DECISION SUPPORT BY COMPUTER AIDED FACILITY MANAGEMENT

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ABSTRACT

Computer Aided Facility Management (CAFM) means the support of Facility Management activities by modern information technology during the life cycle of real estate. It is focussed on the supply of information related to the facilities. All relevant data in the life cycle of facilities are collected, processed and evaluated to support the management in decision making process especially in the area of modelling, evaluation, control, and feedback of key Facility Management structures and processes. This paper will illustrate the cutting edge of CAFM and its relevance for Real Estate and Facility Management decision making. The paper will provide a review of the state of the art and practical experiences of CAFM applications - presenting an analysis of current trends and technologies, and providing recommendations for successful CAFM implementation based on a research study of successful CAFM projects in companies and public institutions. The paper will conclude with an informed speculation on future CAFM developments, trends and research opportunities.

KEYWORDS: Facility Management, CAFM, Decision Support, Strategy

INTRODUCTION

Nowadays Facility Management (FM) and Real Estate activities contribute to about 5-10% of the gross domestic product (GDP) of advanced industrialized countries. For example the total value of FM activity including support services is about 8.2% UK GDP (Harris, 2002). Computer Aided Facility Management (CAFM) software is a new class of ICT tools to support management in the preparation of relevant data in the decision making process especially in the area of illustration, evaluation and control of relevant facility management structures and processes. Recently, CAFM tools have been developing from simple information systems to multifunctional decision support systems for private as well as public organisations. Until now however, little attention has been given to this relevant change in business and academic communities.

At the same time, numerous software systems with various systematic approaches, functions and varying successes have been established on the market. Despite the multitude of suppliers and users in the different branches of trade, uncertainty concerning the procedures and achievable effects still prevails. This is closely related to the lack of well documented, transparent and successful case studies. In addition, little is known about how CAFM can be implemented successfully and the factors leading to its sustainable success. From an economic point of view it is very important to support this process in order to avoid wrong decisions and unnecessary investment. In particular, implementation strategies and formulae for success are of great interest (May, 2002).

The purpose of this paper is to describe the relevance of Computer Aided Facility Management (CAFM) as a decision support tool in the field of Facility Management (FM). The authors will illustrate the recent developments and market demands of FM and CAFM.

The main part will provide an overview of the basic concept as well as building management e.g. CAFM and give detailed insight into the topic and how CAFM may serve as a Decision Support System (DSS) from an organizational perspective. The next part will introduce some examples of good practices. The paper closes with an overview of future developments, trends and research opportunities of CAFM as a decision support tool.

BACKGROUND

According to a survey of Berger (2001), 70% of US companies and 50% of European companies consider their property and real estate as a strategic resource. Top management take this into consideration when making strategic decisions strategies and planning. The relevance of real estate is represented in the balance sheet. According to Cotts (2007) 25-50% of the assets are related to property or real estate. Life cycle costs are 5-7 times higher than the investment costs of buildings (Grabatin, 2001). This shows the need to optimize the operating costs. A professional Facility Management can help to raise the efficiency of the secondary processes of companies for e.g. building facilities and services (Brown, 1995). Therefore the management will need the relevant information of the building services engineering for their decision making. Companies are challenged by limited budgets and high customer expectations. Especially in the field of building services engineering there is a demand for integrated ICT to provide relevant data for the decision support process (May, 2005).

FACILITY MANAGEMENT

Facility Management is developing in various European countries. Certain historical and cultural circumstances, organizations and business areas have been the basis for different views and approaches. In general, all organizations, whether public or private, use buildings, assets and services (facility services) to support their primary activities. By coordinating these assets and services, by using management skills and by handling many changes in the organization's environment; Facility Management influences its ability to act proactively and to meet all its requirements. This is done also in order to optimize the costs and performance of assets and services. “FM is an integrated process to support and improve the effectiveness of the primary activities of an organization by the management and delivery of agreed support services for the appropriate environment that is needed to achieve its changing objectives” (prEN 15221-1, 2006).

The concept of FM was not new when the term “Facility Management” was coined in the USA in 1979, as the management of large facilities or properties for a profit had already been practiced before. The definition used by the International Facility Management Association (IFMA) is: “Facility management is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology” (IFMA, 2007a).

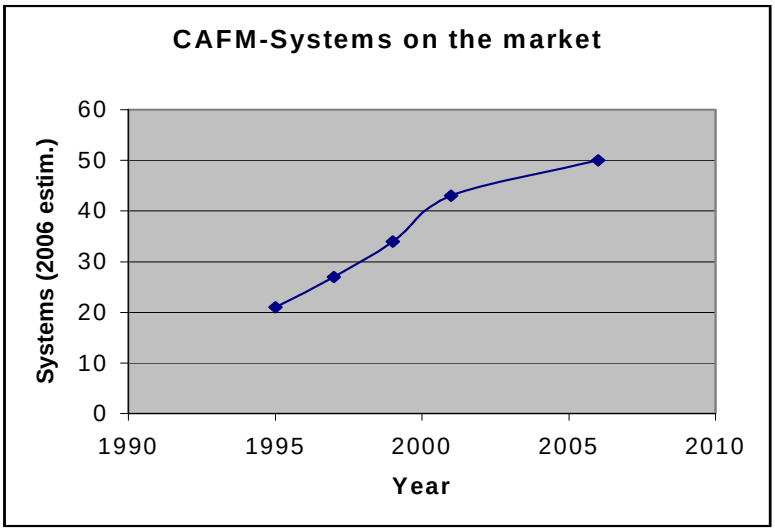
COMPUTER AIDED FACILITY MANAGEMENT (CAFM)

Computer Aided Facility Management (CAFM) means the support of Facility Management activities by modern information technology during the entire life cycle of a real estate property. It is focussed on the supply of information related to the facilities. All relevant data in the life cycle of facilities are collected, processed and evaluated electronically (GEFMA, 2007). Typical CAFM systems combine database technology with graphical systems, e.g.

CAD systems, but also process modelling and integration tools. Without IT support the ambitious goals of FM cannot be reached efficiently. The appropriate use of IT has become a critical success factor for the implementation of FM. Thus IT is a fundamental „Enabling Technology“ for FM (May, 2006).

Since the 1990s Computer Aided Facility Management (CAFM) has been providing efficient IT tools for the mapping, evaluation and controlling of Facility Management structures and processes. During these years numerous software systems with various systematic approaches, functions and varying degrees of success have been established on the market (May, 2004). The following chart (Naevy, 2006) shows the development of different CAFM systems / providers in German speaking countries.

Fig. 1. Growing number of CAFM providers in German speaking countries (Nävy, 2006)



The use of CAFM systems is very common. A Swiss FM study showed that approx. 30% of the enterprises questioned in the study are using CAFM systems. In the strategic range the support is considerably smaller. Only a few companies are using Data Warehouses as management information systems for the decision support (FM-Monitor 2004). The most common IT systems in FM are still office applications and commercial software such as ERP systems. In the future, companies expect more support in the business decision making process.

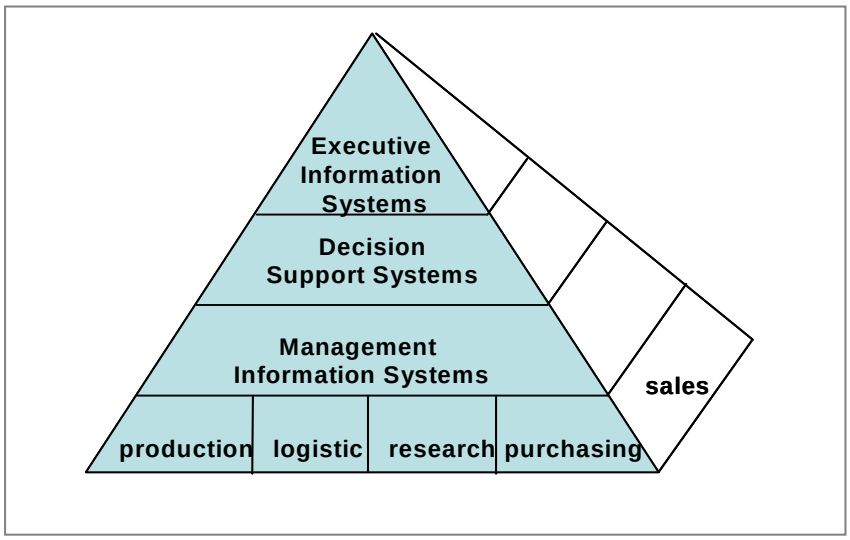
CAFM AS A MANAGEMENT SUPPORT SYSTEM

The strategic value of real estate in companies makes it necessary that the management is supported by information and communication technology. They are generally summarized under the generic term "Management Support System” (MMS) (König, 2003). CAFM systems are developed with the goal to generate relevant information from the existing real estate-economical database and transfer it directly into planning and control processes. Primarily the decision relevant data and representations will be generated for the decision makers. In a further development step CAFM systems will provide detailed and consolidated information for the decision makers via a partly automated report system. Most CAFM

systems have limited interactivity for the users. In the sense of the above categorization this first stage of development of CAFM systems can be called "Management Information System".

Concerning the amount of relevant data in real estate management, the market demands effective support in the planning and decision making processes. Therefore CAFM systems must develop into real "Decision Support Systems". With the use of interactive CAFM modules, the decision making processes will be more effective in the simulation and evaluation of the decision relevant data. Contrary to the pure management information systems, this will support managers in their planning and decision making processes and improve the quality of decisions. In particular, these next generation CAFM systems can support the decision makers by generating and evaluating scenarios more effectively in the future.

Fig. 2. ICT as Management Support Tool (König, 2003)



Businesses rules management systems model routine decisions, analyze the criteria and automate the decisions. If the basic conditions are changing, an enterprise can adapt the decisions with the help of the software within minutes. By the coupling of ICT with business processes, the management of the infrastructure is no longer a stand-alone process from the technical point of view, but is also integrated in the business context.

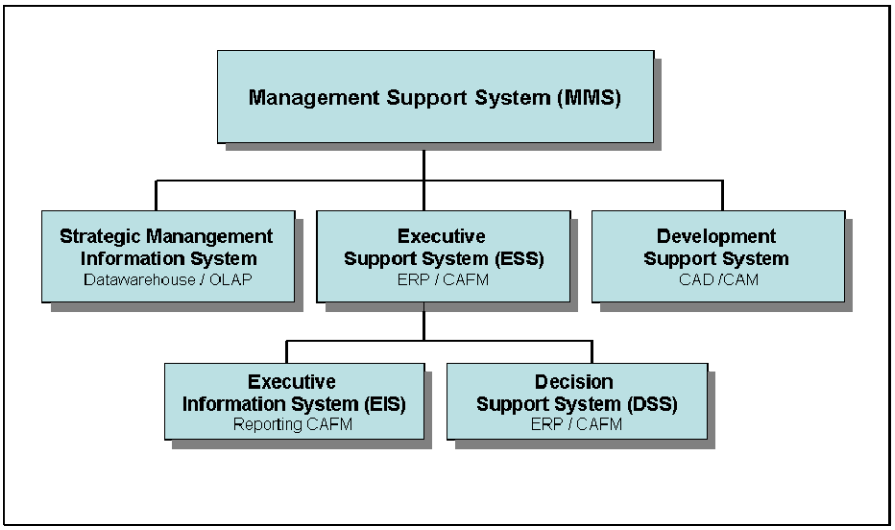
THE RELEVANCE OF CAFM AS A DECISION SUPPORT SYSTEM

Facility Management contains the concepts of cost-effectiveness, productivity improvement, efficiency and the employee quality of life. Very often there are no set answers for fulfilling all expectations, but management decisions still have to be made (Cotts 1992). Organisations cannot ignore the potential for cost saving within their real estate portfolios and increasingly they are using property-based information for corporate strategic decision making. The extent to which the information is fed back into strategic decision making varies depending on the

implementation, experience in using the information produced and the links made between departments within the organizations concerned. (Fenwick, 1998)

After salary and wages, facility and real estate expenditure is the largest cost item for a company and any improvement of cost effectiveness results in a significant overall saving of costs (Finlay, 1998). CAFM systems are increasingly developing into a strategic planning tool in order to support decision making in facility and real estate management, e.g. in the fields of space planning, cleaning, room conditions and maintenance strategies.

Fig. 3. Management Support Systems (Imitation Stahlknecht, 2005)



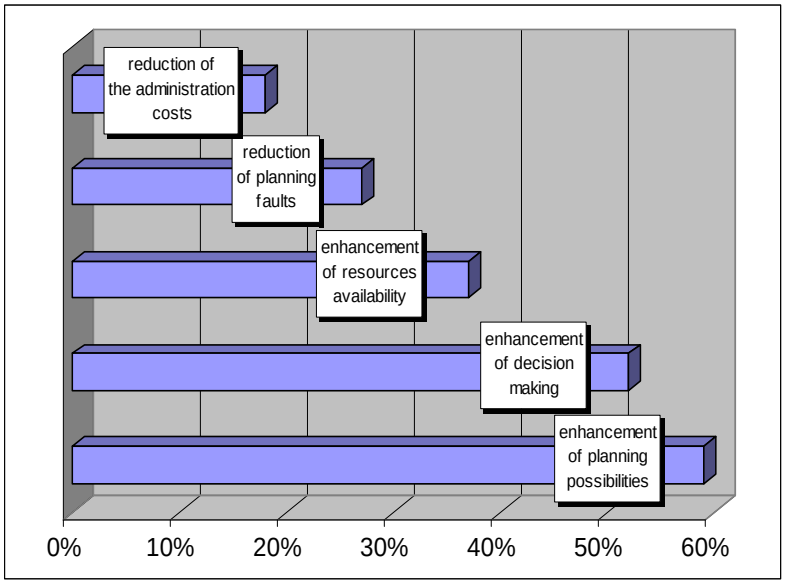
CAFM AS A DECISION SUPPORT SYSTEM

By using CAFM systems, all decision relevant data are represented correctly, in time and transparently. Economic data about real estate is the basis for the strategic management of the facilities. To optimize management processes in Facility Management it is necessary to link real estate information with business processes (Schach, 2005). Decision makers demand more relevant data just in terms of quality and quantity. CAFM systems provide information on the whole range of FM functions enabling tactically pervasive decision making performance for strategic long-term business success (Lunn, 2000).

The use and the saving potential of CAFM are evident in the chart below. In this investigation of the US market (Teicholz, 1990, Naevy, 2006) the improvement potentials after the introduction of CAFM systems were examined. It becomes evident that enterprises regarded the improvement of decision making and improvement of the planning possibilities as the most important advantages of CAFM technology.

The introduction of new work forms such as teleworking, desk sharing and virtual enterprises leads to rapid changes of the use of real estate. Facility management develops into a know-how oriented technology. Modern information and communication systems will simulate different scenarios to find the optimum operating points in relation to the occupancy of buildings. In this context a bi-directional exchange of data between building automation and CAFM system will become necessary in the future (Schach, 2005).

Fig. 4. Benefits of CAFM implementation (Naevy, 2006)



CAFM-BASED DECISION SUPPORT FOR SPACE OPTIMIZATION

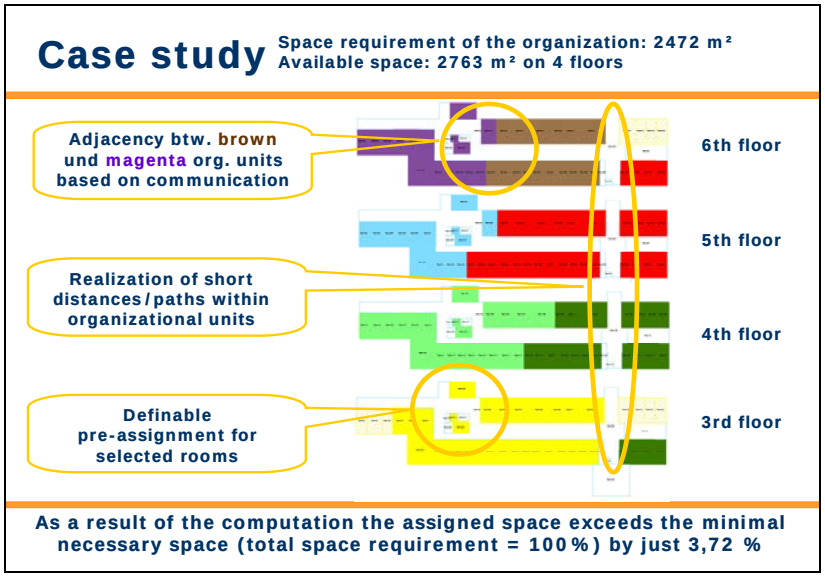
In the following we give one of the few examples so far, where CAFM and related technologies are used to support a real and complex decision process with a considerable economic impact. Optimal utilisation of office space is both a challenge and an opportunity, especially in large organisations. Space allocation is a tedious work and a great challenge for the Facility Manager with considerable economic impact on the entire organisation. To provide for the spatial requirements for a thousand or more employees in a way that maximises overall efficiency is a complex task in which the facility manager will be supported by. For example, an organisation with more than 3.000 employees has to move into a new building or various departments distributed over several buildings are to be located in one place. How does the FM achieve the ideal allocation efficiently? The problem is illustrated in figure 5.

Fig. 5. The space utilization/assignment problem

Nowadays, this work is hardly assisted by any IT tools. This is mainly due to the complexity of the underlying mathematical problems the exact solution of which exceeds the computing power of the most capable computers to date dramatically. So problems to be solved resemble the so-called Quadratic Assignment Problem (QAP) which is known to be one of the hardest (NP-hard) problems in discrete mathematics. So the problem can only be tackled by developing sophisticated heuristic algorithms.

In a research approach an IT tool (ReCoTech) was developed (see Rettinger et al., 2007, Marchionini and May, 2008) which is able to solve the underlying problem in an efficient heuristic way highly automatically. The basis data necessary for the tool come from CAD/CAFM systems. E.g. CAD drawings are used to generate a formalised building model automatically and CAFM systems provide data on the utilization and state of the available space. Not only are the space requirements of organisational units/employees taken into account but also their communication relationships (interaction), which is to result in a spatial adjacency in the final assignment (layout scheme). Figure 6 shows an example result of an automatic assignment.

Fig. 6. Result of an automatic space assignment based on CAFM data



A divide-and-conquer (top-down) approach was used to develop the assignment algorithm which is able to solve in an iterative way subproblems of a certain complexity (number of organisational units and spatial units) optimally. The software developed generates different variants of space allocation and evaluates their quality based on criteria such as reduction of cost, time, number of necessary reallocations, and/or communication traffic. In this way, the FM is able to set free valuable space in one site and to utilise office space more efficiently in other locations. By modifying several parameters this innovative algorithm is able to provide a number of allocation variants in a short time thereby giving the FM a real decision support. This is mainly due to the fact, that the result is easily comprehensible and objective. Additionally, the result can easily be evaluated in graphical form, where standard CAD formats as IFCs are used. The new technology which is considered a strategic planning tool is able to reduce space utilization costs dramatically (see Marchionini and May, 2008).

FINDINGS FOR IMPLEMENTATION

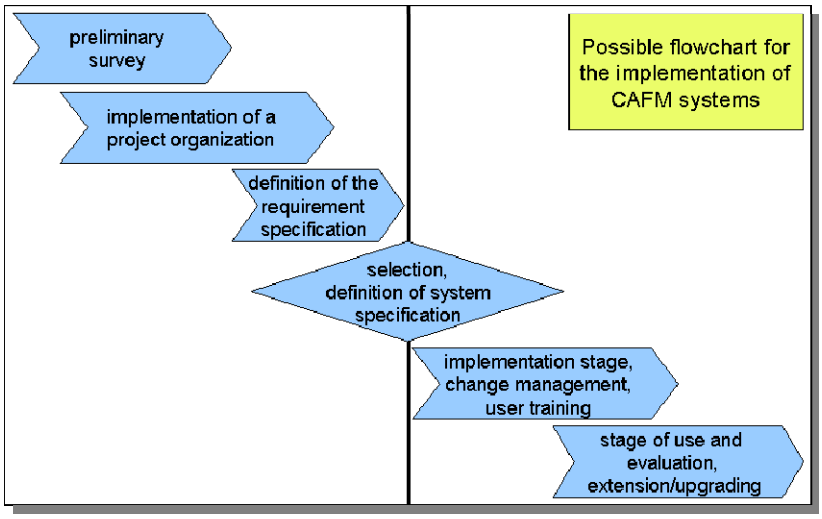
A large area of growth is the use of information between CAFM systems and building automation. By simulating real estate processes, important data can be created in order to support the management in the decision processes to find the potentially most efficient operation point. A further potential lies in the controlling of the efficiency of real estate management. When linking CAFM and building instrumentation, relevant building data can be generated, such as consumption data, malfunction and status messages, operation hours, maintenance and inspection dates as well as repair reports for the controlling process.

A further example for infrastructural building management concerns demand-related cleaning management (Schach, 2005). Instead of static cleaning cycles, information about the actual degree of pollution determines the cleaning cycles. The degree of pollution is determined, for example, by the operational personnel in the areas and the cleaning requirement. The user can be informed about this process and can make decisions for the cleaning process.

Despite the multitude of suppliers and users in different branches of trade industries there is still uncertainty concerning the procedures and achievable effects. This is closely related to the lack of well-documented, transparent and successful case studies. In addition, little is known about how CAFM is implemented successfully and the factors leading to success. From the economic point of view, it is very important to support this process in order to avoid wrong decisions and unnecessary investments. Especially implementation strategies and formulae for success are of great interest.

In 2006 the authors carried out a market survey about CAFM implementation (May et al., 2007). This survey presents the first comparative analysis of CAFM projects in the German-speaking countries. Due to the geographical location of the project partners the entire German-speaking area is covered and thus the results of the analysis reflect the state-of-the-art of CAFM implementation and use in the German-speaking area. The study of successful CAFM projects in companies and public institutions is intended to provide the know-how and practical experience to the public. It presents current trends and technologies and provides recommendations for successful CAFM implementation. The author recommends the following steps (see next Fig.5)

Fig. 5. Recommended steps for the CAFM implementation (May, 2007)



CONCLUSION

The CAFM market is currently facing a permanent development towards the needs of the customers. As mentioned before web-based CAFM solutions are established on the market. In contrast to many standard CAFM systems with client/server architecture, web-based CAFM solutions touch down on a multilevel (multi-tier) architecture. These applications are frequently based on three logical layers (3-tier architecture): presentation layer, business logic layer and data layer. If an enterprise decides to outsource its CAFM solution additional extensive installations for remote access have to be accomplished for client/server systems. With a fully web-based solution only inter-/intranet access is necessary.

The study of MacAndrew, 2005, shows that a new wireless web-based service for CAFM systems would be considered useful by facility managers and would improve current practice. Mobile CAFM solutions are usually no independent solutions, they are modules of CAFM solutions. The mobile devices update the data via an interface with the CAFM data. The operational areas of a mobile solution vary. It can be used e.g. for maintenance management and inventory management.

This development creates a further step to a management information system for FM. National and international enterprises need a holistic view of their real estate in order to optimize the real estate strategy in combination with the enterprise's strategy. This requirement can only be fulfilled, if a high degree of transparency of the data and processes is available in the appropriate quality, in real-time and in the correct format at any time. Also the term ‘workplace management’ comes up more often, which is a combination of facility management, real estate management, project management and other sections. Employee self-service systems guarantee a user-centred approach. With help desks and self-service Intranet, it meets the needs of the customers.

The examples mentioned above show what potential a future CAFM software as a decision-support system can offer to the management. Moreover, key success factors as well as critical points have been identified for the implementation and operation of CAFM systems. Taking a glimpse at emerging technologies, the authors conclude that further development of CAFM systems into decision support tools, which meet the requirements of a holistic integrated facility management, is on the way.

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REFERENCES

Berger, R. (2001): Trend Studie für Facility Management, Roland Berger Strategy Consultants und GEFMA, München

Brown, E., Kevin, R., Lapides, P., & Rondeau, P. (1995): Facility Management, John Wiley & Sons, New York

Cela, E. (1998): The Quadratic Assignment Problem. Theory and Algorithms, Kluwer Academic Publishers

Cotts, D. C., & Lee, M. (1992): The facility management handbook, Amacom, New York

Fenwick, J. (1998): Competitive advantage. Premises & Facilities Management, Vol 4 No.1, pp.23-24.

Finlay, D. (1998): A commercial approach, Premises & Facilities Management, Vol 4 No.1, pp.25.

FM-Monitor (2004), Swiss facility management monitor, pom+Consulting AG, Zürich

GEFMA (2007): Computer Aided Facility Management CAFM – Begriffsbestimmungen, Leistungsmerkmale, GEFMA Richtlinie 400, Bonn

Grabatin, G. (2001): Betriebswirtschaft für Facility Management, TAW-Verlag, Wuppertal

Harris, I. (2002): Bigger and better FM - to improve everyday life, European Facility Management Conference, Madrid

IFMA (2007a): International Facility Management Association: What is FM?. Retrieved January 30, 2007, from http://www.ifma.org/what_is_fm/index.cfm

IFMA (2007b), International Facility Management Association: What is FM?. Retrieved January 30, 2007, from http://www.ifma.org/what_is_fm/fm_definitions.cfm

König, W., Rommelfanger, H., & Ohse, D. (Eds.) (2003): Taschenbuch der Wirtschaftsinformatik und Wirtschaftsmathematik,Verlag Harri Deutsch, Frankfurt am Main

Lunn, S. D., & Stephenson, P. (2000): The impact of tactical and strategic automation, Facilities, Vol.18 No. 7/8, pp. 312-322.

May, M. (2002): How to Implement CAFM Successfully, Proc. I. European Facility Management Conference, Madrid, pp. 41-52.

May, M. (2005): CAFM-Einführung – (K)ein Buch mit sieben Siegeln – Tipps zur CAFM-Einführung. Facility Managemen, Vol.12 No.6, pp. 2-5.

May, M. and Hohmann, J. (2004): CAFM in Europe – Quo Vadis?, Proc. 4th European Facility Management Conference, Copenhagen, pp. 8.

May, M. (2006): IT im Facility Management erfolgreich einsetzen: Das CAFM-Handbuch, Springer-Verlag Berlin Heidelberg New York

May, M., Madritsch, T., Koenig, T., Meier, M. and Scharer, M. (2007): Computer Aided Facility Management im deutschsprachigen Raum – CAFM-Praxiserfahrungen aus Deutschland, Österreich und der Schweiz, BoD-Verlag, Norderstedt

Marchionini, M., May, M. (2008): Neue Technologien zur Optimierung einer strategischen Flächennutzungsplanung. to appear in Der Facility Manager 4(April 2008)15.

McAndrew, S. T., Anumba, C. J., & Hassan, T. M. (2005), Potential use of real-time data capture and job-tracking technology in the field. Facilities, Vol. 23 No.1, pp. 31-46.

Naevy, J. (2006): Facility Management (4th ed.), Springer, Berlin

Rettinger, C., Marchionini, M., May, M. (2007): Computerbasiertes Generieren von Belegungsplänen bei Umzug oder Flächenverdichtung in großen Organisationen“. Facility Management 2007, Frankfurt, pp. 195-203.

Schach, R. (2005): Integriertes Facility-Management: Aus Forschung und Praxis (Bd. 4), expert-Verlag, Renningen

Stahlknecht, P. (2005): Einführung in die Wirtschaftsinformatik (11.ed), Springer Verl., Heidelberg -New York

Teicholz, E. (1995): Computer-Aided Facilities Management and Facility Conditions Assessment Software. Facilities, Vol.13 No. 6, pp. 16–19.

prEN 15221-1, (2006): Facility Management - Part 1: Terms and definition, CEN/TC 348, European Committee for Standardization, CS: 01.040.01;03.080;03.100.99