Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 02, February-2022

Evaluation of The Factors Affecting The Maintenance and Operation Cost of Administrative Buildings in Egypt

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***Abstract*— This paper aims to assess and validate the most influencing factors on the maintenance and operating cost of administrative buildings in Egypt. The questionnaire collected a literature review on administrative buildings maintenance and operating cost to define the factors that affect the maintenance and associated this with interviews for selected experienced buildings' managers in both public and private sectors. Fifty-six factors were defined and classified under several subtitles. Each subtitle represents a specified perspective. A questionnaire list was generated via the collected literature; then, a final questionnaire survey was developed to evaluate these factors. The responses were obtained by various methods, including face-to-face interviews with the building's managers. The data posed to estimate the level of importance of each factor. This prediction occurs by using the ranking grade for each factor and implementing the importance index values to validate the perspective factors. The top five ranked factors were as follows in descending order; firstly: failure in identifying the actual cause of defects, then secondly: design problems. Thirdly at the same level of the second factors: "inadequate finance," fourthly: "poor administration of maintenance management" and finally similar to the fourthly level: "sustainability along with energy consumption and saving."**

Keywords*— *Operating cost, Administrative buildings, manager, lifecycle, maintenance cost

INTRODUCTION

Administrative buildings are considered to be essential assets on cooperates or governmental levels. The service life of the buildings is usually encountered while designing the buildings; however, with time, the buildings deteriorate and request unusual maintenance in some cases. The building is relatively expensive in its construction and time–consuming in its procurement or treatment. It is better to design the building to sustain longer service life, extended to decades rather than a few years (Che-Ghani et al. 2016). Several researchers have studied the factors influencing the operating and maintenance cost of other buildings such as hotels, hospitals, and offices; however, very few posed their research to an administrative building managed explicitly by the public sector. Due to old buildings in age, 50 % of the construction activities are directed to maintenance (Che-Ghani et al., 2016). Several buildings have been exposed to unusual maintenance and operating costs in Egypt after 10 or 15 years from construction. This action attributed to the lack of awareness of the high need to plan and assess the operating and maintenance budget at the construction phase before going to the project.

Buildings such as Mogamma El Tahrir are suffering from misusing and maintenance lack. This deterioration is evident when using the stairs of the building, the elevators, and bathrooms and visiting the offices of specified inquiry. The factors influencing maintenance and operating costs are various. Thus, it is crucial to assess the budget required and schedule the expenditure that should be assigned for maintaining sustainable building longer service life. As defined by BS 3811, it is a combination of any actions to retain an item in or restore to acceptable conditions. While the Chartered Institute of Buildings is identified as the work undertaken to keep, restore, or renovate every facility in every part of the building, this encompasses its service and surrounding utilities or landscapes to reach the acceptable standards acquired while maintaining available resources. Don Sapp defined the facility operation and maintenance by all the services that ensure built performance, achieving its efficient functionality as designed and requested.

Waziri (2016) stated that the primary purpose of building maintenance is to fulfill its function and address its aesthetic appearance continuously. Maintenance is an essential factor in running bu8ilding through its life cycle, and operation is not less critical than maintenance for running the cost of the building during its life cycle. The maintenance and operation cost seems to increase the expenditure for the governmental sector and the private corporate levels.

Rydell (1970) stated that the operating and maintenance cost involves 30 to 50% of the overall cost reliant on the residential buildings. Generally, the operation and maintenance cost consumes about 80% of the total life cycle cost of the buildings (Flanagan et al., 1989; Kirk and Dell'isola, 1995). Thus, it is crucial to plan and estimate the budget required for the building's operation and maintenance at the design phases before construction and allocate funding sources for this process. This action could be achieved by using suitable materials and optimized utilities, facilitating its replacement and maintenance, and ensuring durability for the long-term life cycle.

Therefore, the main objective of this paper is to identify the factors that influence maintenance and operating cost. While doing this small survey was handled to stand on

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 02, February-2022

the crucial factors at which the O and M cost the most by assessing each factor's ranking. This ranking is achieved using importance index factors to verify the vital factors affecting administrative buildings' operating and maintenance costs.

RESEARCH SIGNIFICANT

This paper is an original and significant practice covering the field encountered for validating factors scattered and distributed on several resources primarily derived from the literature review and personal interviews of the selected building's managers in public and private administrative buildings. This paper is of practical significance to administrative governmental, and private buildings managers. It would increase their awareness by focusing on the crucial factors that affect the maintenance and operating cost in the future and what should be performed at the construction phases. This action would ensure efficient operating and maintenance costs during the life cycle of the administrative buildings. Other practical significance encompassed assisting maintenance managers of these facilities category to allocate the budget precisely for the needed items optimizing the factors affecting the maintenance and operation cost; spreading the control process over critical factors in new and old administrative buildings; especially the public sector; controlling the running cost of operating the buildings and forecasting the budget required for the life cycle of the administrative buildings.

RESEARCH METHODOLOGY

Similar to the approaches assigned by other researchers was adopted to achieve the acquired objective of the research. This paper is serious of successful previous papers published by several researchers (Hassanain et al. 2013; Ihsan and Alshibani 2018; Lai and Yik 2008; Au-Yong et al. 2013; Che-Ghani et al. 2016). These researchers focused only on Hotels and hospitals, the public and private sectors.

Thus, the methodology encompassed going through several papers for grabs and optimizing the listing of the factors influencing the operating and maintenance costs for administrative buildings in public and private sectors without differentiation.

The objective of this study exclusively; are as follow:

- Assist maintenance managers of these facilities categories to allocate the budget precisely for the needed items. Optimizing the factors affecting the maintenance and operation cost.
- Spread the control process over critical factors in new and old administrative buildings, especially the public sector.
- Control the running cost of operating the buildings.
- Forecasting the budget required for the life cycle of the administrative buildings.

BACKGROUND AND LITERATURE

El-haram and Horner (2002) verified 24 factors influencing the housing maintenance cost. These findings were obtained through surveys made by over 50 local authorities and housing associations to evaluate the most critical factors. The study revealed that "high tenant expectations," "budget constraints," "improper use of the property," and "right to buy policy" were the most critical factors.

Al-Khatam (2003) surveyed the factors through his literature review. The factors extracted were 34 factors. These factors were classified into seven major groups, namely "engineering services," "labor," "building materials," "environment," "management and administration," "budget and finance," and "building use behavior." Based on his survey, it was deduced that the primary reason for the high cost of maintenance in buildings is: unknown materials standards and specifications, owners' budget for maintenance and operating, poor supervision and maintenance management, poor scheduling, absence of standardized maintenance contracts, and faulty design and construction. Nevertheless, there is no empirical evaluation supporting these outcomes.

Shohet et al. (2003) defined four performance indicators to run the hospital building efficiently and effectively. These indicators encompass management performance, labor composition, maintenance efficiency, and effective organization. They recommended implementing these performance indicators on maintenance buildings rather than just hospitals.

Ali (2009) performed a survey over 200 building manger to study the factors influencing the maintenance cost of the buildings. The study concluded that the "existing building condition" and "complaints received about building performance" are mainly the two factors that influence the maintenance cost at most.

Flyvbjerg et al. (2009) observed that the main problem usually occurred on the faults that carried construction. Usually, the infrastructure project is designed to be finished on time, and cost overruns with very limited shortfalls. These faults were attributed to honest mistakes and unexpected events, forecasting errors, and deception. The study showed that the benefit and cost ratio might be miscalculated or according to specific developers' hidden self-interest incentives.

Ali et al. (2010) verified the critical factors influencing the maintenance cost in residential buildings. The study surveyed over 31 building managers to evaluate the most critical factors. The study educed that the "expectation of tenants," 'buildings materials," "buildings services," "ages," and "failure to execute the work at the right time" are the most critical factors that influence the budget of maintenance.

Love and Li (2000) analyzed two cases of studies. They investigated the cost, budget, and re-maintenance. They noticed that the contact value of re-maintenance was equal to an average of 2.5 % of the overall contract. This percentage was attributed to the errors and omissions in contract documentation" and" changes initiated by the client and end-user."

Pitt et al. (2016) investigated the constraints and challenges of hotel maintenance from the stakeholders' perceptive to validate the strategies and processes employed in maintenance. They observed that skilled workers, types of systems being serviced, and material specialists influence the viability and effectiveness of residential buildings maintenance; these factors are excluded from those inferred

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from the outsourcing maintenance factor. The outsourcing factor was found to have other parameters that encompassed the lack of skilled and trained labor and lower material quality or efficiency energy consumption.

Vij (2012) studied the financial implementation via establishing online surveys and interviews with specified questions. The results were all from the financial managers' perspective. Their only dedicate themselves to lessening the cost without perish quality.

Lai and Yikk (2008) investigated the luxury hotels of Hong Kong, taking into account the performance of various operating and maintenance cost variables. The results stated that the key factors affecting the operating maintenance cost are quality and work volume.

Hassanien and Losekoot (2002) collected the factors assigned by facility management expertise for the hotel renovation process in Egypt. They noticed that the success of hotels is mainly affected by the renovation status of the hotel buildings bundled with several other reasons. These reasons may include strategic, operational, or functional necessities or purposes across the renovation process.

Chan et al. (2001) announced that it is crucial to account for health and safety for good maintenance practice as it lower risks and therefore lessens the cost of maintenance. It is usually related that work environment encountered health and safety are dependent mainly on a good maintenance operation. Their finding extends that health and safety affect the business activities and the energy consumption and guest expectation while concerning the environmental impact implicitly are all other factors that influence the operating and maintenance cost.

Kritic and Marenjak (2012 a, b) investigated the operating and maintenance cost of the universities buildings in Croatia. The study included collecting data about the factors affecting the university buildings' operation and maintenance costs. The variables were summarized based on a questionnaire consisting of four main groups: general building, operational characteristics, facility maintenance plan, and O&M costs.

Hassanien et al. (2013) adopted the same study while investigating the factors that affect hospitals' operation and maintenance costs in Saudi Arabia. They verified 33 factors and classified them into seven groups. These groups are statutory requirements, design, construction, maintenance, and budget estimates. From the hospital facilities managers' perspective, it was found that the most important three factors are included in the "construction category," which deals with the impacts of the construction defects on maintenance.

Low or mid-rise buildings were considered, and several high-rise buildings were explored. Che-Ghania et al. (2016) comprehensively explored the factors affecting the operating and maintenance costs over stratified buildings in Malaysia. The investigation encompassed controllable and uncontrollable factors that significantly influence maintenance and operating costs. These factors include tenants' expectations, building characteristics, and defects.

Au-Yong et al. (2013) generated a regression model for adjusting the maintenance cost performance. The model was established by collecting literature reviews, questionnaires, surveys, and interviews. The model was limited to the most critical factors assessed through the literature and questionnaire adopted. These factors are labor skill and knowledge, spare part and material stock, spare part quality, predetermined maintenance interval length, and failure downtime. Thus, model accuracy was 53% as it was limited just to the factors that distinguished to be critical from their survey

VERIFYING THE FACTORS INFLUENCING THE OPERATION AND MAINTENANCE COST

Accordingly, the literature showed that various researchers explored several factors affecting the maintenance cost of different building facilities. These factors can be applied to administrative buildings as a part of infrastructure buildings. Thus, this paper adopted the factors encountered in the study established by Ihsan and Alshibani (2018). The factors are summarized and classified as follows:-

5.1 Category I: Technical factors

During planning, design, construction, or even maintenance, these factors can occur. The faults during the construction phase or even maintenance can occur due to the following factors:-

1) Design problems.
2) Faulty maintenance.
3) Building characteristics.

These characteristics encompassed building materials, age, and structure

a) Building materials should be durable enough to sustain the abrasion and friction at the floors' surface, and their specification and mechanical properties should be justified. When using the new materials, the specification should be verified and justified according to the mechanical properties required and the specification and function used. Ignorance of materials' specification will lead to undesirable behavior that will need to be maintained or re-maintained again if used as a replacement to an already deteriorated part.
b) Building age includes the corrosion and durability of the material resisting the surrounding environment.
c) Building height can influence the cost of maintenance effectively due to the tools required for that purpose, for instance, scaffolding for doing any repairs on the facades of the buildings.
4) Poor quality control.

   Quality control (Mahmoud, 1994) is defined as the process to inspect, test, and record the procurement, fabrication, and installation according to the cited specification already agreed contractually by both the clients and contractor.

5) Life cycle cost techniques.
6) A common concern to future maintenance.
7) A deficit in identifying the causes of the actual defects.

5.2 Category II: Environment factors

The various environmental factors encompass the following:-

1) New maintenance techniques.
2) Unqualified and unavailability of maintenance contractors.
3) Inadequate standard and specification.
4) Harsh climatic conditions.

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5.3 Category III: Managerial factors

There must be a managerial factor in any building whose prominent roles are organizing, controlling, planning, and staffing. These four phases are translated into significant components that influence maintenance cost-effectively. These components are as follows:-

1) Managing resource.
2) Equipment availability and effectively working.
3) Productivity of skilled maintenance labor, whether via recruitment or outsourcing.
4) Unavailability of skilled laborers and quality relationships.
5) Defects in building due to faulty craft during the construction phase.
6) Uncontrollable laborers during the maintenance phase due to their lower education

5.4 Category IV: Financial factors

For any building, the financial budget of operating maintenance is a vital issue and should be planned before construction, at the designing phase. Fortunately, some buildings, operations, and maintenance can cost, leading to substantial financial losses while operating. It is imperative to include the components that affect the finical funding to avoid them and assess their effects on operating and maintenance costs. These components that agreed to be subtitled under the finical factor are as follows:

1) Inadequate budget allocation.
2) Poor financial control when executing maintenance work is nearly relevant to all the organizational factors stated before: material availability and waste, labor productivity and effectiveness, adequate maintenance planning, and approaches while using suitable tools.

5.5 Category V: Social factors

The social factor is an essential factor that influences the operating and maintenance cost. Although it is related to the sociological behavior of occupancy, many components in this factor negatively influence the operating and maintenance cost by increasing the rate of torture and wearing the buildings' constituency and thus, increasing the maintenance cost. Here are some of these components under the umbrella of social factors as follows:

1) Misuse of buildings and their functionality.
2) End-users behavior affects their deteriorating and tearing out the facilities and furniture due to their disloyalty to the workplace.
3) The occupancy rate of the building
4) Maintenance works execution on time reduces the cost-efficiently.
5) Cultural practices.

5.6 Category VI: Decision-makers

Decision-making is relevant to the manager's skills in managing the budget and allocation for maintenance required. Thus, this factor includes several components that pour into manager skills to allocate the finical budget to the acquired job. These components are as follows:

1) Insufficient building performance leading to a complaint due to Insufficient maintenance
2) There is enough maintenance funding due to adequate assessment of the amount of maintenance required.
3) Safety and health requirements implementation to avoid risking labor and building users.

5.7 Category VII: Maintenance management factors

As decision-making was encountered, the maintenance management factor should also be stated as one of the viable factors influencing operating and maintenance costs. As mentioned previously, it relies on the management skills of managers acquiring the maintenance job to be excitedly, adequately, and effectively. These management skills encamp various components such as the following:

1) Inadequate decision making while maintenance management
2) Lack of documentation, specification knowledge, and checklist while executing the maintenance work can be refed to lack quality.
3) Outsourcing the maintenance executer or contractor
4) Delivering poor maintenance work quality due to lack of training and improvement of maintenance skills personnel

5.8 Category VIII: other factors

Ihsan and Alshibani (2018) discussed these factors from literature and ten local manager experts of hotel buildings in Saudi Arabia. All experts agreed upon these factors and clarified the reason behind these factors. however, some other factors were recommended, such as the following:

1) location of the hotel (e.g., proximity to the materials market or closeness to the industrial areas);
2) the shape of the building (e.g., simple or complicated);
3) number of stories;
4) glass and non-glass façade;
5) taxation (e.g., increase in oil prices due to government financial policies);
6) age of the users (senior, young, or children);
7) gender of the user (male or female);
8) availability of the materials;
9) efficient energy-consuming equipment (e.g., energy star products);

The experts also recommended adding parts related to sustainability and energy consumption or using alternative energy as renewable resources. Greenery indoor and outdoor were also highlighted and mentioned.

Assessment of factors affecting maintenance cost of administrative buildings

Accordingly, the factors mentioned above are adopted from the study of Ihsan and Alshibani (2018) for the affecting factors on hotels' operating and maintenance costs. The experts evaluated these factors through personal interviews to adopt these factors for administrative building in Egypt's public and private sectors. The experts praised the clarity and subjectivity of these factors. They also noted that the questionnaire established from these factors covered all the problems they faced during maintenance or operating the administrative buildings. From the results, 13 responses were received from administrative buildings' managers, which are considered sound pollution for this assessment in a brief period.

GENERATION OF THE QUESTIONNAIRE

A questionnaire was generated to gather the factors affecting administrative buildings' operating and maintenance

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International Journal of Engineering Research & Technology (IJERT)
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costs. The questionnaire was created, as mentioned earlier, by the literature review adopted and the interview of selected managers for administrative buildings who confirm the validity of these factors covering all the acquired aspects. All the fields adopted were marked as required. Some factors were "yes or no" questions required to add other knowledge. The questionnaire was grabbed from the study for hotel buildings (Ihsan and Alshibani, 2018) and modified to fit the administrative buildings. This method ensures all questionnaires' answers and adequately fulfills the required data. As the questionnaire survey takes place in Egypt, the questionnaire was translated into Arabic to make it easier for respondents depending on their preferred language.

The questionnaire encounters mainly three parts: personal information of the respondent (age, experience, number of building managed and operated), general data about the building as age, facilities, and functionality. Finally, evaluating factors affecting operating and maintenance costs would be the least influencing factor. These factors are classified into eight categories, including technical, environmental, finical, managerial, social, decision-making, maintenance management, and other factors that agreed to complete the set of these factors. Firstly, a brief idea on the purpose of handling this study. The rating of each factor was according to its importance and classified by "extremely important" with five points, "very important" with four points, "important" with three points, "minor important" with two points, and "not important" with one point. Each point represents a certain weight, as shown in Table 1.

METHOD OF ASSESSMENT

The assessment method adopted here is the relative importance index (RII). The responses received were tabulated, and the identified factors' relative importance was calculated. The choice of this method was based on two fundamental reasons, its easiness. It can grab the importance of the enormous number of factors, making it a very effective method to assess the importance of each factor relevant to the others.

The relative index (RII) can be calculated as follows:

$$RII = \frac{(100X1 + 75X2 + 50X3 + 25X4 + 0X5)}{(X1 + X2 + X3 + X4 + X5)}$$

RII is the relative importance index. X1 is the number of respondents choosing extremely important for the factor. X2 is the number of respondents choosing very important for the factor. X3 is the number of respondents choosing important for the factor. X4 is the number of respondents choosing minor important for the factor, and X5 is the number of respondents choosing not crucial.

The weighted value for each factor according to its importance is assigned by 100 for "extremely important," 75 for "very important," 50 for "important," 25 for "minor important," and finally 0 for "not important." The scale is shown o-in Table 1. Table 2 shows all the administrative buildings' operating and maintenance costs and the relative importance index calculations. Charts were then drawn, and conclusions were reported in the coming sections.

RESULTS AND DISCUSSION

Respondent and buildings encountered

As presented in Figure 1, the graph pie presented that 9 percent of the work experience are more than 20 years and 55 percent between 10 to 20 years of work experience. Finally, 36 percent of young manager leaders operate and manage the building.

Regarding the education level, this study did not include the education level, which is considered one of the limitations stated in the later section. The figure also shows the building age ranged from 36% old buildings between 10 to 20 yeas life span and newly established or constructed buildings with an age of 2 to 10 yeas only. The study mainly relies on the youth in managing and operating these buildings, a new perspective trend directed by the government.

Influencing factors

The factors covered here in this study are mainly ranked as essential factors; the range is between 50 to 80 percent. The most critical factor is " Failure to identify the true cause of the defect." This factor is under the "Building characteristics" factor, which is on components of the technical factor. Table 3 shows the top-ranked critical factors and their mean of importance that affect Egypt's administrative buildings' operating and maintenance costs. These factors are failure to identify the actual cause of defects, design problems, inadequate finance, poor maintenance management administration, sustainability, and energy consumption and saving. It should be mentioned that two of these factors are ranked on the same level. For instance, the factors of design problems and inadequate finance have the same level of importance and criticalness.

Similarly, poor administration of maintenance management and sustainability and energy consumption and saving have the same importance level. Most of the experts agreed to use the building technology system that is adequate to alert the defects and problems before it happens and control energy consumption. Consequently, saving energy and moving toward sustainable buildings using sustainable material will be the newest items to introduce into the administrative building to lower the operating and maintenance cost and budget.

On the other hand, as stated before, the study did not deviate from the public sector of demonstrative buildings and the private ones. Thus, this is the limitation existing in this study illustrated later. The public sector is anticipated to differ from the private sector; inadequate funding is the top-ranked and critical factor. The source of funding provided for the public sector is the government's budget, which usually faces a deficit, as in the case of Egypt. The private sector mainly relies on the corporate, which is usually rich in resources but not adequately controlled.

Interpretation of results

From Tables 2 and 3, it is noticed that failure in identifying the actual cause of defects in number top-ranked and critical factor. Although their education level is an engineer at most, all managers agree that defects will occur after constructing the buildings. This finding was concluded relevant to the building's age, which is not more than 20 years life span. Thus, the life cycle of administrative buildings should be updated to be considered in code of practice and standard while designing the building in the first place. Increasing the life cycle of the building should provide durable material to

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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use even though the initial cost is high. However, the operating and maintenance cost will be lowered long term. Also, it was noticed that the second problem is not related to operating the building. However, before the construction phase, the design problem was initially, especially for the public sector. It should be revised by a professional consultant or particular public office that is specialist in noticing the design problem before implementing it To maintain quality in administrative construction buildings. Indeed, the annual consumption rate remains a mutual concern between the four- and five-star hotels. They are somehow close to each other in providing facilities and using technology.

It can be summarized that the common concern between all the critical and the top-ranked factors is the poor administration of maintenance management. Poor maintenance management can aggravate rapidly and become cost-effective to rehabilitate and renovate the building. Last, efficient tools to reduce energy consumption are newly introduced in Egypt. They have become more implemented in the administrative buildings, especially the public ones.

Added value by the experts to the study

The questionnaire was limited to state whether the factor is essential or not. It also provided an opportunity for the experts to add their experienced –value through some questions disseminated within the factor. As mentioned earlier, the main obligatory question was marked by star means obligated to the experts filling the questionnaire to write down an answer. However, the other essay questions disseminated through the factors were not obligatory. Although stated later, the experts were interested in sharing their knowledge and answered most of them. The results obtained were awe-inspiring and of important matter to publish. Thus, the experts' feedback on the most critical factors that influence the operating and maintenance cost are summarized below as follows:

Firstly, it is agreed that the maintenance of buildings is an ongoing procedure that lasts through the structure life. If there is no awareness or carelessness in achieving the planned goals, the building deteriorates rapidly. While discussing the availability of skilled labor factors, the experts confronted that this factor can double the cost of maintenance acquired. Some of them went that the labor can be substituted. However, the heavy equipment with ignorance of the labor to operate the equipment may heavily cost the equipment's destruction, which cost much money to repair.

The experts commented that the resources allocated usually happen in the professional world due to the poor financial control factor to execute their required maintenance tasks. This finance might be allocated at the wrong place or assigned location, thus not being used. It was agreed that the issue encompassed all activities, even labor. In the end, efficiently disseminating the resources to the correct place is a significant job that requires reasonable control and highly skilled leadership.

Misusing the building and changing its function after construction has been executed can deteriorate the building, leading to a high maintenance cost. One of the experts pointed out that insufficient training and the need for a skilled service team may affect the misuse of the building factor. Others donated that it should be planned from the very beginning by "what-if scenario."

Last but not least, the experts pointed out that any outsourcing problem is mainly contained in the profit margin that the maintenance contractor should acquire and the inspection before engaging the work of maintenance. This inspection can stand for long to adequately state the defects that affect the building while acquiring hire costs. However, the experts agreed that outsourcing is for a specific, not a regular job. *Outsourcing* is a suitable method for leading this maintenance item and is considered cost-saving.

Finally, the experts agreed that the survey had covered all the factors. They also agreed that the budget planned for maintenance had never been enough at the time of maintenance scheduled. The experts confront as long as the buildings' managers become actively repaired. The defects appear the lower the maintenance cost in the long term, even if the maintenance costs a fortune at the time of defect appearance. They all confirmed that Egyptian culture in using the building does affect the maintenance cost dramatically. The experts added highlighted some other additional factors that might have contributed. For instance, the maintenance cost as the number of building's users exceeds the allowable number assigned for the building, the weather and climate condition due to the building location, human attitude, and others could influence the O and M cost.

Additionally, the use of colossal machinery, its processing time, multi-vendor or open systems, and energy efficiency are also considered influencing factors. Finally, using a reputable building control systems agency includes the agency's reputation in providing the system and maintaining the system in the long run when called. They confronted that the latter might include unrespectable behavior from various agencies available in the Egyptian market. Thus, it is crucial to be adequately skilled while dealing with an agency, whether while outsourcing maintenance contactors or building control system providers.

CONCLUSIONS

In Egypt, the annual budget usually faces deficits that encounter a high portion for operating and maintenance costs of public sectors from infrastructures, administrative and public buildings, and other relevant sectors. Thus, it is assumed hypothetically; that an appropriate amount of the annual budget was lost during these construction buildings' operating and maintenance. The same behavior is noticed with the large cooperate or private sector. This study investigated the factors influencing the operating and maintenance cost of the administrative buildings, particularly in Egypt, whether for the public or private sector. The cost of O&M in buildings, particularly in hotels, represents a significant part of the total cost of the constructed facility. Several literature reviews were presented, and interviews were handled to stand on the adopted questionnaire established or adopted from the literature data collected. The questionnaire, then allocated under several classifications, herein this study, into seven groups. Then, the questionnaire survey was disseminated among buildings' manages experts to stand on the importance of each factor. The survey adopted the importance relevant index method to maintain adequate answers and become much easier for the managers to answer

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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after the data was collected and analyzed to release the first five top-ranked critical factors of high importance in influencing the operating and maintenance costs of administrative buildings. The buildings were chosen 64% of about ten years age and 55% of the respondent were of the high level of education (i.e., Engineers) with experience of not greater than ten years.

The top five ranked factors were as follows in descending order: failure to identify the actual cause of defects. Then secondly, design problems and at the same level as the second factor, inadequate finance. Fourthly, poor administration of maintenance management and finally similar to the fourthly level, sustainability along with energy consumption and saving ."Most of the experts' agreed with using the building technology system that is adequate to health monitor the building to detect the problems before it happens and control energy consumption.

The experts added that the budget planned for maintenance never been enough at the time of maintenance scheduled and confirmed that Egyptian culture in using the building does affect the maintenance cost dramatically. Further research is required to encounter the other factors nationwide. The experts highlighted factors, such as building system agency and their behaviors, climate conditions, and human attitude, including the building user number. In addition, develop a model on the actual cost data for these factors that can guide administrative buildings' operating and maintenance budget allocation.

FURTHER WORK

This study investigated the factors affecting administrative buildings' operating and maintenance costs. The factors encountered were about 56, which are considered the most critical factors covering all the sides in this issue. However, through the investigation, the study did not include some important aspects while analyzing, for instance, respondent education level, whether Bachelor or technical or Trained or untrained. This factor is crucial to the analysis. The experience background influences the respondent's answers to the questionnaire, which should be encountered during analysis. Secondly, the buildings types were not separately encountered as guidance for the importance of the factors relevant to the type of the building. The types of buildings encompassed herein; this study is public and private buildings combined, which differ on their budget assigned in each and resources. Thirdly, the study did not consider new building system technology, renewable energy, and power consumption savings.

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1 Table 1. The weight of importance index

Level of importance	Assigned weight
Extremely important	80-100
Very important	60-79
Important	40-59
Minor important	20-39
Not important	0-19

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 02, February-2022

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Table 2. The Relative importance factors calculated for each facto affecting the O & M cost of administrative buildings

No.	Factors affecting the operating and maintenance cost of administrative buildings	RII
1	**Technical factors**	
1.1	Design problems.	80.77
1.2	Faulty maintenance.	76.92
1.3	**Building characteristics.**	
1.3.1	Building materials used.	76.92
1.3.2	Usage of new materials or ignorance of materials' properties	73.08
1.3.3	Building height and structure.	59.62
1.3.4	Building age.	67.31
13.5	Poor quality control.	73.08
1.3.6	Life cycle cost techniques.	67.31
1.3.7	Low concern to future maintenance.	67.31
1.3.8	Failure in identifying the true cause of defect.	86.54
2	**Environmental factors**	
2.1	New maintenance techniques.	72.92
2.2	Unqualified and unavailability of maintenance contractors.	76.92
2.3	Inadequate standard and specification.	67.31
2.4	Harsh climatic conditions.	69.23
3	**Managerial factors**	
3.1	Resource management problems.	61.54
3.2	Equipment.	69.23
3.3	Labor.	65.38
3..4	Unavailability of skilled laborers.	76.92
3.5	Faulty workmanship in the initial construction.	67.31
3.6	Uneducated labors.	75.00
4	**Financial factors**	
4.1	Inadequate finance.	80.77
4.2	Poor financial control when executing maintenance work.	59.62
5	**Social factors**	
5.1	Misuse of buildings.	70.83
5.2	End-users' behavior.	75.00
5.3	Occupancy rate.	60.42
5.4	Execution of maintenance works become urgent.	68.75
5.5	Culture practice	54.17
6	**Factors considered in decision making of maintenance cost.**	
6.1	Complaint received regarding building performance	56.25
6.2	Availability of maintenance funding	75.00
6.3	Safety and health requirements	75.00
7	**Factors related to the management of the maintenance department**	
7.1	Poor administration of maintenance management	79.17
7.2	Lack of documentation on the maintenance work	75.00
7.3	Outsourcing of the maintenance services	64.58
7.4	Lack of well-trained maintenance personnel	75.00
8	**Additional factors affecting maintenance cost of administrative building**	
8.1	location of the administrative building	50.00
8.2	shape of the building (e.g. simple or complicated);	54.17
8.3	number of stories and / or height;	60.42
8.4	glass and non-glass façade;	58.33
8.5	taxation (e.g. increase in oil price due to governmental financial policies);	62.50

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International Journal of Engineering Research & Technology (IJERT)
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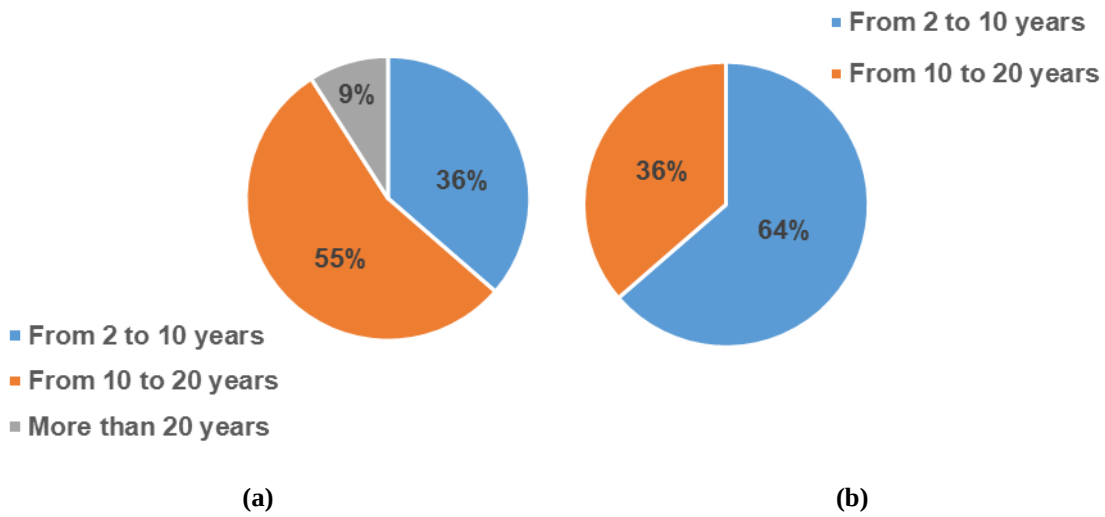
8.6	age of the users (senior, young or children);	47.92
8.7	gender of the user (male or female);	18.75
8.8	availability of the materials;	58.33
8.9	efficient energy consuming equipment (e.g. energy saving products);	66.67
8.10	moving toward sustainability and renewable energy sources; and	79.17
8.11	Greenery of indoor and outdoor environment.	70.83

Table 3. The Relative importance factors calculated for each facto affecting the O & M cost of administrative buildings

Top ranked 5 critical factors that influencing the operating and maintenance cost of administrative building in Egypt	
Failure in identifying the true cause of defect.	4.46
Design problems.	4.23
Inadequate finance.	4.23
Poor administration of maintenance management	4.27
moving toward sustainability and renewable energy sources	4.17



(a) **(b)**

Fig. 1. Shows (a) the respondent experiences and (b) the building age.

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