Building EQ
intelligize your energy management

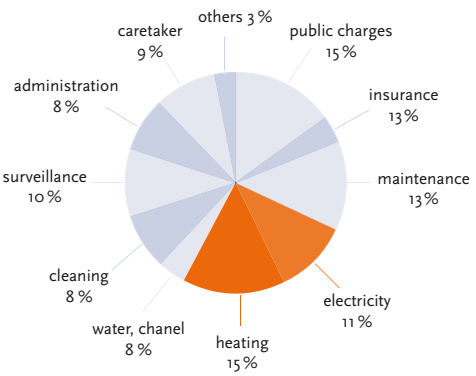
Newsletter Issue 5 | June 2009

The Importance of Monitoring, in Practice

For complex buildings having a life cycle of about 50 years, not even 5 % of the total costs are accounted for during construction. Over 95 % of the life cycle costs arise first after starting the building operation.

According to the latest OSCAR analysis from Jones Lang LaSalle, the building operating costs for air-conditioned buildings in Germany averaged € 3.14/m²/month in 2008. A building with 20,000 m² therefore would have annual building operating costs of about 75,000 euro.

Average values of additional costs
Source: Jones Lang LaSalle, Oscar 2008



The graph shows the percentage of the individual operating costs and makes clear that about one fourth of the costs are due exclusively to energy (heating and electricity).

For the building example shown here, the total energy costs, calculated according to this average, amount to 20,000 euro per year.

In the course of increasing energy prices, the energy costs will take over an increasingly greater part of the total operating costs of a building.

The monitoring of the energy consumption has already become an inherent part in most of the larger building complexes. However, the implementation varies widely in practice – from the detailed acquisition in an automated building through to an manual documentation of the consumption data on an annual basis.

Experts agree that solely by optimizing the available system technology in existing buildings, energy saving potentials from 5 to 40 % can be realized. Part of the activities in the BuildingEQ project is to determine in which way these measures can be carried out in consideration of the economic aspects. ■

International Monitoring Workshop 1 October 2009

Our international workshop within the BuildingEQ Program provides the opportunity for exchange and information on the topic of monitoring in non-residential buildings. The target groups are facility managers, real estate owners, planners and consultants as well as energy service providers. Talks and discussions inform about the topics of energy performance certificates, continuous commissioning and software solutions. International speakers from Japan and USA will share their experience with you.

■ **Title: Certification and performance monitoring of non-residential buildings**
1 October 2009,
10:00 am to 17:30 pm
Landesvertretung
Baden-Württemberg – Berlin, Germany

Further information, program and registration at:
■ www.buildingeq-online.net

Call for Monitoring Survey

The survey results evaluated (see next page) are based only on a small number of participants and therefore are not sufficiently representative. We are also interested in your opinion and would like to hear your answers to the survey questions. We have put the survey on our homepage, where you can access it. We look forward to an active participation!

The survey can be found at:
■ www.buildingeq-online.net

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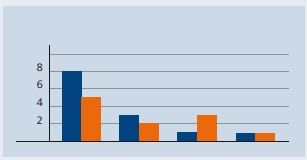
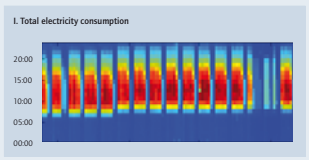


Monitoring survey: Facility manager confirm that the importance of continuous building monitoring is essential. **Page 2**



Optimizing Operation: Changes in operation schedules of the heat pump in Kreuzgebäude results in saving energy costs of 8,000 euro. **Page 3**

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Intelligent Energy Europe

Monitoring Survey

In order to determine the impact of a continuous monitoring program in practice, a survey was carried out among experts during a monitoring workshop in Freiburg in February 2009 Additionally detailed interviews with real estate companies and facility management personnel were made.

Among all 20 participants involved in the survey, the majority found that continuous building monitoring is, in principle, important.

Costs for continuous commissioning

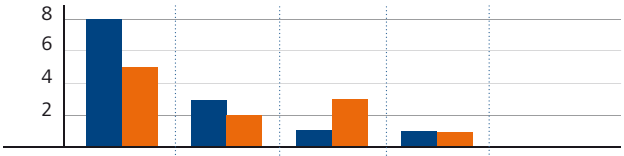
On the question as to what fraction of the annual energy costs would be acceptable to spend on the additional technology needed for data acquisition (e.g. data logger, measurement devices), the opinions varied widely. While 40 % of the participants found that not more than 5 % would be acceptable, 20 % of the people surveyed found that even an investment of up to 20 % of the energy costs was a possibility.

A larger consensus was achieved when answering the question about the expenses for any additional servicing required for the data acquisition. The majority found costs below 5 % of the total energy costs to be acceptable.

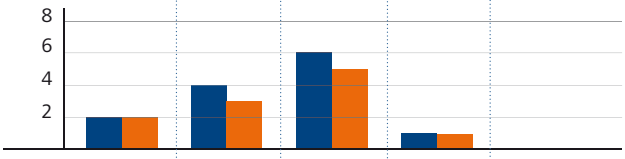
Which of the following functions do you think are useful?

The experts were also questioned on several important aspects of monitoring, which they were asked to evaluate according to the usefulness and practicality in the field.

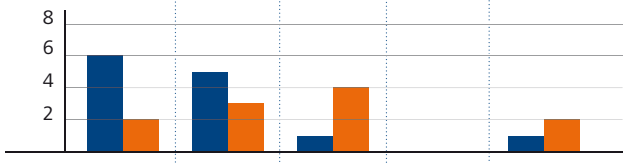
I. Outlier detection



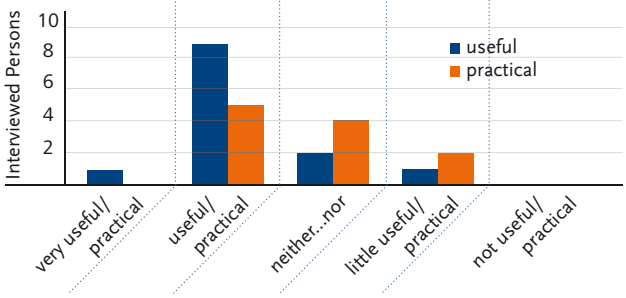
II. Visualization



III. Rule-based fault detection



IV. Model-based fault detection



■ Automated outlier detection for daily consumption

The concept of measuring energy and water consumption daily, to automatically identify out-of-range values and connect this with an alarm function was evaluated to be useful by 11 participants. The practical relevance of such a concept was, on average, valued to be less important. (Graph I)

■ Pre-defined visualization

The higher the resolution of the data acquired, the greater became the significance of a simple analysis. Even experts need to expend a large amount of effort to interpret large amounts of numbers. Here standardized visualizations can help, whereby the practiced specialist can determine upon a glance whether the operation is faultless. According to the survey, the relevance of this visualization was not rated very highly and received an average value of 2.5. (Graph II)

■ Rule-based fault detection

The automatic diagnosis of typical errors based on simple rules appeared to be of more interest to the participants. For example, the correct functioning of a ventilation system can be checked by the following algorithm: "If the circulating pump of the heater battery is operating AND the fan is not operating AND no freeze protection is demanded momentarily THEN unnecessary pump operation→ERROR". In total, 11 survey participants rated the usefulness of this type of error diagnosis as above average. However, there was doubt as to whether such simple rules can be drawn up at all for real applications in the field. (Graph III)

■ Model-based fault detection

As an alternative, mathematical building models can be created, upon the condition of a simplified building model and system technology. The values can be calculated and compared with the available measurement data available. Ten of the participants confirm that this is a useful measure. Also here, the emphasis changes when the practicality is considered. Only 5 people find that this method can be realistically put into practice. (Graph IV)

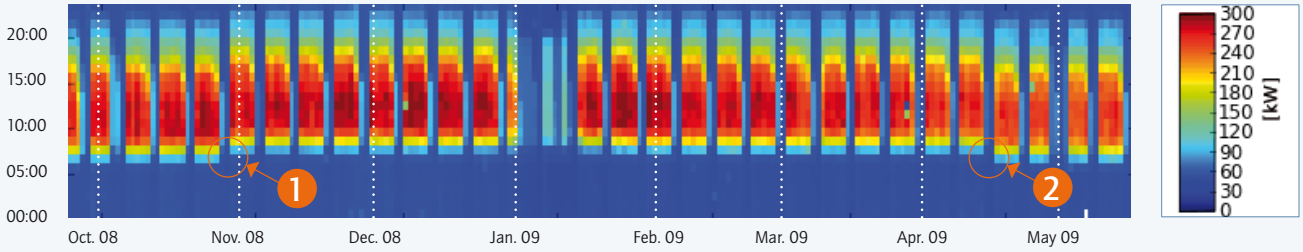
First Measures to Optimize Operation and the Ramifications

In the last newsletter, the first measurement results collected for the Kreuzgebäude in Germany are portrayed and explained. Based on this data, measures have been drawn up which can be carried out immediately without investment. Using this example, we would like to demonstrate the complexity of a rule-based error detection system and the significance of a continuous monitoring system.

From current state...

By plotting the electricity consumption of the building, a distinct usage profile can be observed (Graph V). During the night, the electrical base load for the technical equipment remains constant at 60 kW (blue) During day use, the load increases up to 300 kW, (red) especially due to the lighting and computers. The electricity use can be read easily e.g. during weekdays from about 7:00 to 21:00. In March (1) and October (2), the change to/from daylight savings time it easily recognizable.

V. Total electricity consumption

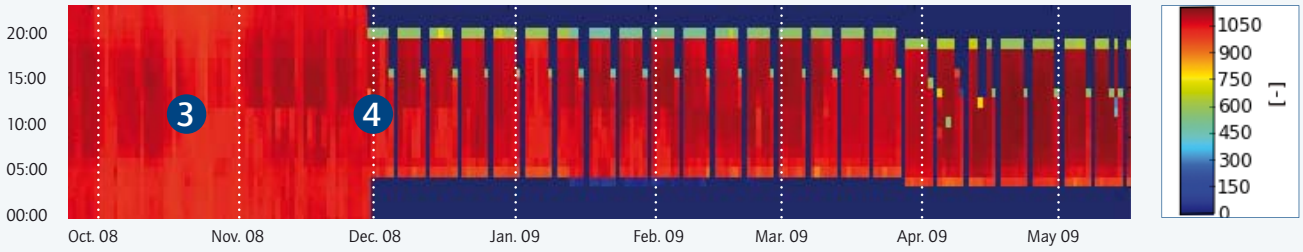


...to first implemented measures...

Although no building use takes place during the night and on Sundays generally, the heating circuit pump runs constantly 24 hours a day (3). This not only results in a high electricity consumption but also in unnecessary heating in the rooms as well as in distribution losses.

As a result, a time control system, which matches the pump operation with the usage times, was implemented for the pump in December 2008. The positive result (4) can be observed very clearly in the graph shown in Graph VI.

VI. Operating time for the heating circuit pump

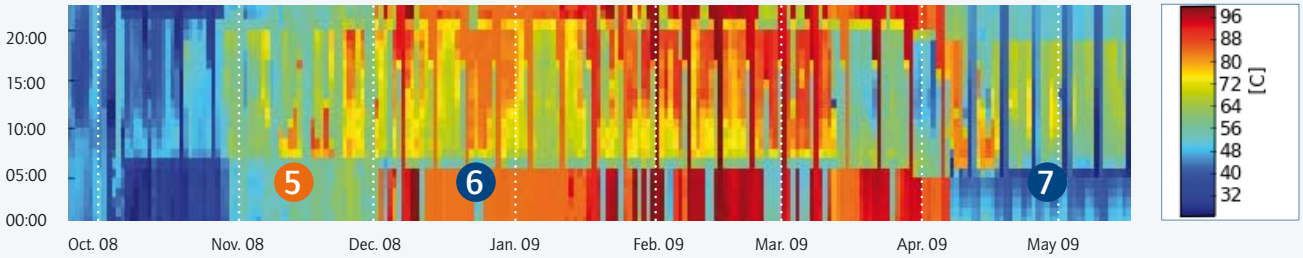


...with unexpected consequences...

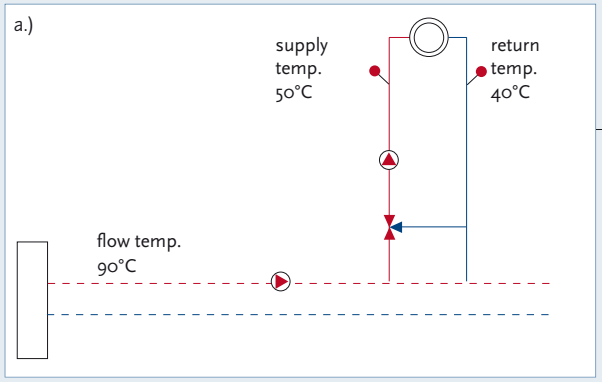
At the same time as this change was made, the supply temperature evidenced an undesired side effect. Suddenly the supply temperature increased in the night from a previous average of 50°C (5) up to 90°C (6). What happened?

It became evident that the 3-way-valve of the heating circuit pump remained in the position it was when the pump shut off. As a rule, the valve was in a partly open position during the cold periods, and the main distribution pump presses the heating water through this valve which leads to an increase in the supply temperature to above 90°C during periods of non-use, i.e. equivalent to the flow temperature (Graph VIII b).

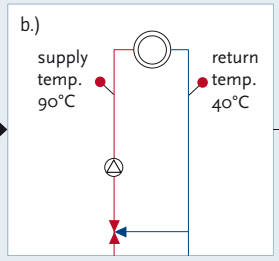
VII. Flow temperature of the heating cycle



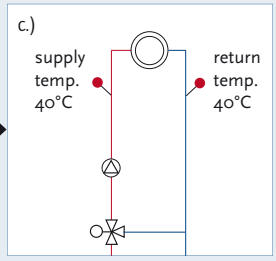
VIII. Schematic of a heating circuit giving the water temperatures for night conditions



Condition up to Dec. 2008:
The heating circuit pump runs at full power. The building is therefore heated continuously during the night, but with reduced inlet temperature.



Condition Jan. – Apr. 2009:
The heating circuit pump is shut off. The 3-way-valve is sometimes at the throughfare flow position and therefore the main pump pushes the heating water directly through the entire pipe system. This also indicates that the pump is overdimensioned.



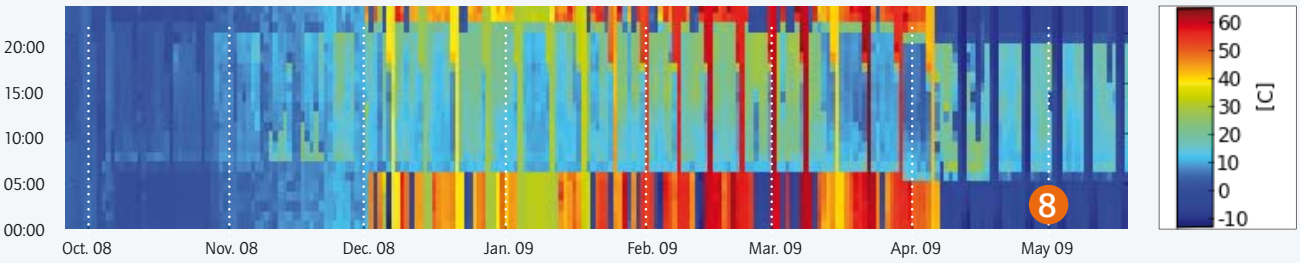
Condition after April 2009:
The heating circuit pump is shut off. The 3-way valve is now always in the position „additive flow".

...to real savings!

A new change was carried out in April 2009, which ensures that the valve closes when the pump is turned off (Graph VIII c). The success of this new adjustment is shown immediately by a supply temperature of only 40°C (VII,7) and a temperature difference between the supply and the return temperature of practically 0 Kelvin. (Graph IX, 8)

Since April 2009, the heating circuit pump runs according to the building usage periods as desired and results in an annual energy savings of c. 8000 euro. This is about 6 % of the total building operating costs.

IX. Temperature difference supply/return



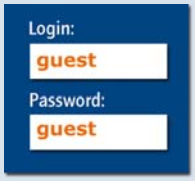
Conclusion

The optimization procedure described here for the Kreuzgebäude presents only one of the many energy saving potentials. It is clear that without gathering the hourly data of the most important system parameters and without the graphic visualization, it would not be possible or at least very difficult to recognize the cause of the faulty operation.

Within the project BuildingEQ, measurement systems for monitoring the building operation were installed in the twelve demonstration buildings.

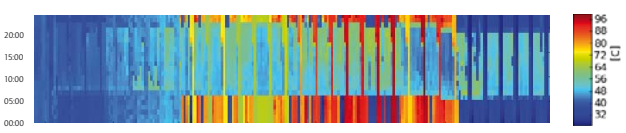
See monitoring data at:

www.buildingeq.eu
Login: guest
Password: guest



How to Read Carpet Plots

Using carpet plots, high-resolution time measurements (e.g. in hourly values) can be portrayed over longer periods of time. Here the course of each day runs along the y-axis from the "bottom" (y=0:00) to the "top" (y=23:00) and the days are plotted next to each other accordingly on the x-axis. The measurement value itself is portrayed in different colours corresponding to its value. For days having a similar course of measurement values, the colour pattern is respectively similar. Such patterns can be visually identified very quickly. ■



Results of Interviews

Using three examples from various countries, we would like to show how different companies in the real estate branch or in the facility management deal with the topic of monitoring.
Interviews were carried out with the persons responsible for the facility management. The interviews are reproduced here in short form.

Interview with Kraft Foods and HSG Zander

interview partner:	Mr. Wutz/Mr. Burger
company:	Kraft Foods/HSG Zander
job in the company:	Facility Management/ Facility Management
Building object:	Company location in Munich

Short description of the company Kraft Foods
Kraft Foods is a company with offices worldwide. It is active in the field of foodstuff research. In the Munich office, 300 employees work in four buildings in which 30 % are offices and 70 % are laboratories.

Short description of the company HSG Zander
HSG Zander covers several areas in the field of Facility and Energy Management. The company is particularly represented in German-speaking and East European countries.

Energy Management in Practice

In Munich the energy management is carried out jointly by Kraft Food's own employees (generally electricians and craftsmen) as well as external service personnel from HSG Zander (production engineers, technicians). A central part of the control of operations is the daily two-hour rounds throughout the buildings in order to identify faults and locate possibilities for optimization.

In general, the energy costs lie far below 10 percent of the operating costs, however, due to rising prices, energy management will gain an increasingly significant role. In the meantime, clear terms have been put down by the heads of the company in this area.

The data collection covers the measurement of the main energy meter as well as the secondary meters for singular heating circuits in the different buildings. In several cases, meters for the technical building services (lighting, pumps, fans, etc.) are provided.

A building automation system is also installed, but up to now it has not been used in the building evaluation. At present, historical data are not stored and analyzed since this would result in additional costs.

Evaluating the Strategy of BuildingEQ

Some of the various approaches in BuildingEQ are seen critically, in part.

An ongoing and detailed monitoring procedure is considered as an enhancement of the daily building rounds which are enough to recognizing most typical faults. Using various graphics to display the measurement data is conceivable for a one-time analysis but not for a daily analysis if it is done manually by the site manager. Automation therefore is seen as a necessety in order to keep cost for perdonell low.

A model-based analysis is considered only relevant for buildings which are not subject to often changing utilization, e.g. office buildings because the effort to "update" the models is considered to be high. When no building automation is available, the expense for the necessary data acquisition is perceived as high.
In general, the BuildingEQ strategy will simplify but not substitute the daily building rounds.

Interview with Siram

interview partner:	Giovanni Amoruso/ Cataldo Fornari
company:	Siram/ Siram
job in the company:	contract manager/ responsible for collection consumption data
Building object:	Policlinico Bari

Short description of the company
Siram is a company which is active worldwide in the area of Energy and Facility Management for commercial customers. In Italy there are presently about 5000 employees in this company, that administer to c. 5000 – 8000 buildings.

Energy Management in Practice

The contractural basis for the energy management services consists exclusively of providing a certain indoor climate with respect to heating. Cooling as well as the electrical energy are not included in the provided services. The payment of the provided service is based on the heated building volume in m³.

Several consumption data for fuel use at the university hospital are gathered weekly by a central building automation system, BAS. Subsidary meters are present for the respective buildings and are read manually on a monthly basis by the operator. These readings are not included in the analysis however. The electricity consumption of the chiller is not measured separately.

Evaluating the Strategy of BuildingEQ

The hourly consumption data is of interest, in principle. However, it is considered to be insufficient to have only one person responsible for the analysis. Essentially this analysis must be carried out automatically.

Theoretically, daily measurements are already possible. The use of the data for optimizing the operation is considered a minor issue at present.

Whether an automated error diagnosis based on simple rules is possible, is put in doubt due to the high complexity of the system. The number of faults communicated should be limited in any case, otherwise they will be no longer considered.

Interview mit Senate Properties

interview partner:	Juha Muttilainen
company:	Senate Properties
job in the company:	chief specialist for building services
Building object:	Senate Headquaters

Short description of the company
Senate Properties is a state owned enterprise under the aegis of the Finnish Ministry of Finance, which is responsible for managing the Finnish state's property assets. In total, they manage about 11,000 buildings, including university buildings, public office buildings, residential buildings, etc.

Energy Management in Practice

Energy Management is a very high priority by Senate Properties. A central company strategy exists with set goals and a good structure for carrying them out.

The energy consumption has been monitored systematically for many years. A uniform monitoring system is installed throughout all of the buildings, which records the heating energy on a monthly basis and the electricity on an hourly basis. In addition, a short time ago guidelines for building planners were developed. According to these plans, the necessary measurement devices are specified for monitoring and the energy efficiency is confirmed for the first two years of operation.

The experience from the past years show that the heating energy consumption is greater by a factor of two without energy management as compared to controlled monitoring.

Targeted savings, and also increased consumption, are passed on to the renters by means of a rewards, or by imposing sanctions, respectively. The possibility of influencing the electricity consumption is low since the renters receive the electricity bill directly from the provider.

Evaluating the Procedures in BuildingEQ

A higher time resolution in the acquired data is seen positively, in principle. However, it is not clear how the data can be used in the most effective way. The minimal data set should at least include the operating times of the ventilation system.

The procedures outlined in BuildingEQ are viewed as neither very relevant nor practical. The aspect of the automated error detection as well as the identification of out-of-range measurements were especially viewed with criticism. ■

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