

INTELLIGENT ASSESSMENT FOR FACILITY MANAGEMENT PERFORMANCE: PILOT STUDY ON A HOSPITAL

Jing ZHANG

Hong Kong Adventist Hospital-Stubbs Road

gabriella.jing.zhang@gmail.com

Joseph LAI

Department of Building Services Engineering
The Hong Kong Polytechnic University

bejlai@polyu.edu.hk

Facility management (FM) plays an important role in providing a safe and efficient hospital environment. In order to investigate how to evaluate hospital FM performance with rigour, a study was carried out. By doing a literature search on hospital performance, it was found that most of the past studies focus either on the clinical side of hospital performance or general building performance, whereas the research effort on hospital FM performance is comparatively limited. Following a five-step process for developing a performance measurement system, a hierarchy comprising the essential aspects of managing hospital facilities was constructed. An interview questionnaire tailored for soliciting the perceptions of hospital practitioners on the importance and performance levels of FM services was designed. With the use of an analytic hierarchy process (AHP), the pilot data were analysed, demonstrating how the FM performance of a hospital could be evaluated.

Index Terms— AHP, facilities, hospital, Hong Kong, performance

1. INTRODUCTION

As an attempt to explore the feasibility of devising a scheme to assess the performance of facility management (FM) in hospitals, a study was carried out on a private hospital in Hong Kong. After a review of the relevant literature, as presented in the following section, the methodology of the study, including the data collection method and how the collected data were analyzed, is reported. Finally, the conclusion drawn from the analyzed findings and the further work required are given.

2. LITERATURE REVIEW

More and more attention has been paid to the assessment of the health system performance in across different dimensions – not just in healthcare but across a range of delivery systems [1][2][3]. The World Health Organization (WHO), which is the most authoritative organization in healthcare,

has summarized the findings concerning health system performance measurement in 192 Member States [4]. The number of projects and programs to assess performance in healthcare has increased over the past years. The Performance Assessment Tool for Quality Improvement in Hospitals (PATH) is one of them initiated by WHO for Europe [5].

Performance indicators are defined as statistics or other units of information, which reflect, directly or indirectly, the extent to which an anticipated outcome or the quality of the processes leading to that outcome is achieved [6]. Different KPIs are designed to evaluate hospital performance from different perspectives, e.g. seeing-doctor process [6], productivity of hospital beds [7] [8], patient safety [9], and the performance of major function departments [10], etc. All of them focus on some aspects to measure hospital performance; they generally are in lack of one important perspective – FM.

What is FM? The International Facility Management Association (IFMA) [11] defines facility management as a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology. The British Institute of Facilities Management [12] emphasizes the function of FM as support and improve the effectiveness of its primary activities. The Hong Kong Institute of Facility Management [13] promotes FM as a process by which an organization integrates its people, work process and physical assets to serve its strategic objectives.

A study on FM literature indicates two ways of performance measurement that will be perceived in FM: first, as a “critical success factor” in the strategic development process and second, a learning process within the FM organization [14]. The presented methodology covered both prescriptive and descriptive researches, and provided a foundation for questionnaire-based performance measurement.

The most famous and popular questionnaire survey is Post-Occupancy Review of Building Engineering (PROBE) – an occupant questionnaire in the UK. The PROBE study is successful in its attempts to provide some systematic methods for post-occupancy evaluation (POE) and is considered to be

the most useful set of trends available on issues of user satisfaction [15]. Besides PROBE, there are two other leading POE tools. Building Quality Assessment (BQA), which is developed in New Zealand to assess what a building provides in terms of facilities, takes a descriptive procedure by indicating a level provision with criteria described on a scale of 1 to 10 assessed by a trained assessor. Serviceability Tools and Methods (STM), similar to BQA, takes ordinal measurements and uses scales. STM is more in-depth than BQA by considering more details, typically four or five dimensions in a single scale. It was developed in North America and has been used in the USA, Holland and New Zealand to evaluate offices.

Besides the above measurement tools, there are some other building/facility performance assessment methods. In the US, a web-based occupant survey was developed by Huizenga et al. [16] to measure satisfaction with environmental factors such as lighting, air quality, office layout, etc. by broadly looping in occupants in a building performance feedback. In Hong Kong, Lai and Yik [17] used five parameters of FM security, cleaning, repair and maintenance, landscape and leisure and general management to measure and analyze the performance and user satisfaction of FM services in a residential estate. The five aspects of FM services were selected by reviewing a focus group discussion with FM practitioners. 297 users were interviewed to gather their perceived levels of importance and performance of FM services. Based on the consistent responses of the interviewees, the final weightings of various FM services were calculated by using the analytical hierarchy process (AHP). In addition, the cost-effectiveness of different aspects of FM services was evaluated.

All the above methods are not tailored for healthcare buildings, which are different from office buildings, or educational or industrial buildings. Healthcare organizations are concerned about the unique functions of hospital buildings – support vulnerable and dependent patient; maintain critical medical equipment in operating theaters; keep a tidy and sterile environment, etc. [18]. The government of Alberta initiated an evaluation tool specifically for healthcare which they called Building Performance Evaluation (BPE) scorecard. Different from the aforementioned building performance evaluation tools, BPE scorecard encompasses four perspectives or performance dimensions – financial, physical, functional, and service, rather than focusing on one or two of them. The BPE scorecard serves as a bridge to connect staff satisfaction with physical environment [19].

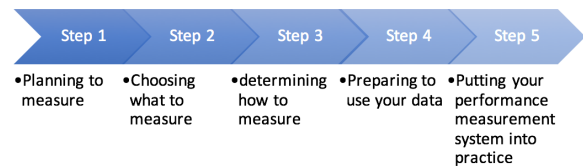
Most of the FM studies on hospitals are focused on some specific areas. Shohet [20] examined three performance parameters (effect of various labor sources mixes, occupancy level of hospitalization wards and buildings ages) to develop four key performance indicators (KPIs) – physical-functional state of the building, manpower sources diagram, maintenance efficiency indicator and managerial span of control.

Dianat et al. used both questionnaire and physical illuminance measurements to assess the effect of lighting condition with its implication on health and safety performance, and to compare employees perception with actual illuminance levels [21]. In Finland, a study was conducted to discuss the price situation in the energy market and compare pros and cons in the perspective of the Life-cycle costs (LCC) of 12 energy management system in a hospital facility case [22]. Cruz raised a hypothesis and used multivariate regression analysis to examine the effects of asset specificity on the financial performance of both external and internal governance structures for medical device maintenance [23]. Yik et al. have conducted a research on impacts of different facility service procurement methods on perceived performance of hospitals [24].

In fact, FM as a support service for hospitals covers a board scopes, including property management, housekeeping, security, maintenance, catering services, Bio-medical (Bio-Med) engineering services, etc. In Norway, Strevalen found the necessity of integrating property management as part of FM deliveries with executive management of Health Authorities and Regional and Local Health Trust [25]. Failures in support services provision in hospitals could result in far more dramatic negative consequences than in other buildings [26][24]. Undoubtedly, hospital expenditure on building and medical equipment has great impact on the use and efficiency of healthcare services, and consequently, on the efficiency of public expenditure [27][25]. Therefore, it is essential to develop a proper FM performance measurement methods for hospitals.

3. METHODOLOGY

In the guidebook of Wolk et al. [28], a five-step process for building or refining performance measurement system is described.



The following reports the methodology taken in the current research study according to the process stated above, with focus on Steps 2, 3 and 4.

3.1. Planning to Measure

Taking the benefits of working in a private hospital with job duties relevant to FM, the researcher has access to gather users perceptions and solicit their opinions towards the FM performance.

As there were no previous studies focusing on the overall FM performance of hospital buildings, this study as a pilot

Table 1: Comparison of FM Aspects

FM Aspects Listed[32]	FM Function Departments in Hospital
Accommodation	Project Management
Maintenance	Repair and Maintenance as of general facilities Bio-medical of medical equipment
Cleaning	Housekeeping
Security	Security
Reception	N/A as usually Patient Business Office will take care of Reception
Utilities	Repair and Maintenance
Internal Decoration	Project Management
Signage	Project Management
Catering	Food services
Others	Transportation

case was designed to evaluate FM performance in a private hospital in Hong Kong.

3.2. Choosing What to Measure

FM is a relatively new profession [29]. It covers a wide range of processes, services, activities and facilities. Different organizations have different definitions. Different buildings have different functions with different performance measurement systems. The Hong Kong Housing Department uses a scoring system called Property Services Agent Performance Assessment System (PSAPAS) [30]. Lai used five FM aspects – security, cleaning, repair and maintenance, landscape and leisure, and general management to evaluate the performance and cost-effectiveness of FM services in housing estate [31]. The methods used by the Housing Department could only assess the perceived satisfaction with the performance of different FM aspects without users’ perceived importance of FM aspects. In Lai and Yik’s study [17], they have overcome this deficiency by asking users to indicate their perceived importance and relative importance between pairs of FM aspects. With the major difference being in building types: residential building vs hospital building, the purpose of the current study was similar to Lai and Yik’s study in that FM aspects including security, cleaning, repair and maintenance are important FM elements in hospital buildings.

According to Friday and Cotts, FM aspects cover, for example, accommodation, maintenance, cleaning, security and reception, utilities, internal decoration, signage, and catering [32]. By incorporating these aspects into the hospital’s organization, the comparison was generated (See Table 1).

In order to have a more accurate result of the analysis, the chart as shown in Figure 1 was created with 3 tiers of FM aspects. The chart has been approved at the Administrative Council of the private hospital.

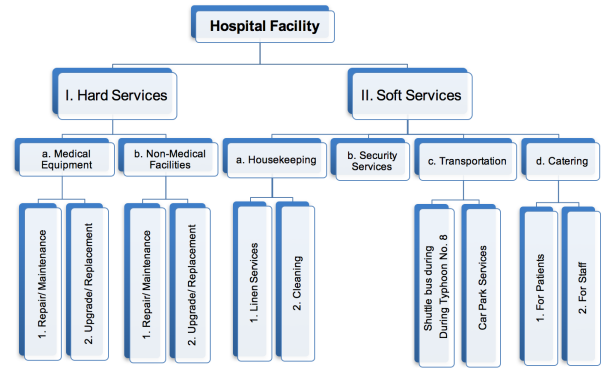


Figure 1: The chart of 3 tiers of FM aspects

Figure 1 clearly summarizes the FM aspects that could be used for analysis:

- Repair and Maintenance of Medical Equipment (R&M M): repair and maintenance of medical equipment;
- Upgrade and Replacement of Medical Equipment (U&R M): upgrade and replacement of medical equipment;
- Repair and Maintenance of Non-Medical Facilities (R&M nM): repair and maintenance of non-medical facilities, e.g. repair and maintenance of building services, etc.;
- Upgrade and Replacement of Medical Equipment (U&R nM): upgrade and replacement of non-medical facilities, e.g. renovation, modification, etc.;
- Linen Services of Housekeeping (LINEN): linen services, e.g. purchasing, distributing, laundry, etc.
- Cleaning of Housekeeping (CLN): cleaning the entire building;
- Security (SEC): managing outsourced security guards, patrols;
- Shuttle bus during typhoon No. 8 of Transportation (STL): the shuttle bus the hospital provides for staff to come to work during Typhoon No. 8;
- Carpark of Transportation (CPK): carpark services for customers, staff, etc;
- Catering Services for Patients (CT-P): food for patients;
- Catering Services for Staff (CT-S): food for staff.

The major attributes of the aspects include:

- Repair and Maintenance of Medical Equipment (R&M M): performance of bio-medical engineers, condition of medical equipment and functioning of engineering services;

- Upgrade and Replacement of Medical Equipment (U&R M): performance of upgrading and replacing the medical equipment, affection, outcomes;
- Repair and Maintenance of Non-Medical Facilities (R&M nM): performance of building services, condition of buildings and functioning of engineering services;
- Upgrade and Replacement of Medical Equipment (U&R nM): performance of renovation progress, affections, outcomes;
- Linen Services of Housekeeping (LINEN): quality, comfortableness, cleanliness and tidiness of linen;
- Cleaning of Housekeeping (CLN): performance of housekeeping staff, cleanliness of common areas, wards;
- Security (SEC): performance of security guards, passage control, security patrol;
- Shuttle bus during typhoon No. 8 of Transportation (STL): the schedule of shuttle bus, comfortableness of the hospital van, the performance of drivers;
- Carpark of Transportation (CPK): the efficiency of carpark arrangement, usage of carpark, the environment of carpark;
- Catering Services for Patients (CT-P): food quality, price, taste, waiting time;
- Catering Services for Staff (CT-S): food quality, price, taste, waiting time.

The above FM aspects are the main components of the questionnaire. The design of the questionnaire is described below.

3.3. Determine How to Measure

In order to collect users' perception of the importance and performance of the FM service they are receiving, a questionnaire survey was conducted on the end-users of the hospital. The key characteristics of this hospital are listed in Table 2. The hospital facilities were used by different stakeholders, which can be classified into 3 categories - patients, visiting physicians and hospital staff. As physicians only use the hospital facilities for a short time and most patients normally stay in the hospital for up to 3 – 4 days only, their opinions cannot reflect the full picture of the facility performance. Therefore, this study considered only the opinions of managers and directors who have used the hospital facilities for a long period.

There are a total of 19 interviewees, with 2 males and 17 females, and they are: one director, 16 managers and 2 supervisors. As regards their working experience, 7 of them have

Table 2: Key information about the building

Characteristics	Key Figures
Total site area	7934 m^2
Total no. of beds	135
Total gross floor area	6286 m^2
No. of floors	10
Size of typical floor	1200 m^2

Table 3: Demographic information about the interviewees

Job Level	No. of Interviewees
Director	1
Manager	16
Supervisor	2
Gender	No. of Interviewees
Male	2
Female	17
No. of years working in hospital	No. of Interviewees
below 10 years	7
10 – 20 years	4
over 20 years	6
N.A	2

worked in the hospital for less than 10 years; 4 of them are with the experience between 10 and 20 years; 6 of them have worked for more than 20 years. The demographic information about the interviewees is as shown in Table 3.

As many hospital users may not be familiar with this type of questionnaire, the survey was conducted by personal interviews with the managers and directors. The questionnaire is composed of three sections. The questions in the first section ask about personal particulars, and request the interviewees to indicate their perceived performance of each of the eleven aspects using a 5–point scale (1: very poor; 2: poor; 3: fair; 4: good; 5: excellent). In the second section, the questions ask the interviewees to indicate their perceived relative importance between pairs of the FM aspects using a 9–point scale (1: equal importance; 3: moderate importance of one over another; 5: strong importance; 7: very strong importance; 9: extreme importance; 2, 4, 6 and 8: intermediate values between the two adjacent judgments), which is used in Lai & Yik's study [17]. In the third part, the interviewees are requested to give their overall perception of, and comments on, the FM performance of the hospital.

3.4. Preparing to Use Your Data

After collecting the data of performance ratings, the mean importance and performance ratings of the FM aspects were calculated by averaging the ratings given by the questionnaire respondents. The AHP method was used to analyze the relative importance of the FM aspects, but not every set of the responses was consistent. In order to ensure data quality, once

Table 4: Performance ratings of the consistent group

Aspects	Mean	Rank	Max.	Min.	S.D.
U & R M	4.000	1	5.000	3.500	0.354
R & M M	3.917	2	5.000	3.000	0.449
CLN	3.778	3	5.000	2.000	0.629
LINEN	3.733	4	5.000	3.000	0.573
CT-S	3.412	5	4.000	2.000	0.771
R & M nM	3.342	6	5.000	1.000	1.027
U & R nM	3.316	7	5.000	1.0000	0.976
CT-P	3.250	8	4.000	2.000	0.675
SEC	3.158	9	5.000	1.000	0.874
CPK	2.692	10	4.000	1.000	0.722
STL	2.846	11	4.000	1.000	0.863

an inconsistent response was found, the respondent was requested to make revision until the response became consistent. Based on the equation developed by Lai and Yik [17], the weighted performance scores of the FM aspects were calculated.

The data analysis process and result are explained in the next Section.

3.5. Putting Your Performance Measurement System into Practice

The data collected were analyzed to evaluate the FM performance of the hospital so that areas that require improvement could be identified.

4. ANALYSIS AND DISCUSSION

4.1. Perceived Performance Ratings

From the responses to the questions regarding performance, the mean performance ratings of the FM aspects were calculated by averaging the ratings given by individual respondents. The result was shown in Table 4. Referring to the result, the performances of Upgrade and Replacement of medical equipment tops the table. The performance of Repair & Maintenance of medical equipment was only a little lower than the first one. Cleaning and Linen Services occupy the third and fourth places. The performance of Catering for Staff (the fifth one) was better than Catering for Patients (the eighth one). Repair & Maintenance of non-medical facilities was the sixth one, followed by Upgrade & Replacement of non-Medical facilities. Security, Carpark and Shuttle Bus were the lowest three ones.

4.2. Weighted Performance Scores of FM services

Using the equation presented in Lai and Yik [17], the weighted performance scores given by individual respondents for a particular aspect were calculated by multiplying the AHP

Table 5: Importance scores of the FM aspects

Average	Mean	Rank	Max.	Min.	S.D.
U & M M	0.197	1	0.574	0.061	0.139
R & M M	0.157	2	0.630	0.029	0.152
SEC	0.105	3	0.228	0.007	0.068
CLN	0.097	4	0.276	0.017	0.086
R & M nM	0.083	5	0.225	0.017	0.086
U & R nM	0.071	6	0.208	0.003	0.057
CT-P	0.057	7	0.109	0.018	0.031
LINEN	0.054	8	0.138	0.017	0.032
CT-S	0.050	9	0.288	0.002	0.065
STL	0.050	10	0.107	0.001	0.031
CPK	0.044	11	0.115	0.002	0.039

Table 6: Weighted performance scores of the FM aspects

Aspects	Weighted Performance Scores	%
U & R M	0.789	23%
R & M M	0.616	18%
CLN	0.366	11%
SEC	0.332	10%
R & M nM	0.276	8%
U & R nM	0.235	7%
LINEN	0.201	6%
CT-P	0.184	5%
CT-S	0.170	5%
STL	0.141	4%
CPK	0.118	3%

importance ratings with the performance scores. The importance scores and performance scores of each aspect were calculated, as summarized in Tables 5 & 6. The overall performance score percentages of the aspects were found to be: 23% – Upgrade & Replacement of Medical Equipment; 18% – Repair & Maintenance of Medical Equipment; 11% – Cleaning Services of Housekeeping; 10% – Security; 8% – Repair & Maintenance of non-Medical Facilities; 7% – Upgrade & Replacement of non-Medical Facilities; 6% – Linen Services of Housekeeping; 5% – Catering for Patients; 5% – Catering for Staff; 4% – Shuttle Bus; 3% – Carpark Services.

5. CONCLUSION

Based on an interview survey on a private hospital in Hong Kong, the performance of the eleven aspects of FM services was evaluated by using the importance levels and performance ratings that the building users perceived. For each of the FM aspects, a weighted performance score was computed by taking into account the consistent judgements of the users on the importance of the aspects and their perceived performance ratings.

The result shows that the best performance belonged to Upgrade & Replacement of Medical Equipment, followed by

Repair & Maintenance of Medical Equipment. Undoubtedly, Medical Equipment is an important element in hospital FM. The weighted performance of Cleaning and Security were intermediate. More efforts should be put to improve the performance of non-Medical Facilities, Linen Services, Catering Services, Shuttle Bus and Carpark Services.

6. FURTHER STUDY

To extend this research, the expenditure on different aspects of FM services needs to be collected to evaluate the cost-effectiveness of hospital FM. By comparing the FM performance scores with the cost of services, a more holistic evaluation of the FM services aspects would be obtained. To this end, it is necessary to carry out more detailed analysis using the cost-performance evaluation matrix of Lai & Yik [17].

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