



Maintenance and maintenance management systems in accommodation

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ABSTRACT

Purpose: of this study is to address the issue of maintenance work in the accommodation sector. The development of the means of transport, the increase in income level and the increase in comfort level create a desire for people to travel more. In the travels to different cities, accommodation facilities such as hotels, holiday villages and apartments are used. Customer satisfaction is very important for the accommodation facilities. In order to ensure customer satisfaction, the services provided should not be interrupted and all machinery and equipment must be in working condition. To ensure this, it is very important to carry out maintenance work on the plants and devices. Therefore, the establishment of a maintenance management system in accommodation facilities is very important and it is necessary to carry out maintenance work. In this context, different maintenance methods are applied in accommodation facilities. In this study, maintenance of accommodation facilities is discussed.

Design/methodology/approach: Within the scope of the study, maintenance and maintenance management in accommodation facilities are discussed. The maintenance principles of accommodation facilities are discussed in detail. The places where maintenance services are conducted in accommodation facilities and maintenance methods are discussed.

Findings: This study shows that that the implementation of maintenance management system will increase customer satisfaction. It has been evaluated that maintenance can be successful not only by maintenance personnel but also with the participation of all plant employees.

Research limitations/implications: In order to see the importance of maintenance in accommodation facilities, it will be appropriate to compare the hotels with the maintenance management system applied and the hotels that are not implemented in terms of customer satisfaction and maintenance expenses. For the future studies, the maintenance management system in hotels can be examined in detail.

Practical implications: Expanding the maintenance management practices in accommodation facilities will increase the capacity utilization rate of the hotels and increase customer satisfaction.

Originality/value: In the field of maintenance, detailed studies have been carried out in the manufacturing sector for a long time and have been examined in detail. However, work in this area is quite limited, especially in accommodation facilities and hotels. In this study, the subject of accommodation facilities and maintenance of hotels was discussed in detail.

Keywords: Accommodation, Maintenance, Maintenance management, Maintenance team, Maintenance for hotels

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INDUSTRIAL MANAGEMENT AND ORGANISATION

1. Introduction

In both the private and the public sector, in past and present practices, maintenance is defined as actions taken to repair a machine or device after it has been broken down [1]. Glossary literally defines maintenance as labour for the development of something, to remain in a good state. Maintenance can also be defined as the measures required to ensure the proper operation of a device, an equipment or component, or to prevent malfunction of its components, or the work required to repair it in case of failure. Data from many studies over the last decade show that most private and public organizations do not allocate the necessary resources to keep their facilities or equipment in proper working order. In general, equipment failure is expected, and then necessary actions are taken to repair or replace the equipment.

Similar approaches are applied not only to machinery or equipment, but also to facilities or hotels. Recently, with the influence of social media, visits to see and recognize different places and cultures in societies have increased. This accelerated the growth of the accommodation sector. However, it is very important to ensure that all infrastructure facilities, machinery and equipment in the hotel are in working condition in order to ensure customer satisfaction in the accommodation sector, institutions such as hotels and holiday villages. In order to ensure this and make it sustainable, concepts such as maintenance and maintenance management have come to the fore in the hospitality sector.

Maintenance is the key to creating a better environment to ensure the safety and satisfaction of customers and users. The maintenance of accommodation facilities is important as it has a direct and significant impact on meeting the demands and expectations of customers and affects the quality of service. For the purpose of proper maintenance management, operations carried out for this purpose in hotel establishments are necessary for a number of reasons, including the following [2-7]:

a) to ensure the safety and security of hotel guests and employees by ensuring that buildings, services and facilities are safe and suitable for use;

- b) to ensure the availability/reliability of all assets and services requested by customers;
- c) maintain or increase market share by satisfying existing or upcoming guests;
- d) comply with or capture new trends and technology in the market (e.g. green movement);
- e) protecting its corporate image, appearance, historical and architectural values around it;
- f) to improve operational stability and efficiency of facilities and systems;
- g) to ensure continuity in energy supply and to increase energy efficiency;
- h) mitigating the consequences of natural disasters such as hurricanes and earthquakes;
- i) fulfil official provisions such as disability law, health and safety regulations;
- j) to ensure that all equipment required for emergency use is always ready for operation;
- k) to increase the life of the property and reduce the malfunctions.

Unfortunately, on the other hand, it reveals that in most organizations maintenance is given little importance and little priority. Inadequate maintenance makes it difficult to use buildings efficiently and to ensure customer satisfaction.

Francis et al. [8] defined building maintenance management as 'a process involving the interaction or combination of technical, social, legal and financial determinants that govern and regulate the use of buildings'. In their study, Athuraliya and Farook [9] examined the accommodation and hotel businesses and focused on the priorities that could be developed for the identification of maintenance-related problems. According to Lee and Scott [10,11], maintenance is a broad term that defines maintenance responsibilities and determines maintenance requirements. The main objective here is to ensure that building assets are properly protected and used effectively and efficiently. Borsenik and Stutts [12] described the management of maintenance and engineering systems for accommodation buildings as follows: 'design, construction, use, repair, renovation and disposal'. Accommodation and maintenance engineering and maintenance systems include:

life safety, heating, ventilation, cooling, electricity, water, transport, external environment, and special equipment. According to this definition, the main purpose of the department can be expressed as: to keep the structure, machinery, systems and products in an existing or determined state of readiness. This definition assumes that everything is kept in repair and operates at a high efficiency level (low energy consumption) and that there is minimal deterioration [12]. In some hospitality establishments, this term is combined under the heading of facility management or facility engineering [13,14].

In recent years, studies examining the maintenance performance of hotels and their relationship with energy have begun to emerge [15]. Marriaga et al. [16], analysed the development of energy characterization, the establishment of energy bases, the index spread to the atmosphere and the consumption of kg CO₂ for the hotel industry. It was concluded that it is possible for the organization to know its business capabilities and a starting point for development through the implementation of an energy review and the establishment of energy performance indicators for accommodation industry.

Zolkafli et al. [17] examined the effects of a good maintenance study for heritage buildings. For this purpose, identification of the factors that cause non-maintenance of heritage buildings, developing strategies for overcoming the lack of maintenance of heritage buildings and analysing the effects of good maintenance on heritage buildings were investigated. The study has shown that the factors leading to non-maintenance of heritage buildings are limited funding, lack of maintenance guidelines and poorly defined maintenance policy. Strategies to overcome the problems have been emphasized that the authorities should provide a financial budget, establish a standard maintenance manual and review the current policy.

In a study conducted by Lai and Yik [18], a 618-room hotel was examined based on computerized maintenance management data, a significant relationship was found between the downtime of the equipment and the amount of maintenance work orders and the maintenance performance of the facility was evaluated. In another study, it was found that the labour productivity of the hotel's maintenance service decreased with increasing working hours and intensity of employees [19]. In addition, Lai [20] introduced a model that allows the analysis of maintenance data according to the period, place, and physical setup of maintenance operations. The analyses conducted in this study showed that the maintenance work at the hotel was highly correlated with the demands, but had little correlation with the input manpower.

Hotel maintenance is the maintenance of various systems and components used in the hospitality industry. These systems include general construction processes such as Heating, Ventilation and Air Conditioning (HVAC), electrical and plumbing, as well as many specific needs for hotels and their customers.

Hotel maintenance may include cooling maintenance, elevators, cable TV, telephone lines, personal computers, room furniture and lighting fixtures. This broad scope of maintenance requires a wide range of expertise from hotel maintenance teams. It also means that maintenance planning is crucial to hotel maintenance success.

2. Structure and maintenance of accommodation industry

The hospitality industry may vary and all of these accommodation areas may have their own maintenance needs. These can be listed as follows:

Hotels: The average hotel needs a wide range of maintenance work, such as heating, cooling, plumbing, lighting, soil maintenance, electronic equipment and numerous others.

Serviced Apartments: Residential hotels offer longer stays and maintenance needs are similar to apartments instead of hotels. However, maintenance needs are still quite diverse.

Holiday Villages: Holiday villages located in remote areas have unique maintenance needs. They often need to provide their own electricity, water and waste disposal while maintaining the additional features they offer. Extras include golf courses, skiing and swimming.

Time Renting: Tenants purchase accommodation for a fixed period each year and are usually responsible for financing part of the maintenance of the property.

Casino Hotels: Casinos offer accommodation as a secondary function outside the primary business. These hostels require much maintenance as other hotels. In addition, machines and food service areas on the property require consistent maintenance work.

3. Maintenance staff for accommodation facilities

The maintenance of the accommodation facilities is carried out by the technical and administrative personnel assigned to the maintenance service. The staff and their duties in the accommodation facilities are briefly given below [21].

Maintenance Technicians: They assume a wide range of responsibilities. His duties include regular scheduled maintenance, as well as corrective maintenance performed on a hotel's numerous systems. Maintenance workers can also take a role in protecting the floors and exterior areas of buildings.

Maintenance Supervisors: Supervise the actions of maintenance technicians and can also assist in regular maintenance tasks. In addition, they report to maintenance managers on various metrics such as planning, compliance with regulations, and safety.

Maintenance Managers: Undertake high-level planning and hotel maintenance tasks, including working with supervisors, reporting to the hotel manager, and setting up policies that employees can follow.

In addition to maintenance workers, cleaning staff also play a key role in identifying problems. They provide communication between maintenance and cleanliness. They can also contribute to solving the small problems they see. This communication is usually carried out by work orders sent to the hotel's maintenance department.

3.1. Qualifications and skills to be able to work in the maintenance department of the hotel management

It should be ensured that all members of the maintenance team, from the apprentice to the maintenance manager, approach the events from an engineering perspective. Everyone in the maintenance team may also need to be trained to understand and know the needs of the hotel's guests and staff on site.

Successful maintenance personnel are expected to have the following skills:

- Project management skills,
- Research skills,
- Purchasing and negotiation skills,
- Time management and multi-tasking skills,
- A flexible and innovative approach to work,
- Problem-solving skills.

3.2. Maintenance team and maintenance management system for accommodation

Guest satisfaction takes priority in the hospitality industry. With the widespread use of social media, accommodation areas have become areas where thousands of potential customers can see and make investigations.

The role of a hotel's maintenance department and all plant and equipment is kept in good condition to ensure the

smooth execution of the process. Maintenance should be seen as a strategic investment in a hotel. Continuous investment in maintenance on the hotel equipment and facilities also has a direct positive impact on guests' experiences.

The availability of a large number of well-maintained rooms can generate more revenue and at the same time increase the number of satisfied guests. Failure of the equipment and maintenance during the customer's presence may adversely affect customer satisfaction. In order to minimize the risk of these problems, maintenance should be considered as an investment, not as an expense, as it will reduce costs in both the medium and long term [22].

The maintenance team is behind the scenes in the hospitality industry, which guests often don't see directly. The Department of Maintenance is of vital importance for the successful operation of the accommodation areas. The maintenance team is responsible for many functions to ensure that all services in the building are available, such as ensuring the continuity of lighting and to keep guests comfortable and happy.

The maintenance department works 24 hours a day and is a vital part of the accommodation facilities. Having the right people with technical know-how puts the maintenance team in an important position in the accommodation business. The maintenance team ensures the safety of all personnel and guests within the organization and is also responsible for increasing energy efficiency and reducing operating costs. Maintenance management is responsible for many systems within the building: building structures (including walls, ceilings and floors); air-condition, heating and cooling facilities; water and sewage plants; furniture, fixtures and equipment; electricity; alarms; area management; supply and much more. Maintenance management is therefore a major responsibility for a hotel, and having the right maintenance team contributes greatly to the smooth running of jobs. In some cases, maintenance departments can resolve certain functions by outsourcing to or from third-party experts, but supervising the operations of third-party suppliers is still a task of the Maintenance Manager [23].

Pitt et al. [24] emphasized the importance of determining the maintenance situations and strategies in hotels. Factors affecting the decisions of hotel operators and maintenance managers and their effects were examined in the study. They indicated that planned and reactive maintenance techniques that efficiently and effectively meet the commercial and regulatory requirements of hotel operators and maintenance managers are required to optimize hotel maintenance. Galán et al. [25] reviewed the maintenance process and management models in their

study and discussed the development of maintenance management over time. In this study, the effect of care models on clinical-hospital environment was examined.

The maintenance management system is very important for monitoring maintenance, reducing costs and providing a higher level of service to the customer [26,27]. The following sections are presented as a list of maintenance that need to be done in a hotel [28,29]:

- Fuel lines, valves, pumps, meters, inspection and maintenance,
- Inspection and maintenance of fuel storage tanks for corrosion damage,
- Fireplace, heater, HVAC, heat pumps and air conditioning which allows you to control and maintenance control of the device,
- Hot water, cold water and sewage systems maintenance and control,
- Before the opening of the pool and Spa control systems and maintenance. Proper drainage and protection of the pool when it closes,
- Fire extinguishers, security systems such as alarm systems and all emergency and safety equipment inspection, testing and maintenance,
- All lighting and electrical circuits, backup systems (diesel generator (DG) sets and UPS), backup control and maintenance,
- Communal areas, sports fields, beach equipment, such as seasonal and trails, and control and maintenance facilities or of the assets that are associated with them,
- Inspection and maintenance of all elevators and escalators,
- Season and off-season inspections and preventive pest control,
- All dead plants, trees and bushes around the cutting and maintenance of plants,
- All boilers, chillers, heat pumps, waste disposal and recycling system, washing machines, polishing machines, etc. control and maintenance,
- Solar energy systems, roof, windows, railings, deck, lit areas such as parking control and maintenance sections,
- Regularly check all equipment for correct and efficient operation and maintenance.

The developments in the maintenance sector and software sector have found application in the hospitality industry and maintenance software systems have been developed and implemented in the hospitality sector. Implementation of Computerized Maintenance Management Software for Hotels (ICMMS) has become an effective way to streamline the maintenance of hotels and resorts. By applying the ICMMS system, the hotel's

maintenance management system has been used more effectively [30].

Implementation of the ICMMS system offers many advantages for hospitality industry. These can be listed as follows:

1. Depending on the size of the hospitality industry, a large number of maintenance requests may come. Without appropriate records, it will be difficult to monitor the demands of the maintenance unit. A computerized maintenance management system allows the request to be recorded, notified to the right people, and the status of the request can be easily checked.
2. Mechanical, electrical or plumbing failure is one of the issues that a hotel maintenance manager often encounters and needs to resolve. At such times, quick response time is very important. The ICMMS system can be configured to notify the right person when such situations occur. Notifications can also be sent to the caregiver via mobile devices such as e-mail, smartphones or tablets. Customer satisfaction can be achieved by informing the customer about the process and result.
3. One of the biggest benefits of having a computerized maintenance management system for hospitality industry is that it contributes to the control of the necessary preventive maintenance. For example, if the pool is closed or the lift is out of service, it may create dissatisfaction for customers. When a preventive maintenance program is implemented, the likelihood of such situations is reduced. The purpose of a planned maintenance program is to reduce failures and emergency repairs to critical equipment. Research shows that having maintenance software such as ICMMS can extend the life of assets by 20%. It is also known that performing scheduled maintenance is much less costly than reactive repairs. Without planned preventive maintenance, reactive repairs and costs increase. Guests' satisfaction may be adversely affected if the facilities are not maintained and used as expected.
4. Using a ICMMS software ensures that maintenance managers have a standardized preventive maintenance plan and that jobs are performed according to the manufacturer's recommendation and industry standards. When failures occur and repairs are required, ICMMS can immediately notify maintenance technicians and contractors. Therefore, problems can be solved faster.
5. Maintenance software applications should have a calendar module or dashboard to enable administrators to easily plan service requests, checks and repairs in preventive maintenance systems. If there is more than one user providing services in different areas, calendar boards can be planned as day, week or month. For

larger operations involving multiple technicians and practitioners, the importance of having a timing module increases. Facility and maintenance managers need real-time viewing of programs and the ability to update, schedule, and assign tasks, depending on which resources are available. Moreover, a ICMMS software can be configured to notify and update contractors and technicians in real time.

6. ICMMS software helps to increase productivity and reduce costs. In addition, maintenance software enables managers to make better decisions by conducting hotel maintenance in a healthy way. It has been seen that this situation provides a great cost saving. Administrators can identify Key Performance Indicators (KPIs) and view these metrics on easy-to-read dashboards or through graphical reporting tools. Some of those; it may also provide information on the number of overdue and critical work orders, employee utilization and performance, maintenance costs over time, repair history and costs on equipment, asset depreciation, inventory levels, and contractor response time and costs.

ICMMS systems are suitable software for a hotel or holiday village with more than 100 units or more than one accommodation system. The key to an effective maintenance program is automating manual operations, scheduling work orders and performing regularly scheduled preventive maintenance. With ICMMS software, hotel and facility managers can manage maintenance requests and respond faster, shorten downtime of equipment and facilities, make better use of staff and contractors, reduce costs, and ultimately meet customers' expectations.

4. Maintenance and importance of accommodation facilities

Accommodation facilities are among the service producing sectors and customer circulation is intensive. In case of unavailability of accommodation facilities or rooms in hotels, loss of income is incurred. On average, suppose a hotel is charged \$ 300/room per night. If there is a significant problem with any of the rooms that will be rented out, it will mean a loss of \$ 750 for each night the room needs to be repaired. Repair work takes several days in one season, and if more than one room needs to be closed, this amount increases. For example, losses may increase if the water pressure on one floor of the building decreases and the time taken for repair is extended.

On the other hand, such problems are generally avoidable, i.e., preventive maintenance and a small investment can be completely eliminated. Preventive

maintenance in the hotel industry, a comprehensive knowledge of all equipment and facilities, is the key to the intervention. Knowing the habits of the guests is a factor that makes the maintenance team's work easier.

In the hospitality sector, there is a basic principle aimed at reducing and correcting errors that may occur with preventive maintenance activities of hotels; for which 80% of the time is allocated for scheduled work and only 20% for off-plan work. In this way, not only improves the quality of guests 'stay, but the cost of unplanned interventions is higher and more savings can be achieved with preventive maintenance.

4.1. Maintenance methods used in accommodation facilities

The design life of most equipment can only be achieved by maintenance. To extend the design life of the equipment, it is necessary to perform maintenance and know how to maintain it. Maintenance after failure of a piece of equipment is called reactive maintenance. Apart from this, types of maintenance such as preventive maintenance, predictive maintenance, or reliability-centred maintenance have also been developed [31].

Traditionally, there are 6 types of maintenance differentiated by the nature of the tasks they involve (see Fig. 1). These types of maintenance include:

1. Failure (Reactive) Maintenance: It is basically a "run until broken" maintenance mode. No action is taken to protect the equipment as long as it is operating. Recent studies show that this is still the dominant style of maintenance. In reactive maintenance, no manpower is spent on maintenance services or there is no need for any expenditure until something happens. Since there are no maintenance costs, it can be considered as if money was saved during this time. In reality, maintenance and capital costs are believed to be saved, but greater costs have to be incurred when failures occur. Equipment life is shortened and parts may have to be changed more often. When the breakdown occurs, labour and parts costs will be higher than normal [31].
2. Corrective Maintenance: Repair and maintenance performed to ensure that a machine, system, or device performs the intended job after the failure has been determined. It is made to correct errors passed to the maintenance department by the users of the machine or equipment.
3. Preventive Maintenance: It is the maintenance that is performed to ensure that the equipment operates without fail by programming and intervening in advance of the failures that may occur at the most

appropriate time. Inspection of machinery and equipment before any problems arise. This method is very efficient because maintenance is performed on demand, saving time and money. By estimating the useful life of hotel equipment, it is possible to efficiently replace parts before a fault occurs and extend the running time without any possible downtime. In the long term, this method improves efficiency, prevents equipment from running at high costs, and allows proper use of human resources wherever and whenever necessary there and then. Among other types of maintenance, preventive maintenance is certainly a very important tool for the administrator. Preventive maintenance aims to predict the occurrence of malfunctions.

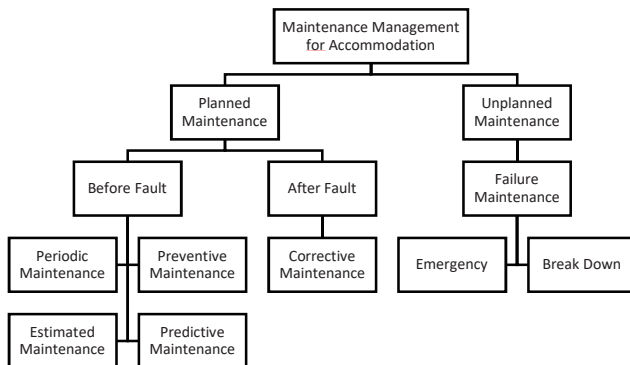


Fig. 1. Overview of planned and unplanned maintenance

4. **Estimated Maintenance:** It can be defined as actions taken within a program that detect, prevent or reduce the failure of a component or system to maintain or prolong its useful life by controlling the failure. Estimated maintenance is a way to increase the reliability of the equipment. When the maintenance activities specified by the equipment designer are carried out, the equipment extends its life and increases its reliability. In addition to increasing reliability, financial savings are achieved. Studies show that these savings can be between 12% and 18% on average [31]. Estimated Maintenance that monitors the performance and condition of the equipment during normal operation to reduce the possibility of failure [31]. Estimated maintenance can minimize problems with reliability or quality. It can help prevent costly failures from occurring [32].
5. **Predictive Maintenance:** Based on the continuous determination and reporting of the status and operational capacity of the facilities. In this context,

values of certain variables representing operational capability are monitored. To implement this maintenance, you can use physical variables (temperature, vibration, power consumption, etc.) must be defined. It is determined which variation or variations result from the indicator of problems that may arise in the device. The goal of predictive maintenance is to predict first when equipment failure may occur (based on certain factors) and then prevent failure through regularly scheduled and corrective maintenance. Predictive maintenance focuses on predicting when device failure will occur and preventing failure from occurring by monitoring maintenance and scheduling maintenance so that maintenance can be scheduled before a problem occurs. One of the hallmarks of predictive maintenance is that the frequency of maintenance is minimal and helps to avoid unplanned reactive maintenance and costs associated with preventive maintenance. Prediction of failure in predictive maintenance situations can be made with the help of one of many techniques. The appropriate technique is selected according to expert opinion and the device used.

6. **Periodic Maintenance (Time-Based Maintenance):** Maintenance is carried out within certain time periods. It is the basic maintenance of equipment made by the users. A number of basic tasks that do not require extensive training (data collection, visual reviews, cleaning, lubricating, tightening screws, etc.) occurs, but these are only a short training.

Hotels are one of the important areas where customer satisfaction should be ensured. In order to ensure customer satisfaction, maintenance in hotels is one of the most important issues. Preventing failures without them is therefore quite important. Periodic, corrective and preventive maintenance are therefore prominent in hotels maintenance (see Fig. 2).

Every corrective maintenance intervention in a hotel must be recorded to identify the source of any given error. Recording these interventions allows hotels to correct operational procedures, detect improper or excessive use of equipment, as well as other recurring causes of failure.

Providing a well-organized corrective maintenance strategy helps speed up processes and improve the experience provided to guests.

It can be indicated that maintenance management one of the most important factor for improving energy efficiency and keeping the total costs optimal. In order to reduce operating costs of maintenance it is very important to monitor energy consumption, maintenance and labour expenses. With a planned maintenance productivity can be

improved, revenues can be increased, operating costs and risks can be reduced [33]. In order to save energy in hotels, maintenance is seen as one of the most important parameters. In their study, Manjunatha et al. [34] indicated that Total Productive Maintenance (TPM) approach is one of the application examples in the hotel industry.

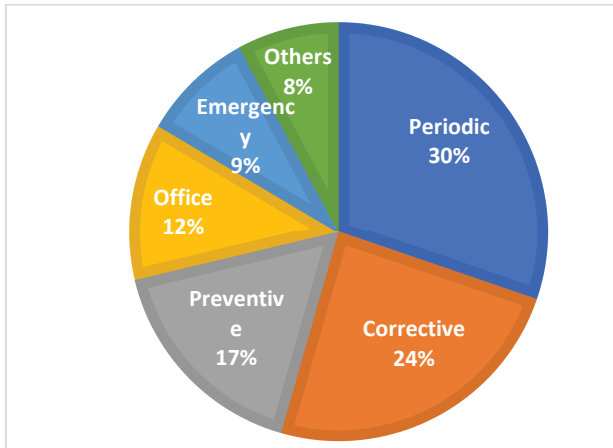


Fig. 2. Share of maintenance activity for hotels [3]

Chan [35] carried out a survey to determine the maintenance cost for hotels in Hon Kong. They defined a maintenance cost index (MCI). It has been shown that MCI were mostly between \$5,000 and \$10,000 per room. If it was above the \$20000, it has been indicated that there was a major problem for the system (see Fig. 3). Omar et al. [36] developed mathematical models for the buildings maintenance to determine the most important maintenance items. They showed that insulation at the walls and roof, water leakage, expansion joints damage on the pipes, cracks of concrete or bricks are important areas for maintenance of buildings.

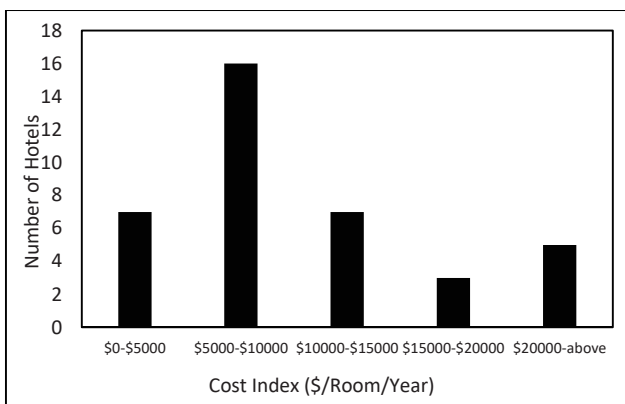


Fig. 3. Maintenance cost for hotels [35]

5. Maintenance areas in accommodation facilities

The maintenance manager should direct the maintenance team to the most needed areas of the hotel to perform preventive maintenance work. These areas should be the areas where the guests are dense and affects the level of customer satisfaction. The most common problem areas and maintenance-related equipment in accommodation facilities are as follows [37]:

Air Conditioning: This is one of the most common guest complaints. The temperature does not reach the desired level or the spread of bad smell from air conditioners are the most complained about issues.

Lighting: Hotels need quality lighting, and lighting devices need to be checked and working frequently to ensure guests don't have problems.

Heating Systems: Heating is among the issues that most affect guest comfort. It is important to always check for possible water leaks and clean them regularly to avoid diseases caused by bacteria.

Water Supply System: Leaks, even at a small level, can greatly negatively impact infrastructure and also the guest experience. Bad smells, especially from failures in the sewer system, can have a negative impact on customers.

Kitchens: Special attention should be paid to the maintenance of all equipment used in the kitchen. Hazard Analysis and Critical Control Point (HACCP) should be performed and the standard in kitchens should be kept high.

Each infrastructure element is different and may have different requirements. These fields are also used by customers. However, if a maintenance manager is well aware of the infrastructure, he can also plan to identify and protect key areas for preventive maintenance of the hotel.

Developments in the software sector have started to affect the hospitality sector. Maintenance software has also started to be used in hotels. One of the main objectives of the maintenance software is to help managers improve their degree of control over the equipment. This helps them to keep all their equipment in good condition and constantly repair it, reduce unnecessary costs and reduce the amount of strenuous administrative work to be done.

6. Relationship between resort facilities, maintenance and energy savings

Due to increasing environmental awareness, hotels are becoming more environmental friendly. In order to achieve

this, procedures that provide greater energy efficiency are applied. In addition, maintenance departments using best-maintenance application are of great importance. Since many of the energy-saving resources need to be replaced or installed by maintenance teams, it will be useful to inform the maintenance team about new and innovative ways to reduce costs and increase efficiency each year.

Many studies can be carried out to ensure energy efficiency in hotels. These can be listed as follows:

- **Housekeeping Department:**
 - Turn off lights, air conditioners or heaters when rooms are being cleaned or not in use;
 - Keep washing linens and towels at a lower temperature;
 - Report water leaks as soon as they are detected. (toilets or taps);
- **Rooms:**
 - Installation of low-flow shower heads and aerators in bathrooms;
 - Switching to low flow or double flush toilets and making sure toilet valves are not leaking;
 - Using LED lighting;
- **General building and general areas:**
 - HVAC systems provide filtration, fresh air and moisture control as well as heating and cooling. It is important to use an Energy Management System (EMS) to avoid the area of conditioning when it is not needed;
 - Replacement of HVAC heating and air conditioning units to include higher energy efficient technologies such as heat pumps;
 - Use of solar water heating systems for hot water needs;
 - Using daylight sensors for lighting, ensuring that the lighting system is lit only when it is dark;
 - Replacing standard bulbs with compact fluorescent bulbs that last longer and consume about 75% less energy than standard bulbs;
 - Maintenance of heating and cooling equipment on a regular basis.

7. Results and conclusion

Today, as in the industry, maintenance has become important in the housing and accommodation sector. One of the most important issues in accommodation facilities is to provide customer satisfaction. For this, the plant and all the machinery in the plant, equipment and devices are required to ensure that it runs smoothly.

When previous studies are examined, it can be seen that the most applied maintenance method in the accommodation sector and hotels is periodic maintenance. On the other hand, when the developments in the maintenance sector are examined, it can be indicated that use of predictive maintenance is increasing currently. In the near future, it can be thought that predictive maintenance can be used more widely in hotels. Studies shows that maintenance has been observed to reduce operating costs. In case of maintenance, energy consumption is also reduced.

With a proper maintenance, breakage, deterioration or decay of the walls, roof, installation elements (such as pipes, valves, faucets, fittings) of the buildings can be prevented. Therefore; it is very important to determine when, how often, and which elements to maintain. In order to use the buildings for a long time, the frequency of maintenance and proper and regular maintenance are very important.

For this purpose, maintenance teams and the establishment of accommodation facilities needs to be run. Applicable maintenance method varies according to the capacity of the enterprise. In recent years, especially maintenance management software, developed for large installations are in service. Management system as a maintenance issue began to develop.

One of the most important issues in accommodation facilities is undoubtedly the. In order to increase the customer satisfaction, it is necessary to ensure that the accommodation facilities itself and all the machinery, equipment and equipment in the facility are running smoothly. For this purpose, maintenance teams should be established and operated in the accommodation facilities. The maintenance method to be applied varies according to the capacity of the enterprise. Maintenance management software developed especially for large facilities has been introduced in recent years. The issue of maintenance has started to develop as a management system.

The establishment and operation of the maintenance management system in the facilities both prevent failures and increase the time of use of the devices. Maintenance and maintenance management system implementation, reduced costs was also revealed by the studies.

References

- [1] K.M. Ghazi, Hotel maintenance management practices, *Journal of Hotel and Business Management* 5/1 (2016) 1000136, DOI: <https://doi.org/10.4172/2169-0286.1000136>.

- [2] K.T. Chan, R.H.K. Lee, J. Burnett, Maintenance performance: a case study of hospitality engineering systems, *Facilities* 19/13-14 (2001) 494-504, DOI: <https://doi.org/10.1108/02632770110409477>.
- [3] K.T. Chan, R.H.K. Lee, J. Burnett, Maintenance Practices and Energy Performance of Hotel Buildings, *Strategic Planning for Energy and the Environment* 23/1 (2003) 6-28, DOI: <https://doi.org/10.1080/10485230309509628>.
- [4] A. Hassanien, E. Losekoot, The application of facilities management expertise to the hotel renovation process, *Facilities* 20/7-8 (2002) 230-238, DOI: <https://doi.org/10.1108/02632770210435143>.
- [5] A. Hassanien, T. Baum, Hotel repositioning through property renovation, *Journal of Tourism and Hospitality Research* 4/2 (2002) 144-157, DOI: <https://doi.org/10.1177/146735840200400205>.
- [6] A.S. Mattila, J.W. O'Neill, Relationships between hotel room pricing, occupancy and guest satisfaction: A longitudinal case of a midscale hotel in the United States, *Journal of Hospitality and Tourism Research* 27/3 (2003) 328-341, DOI: <https://doi.org/10.1177/1096348003252361>.
- [7] M.Y.M. Taib, A. Bakri, Barriers in managing the maintenance activity: towards sustainable and lean maintenance approach, *Proceedings of the 4th International Conference on Rural Development and Entrepreneurship "ICORE2017"*, Alor Setar, Kedah, Malaysia, 2017.
- [8] F.W.H. Yik, W.L. Lee, C.K. Ng, Building energy efficiency and the remuneration of operation and maintenance personnel, *Facilities* 20/13-14 (2001) 406-413, DOI: <https://doi.org/10.1108/02632770210454331>.
- [9] B. Athuraliya, C. Farook, "Revyew" Hotel Maintenance Issue Classifier and Analyzer using Machine Learning and Natural Language Processing, *Proceedings of the 9th Annual Information Technology, Electronics and Mobile Communication Conference "IEMCON"*, Vancouver, 2018, 274-280, DOI: <https://doi.org/10.1109/IEMCON.2018.8615075>.
- [10] H. Hon Yin Lee, D. Scott, Strategic and operational factors' influence on the management of building maintenance operation processes in sports and leisure facilities, Hong Kong, *Journal of Retail and Leisure Property* 8 (2009) 25-37, DOI: <https://doi.org/10.1057/rlp.2008.29>.
- [11] H. Hon Yin Lee, D. Scott, Overview of maintenance strategy, acceptable maintenance standard and resources from a building maintenance operation perspective, *Journal of Building Appraisal* 4 (2009) 269-278, DOI: <https://doi.org/10.1057/jba.2008.46>.
- [12] F. Borsenik, A. Stutts, *The management of maintenance and engineering systems in the hospitality industry*, Fourth Edition, USA, 1997.
- [13] B. Chanter, P. Swallow, *Building Maintenance Management*, Blackwell Publishing, UK, 2007.
- [14] E.M. Zawawi, S. Kamaruzzaman, A. Ali, R. Sulaiman Assessment of building maintenance management in Malaysia: Resolving using a solution diagram, *Journal of Retail and Leisure Property* 9 (2010) 349-356, DOI: <https://doi.org/10.1057/rlp.2010.16>.
- [15] J.H.K. Lai, Investigating the energy performance and maintenance resources of quality hotels in Hong Kong, *Proceedings of the CIB Facilities Management Conference 2014*, Denmark, 2014, 205-216.
- [16] M.A.P. Marriaga, M.P.D. Contreras, A.P. Salas, M.V. Chamorro, P.H.B. Zarante, Analysis of the Potential for Energy Savings in a Company in the Hotel Sector, *Contemporary Engineering Sciences* 11/58 (2018) 2865-2873.
- [17] U.K. Zolkafli, N. Zakaria, A. Mohammad Mazlan, A.S. Ali, Maintenance work for heritage buildings in Malaysia: owners' perspectives, *International Journal of Building Pathology and Adaptation* 31/1 (2019) 186-195, DOI: <https://doi.org/10.1108/IJBPA-07-2018-0062>.
- [18] J.H.K. Lai, F.W.H. Yik, Hotel Engineering Facilities: A Case Study of Maintenance Performance, *International Journal of Hospitality Management* 31/1 (2012) 229-235, DOI: <https://doi.org/10.1016/j.ijhm.2011.05.002>.
- [19] J.H.K. Lai, F.W.H. Yik, A probe into the facilities maintenance data of a hotel, *Building Services Engineering Research and Technology* 33/2 (2012) 141-157, DOI: <https://doi.org/10.1177/0143624411401840>.
- [20] J.H.K. Lai, An analysis of the maintenance demand, manpower and performance of hotel engineering facilities, *Journal of Hospitality and Tourism Research* 37/3 (2013) 426-444, DOI: <https://doi.org/10.1177/1096348012436380>.
- [21] *Hotel Maintenance Management: Why You Need It*, Available at: <https://www.onupkeep.com/learning/maintenance-applications/hotel-maintenance>, 2019.
- [22] P. Machado, *Understanding Hotel Maintenance Management*, Available at: <http://blog.infraspeak.com/hotel-maintenance-management/>, 2019.
- [23] N. Feuilherade, *The role of the maintenance department in hotels*, Available at: <https://www.hotelschool.co.za/role-maintenance-department-hotels/>, 2016.
- [24] M. Pitt, D. Cannavina, R. Sulaiman, N. Mahyuddin, C. Wu, Hotel maintenance management in Sanya, China, *Journal of Facilities Management* 14/4 (2016)

- 304-314, DOI: <https://doi.org/10.1108/JFM-12-2015-0034>.
- [25] M.H. Galán, E.A.M. Gómez, A review of maintenance management models: application for the clinic and hospital environment, *The International Journal of Engineering and Science (IJES)* 7/9 (2018) 1-17, DOI: <https://doi.org/10.9790/1813-0709040117>.
- [26] C.M. Richard, P.W. Tse, L. Ling, F. Fung, Enhancement of maintenance management through benchmarking, *Journal of Quality in Maintenance Engineering* 6/4 (2000) 224-240, DOI: <https://doi.org/10.1108/13552510010373419>.
- [27] T. Jones, D. Zemke, *Managing the built environment in hospitality facilities*, Prentice Hall, 2010.
- [28] K. Potter, 12 Seasonal Maintenance Inspections for Hotels, Available at: <https://transcendent.ai/blog/asset-management/12-seasonal-maintenance-inspections-for-hotels/2015>.
- [29] Engineering Maintenance, Main Duties and Tasks of Engineering and Maintenance Department, Available at: <https://setupmyhotel.com/job-description-for-hotels/bo-n-others/553-engineering-dept-duties.html>, 2019.
- [30] D. Golub, Improve Hotel Maintenance Management using a CMMS, Available at: <https://www.hippocmms.com/blog/hotel-maintenance-management-with-cmms>, 2015.
- [31] S. Anil Kumar, N. Suresh, *Production and Operation Management*, Second Edition, New Age International, New Delhi, 2008.
- [32] Techopedia, Predictive Maintenance, Available at: <https://www.techopedia.com/definition/32027/predictive-maintenance>, 2019.
- [33] S. Aryee, *Hotel Maintenance Management: Strategic practices in hotel operation*, MSc Thesis, Royal Institute of Technology in Stockholm, Sweden Department of Real Estate and Construction Management, 2011.
- [34] B. Manjunatha, T.R. Srinivas, C.G. Ramachandra, Implementation of total productive maintenance (TPM) to increase overall equipment efficiency of an hotel industry, *MATEC Web of Conferences* 144 (2018) 05004, DOI: <https://doi.org/10.1051/mateconf/201814405004>.
- [35] K. Chan, An empirical study of maintenance costs for hotels in Hong Kong, *Journal of Retail and Leisure Property* 7/1 (2008) 35-52, DOI: <https://doi.org/10.1057/palgrave.rlp.5100081>.
- [36] N.S. Omar, W.A. Hatem, H.I. Najy, Predictive Modeling for Developing Maintenance Management in Construction Projects, *Civil Engineering Journal* 5/4 (2019) 892-900, DOI: <https://doi.org/10.28991/cej-2019-03091297>.
- [37] P. Machado, How to Utilise Preventive Maintenance in Hotels, Available at: <http://blog.infraspeak.com/preventive-maintenance-hotels/>, 2019,