in the case of SC 1: To find the possible connection between cooling load electricity and other factors. The expected result: was: A model by which the shop can control its electricity consumption for attaining optimum conditions and total costs.

2.3 Cost and performance indicators applied in the assessments

First phase of continuous measurements in one service area for one week in autumn 2008:
- Indoor air temperatures, CO2-concentration, relative humidity
- Supply and exhaust air temperatures, air flows in terminal devices
- Single measurements, carried out during one monitoring day
- Control of air flow rates
- Lighting level, illumination
- Interviews of shop managers

After the first measurement period some preliminary evaluation based on results was done, as in the previous case. The measurements in SC 2 were performed approximately at the same time than in SC 1, just after the measurement period of SC 1.These first period results show how the indoor air conditions depend on internal loads and type of the shop, as in the case of SC 1. The women's clothing shop had a weaker lighting than other clothing shops (figure 4). However the indoor temperatures were higher than in other shops (figures 8 and 9). The reason could be in the types of lightning. The lighting levels are a little bit lower than in SC 1. The general lighting at SC 2 is from 1995. In SC 1 the overall lighting has been renewed in 2007 and the spot rails can be moved shop specifically.

Hence, the number of customers and their average staying time in shop also influences on the indoor conditions and the type of the shop.

The second period was done in March 2009. The measurements followed the previous schedule. The third, abridged measurement period was carried out in the summer conditions June 2009.

Consumption of electricity did not vary significantly between the periods. Figures 5 – 8 show the specific electricity consumption and specific power during the measurement periods. There are no big differences between the periods – the night consumptions vary, in the shoe shop the sum-

mer consumption by nights is triple compared with the spring, in women's clothing the consumption is twice as much than in the spring period. Compared with SC 1, the electricity consumption seems to be lower, but the difference comes from higher nightly consumption of the shops in SC 1. The differences may depend on the lighting levels, which seemed to be higher in SC 1.

First measurements period

The indoor air temperatures of these three shops are introduced in the figure 9. The common thing for those shops is that all of them are dealing with clothing and also shoes. They should be same type of shops. There are small but clear differences between the indoor temperatures (2 °C difference between shoe shop and women's fashion shop). CO2- and RH-contents followed same trends compared with the other shopping centre SC 1. CO2-concentration is at the level of 400 – 500 ppm and relative humidity is increasing up to 50 % at the shoe shop at it's highest (it has the lowest indoor temperature which partially explains it).

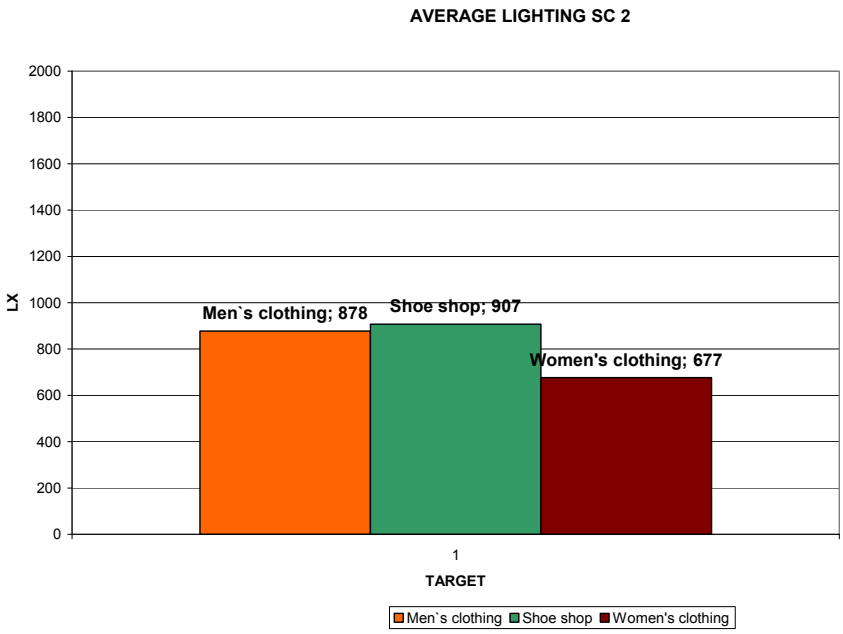


Figure 4. Average lighting

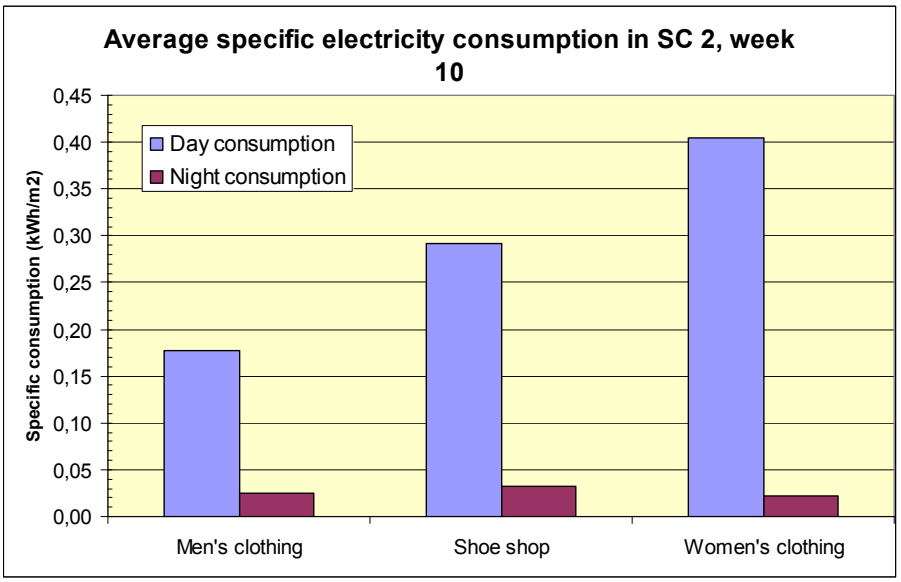


Figure 5. Average specific consumption of electricity, winter/spring period

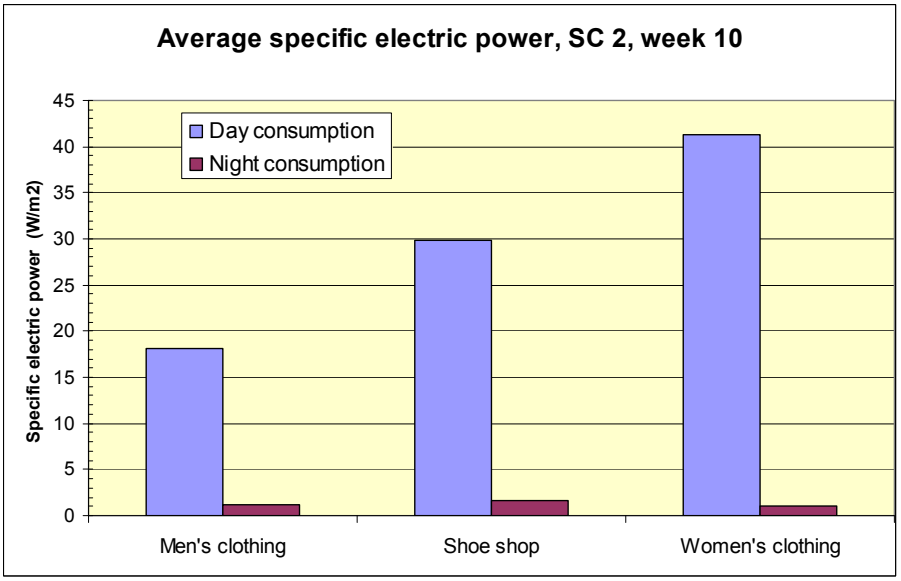


Figure 6. Average specific electric power, winter/spring period

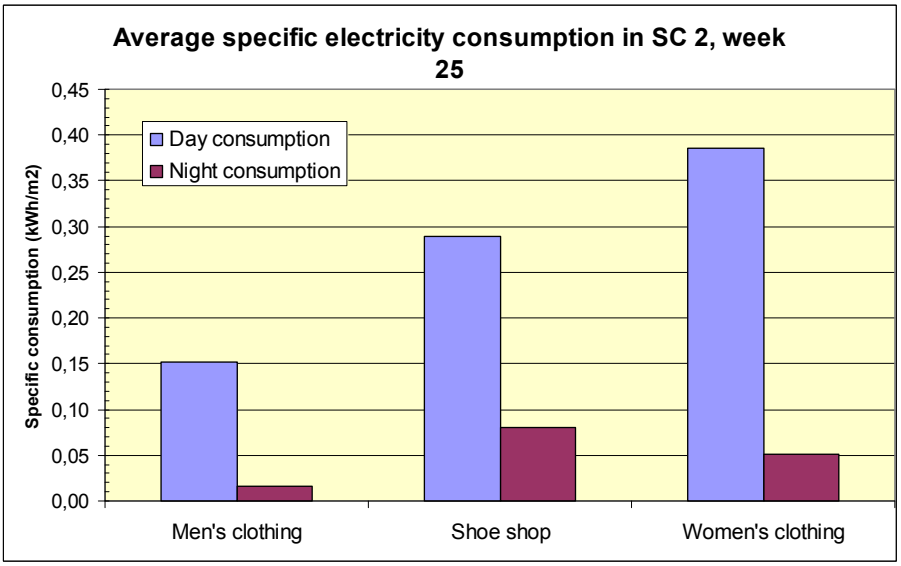


Figure 7. Average specific consumption of electricity, summer period

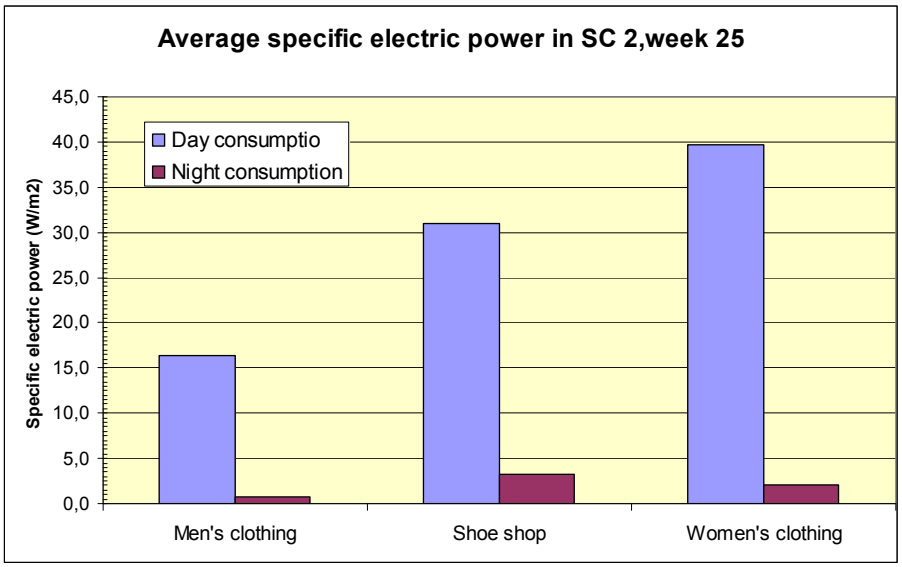


Figure 8. Average specific electric power, summer period

Second period

Indoor air temperatures, relative humidity and CO_2-content follow the same trends than in the other shopping centre and also the results of first period. The lighting level is lower than in the other shopping centre, but e.g. the electricity consumption varies between the shops. The men's clothing shop consumes much less electricity than the two others. The overall electricity consumption is lower in these three shops than in the other shopping mall. The temperature differences were higher than compared with autumn period. Cooling temperatures were in the same level than in the first period. CO_2 levels were approximately at the level of 600 ppm, except one weekend when the levels were 700 ppm. Relative humidity level was lower than in November, because outdoor air humidity was lower.

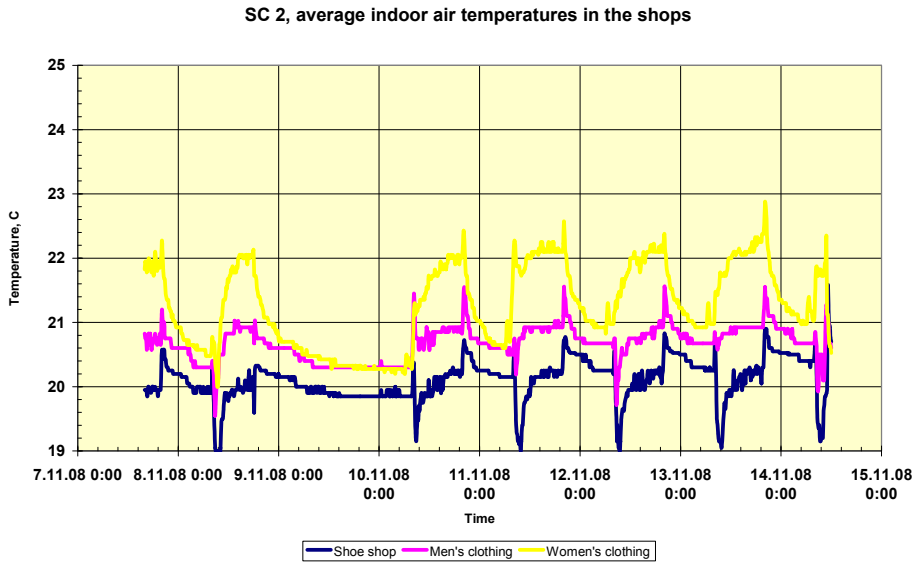


Figure 9. Average indoor air temperatures/November (1st period)

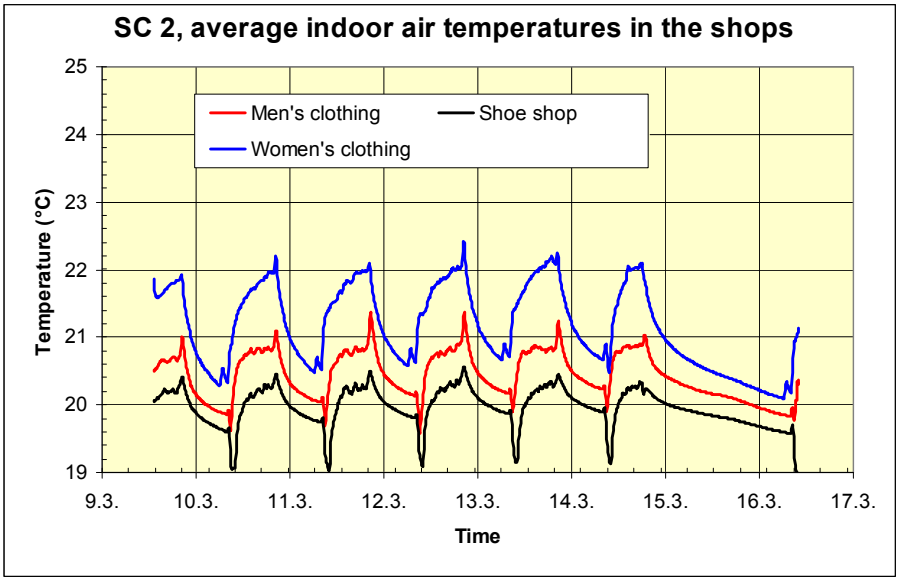


Figure 10. Average indoor air temperatures/March (2nd period)

According to ventilation measurements, the air flows seem to be short of designed. In the shoe shop and women's clothing shop the air flow rates were below plans. The air flow rates should be checked and rebalanced. If exhaust air flow is much higher than supply air flow, there will be inflow from other spaces (aisles) to the business space. The cooling units did not work in women's clothing shop. The cooling units should be checked, too.

The overall summary of the results follow the ones measured in SC1. The building services and ventilation systems performed better than in SC 1, but for instance the insufficient function of cooling convectors might cause the temperature increase during business hours. The KPI`s would be defined equally with SC1.

Business space specific Key Performance Indicators
- Indoor temperature and the stability of temperatures
- Lighting
- Temperature of supplied air
- Cooling temperature and cooling power
- Air flow rates
- Electricity consumption, heating energy consumption, water consumption (in general: utilities consumption)
- Air quality, CO2
- Classification of business spaces, e.g. I, II and III according to the use
- Indoor ranking and classification, e.g. Σ(ak1+bk2….+nkn), in which a….n are weighting coefficients and k1….kn = characteristic factors

Facility specific Key Performance Indicators
- Electricity consumption, heating energy consumption, water consumption (in general: utilities consumption)
- Maintenance costs
- Cleaning costs
- Investment costs
- Taxes, insurances etc

In some cases the actual costs distribution depends also on the booking system – how to organize the maintenance costs, investment costs etc. The basis should be consistent with each other.

2.4 Relation to different enterprises and national benchmarking

Citycon's contribution in CREDIT project involves indoor air and energy efficiency-related measurements carried out during the autumn season 2008 and winter/spring season 2009 in two shopping malls, named shopping centre 1 and shopping centre 2. The company have its own facility management and energy management system, but it is not detailed enough at the moment to find out some deviations, malfunctions or operation errors on-line., depending on the centre in question. The main interest of the participant is to find relevant indicator to manage and control technical performance of real estates and also share the costs by proper way between the customer shops in both centres.

The level and type of existing building automation system varies depending on the target. The third goal was to analyze what kind of changes or additional installations (sensors etc) are needed to improve the facility management, including reporting.

There are no general information dealing with shopping malls available – also the generally accepted performance level classification and indoor conditions ranking is missing, but various retail chains and shopping mall owners have their own procedures and concepts, but in most of the cases these concepts are not public. The building codes and indoor air classification determine the general requirements, but e.g. the overall commissioning (Cx) (Pietiläinen et al 2007) procedures are not in use at the moment.

2.5 Visions and innovation for future improvements

To determine the key performance indicators in the level of single spaces is not any unambiguous task in the shopping centres. The needs of the shops are different – the performance of the systems must be mirrored against the required values. When it all comes around we have to recognise that the key issue of the owner is optimizing the cooling and share the costs in proper way in this particular case study.

Based on the results a procedure is created for monitoring and increasing the shops activity control for their utility consumption. In the future, also the reflections to key performance indicators (KPI`s) and the validity of these KPI`s will be discussed. The same indicators are valid for both centres. The results showed that first some adjustments should be done in case of ventilation system and cooling convectors in both cases. The systems should be brought to operate by correct way and in propel level. Probably same type of problems occurs in other shopping centres. It also means some new concepts when designing building automation systems and installations and facility management systems. Also the "owner's requirements" should be set more detailed than at the moment. In shopping centres the building commissioning (Cx) procedure should show its usability if it would be used.

3. Enterprises – assessments and indicators internally applied

3.1 The actual enterprise, company and firm

The building and real estate owners have their own concepts, mainly based on facility management software based on the information building automation systems. Interactive operation and maintenance manuals are typical tools for that. In ideal cases the building owner should use a monitoring system, by which one could do benchmarking and compare the consumptions, costs and distribution of costs and consumptions between the different buildings and, if possible, with similar building stock. This case study shows that even if the enterprise has such a system, the details which actually determine the performance, can not be monitored in all of the cases. The integration of building services is a key issue – it is how well the heating system, ventilation system, cooling system etc will work together, and matching the actual needs.

3.2 Assessment methods and tools applied in the enterprise

The significance of indoor environment factors also depends on the type and use of the buildings. Even the building will fulfil the standards, acoustics factors may be important in certain buildings and visual features in another building. The thermal conditions are the sum of the factors mentioned before. Therefore, the performance is always a sum of many interacting factors.

A proper instrumentation has also a key role, building automation system should generate suitable information for energy and facility managers and also facility management tools should be connected to the system in order to have adequate data to base reports used for managing the building. Operation and maintenance manual is very good tool for this; anyways; there are a lot of weak points in monitoring and measuring systems, but if there are no measurements, there is no possibility to optimise, save and manage the building in the best possible way.

Enterprise should set so called owner's requirements according to the facility type. In case of shopping malls it means that the owner could classify the business space e.g. into two or three categories, which all have own KPI`s – such as temperature level variations (inside requirements and indoor air classification ranks), rate of ventilation etc. Facility management costs should be directed by righteous way, i.e. "Level 1" space will cost more than "Level 2". The operation costs should be dealt equally but the business-space related costs must be addressed user-specifically. Limiting factors are the various needs of the customers, and also the technical solution of HVAC-system: Centralized, distributed or some other solutions. During the life-cycle of the building, the customers may vary the use of the building or part of the building can be changed, so the selected installation is always a compromise. The rate of flexibility will improve the yield but can cause some problems in technical performance.

Also the tenants, customers, should have plans for indoor conditions, like lighting level and efficiency, and these goals should be fitted with the goals of real estate owner If possible).

3.3 Costs and performance indicators applied in the enterprise

The first step is to organize the data collection regarding to the actual needs. The second step is to organize the reporting matching to the goals. The technical key performance indicators as well the economic and space indicators should be connected according to the needs of the owner. As mentioned before, the owner's requirements are the essential factors.

3.4 Relation to building cases and benchmarking organisations

Every retail chain and shopping centre owner has its own concept how to manage the facilities. KPI`s will give some landmarks to organize and rationalize the management system, but the business itself should launch a R-D-program dealing with this topic (if different parts see it useful). In the end of this report are two international examples briefly introduced: Accor Hotel Chain and WallMart, which is retail chain. The both chains have well fixed goals and requirements connected to their vision.

3.5 Visions and innovation for future improvements

The enterprise is monitoring the facility and energy costs, but to create the updated information needs a more detailed and focusing data collection and reporting system.

This must be taken into account in design of new buildings and in renovation, especially in designing of details which will effect on the performance and energy efficiency. The building automation system and facility/energy management system (mainly built above the building automation system) are in very important role. This procedure should give on-line updated information about the recent situation and conditions.

4. National benchmarking – indicators, assessment and organisation

4.1 The actual benchmarking organisation and its purpose

Dealing with shopping centres there are general information available but a specific analyze between various shopping centres has not been publish. The existing information could be collected and organized from various sources – in most cases the key figures are not public, depending on the owner (e.g. retail chains keeps their figures confidential).

4.2 Assessment applied in the benchmarking organisation

There is number of software available using which it could be possible to analyze different shopping centres. The data from the shopping centres should be gathered up and organized; it means that there should be e.g. an interactive internet-based spreadsheet where the participants could send their information. This would be relatively easy to realize inside an enterprise. Problems may be between the enterprises. There are examples (printing houses, wellness and spa hotels etc) that benchmarking and facility management tools over an industrial branch can work /4/. There must be a service provider who takes care to run the system.

4.3 Cost and performance indicators applied in benchmarking

Cost and performance indicators can be divided into two parts: General indicators which are regardless of the branch and then business specific indicators. Dealing with the shopping malls, this study showed that such concepts need further studies inside the business area. Individual shopping centres or real estate owner's can use their own existing system, but dealing with technical performance, there are lot of "black holes" being due to inefficient use of building automation systems and deficiencies in reporting. The systems are designed for the daily operation but not on the point of view of facility and energy management or set requirements.

4.4 Relation to enterprises, building project and real estate

Referring the results and items discussed in the previous chapters, there would be possible to create a datafile, used which the business could compare the facility costs – within the limitations of trade secrets and competitive positions. MOTIVA (National Agency of Energy Savings) has information based on energy audits of the shopping centres. Inside the branch there are company-specific studies, which may be not public. Also the owner's requirements may change, depending on the type of business. There are various tools available, which could be used in benchmarking and analyzing of the shopping centres, but at the moment (excluding general requirements) there are no such generally accepted indicators or list of factors which could be used, but common interest is obvious.

4.5 Visions and innovations for future improvements

In Finland the most building projects are based on life-cycle evaluation and costs. Shopping centres are facilities, which can change the use with time, and have several renovations during the lifetime. The location of shopping centre is very essential, and also they could be totally rebuilt if the overall conditions will change. For the owner, the flexibility and usability and space management are very important factors, which will set up some limitations and boundary conditions for planning. The performance – technical performance and space performance – and the position of the building on life-cycle curve should be determined in all the stages, which mean that the monitoring system must be good enough to give relevant information to the facility manager and owner. It includes both proper installation of sensor and meters, monitoring system and finally up-to-date reporting system.

Each business branch should have concepts which will include also the branch-specific indicators. These indicators depend on the needs and goals of the owners. Because the conditions in Scandinavian countries are relatively similar, the benchmarking concept could be common for these countries.

5. Discussions and conclusions

5.1 Buildings - lessons learned and recommendations

The basis for energy efficiency and energy management is that owner's requirements has been set – it means that the main factors effecting on the indoor conditions are recognized and also the connections between the factors and the planned performance level are known. In practice it means that owner will specify the performance level and it will be verified in design, implementation and in use stage. The key performance indicators are used for that purpose. To reach the goal the detailed plans are needed, which means more detailed design and installation control. Building commissioning procedure is a tool for realizing the goals. The key factor is how to integrate the building services and systems together to product the planned conditions. This also means new way of planning or improved planning the instrumentation and building automation system, that the instrumentation and building automation system will serve better the facility and energy management. The tab-stage (testing and balancing) period should cover better than nowadays the performance of the building. One tool is to improve to use of operation and maintenance manual, which should be interned-based interactive system. Facility management system, based on building automation system, should generate reports (e.g. like drift reports in industrial plants) which will give daily/weekly/yearly information and also trends and benchmarking data.

In this case study some goals were set, and the measurements were carried out in consideration of these targets. The measurements demonstrated that before the costs can be shared by the planned way, first the existing ventilation system and cooling system must be adjusted, and rebalanced. The measurements showed some problems in indoor conditions, which depended on the insufficient functioning of ventilation and cooling systems. These findings did not cause any major problems in the shops; that's why there were no reclamations. One can say that these malfunctions did not prevent the every day use and probably did not increase the costs significantly, but also showed the fact that many details will leave unnoticed.

The case study also showed that there should be overall requirements (in addition to general building codes) for the shops and also shop owners should pay more attention to various performance factors, such as design of lighting etc. Shops have no goals for indoor conditions. The space use, placing of the merchandise and layout is mainly the most important factor. Lighting causes lot of heat load and electricity consumption, it should be planned very carefully (e.g. the maxim lighting load).
If the tenant will optimize their electricity consumption, the building maintenance costs will be reduced, because at the moment operation and maintenance rent includes the maintenance costs of the real estate company.

A short summary of the results:
- there are differences and deviations in electricity consumption, which must be in closer examination – e.g. the night consumption variations, see also the results of shopping centre 1 (SC 1).
- some of the cooling convectors did not work
- differences in lighting and indoor temperatures

– air flow-rates, especially supplied air flow rates were lower than designed (see also SC 1)
– supplied air temperatures were higher than planned
– the ventilation and shop-specific cooling systems must be checked before the next steps – now the exhaust air flow rate was > supplied air flow which causes air flow from the aisles to the shops
– In general, indoor temperature could be decreased 1 ºC – 2 ºC
– partially the increase of temperatures is caused by the cooling system

5.2 Enterprises - lessons learned and recommendations

– Building automation system (BAS) should generate information (reports), by means of which one could see the actual situation (indoor conditions, energy consumption)
– Planning of additional instrumentation, the design of instrumentation
– At the moment the existing system does not support facility management enough
– The use of the shop – branch of business – the needs are varying
– Indoor- and thermal comfort factors (KPI = Key Performance Indicators) also to the shop level-
– It will ease reporting
– Measurement of essential factors (Key Performance Indicators)

Limiting factors and boundary conditions:
– In the service area of one air supply unit can be many type of buildings (solutions: division of distribution, time sharing, shut-offs, controls)
– Desired values for the shops
– Ventilation system should match the requirements/needs
– Minimization of cooling energy (optimization of electric power)

5.3 National benchmarking - lessons learned and recommendations

There is a need for generally accepted procedure for benchmarking shopping centres. The business branch has the key role in developing such concept. Besides technical performance, there are many other factors which may be more important from the owner's point of view. Technical performance includes also other factors than energy efficiency and indoor conditions (use of space, maintenance costs etc). Without a proper monitoring system there is no possibility to go into the details and distribution of the consumptions. Finally, there are two examples of commercial building performance procedures, from Accor hotels and Wall-Mart retail chain.

Some international enterprises have launched energy saving programs/performance program, e.g. Accor hotel chain (Bouilleaud, 2008). The key figures of Accor in 2004 were:
– 158 000 employees
– 7 Billions € turnover
– 140 countries
– Hotels, restaurants
– Services (Ticket Restaurant…)
– Casinos
– Distribution (travel agencies…)
– 4 000 hotels
– 450 000 guest rooms

The General Management of Accor Hotel Technical Services is in charge :

– To write the Technical Standards Documents
– To manage construction of new properties and main
– refurbishment
– To coordinate the hotels technical maintenance
– To coordinate the budgetary control of the minor refurbishment

The main goals were in Accor specifications on HVAC are:
1. Environment (energy saving, legionella etc.)
2. Comfort criteria (temperature, fresh air, noise)
3. Sizing criteria (nr of guests per room, 2 adjacent rooms are at the same temperature…)
4. Design conception (redundancy criteria…)
5. Kind of material (Pipe in copper…)
6. Test and start-up

In technical solutions, Accor specifications are directed to engineering designers who have to adapt them to each particular project. Accor specificities
– Design the building
– Built the building
– Use the building

Operating and construction cost shall be optimized – the company's watchword is "We know what we want, we know what it is efficient for our guests and for us" – which means that owner's requirements are properly fixed – one example of the hotel-type ranking dealing with BMS (Building Management System). Accor follows separate strategies concerning BMS system installations.

In economical IBIS hotels BMS is not installed, because guest room thermostats must be simple and cheap and size of the hotel is medium. Small hotels do not have maintenance team and making over investments is prohibitive. BMS system is not appreciated by the guest, it does not save substantially energy and technical complexity of the hotel does not justify it.

In Sofitel hotel chains BMS is installed to specified spaces. It is not installed to guest rooms; guest doest not see it and it does not save substantially energy. BMS system is installed to general services, public spaces and production spaces. In those spaces the systems gives better comfort, e.g. temperature in meeting rooms and restaurants is comfortable. Those units have also automatic start/stop of air handling unit and supervision of boilers, chillers and pumps. Technical alarms are also well organized.

The other example comes from WallMart – international retail chain (Scott, 2008). The vision of WallMart is introduced in figure 11. Wall-Mart's Environmental Goals are:
1. Reducing greenhouse gases at our existing store, club, and DC base around the world by 20% over the next 7 years.
2. Designing and opening a viable prototype that is 25-30% more efficient and will produce up to 30% fewer greenhouse gas emissions within the next 4 years.
3. Sharing all learning in technology with the world, including our competitors (the more people who can utilize this type of technology the larger the market and more we can save our customers).

Figure 11. Wall-Mart business model and accessible resources

References

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

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

Pietiläinen, J et al. (2007). ToVa-käsikirja. Rakennuksen toimivuuden varmistaminen energiatehokkuuden ja sisäilmaston kannalta (Building Commissioning Handbook: The commissioning of buildings in terms of energy efficiency and indoor environment). VTT Research notes 2007.

ProMain web site. Available at: http://www.promain.fi (Accessed 6.10.2009).

Bouilleaud, D. (2008). Accor technical adviser: Vision of a multi properties owner. Presentation at ICEBO2004 conference, Paris, France.

Scott, L. (2008). Sustainable Building design. Energy Efficiency Strategies for Large Retail – WallMart. IEA Annex-46 Workshop, New York.

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Construction and Real Estate -
Developing Indicators for Transparency

This report represents the finding and results from the sixth Finnish case study (FI06) called Shopping Centre 2. 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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