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## The implementation impacts of IT systems on energy management in real estate organisations

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### ABSTRACT

**Purpose:** Real estate organisations change over time, but they must always have a proper overview of their building portfolio and performance to ensure efficient facilities management. IT systems and access to valid data can provide the overview and bring other benefits to real estate organisations. The paper studies which impacts the implementation of IT systems Integrated Workplace Management System (IWMS) and Energy Management System (EMS) has on energy management in real estate organisations and for their customers/tenants.

**Method:** The theoretical framing includes aspects of change management and organisational theory. The research is based on a case study of IWMS and EMS implementation. The case is The Danish Building and Property Agency (BYGST) that manages a large property portfolio (over 4.000.000 m<sup>2</sup>) and currently implements IWMS and EMS as part of an organisational change process. The empirical data is collected through field observations and document studies. Document studies include project initiation documents, system design documents on energy management and observation notes. The study is a snapshot of the implementation and covers period March-December 2017.

**Key findings:** The study indicates that the implementation of IWMS and EMS can provide more consistent data on the building portfolio and ensure better overview of actual building performance. The successful deployment of IWMS and EMS is though conditioned by several prerequisites such as availability of internal resources and their competences, and clear definitions of which business processes the new IT systems should support. The results indicate that energy management can be improved when valid core building data and consumption data is provided, combined, and properly presented to different stakeholders such as energy specialists, facilities managers and tenants. Furthermore, the systems can be used for reporting and benchmarking of energy consumption across the building portfolio.

**Impacts of the study:** The paper shows how real estate organisations, including FM departments, can use IT systems IWMS and EMS for energy management. The study shows that new, exhaustive insights on energy consumption and usage patterns increase focus on actual energy performance across the building portfolio and highlight possibilities for further energy optimisation and energy savings in practice.

### Keywords:

energy management, IWMS, EMS, dynamic data, building performance

## 1 INTRODUCTION

Buildings in the EU are responsible for 40% of energy consumption and 36% of CO<sub>2</sub> emissions (European Commission, 2018). The average specific energy consumption in the non-residential sector is 280 kWh/m<sup>2</sup> which is at least 40% larger than in the residential sector. While hospitals, hotels and restaurants represent the highest energy intensive type in specific terms, offices, wholesale and retail trade buildings, on the other hand, represent more than 50% of energy use. Education and sports facilities account for 18% of the energy use while other buildings account for 6% (BPIE, 2011).

IT systems and valid consumption data can improve energy management and bring other benefits to real estate organisations. However, successful IT implementation is an extremely complex process which normally concerns the whole organisation. It is a process beginning as a concept and ending with the implementation, and must therefore be managed as an organisational change project. The implementing conditions become more favourable when the benefits of the IT system are demonstrated during the implementing process (Madritsch and May, 2009).

In facilities management, IT software systems can be divided in Data Containers (e.g. FTP servers, databases and BIM) and Workflow Systems (e.g. CMMS and CAFM) (Ebbesen and Bonke, 2014). This paper studies the workflow system Integrated Workplace Management System (IWMS) and the supporting Energy Management System (EMS).

The research and advisory company Gartner invented the term “Integrated Workplace Management System” in 2004 and defined IWMS as an enterprise suite that includes five components: capital project management, real estate/property portfolio management and lease administration, space and facilities management, maintenance management, and sustainability/facility optimisation and compliance (Schafer, 2014). In other words, IWMS supports organisations in managing and optimising real estate portfolio and business processes including lease administration, project management, space management, maintenance management and environmental sustainability. In the European context, IWMS comes very close to the understanding of Computer Aided Facility Management software (CAFM) (Madritsch and May, 2009).

The purpose of this paper is to demonstrate how real estate organisations (including FM departments) managing non-residential buildings can improve energy management through the implementation of IWMS and EMS. The goal is achieved by studying the research question: What are the implementation impacts of IWMS and EMS on energy management in real estate organisations? The research question is answered through findings from a case study of a public real estate organisation.

The paper begins with theoretical framework in section 2 and describes the research method in section 3. It then presents the case study in section 4. Findings and discussion are in section 5 and the conclusions are in section 6.

## 2 THEORETICAL FRAMEWORK

Technology is usually the element intended to stabilise a rather fragile change. Three dimensions are important when technology is used for change: coverage, functionality and dynamics (Kamp et al., 2005a). Coverage explains technological coverage of a company as the supplier imagines it. Functionality defines what the technology can and is usually described in modules or blocks. Dynamics highlights that technology is not static, but develops over time. Many dynamics are at

stake after planned change. Internal and external development impacts organisational change both intentionally and unintentionally. There are for example intended internal changes in the organisation, and unintended external changes like suppliers offering new system versions, modules or systems that by implementation change parts of the organisation.

There are, according to Mintzberg (1980), five basic organisational configurations (Simple Structure, Machine Bureaucracy, Professional Bureaucracy, Divisionalized Form, and Adhocracy) and five basic mechanisms of coordination (mutual adjustment, direct supervision, and standardisation of work processes, outputs and skills) in an organisation. Implementing an IT system like IWMS to real estate organisations could e.g. contribute to standardisation and change the organisational configuration.

The strategic improvements in business value are called benefits and are usually achieved through programme and project management. The creation of business value depends therefore strongly on programmes and projects delivering the expected benefits, as illustrated in Figure 1 (Serra and Kunc, 2015).

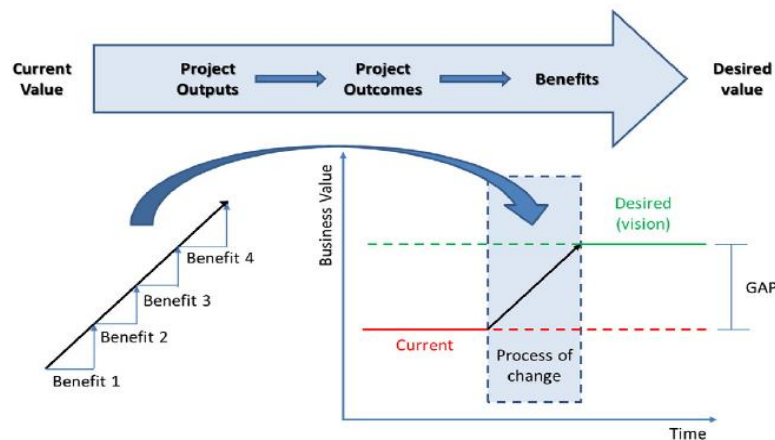


Figure 1: Moving from current to desired business value requires changes. (Serra and Kunc, 2015)

Business Process Reengineering (BPR) considers IT as a tool for supporting and enabling changes in business processes. Reengineering restructures business processes across entire organisation through radical thinking, while IT is only a lever for such process changes (Hviid and Sant, 1994). IT systems must inevitably support activities relating to cross-disciplinary business processes and solve issues with long lead times, high management, administration and overhead costs, and break down barriers between subject areas, functions and between organisation and its surroundings in general. The focus is on customer needs and value creating processes (Kamp et al., 2005b; Jensen, 2008).

IT implementations are cross-disciplinary and include different stakeholders (e.g. top management, consultants, system users). Determining the relationship between different stakeholders and new IT systems, as well as the impacts of implementing process on the organisation, is therefore important. The implementing process can include different impacts on: improvements and changes of the technology (*product innovation*), the work processes which the technology is meant to support (*process innovation*), and cause or require improvements and changes in the organisation (*organisational innovation*) (Ebbesen and Bonke, 2014).

Implementing IT systems changes the way organisations operate and perform. Change management includes two basic concepts for managing changes in the organisation: quasistationary equilibrium and permanency (Ebbesen and Bonke, 2014). Quasistationary equilibrium reflects the level of behaviour between forces pushing for and resisting change. The relationship can be changed by either adding forces, or removing the resisting forces (Hayes, 2010). Removing the resisting forces, rather than adding forces, is more likely to result in a more permanent change. Permanency defines that successful change requires three steps: unfreezing, movement and refreezing. Unfreezing means destabilizing the balance of driving and restraining forces. Movement modifies the driving and restraining forces towards a new state. Refreezing reinforces the new state and avoids a relapse. When studying an implementation process, it is important to highlight in which step the study takes place.

IT implementation changes the technological component and thereby triggers changes in the other components of the organisation (Ebbesen and Bonke, 2014). The expansion of knowledge requires extensive input from the field. Communication and user involvement in the organisation in the early stage is crucial, especially because IT implementation typically runs over several years (Foley, 2012).

Identifying which changes will occur and ensuring realisation of desired vision can be complicated. Successes in IT projects depends on categories such as system quality, information quality, information use, user satisfaction, individual impact and organisational impact (Ebbesen and Bonke, 2014). IT systems that are not in line with company traditions and root processes have higher failure rate (Kamp et al., 2005c). Some IT systems are more complex than expected and bring unexpected and changed routines to the organisation. Studying different categories can reveal whether the implementation leads to failure or success.

### **3 METHOD**

The research is based on a qualitative case study of IWMS and EMS implementation (Yin, 2014). The Danish Building and Property Agency (BYGST) currently implements IWMS and EMS as part of an organisational change process and is therefore selected as a case.

The implementing process involves three companies: Trimble, KMD, and Implement Consulting Group (ICG). Trimble is a global software developer and provides IWMS solutions. KMD is a large Danish IT company responsible for delivering Trimble's IWMS and own EMS solutions to BYGST. The first author is industrial PhD candidate affiliated to KMD and has as such achieved access to research data presented in the paper. ICG is an external consulting company hired by BYGST and is responsible for the implementing process.

Field observations and document studies are used for collecting the data. The study is based on observations from 6 implementation meetings, 4 workshops, and 7 observation days on-site. Implementation meetings cover internal KMD meetings, and meetings between KMD/Trimble business specialists and BYGST's energy specialists on energy management design solution. Workshops cover team sessions including representatives from all four organisations involved in the implementation. On-site observations are personal observations from BYGST's headquarter.

Furthermore, the study is supported by document studies of project initiation documents, system design documents on energy management, and notes from meetings, observations and workshops.

The system implementation is still ongoing, and the complete solution will go live December 2018. The EMS is partly implemented and has collected consumption data from office buildings since

May 2017. The study presented in this paper is a snapshot of the implementation and covers the period March-December 2017. The results are therefore preliminary, and a follow-up study is planned.

## **4 CASE STUDY AND RESULTS**

### **4.1 About BYGST**

BYGST is the Danish state's property enterprise and developer whose main task is to provide work spaces and office and research environments on market terms for its customers, including universities, central administration, police and the courts. BYGST was established in October 2011 as part of Danish governmental formation. Several governmental agencies (part of the Agency for Palaces and Properties, University and Building Agency, Business and Construction Agency) have been consolidated into BYGST, and the agency is still undergoing organisational changes. BYGST solves its task by owning and renting out buildings of the state through new construction and modernisation, and by redistribution of private leases to the state institutions. The agency has about 300 employees that manage 1.800 leases covering more than 4 million m<sup>2</sup> of building area. About 1,2 million m<sup>2</sup> are private leases and public-private-partnerships, 2 million m<sup>2</sup> are used by the universities, and approximately 800.000 m<sup>2</sup> are office buildings owned by BYGST (Bygningsstyrelsen, 2017a).

BYGST's current IT system landscape is diverse due to former reorganisations, different employee needs, working cultures and local IT-solutions emerged over many years prior to the consolidation. The IT system landscape is a product of long-term accumulation of silo-based systems that support individual needs of different departments at BYGST. The agency has characteristics of Divisionalized Form and faces challenges in maintaining and developing many diverse IT systems. Furthermore, several IT systems contain same type of data that is updated individually in each system, leading to missing coordination and poor data quality. BYGST therefore needs a more consolidated IT system landscape that can reduce the amount of IT systems and secure consistent, valid data across the entire organisation. For solving the problem, BYGST visited several real estate organisations using IWMS outside Denmark (The Dutch Building and Property Agency and 4 companies/municipalities in UK). Based on the experiences and recommendations from a market survey, BYGST decided to introduce IWMS (Bygningsstyrelsen, 2015). The internal need analysis and the market survey was initiated in 2012. The tendering and contract sign-off took place in 2016. The implementing process (design-build-test) was initiated in early 2017 and runs till the end of 2018.

BYGST has a vision of being the preferred property manager for customers and the state. The strategic goal is to build up a strong, data-driven knowledge organisation concerning work spaces and efficient building processes, construction and facilities management. A stronger, data-driven knowledge organisation is expected to create the basis for advising and decision-making that will result in cost effective solutions for the agency and their customers (Bygningsstyrelsen, 2012). By introducing IWMS and EMS to Business Process Reengineering, BYGST wants to combine data, knowledge and professional experience to change the organisational configuration and deliver improved customer service.

The external implementation consultants ICG and BYGST have developed benefit realisation diagrams for defining changes and goals of IWMS and EMS implementation. Several benefits from IT implementation must be realised to achieve strategic vision: higher customer satisfaction

with BYGST's service, more time for new tasks, decrease in IT-costs, increased process coherence, more valid data, and better IT security.

#### 4.2 Energy management – benefit realisation diagram

BYGST does not consider the IWMS/EMS implementation as a definite IT project, but as an organisational change process consisting of several module-specific implementation projects. Each module has its own benefit realisation diagram and implementation track.

Regarding energy management, BYGST has a special role in pointing out possibilities for reducing the energy consumption in buildings and instructing tenants on energy savings (Bygningsstyrelsen, 2012). By implementing new IT systems, BYGST also puts focus on energy management of the property portfolio. The benefit realisation diagram in Table 1 shows which changes and goals IWMS and EMS must realise to deliver energy management benefits for the agency.

**Table 1: Benefit realisation diagram for energy management at BYGST. (ICG 2017)**

<b>Deliveries</b>	<b>Skills</b>	<b>Behaviour</b>	<b>Effect</b>	<b>Goal</b>
<i>User (BYGST employees) training</i>	<i>Energy dept. can use EMS and IWMS</i>	<i>Consumption is calculated through distribution keys</i>	<i>Energy savings for customers thorough increased focus on consumption</i>	<i>Contribute in creating a solid foundation for BYGST's eligibility</i>
<i>IWMS (Energy module)</i>	<i>Energy dept. can create energy reports in IWMS for different organisational levels</i>	<i>Appointing responsible BYGST employees for monitoring and optimisation proposals of energy consumption</i>	<i>Time savings on data retrieval</i>	<i>Better customer service</i>
<i>EMS</i>	<i>Energy dept. can set necessary alarms for i.a. higher energy consumption</i>	<i>Monthly e-mails to customers regarding their individual energy consumption</i>	<i>Time savings for reporting on energy data</i>	<i>Savings on energy consumption</i>
<i>Web module for Tenants</i>	<i>Energy dept. can set necessary alarms for i.a. higher energy consumption</i>	<i>Monthly e-mails to customers regarding their individual energy consumption</i>	<i>Increased customer satisfaction with energy managmeent</i>	<i>Valid energy data</i>
<i>Importing building data in EMS</i>	<i>Exchanging data between IWMS and EMS</i>	<i>Quality control of energy data once a week</i>	<i>Increased customer enquiries regarding energy saving measures</i>	<i>Increased employee satisfaction</i>
<i>Two-way integration between IWMS and EMS</i>		<i>E-mail notifications to BYGST's energy responsible in case of higher energy consumption</i>	<i>Less customer enquiries regarding data validity</i>	

The deliveries encompass the implementation of IWMS and EMS with connected webservice for tenants. The data must be imported in the systems, and two-way interface between IWMS and EMS must be developed. BYGST employees must also receive user-training in the systems.

Changes are reflected through developing new skills and behaviour in the organisation. The Energy department must be able to use and exchange data between IWMS and EMS, and to create reports for different organisational levels. The Energy department must also develop skills in configuring notifications for e.g. higher energy consumption. Customers will receive monthly notifications regarding their energy consumption. BYGST's energy responsible person will receive notification in case of higher energy consumption. Once a week, quality control of energy

data is performed. The aim is to provide energy savings for tenants (external development) and time savings on data retrieval and reporting (internal development). The deployment of IWMS and EMS must increase tenant focus on energy management and energy savings, and reduce enquiries regarding data validity.

### 4.3 Design solution

Figure 2 shows the design solution for energy management at BYGST. The model is designed to support different stakeholder needs on consumption data in and outside of BYGST. The implementation includes a module-based IWMS “Manhattan Software” (called “KMD Atrium” in Denmark) covering Core, Lease, Customer Relationship Management, Project and Energy modules. Each module has its own implementation track in a project. Besides IWMS Energy module, the EMS “EnergyKey” and the connected webservice “Webtools” are also included in the energy management track. EnergyKey manages energy data collection, meter readings, data analysis, consumption visualisation and reporting. Webtools is an add-on module to EnergyKey and displays energy consumption to end-users, in this case BYGST’s tenants. Since IWMS is master on building data and EMS on consumption data, a two-way application programming interface is developed for data exchange.

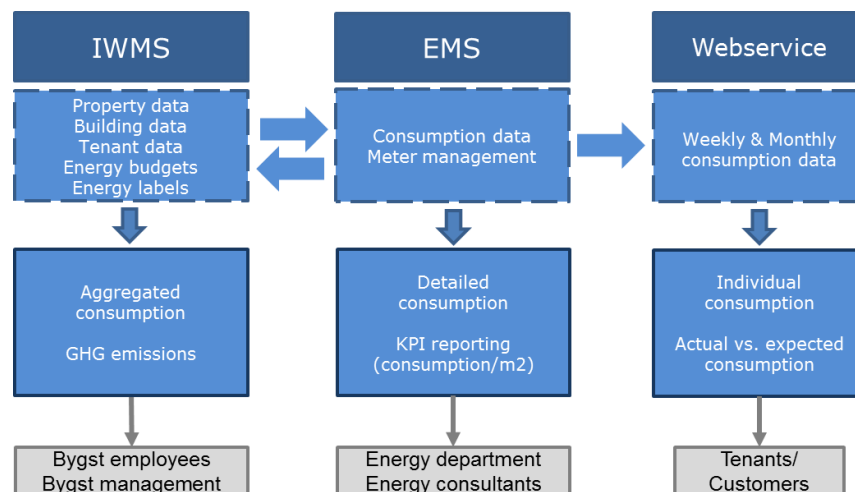


Figure 2: Energy management model at BYGST. (based on system design document)

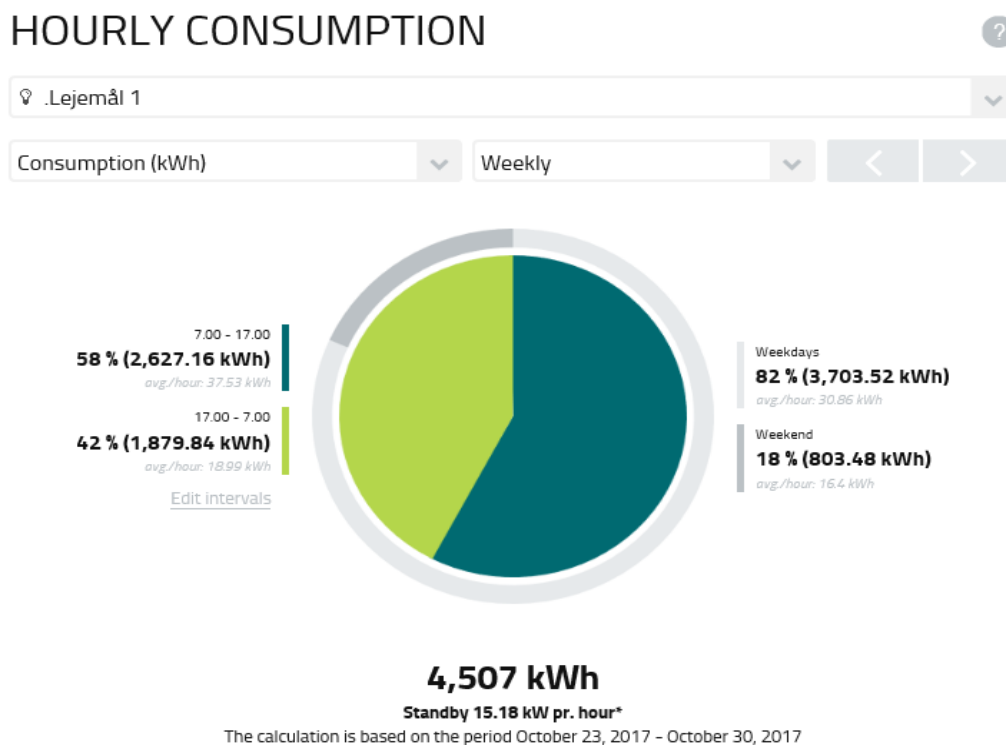
Energy management reports electricity (kWh), heating (kWh) and water (m<sup>3</sup>) consumption on different building levels (property-building-lease unit) and for different tenants.

EMS is internally used by BYGST’s Energy department and operates as an engine for meter management and consumption readings. It provides deep insight on energy performance in each BYGST lease unit, building and property. The consumption readings in office buildings were earlier collected in different formats, by using data loggers, automatic meter readings and manual meter readings. This reading process caused data inconsistency due to different reading formats, frequency, and technical failures. The 95% of electricity, 65% of heating and 35% of water consumption in office buildings is now delivered directly from the utility companies to EMS through remote readings (Bygningsstyrelsen, 2017b). The remaining consumption is still collected through dataloggers, but will over time be delivered directly from utility companies. The Danish Meteorological Institute delivers degree-day data to EMS daily, and heating consumption is benchmarked right away, regardless of weather conditions.



IWMS is a master system on core data and delivers data on buildings, energy budgets and tenants to EMS. By combining core data from IWMS and own consumption readings, EMS calculates energy consumption for each tenant and provides performance indicators (consumption/m<sup>2</sup>) on different building levels. IWMS receives aggregated monthly consumption data from EMS through an interface and calculates greenhouse gas emissions. The monthly consumption and emissions are available to relevant BYGST employees for reporting purposes on the property portfolio.

The tenants have access to the webservice, where they can login and follow their own electricity, heating and water consumption. The tenants can monitor their monthly/weekly/hourly consumption and compare it with expected (last year) consumption.



**Figure 3: Webservice solution for BYGST's tenants. (Webtools)**

Figure 3 shows the webservice solution for weekly electricity consumption for Lease 1 (Lejemål 1) in a multi-tenant office building. The webservice displays consumption for working hours (7.00-17.00), non-working hours (17.00-07.00), and weekends. The associated facilities managers have access to the data and can e.g. observe that 42% of electricity consumption is used outside of working hours, and that 18% of electricity is used in weekends. Since an office building has working hours 7.00-17.00, this information can be useful for identifying potential energy losses. The data is also useful for benchmarking energy consumption between tenants, and for monitoring stand-by consumption.

Another example of how IT systems impact a real estate organisation was observed few days after the deployment of EMS. A facilities manager observed that the electricity consumption in one lease unit was higher than expected during non-working hours. The observation led to identifying defects in some light sensors that were replaced afterwards, and electricity consumption was normalised.

## 5 FINDINGS AND DISCUSSION

Implementing IWMS plays a key role in the change management process at BYGST. The system is used for internal, mutual adjustment, and aims to create common data platform for BYGST's employees and to deliver better service to BYGST's customers. However, the implementing process is complex since it impacts all three innovation spheres (product, process and organisational innovation). The product (IWMS) is further developed during the implementation and configured to match BYGST's needs. BYGST's business processes are reviewed in parallel, meaning that they can be changed to match the system functions. During the implementation, several key persons from BYGST (e.g. IT project manager, Head of IT department) have left the agency, illustrating unfreezing and movement steps in a change management process. Also planned user trainings demonstrate unfreezing and movement steps since the trainings will change users' IT skills.

Business Process Reengineering characterises the implementation since IT is used for supporting organisational change and focuses on value creating for customers. The implementation supports standardisation of work processes, outputs and skills, and is expected to improve interoperability, transparency and data reliability.

IWMS can support users in solving their tasks and improve business processes, but it can only happen if the system configuration matches the needs of organisation. The system itself is not an off-the-shelf solution, but highly dependent on user inputs during the implementation. On the other hand, real estate organisations must at the same time critically review their business processes, e.g. through BPR.

Due to the scale and complexity, the implementation is still ongoing. The implementation takes long time and underlies the importance of benefit realisation diagrams for tracking, whether the implementation follows the initial plan and delivers planned benefits.

Even though the systems are not fully implemented yet, the results indicate that several goals for energy management are already realised. For example, BYGST and tenants in office buildings have now access to valid energy data, and the agency provides better customer service through the webservice. Savings on energy consumption are also observed. However, the question remains, whether full systems implementation will deliver all, or only some benefits? To which degree will the complete solution fulfil the actual needs of different stakeholders? Will benefits to one stakeholder bring disadvantages to another? This will be investigated further in the follow-up study.

## 6 CONCLUSION

The implementation of the IT systems IWMS and EMS creates several impacts on energy management in real estate organisations. The study shows that new, exhaustive insights on energy consumption and usage patterns increase focus on actual energy performance across the building portfolio and highlight possibilities for further energy optimisation and energy savings.

IWMS and EMS can provide more standardised data on property management and ensure better overview of actual building performance. The successful deployment is though conditioned by several prerequisites such as availability of internal resources and their competences and clear definitions of which business processes IT systems must support. The IWMS implementation is a complex process involving many different stakeholders and takes long time to complete.

Energy management can be improved when valid core data and consumption data is provided, combined, and properly presented to different stakeholders such as property managers, energy specialists, facilities managers and end-users/tenants.

Further studies will develop an IWMS implementation guide and propose a method for improving environmental building performance thorough IT systems and dynamic data.

## ACKNOWLEDGMENTS

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