

Qualitative Survey on Managing Building Maintenance Projects

Edmond W.M. Lam, Albert P.C. Chan, and Daniel W.M. Chan

Abstract—Buildings are one of the valuable assets to provide people with shelters for work, leisure and rest. After years of attacks by weather, buildings will deteriorate which need proper maintenance in order to fulfill the requirements and satisfaction of the users. Poorly managed buildings not just give a negative image to the city itself, but also pose potential risk hazards to the health and safety of the general public. As a result, the management of maintenance projects has played an important role in cities like Hong Kong where the problem of urban decay has drawn much attention. However, most research has focused on managing new construction, and little research effort has been put on maintenance projects. Given the short duration and more diversified nature of work, repair and maintenance works are found to be more difficult to monitor and regulate when compared with new works. Project participants may face with problems in running maintenance projects which should be investigated so that proper strategies can be established. This paper aims to provide a thorough analysis on the problems of running maintenance projects. A review of literature on the characteristics of building maintenance projects was firstly conducted, which forms a solid basis for the empirical study. Results on the problems and difficulties of running maintenance projects from the viewpoints of industry practitioners will also be delivered with a view to formulating effective strategies for managing maintenance projects successfully.

Keywords—characteristics, problems, building maintenance, Hong Kong

I. INTRODUCTION

BUILDINGS have been considered as one of the most valuable assets of a nation to provide people with shelter and facilities for work and leisure. In fact, no building can stand against the attacks of weather and so maintenance is essential to preserve it so as to meet the changing demands of the users. Building maintenance accounts for over half of the total output of the building industry [1]. In Britain, building maintenance activities have reached a level of 50% of all annual construction activities [2,3]. While there has been a significant increase in refurbishment works both in the UK and in the Italian construction industries in the last 30 years, the gross value of general trades such as decoration, repair and maintenance, and construction work at minor work locations has been increased over the past 5 years in Hong Kong [4,5]. Statistics show that the percentage of the gross value of repair and maintenance work to that of the total construction work has increased steadily from 20% in 2000 to 28% in 2004. While the total contract value in 2007 was only 70% of the total at its peak value at \$139 billion in 1997, the share of repair and maintenance works increased more than a double over the past 10 years (from 22.5% in 1997 to 51.6% in 2007) [6].

Edmond W.M. Lam, Instructor, Department of Building and Real Estate, The Hong Kong Polytechnic University, bsellam@inet.polyu.edu.hk

Albert P.C. Chan, Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University.

Daniel W.M. Chan, Assistant Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University.

Al-Arjani [7] also added that governments all over the world have considerable expenditure directed toward maintenance and operation projects.

The number of accidents in repair, maintenance, minor alteration and addition work has also been increased with the growing number of building maintenance works. In Hong Kong, although the total number of reported accidents has been decreased significantly over the last 10 years (from 19,588 in 1998 to 3,042 in 2007), the percentage of the accidents in the repair and maintenance work to all reported construction accidents has increased by more than 50% over the period [8]. In fact, the maintenance of buildings plays an integral role in the whole design and construction process of buildings [9]. However, some building owners regarded maintenance as an undesirable overhead and considered as the first target for reductions in budget when the time of recession comes [10]. Most research has focused on managing new construction and Wood [11] claimed that building maintenance is even under-researched. Given the short duration and more diversified nature of work, project participants may have encountered problems in running maintenance projects in practice, which should be properly documented for devising corresponding project management strategies. This study sets out to identify the problems in running building maintenance projects in practice. It begins with outlining the methodology for the research. Findings from the literature survey and structured interviews with ten industry practitioners will be presented, followed by conclusions for the research.

II. METHODOLOGY

The aim of this paper is to identify problems of running building maintenance projects from the practical experience of the project participants in the Hong Kong construction industry. The research disseminates the preliminary findings of establishing a benchmark model for maintenance projects. Similar research has been undertaken by the authors on the perceptions on the D&B procurement method from the viewpoints of the stakeholders and the measurement of success for maintenance projects [12,13]. The present research was conducted by means of literature survey and structured interviews. Relevant textbooks, high-ranked journal papers and conference proceedings were screened for the characteristics of maintenance projects reported by previous researchers and practitioners. Research efforts have also been put on organizing structured interviews with the participants of maintenance projects in the Hong Kong construction industry. The interviewees were selected from local client and contractor organizations, and they were contacted between May and June 2006. A list of questions was attached to the letter of invitation, and the interviews were recorded and transcribed for subsequent analysis. Findings of the structured interviews were analyzed and quantified to differentiate the responses of the project

participants and to obtain the relative importance of ~~Vol.4~~ attributes.

III. REVIEW OF CHARACTERISTICS AND DIFFICULTIES OF RUNNING BUILDING MAINTENANCE PROJECTS

Maintenance can be defined as work undertaken to keep or restore every facility to an acceptable standard [14]. This work may be organized and carried out with forethought, control and records or carried out on an emergency basis when the need arises. Kherun et al. [2] perceived building maintenance projects as improvement, refurbishment, maintenance and repair works which have a number of unique features distinctive from new construction. Therefore, building maintenance management is regarded as a practical technique that is fragmented and uncoordinated in most circumstances [15]. Previous researchers agreed that managing maintenance projects brought along with some practical problems in dealing with people, the environment and the project itself.

A. Tackling with project stakeholders

Arditi and Nawakorawit [16] pointed out that few building owners regard planned maintenance as a matter for serious concern. Some designers and contractors also give a low status to refurbishment work when compared with new construction [17]. Therefore, the lack of cooperation among the parties, especially the contractor and the designer at the design stage, may lead to problems of maintenance [18]. While few building owners realize the importance of timely maintenance, other project parties are also reluctant to assume further responsibilities and so more qualified workers are not attracted to maintenance projects [18,19]. Some clients of small building works in private residential blocks are relatively inefficient at acquiring the necessary information themselves [20]. As a result, the infrequent communication between property managers and building designers often causes design-related maintenance problems [16]. Tensions and conflicts can also arise among residents and other stakeholders in relation to a range of management and maintenance issues [21].

B. Tackling with project environment

Refurbishment often involves working on confined sites with restricted access and so such maintenance work is often said to cause inconvenience to a building owner or occupier [10,17]. Some projects may still be in operation while maintenance works proceed and there are problems of congestion and interference between users and workers, resulting in unproductive time [17]. The restricted site conditions also cause problems in shared access with other sub-contractors, the public, the occupants, and the space for removing waste and bringing in new materials [22]. As maintenance projects involve more uncertainties and risks than new build construction, hidden risks are entailed due to partial or unreliable information from the client which may result in ambiguous scope of work [4,23]. Moreover, since the scope and extent of refurbishment is wide, it is often difficult to specify the extent of the work prior to commencement on site [23,24]. Therefore, project definition may take longer owing to uncertainty and the difficulty to capture the actual condition of the existing building completely [17,25].

C. Tackling with project management

Maintenance projects potentially contain more technical and economic uncertainties [25]. Zavadskas et al. [26] described building maintenance as being carried out in a minor, short-term and discontinuous process mostly performed manually. In practice, maintenance work normally requires works to be attended at short notice, which can lead to problems in resource mobilization [20]. Moreover, it is more difficult to use standard products on refurbishment and renovation projects and so opportunities for prefabrication and industrialization are limited [25]. Chew and De Silva [27] also criticized the expertise and equipment are always limited in repair and maintenance works. The lack of a systematic maintenance recording system, long response time and limited budget are leading factors for the inefficiency of most maintenance programmes. Moreover, there are greater uncertainties in maintenance projects because of the difficulty of securing accurate as-built drawings [28]. Even if original drawings and specifications are available, substantial changes and renewals have been undertaken during the maintenance works [17].

IV. PERSPECTIVES OF CLIENTS AND CONTRACTORS ON PROBLEMS OF RUNNING BUILDING MAINTENANCE PROJECTS

Apart from conducting the literature search to provide a comprehensive knowledge base for the study of the characteristics and difficulties of running building maintenance projects, an empirical study has been launched with ten participants of maintenance projects within the Hong Kong construction industry to understand the problems of running building maintenance projects in practice (Table I).

TABLE I
DETAILS OF INTERVIEWEES

ID	Group	Title	Project type
Cl1	Client	Chief Building Surveyor	Residential
Cl2	Client	Senior Maintenance Surveyor	Residential
Cl3	Client	Project Manager	Commercial
Cl4	Client	Technical Secretary	Residential
Cl5	Client	Property Centre Manager	Commercial
Ctr1	Contractor	Senior Estimator and Asset Maintenance Manager	Civil works
Ctr2	Contractor	Director	School building
Ctr3	Contractor	Manager	Commercial
Ctr4	Contractor	Contracts Manager	Residential
Ctr5	Contractor	Contracts Manager	Commercial

The interviewees were labeled with prefix Clt- or Ctr- to represent client and contractor organizations respectively. Five came from the client group and five from the contractor group, who were chosen from the senior and middle management level in the local context. The interviews were conducted from June to July of 2006 based on the following question as reported in the current study:

What are the problems of running building maintenance projects?

Table II shows the results of the interviewees on Vol. 4, No. 5, 2019. problems of running building maintenance projects in construction.

TABLE II
PROBLEMS OF RUNNING BUILDING MAINTENANCE PROJECTS

Respondents	Constraints of existing buildings	Unclear scope	Inadequate contract and specifications	Fragmented nature	Short duration	Inefficient Communication	Inactive Attitude of participants	Lack of expertise
Cl1	✓				✓			
Cl2	✓			✓		✓		✓
Cl3	✓				✓	✓	✓	
Cl4	✓					✓		
Cl5		✓				✓		✓
Ctrl				✓	✓			
Ctrl2	✓		✓	✓				✓
Ctrl3	✓					✓		
Ctrl4		✓	✓	✓	✓			✓
Ctrl5				✓		✓		
Total	6	2	2	5	4	6	1	4

A. The Clients' viewpoints

Cl1 pointed out the problem of managing maintenance projects within the constraints of a confined space. It is only upon opening up can the problem be discovered, such as the obstacle from wiring and footing for lift pit (Cl4). As maintenance works are carried out in occupied buildings, proper work arrangement and coordination was required. Moreover, most maintenance works for commercial buildings proceed at night while those for residential buildings at daytime, complicating the technical and work scheduling. Clt 2 interviewee also found it challenging to come up with a schedule with the occupants in the building. During construction, it is necessary to control dust within the unit and contractor has to take into serious consideration the service provided to the occupant. Most client interviewees believed that disruption to the occupants will be another problem. Clt 3 pointed out that cooperation with the operational team to suit the noisy hour requirements and controls is particularly difficult while Clt 4 stressed the importance of setting up protective measures to minimize disturbance. Clt5 highlighted problems in execution, which lie in the tendering work, the component itself, and the program of work which involves great challenges to reduce disturbances to users. Some renovation works were being carried out while other parts of the building were still doing business, which confers additional challenges to the management team.

The fragmented nature was cited by Clt2 as one problem area in managing maintenance projects where the duration is shorter and it is difficult to sustain a steady workforce. More time is also consumed to liaise with occupants above and below the affected area. Both construction and service should be managed, emphasizing that maintenance work is not just providing expertise in construction but also quality service to users of the building. Clt4 further pointed out that liaison with the clients and tenants is difficult. In case of rental housing, consultation also has to be made with the

Vol. 4, No. 5, 2019. end-users of the estate. Different end users have different requirements that can hardly be met by the project team. This was echoed by Clt5, who claimed that communication with the staff itself and end-users is important and challengeable.

Clt3 regarded the inactive attitude of participants as one major problem of managing maintenance projects, including the client themselves. To obtain approval from the owner and provide justification to carry out maintenance works is also difficult. From the business point of view, the client may concern whether business will be improved because of the maintenance works. This is subjective and only when the maintenance works have been done can the effect be seen. What the project team suggested or recommended may not be proved to be correct unless the client was provided with hard data. In case the estimate on profit is too conservative, it may not be convincing enough for the client to agree on the maintenance works. Clt5 also opined that most clients were conscious about budget allocation by considering seriously the life cycle and life span of the building components, and would decide whether to replace them or to maintain them by comparing the cost with the payback. This may test the ability of the project team to estimate the economic life of the building and planning in advance requires a clear understanding of the job nature so that approval can be granted from the client. Clt2, on the other hand, criticized the lack of expertise of other project team members. The quality of contractors sometimes varies in the planning and procurement of materials aspects. In most cases, they have difficulty in time control and craftsmanship of the work. Control on noisy work is also another challenge to the contractor in maintenance works (Clt3).

B. The Contractors' viewpoints

Most contractor interviewees found it challengeable to deliver maintenance projects. One problem is related to the constraints of the existing building. Ctrl2 emphasized the importance of close attention on the transportation of materials because of the site constraint and it is not practical to install hoist for transporting materials to upper floors in maintenance works when compared to material delivery in new works. Instead, a routing with minimum disturbance to users is chosen. Great care should also be given to the scaffolding works such as security since the premises are in use but which are not totally enclosed. It is necessary to find the same materials to match with the existing features since in maintenance works, normally only a particular part is to be replaced. In case the materials are not available on market, close substitutes have to be confirmed with the users. Ctrl3 further added that unexpected problems may exist on the surrounding area, say, for example, when the air-conditioning system sudden breaks down and people may feel uncomfortable. The project team has to act fast to maintain a safe and comfortable environment for the existing users. In fact, maintenance works can only be undertaken when the components concerned are not in operation in order to reduce interruption to a minimum level.

Ctrl4 expressed that most maintenance contracts are re-measurement contracts without fixed bills of quantities but with schedules of rates. In most cases, the job descriptions are not detailed and final measurement has to be submitted from the contractor after completion of the works. If the site diary is not clearly recorded, there are problems in claiming the works done. He further quoted his personal work

experience for not being able to claim for the works done, because of the absence of submitting the site instructions and tight budget. Proper recording on site is difficult as additional works could only be discovered from the actual working environment. Checking the number of workers on site is another teething problem since it is not possible to install one checking system in every site given the scattered nature and the great number of maintenance works. Moreover, there is a lack of supervisory staff to inspect the number of workers on all sites and claims concerning the workers can be unreasonably large. With the introduction of workers registration system, extra burden will be added to the contractor to comply with the legislation. Ctr2 and Ctr5 further attributed the low tender price to the scattered nature of maintenance projects, which may produce low quality work. While maintenance works are technically simpler, the planning of manpower for a variety of jobs is more problematic. Ctr2 added that because of the unstable volume of maintenance works in the market, it is impossible to house a variety of workers for better quality control. This was agreed by Ctr4 who claimed that it is difficult to forecast workload in maintenance projects. As a result, additional manpower is required for some unforeseeable work types.

Ctr2 believed that managing maintenance works is not just a matter of construction but involves taking care of the end-users since in most cases, only a portion of the building was necessary for maintenance works. This was agreed by Ctr5 who stressed that communication is a challenge to the project team since all activities are confined to an inhabited site and it is necessary to plan the works carefully to minimize disturbance to the users. He also pointed out the misconception of some clients who consider maintenance works inferior and so fewer resources are invested in maintenance works. Most contractor interviewees concurred on the lack of expertise in maintenance projects. Ctr1 expressed that while some maintenance projects could only be carried out at night, the construction methods would be restricted to observe the rules of the government. Ctr2 also agreed that tactful skills were required to plan resources and estimate the quantity of works properly, such as what trades most likely appear in the contract. Some maintenance works may involve multi-users and liaison becomes a difficult task for the contractor to satisfy the schedules of all users affected (Ctr3). Given the scattered and varied nature of maintenance works, it is challengeable for the contractor to come up with a genuine estimate within 10% in the re-measurement works (Ctr4). A further problem concerns the workload which has to be estimated by experience. Therefore, the manpower planning should be flexible and the project team should be alert to the sudden increase in workload.

V. CONCLUSIONS

The management of maintenance projects is an important process to provide systematic and effective measurement and control for better project performance. The research provides a desk study of the characteristics and difficulties of running building maintenance projects, followed by an empirical study with the industry practitioners in the Hong Kong setting. With the increasing number of maintenance projects in most cities worldwide, there exists an urgent need to identify major problems for establishing better management strategies. The review of literature classifies

those concerned with project stakeholders, project environment and project management. In practice, most clients and contractors consider "Constraints of existing buildings", "Inefficient communication", "Fragmented nature", "Short duration" and "Lack of expertise" as the top-ranked problems, which agreed well with the literature and were related to project environment, project stakeholders and project management issues. While the client interviewees regarded "Constraints of existing buildings" and "Inefficient communication" as the most difficult to tackle, the contractor interviewees believed "Fragmented nature" as their teething problem. Further research can be done on analyzing the critical factors enhancing the success level of running maintenance projects in order to cater for the increasing number of ageing buildings worldwide.

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REFERENCES

- [1] Wordsworth, P. (2001). *Lee's building maintenance management*. 4th edition, Blackwell Science.
- [2] Kherun, N.A., Ming, S., Petley, G. and Barrett, P. (2002). Improving the business process of reactive maintenance projects. *Facilities*, 20(7/8), 251-261.
- [3] Shohet, I.M. (2002). Key performance indicators for maintenance of hospital buildings. *Proceedings of the CIB Working Commission 070, CABER, Glasgow Caledonian University*, Sept 2002, 79-90.
- [4] Egbu, C.O., Marino, B., Anumba, C.J., Gottfried, A. and Neale, B. (2002). Managing health & safety in refurbishment projects involving demolition and structural instability. *Proceedings of the CIB Working Commission 070, CABER, Glasgow Caledonian University*, Sept 2002, 315-327.
- [5] Edmond W.M. Lam, Albert P.C. Chan and Daniel W.M. Chan (2009). Potential problems of running building maintenance projects in construction. *The 3rd International Conference on Construction Engineering and Management (ICCEM) / 6th International Conference on Construction Project Management (ICCPM) 2009*, 27-30 May 2009, Jeju, Korea (In Abstract booklet; p. 234).
- [6] Census & Statistics Department. (various years). *Report on the quarter survey of construction output*, The HKSAR Government.
- [7] Al-Arjani, A.H. (2002). Type and size of project influences on number of bidders for maintenance and operation projects in Saudi Arabia. *International Journal of Project Management*, 20(3), 279-287.
- [8] Labour Department. (2008). *Accidents in the construction industry of Hong Kong (1998-2007)*. Accident Analysis & Information Division, Labour Department.
- [9] Shabha, G. (2003). A low-cost maintenance approach to high-rise flats. *Facilities*, 21(13/14), 315-322.
- [10] CIOB (1990). *Maintenance management - A guide to good practice*. The Chartered Institute of Building.
- [11] Wood, B. (2005). *Innovative building maintenance*. Conference Proceedings of The Queensland University of Technology Research Week International Conference, 4-8 July 2005 Brisbane, Australia, 601-607.
- [12] Lam, E.W.M., Chan, A.P.C., and Chan, D.W.M. (2003). A Critique of The Use of Design-Build in Hong Kong: Its Implications for the Construction Industry. *Proceedings of the 5th Asia-Pacific Structural Engineering and Construction Conference*, 26-28 August 2003, Johor Bahru, Malaysia, 105-119.
- [13] Albert P.C. Chan, Daniel W.M. Chan and Edmond W.M. Lam (2007). A Qualitative Survey on Success for Maintenance Projects. *5th triennial International Conference on Construction Project Management (ICCPM)/2nd International Conference*

on Construction Engineering and Management (ICCEM), Vol. 4, No. 5, 2010
 March 2007, Singapore (In Abstract booklet; p. 60).

- [14] Lawson, F.R. (1995). Hotels and resorts, Architectural Press.
- [15] Allen, D. (1993). What is building maintenance? *Facilities*, 11(3), 7-12.
- [16] Arditi, D. and Nawakorawit, M. (1999). Issues in building maintenance: property managers' perspective. *Journal of Architectural Engineering*, 5(4), 117-132.
- [17] CIRIA (1994). A guide to the management of building refurbishment. Construction Industry Research and Information Association, CIRIA Report 133.
- [18] De Silva, N., Dulaimi, M.F., Ling, F.Y.Y. and Ofori, G. (2004). Improving the maintainability of buildings in Singapore, *Building and Environment*, 39, 1243-1251.
- [19] Kwong, A.C.W. (2005). Forging quality buildings through market force. The HKIE Building Division 4th Annual Seminar Quality Building - A Culture or a Myth?, Friday, 18 March 2005 Hong Kong, 26-33.
- [20] Yiu, C.Y., Lo, S.M., Ng, S.T. and Ng, M.M.F. (2002) Contractor selection for small building works in Hong Kong. *Structural Survey*, 20(4), 129-135.
- [21] Yip, N.M. and Forrest, R. (2002) Property owning democracies? Home owner corporations in Hong Kong. *Housing Studies*, 17(5), 703-720.
- [22] Rahmat, I, Torrance, VB and Young, BA (1998) The planning and control process of refurbishment projects. Association of Researchers in Construction Management Fourteenth Annual Conference, September 9-11, University of Reading, Vol 1, 137-145.
- [23] Reyers, J and Mansfield, J (2001) The assessment of risk in conservation refurbishment projects. *Structural Survey*, 19(5), 238-244.
- [24] Headley, J and Griffith, A (1997) The procurement and management of small works and minor maintenance, Longman.
- [25] Lee, CCT, Hayles, C and Egbu, C (2005) The adoption of requirements management in the delivery of refurbishment projects. Conference Proceedings of The Queensland University of Technology Research Week International Conference, 4-8 July 2005 Brisbane, Australia, 851-861.
- [26] Zavadskas, E, Bejder, E and Kaklauskas, A (1998) Raising the efficiency of the building lifetime with special emphasis on maintenance. *Facilities*, 16(11), 334-340.
- [27] Chew, M.Y.L. and De Silva, N. (2003) Maintainability problems of wet areas in high-rise residential buildings. *Building Research and Information*, 31(1), 60-69.
- [28] Fawcett, W. and Palmer, J. (2004) Good practice guidance for refurbishing occupied buildings, *CIRIA*, C621, 112 pages.