Purpose
This study aims to investigate the attitude towards shared space in an urban context with a particular focus on meeting facilities. The Lyngby-Taarbæk City of Knowledge is used as a case, as this organisation has a vision of sharing facilities to stimulate regional development.

Design/methodology/approach
The attitude towards shared space in the Lyngby-Taarbæk City of Knowledge is studied in a three-step qualitative research process. An initial survey investigated the City of Knowledge's members' attitude towards shared space in general, a workshop further explored motivations and practical needs and a second survey investigated the attitude towards shared meeting facilities. The Brinkø Typology of Shared Use of Space and Facilities is used as the theoretical framework for the study (Brinkø et al., 2015).

Findings
This study shows that the respondents are very positive towards the concept of shared space but more reluctant when it comes to sharing own facilities. A majority of the informants are often using externally owned facilities for meetings and events and prefer professional meeting facilities to schools, universities and sports facilities. This points to a need for developing relevant service concepts, if a shared space strategy with focus on meeting facilities were to be used to increase the use rate of existing buildings not already intended for this use.

Originality/value
This study adds to the so far limited amount of scientific knowledge on the topic of shared space, by investigating the attitude towards shared space among a specific group of people, in relation to the use of external meeting facilities.
Multiplying the use of space and what it implies in practice: a cross-case analysis

Purpose
Shared space is a design and engineering concept that gains attention in the context of both regeneration of, for example, former production sites and in the context of designing new building complex(es) with a multifunction strategy. But the practicalities of realising shared space are generally overlooked, despite its importance for the user experience and the degree of success with shared space initiatives. The purpose of this study is to increase the knowledge of shared space and the complex processes involved in realising multiple use of space. Design/methodology/approach
To achieve the purpose stated, the paper presents a study of current literature and four cases of shared space, including a commercial building, a public sport facility, a public health centre and an educational building. The study draws on theory from the fields of property management, space management, urban design and architecture, as well as from the social sciences and geography, to provide an as complete picture as possible of the challenges related to shared spaces in practice. Findings
The result of the study presented is increased knowledge of the processes involved in sharing space in a facilities management context, supported by specific recommendations regarding attention to issues of territoriality, involvement and practicalities. Originality/value
Not much scientific work has been conducted on the topic of shared space in a facilities management context, and this study adds to the so far limited knowledge within the area.

Environmental indicators for non-residential buildings: When, what, and how to measure?

Purpose
The purpose of this paper is to investigate environmental indicators for non-residential buildings. The study focuses on the development of indicators that can be used to assess the environmental impacts of buildings. Design/methodology/approach
The paper presents a review of existing indicators and identifies a set of indicators that can be used to measure environmental impacts. Findings
The result of the study presented is a set of indicators that can be used to measure environmental impacts of buildings. Originality/value
This study adds to the limited knowledge on environmental indicators for non-residential buildings.
Hvad sker der i FM forskningen
Der er fantastisk meget viden fra forskning i FM, der betyder at du kan skyde genvæj, hvis du kender til den. Det tager lang tid, hvis du i stedet skal erfare det hele selv.

Ja til drifsvænligt byggeri - men hvordan i praksis

Research papers for EUROFM’s 16th research symposium, EFMC 2017

The characteristics to consider in municipal shared spaces
Purpose
The purpose of this study is through collaboration with practitioners to identify key characteristics of municipal shared
spaces and, based on these, developing a guide for establishing a shared space in a municipal real-estate portfolio.

Design/methodology/approach
This paper builds on existing theory on the subject of shared space as well as the practical experience of professionals within the fields of property management, space management and facilities management. The guide presented is the result of data collected through case studies, interviews, surveys and literature reviews. This knowledge is combined with data collected through a workshop with practitioners from municipalities and the private sector, to provide a final guide that is directly applicable as a tool for working with shared space as a part of a property management strategy.

Findings
The result presented is a guide to establishing a shared space in a municipal real-estate portfolio, created in collaboration between researchers and practitioners. It provides an introduction to the topic and outlines a number of tasks that must be completed in different parts of a project, thereby providing a tool which practitioners can use to realise shared space as a strategy in the context of public real-estate management.

Originality/value
The guide presented is a first in connecting theory with practical application and through collaboration between researchers and practitioners, creating a tool to be used when working with shared space in a municipal real-estate portfolio.

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DOIs:
10.1108/JFM-11-2016-0051
Source: FindIt
Source-ID: 2390167078
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review

Access over ownership: the case of meeting facilities in Lyngby
Collaborative Consumption, access economy or the sharing economy are all terms describing the new fast growing business built on the sharing of resources and promoting access over ownership. It is a paradigm shift that has made it to the Times magazine list of the “10 ideas that will change the world”. Within this overall paradigm, shared space, is also gaining grounds. The purpose of the study is to investigate the attitude towards shared space in an urban context with a particular focus on meeting facilities. To what degree is there an interest in sharing meeting facilities within a city or a municipality? The Lyngby-Taarbæk City of Knowledge is used as case, as this strategic collaboration on municipal level includes a vision of sharing facilities to stimulate regional development. The attitude towards shared space in the Lyngby-Taarbæk City of Knowledge is studied in a three-step qualitative research process. The first survey investigates the City of Knowledge’s members attitude towards shared space in general with questions like, what are you most likely to share with others? And what would you like to gain access to? A workshop further explored motivations and practical needs. The second survey investigates in particular the attitude towards shared meeting facilities. The Brinkø Typology of Shared Use of Space and Facilities is used as the theoretical frame of the study (Brinkø et al 2015). This study show that the members of the Lyngby-Taarbæk City of Knowledge collaboration are very positive towards the concept of shared space, but more reluctant about sharing own facilities. A majority of the informants are often using externally owned facilities for meetings and events, and they prefer professional meeting facilities to schools, universities and sports facilities. This point to the need for buildings owners/operators to develop relevant service concepts, if a shared space strategy, should increase the use rate of existing buildings. The study show that in the Lyngby-Taarbæk City of Knowledge there is a positive attitude towards shared space as concept and as local strategy for gaining access to e.g. meeting facilities. The survey also
demonstrates the member’s experience of barriers, which suggest that there are practical barriers to overcome before access is more important than ownership, not only in theory, but also in practice.

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Contributors: Nielsen, S. B., Brinkø, R.
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Alternative learning environments by alternative retrofitting processes

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Organisations: Department of Management Engineering, Systems Analysis, Tampere University of Technology, Aalto University, Norwegian University of Science and Technology, Chalmers University of Technology
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Campus Retrofitting (CARE) Methodology: A Way to Co-Create Future Learning Environments
The future learning environments are not based on standardized design solutions like lecture theatres for 100 persons or classrooms for 40 persons. As new technology and new ways of studying are being developed new demands are put on university environments. At the same time utilisation of resources in form of both teachers and university facilities is challenged by development of integration of learning, teaching and the spaces where it takes place. The challenges are shared among users and owners of campus, where retrofitting is needed too. This paper aims to describe Campus Retrofitting (CARE) methodology for user-centric and co-creative campus retrofitting processes. The campus development research in Nordic countries and co-creation in retrofitting processes are discussed. The campus retrofitting cases in different countries are described by emphasising especially the methods they used. Based on the analysis of the methods the framework for Campus retrofitting (CARE) - methodology is presented and discussed. CARE-methodology is a tool to capture new logic to learning environment design. It has three key activities: co-creating, co-financing and co-evaluating. The integrated methodology and the formulation of the guiding principle of the CARE-way of sustainable retrofitting of university campuses opens up an agenda for investigating a new methodology for sustainable urban retrofitting in a Nordic context.

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Centralisering af FM organisationer

Centralisering af FM organisationer kan let føre til mange frustrerende arbejdsdage for medarbejdere og deres leder. Denne artikel giver et bud på hvad kommuner og andre kan gøre for at komme bedre igennem en omorganisering.

Centralizing municipal FM organisations: Danish experiences

Centralizing Public FM organisations: Danish experiences with success criteria, results and realisation processes
Dynamic optimization of building performance: Use of real-time building data for improving facilities management

In this digital age many companies consider data as new oil. It also includes facilities management organizations. Facilities managers in many private and public organizations are interested in data sets on building characteristics, operation and maintenance activities, usage patterns, space management, energy management, asset management etc.

The research focus of this industrial PhD is to study how these different building data sets can be used and combined for improving total value of buildings, with special emphasis on environmental building performance from lifecycle perspective.

The project follows the implementation of Integrated Facilities Management System KMD Atrium in Danish Facilities Management organizations. The focus is on non-residential buildings from user- and facilities manager perspective. By studying the implementation effects of KMD Atrium, this industrial PhD develops a methodological basis and purpose-based software for simultaneous calculation of total value and environmental performance of non-residential buildings.

So far, a literature study has identified 8 indicator categories that should be considered when addressing environmental performance of building: Energy, GHG emissions, Water, Waste management, Land use, Building materials, Reuse/recycling potential and Indoor Environmental Quality. The study indicates that research is mainly focusing on energy and GHG emission related topics, while other environmental categories are not investigated sufficiently.

The next step of the project combines research and practice through various case studies in which environmental building performance of non-residential buildings will be studied. Case studies will investigate which environmental indicators are used in practice and why, and disclose how building data related to these indicators is collected, used and combined.
Housing organizations using social media in sustainable building operation - a review of eighteen Danish cases

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Hvad er hot og hvad er not? Forskning i FM - 2016
I anledning af årsskiftet og DFM netværks nytårskur giver jeg her et bud på, hvad der kendegner forskning i FM netop nu.

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Impact of Personnel Capabilities on Organizational Innovation Capability
One of the most dynamic capabilities that lead to the strongest competitive advantage in the organizations is the innovation capability. Analysing the development of a firm’s innovation capability is an important research project, and can help organizations to achieve competitive advantage in this rapidly changing world. This research focuses on
definition of the personnel aspect of innovation capability, and proposes a conceptual model based on the scientific
articles of academic literature on organisations innovation capability. This paper includes an expert based validation in
three rounds of the Delphi method. And for the purpose of a better appreciation of the relationship dominating the factors
of the model, it has distributed the questionnaire to
Iranian companies in the Food industry. This research proposed a direct relationship between Innovation Capability and
the Personnel Capability. Also, it offers the most important components and indices which directly influence and are
related to the Innovation Capability.

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Research Network Group

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Structural Capability of an Organization toward Innovation Capability

The scholars in the field of strategic management have developed two major approaches for attainment of competitive advantage: an approach based on environmental opportunities, and another one based on internal capabilities of an organization. Some investigations in the last two decades have indicated that the advantages relying on the internal capabilities of organizations may determine the competitive position of organizations better than environmental opportunities do. Characteristics of firms shows that one of the most internal capabilities that lead the organizations to the strongest competitive advantage in the organizations is the innovation capability. The innovation capability is associated with other organizational capabilities, and many organizations have focused on the need to identify innovation capabilities. This research focuses on recognition of the structural aspect of innovation capability and proposes a conceptual framework based on a Qualitative Meta Synthesis of academic literature on organizations innovation capability. This is proposed for the development of the concept of innovation capability in the organizations and this paper includes an expert based validation in three rounds of the Delphi method. And for the purpose of a better appreciation of the relationship dominating the factors of the conceptual framework, it has distributed the questionnaire in Iranian companies of the Food industry. At last, this research proposed a direct relationship between Innovation Capability and Structural Capability. Also, it offers the most important components and indices which directly influence and are related to the structural capability of innovation capability.

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Sustainability

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Sustainability in facilities management: an overview of current research
Purpose: Climate adaptation, energy efficiency, sustainable development and green growth are societal challenges for which the Facilities Management (FM) profession can develop solutions and make positive contributions on the organisational level and with societal-level effects. To base the emerging sub-discipline of sustainable facilities management (SFM) on research, an overview of current studies is needed. The purpose of this literature review is to provide exactly this overview. Design/methodology/approach: This article identifies and examines current research studies on SFM through a comprehensive and systematic literature review. The literature review included screening of 85 identified scientific journals and almost 20,000 articles from the period of 2007-2012. Of the articles reviewed, 151 were identified as key articles and categorised according to topic. Findings: The literature review indicated that the current research varies in focus, methodology and application of theory, and it was concluded that the current research primarily addresses environmental sustainability, whereas the current research which takes an integrated strategic approach to SFM is limited. The article includes lists of reviewed journals and articles to support the further development of SFM in research and practice. Research limitations/implications: The literature review includes literature from 2007 to 2012, to manage the analytical process within the project period. However, with the current categorisation and the access to the reviewed journals and articles, it is possible to continue with the latest literature. Practical implications: The article provides an overview of theoretical and practical knowledge which can guide: how to document and measure the performance of building operations in terms of environmental, social and economical impacts? How to improve the sustainability performance of buildings? What are the potentials for and barriers to integrating sustainability into FM on strategic, tactical and operational levels? Originality/value: The paper presents the most comprehensive literature study on SFM so far, and represents an important knowledge basis which is likely to become a key reference point for pioneers and scholars in the emerging sub-discipline of SFM.

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Tips og tricks til mere idrætsliv på samme areal

I forbindelse med en om- og udbygning har Lyngby Idrætsby og Lyngby-Taarbæk Kommune gjort sig inspirerende erfaringer om, hvordan idrætsfaciliteter kan benyttes af så mange som muligt. Her er tips og tricks til fri afbenyttelse.

Tips og tricks til mere idrætsliv på samme areal

I forbindelse med en om- og udbygning har Lyngby Idrætsby og Lyngby-Taarbæk Kommune gjort sig inspirerende erfaringer om, hvordan idrætsfaciliteter kan benyttes af så mange som muligt. Her er tips og tricks til fri afbenyttelse.

Towards sustainable public FM: collective building of capabilities

Purpose

Public facilities management (FM) is in the unique position of aligning building projects and FM with the policies of sustainable development at societal level. However, sustainable facilities management (SFM) is an emergent profession, and there is a need to build a code of conduct for SFM in FM organisations. The purpose is to develop and test a workshop based concept for collective building of capabilities targeting in-house FM organisations, in particular public in-house FM organisations.

Design/methodology/approach

This research explores the role of public facilities managers and examines how an empowerment process can help FM employees develop collective competences for SFM. The methodologies used are literature review, and a 3–year-long action research process in the Danish local authority, Albertslund, which is internationally recognised for its innovative and green profile.

Findings

This paper describes the phenomenon of public SFM imbedded in societal steering paradigms and suggests a framework for a sustainable FM code of conduct. The suggested “Next generation SFM code of conduct” support the employees in taking a proactive strategic position in which translation between politics, strategy, tactics and daily practice becomes the basis for prioritisation and decision-making. The capabilities needed is FM knowledge (including FM know-how, understanding of technologies for sustainability and public governance); it is the FM code of conduct, and it is control of own practice to be obtained through strategies and planning, collaboration and education.

Research limitations/implications

This study is based on findings in a single local authority, why the findings are primary valid for concept development to be further developed and tested. However, the local authority of Albertslund is recognised as a front runner in green FM, why this case, compare to other cases, represents a relatively mature thinking in terms of FM contribution to sustainability at societal level. When this FM organisation express a need for developing collective competences for sustainability in FM, it
can be assumed that less mature FM organisations need it even more. The findings seem relevant beyond public FM organisations.

Practical implications

The produced framework for a sustainable FM code of conduct is useful for educational purposes as well as for strategic decision about FM organisations collective competence profile. The use of workshops for the building of collective competences might be useful for many other organisations and not only public FM organisations.

Social implications

Public FM organisations manage significant shares of existing buildings and can be a driver for societal change if they have the capabilities. This paper provides an answer to how these collective capabilities can be build within an organisational development process, through dialogue and collective reflections.

Originality/value

This paper is a pioneer in understanding the capabilities needed in FM organisations to take leadership in an integration of sustainability in FM processes.

Bibliographical note

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Access over ownership – a typology of shared space

**Purpose** – This paper aims to explore shared use of space and facilities as a concept, and present and illustrate the use of a typology to help classify and describe the different options for sharing space and facilities within buildings for optimised use of a building portfolio.

**Design/methodology/approach** – The content presented is based on a cross-sectional study with an inductive approach. The results are based partly on secondary data in the form of a literature review and a mapping of 20 examples from Europe, USA and Australia, and partly on primary data from observations and interviews with key actors from two cases in Denmark and an illustration case from Ireland.

**Findings** – The typology classifies and describes four archetypes of sharing between different people, building owners and organisations, to be used when discussing, planning, establishing and evaluating new and existing shared spaces.

**Research limitations/implications** – The typology is the result of a first exploration of shared use of facilities and does not claim to be fully comprehensive or final.

**Practical implications** – The typology is intended for both researchers and practitioners, and aims at increasing the understanding of sharing as a way to minimise the need for building new by better utilisation of the existing building stock.

**Originality/value** – Shared space and facilities is a relatively new topic with not much research undertaken. This typology provides a language for discussing shared spaces and a base for further developing the research field.

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Bærekraftig FM til tiden/ Bærekraftig FM på tid

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Research output: Non-textual form › Sound/Visual production (digital) – Annual report year: 2015 › Research

Coupling and quantifying resilience and sustainability in facilities management

Purpose – The purpose of this paper is to consider how to couple and quantify resilience and sustainability, where sustainability refers to not only environmental impact, but also economic and social impacts. The way a particular function of a building is provisioned may have significant repercussions beyond just resilience. The goal is to develop a decision support tool for facilities managers.

Design/methodology/approach – A risk framework is used to quantify both resilience and sustainability in monetary terms. The risk framework allows to couple resilience and sustainability, so that the provisioning of a particular building can be investigated with consideration of functional, environmental, economic and, possibly, social dimensions. Findings – The method of coupling and quantifying resilience and sustainability (CQRS) is illustrated with a simple example that highlights how very different conclusions can be drawn when considering only resilience or resilience and sustainability.

Research limitations/implications – The paper is based on a hypothetical example. The example also illustrates the difficulty in deriving the costs and probabilities associated with particular indicators.

Practical implications – The method is generic, allowing the method to be customized for different user communities. Further research is needed to translate this theoretical framework to a practical tool for practitioners and to evaluate the CQRS method in practice.

Originality/value – The intention of this research is to fill the gap between the need for increasing sustainability and resilience of the built environment and the current practices in property maintenance and operation.

General information
Determination of Innovation Capability of Organizations: Qualitative Meta Synthesis and Delphi Method

Characteristics of firms, especially service firms, are defined by rapid change, globalization, hyper innovative competition, etc., and recent research shows that one of the most dynamic capabilities that lead to the strongest competitive advantage in the organizations is the innovation capability. The innovation capability is associated with other organizational capabilities. So, many organizations have focused on the need to identify innovation capabilities and resources or strengths in relation to external opportunities and threats according to inside-out view because innovation capability has consistently been defined as a new service, a new product, a new technology, or a new administrative practice and process. Developing the innovation capability as an important aspect of dynamic capabilities of a firm is an important research project and it can help to achieve competitive advantage in this rapidly changing world.

This research focuses on recognition of the aspects of innovation capability and proposes a conceptual model based on a qualitative Meta-Analysis of academic literature on organisations innovation capability. This is proposed for the development of the concept of innovation capability in the organizations and this paper includes an expert based validation in three rounds of the Delphi method.

This research proposed a direct relationship between Innovation Capability and three main capabilities that is called Structural Capability, Personnel Capability and Operational Capability (S.P.O. Model). Also, it offers the most important
indices which directly influence and are related to the Innovation Capability.

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Contributors: Momeni, M., Nielsen, S. B., Kafash, M. H.
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**Dialogue and collaboration for Energy Efficient Facilities Management: municipal sector strategies and the role of external service providers**

**Purpose.** Energy efficiency is seen as key to sustainable building operations. However, identified by literature are market failures and barriers involved in hindering energy efficiency improvements, especially in refurbishment and maintenance of existing buildings. This paper deals with the challenge of overcoming energy efficiency gaps in the municipal sector that should set an example for adjacent society.

**Method.** The research is based on literature that point to the need of a better match between FM organisations and energy efficiency service providers, and inform on knowledge management and public-private partnership in FM. The paper covers the empirical case of a Swedish policy that stimulates energy efficiency strategies on municipal level. A dialogue-oriented interview methodology is used to assess the current strategies and practices for buildings owned and managed by municipal FM organisations.

**Findings.** Silo mentality can hinder strategies and practices from becoming as comprehensive as intended by policy regulation, e.g., focus on non-residential rather than residential buildings is demonstrated by reported activities and impact on specific energy use. Findings also confirm reorientations on the Swedish energy efficiency service market, e.g., municipal organisations show greater preference for in-house capacity as opposed to long-term contractual arrangements with external companies. Collaborations are sought with energy efficiency service providers that can deliver real and perceived values, which requires a probing dialogue to result in custom-made solutions. A process-based assessment approach is suggested to characterize the maturity of municipal FM organisations and facilitate collaborations in Energy Efficient FM.

**General information**

Publication status: Published
Organisations: Department of Management Engineering, Centre for Facilities Management, Systems Analysis, DTU Climate Centre, Energy Systems Analysis, EVU Energi & VVS Utveckling AB
Contributors: Stenqvist, C., Nielsen, S. B., Bengtsson, P.
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Title of host publication: Research Papers. Advancing Knowledge in Facilities Management: People make Facilities Management
Publisher: EuroFM
Editors: Alexander, K., Price, I.
(EuroFM Research Papers).
Electronic versions:
Dialogue_and_collaboration.pdf
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2015 › Research › peer-review

**Facilities management innovation in public-private collaborations: Danish ESCO projects**

The purpose of the article is to investigate how Facilities Management (FM) units navigate Energy Service Company (ESCO) collaborations, here defined as examples of public collaborative innovation within the context of FM. The driving motivation is to inform and inspire internal FM units of local institutions on how to navigate and manage collaboration of different, intra- and inter-organisational actors throughout ESCO projects.

**General information**
Nordic campus retrofitting concepts - Scalable practices
Multidisciplinary collaboration and transformations in learning processes can be supported by activity-based campus retrofitting. The aim of this paper is to analyse the ongoing campus retrofitting processes at the three university campuses and to identify the elements of activity-based retrofitting. We answer the questions “What kind of examples of retrofitting are there at Nordic Campuses?” and “What kind of elements are typical for activity-based retrofitting concepts?” The 3-level framework of campus retrofitting processes was employed when conducting the three case studies. The cases were about the new ways of researching, collaborating and learning with the concepts of Living lab, Creative community for innovation and entrepreneurship and Network of learning hubs. The cases provided the first insights on retrofitting based on users' changing needs and the requirements of more sustainable solutions at campuses. Notably, a technical and spatial solution covers only part of retrofitting processes. The activity-based retrofitting consists on multidisciplinary collaboration and learning processes where diverse users have diverse roles during retrofitting processes. A process and a product are equally important for a viable retrofitting concept.

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Organisations: Department of Management Engineering, Centre for Facilities Management, Systems Analysis, DTU Climate Centre, Energy Systems Analysis, Aalto University, Norwegian University of Science and Technology, Chalmers University of Technology
Contributors: Eriksson, R., Nenonen, S., Junghans, A., Nielsen, S. B., Lindahl, G.
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Research output: Contribution to journal › Conference article – Annual report year: 2015 › Research › peer-review

Shared space in a municipal sports facility The case of Lyngby Idraetsby
Purpose: The concept 'shared space', where different users use the same space, is expected to be a way towards a more environmental, economic and social sustainable build environment. This paper presents important aspects of establishing a shared space in a real-world context by studying Lyngby Idraetsby ('sports city') in Denmark, with the purpose of increasing the understanding of shared space as a strategy towards a more sustainable space- and portfolio management.

Theory: Shared space in the form of coworking and hot-desking are well described in literature. The case in this paper is a public real-estate complex within sports, and the theory used will be centred on usability, user involvement and space management.

Design/methodology/approach: The paper is based on a study of a specific case; Lyngby Idraetsby. The approach is inductive, and the information gathered via interviews with planners, facilitators and users, with additional information collected via documents and observations at planning and user meetings.

Findings: The project shows how shared space is relevant for the users and the project as a whole, and sheds light on key challenges regarding user involvement and facilitation that have to be handled when establishing a shared space.

Originality/value: Shared space is receiving increasing attention, as part of the topics of the 'sharing economy' etc. These themes illustrate trends in society, but there is little empirically material available when it comes to FM. This paper intends to fill part of this knowledge gap with an in-depth case study.
Simple future weather files for estimating heating and cooling demand

Estimations of the future energy consumption of buildings are becoming increasingly important as a basis for energy management, energy renovation, investment planning, and for determining the feasibility of technologies and designs. Future weather scenarios, where the outdoor climate is usually represented by future weather files, are needed for estimating the future energy consumption. In many cases, however, the practitioner's ability to conveniently provide an estimate of the future energy consumption is hindered by the lack of easily available future weather files. This is, in part, due to the difficulties associated with generating high temporal resolution (hourly) estimates of future changes in air temperature. To address this issue, we investigate if, in the absence of high-resolution data, a weather file constructed from a coarse (annual) estimate of future air temperature change can provide useful estimates of future energy demand of a building. Experimental results based on both the degree-day method and dynamic simulations suggest that this is indeed the case. Specifically, heating demand estimates were found to be within a few per cent of one another, while estimates of cooling demand were slightly more varied. This variation was primarily due to the very few hours of cooling that were required in the region examined. Errors were found to be most likely when the air temperatures were close to the heating or cooling balance points, where the energy demand was modest and even relatively large errors might thus result in only modest absolute errors in energy demand.
Studenterprojekter - 2015: Styrkelsen af kontakten mellem DTU og Lyngby: Lyngby som en vidensby

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Organisations: Department of Management Engineering, Centre for Facilities Management, Systems Analysis, DTU Climate Centre
Contributors: Frier Ørgaard, L., Nielsen, S. B.
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Publication information
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Original language: English
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Research output: Book/Report › Report – Annual report year: 2015 › Communication

Syv skridt til lettere etablering af centrale ejendomscentre

General information
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Contributors: Nielsen, S. B.
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URLs:
http://www.ktc.dk/artikel/syv-skridt-til-lettere-etablering-af-centrale-ejendomscentre

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Source-ID: 116570385
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Teaching sustainable solutions in engineering

The increasing societal and industrial emphasis on sustainability requests that the next generation engineers needs to be trained in the context of sustainability. One of the means to address students at DTU is the establishment of a course aimed at bachelor students from all of the university's study lines. The objectives of the course 'Sustainability in engineering solutions', is for the participants to understand the basic concept of sustainability and its three dimensions (people, profit, planet), as well as to analyse problems and synthesise solutions that are sustainable throughout their life cycle. The course runs over a full time 3-week period and employs project-based learning with several sub-projects/-problems. This paper takes an in-depth discussion of the considerations concerning how to teach such a complicated subject to students of widely differing backgrounds, and reflects both the teachers’ and the students’ experiences with the course.

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Organisations: Department of Management Engineering, Quantitative Sustainability Assessment, Production and Service Management, Centre for Facilities Management, Systems Analysis, DTU Climate Centre, Energy Systems Analysis,
The organizational context for sustainability in Municipal Facilities management: A contribution to Smart Livable Cities

General information
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Contributors: Nielsen, S. B.
Number of pages: 1
Publication date: 2015

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Publisher: Technical University of Denmark (DTU)
Article number: L-4
Electronic versions:
L4_DTU_Sustain_2015.pdf
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2015 › Research › peer-review

A collaborative quest for sustainability at DTU

General information
Publication status: Published
Organisations: Campus Service, Department of Management Engineering, Quantitative Sustainability Assessment, Production and Service Management, Centre for Facilities Management
Contributors: Michaelsen, L., Olsen, S. I., Nielsen, S. B.
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Media of output: PowerPoint

Event information
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Location: Technical University of Denmark, Lyngby, Denmark
Electronic versions:
Presentation
Research output: Non-textual form › Sound/Visual production (digital) – Annual report year: 2014 › Research

DTU says yes to operational friendly buildings but how should it be done in practice?
Facilities managers often fight to be allowed to contribute their operational experiences to new building projects, but not at Campus Service of the Technical University of Denmark (DTU), where “ask the operations manager” has become a mantra for every building project in recent years, and there are currently 15 building projects under way. But how is this knowledge transfer organized in practice so that both the buildings department and the operations department maintain a good and effective relationship?

General information
Publication status: Published
Organisations: Campus Service, Department of Management Engineering, Production and Service Management, Centre for Facilities Management
Contributors: Rasmussen, H. L., Nielsen, S. B., Møller, A. B.
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Peer-reviewed: No
**Jal Til driftsvenligt byggeri på DTU - men hvordan i praksis?**

**General information**
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Organisations: Campus Service, Department of Management Engineering, Production and Service Management, Centre for Facilities Management  
Contributors: Rasmussen, H. L., Nielsen, S. B., Møller, A. B.  
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**Kompetenceopbygning til bæredygtighed i FM**

**General information**
Publication status: Published  
Organisations: Department of Management Engineering, Production and Service Management, Centre for Facilities Management  
Contributors: Nielsen, S. B.  
Publication date: 2014  
Media of output: PowerPoint

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**Sustainable resilience in property maintenance: encountering changing weather conditions**

**Purpose:** The purpose of the study is to develop a methodological approach for project management to integrate sustainability and resilience planning in property maintenance as an incremental strategy for upgrading existing properties to meet new standards for sustainable and climate resilient buildings.

**Background:** Current maintenance practice is focused on the technical standard of buildings, with little consideration of sustainability and resilience. There is a need to develop tools for incorporating sustainable resilience into maintenance planning.

**Approach:** The study is primarily theoretical, developing the concept of sustainable resilience for changing weather conditions

**Results:** The paper suggests a decision support methodology that quantifies sustainable resilience for the analytical stages of property maintenance planning.

**Practical Implications:** The methodology is generic and expected users are FM organisations with responsibility of property
maintenance, and consultants offering property management planning as a service.

**Research limitations:** The methodology is conceptual and has not been tested. However the concept is to be further developed in dialogue between the authors, the Danish local authority Gentofte Properties and other potential users.

**Originality/value:** The paper suggests a new methodology to explicitly integrate sustainability and resilience planning in property maintenance planning.

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**Sustainable Retrofitting of Nordic University Campuses**

**Purpose** The purpose of this paper is to identify the state-of-art of Nordic campus development and identify how campus areas can be retrofitted by addition of new technologies, features, functions and services. The leading research question is: how to develop Nordic resilient campus management in all five countries with closely comparable circumstances both on a societal and on an infrastructural level.

**Theory** The current Nordic campus built environment, which represent both a technically and functionally ageing real estate portfolio is approached by applying a systemic understanding of university campuses as socio-technical systems.

**Design/methodology/approach** State-of-art analysis is conducted using literature review and document analysis.

**Findings** The results identify the trends and challenges on strategic, tactical and operational levels and the three-level roadmap for future campus retrofitting and research is presented.

**Originality/value** The research is conducted as part of the preparation for a Nordic research and campus development collaboration initiative and will serve as a framework for demonstrations conducted on different Nordic campuses.

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**Teaching sustainability in engineering solutions with Campus Service as case**

Engineers potentially influence the sustainability of technological solutions significantly. At DTU Management Engineering we aim to address sustainability to all engineering students at DTU. One of the means to address students throughout DTU is the establishment of a course aimed at bachelor students on all study lines. The objectives of the course is for the participants to acquire an understanding of the basic concept of sustainability and its three dimensions as well as getting an overview of a number of tools for analysis and synthesis of solutions that are sustainable throughout their life cycle and acquire the skills to use the most central of the tools. Furthermore, they should understand the engineer's role and responsibility in the development of sustainable solutions. Examples of learning outcomes are:
Explain that each sustainability dimension is multifactorial and that trade-offs exist within and between them.
Illustrate how companies can work towards the development of sustainable solutions.
Know and use various simplified tools for use in sustainability assessment.
Be able to relate critically to the results of various tools.
Master the analysis of solutions using life cycle check.
Master the synthesis of solutions using ideal concepts in product development.

The course runs over the June three week period. It employs project based problem oriented learning and is organized around a theme within which there are several subprojects/problems that the students work on in groups of 4-5 persons. Different themes have been used but especially “The Sustainable Campus” in cooperation with CAS has been successful. CAS frequently has to choose between different solutions for DTU Campus - but how to choose the most sustainable? The students get engaged since DTU Campus is part of their everyday life and they get a real opportunity to influence how CAS operate. The general outline of the course is that theory lectures and exercises are given in the morning whereas the afternoons are fully devoted to project work applying the theory learned in the morning. However, app. half of the days are fully devoted to project work with supervision. Several milestones for the project are defined at which the student presented their work. The students were evaluated on their presentations, their final report and a multiple choice questionnaire.
The quest for sustainability in existing buildings

Centre for Facilities Management (CFM) at DTU has the mission of developing the management discipline Facilities Management (FM). FM deals with design, operation and development of buildings and infrastructure so that this constantly is adjusted to user needs; while also contributing to sustainability at societal level. Due to lack of professional skills, decisions about operation and renovation of buildings are made every day in Denmark and beyond, without adequate knowledge about e.g. energy management and the potential ways of integrating sustainability (social, environmental and economic). The consequence is energy-ineffective building stock and an extremely slow transmission into more sustainable buildings and cities. The professionals in facilities management has so far been overlooked as a key to ensure energy effective buildings. Through research, education and practice collaboration CFM intend to change this by upgrading the skills of especially Danish but also European facilities managers. The workshop includes an introduction to sustainability in FM (SFM) and CFM; but also participant reflections on the collective quest for sustainability in the existing buildings at DTU.

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Contributors: Nielsen, S. B., Michaelsen, L., Jensen, P. A.
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Publication date: 2014

The Shared Building Portfolio: an exploration and typology

Purpose: The purpose of this paper is to explore shared-use of facilities as a concept that can help organizations to make better, more sustainable use of their building portfolios. The practical aim is to present a typology to help classify, describe and evaluate the different options for sharing facilities from a facility manager’s point of view.

Background (State of the Art): Space management literature provides examples and concepts for sharing space, such as ‘hot-desking’, within a given organisational and physical setting. However, this literature rarely deals with sharing on a building level or between organisations. Literature on the so-called ‘sharing economy’ deals with sharing itself, but not on buildings and the management of these. The shared building portfolio, the topic of this paper, draws from both of these.

Approach: The paper is the result of a first, explorative study of the topic. Its contents are based on a literature review, a mapping of 20 examples from Europe, USA and Australia, and on primary data from interviews with selected key players in Denmark. The study has been cross sectional, the approach inductive and the overall research philosophy pragmatism.

Results: The typology classifies 4 types of sharing and illustrates ways of organizing and managing the sharing of facilities between different people, building owners and organisations.

Practical Implications: The presented typology is intended for both researchers and practitioners such as property managers of municipalities and larger companies. It can help them get a better understanding of how they can minimize the need for building new by better utilization of the existing building stock for increased sustainability or as a corporate-social responsibility activity.

Research limitations: The typology is a work in progress and the result of a first exploration of the concept of shared facilities and does not claim to be fully comprehensive or final.
Energioptimering ved hjælp af ESCO-samarbejde

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Original language: Danish
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Udgives af Kommunalteknisk Chefforening, KTC
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Erfaringer med ESCO i danske kommuner

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Source: dtu
Source-ID: u::6664
Research output: Contribution to journal › Journal article – Annual report year: 2013 › Communication

ESCO i danske kommuner: En opsamling af motiver, overvejelser og foreløbige erfaringer med ESCO i kommunale bygninger
This paper presents current research on Danish municipalities’ use of ESCOs (Energy Service Companies) as a way to improve the standard of public buildings and to increase energy efficiency. ESCO has for many years been known as a way to realise energy efficiency in buildings. In Denmark, it has mainly been used in the industry so far, but in recent years more and more municipalities have taken up ESCO initiatives, in order to retrofit existing public buildings, and to make them more energy efficient. ESCO is in many ways a new way of collaboration for Danish municipalities, and therefore include many challenges. At the moment 15 municipalities (of 98 municipalities in Denmark) are involved in ESCO contracting. The purpose of this paper is to discuss the various experience gained so far by municipalities, and to discuss the drivers and barriers behind the development. We also discuss whether ESCO might lead to new ways of working with energy efficiency in public buildings, and possibly generate innovation in the public sector. There is already some evidence from the municipalities that on-going ESCO projects have led to new ambitious initiatives and plans for energy savings in municipalities ESCOs have received much attention in different Danish energy-efficiency policies, where ESCOs are often described as a promising way to achieve energy savings in existing housing and to overcome barriers encountered by other attempts at energy savings. Instead of assessing ESCO only on the amount of energy saved, we suggest that ESCO contracting could potentially become a learning process for municipalities, enabling and encourage public administrations to work in other ways with public-private and public-public partnerships on energy savings. Theoretically, it will compare the Danish development with international ESCO experience as well as refer to public innovation literature. Combined with empirical case studies on ESCO contracting, we discuss factors and conditions that influence decisions on ESCO, the flexibility of ESCO contracts and whether it implies an innovative process, or as a possible contrast, a ‘once in a lifetime experience’ for municipalities. The paper is based on an on-going research project, which aims to identify the opportunities and barriers of applying ESCO in the Danish housing market. The results are therefore preliminary.
Greening Public Buildings: ESCO-Contracting in Danish Municipalities

This paper presents current research on Danish municipalities’ use of Energy Service Companies (ESCO) as a way to improve the standard of public buildings and to increase energy efficiency. In recent years more and more municipalities have used ESCO-contracts to retrofit existing public buildings, and to make them more energy efficient. At the moment 30 municipalities (of the 98 municipalities in Denmark) are involved in, or preparing, ESCO contracts. Nevertheless, ESCO-contracting still faces many challenges on the Danish market, as there is a widespread skepticism towards the concept amongst many stakeholders. The purpose of this paper is to discuss the various experience gained so far by municipalities use of ESCO-contracting, the different approached to ESCO-contracting being used in practice, as well as the different viewpoints drivers and barriers behind the development. The strong growth in ESCO-contracts reflects that the ESCO-concept fits well with a number of present problems that municipalities are facing, as well as a flexible adaptation to the local context in different municipalities.

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Contributors: Jensen, J. O., Nielsen, S. B.
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Bibliographical note
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Udgives af Dansk Facilities Management netværk (DFM)
Research output: Contribution to journal › Journal article – Annual report year: 2013 › Communication

Greening Public Buildings: ESCO-Contracting in Danish Municipalities

This paper presents current research on Danish municipalities’ use of Energy Service Companies (ESCO) as a way to improve the standard of public buildings and to increase energy efficiency. In recent years more and more municipalities have used ESCO-contracts to retrofit existing public buildings, and to make them more energy efficient. At the moment 30 municipalities (of the 98 municipalities in Denmark) are involved in, or preparing, ESCO contracts. Nevertheless, ESCO-contracting still faces many challenges on the Danish market, as there is a widespread skepticism towards the concept amongst many stakeholders. The purpose of this paper is to discuss the various experience gained so far by municipalities use of ESCO-contracting, the different approached to ESCO-contracting being used in practice, as well as the different viewpoints drivers and barriers behind the development. The strong growth in ESCO-contracts reflects that the ESCO-concept fits well with a number of present problems that municipalities are facing, as well as a flexible adaptation to the local context in different municipalities.

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Web of Science (2013): Impact factor 1.602
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Bibliographical note
Handlerum til bæredygtig FM?

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Editors: Nielsen, K., Jensen, P. A., Kartholm, E.
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(FM Update).
Electronic versions:
Nielsen_2011_2013
Source: dtu
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Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2013 – Communication

Mod bæredygtig FM i Danmark

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Peer-reviewed: Unknown

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Original language: Danish
Electronic versions:
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Source-ID: u::7884
Research output: Contribution to journal – Journal article – Annual report year: 2013 – Communication

Mod nyt kvalitetsmål: et pilotstudie af bæredygtighed i FM på Danmarks Tekniske Universitet

General information
Publication status: Published
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Contributors: Nielsen, S. B.
Pages: 65-67
Publication date: 2013

Host publication information
Teaching sustainability in engineering solutions as a generic bachelor course

Engineers have the potential to significantly influence the sustainability of technological solutions. At DTU we aim to address sustainability to all engineering students at DTU. One of the means to address students throughout DTU is the establishment of a course aimed at bachelor students from all of the university’s study lines. The objectives of the course, which is named “Sustainability in engineering solutions”, is for the participants to acquire an understanding of the basic concept of sustainability and its three dimensions (people, profit, planet), as well as to get an overview of a number of tools for the analysis of problems and the synthesis of solutions that are sustainable throughout their life cycle. The course ensures that the participants acquire the skills to use the most central of the tools introduced. Furthermore, the participants should understand the engineer’s role and responsibility in the development of sustainable solutions. Examples of learning outcomes are:

• Describe the three dimensions of sustainability
• Explain that each dimension is multifactorial and discuss the trade-offs that exist within and between them
• Illustrate how companies can work towards the development of sustainable solutions
• Know and use various simplified tools for use in sustainability assessment
• Be able to relate critically to the results of various tools.

The course runs over a three week period, where the students work full time on the course. It employs project-based learning and is organised around a theme, within which there are several subprojects/-problems that the students work on in groups of 4-5 persons. The theme in 2011 was “everyday appliances”, in 2012 “the sustainable primary school”, and in 2013 “the sustainable campus”. In 2012 the students worked together with a primary school interested in improving their environmental performance and in which they could do some empirical work. Several sub-projects were suggested and 5 were chosen: heating, water use/supply, use of electronics, cleaning, and ventilation. Similarly in 2013 they worked with DTU Campus service who defined a number of projects. The general outline of the course (especially in the beginning) is that theory lectures and exercises are given in the morning and the afternoons are fully devoted to project work, applying the theory learned in the morning. As the course progresses and after the front-loading of large amounts of the course material, a number of the days are fully devoted to project work with supervision. Several milestones for the project are defined, where the students should present their work. The students are evaluated on their project presentations and final report, plus a multiple-choice examination, to test their theoretical understanding.

This paper takes an in-depth discussion of the considerations concerning how to teach such a complicated subject to students of widely differing backgrounds, and reflects both the teachers’ and the students’ experiences with the course.

General information
Publication status: Published
Organisations: Department of Management Engineering, Production and Service Management, Centre for Facilities Management, Department of Mechanical Engineering, Engineering Design and Product Development, Technical University of Denmark

The climate crisis and the new technological possibilities for building low energy buildings give the opportunity to improve the municipal heating systems. The heating demand will be less in the future and renewable energy has to be integrated in the design of district heating systems. The paper suggests a plan for an energy efficient District Heating (DH) system with low operating temperatures, such as 55°C supply and 25°C return; connected to low-energy buildings. Different case studies referring to typical DH planning situations could show the rational basis for the integrated planning of the future’s sustainable and energy efficient heating infrastructure. In this paper, a case study which focuses on dimensioning method of piping network of low-energy DH system in a new settlement, located in Roskilde Municipality, Denmark, is presented. In addition to the developed dimensioning method, results about the optimal network layout and substation type for low-energy DH systems are also pointed out regarding to this case study. A second case study, included in this paper, focuses on technical and economical aspects of replacing natural gas heating system to low-energy DH system in an existing settlement, located in Gladsaxe Municipality, Denmark. The technical results of the case studies also conclude with an outline of possible municipal planning of DH system with regard to climate and energy.
Decentralized Services: The Nordic Experience

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ESCO Activities in Denmark

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Organisations: Department of Management Engineering, Production and Service Management, Aalborg University
Contributors: Jensen, J. O., Nielsen, S. B., Rohr Hansen, J.
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Editors: Langlois, P., Hansen, S.
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Esco in Danish municipalities: Basic, integrative or strategic approaches?
Purpose: The aim of this paper is to discuss the possible benefits of involving Energy Service Companies (ESCO) in realising energy savings in municipalities, and how ESCO projects can be formulated very differently in the various municipalities, according to building volume, use of technologies, energy savings, type of collaboration etc. Background: Since 2008, several Danish municipalities have started energy retrofitting of municipal buildings, based on contracts with Energy Service Companies. In spite of the strong growth of ESCOs, there is also widespread scepticism about ESCO, as many municipalities see an in-house approach as a better alternative. Approach (Theory/Methodology): Our research is based on literature studies and on qualitative interviews with Danish municipalities carrying out ESCO projects, as well as with ESCO providers. Results: Our studies suggest that different ESCO approaches are being used in Danish municipalities, which we label the basic, the integrated and the strategic ESCO approaches. The three approaches include different ambitions, technologies, economies and innovation potentials. Whereas the basic approach implies a ‘traditional’ guarantee-based model, with relatively few buildings, energy retrofitting and low investments, the integrative and strategic approach include a higher degree of partnership, a more ambitious building renovation approach, and more innovative understandings of facilities management. We also compare ESCO with energy retrofitting as an in-house approach, which many municipalities are considering. Practical Implications: We suggest the practical implications of our findings, as a short characteristic of the different approaches, intended for municipalities to start up energy retrofitting of municipal buildings.

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Publication status: Published
Organisations: Department of Management Engineering, Production and Service Management, Aalborg University
Contributors: Jensen, J. O., Hansen, J. R., Nielsen, S. B.
Facilities management research in the Nordic countries: Past, present and future

General information
Publication status: Published
Organisations: Department of Management Engineering, Production and Service Management
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How to increase the usability of academic FM research for practitioners?

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Contributors: Alexander, K., Nielsen, S. B.
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How to increase the usability of academic FM research for practitioners?

General information
Publication status: Published
Organisations: Department of Management Engineering, Production and Service Management
Contributors: Alexander, K., Nielsen, S. B.
Pages: 1-2
In search for the added value of FM: what we know and what we need to learn

**Purpose** – This article aims to present and compare research perspectives and theoretical reflections from a variety of academic fields on the concept of added value of facilities management.

**Design/methodology/approach** – The starting point is the so-called FM Value Map, which was presented in a recent article in Facilities by Per Anker Jensen in 2010. The article is a first result of the work in the EuroFM research collaboration group and is based on literature reviews of the most influential journals within the academic fields of facilities management (FM), corporate real estate management and business-to-business marketing.

**Findings** – Good relationship management and building on trust is shown to be equally important as delivering the agreed services.

**Originality/value** – Usually the concept of added value is discussed from a monodisciplinary point-of-view. The different backgrounds of the authors add value to an increased understanding of the added value of FM by comparing and testing different ways of conceptualising this issue. This is of great importance to FM research and evidence-based FM as a sound basis for the long-term recognition of FM.

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**Introduction**

In this book about research on Facilities Management (FM) leading researchers from the Nordic countries present their ideas and findings:

- Past: The historical development and current trends in FM research in Denmark, Norway, Sweden and Finland.
- Present: Ongoing FM research within the following six themes: Working Environments, Sustainability, Innovation and Usability, Partnerships, Knowledge Implementation, and Added Value.
- Future: Identification of future trends, challenges and research agendas for Nordic FM.

The book is a result of a Nordic FM Conference arranged by the Centre for Facilities Management – Realdania Research.
Mod nyt kvalitetsmål: Et pilotstudie af bæredygtighed i FM på Danmarks Tekniske Universitet

Realizing Sustainability in Facilities Management: a pilot study at the Technical University of Denmark

Purpose: The research project "Sustainability in Facilities Management" addresses the challenge of integrating sustainability in facilities management of existing facilities, to achieve measured improvement of environmental and social performance, to fulfill strategic responsibilities and create shared value. The paper presents a pilot case study on sustainability in facilities management and is intended for a mixed audience of practitioners and researchers. It draws upon the case study findings to establish a baseline of performance and presents practical management implications of integrating sustainability in facilities management (FM).

Design, methodology and approach: The approach uses an action-oriented research methodology as a means of co-generation of knowledge on realization of sustainability in FM. Case studies take a phased, multi-method approach including organizational profiling, stakeholder interviews, focus groups, usability evaluations and practice-research workshops. The Technical University of Denmark (DTU) is the pilot case of an international collaboration, and more studies are planned to follow.

Findings: The paper presents a framework for qualitative research on Sustainable Facilities Management (SFM), which can guide future research on Sustainability in FM and increase comparability between case studies. The research identifies the challenges and opportunities for integrating ecological, social and economical sustainability in university FM. The paper presents the analysis and conclusions of the pilot case study in the period 2011-2012, including reflections of the case study framework and methodology.

Practical implications: FM can play an important role in the transition towards sustainable FM, and this paper presents the
lessons learned in the pilot study with conclusions drawn from both practice and research. The lessons learned at the Technical University of Denmark (DTU) are particularly relevant for universities and other public building owners, their Facilities Managers and consultants.

Research limitations and implications: The paper is based on literature studies, qualitative research and the preliminary analysis of a single, pilot case study of The Technical University of Denmark. Progress with the other complementary cases will be included in the presentation. The cases should be supplemented by more research on sustainable facilities management.

Originality and value: The paper is based on action research to establish a collaborative framework in late 2011 and the findings of the pilot study, and have not been published before.

The Added Value of Qualitative Research Approaches

Purpose: This chapter presents research perspectives and theoretical reflections on the concept of added value of FM from a variety of academic fields.

Methodology: A literature review of the most influential journals within the academic fields of Facilities Management (FM), Corporate Real Estate Management (CREM) and Business to Business Marketing (B2B Marketing).

Findings: The research shows different definitions and focus points, dependent on the academic field and the area of application. The different research perspectives explored a holistic view on the added value of FM by the integration of an external market based view (with a focus on the aimed output) and the internal resource based view (with a focus on the input from FM and real estate). Good relationship management and building on trust shows to be equally important as delivering the agreed services.

Practical implications: A clear conceptualization of the concept of added value of FM is of utmost importance for further research into the added value of FM and well-considered, evidence- based Value Adding Management in practice.

Research limitations: Due to limited time not all FM-related journals could be included in the literature review. The included journals were analysed over a time period of ten years, with a focus on interesting topics and less on a thematic cross-paper analysis in-depth.

Originality/value: Usually the concept of added value is discussed from a mono-disciplinary point of view. The different backgrounds of the authors add value to an increased understanding of the added value of FM by comparing and testing different ways of conceptualising this issue.
CLAIMS OF SUSTAINABLE FACILITIES MANAGEMENT: Exploring current practices

Purpose: The purpose of the paper is to provide an overview of current practices within the emergent management discipline: Sustainable Facilities Management (SFM). Background: To develop a sustainable society, facilities managers must become change agents for sustainability in the built environment. Facilities Management (FM) is contributing to the environmental, social and economical problems, but can at the same time also be a part of the solution. However, to integrate sustainability in FM is still an emergent niche within FM, and the examples of SFM so far seems to come out of very different mindsets of aims and means. Approach: SFM is studied as a phenomenon and a socio-technical construction using qualitative research methods in the period 2008-2011. This paper presents a synthesised understanding of SFM, based on literature studies, participation in research projects, testing of preliminary findings and dialogue with practitioners. Emphasis is on the openings for SFM in order to contribute constructively to the further research and development of the discipline. Results: The result is a framework which relates the studied examples and openings for SFM with the organisations general FM strategy and with the organisations general integration of sustainability as a value in core business. The general FM strategy and the role of sustainability in core business seem to be the most dominating factors for the possibilities for even starting to realise an SFM strategy. Three understandings of SFM are identified which have different strategic approaches: • The incremental: Limit environmental impact from organisation activities • The radical: Towards a vision of a sustainable future • The transformative: Going beyond the organisation to establish new partnerships for co-creating of new socio-technical services and technologies These SFM understandings are concluded to be coexisting claims of SFM definitions. Practical Implications: Facilities managers will be able to identify the mindset behind different services and technologies that are promoted as SFM. But maybe just as important is that they are provided with concepts that can help them clarify and improve their own emerging strategy of SFM. The limitations of the research call for deeper investigations and a collaborative effort from researchers and practitioners to develop SFM in practice and theory.
Disconnecting the autopilot in urban water projects: creating an innovation platform for sustainability

How can we motivate urban planners, water utilities and house owners to collaborate about sustainable urban water projects and to aim for solutions that go beyond the narrow perspective of individual stakeholder interests? A concept for framing a multidisciplinary learning process is developed in the research project: Black blue green: Integrated infrastructure planning as key to sustainable urban water systems, with the acronym 2BG. The concept addresses the need for local authorities to develop competences for adopting an integrated approach including different internal departments. The concept is referred to as ‘the 2BG platform concept’. The 2BG platform concept as been tested three times and proves to a step in the intended directions of developing organisational competences for an integrated approach in sustainable urban water projects. Primarily because it invites urban planners, road and park managers, and sewage managers to a dialogue about sustainable urban water projects while exploring cases of new design solutions; secondly because it promotes an appreciative communication between “softer” and “harder” disciplines, and thirdly because it invites urban planners, road and park managers, and sewage managers to a dialogue about sustainable urban water projects while exploring cases of new design solutions; secondly because it promotes an appreciative communication between “softer” and “harder” disciplines, and thirdly because it promotes multidisciplinary thinking during the early stages of an urban water project. To realise new sustainable urban water designs a project team will need to engage and get acceptance from internal and external stakeholders, and this calls for communication and social skills rather than technical skills. The paper identifies potential stakeholders that can support or potentially stop urban water projects. Competences of network governance represent a need to break out of the conventional urban water design and to develop new designs where storm water is handled visible to citizens. The platform concept is in a Danish context a milestone in capacity building for integrating urban planning with water management and management of parks and roads, and might inspire others to rethink planning processes and to build organisational competences to innovate urban water management for the benefit of present and future citizens.

Esco in Danish municipalities: Basic, integrative or strategic approaches?

Purpose: The aim of this paper is to discuss the possible benefits of involving Energy Service Companies (ESCO) in realising energy savings in municipalities, and how ESCO projects can be formulated very differently in the various municipalities, according to building volume, use of technologies, energy savings, type of collaboration etc. Background: Since 2008, several Danish municipalities have started energy retrofitting of municipal buildings, based on contracts with Energy Service Companies. In spite of the strong growth of ESCOs, there is also widespread scepticism about ESCO, as many municipalities see an in-house approach as a better alternative. Approach (Theory/Methodology): Our research is based on literature studies and on qualitative interviews with Danish municipalities carrying out ESCO projects, as well as with ESCO providers. Results: Our studies suggest that different ESCO approaches are being used in Danish municipalities, which we label the basic, the integrated and the strategic ESCO approaches. The three approaches include different ambitions, technologies, economies and innovation potentials. Whereas the basic approach implies a ‘traditional’ guarantee-based model, with relatively few buildings, energy retrofitting and low investments, the integrative and strategic approach include a higher degree of partnership, a more ambitious building renovation approach, and more innovative understandings of facilities management. We also compare ESCO with energy retrofitting as an in-house approach, which many municipalities are considering. Practical Implications: We suggest the practical implications of our findings, as a short characteristic of the different approaches, intended for municipalities to start up energy retrofitting of municipal
Design practice for urban drainage including climate change impacts

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Planning and Management of the Built Environment, DTU Climate Centre, Systems Analysis Division, Risø National Laboratory for Sustainable Energy, Department of Management Engineering
Contributors: Zhou, Q., Arnbjerg-Nielsen, K., Mikkelsen, P. S., Nielsen, S. B., Halsnæs, K.
Number of pages: 5
Publication date: 2010

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Research output: Chapter in Book/Report/Conference proceeding – Conference abstract in proceedings – Annual report year: 2010 – Research

Design practice for urban drainage incorporating climate change impacts

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Publication status: Published
Organisations: Department of Environmental Engineering, DTU Climate Centre, Systems Analysis Division, Risø National Laboratory for Sustainable Energy, Planning and Management of the Built Environment, Department of Management Engineering
ESCO: En vej til læring fra industri til kommuner til boligejere?

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Publication status: Published
Organisations: Planning and Management of the Built Environment, Department of Management Engineering, Aalborg University
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ESCO as Innovative Facilities Management in Danish Municipalities

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Contributors: Jensen, J. O., Oesten, P., Nielsen, S. B.
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The Added Value of FM: Different Research Perspectives

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Organisations: Planning and Management of the Built Environment, Department of Management Engineering, Delft University of Technology, University of Zurich, Aalto University
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Translating sustainable development to the domain of a local authority: the case of urban districts in Copenhagen

General information
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Organisations: Planning and Management of the Built Environment, Department of Management Engineering, Danish Building Research Institute
Contributors: Nielsen, S. B., Jensen, J. O.
Pages: Track 38
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When Sustainable Development is Core Business: Changing FM Focus in a Local Danish Authority

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Organisations: Planning and Management of the Built Environment, Department of Management Engineering
Contributors: Galamba, K. R., Nielsen, S. B.
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When Sustainable Development is Core Business
local authority for the benefits of other local authorities as well as their collaborating FM partners.

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Organisations: Planning and Management of the Built Environment, Department of Management Engineering
Contributors: Nielsen, S. B., Galamba, K. R.
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_Delicately protecting facilities for bydele i København_

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Organisations: Planning and Management of the Built Environment, Department of Management Engineering, Danish Building Research Institute, Københavns Kommune
Contributors: Jensen, J. O., Kjærulf, A., Wilhelmsen, C., Nielsen, S. B.
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_Decentralized Services: The Nordic Experience_

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Organisations: Planning and Management of the Built Environment, Department of Management Engineering, University of Iceland, Lund University
Contributors: Pietilä, P., Gunnarsdottir, M. J., Hjorth, P., Nielsen, S. B.
Number of pages: 363
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Publication date: 2009

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Publisher: Earthscan
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ISBN (Print): 978-1-84407-656-7
Source: orbit
Source-ID: 241798
Research output: Chapter in Book/Report/Conference proceeding - Book chapter - Annual report year: 2009 - Research - peer-review

_Delivering Sustainable Facilities Management in Danish Housing Estates_

Housing plays 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.

General information
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Organisations: Department of Management Engineering, Planning and Management of the Built Environment, Danish Building Research Institute
Contributors: Nielsen, S. B., Jensen, J. O., Jensen, P. A.
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Inspirationsguide for proaktiv klimatilpasning i vandsektoren

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http://danva.net.dynamicweb.dk/Default.aspx?ID=2241&TokenExist=no
Source: orbit
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Research output: Book/Report › Report – Annual report year: 2009 › Communication

Mobilizing the Courage to Implement Sustainable Design Solutions: Danish Experiences
Within the built environment, stakeholders tend to implement well-known design solutions, even though sustainable alternatives exist. The key question posed in this paper is: what characterizes successful processes of implementing sustainable design solutions? In an attempt to answer the question, the work focuses on examples of successful implementation in an attempt to understand the competences required. Danish frontrunner projects are described and analysed: one case concerns the implementation of lowenergy houses and another describes innovative planning processes in the water sector in order to ensure consideration of sustainable design criteria in the early phases of building projects. In the first case, the public authority succeeds in supporting design managers and other stakeholders to implement sustainable design solutions; in the second case, establishment of new multidisciplinary networks and creative work forms constitutes the outset for change. The work is inspired by the actor-network theory, emphasizing the momentum of prevailing practices, and the need to (re)develop networks to support implementation of sustainable design solutions. Conclusions point to the importance of design managers and others to develop socio-technical networks and storylines to integrate sustainability in the design and building processes. Implementation of sustainable design solutions takes more than courage; it requires key competences in catalysing network changes.
Tænketank for infrastruktur og byudvikling i Århus

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Contributors: Nielsen, S. B., Jørgensen, G., Egdal, J.
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Facilities Management Best Practice i de nordiske lande: 36 cases

General information
Publication status: Published
Organisations: Section for Planning and Management of Building Processes, Department of Management Engineering
Contributors: Jensen, P. A., Nielsen, K., Nielsen, S. B.
Number of pages: 300
Publication date: 2008

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Research output: Book/Report \ Book – Annual report year: 2008 \ Research \ peer-review

Facilities Management Best Practice in the Nordic Countries: 36 cases

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Organisations: Section for Planning and Management of Building Processes, Department of Management Engineering
Contributors: Jensen, P. A., Nielsen, K., Nielsen, S. B.
Number of pages: 300
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Miljøstyret bygningsdrift i danske boligejendomme

General information
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Organisations: Planning and Management of the Built Environment, Department of Management Engineering, Danish Building Research Institute
Integrated sustainable urban infrastructures in building projects

Current strategies in urban planning and development merely promote standardized building solutions, while failing to prioritize innovative approaches of integration between building projects and sustainable urban infrastructures. As a result of this, urban infrastructures – the urban veins – are outdated from a sustainability perspective. This paper looks into more holistic ways of approaching building projects and discuss whether this provide a basis for an increased integration of urban infrastructures within building projects. In our study, we especially emphasise how conventional ways of approaching building projects are influenced by lock-in of existing infrastructural systems and compare this with two examples of more holistic ways of approaching building projects, developed by two architecture firms. The paper points out that such holistic perspective in building projects provide an improved breeding-ground for more innovative integration of sustainable urban infrastructure, but we also point out other important issues to be dealt with.

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Organisations: Section for Planning and Management of Building Processes, Department of Civil Engineering, Arkitema K/S
Contributors: Nielsen, S. B., Quitzau, M., Elle, M., Hoffmann, B., Rødtnes, M., Becht, J. P.
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SBN et al 2007- Integrated sustainable infrastructure and building.pdf
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Uddannelse af fremtidens tekniske chefer på DTU!

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Contributors: Nielsen, S. B., Elle, M., Hoffmann, B.
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Research output: Contribution to journal › Journal article – Annual report year: 2007 › Communication

BYG•DTU Annual Report 2005

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Organisations: Department of Civil Engineering, Section for Structural Engineering, Section for Construction Materials, Section for Building Physics and Services, Section for Planning and Management of Building Processes, Section for Geotechnics and Geology
Contributors: Kristensen, K. K., Borchersen, E., Møller, J. S., Ottosen, L. M., Jensen, K. I., Koch, C., Leth, C. T., Poulsen, P. N., Nielsen, S. B., Rode, C., Kristiansen, K., Emmitt, S.
Practical Implementation of Sustainable Urban Management Tools

The paper discusses how to promote the use of decision support tools for urban sustainable development. The interest in decision support tools based on indicators is increasing among practitioners and researchers. The research has so far focused on indicator types and systems of indicators and goals for urban sustainability whereas less focus has been on the context of implementation and even less on what we can learn from practical experiences about the usefulness of urban sustainable indicator tools. This paper explores the practical implementation of urban sustainable management tools. It is generally agreed that in order to make indicators and other sustainability management tools work it is necessary that they are integrated in the relevant urban organisational levels, in a way that creates commitment to the subsequent goals. This includes involvement of organisations, individuals and other urban actors around indicators, goals and actions for sustainable urban development across organizational levels. Hence the key question is how to implement urban sustainable management tools in urban management gaining validity from an expert perspective as well as a lay-man perspective. The paper points to the importance of intermediary actors as bridge-builders between municipal administration, citizens and infrastructure bodies, and their role in anchoring the tool in the local context. We use the Ecological Modernisation as a frame for understanding the need for tools and the development of intermediary actors. The paper is based on the Danish part of the PETUS-project (Practical Evaluation of Urban Sustainability) and the INTERMEDIARY-project (New intermediary services and the transformation of urban water supply and waste water disposal systems in Europe). Further the paper draws on Danish experiences with urban sustainable management tools. The experiences rank from simple approaches of municipalities publishing indicators or green accounts, to more advanced approaches of urban sustainability integrated in environmental management systems.
Sustainability in the existing building stock: the role of sustainable facilities management

This paper explores the role of Facilities Management in the relation to sustainable development in the existing building stock. Facilities management is a concept still developing as the management of buildings are becoming more and more professional. Many recognize today that facilities management is a concept relevant to others than large companies. Managing the flows of energy and other resources is a part of facilities management, and an increased professionalism could lead to the reduction of the use of energy and water and the generation of waste and wastewater. This is, however, QWRfacilities management’s most important contribution to sustainable development in the built environment. Space management is an essential tool in facilities management – and it could be considered a powerful tool in sustainable development; remembering that the building not being built is perhaps the most sustainable building. In other words: the question is if it sensible to talk about a ‘sustainable building’ without taking the activities in the building into account? In many contexts, maintenance of the existing building stock is not a hot political topic. Facilities management can, however, be a vehicle for more political attention to the large problem of maintenance, especially when facilities management is in focus of new public private partnerships or other new ways of collaboration.

General information
Publication status: Published
Organisations: Section for Planning and Management of Building Processes, Department of Civil Engineering
Contributors: Elle, M., Nielsen, S. B., Hoffmann, B., Jensen, J. O.
Useful design tools? Innovation and experiences from sustainable urban management

Tools for design management are on the agenda in building projects in order to set targets, to choose and prioritise between alternative environmental solutions, to involve stakeholders and to document, evaluate and benchmark. Different types of tools are available, but what can we learn from the use or lack of use of current tools in the development of future design tools for sustainable buildings? Why are some used while others are not? Who is using them? The paper deals with design management, with special focus on sustainable building in Denmark, and the challenge of turning the generally vague and contested concept of sustainability into concrete concepts and building projects. It describes a typology of tools: process tools, impact assessment tools, multi-criteria tools and tools for monitoring. It includes a Danish paradigmatic case study of stakeholder participation in the planning of a new sustainable settlement. The use of design tools is discussed in relation to innovation and stakeholder participation, and it is stressed that the usefulness of design tools is context dependent.

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Organisations: Section for Planning and Management of Building Processes, Department of Civil Engineering
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Water Saving Strategies & Ecological Modernisation: Transitions, Targets & Tools

Drawing on case studies of water saving campaigns and new collaborations, the paper will serve, on the one hand, as an interpretation of the water saving strategy in Copenhagen in the light of Ecological Modernisation, and on the other hand, as a critical discussion of Ecological Modernisation as a frame for understanding resource management. The water management in Copenhagen has in recent years undergone a rather radical transition. Along with strong drivers for resource management in the region the municipal water supplier has tested and implemented a number of initiatives to promote sustainable water management. The paper focuses on the experiences from different water saving initiatives carried out since the mid 80s relating them to some central aspects of Ecological Modernisation theories: Demands for tools and targets - New tasks and roles for suppliers, consumers and stakeholders and the emergence of a new group of intermediary actors - The changing logics of sustainability and the development of storylines The ecological modernist discourse implies a participatory approach, by which citizens are made co-responsible and included in efforts towards a sustainable development; however, the paper challenges the way this perspective is developed by Ecological Modernisation scholars. Empirically, the paper draws on case studies from the Copenhagen region, where water-ter saving activities have resulted in a radical decrease of water consumption in households - from 168 l/capita/day in the 80s to 125 l/capita/day in 2002. A series of different strategies, targets and tools have been implemented: Emphasizing demand side instead of supply side, using and communicating indicators, formulating goals for reducing water consumption and developing learning processes in water management. A main feature is the use of intermediary actors as links between suppliers and consumers, and as facilitators of learning processes in water savings and local water management. Hence the questions are: How does EM help us understand the development of water saving activities and the emergence of
intermediary services such as water metering, local water saving campaigns and new collaboration? How can the EM approach to citizens’ participation be developed? The paper is based on research carried out in the two EU-based research projects, PETUS and Intermediaries. While the first discusses practical evaluation tools in urban sustainability, the last explores the emergence and roles of a new group of actors in urban infrastructure.

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**Managing facilities in a Scandinavian manner: creating a research agenda**

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**Managing facilities in a Scandinavian manner: creating a research agenda**

Presents the aims and needs of research in facilities management (FM) at the section of Planning and Management of Building Processes at BYG*DTU. As the building stock in Denmark is rapidly increasing, socio-demographic developments implies profound changes in both the needs of inhabitants and the way that buildings are used, combined with an increased consciousness of sustainability. Buildings should be seen as long-term ‘investments’ while also keeping in mind the construction sector’s needs for increased productivity, long-term product quality and enhanced value. This is the background for developing a research position. Identifies the Scandinavian Way as using FM on a multiactor level, rather than just to serve the interests of a single organisation. The aim is to focus on small and medium sized enterprises, non-profit associations and tenants, as well as the bodies administrating infrastructure within the mainstream FM field. There is an urgent need to address how society can best manage the growing (and decaying) building stock, to develop life-cycle rooted infrastructure and building design, and finally allow buildings to be appropriated by their current and future users.

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Sustainable Facilities Management: Lessons to be learned from the Danish public housing

The Danish public housing sector has more than 20 years of experience with sustainable facilities management based on user involvement. The paper outlines this development in a historical perspective and gives an analysis of different approaches to sustainable facilities management. The focus is on the housing departments and strategies for the management of the use of resources. The research methods used are case studies based on interviews in addition to literature studies. The paper explores lessons to be learned about sustainable facilities management in general, and points to a need for new intermediary services to facilitate implementations of new and environmentally sound technologies and everyday practices.

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The Seven Challenges of Sustainable Cities

The departing point for this paper is that we do not know what a sustainable city is. The present situation is characterised by small demonstration projects and strategies for urban sustainable development that are not coherent. The modern city can be viewed as a complex technological system. The urban infrastructure, the buildings and their users interact in numerous and increasingly complex ways. The paper analyses some of the challenges cities meet in their quest for sustainability: Lack of awareness and ethics; Lack of tools for decision making; Lack of models for sustainable urban management; Lack of diffusion of innovations; The momentum of existing infrastructure; Counteracting trends in the development of modern society and the need for reinventing planning.

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Contributors: Hoffmann, B., Nielsen, S. B.
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Infrastruktur i forandring

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Contributors: Nielsen, S. B., Elle, M., Jensen, J. O.
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Vurdering af bæredygtig spildevandshåndtering i kloakløse bebyggelser

General information
Vurdering af spildevandsløsninger i det åbne land - et casestudie om Hillerød Kommune

Assessing the potential of change in urban infrastructure systems

Assessing the sustainability of small wastewater systems. A context-oriented planning approach
Decentralized Technology in Centralized Networks: Interpretative Flexibility of Rainwater Percolation in Copenhagen

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Contributors: Nielsen, S. B.
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Publisher: Institut for Miljøteknologi og Institut for Planlægning
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Assessing the sustainability of small wastewater systems: A context oriented planning approach

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Contributors: Hoffmann, B., Nielsen, S. B., Elle, M., Gabriel, S., Eilersen, A. M., Mikkelsen, P. S., Henze, M.
Publication date: 1999
Transformation of technical infrastructure
The scope of the project is to investigate the possibilities of - and the barriers for a transformation of technical infrastructure concerning energy, water and waste. It focus on urban ecology as a transformation strategy. The theoretical background of the project is theories about infrastructure, the evolution of large technological systems and theories about organisational and technological transformation processes. The empirical work consist of three analysis at three different levels: socio-technical descriptions of each sector, an investigation of one municipality and investigations of one workshop on sustainable sewage management.

Conclusions on reconfiguration of networks
The conclusions are based on the findings from the empirical analysis. The project has shown that it is possible to transform infrastructure in a sustainable way, but there are also important barriers to overcome. The conclusions are divided into three parts: socio-technical descriptions, municipality investigations, and workshop investigations on sustainable sewage management.

Bæredygtig infrastruktur

Conclusions on reconfiguration of networks
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Bæredygtig infrastruktur

Conclusions on reconfiguration of networks
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Decentralized Technology in Centralised Networks: Interpretive Flexibility of Rainwater Percolation in Copenhagen

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Reconfiguration of Networks

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Sustainable infrastructure

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Transformation of technical infrastructure

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Organisations: Department of Planning
Contributors: Nielsen, S. B.
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Planning the invisible city: about infrastructure and municipal planning

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Sewage treatment of the future: A Report of a workshop held at DTU on 14th May 1997

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Publication date: 1996

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