

TECHNICAL NOTE

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**A SURVEY ON THE IMPLEMENTATION OF FACILITIES  
MAINTENANCE MANAGEMENT SYSTEM OF BUILDING IN IRAN**

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**Abstract:** The degree of the implementation of building facilities maintenance management (FMM) has a major impact on its performance. As a result, the influence of facilities management on the maintenance of buildings is greater than ever before. The issue related to building maintenance is a universal one and its consideration at the facilities maintenance stage is of great importance on the future performance of the building. This research has been conducted to study the impact of maintenance-related issues on facilities maintenance management system. Building maintenance includes cleaning, inspecting, repairing, and replacing the building's various systems and components. Questionnaires were distributed in big cities of Iran. The findings identified the level of companies' knowledge in facilities maintenance-related issues; the degree to which executive staff is exposed to training in facilities maintenance-related matters; the extent to which companies consult maintenance consultants; the relative importance of facilities maintenance (FM) issues to other performance factors and the level of difficulty in cleaning, inspecting, repairing, and replacing various building components. Based on the findings, the main problems related to management of facilities maintenance system of building needs serious attention from the authorities in order to improve the overall maintenance system.

**Keywords:** *facilities maintenance management (FMM), building, wastewater plumbing system*

## 1.0 Introduction

Facilities maintenance management of building is one of the most important problems in the field of building management (Langevin, 2006). In general, maintenance science is repair, replacement and changing construction components which also include cleaning, inspecting the building's various systems, components, and materials (BSI, 1993; CIB,

1990; and Vanier, 2001). This science starts from the point of time after construction completion (Yu, 1999). Period of repair and building maintenance constitutes almost 95% of the life period of a building. All buildings require repair and maintenance after construction period. The operation period will exhibit how repair and maintenance play an important role in the construction costs. As it is clearly impractical, and even undesirable to replace all older buildings, everyone who concerned with building integrity and reliability, whether as owners, designers, contractors, or users, should take a serious interest in this vast problem of building maintenance. This research has been conducted to study and survey the level of Iranian companies' knowledge about building facilities maintenance-related issues and existing system achievements. The study identifies the sections of building facilities that have main problems from aspects of cleaning, inspecting, repairing and replacing. The purpose of this paper is to provide an insight into the growth stage of facilities maintenance practice (FM) in Iran.

## **2.0 Building Facilities Maintenance (BFM)**

Building Facilities Maintenance (BFM) is an integrated approach to operating, maintaining, improving and adapting the buildings and infrastructure of an organisation in order to create an environment that strongly supports the primary objectives of that organisation (Pathirage *et al.*, 2008). This science is no longer a new concept in the USA, Japan, Western Europe and other parts of Asia. Asset managers are found in large corporations, hospitals, the manufacturing industries, schools and hotels, in fact, in almost every structure where there are plants, public buildings and services to be provided in support of the main core business. Facilities maintenance management is increasingly becoming an important function in the built environment. With development well under way in both the developed and developing countries, the number of buildings and infrastructural facilities which need to be professionally managed and maintained has grown to reach the same level of significance traditionally found in new construction works (Pheng, 1996). In general, building maintenance follows a specific set of objectives including (Lee, 1987): Repair, replacement, renewals, modification, protection that protects the basic materials (i.e. external painting and thin coating), decoration that protects of the internal surface of the building (i.e. painting and etc.), and cleaning for maintaining the internal face of the building. From the perspective of construction engineering, building facilities maintenance includes components such as: (1) Interior surface, (2) exterior surface, (3) mechanical system, (4) electrical system, (5) telecommunication, (6) clean water system, (7) wastewater plumbing system, (8) structural system and roof.

### 3.0 Methodology

A set of questionnaire was designed to identify the relationship between the level of companies' knowledge and the building maintenance process in Iran. The questionnaire was distributed to the largest 100 building consultant companies in the country. Only the companies involved in building performance were selected which includes consultants and contractors. The 100 questionnaires were sent to the top executives (presidents, chairmen of the board, or chief executive officers) of the consultants companies and contractors. A number of 40 questionnaires feedback were received, constituting a 40% response rate. The questionnaire includes questions regarding the characteristics of the companies, the contractors and consultants' existing level of facilities maintenance-related knowledge, the extent of their communication with maintenance consultants, the factors that they consider important when implementing building maintenances, and assessment of the problems related to the facilities maintenance science of buildings and situation of building maintenance system from standpoint of engineers and architects.

### 4.0 Findings and Discussion - Quick Look at the Companies' Profile

Most of the companies (73%) employ between 51 to 100 employees (Question 1), and 89% of the respondents have been in business more than 20 years and 11% that have been in business between 10 to 20 years (Question 2). That statistics show that most companies are relatively large and established. The companies offer services including structure and architecture (70%), interior design (18%), and building equipment (11%) (Question 3). Answers to Question 4 showed that 58% of the companies get their work from private sectors while the remaining 42% from government organizations. The major building types that the companies maintain are 20% residential, 17% business, 15% industrial, 14% educational, 13% assembly, 11% Skyscraper and 10% mercantile (Question 5). Most of the respondents built more than one type of building, except those that specialise in industrial or skyscraper buildings.

#### 4.1 *Assessment of Facilities Maintenance Issues in Iran's Buildings - Companies' Existing Facilities Maintenance Capabilities*

Through literatures, six dominant variables that are associated with the decision making of building cost were identified. The variables are (Azlan 2009):

- (1) Existing building condition;
- (2) Building age;
- (3) Complaint received regarding building performance;
- (4) Client's request;
- (5) Availability of funding; and
- (6) Safety and health requirements.

All of the above are evaluated after structures construction and during operation. Facilities will be deteriorating as the increase of building's age. If regular maintenance is not carried out properly especially repair and replacement, hence deterioration will occur and building health will be reduced thus increase of maintenance costs. Questions 6 and 7 were discussed about the standpoint and interest of companies' members in conferences and seminars related to repair and building facilities maintenance and assessment of staffs' knowledge in relation to the science of building facilities maintenance. Most respondents (59%) show in their answers to Question 6 that members of their companies seldom receive training on building facilities maintenance or related subjects. A percentage of 22% answered sometimes, only 11% of the respondents said Often and 8% chose Never. When the answers were analysed by companies' age, it was observed that older companies answer (between 20 to 40 years) was close to Often and younger companies answer (less than 20 years) was close to Seldom, possibly because older companies encouraged their members due to more experience in building maintenance field.

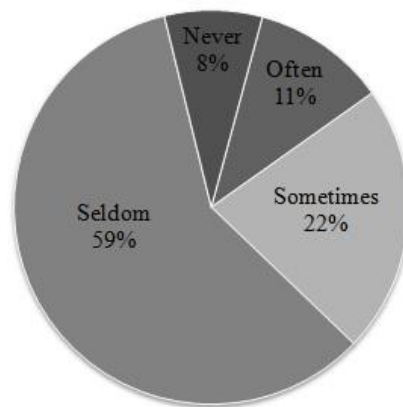


Figure 1: Frequency of training members of companies on conferences of facilities maintenance management

Question 7 was about ranking the level of facilities maintenance knowledge of architects/ engineers in building companies, the large majority of the answers by engineers show that it is Poor (52%), Fair (22%), or Good (15%). Only 7% said it is Very Good, and 4% Very Poor. Assessment showed that answers are close to Poor. This respond indicates that facilities maintenance knowledge in Iran could not improve consistently alongside western countries and South East Asia.

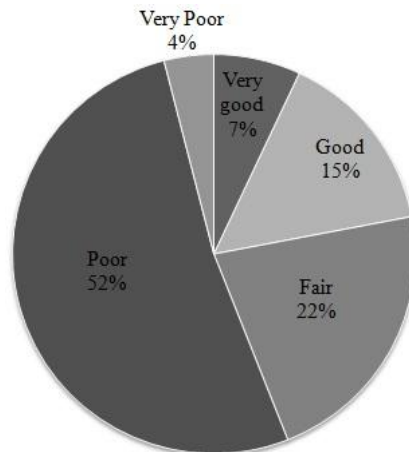


Figure 2: Frequency of level of members' knowledge of company about building facilities maintenance management

The findings in Questions 6 and 7 are undoubtedly linked to each other because the level of knowledge is related to the level of training. We can summarise the results as follows:

1. Older companies appear to have ranked themselves slightly higher than younger companies, a trend similar to the one observed in Question 6 (training).
2. Older companies have more knowledge than younger companies on matters related to building facilities maintenance where they have more experience in the field of building maintenance.
3. Low level of knowledge in the field of building facilities shows lack of maintenance science among Iranian companies which resulted to poor management in this area and hence structural life reduction and increase of maintenance costs.

#### 4.2 *Communication with Facilities Maintenance Consultants during Construction*

A variety of factors affect the building performance which are present from the design stage of a building until the operational period. Full cooperation and coordination among parties involved in these factors is required for better building performance. Designer, client, quantity surveyor, consultant and contractor need to have various meetings for better coordination in project performance. In reality, a building project involves four life-cycle stages of development: (1) Design; (2) construction; (3) operation; and (4) maintenance. As previously mentioned, a building requires surveillance and maintenance during its life. This maintenance includes all mechanical systems, telecommunications, wastewater plumbing system, electricity, and others all of which require strong management and efficient handling.

Contractors and Project Managers must provide the necessary conditions for communication and consultation with facilities maintenance advisors during

construction projects. This action is for controlling the problems that might arise after construction of the structure in relation to facilities maintenance. The efficiency, convenience, life span, economic viability, appearance, and overall performance of a building can be affected by decisions taken and actions performed at any time in the history of a building project, from its initial conception to its final demolition. The decisions made in the design stage and project performance affect all decisions made in subsequent stages and vice versa. That is why the contractor's relationship and executive with the consultants of repair and facilities maintenance in the construction and operation stages is very important.

Question 8 was designed to investigate the frequency of engineers' communication with maintenance consultants. Question 8 determined whether or not the companies engage building maintenance consultants during the construction process. Most of the respondents (73%) indicate that facilities maintenance consultants were not hired in any project. Of the 27% who reported using maintenance consultants, 24% consulted them in some of their projects and only 3% in all of their projects. Again, all of the respondents are large firms and have considerably accumulated experience and many in-house resources. Two modes are in this section:

(1) They probably have frequent in-house training programs and they consider themselves quite knowledgeable in these matters. Furthermore, some companies may have employees who are experts that specialize in maintenance. As a result, contract outsourcing of maintenance consultants may be unnecessary in many of the responding companies.

(2) Companies' scientific and executive management levels do not request for services from facilities maintenance consultants yet. From the research and interviews done, it was identified that facilities maintenance consultant do not act independently and they are neither associates in the contractor companies nor with the consultants, the design engineers and structure executive.

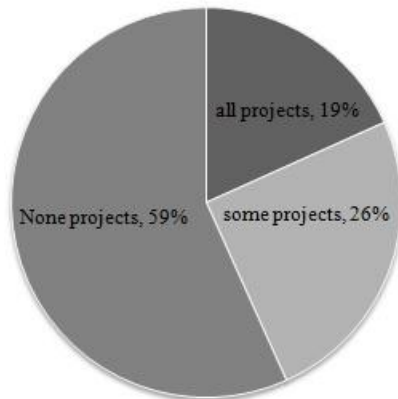


Figure 3: Frequency of consultants building maintenance partnership in project

#### 4.3 Importance and Degree of Difficulty of Building Factors during Building's Age

The design and performance of a building is a process that involves the consideration of a variety of factors. This design and performance must be done based on building better management in future because better management will result to better maintenance and high productivity during building operations. Questions 9–12 were designed to determine the status of facilities maintenance-related factors relative to other factors. The respondents were asked to rank 14 factors in order of importance, using a scale of 0–4, where 0 represents not important, 1 not very important, 2 somewhat important, 3 very important, and 4 extremely important. The factors in this question are grouped into five categories: 1. Safety: Includes fire protection, security. 2. Design quality and performance: Includes choice of installation equipment, and choice of materials. 3. Building user comfort: Includes air circulation, indoor air quality, humidity control, lighting, heat loss/heat gain, vertical transportation. 5. Building services: Includes clean water supply, wastewater plumbing system disposal, garbage disposal, and telecommunications. Figure 4 shows the distribution of the 14 factors that responding engineers considered when designing and constructing a building, organized in order of importance (Arditi and Nawakorawit 1999). If one looks at the factors that have received an average importance score of 3.06 (very important) or better, one notes that they include 8 out of the list of 14 factors. This respondent indicates that choice of installation equipment is very important (3.71) for engineers in construction. After that heat loss/ heat gain is very important (3.35) from category of building user comfort too. Figure 4 shows that design quality and performance (choice of installation equipment and choice of materials), building user comfort (heat loss/ heat gain, lighting, indoor quality and air circulation), building service category (wastewater plumbing system) and safety category (fire protection) are the most important factors for better management in

field of building maintenance from the point of view of engineers and architectures. Between these categories, building user comfort has maximum numbers of very important values but most attention is related to choice of installation equipment. It shows that most companies have problems about subject of facilities maintenance during the building's age. Out of the list of 14 factors, the factors in the building user comfort category ranked 9th, 11th, and 12th in the order of importance. It appears that maintenance is not at the top of building designers' and property managers' priority lists when they design and manage buildings, respectively. According to the answers, engineers do not care much about the factors in the building maintenance category compared with other categories, probably due to building owners often place undue emphasis on initial costs and ignore the periodic cost of upkeep, inspection, repair, and replacement. Yet, the lowest initial cost is not necessarily the most economical in the end. Cheaper materials often require more frequent maintenance and may have a shorter working life than the more expensive alternatives. This is particularly true of wall and floor surfaces, moving parts of machinery, the roof, and many other parts of a building. In many cases the client is not the final user of the building and sometimes has little understanding of the problems of the particular building in use. The client's only concern is too often the possible short-term financial return.

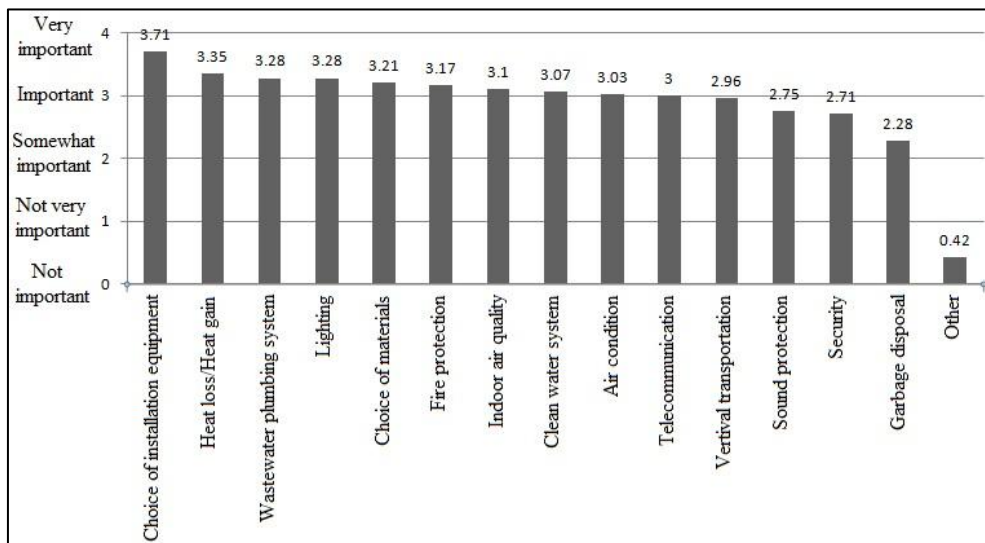


Figure 4: Factors considered by engineers in buildings performance, in order of importance



Engineers were asked in Questions 10-12 to indicate which building components are the three most difficult to clean, inspect, repair, and replace.

- A clean building is important to attract new tenants and retain satisfied tenants. As shown in Figure 5, from the engineers' standpoint, the three most difficult components to clean are the mechanical system, the wastewater plumbing system and the exterior surface.

- Regular inspections are an important part of the procedures for the facilities maintenance of buildings. A general inspection covering all parts of a building is needed in planned facilities maintenance programs. The respondents indicated that the three most difficult components to inspect (Figure 5) are the mechanical system, the electrical system, and the wastewater plumbing system.

- Repair is defined as work to restore damaged or worn-out property to a normal operating condition and replacement as the exchange or substitution of one fixed asset for another having the capacity to perform the same function (Cotts and Lee, 1992).

Question 12 is very important about situation of facilities maintenance system in Iran. The three most difficult components to repair and replace that were indicated by the respondents in the wastewater plumbing system, the mechanical system, and the electrical system, as shown in Figure 5. The wastewater plumbing system appears to be one of the major areas of difficulty because it was ranked by assessors and engineers within the two most difficult to inspect, repair and replace. Asset managers expressed a similar opinion in a survey of property management practices, indicating consensus between engineers and property managers that engineers should make every effort to specify the appropriate wastewater plumbing system, and that, in turn; component managers should make every effort to institute an effective maintenance schedule for these systems. Assessments show that mismanagement in the field of wastewater plumbing affects on increasing cost of building with building's age enhancement. Most companies faced with this kind of problem concerning repair of wastewater plumbing includes reproductive equipment, heat equipment, fittings equipment, and transfer equipment and distribution. These problems are mostly about time of repair for each of the respective equipment. Not having information and knowledge about facilities life cycle system will result to lack of equipment repair on time and hence, increasing cost and reducing building's age.

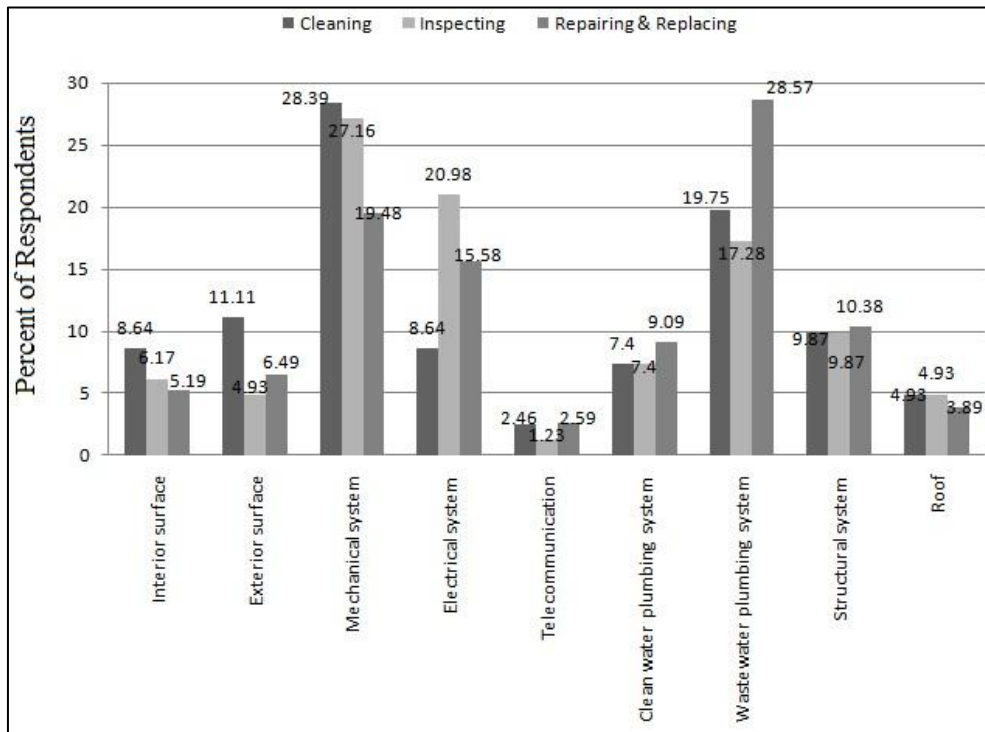


Figure 5: Difficulty of cleaning, inspecting, and repairing and replacing building components

## 5.0 Conclusions

A survey was conducted among 100 large building maintenance consultants and contractors in Iran to investigate the problems related to facilities maintenance and building maintenance system. The findings indicate that level of maintenance knowledge is poor in Iran and Iranian companies could not prosper as fast as the industrial countries in this field. Members of companies seldom receive training on building facilities maintenance and consultation with facilities maintenance advisors is done at very low level. Findings also show that choice of installation equipment (mechanical system and wastewater plumbing) are the most important factors for better management in field of building maintenance from engineers' and architects' standpoint of view. The finding indicates that the wastewater plumbing system appears to be at the top of the list of building components with regard to difficulty of inspection, repair, and replacement. It appears to be consensus between engineers and property managers in this matter. Ease of repair and replacement, access to repairing area, and ease of inspecting are ranked by engineers to be among the least important factors. Building management executives should be more sensitive to these issues. Executives and contractors must use consultants and experts in the field of building repair and

component replacement independently. Research shows that facilities maintenance performance knowledge of building in Iran is low, and companies could not get integrated system for repair or facilities timely replacement during building's age, especially for public building (hotel, hospital and schools).

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