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DELIVERING SUSTAINABLE FACILITIES MANAGEMENT IN DANISH HOUSING ESTATES

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Summary. *Housing is an area, which ay a central role in sustainable development due to large resource consumption and as transition agent towards sustainable lifestyles. The aim is to evaluate current practice of housing administration in Denmark in order to evaluate if and how sustainable facilities management is supporting social, economical and environmental sustainable development. Sustainable facility management (SFM) is as an 'umbrella' for various ways of reducing flows of energy, water and waste in the daily operation of the buildings, for instance by regular monitoring the consumption, by using 'green accounting', by applying policies for sustainability, enhanced user awareness etc. In Denmark, despite attempts by government and NGO's, implementation of sustainable resource consumption in existing buildings is still unsolved. Monitoring the resource consumption is part of the solution, but the entire FM-setting including the ownership of the building, the organisation of daily operation, the roles and relation between stakeholders are equally important in order to utilise the monitoring as a mean for transformation towards sustainable buildings and lifestyles.*

1 INTRODUCTION

Sustainable management of existing buildings is one of the most important strategies in the transformation towards a sustainable society due to the huge quantum of square meters compared to new buildings, where sustainable design has been applied. In this paper we analyse current practice of housing administration in Denmark in order to evaluate if and how sustainable facilities management is delivered in housing estates.

Elmualim et al [1] argue in their article about the practice of sustainable facilities management, that "Facilities managers are in the forefront of delivering sustainable assets management and hence further the venture for mitigation and adaptation to climate change..."

but the overwhelming barrier for implementing sound sustainable FM is the lack of consensual understanding and focus of individuals and organizations about sustainability”¹. This paper show state of the art in the Danish housing sector and provides a deeper insight into the stakeholder perspectives on sustainable FM and different ways of developing local practices of sustainable FM.

There is a growing interest in integrating sustainable measures in building operation; more and more facility managers and building owners are showing an interest in sustainable issues. It is increasingly acknowledged that facilities managers and 'building operators' are key actors in implementation of sustainable measures in the building operation [2]; [3]. Facility managers need to develop a 'sustainable strategy' that can fit into the organization's financial management, where new management tools such as Total Cost of Ownership (TCO) can be an important tool for promoting sustainable building operation [2]. It has, however also been stressed that there is often a gap between the environmental benefits that users demand in building operation, and the services delivered by the facility management. For example, customers have too little knowledge of the environmental services that Facilities Management operators are able to deliver, or facility managers have too little knowledge of user demands [4]; [5]. Also, these services can be very diverse, as there are big differences among facility managers and administrators on the environmental themes that are considered essential [6].

Some of the barriers for implementing sustainable measures in the building operation are limited data on local consumption of energy, water etc., lack of incentives to create routines around environmental issues, limited knowledge about environmental themes in the housing organization, and that housing administrators have too little time and too few resources [6]. Other studies conclude that the organization of housing companies have great importance for their environmental performance [7]. Brunklaus identifies a wide range of studies showing that there are several technical options for reducing environmental impact, but that an offensive attitude amongst owners and administrators is missing, and that limited resources within the organization and lack of long-term maintenance are significant barriers to environmental performance [8]. The results of a survey of consumption data over 10 years in two residential areas in Gothenburg suggest that a housing organization based on flexible planning and control are better able to absorb new energy and environmental requirements than an organization with more rigid procedures. Therefore the local organization and the housing management are crucial factors for the sustainable measures, possibly leading to a 25-30% difference in energy and water consumption [7].

In a Danish context the thesis on organisational structures influencing sustainable building operation is highly relevant, mainly in relation to different types of ownership; in relation to implementation of sustainable measures in new buildings, the social housing sector has for many years been leading, compared to other types of ownership (private renting, co-ops and owner-occupancy). Although we expect that this also goes for the building operation as well, due to the generally well-organised organisational structure of the social housing sector [8], we have so far not had any substantial picture of the differences between different types of

ownerships on how and to which extent sustainable measures are being implemented in the building operation.

Through building operation and ordinary maintenance there are a number of smaller initiatives and investments that can improve the environmental performance of the building, for instance by using technologies as low energy windows, low flush toilets, low-energy bulbs on shared spaces etc. Realising these potentials however requires skills, knowledge and competences amongst the operation staff, as well as a determined building owner and dedicated residents. Sustainable building operation therefore acknowledges that behaviour and use from the residents are as important factors as the purely technical qualities of the building.

2 METHODOLOGY

This paper is based on the Danish research project “Sustainable Building Operation in Housing Estates” where researchers from the Technical University of Denmark and the Danish Building Research Institute in 2007-2008 explored the current practice of sustainable facilities management through literature review, interviews, workshops and questionnaires. The aim of this research project was to identify how and to which extent sustainability issues are integrated in the operation of housing estates, with different types of ownership and in different organizational contexts [9].

The methodology consisted of three different phases supplemented with a continuous literature study:

- First a workshop on sustainable housing operation was held with a range of leading practitioners and researchers in the field to establish an initial understanding of current practice. A number of examples of environmentally managed housing operation from practice were presented and key issues in the area were discussed, including the potentials and barriers for further learning. The results from the workshop were used in the development of the questionnaires for the following survey.
- A questionnaire survey to 357 private and public housing administrators out of which 108 responded – equivalent to a response rate of 31%. The questionnaire included general questions on the one hand, the administration and partly questions about specific environmental actions in the operation and detailed questions about particular barriers to integrating environmental aspects into operations. The results from the survey was discussed and confirmed at a workshop organised by the environmental group of social housing administrations.
- Finally, five case studies of practical examples of sustainable housing operation were conducted, based on document studies and interviews with key persons. The case selections were made to explore the social interactions in the management processes and

be able to display one of the most advanced examples of SFM within each type of ownership.

3 TOWARDS SUSTAINABLE FACILITIES MANAGEMENT

This section presents the theoretical basis of our research which drawing on theories of Facilities Management and Ecological Modernisation.

3.1 Monitoring in a perspective of Ecological Modernisation

Ecological Modernisation (EM) is a policy concept suggesting how environmental considerations are increasingly being integrated into institutional, business and personal decision-making, rather than being something external and only within the environmental sector. This integration happens through measuring and visualisation [10], [11], [12], through new economic instruments and new types of co-operation, such as more voluntary agreements [13], [14] and through new roles for both nation states, social movements and market actors [15].

An important feature of EM concerns calculability of environmental issues. EM focuses on how substance flows, such as water resources, could be better managed and controlled integrating both technical and social aspects. During the integration of environmental values into the institutions, environment is transformed into manageable entities - e.g. measurable goals, quotas, norms and green taxes also serving marked purposes [13], [16], [8].

Moreover, EM implies new institutional arrangements in which the authorities' collaboration with other stakeholders is central, as a contrast to traditional politics, where changes are sought through legal regulation. The new types of collaborations are formed around so-called 'story-lines', an argumentative way of defining environmental aspects within central themes. A story line is a way to communicate complex issues in a simple and metaphoric way, bringing partners (authorities, public bodies, NGO's, etc.) together in *discourse coalitions* [10]. Story lines are seen as fulfilling "*an essential role in the clustering of knowledge, the positioning of actors, and, ultimately, in the creation of coalitions amongst the actors of a given domain*"¹ (ibid.: 63).

Mol & Sonnenfeld suggests 3 stages in the development of EM theory; while EM originally developed in the sphere of industrial production focusing on the role of technological innovations and market actors, the second stage gave more attention to institutional and cultural dynamics. The third stage includes studies of ecological transformation of consumption [11]. Hence some scholars have begun to promote an expansion of EM to include the daily practises of households [12], [17], [14]. Boström states that the EM approach in general is oriented towards self-regulation and cooperation and consultation with those to be regulated [14]. He also emphasises that new intermediary actors are involved in facilitating the participatory strategies (ibid.:176). However, the EM approaches to

participation are very much focused on the individual role of citizens as consumers and the 'greening of lifestyles'. No doubt that "*consumers looking for opportunities to 'green' their lifestyles and domestic routines are getting 'served' much better*"^[17], but the question is if the consumer as Spaargaren and Boström assume can be regarded as the main driver for change? We argue that changes in environmental performance of buildings should be seen as a combination of user participation, building on social learning processes, and community based strategies emphasising also soft outcomes, such as the building of institutional capacity [18] and [19].

3.2 Regulation and tools for sustainable building operation

Sustainable building operations is used in this project as a collective term for the variety of environmental projects and initiatives that deal with the daily building operation - including the ongoing maintenance, monitoring and maintenance of installations and heaters, etc. Parts of this concerns mandatory arrangements due to public regulation, part of it concerns voluntary tools, arrangements and initiatives.

Over the last decade there have been various initiatives to increase monitoring and visibility of 'substance flows' of buildings. In the following we will shortly describe examples on mandatory schemes and voluntary arrangements:

Individual metering: Individual metering has been a main issue in the greening of the housing sector in recent decades. Whereas supply of district heating and water was formerly regarded as collective welfare services, law and regulation has made individual metering of these services mandatory, often leading to large reductions in consumption. Individual consumer metering of heating, electricity, fuel gas and water came into law in Denmark in 1995 (Act no. 362 on individual metering of consumption for electricity, gas, water and heating). The history of this act referred to studies that document up to 20 % savings with individual metering and there is no doubt that individual metering has helped reduce consumption in many existing buildings, where savings around 15 and 20 % are often obtained when individual metering is established. However, in this case there is a link between individual metering and individual payment, so individual payment probably strongly contributes to the savings as well as visibility of the consumption.

Within consumer measurements and surveillance there is still a large potential, since many households still have shared meters. For example only 4 % of the flats in Copenhagen had an individual water meter in 2003. In many older housing estates there are many water-strings in each flat, and as each string needs a meter, it is expensive to establish individual measuring, and also resource-demanding to read the meters.

Energy labelling of buildings: The Energy Labelling of Buildings in Denmark demands an energy review of the building by every sale or as minimum each 5th year. In 2007 it substituted a former arrangement, where energy consultants each year made a review of buildings over 1.500 m² where they noted the energy consumption of the building and

suggested ways to improve the energy efficiency of the building. Although this arrangement was also criticised for not being efficient, it has the quality of delivering annual registrations of the energy consumption, which many owners and administrator are missing today with the Energy Labelling of Buildings. The Energy Label has been widely criticised by building owners, residents, administrators and consultants for being too costly and causing too little changes in the owners practice. Since there are no obligations to act on the recommendations included in the energy report. A recent evaluation of the Danish energy saving initiatives rated the Energy Label of Buildings as the worst initiative, in terms of efficiency gained in relation to costs [20]. For this reason, the government currently considers a revision of the scheme.

Parallel to the mandatory regulation, a number of voluntary tools and methods to systematically manage sustainable issues in buildings have been developed. In Denmark this includes:

Green accounting for residential buildings: A programme for a standardised consumption monitoring of a building, for calculating CO₂-emissions, and enabling comparison of key figures with similar buildings [21]. The program is free for download, and has been relatively successful.

Green Homes: An environmental management scheme, developed for social housing departments by the National Organisation for Housing Associations. It requires that the housing department establishes an action plan to reach a number of self-defined environmental targets. When the department has fulfilled these criteria, they can use the logo of the scheme, and raise the 'green flag'. The scheme has recently been opened for other types of ownership, private co-ops being the most relevant.

Energy Management: This is a method for monitoring and visualising energy flows in a building, making it possible to react quickly if the consumption rises, or improving the basis for investments decisions in energy efficient building technologies. Energy management is a service offered by several consultants.

Based on our research, we argue that the use and benefits of these tools are closely related to the local institutional capacity, where the FM-function is central in a building context. Monitoring of buildings is the very foundation of Facility Management: 'What gets measured gets managed'. Therefore, Sustainable Facilities Management can be seen as EM applied on existing buildings. The local capacity can be seen as the Facilities Management-function of housing estates. The Facilities Management function frames the monitoring process, and provides the technical and organisational setup. With respect to buildings and monitoring, the local capacity to apply monitoring in a pro-active way and as a lift-off for environmental improvements is essential.

3.3 Facilities Management

Facilities Management (FM) is according to the European standard EN15221-1 on terms and definition of FM [22] defined as “*integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of the primary activities*”²². The standard includes an annex with a model of FM, which shows that FM concerns the mediation between the demands of the primary activities in an organisation and the supply of facility services from internal and/or external providers. The interaction between the demand and supply side takes place on strategic, tactical and operational level. On the demand side the organisation is represented on strategic level by a client that procures facility services by means of a FM agreement and on tactical level by a unit that specifies and orders the delivery of the facility services within the terms and condition of the FM agreement. The end users represent the operational level of the demand side

In a housing organisation the primary activities are related to accommodation, and the end users are the residents. The support functions cover a number of activities. On operational level there are activities like building operation and maintenance, cleaning, gardening, security, rent administration and bookkeeping, On tactical level there are activities like maintenance planning, tendering, project management and energy management. On strategic level there activities like development of strategies and policies, negotiating agreements, portfolio planning, defining service levels and monitoring performance.

3.4 Monitoring and Sustainable Facilities Management

In the following we will discuss monitoring as a part of Sustainable Facilities Management (SFM), and outline different elements of monitoring. Monitoring is in different ways central for sustainable facilities management and as an on-going process of environmental management. This might include different aspects of monitoring:

- monitoring through individual metering (household level)
- monitoring through collective metering and shared facilities (housing organisation level)
- green accounting (comparing housing organisations and households, providing benchmarks)
- setting green goals
- developing sustainable management plans
- implementing and sustaining goals and plans
- evaluation of goals and management plan
- repeat metering, compare goals, make new goals, revise management plan etc.

The role of the facilities manager is principally to manage this process, and to include the relevant actors, persuading them to join, asking them to define goals and suggest initiatives, delegating responsibility to them etc. Also information and knowledge support is necessary

on all levels of the process. The housing organisation and its actors has to be updated with recent technological development, and the possibilities of using these in order to optimise the environmental performance of the building, especially in relation to reducing flows of water and energy.

This involves many different actors, inside the organisation (administration, operation staff, residents etc.) and outside the organisation (FM-managers, FM-providers, consultants, infrastructure suppliers, green ngo's, local authorities etc.). The role of the facilities manager can therefore in principle include providing relevant FM-services, the relevant information and managing different actors in the process of creating a sustainable agenda for the housing organisation. However, how this looks in real life depends on the way the properties are managed, which varies with different types of ownership.

In this paper we exclude the discussion of exactly which measures to include when monitoring resource consumption since this is not our aim. But we recognise that this is an important discussion in order to be able to evaluate and maybe benchmark SFM delivered by different organisations to different housing units.

4 DELIVERING SUSTAINABLE FACILITIES MANAGEMENT

To understand the possibility of delivering SFM it is necessary to understand the frames for housing operation under different types of ownership.

4.1 Danish housing estates

There are about 1 million multi-storey dwellings in Denmark [9] representing 38% of all dwellings in the country. Due to their relative small sizes (on average 79 m²), they represent only 27% of the residential area. There are app. 87.000 multi-storey buildings for housing in Denmark. They have in average 12 dwellings per building, and an average floor area of 923 m². There are however differences amongst the different types owners, see figure 1.

Private renting and private co-ops: In private rented dwellings the building operation is mainly decided by the owner, and residents have limited influence. For private co-ops, the residents buy a share of the co-op which gives them a right to rent the dwelling, and the right to vote at the general assembly, which takes all decisions about the co-op. Over recent years a large amount of private rented dwelling have been transformed to private co-ops, as the legislation has given the residents the possibility to buy the building when it was going to be sold. This has been very popular amongst the residents, who as co-op sharers get much more influence on their dwelling and building. Private renting and private co-ops represents each 14% of the dwellings in multi-storey buildings. They are dominated by many small buildings (100-1.000 m²) with a limited number of dwellings.

Social housing: In social housing the residents rent a dwelling in a social housing department, which is an independent organisational and economic unit. It is typically administered by a

larger administrative social housing organisation. The residents have the right to vote at the general assembly for the housing department, who takes all important decision, including economy, maintenance, election of the local board etc. This is the essence of the extensive 'residential democracy' in the sector. Social housing represents 36% of all dwellings in multi-storey buildings, and has a relatively high proportion of buildings between 1.000-5.000 m².

Owner-occupied dwellings: These are dwellings in multi-storey buildings individually owned by the residents. Here, the common decisions concerning the building are decided by an organisation between the owners. The owner-occupied dwellings represent 21% of the all dwellings in multi-storey buildings. As for private rented and private co-ops, the owner-occupied dwellings are dominated by many small buildings (100-1.000 m²).

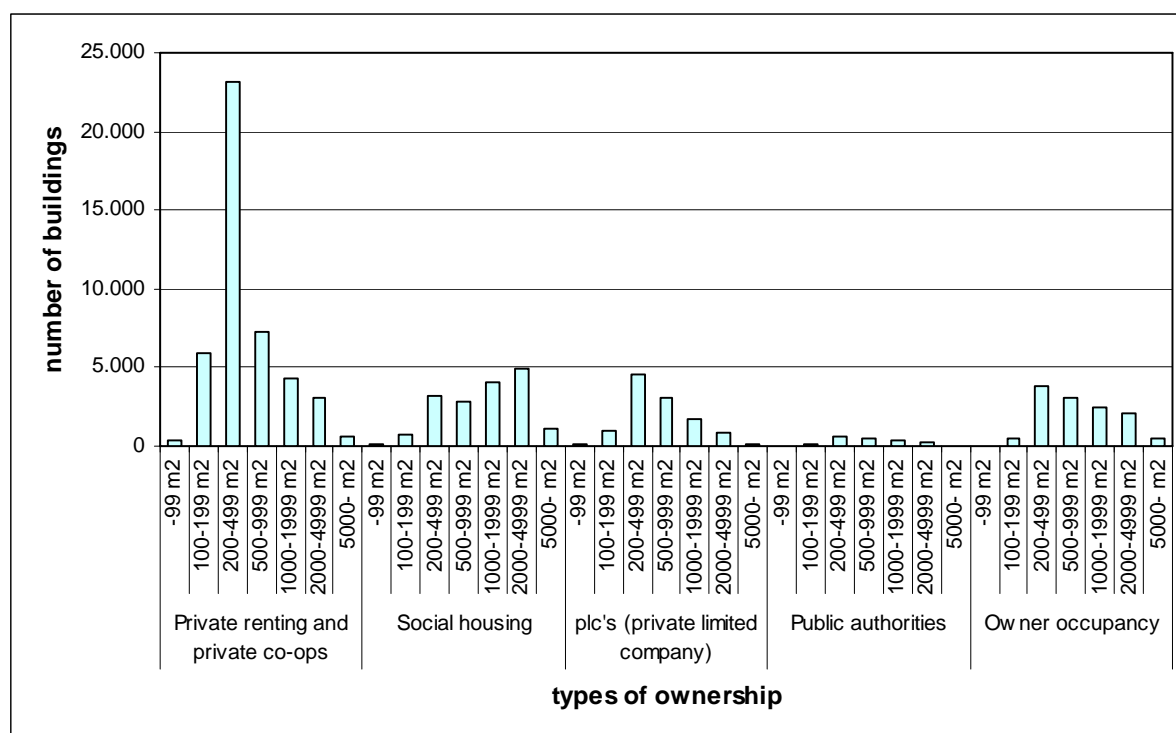


Figure 1. The number of multi-storey buildings in Denmark (y-axis), divided by size of building (m²) and type of ownership (x-axis). Source: Denmark's Statistics.

The other types of ownership, private limited companies and public authorities, represents a total of 12% of the multi-storey dwellings, but have been left out of this research.

Type of ownership as well as sizes of the buildings are relevant to the way they administered and managed. The different types of ownership give different influence to the residents, and different ways of making decisions. The many small buildings in private rental, private co-ops and owner-occupied dwellings, means that there are many small owners and administrators in

this sector, whereas in social housing there are many relatively large housing organisations, that takes care of the building operation and facilities management for the different local boards. Table 1 gives a brief overview of the characteristics by different types of ownership.

	Social housing	Owner-occupancy and private co-ops	Private renting
Manager	Housing organisation	Private administrator, or self-administration	Private administrator; can be smaller or larger
Residents influence on building operation	Residential based democracy. Residents selects local board and decides on local budgets	Residents select local board and decides on local budgets	Limited formal influence (for instance to veto decisions)
Organisational unit	Local department board	Local department	local renters organisation (optional) with very limited influence
Owner	Local housing department	Owner-occupied (residents) or by a co-op	Private landlord
Operation staff (janitor, inspector, gardener etc.)	In-house and employed by the housing organisation, limited service from the outside	Service from operators (contracts and ad-hoc), and from DIY-work.	Smaller administrators have no operation staff (owner must arrange service-operators). Larger administrators have in-house staff

Table 1. Characteristics of stakeholder roles under different types of ownership

This section presents the findings in our research starting with the organisation of FM in relation to ownership followed by analysis of what tools they use, and their motivation for doing so.

4.2. Ownership and the organization of facilities management

The organisation of FM in housing has been analysed in accordance with the model in the European standard EN15221-1 mentioned in section 2.1 in relation to the demand side and the supply side with FM mediating on strategic, tactical and operational level. Table 2 shows the parties involved in the organization according to these divisions for the different types of ownership of housing.

Ownership	Level	Demand side	FM mediation	Supply side
Social housing	Strategic	National or regional housing association		
	Tactical	Local tenants boards	Specialist staff	Consultants
	Operational	Tenants	Local inspectors	Mostly in-house staff centrally and locally
Owner occupancy and private co-ops	Strategic	Annual association assembly		
	Tactical	Association board	Association chair	Consultants
	Operational	Residents	Association chair	Private administrator and local providers
Private renting	Strategic	Director from owner organisation	Director from private provider	Private provider and consultants
	Tactical	Manager from owner organisation	Manager from private provider	Private provider and consultants
	Operational	Tenants	Inspector from private provider	Private provider and sub-providers

Table 2: The organisation of FM related to ownership of housing

One challenge in analysing housing association based on the FM model is that FM is the core business of housing. It all has to do with providing accommodation for the residents or tenants. However, a number of other organisations – besides pure FM-providers - have FM as their core business, for instance organisations responsible for airports, sport facilities, shopping centres and public buildings and infrastructure in general. Independent of that, the organisation has to manage their demand and supply of facility services.

The table shows that social housing associations are very self-contained organisations with most functions in-house. There is not indicated any FM-mediation and supply side on strategic level. That does not mean that such associations do not deal with strategies, but this takes place in the top management of the organisation on the demand side. In general social housing associations in relation to FM can be said to be purely demand driven. The specialist staff indicated at tactical level of FM-mediation are technical specialists in the housing association and they mediate with consultants and providers for instance in relation to energy management and major maintenance work, but they also function as internal consultants.

The owner occupancy and private co-ops resembles social housing association by being very demand driven, but they are typically small and local organisations without many resources and very dependent on voluntary work by elected residents in their association board. Strategic decisions are solely made collectively at annual assembly meetings by all active residents. The association chair has a central role in FM mediation. The association usually has an ongoing collaboration with a private administrator, which mostly takes care of rent administration and book-keeping. These administrators are remunerated by a fee as a percentage of the total rent and are usually selected by reputation without any economical

competition. The administration is often carried out by small lawyer firms or similar without any technical staff.

The private renting is mostly carried out by institutional investors like capital and pension funds. There is also some private owned rented-out housing and for these the situation resembles very much the one for owner occupancy and private co-ops except that most things are managed by an owner representative and there is no association with an elected board and annual assembly. The situation indicated in the table is related to large organisations with a private provider responsible for all facility services. This represents a quite recent development related to the general development of the FM market. The provider can be an in-house organisation but if so it is usually organised as a separate subsidiary company owned by the investor company and with the possibility to operate on the open market. There is an increasing trend towards economical competition between providers and towards extending the providers responsibilities for optimising the yield of the real estate investment. This increases the strategic focus on the development the property to increase the rent and to optimise the building operation and administration. The private renting in large organisations is in this way becoming more and more supply driven.

4.3. Motivations and conditions for Sustainable Facilities Management

The incentives and barriers to implement SFM are very dependent on the ownership. In social housing the situation depends on the overall policy of the association. Some associations has a very high profile in relation to sustainability and see it as a part of there mission to support overall societal objectives. It can also be part of creating a progressive image and be attractive to preferred groups of tenants. The social housing associations are in general fairly big national or regional organisations with a central office with highly qualified technical staff. The engagement in relation to SFM also depends on the attitudes and competences of the technical staff and some associations have a technical staff, that is very enthusiastic about implementing SFM. The attitudes among the tenants is also very important and there are examples of the tenants acting as a barrier to implementation of SFM – particularly if it has increased rent as a consequence. Table 4 show the difference in environmental attitude among private administrators and social housing administrators.

On a national level, the National Social Housing Association (BL) provides various tools and offers to promote environmental measures in the local associations and departments. For instance, BL has developed the scheme 'green homes' mentioned earlier. Moreover, BL provides environmental training and education for the operation staff in the social housing organisations.

The situation in owner occupancy and private co-ops resembles the social housing association in the way that it depends a lot on the attitudes among the tenants. But because these organisations usually are small and local, they do not have any technical staff and are dependent on voluntary work and residents competences or on consultants. However, due to

limited budgets such associations are often reluctant to engage consultants unless there is a clear business case demonstrating cost savings.

Among private renting there is a large barrier in the lack of incentives, because investments in improvements mostly have to be made by the owners, while savings on energy costs mostly benefits the tenants. Due to legislation the owners cannot in most cases increase the rent. There is not at the moment indications that investors see it as a necessary to use SFM as part of the image of their property to attract tenants. However, larger providers have the technical competences and they experience that environmental considerations over time are becoming a normal part of professional FM.

Type of environmental service (part of ordinary service from administrator)	Private administrators	Social housing administrators
Energy management	67%	16%
Green accounting	0%	25%
Energy labelling of property	6%	51%
Environmental information and campaigns towards residents and staff	11%	59%

Table 3: Type of environmental service offered by private and social housing administrators as par of the ordinary service from the administrator

Environmental attitude	Private administrators (% totally or partly agree)	Social housing administrators (% totally or partly agree)
It's important for us to achieve and offer environmental competences	33%	71%
We try to make our clients interested in environmental measures for the building operation	45%	89%
We don't think our clients are interested	45%	52%
We don't think environmental services are relevant for our mission	55%	17%

Table 4: Own environmental attitude according to private and social housing administrators

Environmental practices	Private administrators (% answers: 'used in 75-100% of properties')	Social housing administrators (% totally or partly agree)
Monitoring of heat central / boiler room	32%	77%
CTR-steering of heat central	5%	21%
Monitoring consumption of heat, water and electricity	26%	72%

Table 5: Types of monitoring done by private and social housing administrators

Environmental tools	Private administrators (% answers: 'used in 75-100% of properties')	Social housing administrators (% totally or partly agree)
Green accounting	5%	10%
Energy Management	10%	42%
Green Homes	0%	0%

Table 6: Environmental tools used by private and social housing administrators

Our research on sustainable housing operation amongst different types of ownership documents that there is a considerably difference on the degree of monitoring and integration of sustainable measures in the housing operation amongst different types of ownership as table 3-6 show. In table 7 we summarises our main observations from our survey and case-studies amongst sustainable housing operation.

Type of ownership	Strengths	Weaknesses
Social housing	<ul style="list-style-type: none"> - Strong in-house organisation and competences - Strong commitment to sustainable issues amongst administrators - Many large units 	<ul style="list-style-type: none"> - Often residents feels little ownership to the housing department - Often residents have short time-horizon, and no incentives for long-term investments
Private owned and co-ops	<ul style="list-style-type: none"> - Strong ownership and responsibility amongst residents - No owner-renter conflicts, stronger economic motivation for saving energy and water 	<ul style="list-style-type: none"> - Limited in-house knowledge - Strong focus on reducing operation costs => cutting external FM services - Many small housing estates (<500 m2) - Administrator not committed to promote sustainable FM
Private renting (institutional owners)	<ul style="list-style-type: none"> - Often large knowledge and competences in FM-organisation - Limited influence from residents 	<ul style="list-style-type: none"> - Owner has strong focus on economic performance - Residents feels little ownership - Potential owner-renter conflicts - Residents have short time-horizon, no incentives for long-term investments - Administrator not committed to promote sustainable FM

Table 7. Strengths and weaknesses for sustainable housing operation amongst different types of ownership

5. Sustainable Building Operation as Network Management: Two examples

The answers from the survey and the case studies of sustainable building operation carried out suggests that the FM-function, i.e. the local institutional settings, are important if monitoring practices should lead to environmental progress. We will illustrate this with two short examples from our case studies, both in social housing departments who have both developed their own versions of sustainable facilities management

The first case, the social housing Brændegårdshaven, is an example of SFM and it shows how the competences of the operational unit (including an environmental coordinator) is supplemented with the competences of residents and external knowledge centres through collaboration and networking. The second case, the social housing Blågården, is another example of SFM and it shows how SFM is the result of negotiations between several decision makers and the result of one single FM-mediator.

Together the cases illustrates that monitoring does not alone lead to environmental progress; the local institutional settings and FM-organisation are active in establishing the monitoring, providing benchmarks, defining goals, establishing initiatives, mobilising other actors etc. Another important element is the ability to 'embed' the process in the administration and local FM-organisation, so that it will not stop when the active residents moves away from the department. The organisational embedment makes it possible to continue a process of monitoring, defining goals, starting new initiatives, evaluating, learning etc. Finally, it is important to notice that the SFM-service in the social housing departments is carried out by several different actors, and as argued before, implementing sustainability measures becomes more a challenge of network management than 'traditional' FM-services.

5.1. Brændegårdsparken: 'Green homes' as sustainable facilities management

Brændegårdsparken is a social housing department with 324 dwellings, built in 1966-68. It is administrated by a social housing organisation (Fruehøjgaard) that includes 20 housing departments, with a total of 1.430 dwellings. Three staff members are permanently employed in Brændegårdsparken, moreover they can use the staff (carpenters and painters) from the housing organisation. The housing organisation Fruehøjgaard has employed an environmental coordinator, who has been working with environmental initiatives in the various departments. In Brændegårdsparken she has been a main reason why the department has achieved the Green Homes, the sustainability scheme for social housing departments. This includes that a sustainability policy, an environmental plan and a green accounting should be outlined and communicated to the residents, in order to promote savings on water and energy. As an example, their goal in 2007 for the environmental theme 'water' is to save 2.5% of their consumption, compared to 2006. In order to reach this goal the water meters will be read once a month, and from this 4 pillars will be designed, illustrating the water consumption in each of the four parts in the department. It is expected that this will motivate the residents to reduce their water consumption. Already within the first year with the Green Homes (from 2005 to 2006), the water consumption dropped by 13,2%, due to various initiatives. Other projects include use of LED-lights on shared spaces, which has reduced the electricity consumption with 9.5% from 2005 to 2006. The initiative to make the department apply for the 'Green Homes' came from the environmental coordinator. As there were several environmentally interested board-members in Brændegårdsparken, the department decided to apply for the Green Homes. According to the board, the initiatives are based on a combination of the voluntary work carried out by the board members on one hand, and the paid work carried out by the housing organisation, including the staff and especially the environmental coordinator. Also, the department has collaborated with other local actors and organisations, for instance

the local 'Energy Center' and the municipality of Herning. But the board members also use their professional background in the environmental initiatives. For instance, one of the board members is a former plumber, which has been very useful in the initiatives for water savings. This case illustrates how the organisation of the housing department is able to initiate and maintain initiatives that the local board is receptive towards, and thereby support a local interest in sustainable building operation to actually complete a number of measures.

5.1. Blågården: an frontrunner for sustainable facilities management

Blågården is a social housing department with 863 dwellings as well as some commercial and cultural facilities in the inner Nørrebro in Copenhagen. The department is administrated by the social housing organisation FSB which today is a housing administrator with a high SFM profile [23].

Blågården was the department, which initiated the SFM thinking in housing administrations back in the 1980'ies. Active residents requested new and sustainable solutions and the dialogue between the local board and the administrative organisation has over the year's innovated housing administration to the SFM we see today. Not only within the department but also with the development of new services from the administrative organisation, which has been offered to all departments within FSB. Monitoring the departments resource consumption (electricity, heat and water) is today included in the ordinary service from the administrator. Surprisingly, the environmental coordinator, the department has had its own since late 1990'ies, also make her own monitoring, because it is possible for her to make more precise registrations and therefore she can solve the monitoring task better than the administration organisation. Especially the monitoring of waste and waste sorting is much more precise. The department is in other ways a department with an operational staff with focus on SFM. Their special focus is communication of environmentally sound habits to the residents, which is a special challenge when the residents have many different ethnical backgrounds. They have had educational events about "green cleaning" and "energy saving". Even though the environmental profile of the department is still remarkable in a Danish context, the environmental coordinator state, that there are periods where the basic operational tasks like keeping the common areas clean and maintaining the buildings takes up all available resources within the operational staff.

6. Conclusions

Our results show that there are many good examples on sustainable building operation in Danish housing estates, where local building managers, residents etc. have gained impressive results. In the broader sense, however, there is a limited use of available methods and technologies. Barriers for the use of sustainable building operation have been identified, and related to different types of ownership (social housing, private rented, owner-occupied and private co-ops). The survey indicate that the social housing sector have better conditions for implementing sustainability goals in their building management, compared to other types of ownership, and that a considerable expertise on has been generated in the sector. Our survey

raises questions on how to spread this knowledge to other actors in the sector, and to overcome barriers for sustainable building operation.

- The effect of monitoring in sustainable FM depends on the organisational settings; if there are no-one to use the monitoring data in a pro-active way the effect will be limited. We argue that it is central that the policies of recent years to increase monitoring and visibility of substance flows in buildings have not been met with a similar development of the Facility Management function in existing buildings.
- FM takes place in networks. In practice, for the most advanced housing departments, the various FM-elements are taken care of by a number of different actors. There is not just one FM-operator; sustainable FM is practiced in a network. The role of the formal FM-operator can therefore be characterised as 'network management', where social and communicative skills are as important as technical expertise.
- Different types of ownership will demand different types of FM-solutions.

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