THE COMPLEXITY AND PERFORMANCE OF HOUSING REFURBISHMENT PROJECTS

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ABSTRACT

Housing refurbishment sector is increasingly becoming an important sector in the Malaysian construction industry. However, it has not been established why this is so. The increase in demand for house refurbishment encourages contractor to be involved in it. Many of them have little knowledge the main problems of managing refurbishment project. Literature review revealed than the majority of refurbishment projects performed badly. Hence, this study is to establish the reasons for house refurbishment, the management problems related to it and the performance of house refurbishment projects. Face to face interviews were conducted with 30 refurbishment managers operating within the Klang Valley, Malaysia. This study concludes that obsolescence rather than deterioration is the main reason for initiating house refurbishment projects. House refurbishment cycles due to obsolescence tend to be shorter than those due to deterioration. The performance of house refurbishment projects is generally poor. The majority of house refurbishment projects tend to exceed the target cost and target time. The traditional house method tend to perform better than prefab the refurbishment projects The main problems faced by house refurbishment managers are the settlement of variation orders, the difficulty of access to the site, storage of materials on site and dust and noise control.

Keywords: House refurbishment, complexity, project performance

Introduction

Building house refurbishment, in its many forms, such as modernisation, renovation, rehabilitation and repair is one of the most important economic drivers in the construction industry of many developed countries. In Malaysia, the contribution of house refurbishment to the construction industry output is not precisely known. The unpublished data obtained from the CIDB shows that R& M contributed RM1.2 billion or about 2% of construction output in 2001. But since the CIDB Malaysia statistics on the R & M sector do not include works carried out illegally by many house owners, i.e., house refurbishment works without the approval of the Local Authorities, the actual size of house refurbishment work is probably much larger.

The literature review revealed that house refurbishment projects are initiated for various reasons. Flanagan et al (1989) include physical deterioration and obsolescence due to functional, technological, economical social, locational, legal, aesthetic and visual (fashion/image). as the major reasons for house refurbishment.

These factors contribute to the high demand for refurbishment. Figure 1 shows that the output of refurbishment sector from 2002 to 2006 increased sharply except for 2004 when the output declined. However, refurbishment activities picked up in the following year. This was due to the government policy of putting more emphasis on repair and maintenance activities, rather than on new construction projects. The trend is expected to continue in the future since more money has been allocated for repair and maintenance in the Ninth Malaysian Plan.

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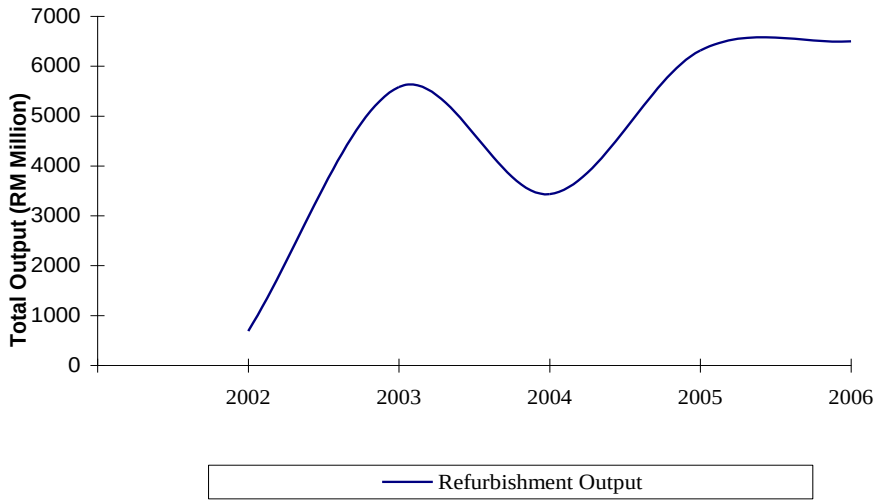

Figure 1+: Refurbishment Projects Output in Malaysia

In the 9th Malaysia Plan, the government forecasted that the construction sector would have an average growth of 3.5 percent per annum, compared with only 0.5 percent average growth during eighth Malaysian Plan. One of the largest allocations is for the construction sector, in which the government will inject almost 19 billion Ringgit Malaysia during the next five years. This allocation includes provision for infrastructure, building, and repair and maintenance projects. The development plan allocation for repair and maintenance works increased from RM 296 million during the Eighth Malaysian Plan to RM 1079 million in the Ninth Malaysian Plan (Malaysia, 9th Malaysian Plan, 2006). Hence, it is expected that refurbishment work will become more important in the future.

In year 2006 refurbishment constituted 16 percent of total Malaysian construction output (CIDB, 2007). However, many refurbishment projects carried out are unreported, especially those undertaken by house owners who have carried out illegal renovation works. Therefore, if this figure is taken into account, the actual value of refurbishment works in this country should be higher.

Refurbishment is generally considered more complex and of higher risk and as having more cost and time over-runs than new build projects (Boyd and Weaver, 1994). Egbu (1994) however argued that the degree of complexity depends on the types of building, with hospital refurbishment to be the most complex. Ismail (1997) however found that the degree of complexity depends on many factors. There was no significant difference in complexity between different types of building. Many house refurbishment projects were also found to be complex and difficult to manage since many of them were occupied.

Research on house refurbishment, however, has been relatively ignored, with the focus of research mainly directed to new build (Douglas, 1988; and Young and Egbu (1992).

The main objectives of the study are as follows: -

1. To determine the reasons for house refurbishment
2. To determine the factors that contribute to the complexity
3. To determine the performance of house refurbishment projects

Methodology

The methodological procedure is to ensure that the information obtained for this study was rigorously obtained, relevant and capable of scientific evaluation.

Face to face interviews were conducted with 30 companies undertaking refurbishment projects. The companies were identified from the lists given by the Majlis Perbandaran Klang, Majlis Perbandaran Subang Jaya and Facility and Maintenance Department, Universiti Teknologi MARA. The size of the construction companies is shown in table 1.

Table 1: The size of the construction firms participated in the research

Size (annual turnover 2002)	Construction companies (N=30) %
Less than RM1 million	41.2
RM1 million to RM10 million	29.4
RM11 million to RM100 million	23.5
More than RM100 million	5.9

The construction companies were asked to select the most recent house refurbishment project carried out by them. The refurbishment project must be must start after 31 December 1998. The inclusion of this criterion was considered to be necessary, in order to ensure that only the most recent projects were chosen and reduce the effects of variability in market conditions. Besides, accuracy in measurement could also be affected by memory lapse (Moser and Kalton, 1993).

For this study, the Statistical Package for the Social Sciences (SPSS for Windows Version 11.0 was used for data transformation and analysis.

Frequency distributions and descriptive statistics are used to show the general trends in the reasons for refurbishment, the difficulty of refurbishment projects and the project performance scores. The results are presented in tabular forms.

The Reasons For House Refurbishment

The house refurbishment of a building may be initiated for various reasons. Flanagan et al (1989) include physical deterioration and obsolescence as the major reasons for house refurbishment. The factors that contribute to obsolescence as stated above are functional, technological, economical social, location, legal, aesthetic and visual (fashion/image) and environmental obsolescence.

Many old buildings in Malaysia have deteriorated, that is, the physical quality of the building is slowly declining and not performing the way it was intended. Large stocks of buildings especially in the Malaysian cities have been underutilised, wrongly used or have become dilapidated. The deterioration of the buildings exerts pressures on both public and private building owners to refurbish their buildings. During the present economic recession, building owners are pressured to conserve resources. During this time, many of them began to recognise the value of their existing building. The shortage of land and the explosion in land prices especially in the Klang Valley discouraged many property owners from buying land and building new buildings. These make refurbishment a more attractive option.

Technological, social, location, legal, aesthetic, image and environmental changes have also contributed to buildings becoming obsolete and disused. Technological change shortens the functional life of buildings at an increasing rate, which requires modernisation of services

on those buildings. This is especially true for shops and offices. Some houses were refurbished because of their historical and cultural values. The pressures from social and preservationist groups which are in favour of keeping national heritage buildings, has also contributed to the growing demand for refurbishment. In addition, sustainable construction, which results from a growing environmental awareness to save natural resources, has become a common theme between practitioners and academics in the Malaysian construction industry. They are likely to promote refurbishment, which would help to boast the growth of refurbishment sector in Malaysia.

Aikivuori (1996) conducted a study in Finland to determine, quantitatively, the most important factors that contribute to increased demand for refurbishment projects. The factors are classified into five categories, i.e. failure in building due to deterioration, optimisation of economical factors, change in use, change in circumstances and subjective features of the decision-maker. The study discovered that nearly half of the refurbishment projects were initiated due to subjective features of the decision-maker i.e. to add comfort and to improve the appearance of a building. More than a quarter were refurbished because of change of use. Refurbishment due to deterioration constitutes less than a fifth of all refurbishment project being carried out.

This study investigated the reasons for house refurbishment projects in Malaysia. The results are shown in table 2. Like Aikivuori's (1996) finding, refurbishment due to subjective features of the decision makers, such as to add comfort and to improve appearance are the main reasons for refurbishment. However, refurbishment due to deterioration contributes highly in this research.

Table 2: The reasons for house refurbishment

	Reasons for house refurbishment	House refurbishment Projects (N=30) %
1	Rearrangement of space use	68.0
2	To add comfort of the building	66.7
3	To improve the appearance of the building	62.5
4	Change of use	48.0
5	The building has deteriorated into unacceptable condition	36.0
6	Change in the family size	33.3
7	Improving market value	25.0
8	Reducing cost of maintenance	20.8
9	Change of owner	20.8
10	Reduce the operating costs	16.7
11	Change due to additional health needs	12.5

Refurbishment projects due to subjective features of the decision makers tend to have a shorter refurbishment cycle compared to refurbishment projects due to obsolescence. Shorter refurbishment cycles create greater demand for refurbishment.

The Degree Of Complexity Of House Refurbishment Projects

Complexity and uncertainty are inherent in all construction, no matter what the size of the project (Thompson and Perry, 1992; Smith, 1989 and Gorgone, 1992). They are characterised by intense interactions between groups of participants, which tends to lead to inter-group and interpersonal conflicts. To reduce conflicts and to achieve coherent objectives, construction projects require integration of many disciplines across organisational boundaries.

Young et al (1996) maintained that managing a refurbishment project is managing a dynamic environment, a condition in which the situation is ever changing such that the present data may turn out to be a poor guide to future states. Refurbishment planning involving many interdependent decisions on interrelated aspects of the works, and for decisions to be fully and effectively accommodated, refurbishment planning would need to address complexity and uncertainty more explicitly and systematically.

The review of literature reveals that many management writers, outside construction have proposed methods of measuring the complexity and uncertainty faced by an organisation. Duncan

(1972), Lawrence and Lorsch (1967) measured complexity and uncertainty subjectively, based on people's perceptions. Michael (1973) and Weick (1969) argued that subjective measurement is valid. Since actions are instituted by individuals, management activities are affected only after someone has perceived environmental conditions and interpreted them as having an impact on the organisation. Thus, complexity and uncertainty may be meaningless for organisational action until the decision-makers classify it as important. The determining factor in a manager's action is his perception of complexity and uncertainty.

Van de Van and Delbecq (1974) in their study titled, 'A task contingent model of unit work structure', measured the effects of uncertainty on the extent to which departments in an organisation used various integrative mechanisms. In the study, the degree of uncertainty was measured subjectively, by asking the respondents whether the task uncertainty faced by their organisations was simple, medium or complex. Ven de Van and Delbecq (1974) found that in general, increased uncertainty faced by an organisation led to an increase in the extent to which the integrative mechanisms were used.

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Faniran et al (1994) in their studies titled 'The effectiveness of construction planning' measured the complexity of construction project subjectively and objectively. Among the situational variables measured objectively were; the number of subcontractors and the number of construction trades employed in the construction projects. The variables measured subjectively by them were the percentage of completion of design before the onset of construction, past construction experience, weather predictability and the availability of labour and material in the vicinity of the construction project.

In this study, subjective measurement based on respondents' perceptions were used to measure the complexity of the refurbishment projects. the degree of complexity of 22 variables on the different types of house refurbishment projects. The respondents were asked to rate the degree of difficulty of each variable on a four point scale, ranging from 1 for very easy to 4 for very difficult. The mean score for each variable was obtained. The scores are classified as follows:

Mean score	degree of difficult
1.0 –1.5	very easy
1.6 –2.5	Easy
2.6 – 3.5	Difficult
3.5 – 4.0	Very difficult

The results are shown in table 3

Table 3: The degree of difficulty of situational variables

	Complexity variables	Mean
1	Settlement of variation orders	2.8
2	Reducing noise	2.8
3	Reducing dust	2.7
4	Access to site	2.7
5	Space available on site	2.6
6	Settlement of final account	2.6
7	Liaising with local authorities	2.6
8	Handling hazardous materials	2.5
9	Coordinating with neighbours	2.4
10	Ensuring security	2.4
11	Getting funds for the project	2.4
12	Liaising with design team	2.4
13	Managing contract	2.4
14	Achieving satisfactory planning and control	2.4
15	Availability of labour	2.4
16	Complying with building regulations	2.3
17	Feasibility study	2.3
18	Availability of design information	2.3
19	Achieving safety	2.3
20	Choosing subcontractor	2.3
21	Availability of material	2.2
22	Weather	2.1

These results show that settlement of variation orders, access to the site, and reducing dust and noise control were four of the most difficult management tasks in house refurbishment projects. On the other hand, weather and availability of labour and material were two of the easiest ones.

Changes in design during construction have two major implications. Firstly, it is susceptible to opportunistic behaviour. Invariably, the contractors would claim for higher variation orders. This may cause increase project cost, delays and reduced client satisfaction. It may also lead to conflicts in the project, especially between the client and the main contractor Quah (1986) noted that most refurbishment projects were set out for tendering on the basis of very little structural survey of the existing buildings. Detailed survey is not always feasible because the buildings tend to be occupied (Boyd and Jankovich 1993). This necessitates a greater proportion of provisional sums and contingency allowances in the tender documents than that of new build work. This, according to Quah (1986) was necessary because of the unknowns, which may be uncovered during the execution of the work. There are also a higher proportion of variation orders in a refurbishment contract, and the tendency for the job to expand to meet the budget

Noise and dust control are two of the most difficult management tasks faced by refurbishment managers. The effects of noise, dust and vibration on the occupants of a building are often underestimated. This is especially true for building with high content of demolition and services work. For hospital refurbishment projects, these problems could be very difficult to manage. They constitute very significant problems which can be eased only

by careful selection of equipment and techniques together with good communications, warnings and planning.

In occupied refurbishment projects, the occupants and the construction workers have to share the same space. This situation is described by management writers such as Walker (1989) as pooled interdependency whereby the participants involved in a construction project share an independent resource. Sharing the same limited space requires the participants to be tolerant, adopt the spirit of give and take and respect others' needs. When the contractor in a refurbishment project fails to consider the needs of the occupants for space to carry out their daily activities, conflicts with the occupants are more likely to occur. The client often reserves the right to stop the refurbishment work if they found that their daily business activities are severely affected.

Quah (1992) maintains that there is an underlying requirement that refurbishment operations should not interfere with the normal usage of the building. Summers and Fellows (1987) point out that when the buildings to be refurbished are occupied, extra precautions are necessary in order to provide dust and noise protection and to ensure effective management and supervision. The contractor must ensure that the origins of the dust and noise and the occupants and equipments inside the building must be separated. The use of dust covers and temporary walls could reduce the problems.

In many refurbishment projects, the works have to be carried out in sensitive premises, such as embassies and government offices. A contractor undertaking a refurbishment work in such premise needs to take extra precautions to ensure the security of sensitive documents kept on the premise. In addition, on such premise, the client or occupants may impose restrictions on access to certain parts of the buildings and thereby restrict the movement of site operatives within the building. This makes it difficult to have continuity in the work and therefore requires more effort in coordination, planning and control.

Traffic restrictions in the heavily developed and disturbance–sensitive business areas where many refurbishment projects are undertaken may require all deliveries to be made in the early hours of the morning. The difficulty of access to the project site is more prevalent in shop and office refurbishment projects because most of these buildings are located in commercial areas and they often share party walls with the adjoining properties.

Many of the refurbishment projects have to be executed on confined sites with adjoining buildings continuing full operation. When tower crane is used, the jib of the tower crane may over sail the adjacent property. Hoists may have to be installed passing the windows of occupied rooms. The contractor will have to get the permission of the neighbours who own the adjacent properties to let the jib of the tower crane to over sail them and to let hoists to be installed in front of the neighbours' windows. However, in most situations, the neighbours do not have any direct interest in the refurbishment project. The neighbour will naturally wish to continue the normal use of his own building and will resist any disruption to that use. They have to take unnecessary safety and security risks for a refurbishment project that does not benefit them. It is not uncommon to have neighbours opposing the refurbishment work and motivated to impede or to gain benefits from it. Even though they initially agreed with the development, they change their attitude when the construction work has started when they have to cope with the persistent sounds of mechanical hammers, noise and dust problems. They become less willing to cooperate and often become hostile to the project.

In addition, the contractors need external and internal construction access for the movement of workers, materials and equipment. Parking and off-loading points for contractor's vehicles must be provided. However, this problem is normally handled by taking the parking space for occupants. This may cause resentments and hostilities from the occupants.

The lack of space, horizontally and vertically is one of the factors that contributes to the complexity and uncertainty of refurbishment projects. Space is needed on construction sites for loading and unloading, car parking and placing building materials, big plant and equipment. However, most refurbishment projects are carried out in congested areas, where space is normally limited. Rahmat (1997) found that about 60 percent of refurbishment projects have small or very small space on site. Some refurbishment projects solve this problem by constructing high level cantilevered platforms, constructed above the roads adjacent to the building. However, in order to do this, planning approval from the local authority must be obtained. Some local authorities may not allow the platform to be built above very busy streets, for the safety of the passers-by. Hence, due to limited space, the refurbishment project might have to be carried out in small packages, to avoid congestion in and around the buildings. This makes the refurbishment projects difficult to coordinate.

Some refurbishment projects also suffer from the lack of clear eaves height which limits the use of cranes. Under this circumstance, the construction trades have to rely on hoists which are less efficient that tower crane. The building materials may have to be moved manually, making it labour intensive and necessitating a higher degree of supervision. All these make refurbishment works less productive and would increase the costs of the refurbishment project.

Smaller space on site means that fewer trades can work simultaneously at the same location. Because of restrictions on storage, delivery of materials and disposal of excavated and other waste materials, including the substantial amounts arising from demolitions, the refurbishment project may have to be carried out in uneconomically small batches. Thus the work of refurbishment projects tends to be more fragmented. Since smaller amount of materials can be stored on site, materials can only be delivered in small batches at a time. This necessitates more frequent deliveries. One option is to deliver material during unsocial working hours, such as between 6.00 p.m. and 6.00 a.m. This is to ensure that the efficiency of movement on the refurbishment project site and the activities and safety in the adjacent property is not affected.

It is, however, interesting to note that out of 22 variables; only 7 were found to be difficult/very difficult. Thus it could be argued that, generally, house refurbishment contractors in Malaysia perceived house refurbishment projects as moderate to ‘easy’. Their projects performance, however, were proven otherwise.

The Performance Of House Refurbishment Projects

This study examined the cost variance of 30 the house refurbishment projects. Cost variance refers to the extent to which the planned cost corresponds to the actual cost.

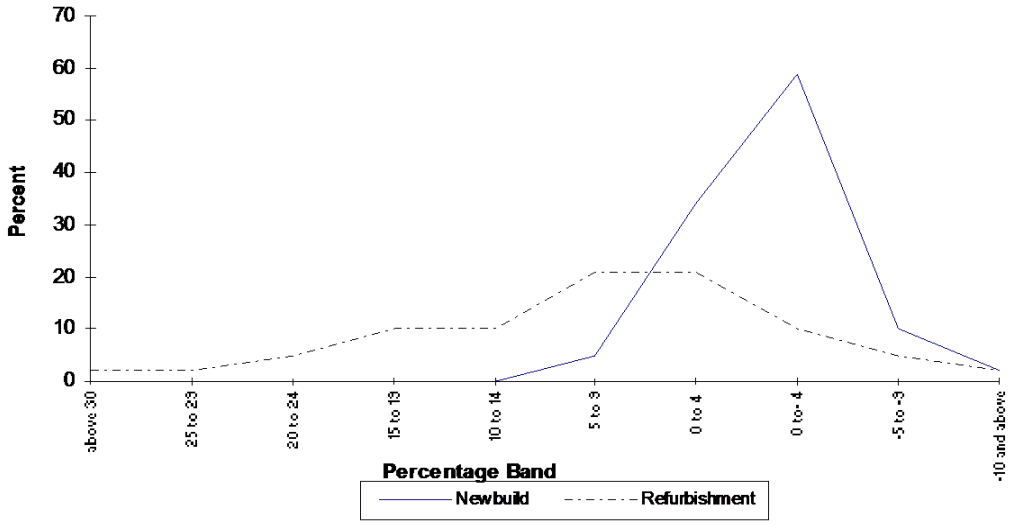
The cost variance of less than 1 means that the actual construction cost is less than the target construction cost. The cost variance of more than 1 means that the actual construction cost is more than the target construction cost. The results are shown in table 4

Table 4: The cost variance of house refurbishment projects

Cost variance	House refurbishment projects (N=30) %
Less than 0.90	16.7
0.90 – 0.99	12.5
1.0	20.8
1.01 – 1.09	12.5
More than 1.10	37.5

Table 4 shows that house refurbishment projects tend to exceed the target cost. Half of the house refurbishment projects exceeded the target cost. Nearly two-fifths of the house refurbishment projects exceeded the target cost by more than 10%.

This finding is almost similar Boyd and Weaver's (1994) finding. Boyd and Weaver's (1994) compared the cost variance between 42 refurbishment and 41 new build projects. Cost variance refers to the extent to which the planned cost corresponds to the actual cost. The tender price was used to indicate the planned cost. The final account figure was used to indicate the actual cost. The final account figure includes variations, extra remedial work, and prolongation and disruption costs. Boyd and Weaver's (1994) results are shown in Figure 2.



Source: Boyd and Weaver (1994

Figure 2: Cost Variances of new build and refurbishment projects

Figure 2 shows that that there is a greater variation in cost in refurbishment projects than new build. In refurbishment projects, the difference between the target and actual prices range from above +34 percent to -10 percent. In new build projects, the differences range from +7 percent to -13 percent. In addition, more than 50 percent of refurbishment projects exceeded the tender cost by greater than 5 percent, compared to less than 5 percent for new build. This shows that the majority of refurbishment projects go significantly over budget. According to Boyd and Weaver (1994) the greater variation in cost induces the feeling of uncertainty and high risk in refurbishment that feed back onto the tender bids.

From the analysis of the final account of eight refurbishment projects, Boyd and Weaver (1994) found that the reasons for the projects to go over budget are change in specification, and extended contract periods due to additional works. These comprised largely of additional repairs and replacement of fabrics, finishes or services to the building, disruptions by the occupants and changes made by the clients.

Therefore, it could be concluded that there is a tendency to underestimate the problems in refurbishment projects and the main reason for final account costs to frequently exceed beyond original estimates.

In addition, the uncertainty of refurbishment projects makes it difficult for the estimators to price the project using systematic procedures. The estimators often make many

assumptions and decide based on intuition. The estimator is more likely to either increase the profit margin or allow greater amount of money for contingencies in their tender bids. The unrealistic estimates could lead to difficulty in monitoring and controlling the project, and achieving the performance targets.

Increase in cost is normally associated with increase in time. In this study the time variance was measured in terms of the ratio of the actual construction time to target construction time as stipulated in the contract document. The results are shown in table 5

Table 5: The time variance of house refurbishment projects

The time variance	House refurbishment projects (N=30) %
Less than 0.9	8.0
0.90 –0.99	8.0
1.00	12.0
1.01 - 1.09	16.0
More than 1.10	56.0

Table 5 shows than nearly three quarters of house refurbishment projects exceeded the target time. Nearly three-fifths of the projects exceeded the target time by more than 10%.

Hence, the performance of house refurbishment projects in terms of cost and time are indeed very poor. Quah (1992) maintains that the uncertainty of house refurbishment work means that decisions are made based on intuition rather than systematic procedures. This could lead to difficulty in implementing performance targets. According to Boyd and Weaver (1994), the greater the uncertainty in house refurbishment projects, the more difficult it is to predict the performance of house refurbishment projects.

The design and build procurement system which has been hailed to provide much greater integration was found to perform better that the traditional procurement system, albeit with minor significance. Considering that the house refurbishment projects using the design and build procurement system are significantly larger in size and arguably, more difficult to plan and control, their performance was expected to be lower. Due to the small number of house refurbishment projects using design and build the author considers that it is more appropriate to compare the planning performance of two procurement systems by using descriptive statistics. The results are shown in tables 6.

Table 6: The cost variance of house refurbishment projects using the traditional and design and build procurement systems

Cost variance	Traditional (N=13) %	Design and build (N=9) %
Less than 0.95	23.1	22.2
0.96- 1.05	23.1	33.3
More than 1.05	53.8	44.4
Total	100.0	100.0

Table 6 shows that the house refurbishment projects using the design and build appear to perform better than the house refurbishment projects using traditional procurement system both in terms of cost variance. More than half of house refurbishment projects using the traditional procurement system have a cost variance 1.05 or in contrast, only 44.4% of the house refurbishment projects using the design & build method have a cost variance of 1.05 or more.

Conclusions

a. The house refurbishment sector is still in its infancy stage in Malaysia. In 2002, it contributed only 2% of the construction output. However, the large stock of redundant and ageing buildings, modernisation, and social, economic, political and technological changes are the major factors that will cause an increase in the demand for house refurbishment projects.

b. Obsolescence rather than deterioration is the main reason for house refurbishment. Therefore, building designs should be flexible, to incorporate future house refurbishment and adaptation.

c. The house refurbishment cycles differ from one type of building to another. The house refurbishment cycle for residential building is 13.6 years and for office is 20 years.

d. Based on the cost variance and time variance, the performance of house refurbishment projects is poor. More than half of house refurbishment projects exceed the target construction cost and target construction time. House refurbishment projects using design and build tend to perform better than that using traditional procurement system.

e. The most difficult tasks faced by house refurbishment managers are the settlement of variation orders, the difficulty of access to the site, storage of materials, dust and noise control.

Recommendations for further research

1. A study of the application of information technology in planning and control of house refurbishment projects is suggested. The main objective would be to establish the potential of information technology to help to increase integration in the planning and control processes of house refurbishment projects, with the view for more effectively integrating the key participants who are operating at different locations, at different times and employed in different organisations.

2. A study on improvement the delivery systems for house refurbishment projects. The concept of 'Just in time' management is of significant interest in view of the difficulty of access to house refurbishment project sites and the limited space to store materials on site.

3. A further, more wide-scale investigation along the line of this study in order to provide a greater statistical support to the findings

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