

Improving the implementation of Sustainable Facilities Management: the role of end-users in realising energy efficient solutions.

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ABSTRACT

The focus on sustainability and circular economy is becoming increasingly important for the Facility Management (FM) sector. In order to adapt to the recent national and EU-regulations and policies, the sector needs to adapt its practices and processes. Research has demonstrated that FM can play a central role in implementing sustainable solutions, but it appears that practitioners don't have sufficient access to knowledge and tools to develop their practice efficiently. It is not so much the implementation of technical solutions which are challenging the practices of sustainable FM, but rather the process of ensuring the adequate use of the buildings. In particular, methods to secure that the occupants of the various facilities act accordingly to the new buildings' prescriptions, indispensable to the success of these initiatives, seem to be missing.

Building on a three years research project aiming at strengthening FM competences in the Nordic countries, our study identifies and documents the bottlenecks of sustainable FM implementation related to the participation of end-users as well as the type of tools or solutions that can help to obtain the expected benefits.

The paper presents the results of two complementary activities: A workshop with more than 40 practitioners and the realization of four in-depth case studies. Whereas the workshop has allowed us to map the different issues related to sustainable FM, the case studies enable a deeper understanding of these challenges. The cases, two renovation projects and two solutions for sustainable operation and maintenance, face similar problems when it comes to realise the energy potential of the implemented technical solutions. As apartment renters or offices workers, end-users tend to ignore the needed adequate compartments and jeopardise the measures taken by the FM practitioners.

The results of our project are beneficial for the FM sector and the education institutions as they summarise the principal challenges related to the implementation of sustainable FM and as they indicate solutions to successfully reach the sustainable targets.

Keywords

Include max. 5 keywords separated by commas, for instance: Facilities Management, sustainability, challenges, users, energy

1 INTRODUCTION

The accepted papers and the panel statements of the conference are published in *EuroFM Research Papers 2018*. We wish to give the proceedings a consistent, high-quality appearance. We therefore ask that authors follow these basic guidelines.

It is now widely accepted that Facilities Management (FM) can contribute to reaching sustainability goals. There is potential to reduce energy and material consumption during operation and maintenance; transformation of buildings can improve users' health and well-being, and at the local level, FM can influence social surroundings and contribute to social coherence (Elmualim et al. 2010). However, whereas there is a broad agreement on the need to implement sustainable measures, the concept of sustainability, upon which theory policy and practice are developed is far from being well defined and miss a shared understanding of its dimensions and applications (Sarpin et al. 2016). Moreover, the concept encompasses internal tensions and contradictions creating debate and uncertainty in its realisation (Buser and Koch 2014). So, it can be difficult for FM practitioners to orient themselves in the complexity of sustainability and make decisions on a daily base accordingly. In particular, the combination of environmental, economic and social ambitions requires multidisciplinary competences. Whereas professional guide lines, standards and regulations offer support to the practitioners, they are not always sufficient to define and implement concrete solutions to the sustainability challenges at the local level (Sarpin et al. 2016). Besides, focusing on theoretical calculation of energy other measurable features, they fail to address the questions related to the regular use of the facilities and the implications of the users for achieving successful operations (Sezer, 2016, Gram Hansen et al. 2017). Researchers have underlined the need to include all the stakeholders and in particular the users already from the early planning and design phase to ensure the efficiency of the renovation (Kaatz 2004, Menassa and Bear 2014, Støre-Valen et al. 2016). Meehan and Bryde (2015) have emphasised a need for integrated and collaborative strategies adapted specially to the practitioners' context and stakeholders needs rather than generic solutions. However, FM practitioners are not always equipped to handle users integration in a resource optimal manner and may find it difficult to achieve (Støre-Valen and Buser 2017). Moreover, the participation of users in the early phase if needed to achieve efficient solutions is not a guaranty for a successful building operation on a longer sight. The measures taken to ensure the adequate use of the buildings once it is renovated may be challenged by the users anyway (Van de Bom et al, 2016, Gram Hansen et al. 2018). FM providers seem to be missing methods to secure that the occupants of the various facilities act accordingly to the new buildings' prescriptions (Støre-Valen and Buser 2017).

Building on a three years research project aiming at strengthening FM competences in the Nordic countries, the purpose of the present paper is to identify and document the bottlenecks of

sustainable FM implementation related to the participation of users from design to operation and suggest solutions on the base of the observed practices to overcome them. We allow ourselves to refer to the term “users” to cover both tenants and office workers, as the adaptation to the sustainable facilities by these two groups seems to share similar features in terms of attitude and practices.

2 METHOD

The present paper presents results taken from a Nordic Built project aiming at strengthening Sustainable FM and develop accordingly teaching material. The team includes two professional schools in Denmark: KEA in Copenhagen and VIA in Horsens; and two universities Chalmers University of Technology in Gothenburg Sweden and the Norwegian University of Science and Technology in Trondheim (NTNU) in Norway under the management of the Danish Association of Building Experts, Managers and Surveyors, Konstruktørforeningen (KF).

The framework of understanding builds on an interpretive sociological approach appreciating a strong empirical orientation and uses a mix methods approach to gathering data. The paper draws on different parts of the project carried during the three last years:

A one-day workshop with more than 40 Danish practitioners and Scandinavian academics during which the challenges of sustainable FM were discussed. The participants were distributed during in smaller work groups addressing five different topics, users being one. An observer was present in each group taking notes and some of the sessions were also recorded, besides each group had to fill up a matrix organising the identified issues.

Four cases studies conducted by the research team members in their respective countries two in Denmark, one in Norway and Sweden. The case studies enable a deeper understanding of the challenges identified in the workshop and were conceived as teaching material for a summer school. The cases, two renovation projects and two solutions for sustainable operation and maintenance have been chosen for their integration of sustainability concerns, three of them have achieved a milieu certification.

1. **University**, a Swedish project aiming at engaging the users of a retrofitted university building to act and use the building according to the new specification, besides the case study, the author has been involved in the users' participation programme organised by the architects before the renovation, the meetings have been recorded.
2. **Social housing**, a Danish project of a social housing retrofit focusing on inner climate and on engaging the residents to act accordingly to new standards, the case was part of an action research project carried by Via Horsens
3. **Eco Housing**, the second Danish case a new built eco housing area which goal is to motivate the residents to take responsibility, operate and maintain the buildings and surroundings, the case was part of a PhD. thesis carried at KEA and Copenhagen architecture school.
4. **Hotel**, a Norwegian project dealing with the luxury renovation of an hotel built in 1870;

The cases material includes site visits, interviews with the different stakeholders, in three cases observation of meetings between FM providers and the users, questionnaire to the users in two cases and the compilation of the projects' internal documents and blue prints. The use of multiple

sources such as interviews, field observations, visits, and document analyses enabled triangulation and increase the trustworthiness of the results (Bryman and Bell, 2015).

3 FINDINGS

The table below is indicative and presents a summary of the fourth case studies context, goals, and contents. As already mentioned, the workshop has enabled us to identified among the main challenges, the difficulty for both owners and FM providers to obtain during the operation phase the theoretically estimated results. The four cases had in common to hope to be able to bypass users' disengagement but in very different context. We present here their process and results

Table 1. Short description of the four case studies

Case	1 University, Sweden	2 Social housing Denmark	3 Eco housing, Denmark	4 Hotel, Norway
Building category	Education and office building	Housing, cooperative apartments	Residential housing	Hotel
Owner	The university	Public housing company	Public housing company	Large property company
Management, operation and maintenance	The university property management	Public housing company	Residents' responsibility	Large property company
Context	Retrofit of a university building, the creation of small open offices and new meeting area	Designing retrofit for social housing targeting inner climate issues	New built of sustainable housing, users participation in operation and maintenance	Large ambitious renovation of a hotel built in 1870
Goal	How to engage users (students and employees) to behave according to the sustainable goals integrated in the building	To solve inner climate issues and engage the residents to act accordingly to new standards	To motivate the residents' association to take responsibility, operate and maintain the buildings and surrounding	How to integrate sustainable solutions including the hotel's guests
Client	Facilities management company	Public housing company	Public housing company	Contractors
Challenges	To create an attractive environment that inspires and supports the interaction between researchers, students and companies.	To engage and motivate residents to take an active role	To motivate the residents to do self-management and operation of housing and common areas	To create a luxury hotel which builds on sustainable principles and engage clients to behave accordingly

3.1 University

The planning phase of the university building renovation took over 10 years, as the scope and the financing of the project were hard to balance. The building needed façade renovation as well as a new assignment of room as the civil engineering department was to join the architecture one, space had to be redistributed accordingly. The final solution included open space offices which were

distributed along the outside side of the building; the inner space looking down at a large atrium yard was dedicated to computer and meetings room as the light measurement of these spaces did not live up to the milieu standard expectation. A new heating and ventilation system was also installed and the building earned a silver green certification. A long participation process including both employees and students of the university took place to adjust the new configuration to the users' needs. However, most of the proposition suggested by the users were rejected by the architects or the FM company as they were either too expensive or not fitting with the new concept. The situation created a gap between the employees favourable to the new design and the ones opposing it. After a delivery of the premises a bit longer than expected, the building has been operational for several months. The divide between the people in favour or against their new offices is very visible as the latter avoid in principle to be at work unless forced to do so. So, most of the office appears half empty even though the number of employees and students for the matter exceeds the one for which the renovation was conceived. The internal temperature is electronically controlled by a central system to a general temperature of 21 °C, but the particular situation of each office or meeting room is challenging this average. The main conversation topic among employees has been since they moved in the cold of the office. This situation is re-enforcing the employees' absence. It is worth noticing that most of the researchers employed in this department are working with sustainability in one way or another and are quite well informed about the efforts that sustainable challenges require. Besides, the distribution of activities in specific spaces is challenged as well: the quite room equipped with sofa is used for meeting and the small silence offices dedicated to temporary quite work have been appropriated by employees unsatisfied by their desk in open office. So, the initial goal to create an environment favouring interaction is not yet realised.

3.2 Social housing

The social housing project concerns a large group of are 3-storey residential buildings in yellow brick built in the period 1960-1968. The properties appeared generally well maintained. Kitchens were replaced in 1992. Bathrooms were partially renovated. And recently, a new mechanical extraction has been established from kitchens. The renovation was meant to improve the results of an already complete building renovations which took place in the period 2011-2014 and had focused on improving indoor climate and minimizing heat loss.

However, residents were generally dissatisfied with the work carried and claimed that their apartments were better before renovations. They identified difficulties to heat the place uniformly, draft between the rooms; condensation and cold fall on the windows. Measurement showed that a third of the apartments had an average temperature just above 20° C and that the amount of CO₂ was too high in the majority of them. Though the humidity measurement did not reveal problem, tenants' behaviours jeopardised the inner climate balance by misusing the premises for example when drying clothes on the radiators. Besides, the genitors noticed inappropriate and wrong ventilating occurring in large parts of the year. The concrete goal of the building renovation was to achieve concrete and measurable indoor climate improvements of at least 50 percent of residents after implementation: Humidity should be improved with min. 10%; CO₂ content must be improved with min. 10% and heat consumption must be reduced by 10%. To achieve this, they planned to carry a renovation of fall trunks and pipes, installation of extractor in kitchen and bathroom, installation of heat source (radiator) in kitchen but also a reduction of the energy consumption. Besides, saving energy and reducing the emission of CO₂ the housing company

housing aimed as well at improving the health, wellbeing and happiness of residents by improving, among other things, indoor climate. However, it was considered not enough to insulate the buildings or to control the ventilation mechanically. The tenants should be helped to understand the new functioning of their apartments and learn how to use the new control tools.

The housing company opted for value-creating solution empowering the inhabitants. They started with a detailed questionnaire listing the habits and routines of the occupants to identify among people behaviours what needed to be changed or improved. They invested in a control tool enabling the tenants to manage and control indoor climate and heat consumption based on their own wishes and values. Through measurements of temperature, humidity and CO₂ content, for example, it is now possible to get a feedback-oriented on an apartment own. The company aimed at including standardization in the process to increasing the individual's understanding of why it is important to focus on indoor climate and energy consumption.

3.3 Eco housing

The target group was families who could and would make an extra effort and were prepared to adjust their homes themselves. The project is architecturally-built housing that were mass-produced, and therefore cheaper than traditional construction. Part of the cheap price was also a thorough joint planning, framework offering, mass production, prefabricated modular construction and assembly line technology. The newly built homes were proposed to new residents for a rent of approximately DKK 8,000 per month for a family apartment of 130 m². The properties were listed as low-energy homes according to energy class 2020 with the expectation that energy consumption would be kept to a minimum. The intention was that the residents should jointly care for cleaning and maintenance of the surroundings for example, hedge raising, snow removal, outdoor cleaning and participation in residents' meetings. The condition to be considered eligible to the project was that the residents were committed to day-to-day operations and that all communication with the administrative division of the housing company was to be digital. However, the self-driven aspects of the project have created unexpected problems: Instead of managing the surrounding themselves, the users have outsourced some of their tasks and accordingly increase the cost of maintenance. The residents managing the technical installations were not acquainted with the equipment and misunderstood their functioning resulting in an increased consumption of energy. The digital user information network which was supposed to allow the operating phase to be coordinated was not being maintained and operated properly creating disruption in the maintenance organization. Besides, the transfer of the management of maintenance tasks to a digital network created a void in the collaboration between users as there was no physical meeting point where people could meet or deliver papers or tools. The housing board, composed of residents and responsible for the economy of the premises, became the local police officers in charge of controlling the contribution of all the members as the distribution and completion of tasks and workloads as the users were self-managing the operation was challenged by some underperforming residents.

3.4 Hotel

The former goal of the hotel renovation was to achieve luxury accommodation with state of art sustainable solutions while preserving the history of an iconic building. In order to achieve this the

hotel should be shaped to simultaneously offer the outstanding facilities and services expected of a 5 stars hotel but respecting sustainable principles. Parts of existing building stock are protected. This means that state conservator had to be involved in any decision and approve of the solutions. New building stock had to be integrated with existing building stock. The hotel been situated in a dense city centre area, the space was limited and existing building materials provided significant challenges related accessibility for the technical installations especially for ventilation channels.

The premises were divided into 3 main areas. Building 1 is so-called the new building, which is listed in accordance with Passive House Standard. Building 2 is the oldest part and is protected. Building 3 is the rehabilitation of newer building stock according to the Norwegian low energy standard. The owner instated for the perceived quality to be very high. The climate and temperature in the hotel were interpreted by the contractor as a significant part of the quality. For example, one should quickly change the temperature in hotel rooms according to the customer's wishes increasing need for quick monitoring and control tools to be able to regulate the temperature instantaneously.

It is a challenge that the owner has high ambitions and focus on proper and efficient energy use, despite the fact that the customer's perceived quality is to be prioritized and ahead. However, the perceived quality is a subjective notion which happened to be difficult to understand and translate into a generic solution for the contractor. The contribution of the users was discussed extensively but ended up with a focus on technical solutions to optimise the building in particular when the clients would not be in their rooms.

5 DISCUSSION AND CONCLUSION

The examples above show the difficulty to implement sustainability not so much in term of energy saving and technical solutions but by failing to engage the users to actually understand, accept and support an efficient use of the renovated facilities. The hotel gave up focusing on users' behaviours as the team could not foresee how to compromise between a luxury feels for the customers and having the latter engaging in a milieu friendly attitude. The University renovation project did not succeed to secure the involvement and contribution of the employees in supporting the new milieu friendly features, ending up with a result opposed to the announced goal. The building became a resistance tool for some of the employees against the school employment and organisation strategy. The Eco housing though selecting an environmental friendly audience for his project fail to maintain the inhabitants active to contribute to the common chores. It seems that whereas people have made a conscious effort to support milieu friendly initiatives, their commitment tend to relax regarding new proposals as they feel they have already contributed to a better climate (Gram Hansen, 2017). The Social housing has focused for their second renovation on the roles of users and proposed some tools to avoid the frustrating results of their first attempt. It seems difficult though even for their second trail to encourage the collaboration of residents who expect the service they paid for to be delivered without other contribution form their side. Their solution involved training and analytical nudging. However, it is not certain that this solution will still be effective once gone the novelty of the tools. Sustainability concerns have created new demands regarding the collaboration between FM providers and their customers. Whereas in the past service delivery could be described as "one way" distribution, to attain the realization of sustainable goals, users need to be actively participating in the operation of the building. Whereas in the past service

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