
Different Approaches to Building Management and Maintenance Meaning Explanation

Iveta Puķite*, Mg. sc., Ineta Geipeleb, Prof., Dr. oec.

*a, b Riga Technical University, Institute of Civil Engineering and Real Estate Economics, 6 Kalnciema Str., Riga, LV-1048, Latvia

Abstract

The present paper examines the connection between building and property management and building management system. It provides an insight into the concept of building management. Building management is a particular economic activity, a set of property maintenance, operation, repair and maintenance. This is a legal and technical set of operations required for building maintenance and preservation of usable condition, as well as functionally required for the maintenance of the land to ensure that property is used in accordance with the purpose.

The aim of the paper is to conduct a literature review of different approaches to defining building management and building maintenance. Through the analysis, common themes identified are a number of terms and their definitions that appear in studying building management and maintenance processes.

The continuous growth of socially responsible building management indicates that there is a need for a more effective management system of the building lifecycle to provide sustainable residential property development.

Introduction

Building Management and Maintenance is an organized and effective system of maintenance operations, which is set up to deal with problems related to the upkeep of a building. The main aim of maintenance is to protect a building...
at its preliminary stage and to retain the value of investments in the property. Keeping a building in a condition in which it continues to fulfil its purpose and making sure it presents an attractive exterior are also important factors made possible through proper building maintenance.

Building maintenance is an expensive process both from financial aspects (operational costs, real estate management, administration, job with debtors, legal services etc.) and environmental aspects (climate change, greenhouse emissions, and energy efficiency measures). Businesses aim to reduce the costs of buildings transforming them into a more efficient and sustainable infrastructure.

Maintenance is often defined as the series of activities undertaken to take care of the building structure and services to ensure the intended functions and optimal performance of a building life cycle. The management department of a building is usually responsible for the enhancement of the indoor environment quality by service delivery and for boosting occupant productivity and satisfaction [22].

The aim of the paper is to conduct a literature review of different approaches to the organisation and implementation of building management and maintenance processes, which are examined in various scientific publications.

The present literature review is based on the analysis of different articles to provide an understanding of how the terms “building management” and “building maintenance” are defined in scientific literature. The paper identifies and evaluates building management and maintenance as an instrument of building property management system, as it is important to generate discussions regarding this topic.

In the scientific literature on building management and maintenance, different approaches are used to define the given terms, explain their scope of application and implementation conditions.

Research subject is building management and maintenance.

The paper is structured as follows. In Section 1, a review of building maintenance and management is provided. Section 2 highlights the existing literature of building management and maintenance systems. Section 3 discusses the economic aspects of building management systems. Through the analysis of the articles, an attempt is undertaken to answer the following questions: What are the main conclusions made by scientists and will an open study affect the subjects studied? Implications for future research and main conclusions are provided in Section 4.

The approach to the literature review lied in multiple searches performed within the Academic Search Premier databases along with the library of journal articles by the Association for Information Systems, in which the search criteria involved keywords such as building management, building maintenance, housing maintenance, property management. Most articles were published over the last five years. To understand the differences between the study periods, several additional articles published over the last six to ten years were also studied. This review provided information regarding building management processes and systems.

1. Different Interpretation of Building Maintenance and Management

The definition of building maintenance and management can vary across disciplines; however, the processes involved in the discovery, capturing, sharing, and application of the management and maintenance process will still be present.

Glossary of Academic Terminology offers different translation variants of building maintenance and management, but more or less all of them provide explanation that it is a process with many operations such as planning, implementation of plans, support, control, decision making etc., which are important for running successful businesses. The term is also defined as supervision, management of an object according to owner’s objectives, strategy, principles of economy, etc. When analysing various scientific articles from different time periods, it is possible to identify development trends and main functions of a process. Since 2010, publications demonstrate a trend to research technical processes rather than management [2].

Building maintenance is defined as “work” in order to keep, restore or improve every part of a building, to maintain the performance of building fabric and its services and surrounds, to accepted standard and to sustain the utility and value of the building. It includes improvement, refurbishment, upgrading as well as repair works of the existing facilities [38].

Alner and Fellows stated the purposes of building maintenance: (1) to ensure that the buildings and their associated services are in a safe condition; (2) to ensure that the buildings are fit for use; (3) to ensure that the condition of the building meets all statutory requirements; (4) to carry out the maintenance work necessary to maintain the value of the
Building maintenance management is often related to the innovative strategy and future sustainability. Various working methods are introduced to the performance of building maintenance management [1]. There are two things: one is categorised as asset management and the other as building maintenance management. Both elements need cost assessment and budget allocation to achieve success of their activities [3]. Interior maintenance encompasses all the services required to keep the inside of the building safe, pleasing, and usable, and includes surfaces and finishes, doors and windows, fixed equipment, and fire protection and safety [27].

Hauer et al. indicate preventive maintenance and emphasise its important role. The following best practices for preventive maintenance are recommended: (1) to perform inventory of building components and assess their conditions; (2) to build the capacity for ranking maintenance projects and evaluating their costs; (3) to plan strategically for preventive maintenance in the long- and short-term; (4) to structure a framework for operating a preventive maintenance program; (5) to use tools to optimise the preventive maintenance program; (6) to enhance the competence of maintenance workers and managers; and (7) to involve appropriate maintenance personnel in decision making and in communicating buildings’ needs [8].

The researchers from Malaysia have conducted a study on residential building maintenance. The continuous growth of high-rise residential properties indicates that there is a need for an effective property management system to provide sustainable high-rise residential property development. As intensive as these studies are, they do not attempt to investigate the correlation between property management systems with the trends of Malaysian high-rise residential property development. By examining the trends and scenario of Malaysian high-rise residential property development, this paper aims to gain an understanding of impact from the effectiveness of property management. Findings from this scoping paper will assist in providing a greater understanding and possible solutions of the current Malaysian property management systems for expanding the high-rise residential unit market [22].

Management term is also used due to different types of programmes. At present, services for building management are provided by different stakeholders using their own software applications [25]. McIntosh indicated that a firm understanding of build maintenance is essential for project managers to allocate personnel and resources in order to accomplish maintenance tasks effectively and reduce the build maintenance overhead on regular development tasks, such as fixing defects and adding new features. Build maintenance has been empirically studied in one proprietary and nine open source projects of different sizes and domain [20]. Build maintenance refers to the changes made to the build system as a software project evolves over time and has been shown to impose a significant overhead on overall development costs, in part because changes to source code often require parallel changes in the build system [28]. The complex task of packaging a software product for release is typically automated by the build system, ensuring that the correct versions of software components, required libraries, documentation, and data files are included in the release [18].

Some major reasons for maintaining a building include retaining its reputation and value of investments, maintaining the building in a condition, which allows it to accomplish its purpose, and presenting a good outer shell [24].

2. The Economic Aspects of Building Management Systems

Chen et al. associated housing maintenance and housing cycle with the decision-making procedure. Maintaining and renovating with scientific evaluation principles and decision making technique must be carried out in order to guarantee housing normal function during its life span and make its life span longer. The concept of the best maintenance cycle (hereinafter designated as \( T_m \)) of housing appears according to its character of maintainability and establishes the \( T_m \) of housing at state of repair and renewal [31].

A broad view to the process was provided by Hao et al. Taking Shenzhen as an example, some typical hidden troubles related to buildings and facilities during their life cycles were briefly reviewed and the proposed management system of building safety was then presented in their paper. This system would include the following nine aspects: regulation for industry management, laws for building management, function of property management departments, technical specifications for general investigation of buildings, technical standards for design and construction as well as maintenance of buildings, building information system on the internet/intranet, emergency measures, popular education on building safety, and expert decision making system for building management [8].
Chanter and Swallow have conducted research in this field and found that far too often maintenance regimes, especially planned preventative maintenance, fail due to poor information management. Management controls such as programming, budgeting, costing and their reporting are discussed along with practical challenges to their implementation, such as contractor selection, procurement and the different forms of service agreements and contracts available, from traditional forms (JCT) to PFI, PPPs and others [5].

Providing housing maintenance and focusing on building repairs, in recent years there has been a tendency to use a three-dimensional (3D) model. The management of information related to the maintenance of buildings is based on the planning of action to be taken and on the log of completed work. The three-dimensional (3D) model of the building linked to a database concerning maintenance produces a collaborative virtual environment, that is, one that can be manipulated by partners interested in consulting, creating, transforming and analysing data in order to obtain results and make decisions [32]. The use of 3D visualisation has long been established as a major breakthrough in closing the gap between client’s needs and what is perceived by the designer to be the needs of the client [28].

Implementing housing maintenance, an important aspect is the renovation of buildings. Researchers from Lithuania have developed a knowledge-based model for standard housing renovation. The key idea of the model is to transfer the knowledge gathered from already implemented typical renovation projects to the forthcoming renovation projects by selecting the best project alternatives. In order to solve this task, MCDA (Multiple Criteria Decision Analysis) approach is used. The concept of knowledge transfer in renovation is discussed, the developed model is presented, and main stages of its implementation are described [9].

Critical Success Factor (CSF) is used to measure an organisation’s performance in achieving its mission. In building maintenance, CSF is important as it can identify the cause of failure as well as improving the system [21].

Economic aspects of the Building Management System are: comfort, user’s safety and improvement of energy-efficiency of the building. Relatively low investment expenditures enable us to save energy up to 40% [4].

To ensure successful performance of maintenance, it is necessary to introduce the so-called calendar module. This takes each maintenance plan and displays it using a graphical summary for the entire projection that shows peaks and troughs in estimated expenditures [36].

Asset management is a “process” of guiding the initiation, acquisition, use and maintenance and disposal of assets; to make the most of their service delivery potential.

3. Trends in Research of Building Management Systems

Intelligent buildings are equipped with the monitoring equipment system and integrated system for management of all installations in the building. The building can react to the changes of outside and inside conditions that leads to the increase in functionality, comfort and user’s safety, and also to minimisation of maintenance costs.

Buildings in particular are infused with devices connected to the Internet creating a network of connected pervasive things, namely the Internet of Things (IoT). The IoT is one of the key components in building automation systems, as buildings can be instrumented and interconnected using modern digital technologies (e.g., sensors, actuators, etc.) and often wireless communication technologies, providing information about the state and health of the physical infrastructure of buildings. This enables efficient monitoring of resources and prompt reaction to unpredictable situations.

Based on the main values of building management, during decision making processes users should take into consideration both the objective and subjective requirements of users [13].

To develop a new uniform building maintenance standard on the basis of laws and regulations, the study examined the latest construction technologies, structure inspection technologies, new building materials, as well as maintenance and management processes [37].

To perform building sustainability assessment, researchers from Sweden and Lithuania present a new multi-criteria decision-making technique to select criteria for building sustainability assessment. The methodology of building certification system is integrated with the multi-criteria decision-making (MCDM) methods. The criteria set for assessment are determined based on the Swedish certification system Miljöbyggnad. Criteria weights are determined by applying the Analytic Hierarchic Process (AHP) method [19].

Building Management Systems (BMS) could be seen as a kind of module inside a wider SmartGrid system [16]. Data captured by the Building IoT is often sent to Building Management Systems, which alongside with other tools
evaluate the health and state of the building and its assets. The efficient monitoring of buildings involves creating, processing and communicating information, and therefore data has a pervasive influence on Smart Buildings and will be used to manage and improve the integration of data that will trigger building events and services. The system involves accounting, management and monitoring solutions. Building Management Systems are the most effective solutions for upkeep of buildings and energy savings, and they also integrate multi-building utility systems, which allow efficiently and economically managing buildings.

One of the challenges in implementing a distributed smart building management system is to enable interoperability of many different computational platforms by providing a common protocol across a wide range of devices with different capabilities and resources [35]. Smart meters provide a communication infrastructure among building owners and tenants [38]. The efficient building monitoring system enables the manager to save energy and create a comfortable and safe environment for users. The Smart Building is an infrastructure for end-users in a power distribution network and improves the responsiveness, reliability, interactivity, and transparency in the distribution system. The aim of the Smarter Building Architecture is to provide the efficient and intelligent operation and management of the building physical infrastructure.

Smarter Building architecture consists of a layered structure composed of three main modules for BMS: data collection, event management and enrichment, and asset and work order management. The design of a smart building application based on this architecture is illustrated and tested; the results confirm the viability and efficiency of the proposed framework [34].

Building Management System emerges as an important instrument for boosting operational efficiency of private and public buildings and campuses. Such an automation system will be an important element (a kind of module) of energy-efficient Smart Grid. The integration of BMS into a wider system will require standard harmonization, closer interaction among key elements of these systems – Advanced Metering Interface (AMI), Building Automation and Control System (BACS); high level applications that enable commercial models and enhanced Energy Data Management System (EDMS) as one of the key elements of Smart Grids.

Automatic and Control Systems support these applications: automatic fault detection; assignment of interventions to maintenance operators; on-the-field support (such as aided fault location); and communication to tenants about the intervention status. Automated support for building maintenance provides several advantages: if we consider, for example, an office building, the automatic notification to each office tenant of currently scheduled maintenance operations and real-time end of the intervention can dramatically reduce the intrusiveness of maintenance operators and significantly increase the overall efficiency of an intervention [18]. Building energy management system (BEMS), which forms an integral part of a smart grid, enables building operators to monitor, manage and control the energy utilised in their buildings, thus reducing the demand and consumption of energy [33].

While conventional buildings have been practicing various energy saving and building management measures by each building individually, the recent innovation of Information and Communication Technologies (ICT) proposes valuable solutions by enabling interconnection between building systems and miscellaneous devices, such as end-use appliances, mobile phones, automotive, and power grid [17].

Flexible system for Building Lifecycle Management (BLM) includes energy management, facility management, maintenance management, and product/information traceability management operated in a system to help users to integrate and reuse building information and domain knowledge throughout the building lifecycle.

For example, Finnish researchers Kubler et al. carried out an in-depth study of the lifecycle of the building in the course of maintenance activities. Their paper investigated existing messaging protocols in order to identify which one was the most appropriate for supporting building lifecycle management, i.e. a flexible protocol that provided sufficiently generic communication interfaces. A platform set up on a university campus based on the selected messaging protocol was then presented. Within this context, the research agenda that should be pursued to develop new techniques and algorithms for optimising the building energy management was announced [12].

In turn, researchers from Sweden explored the new public management theory, indicating the political property of management, praising the management of liberalisation, advocating market-oriented management, and promoting entrepreneurial leaders. The programmed control, standard considerations, continuous improvement of the party building management could be achieved by teasing, integrating and optimising building management, regulations, processes and systems according to the new public management theory. Integrating building management into various
tasks in a mechanism is good to make building management from the “soft” management into the “rigid” operation and enhance the quality and level of building management [14].

In Latvia, one of the study objects is also a housing policy. Over the past 20 years, there have been a number of considerable aspects in the housing policy of Latvia that affect the development of housing policy in general [26]. The real estate market is never perfect; there are market failures. The housing sector is aging, if it is not renewed to the extent required. The real estate market can offer real estate taking into account not only the need for provision of housing functions, but also the potential to create a solvent demand by offering high-quality dwellings in new and modern development projects. For this purpose, conceptual solutions can be found to increase efficiency measures and to promote the housing sector management [7].

As shown in Table 1, one subcategory was identified, which pertains to the building or housing maintenance management, but another category – to the building management systems.

Table 1. Literature Review.

<table>
<thead>
<tr>
<th>No.</th>
<th>Keywords</th>
<th>Additional conditions</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Building Maintenance and Management</td>
<td>Article title, Abstract, Key words; All subject areas; All document types</td>
<td>[5; 6; 7; 10; 11; 12; 13; 16; 17; 18; 21; 22; 25; 26; 27; 28; 29; 30; 32; 33; 38]</td>
</tr>
<tr>
<td>2.</td>
<td>Housing/ Facility/ Property Management</td>
<td>Article title, Abstract, Key words; All subject areas; All document types</td>
<td>[2; 3; 7; 8; 9; 17; 19; 20; 23; 34; 36; 37]</td>
</tr>
<tr>
<td>3.</td>
<td>Building Management Systems</td>
<td>Article title, Abstract, Key words; All subject areas; All document types</td>
<td>[4; 14; 29; 27; 31]</td>
</tr>
<tr>
<td>4.</td>
<td>Building Communications Systems</td>
<td>Article title</td>
<td>[15; 24; 35]</td>
</tr>
</tbody>
</table>

Correct and appropriate housing maintenance and repair can not only extend the life cycle of system components of the house, but also can compensate for some loss caused by buildings in the state of despair; and it can make a financial gain by cutting down a lot of expenses on the housing maintenance and repair work [29].

Conclusion

Some of the major elements of building maintenance have been identified towards achieving sustainable buildings. These include retaining reputation and value of investments, maintaining the building in a condition, which allows it to accomplish its purpose, and presenting a good outer shell. One article offers techniques for managing and maintaining a clean, safe, and pleasant school building.

Some researchers have initiated to support centralised and interoperable design of building and maintenance processes. Typically, building construction and maintenance are supported by several non-interoperating software applications, acting on non-integrated data. Management controls such as programming, budgeting, costing and their reporting are discussed, along with practical challenges to their implementation, such as contractor selection, procurement and the different forms of service agreements and contracts available. One particular paper gives the design of Housing Maintenance Engineering System (HMES) by a concrete analysis and does the best to find some useful methods for problem solutions for the status of the property management system, housing maintenance.

One of the challenges in implementing distributed smart building management systems is to enable interoperability of many different computational platforms by providing a common protocol across a wide range of devices with different capabilities and resources. The information collected serves as a basis for the implementation of applications using interactive visualisation technologies to support the planning of building maintenance, even using 4-dimensional visualisation.

While conventional buildings have been practicing various energy saving and building management measures by each building individually, the recent innovation of Information and Communication Technologies (ICT) proposes valuable solutions by enabling interconnection between building systems and miscellaneous devices, such as end-use appliances, mobile phones, automotive, and power grid.

Critical Success Factors (CSF) can be used to measure an organisation’s performance in achieving its mission. In building maintenance, CSF is important as it can identify the cause of technical defects as well as improving the system operation. Research observed proves it with certain aspects of Building Maintenance Management of Local
Authority in Malaysia.

The development of a Knowledge-Based System (KBS) has been developed for predicting strategic maintenance in residential property using a Client Centred Approach (CCA). Some investigations focus on the maximal social effects by investigating an incentive pricing scheme for building load management.

Management System of Building Safety (MSBS) may include the following nine aspects: regulation for industry management, laws for building management, function of property management departments, technical specifications for general investigation of buildings, technical standards for design and construction as well as maintenance of buildings, building information system on the internet/intranet, emergency measures, popular education on building safety, and expert decision making system for building management.

The concept of the best maintenance cycle of housing at state of repair, ethnical systems for efficient operation and gist of quantitative decision-making of housing maintainability have been developed.

The continuous growth of high-rise residential properties indicates that there is a need for an effective property management system to provide sustainable high-rise residential property development.

Building management primary refers to functions, such as decision making and performance of actions in order to reach a certain level of results (technical maintenance of property, value maintenance of property and/or increase, right operation).

Building management refers to a set of activities required to keep the building in proper condition as well as to maintain the land in order to use the building in compliance with the main goal of the property. By contrast, building maintenance is a technical complex of measures, which help implement decisions made during the building management process for housing and land maintenance and preservation. There are more than several tens of maintenance disciplines, but they can be divided into hard services and soft services. Hard or technical services contain effective, safe and harmless exploitation of conditioning equipment according to normative regulations. Soft services mean cleaning of equipment, control of subcontractors’ work (based on schedules for equipment technical check-up) and similar events. Computer software plays an increasing role for management development. The scope of required work is largely determined by the complexity of construction solutions rather than by real customer needs. There is a considerable difference in process complexity of management of multi-storey serial type living house and multifunctional skyscraper. Housing manager has the most power to influence life quality of building due to the allocated resources. It is important to understand difference between real estate management and maintenance. It is obvious by looking at the cash flow.

Management is an activity, which leads to a cash inflow from an object (money in). However, maintenance provides the wholesome functioning of an object for likely longer time period with much lower costs (money out).

Management has quite a wide range of operations and is one of various real estate exploitation processes with its quite specific functions and tasks.

Management is more related to entrepreneurship. Proper management requires specific knowledge and technical skills. Good management is when operations are transparent and reliable; there is regular reporting and participation, and fast reaction to client needs and complaints. This process is also time-consuming, knowledge-intensive and expensive.

During the management process, owners of building have to resolve several issues, such as how to organise building management effectively and in compliance with the existing regulations. They have to choose the most appropriate and economically justified management form.

References
