

STATE OF THE ART IN SUSTAINABLE FACILITY MANAGEMENT

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The European Union is targeting a sustainable development of the economy. Therefore it is important to develop better technologies and better management. Facility Management can contribute to a sustainable development of the built environment with regard to the interaction between companies and their business surroundings. This is because of its responsibility for the integration of primary processes and support processes within organizations. Facility Management influences the procurement and delivery of construction in direct and indirect ways. Direct influences on the sustainable development of the built environment are seen within the three main areas of responsibility: support of “primary processes”, development of “space and infrastructure”, and development of “people and organisations”. Facility Management contributes indirectly to the overall objectives of sustainability concerning society, the environment and the economy. A review of the international literature in Europe in particular of scientific publications revealed up to now no common definition or consistent application of the term “sustainable facility management” in Europe. Therefore a preliminary SFM-model was developed and discussed in expert workshops.

KEYWORDS: Facilities Management, Built Environment, Sustainable Development, Sustainability Strategy, Europe

INTRODUCTION / OBJECTIVE

Sustainability has gained increasing importance for Facility Management in practice, education and research. “Sustainable operation” was the topic of a recent student project within the master study program “Sustainable Structures” at the University of Applied Sciences in Frankfurt am Main. In 2009 students interviewed visitors and exhibitors at the Facility Management Fair in Frankfurt am Main and recorded a strong interest in sustainability. At the same time the students learnt that practice has neither a common understanding of the term sustainability nor uses systematic procedures for its application (CAZ 2009, p. 19). These first interviews results were the starting point for further research in this field. The state of the art in Sustainable Facility Management was studied during a research semester at the faculty of architecture at NTNU – Trondheim Norwegian University of Science and Technology in 2010. The objective is to develop a basis for education and research focussing on Sustainable Facility Management and its contribution to construction procurement and delivery.

Facility Management background

Facility Management is responsible for of the support and improvement of primary activities within organizations. In the European context Facility Management means: “The integration of processes within an organization to maintain and develop the agreed services which support and improve its primary activities.” (EN 15221-1) Facility Management therefore contributes to economic development. Furthermore Facility Management organizations

themselves are also part of a growing sector within the economy. The European Facility Management market volume has been estimated at about 655 billion EUR. (Teichmann 2009, p. 5) The value added for “construction” as one of the non-financial economy sectors in the European Union (EU-27) amounted to 465 billion EUR in 2005. The sector of “real estate, renting and business activities” included activities within the existing buildings and was estimated at about 1,171 billion EUR. (eurostat 2009, p. 300) Facility Management and the construction industry play a leading role in the development of the built environment. Both market segments are a strong part of the European economy.

Sustainability background

The sustainable development of the economy is one of the main objectives within the sustainable development strategy towards the year 2020. Sustainability is targeted with regard to the triple bottom line of social, environmental and economic targets. Important objectives for the sustainable development of the built environment are: “Reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30%, if the conditions are right, increase the share of renewable energy in our final energy consumption to 20%, and achieve a 20% increase in energy efficiency.” (EU 2010, p. 30) Sustainability is generally defined as a state or condition in which all human activities are required to consider the protection of the ecosystem earth and its functions. Furthermore, sustainable development means a securing the functionality of the components of the ecosystem for the present and future generations. (prEN 15221-4, ISO 15392) The basis for sustainable development was defined in the eighties:

“Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainability does imply limits – not absolute limits, but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new area of economic growth.” (Brundtland et al. 1987, p. 24)

Sustainable development in construction

Buildings, constructions and facilities must be tailored to suit the company’s need to maintain profitability and achieve business growth. The construction, operation and usage of buildings require a lot of energy and resources. “The volume of the total abiotic primary material used in the German economy was 1,342 million tonnes in 2003. That makes 16.3 tonnes per capita of the population. Almost half (53%) of this was raw construction materials (for instance sand, gravel and broken natural stone) and some other mineral raw materials, which are used in particular in the glass and ceramics industry.” (Federal statistical office 2005, p. 7) According to Brundtland, sustainable business development can be achieved with enhanced technology and better management methods. Facility Management in particular can sustainably shape the interdependency between the built environment and the business environment, because FM adds a special area of responsibility at the interface between the companies’ core business and the accompanying secondary business processes.

The scope of FM has been broadened from the purely technical matters, i.e. the smooth operation and maintenance of facilities to overall real estate management over the last 10 years. Rondeau puts in a nutshell as follows: “In a number of organizations Facility Management has moved from the boiler room to the board room.” (Rondeau 2006, p. 554). Scandinavian research engineers have compiled a “facility management value map” which measures the added value produced by FM. Taking account of its use of resources, its

processes and products, and its influence on the environment and on companies' core processes. (Jensen et al. 2008, p. 297) Moreover, a clear trend in Facility Management is visible: FM is extending its scope from a single building to the building peripherals and the built environment: Facility Management is on the move!

What still needs to be discussed is, how FM can contribute to a sustainable development of the built ecological environment. Possible assumptions are that FM can enhance this development directly through its improved use of resources, FM processes and applied FM products as well as indirectly through its influence on the economic, social and ecological environments.

METHODOLOGY / APPROACH

Model design as first phase in the model building methodology

Model building encompasses four phases: model design, model experiments and findings, interpretation and rechecking of findings in practice, and incorporation of findings into theory (Pilop 2004, p. 8). This paper presents findings from the first phase "model design".

A review of the literature research was the basis for the development of a preliminary model. The model development was discussed with researchers and professionals in four international workshops:

1. Presentation of the idea and preliminary SFM approach and discussion with researchers from SINTEF and NTNU, workshop in August 2010 at SINTEF in Trondheim.
2. A SFM research approach for a European study was presented and discussed at the European Research Network group workshop in September 2010 at EuroFM Meeting in Lisbon.
3. First results of the literature reviews were reconsidered, workshop in October 2010 at the Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology in Trondheim,
4. Presentation and discussion of SFM model design with researchers from Denmark, Finland, Germany and Norway, workshop in November 2010 at the Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology in Trondheim,

Planning and realization of literature review

Prior to the literature review on the research topic "Sustainable Facility Management", relevant buzz-words were selected. Initial tests showed that the number of hits varies significantly between "Facility Management" and "Facilities Management". Major differences were also noted between "Sustainable" and "Sustainability". Accordingly, both buzz-words had to be entered independently and the results had to be summarized by category and in total. The only catalogues selected for the literature review were those which offered a quick and reliable data query, and a comprehensive and up-to-date literature portfolio and permitted a sorting according to the year of publication or the regional distribution of the publication location.

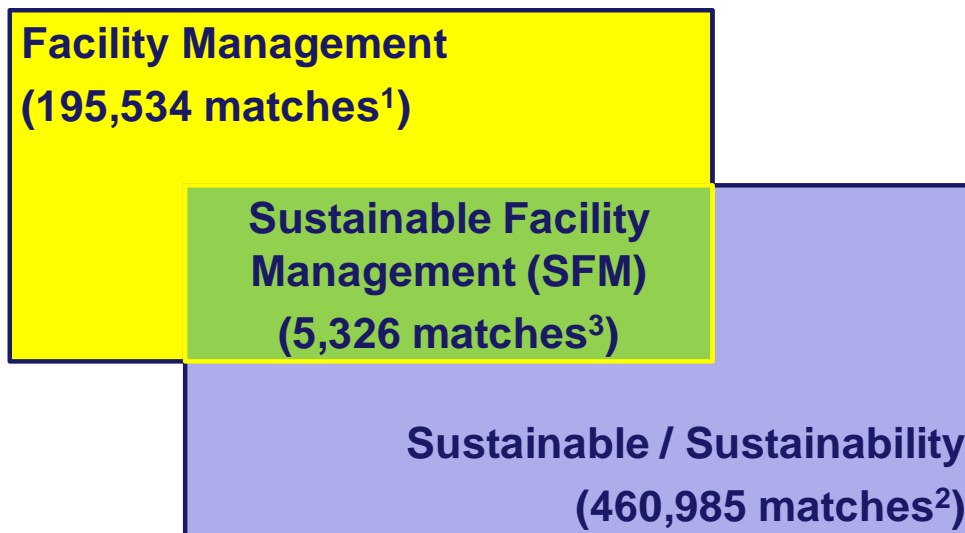
The literature review was conducted in three steps: first, the most up-to-date, internationally available total portfolio of literatures was queried systematically. Secondly, the chronological development of the publications within the last five years was investigated. Thirdly, the national distribution of publications within Europe was determined.

RESULTS

Results of the literature review

The following results were obtained: „WorldCat“ is an international publication catalogue covering mainly the American inventory and is accessible online at www.worldcat.org. “Facility Management” and “Facilities Management” produced 195,534 matches; “Sustainable” and “Sustainability” 460,985 and “Sustainable Facility Management” in all 4 combinations 5,326 matches (www.worldcat.org, query from Oct. 21st, 2010).

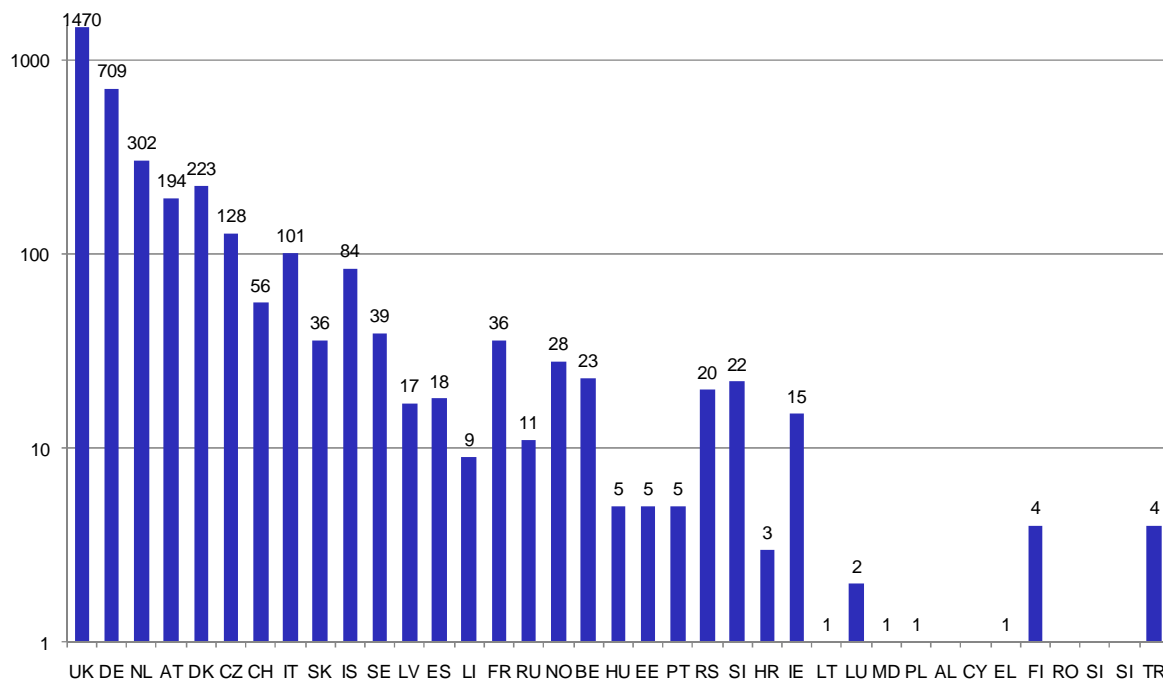
Figure 2: Results of international literature review in WorldCat



1. Facilities Management (FMies):134,702, Facility Management (FMMy): 60,832.
2. Sustainability (Sy): 122,084, Sustainable (S): 338,901.
3. Sy & FMies: 2,109, S & FMies: 1,192, S & FMMy: 1,419, Sy & FMMy: 606.

„The European Library“ is a unified catalogue of national library catalogues in Europe. The unified catalogue allows sorting of the place of publication in Europe and is also accessible online: <http://search.theeuropeanlibrary.org>. It is noticeable that the query in the European catalogue resulted in only 3,573 publications for the buzz-words “Facility Management” and “Facilities Management” and no hits at all for “Sustainable Facility Management”.

Figure 3: Number of Facility Management publications in European countries



It was therefore necessary to investigate alternative literature sources for European research papers. Furthermore, in the absence of matches for the buzz-words, a qualitative analysis of the published content would make sense. Out of the FM relevant magazines, i.e., “Facilities”, “Building and environment” and “Journal of Facilities Management” and recent conference documentations, i.e., “European Facility Management Conference (EFMC)”, “International Council for Research and Innovation in Building and Construction – Facilities Management and Maintenance (CIB W 70)” and „International Conference on Sustainability Measurement and Modelling (ICSMM)“, SFM relevant publications were selected.

Preliminary Sustainable Facility Management model

In this section, basic principles are compiled and a preliminary structure and method for “Sustainable Facility Management” (SFM) are developed.

Facility Management contributes directly to a sustainable development of the built environment within the three major areas of responsibility: Support and improvement of the “main activities”, preservation and development of supply of services in the areas of both “space and infrastructure” and “people and organization”. Furthermore, FM contributes indirectly to the three overall target areas of sustainability: “the ecosystem, society and the economy”.

The preliminary SFM-model was developed in two steps:

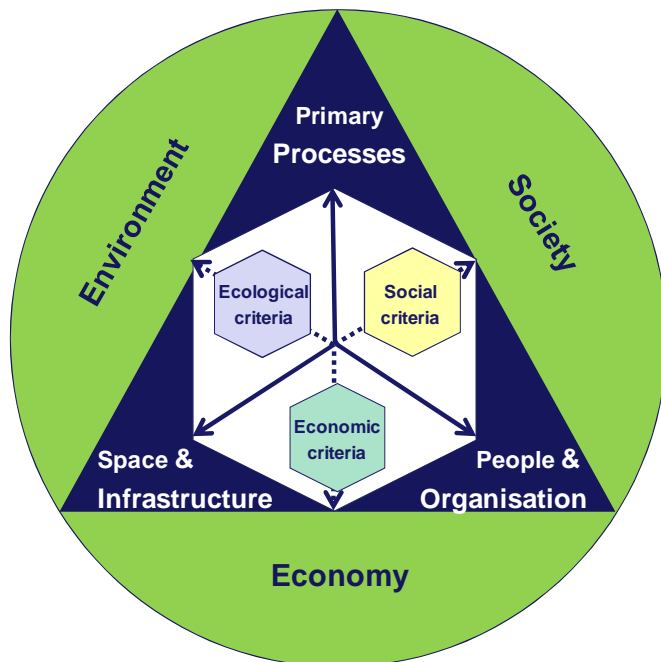
1. Awareness of sustainability
2. Integration of sustainability

1. Awareness of sustainability means to be aware if and how Facility Management impacts are sustainable. The organization’s surroundings become the focus of observation. What impacts on society, the environment and the economy are noticeable? How can sustainability be assessed in social, environmental and economic criteria? Up to now a comprehensive SFM

assessment tool is not available. Existing systems can be used in some cases. For example the US Green Building Council (USGBC) has published a guideline which is suitable for the assessment of existing buildings: „LEED 2009 for existing buildings operations and maintenance“ (LEED-EB 2009).

2. Integration of Sustainability targets the development of sustainable organizations through the integration of sustainable targets. After the basis of sustainable Facility Management is established and assessment targets and measurement categories are defined it is possible to view the whole system from a higher level. Gaining a perspective from outside the whole system makes it easier to see how the organisation interacts with its surroundings. The task is the integration of social, environmental and economic targets within the business strategy in Facility Management. The sustainable organization can be considered as one component of a sustainable society.

Figure 1: Basic structure of Sustainable Facility Management – SFM-Model.



The primary processes of companies can be defined by their mode, size and performance. European statistics on the economy separate them into four company sizes: Large enterprises (more than 250 employees), medium-sized (50 to 249 employees), small (10-49 employees) and microenterprises (1-9 employees). The eight main categories of non-financial business economy sectors are: mining and quarrying, manufacturing, electricity, gas and water supply, construction, distribution trades, hotels and restaurants, transport storage and communication, real estate renting and business activities. (eurostat 2009, p. 300) The development of SFM strategies needs to consider the various sizes and mode of operation of companies due to different frameworks and targets. An SFM strategy which incorporates the required FM services of a small-sized handicraft business providing construction services is not comparable with a large, internationally operating energy enterprise due to its different focus areas and contents.

FM services in the category „space and infrastructure“ support the real-estate related core processes of the companies and are, depending on the needs of the contractor, structured into: accommodation, workplace, technical infrastructure, cleaning and other spaces or

infrastructure. Services that have a direct impact on the built environment are: strategic space planning and management; conception and briefing of a room- and space-management program; design and building construction; lease and usage-management; building management and maintenance; refurbishment and/or reconstruction. Services in the area of technical infrastructure have an impact on the energy requirements and ecological quality of the built environment: energy- and energy-source management; sustainable environmental management; managing and maintaining the technical infrastructure; managing and maintaining the building's control system; maintenance of equipment; disposal management (including dangerous goods). (EN 15221-1)

The FM service category „people and organization“ supports organizational core processes of companies and includes services in the following areas: health; safety at work; security and environmental issues; hospitality; information and communication; logistic and other supporting services. Examples of this FM service category are: office and welcome desk services; help desk; catering and vending machine services; organization of conferences, meetings and special events; human resources; supply of work clothes (EN 15221-1). As services provided in this category influence the quality of the workplace and result in specific demands for ecological products, they impact the interdependency between the company and the built environment.

Targets for SFM have to be structured according to the three dimensions of sustainability: society, the environment and the economy. Social targets may be: supply of adequate buildings for work and life; compliance with health, safety and security requirements. Ecological targets may be: reduction of resources, usage of recyclable building material; considering the separability of used material for re-use; reduction of energy consumption and usage of renewable energy sources; reduction of space requirements and soil sealing; safeguarding the ability to maintain and de-construct buildings; preventing the usage of material causing excessive emissions (prEN 15221-4). Economic targets are: building space optimization for a most efficient usage; optimization of building life-cycle costs; facilitating the most efficient management methods.

DISCUSSION / CONCLUSION

The international literature research resulted in 195,534 matches for „Facility Management“ and 5,326 for “Sustainable FM”. The publications covered in this catalogue are mainly American (see figure 2). The query in the European union catalogue resulted in 3,573 matches in the „Facility Management“ category. The majority of these publications are from the United Kingdom (1,470 matches), Germany (709 matches) and the Netherlands (302 matches). No hits were obtained in the buzz-word category “Sustainable FM” (see figure 3).

American publications in the Facility Management sector far outnumber European publications. Possible reasons for this huge deviation may be: possible different levels of up-to-datedness and completeness of the data banks used. Moreover, the fact that FM has been known in Europe for only 25 years and few research institutes exist may be reasons for few European publications in the FM area. For example, there is only one University chair in FM. Most of the FM degree programs are interdisciplinary programs and FM Professors reside in other university departments, e.g., business administration, architecture, construction engineering, building services engineering, mechanical engineering, life sciences and nutritional science and home economics. Another possible reason for the small amount in European publications may be the lack agreed definitions for FM services in Europe referred

to above. It may additionally be possible that the buzz-words have been stored differently in the different catalogues used and need to be queried by various possibilities.

Development trends in publications within the last five years and further trend indications

The number of international publications in the buzz-word category „Sustainability“ has been constant over the past five years. A declining trend for the “Facility Management” area was observed between 2005 and 2007, with a recovery in 2008 slightly above the 2005 level and drastic decline in 2009. “Sustainable FM” increased from 360 hits in 2005 to 677 hits in 2008 and decreased slightly in 2009 to 592 hits.

The qualitative in-depth analysis of publications showed that the term SFM is used differently. Most scientists use SFM mainly for ecological construction technologies or for techniques optimization to lower the energy consumption of existing buildings. Despite the fact that work is in progress in many locations, Jensen’s findings from two years ago are still valid: “The present knowledge about SFM is limited and incoherent, and there is a need to establish more research-based knowledge in order to define relevant strategies for different types of organizations and facilities.” (Jensen et al. 2008, p.4)

The following quotations reflect the most up to date perception of SFM:

“Sustainable facility management (SFM) is an 'umbrella' for various ways of reducing flows of energy, water and waste in the daily operation of the buildings, for instance by regularly monitoring the consumption, by using 'green accounting', by applying policies for sustainability, enhanced user awareness etc.” (Balslev et al. 2009, p. 1)

The conference paper “Delivering sustainable Facilities Management in Danish housing estates” by Balslev, Jensen and Jensen was presented at the International Conference for Sustainability Measurement and Modeling in 2009 (ICSMM 09). Susanne Balslev Nielsen, Jesper Ole Jensen and Per Anker Jensen are Professors and Researchers from the Technical University of Denmark and the Danish Building Research Institute. They indicate the central role of housing in sustainable development due to the large resource consumption. Current practice of housing administration in Denmark was the focus of their evaluation (Balslev et al. 2009).

In addition earlier scientific publications from the Technical University of Denmark “Sustainable FM – a new field of research and practice” (Jensen et al. 2008a) and “Managing facilities in a Scandinavian manner” (Elle et al. 2004) illustrate the Danish view on Sustainable Facility Management: “Sustainable Facilities Management (SFM) is one of the focus areas of the research centre. The concept covers social, economic and environmental sustainability; however our competences are implementation of new and sustainable technologies and practices in the built environment.” (Jensen et al. 2008, p. 1) “In the Scandinavian context, the main focus has been on environmental sustainability.” (Elle et al. 2004, p. 313)

Researchers from the UK have published “Barriers and commitment of the facilities management profession to the sustainability agenda” and illustrated the state of the art in Facility Management practice. The authors Abbas Elmualim, Daniel Shockley and Roberto Valle from the University of Reading - ICRC, The School of Construction Management and Engineering and Gordon Ludlow from the British Institute of Facilities Management (BIFM) analyse a survey of the experiences of facilities managers in the UK. The findings

demonstrate that “time constraints, lack of knowledge and lack of senior management commitment are the main barriers for the implementation of consistent and comprehensive sustainable FM policy and practice.” (Elmualim et al. 2010, p. 58) “Facility Managers have a great role in contributing to the reduction of the built environment impact on the environment and hence advancing the sustainability agenda across the three bottom lines of sustainability, the economic, environmental and social strands.” (Elmualim et al. 2010, p. 58)

From the US, the publication “A facility manager’s approach to sustainability” shows the role and responsibility of Facility Managers concerning sustainable and green practices. Christopher P. Hodges is founding Principal of Facility Engineering Associates and has over 25 years experience in the evaluation of building systems. (Hodges 2005, p. 312) "Reduction in water consumption, operations and maintenance (O&M) costs, building-related illnesses, waste and pollution, and increases in the comfort and productivity of occupants are also significant benefits of sustainable and green building practices." (Hodges, p. 314) "The primary incentive for following sustainable and green building practices is the reduction in energy consumption and the subsequent reduction in reliance on fossil fuel to produce that energy." (Hodges 2005, p. 314)

Final considerations on the definition of „Sustainable Facility Management“

FM has been defined as direct impact between companies’ core processes and two categories of supporting service processes: 1. Building space and technical infrastructure; 2. Employee and organizational processes. Furthermore, the indirect impact on the environment, society and the economy has been described. FM influences the interdependency between the company and its environment, including the companies’ real-estate asset and infrastructure related constructions, which are also known as the built environment.

The publications analyzed focus on sustainable buildings and ecological modernization. This paper has not elaborated further on the interdependency of the companies’ core processes and their supporting FM processes. However, the corresponding dependency has been established by Jensen as part of a newly introduced SFM core research area at a scientific institute in Denmark (Jensen et al. 2008) and was included by Hodges in his survey on FM practices in the United Kingdom (Hodges 2006).

ACKNOWLEDGEMENTS

The author would like to thank the Centre for Real Estate and Facilities Management and the Department of Architectural Design and Management at NTNU – Norwegian University of Science and Technology for inspiring academic discussions and great support during the research visit in Trondheim. Also special thanks go to the University of Applied Science Frankfurt am Main to facilitate this research semester.

REFERENCES

Balslev Nielsen, Susanne; Jensen, Jesper Ole; Jensen, Per Anker (2009): *Delivering sustainable Facilities Management in Danish housing estates*, conference paper: 2. International Conference on Sustainability Measurement and Modeling, ICSMM 09, CIMNE, Barcelona 2009.

BPF 2010: Department of Architectural Design and Management at NTNU – Norwegian University of Science and Technology, <http://www.ntnu.edu/bpf>, December 2010.

Brundtland, Gro Harlem (1987): *Our common future*, United Nation, General Assembly, Report of the World Commission on Environment and Development, 4 August 1987.

CAZ 2009: *Masterstudierende bei Facility Management Messe*, Campuszeitung der Fachhochschule Frankfurt am Main – University of Applied Sciences, Nr. 1, 2009, <http://www.fh-frankfurt.de/de/.media/pressestelle/ffzarchiv/caz1.pdf>, December 2010

CFM 2010: Centre for Facilities Management – Realdania Research, DTU Management Engineering, Technical University of Denmark, <http://www.cfm.dtu.dk/English.aspx>, December 2010

EN 15221-1: *Facility Management – Terms and Definitions*

prEN 15221-4: *Taxonomy of Facility Management*

EU 2010: Europe 2020 - *A European strategy for smart, sustainable and inclusive growth*, European Commission, Brussels, 2010.

Eurostat (2009): *Europe in figures*, Eurostat yearbook 2009

Elle, Morten; Engelmark, Jesper; Jörgensen, Bo et al. (2004): *Managing facilities in a Scandinavian manner – Creating a research agenda*, Facilities, Volume 22, Number 11/12 2004, pp. 311 - 316

Elmualim, Abbas; Shockley, Daniel; Valle, Roberto; Ludlow, Gordon; Shah, Sunil (2010): *Barriers and commitment of facilities management profession to the sustainability agenda*, Building and Environment 45 (2010), pp. 58-64.

Federal statistical office 2005: Energy, raw material and environment, Environmental economic accounting, 2005, <http://www.destatis.de> (request March 2011)

Hodges, Christopher P. (2005): *A facility manager's approach to sustainability*, Journal of Facilities Management, Vol. 3 No. 4, pp. 312-324.

ISO 15392 (2008): *Sustainability in Building Construction - General Principles* published in May 2008.

IFMALI (2010): IFMA Long Island Chapter, in: <http://ifmali.org>: *Welcome to the International Facility Management Association – What is Facility Management?*, December 2010.

Jensen, Per Anker; Balslev Nielsen, Susanne: *Sustainable FM – A new field of research and practice*, ontwerpmanager, Vol. 3, 2008 (2008)

Jensen, Per Anker, et al. (2008): *Facilities Management best practice in the Nordic countries*, Centre for Facilities Management – Realdania Research, DTU Management Engineering, Technical University of Denmark, 2008.

KIT 2010: Institute for Technology and Management in Construction at Karlsruhe Institute of Technology, <http://www.tmb.kit.edu/english/937.php>, December 2010

Kyrö, Riikka; Määttänen, Eeva; Anttila, Anna; Lindholm, Anna-Liisa; Junnila, Seppo (2010): *Green Buildings and FM – A Case Study on How FM influences the Environmental Performance of Office Buildings*, CIB W070 Conference in FM, September 2010, Sao Paulo, Brazil, pp. 309-319.

LEED-EB 2009: *LEED 2009 for existing buildings operations and maintenance*, US green building council (USGBC), member approved November 2008, updated July 2010.

Metamorfose 2010: Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology, <http://www.metamorfose.ntnu.no/english/index.php>, December 2010.

Pilop, Marko (2004): *Die Methode der Modellierung und ihre Anwendung in der psychologischen Forschung*, Institut für Psychologie, Humboldt-Universität zu Berlin, 2004.

Rondeau, Edmond P. et al. (2006): *Facility Management*, second edition, Wiley & Sons, New Jersey 2006.

Ruiz, M.C.; Fernandez, I. (2009): *Environmental assessment in construction using a Spatial Decision Support System*, *Automation in Construction* 18 (2009), pp. 1135-1143.

Teichmann, Sven (2009): *FM Market Size in Europe*, *European FM Insight*, issue 11, p. 5-7, September 2009.

Wood, Brian (2006): *The role of existing buildings in the sustainability agenda*, *Facilities* Vol. 24 No. 1/2, pp. 61-67, 2006.