A Study of Design Performance of Refurbishment Projects in Malaysia

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Abstract

The refurbishment sector has the potential to keep growing and contribute to the growth of total-Malaysian construction output. The increased number of obsolete and deteriorating buildings, coupled with the limited land for new development will contribute to increased demand for refurbishment works in Malaysia. However, the performance of refurbishment projects in most developed countries is unsatisfactory. One of the sources of unsatisfactory performance is related to design problems. This study analyses the variables that could be used for measuring design performance and reviews design performance of refurbishment projects in Malaysia. The study concludes that the design performance of refurbishment projects in Malaysia is used in three-quarters of refurbishment projects. The percentage of completeness of design before work starts on site was more than 80 percent. The additional construction cost attributed to design changes during the construction stage was more than 20 percent of the original estimated cost.

Keywords: refurbishment; design; performance; implementation; Malaysia

1. Introduction

Refurbishment is an important sector in the Malaysian construction industry, and has been growing rapidly over the last five years. In 1992, it grew by only 2 percent, but this increased to 16 percent in 2006 (CIDB, 2007). Despite its increasing importance, only a few pieces of research have been conducted on refurbishment projects and the factors that contribute to their performance.

Factors that initiate refurbishment activity are mainly building deterioration and obsolescence (Aikivuori, 1996). Change in use, economic change, investment decision, historical value, technology change, social change, new image, legal and sustainability are the main factors contributing to building obsolescence. Buildings wrongly used, and lack of maintenance were identified as the main reasons why buildings deteriorate faster.

Refurbishment projects are generally more uncertain than other construction projects (Rahmat, 1997; Rayers and Mansfield, 2001), and are mostly completed exceeding the targeted cost and time. The main factors contributing to this problem are design related, such as late discovery of design information, especially during the design development stage (Daoud, 1997). However, research on the performance of refurbishment projects is still lacking. Hence, this study is to investigate the design performance of refurbishment projects in Malaysia and to identify the variables that are appropriate for improving refurbishment design performance.

2. Refurbishment Design Performance

The measurement of performance is important in providing an indicator of the level of success and for improving the quality of work. Salter and Torbett (2003) noted that the measurement of performance could lead to innovation and comparativeness. Without an indicator to measure products, it is difficult for the individual or organization to improve their product wisely. With the performance measurement of a project, participants, especially the project manager could tell their client whether the project was running well, was profitable and when the necessary action could be taken for improving the project performance while the project was still in progress (Markus, 2003; Ward et al., 1991).

In measuring project performance, some of the indicators that are normally used are time and cost. Most practitioners agreed that project performance is typically categorized in terms of schedule, cost and...
functionality (Hollows, 1998). Meanwhile, Sidewell (1990) maintained that variables with regard to cost and time were suitable in measuring the performance of projects. In some cases, the number of occurrences, such as days lost or factors associated with weather could influence project performance.

The measurement is normally converted to a ratio between the actual and planned project goals. Most of the criteria would be measured based on achievement against intention, and it is suggested that the project time and budget could be measured using the variances between actual and planned figures (Rush, 1986; Yetton et al., 2000).

In this study, 'design performance' covers both the process and product of the design. Since there is limited literature dealing with the measurement of design performance, the author used some of the methods used in measuring project performance, such as cost and time variances. This is because the design process is a part of the construction project. Anything affecting the design would affect the overall project performance as well, so the use of similar methodology in the measurement of design performance is justified. In addition, this study included the factor of completeness of design, percentage of changes and provisional sum as measurements of design performance. Thus, the design performance measurements used for this study are listed below:

- The percentage of completeness of design before work started on site
- Changes in design after work started on site
- The percentage of provisional sum to contract value
- Time variance for design work
- Cost variance for design work

2.1 The Percentage of Completeness of Design before Work Starts On Site

One of the attributes of design document quality is the completeness of design (Andi and Minato, 2003). The availability and completeness of design documents are important because they provide most of the design information required. However, measuring the completeness of design based on perception is difficult (Andi and Minato, 2003). It is very likely that the designers are not willing to accept that the designs produced by them are incomplete. The contractors, on the other hand, are more likely to blame incomplete design as the main reason for their poor performance. Hence, when the perceptions of the contractors were measured, it was found that the design for refurbishment work was generally considered to be incomplete (Rahmat, 1997).

It is necessary to measure the degree of completeness of refurbishment design because this reflects the degree of uncertainty and the complexity of refurbishment projects. In uncertain projects, the amount of design information available is limited hence; designers may find it difficult to complete the design. Some of the important information for refurbishment design is the history of a building, its structural system and the cause of any existing damage (Friedman, 1998). This implies the importance of having sufficient information for refurbishment projects, and without it; almost certainly, the final design document cannot be completed as required.

The completeness of design would also give an indication of how well the design process is implemented before work starts on site. The completeness of a design requires a high degree of accuracy regarding design information used in the design process. A good designer would be able to gather all information needed to produce a complete and accurate design by using suitable approaches. Since Georgy et al. (2005a,b), Andi and Minato (2003) have used the variable "completeness of design" to indicate the performance of design, the researcher has used a similar variable to measure the design performance in the present study.

2.2 The Percentage of Provisional Sum to Contract Value

Provisional sum in a contract document is used to cater for uncertainty regarding particular design items such as roof structure in contract documents (Rayers and Mansfield, 2001). The purpose of provisional sum is to make the tentative refurbishment final sum in a tender documents more complete. However, the use of provisional sum could result in a high variability concerning tender price, which disrupts the certainty of the contract's price. Therefore, it should be the main aim of designers to reduce the percentage of provisional sum in a contract.

It could be argued that the percentage of provisional sum to the contract value is a good indicator of refurbishment design performance. However, the uncertainty of refurbishment projects causes designers to include a provisional sum in the contract. Some parts of the design remain uncertain during the construction stage due to unavailability of accurate information. Rayers and Mansfield (2001) mentioned that assumptions need to be made due to the limited amount of information that can be obtained during the initial design stage. Information is limited because knowledge of the items involved can only be uncovered during the implementation of works. However, CIRIA (1994) highlighted that most clients do not like to have a provisional sum in the tender documents, and tend to apply the same rules as new-build projects in approving refurbishment estimates. This is probably because clients lack knowledge about some aspects of uncertainty inherent in refurbishment projects. Therefore, the researcher has used the percentage of provisional sum as one of the variables to measure the performance of refurbishment design. A higher provisional sum would reflect the poor performance of a design.
2.3 Changes in Design during the Construction Stage

Defective design is defined as product design that does not conform to an acceptable level of quality as required by the owner, contractor or codes and regulations (Andi and Minato, 2003). This statement includes errors, changes, revisions and reworking of design during the design process of a project.

During construction, a greater number of instances of changes are carried out compared to during the design documentation. Manavazhi and Xunzhi (2001, 2004) discovered that most of the changes occurring in the construction stage are due to change of preference by the client, designer error, change of regulations and change of site conditions. The inefficiency of the design process that caused design changes at this stage would influence the overall performance of the construction project. The element of change is one of the factors used in measuring defective design that affects a projects performance (Chapman, 2001; Love, 2004). Similarly, Andi and Minato (2003) found that design changes were the most important factors contributing to design deficiencies. Burati et al. (1992) used changes as an indicator to measure quality deviation in design and construction for both new-build and refurbishment types of projects. In the study, design changes were identified as a major cause of deviation in the quality of the design, apart from design effort and design omission. This implies that 'changes' is commonly used for measuring the performance of design for projects. Therefore, in the present study, the percentage of design changes made after work started on site are used to measure the refurbishment design performance.

2.4 Cost Variance in Design Works

Researchers frequently use the element of cost to measure the performance of projects. For instance, Josepson and Hammerlund (1996) used cost variance for the measurement of design that caused defects for new-build projects. Daoud (1997) maintained that cost was an indicator of the performance of refurbishment projects. The majority of refurbishment projects suffer from delays and escalating cost. This is due to a high degree of uncertainty in defining the scope of work, especially when handling a building that is badly damaged due to war or fire (Daoud, 1997).

According to McKim et al. (2000), the cost of design is one of the many ways to measure the performance in refurbishment projects. The element of cost as an indicator in refurbishment project performance is closely interrelated with other performance indicators that could be used to achieve overall control of project performance. This view is supported by Salter and Torbett (2003), who indicated that cost variance was the most common technique used to measure design performance.

Design in engineering has implemented the same approach of measuring design performance. Georgy et al. (2005a, b) suggested the element of cost to measure the performance of engineering design in construction. The study also suggested that the cost overrun associated with design in construction could be one of the indicators to gauge the performance of design work.

The cost variance was extensively used to measure the performance of design and overall construction project. Hence, in the present study, cost variance is calculated by the variance between the actual and the budgeted design cost in refurbishment projects.

2.5 Time Variance in Design Work

Another common method used in measuring project performance, besides cost, is time. Time is normally correlated to project cost and when the time is extended, the cost will increase as well. Time variance is one of the techniques for assessing design performance in construction projects (Chan, 2001; Odeh, 2002; Ofori, 2001). The element of time could indicate to designers that the project was not running as smoothly as scheduled.

Refurbishment projects are characterized by taking more time than estimated during the design stage (Daoud, 1997). This is due to the high degree of uncertainty in defining the scope of work. Often, new information is discovered during the period of construction, which requires changes in design. As a result, designers need to do additional work, which requires more time to complete. Daoud's (1997) study highlighted time as one of the indicators to measure the performance of refurbishment projects. Similar to cost, time variance is normally measured by the ratio between scheduled time for design during the design process and actual design time taken to complete the design tasks.

3. Research Methodology

This study used the triangulation technique as its research methodology, which combined both qualitative and quantitative approaches. The triangulation technique used was sufficient to obtain the required information that could be used to answer the research objectives. Three stages of data collection methods were used including literature reviews, followed by semi-structured interviews of 21 registered professional architects and the final questionnaire survey which resulted in 82 (36%) responses. Limitation of the study and rationales for decisions made in designing the research were discussed. Finally, various statistical analysis techniques, which covered both qualitative and quantitative analysis, were described.

Semi-structured interviews helped to clarify certain ambiguous information obtained from the literature reviews, and also provided an opportunity to verify some of the variables that were not discussed during the literature reviews.
Since this research focuses on the design process of refurbishment projects, the appropriate profession is architecture. Architect in this study refers to certified professional architects who are registered with The Board of Architects, Malaysia (BOAM). The respondents of this study are limited to registered professional architects only, because the architectural profession contributes the major part of the design work in refurbishment projects compared to other disciplines such as engineers, quantity surveyors, specialists, clients or contractors (Delio, 1990). Besides, architects play an important role as the design team's leader, who controls and monitors all design activities for refurbishment projects. Therefore, all information required with regards to this study could be obtained from the architects. The demographic profiles of the respondents who took part in the final survey are set out in Fig.1.

![Fig.1. Job Title of the Respondents](image)

The pie chart indicates that the majority of respondents comprised principal architects (68 percent) followed by senior architects, architects and others with 15 percent, 10 percent and 7 percent respectively. 'Other' included project architects, chief executives, directors and partners. The designation implies that the respondents were important persons handling the design work.

4. Data Collection and Discussion

The results of the performance of refurbishment design are presented and discussed. Five performance variables were tested using the questionnaire survey and the results are discussed below.

4.1 Percentage of Completeness of Design before Work Started On Site

The respondents were asked about the degree of design completeness before work started on site, using multiple-choice answers. In this study, completeness refers to design that is accurate and complete with all information required during the construction stage. The results are given in Table 1.

| % Completeness | Percentage (N=82) |
|----------------|-------------------|
| 0%-50%         | 1.4               |
| 51%-60%        | 4.2               |
| 61%-70%        | 4.2               |
| 71%-80%        | 12.5              |
| 81%-90%        | 38.9              |
| 91%-100%       | 38.8              |
| Total          | 100.0             |

The results indicate that in more than 75 percent of the refurbishment projects, the percentage of completeness of design before work started on site was more than 80 percent. This implies that the architects had sufficient design information during the preparation of design before work started on site.

The semi-structured interviews with twenty-one architects indicated the importance of having accurate and timely information during the design process. All the interviewees agreed that the percentage of completeness of design was affected if the required information was not available when it was needed.

However, these findings contradict those of Rahmat (1997) who found that only about 20 percent of refurbishment projects in the UK started with a percentage of completeness of design recorded at more than 80 percent. The difference in results is probably because buildings involved in refurbishment in the UK are older, and as-built drawings are often not available. On the other hand, in Malaysia the buildings involved are still relatively new and have less deterioration and obsolescence. Therefore, it is easier to find information relating to building condition. Second, since the answers came from architects, there could be an element of bias, in that the respondents might not be willing to accept the fact that their designs were incomplete. Thus, the answers given might not reflect the actual situation.

The result however, is still inconclusive. The percentage of design completeness in Malaysia, which is higher compared with the UK, needs further clarification. There is a need to check the percentage of changes and provisional sums allocated in the projects. It is possible that the designers used much inaccurate information or assumptions to complete their tasks. If this happened, more design changes would have taken place during the construction stage. This will be revealed during discussion of the research hypothesis.

4.2 Percentage of Provisional Sum to Contract Value

Table 2. shows that almost 40 percent of the refurbishment projects in this country had more than 20 percent provisional sum in the contract document, in contrast with Rahmat's (1997) finding in Table 3. in which only about 4 percent of refurbishment projects in the UK had such a high provisional sum. This result clearly indicates that design performance for refurbishment projects in this country is poor, and that little information is available before work starts on-site.

By comparing results from developed countries such as the UK, it is possible to obtain a realistic forecast concerning performance of the refurbishment sector. The UK has been selected as a comparative country in this study based on two reasons. First, the Malaysian construction industry has been quick to emulate practices in the UK such as procurement systems, design concepts, construction techniques and
professional practices. The globalization effect would expedite the integration of the Malaysian construction industry with the UK. Second, Malaysian consumers' expectations and lifestyles are showing similar patterns to those in the UK.

Table 2. Provisional Sum as a Percentage of Contract Value

| % of Provisional Sum | Percentage (N=79) |
|----------------------|------------------|
| 0%                   | 4.3              |
| 1%-10%               | 27.5             |
| 11%-20%              | 31.9             |
| 21%-30%              | 13.0             |
| 30%-40%              | 11.6             |
| More than 40%        | 11.6             |
| **Total**            | **100.0**        |

Table 3. Percentage of Provisional Sum to Project Contract Value in the UK

| % of Provisional Sum | Percentage (N=62) |
|----------------------|------------------|
| Less than 5%         | 33.3             |
| 6%-10%               | 34.9             |
| 11%-15%              | 22.2             |
| 16%-20%              | 6.3              |
| More than 20%        | 4.2              |
| **Total**            | **100.0**        |

Source: Rahmat (1997)

The result implies that the amount of information available is insufficient for refurbishment projects in Malaysia. This induces more assumptions by designers in order to make their design merely complete, as mentioned by (Rayers and Mansfield, 2001). The result also implies that designers need to increase their information processing capacity during the design process. This could be done by increasing the use of integrative mechanisms such as meetings, contacts, information technology and degree of involvement of key participants during the information gathering process (Galbraith, 1973).

In addition, the knowledge of designers also needs to be improved, especially regarding building survey. This could improve the accuracy of the information used in the design work. Moreover, architects also need to advise the client to have a proper briefing process so that all the consultant inputs in the design can be finalized before the construction stage. This could reduce the risk of having a high provisional sum in the design.

4.3 Percentage of Changes to the Original Design during Construction Stage

The third performance variable examined was the percentage of changes to the original design during the construction stage. The questionnaire used six multiple answers as shown in Table 4.

The result shows that nearly half of the refurbishment projects had changes in their original design of more than 20 percent, with an average of between 11 and 20 percent. Less than 10 percent had design changes amounting to more than 50 percent of the original design.

Table 4. Percentage of Changes from Original Design during the Construction Stage

| Changes      | Percent (N=82) |
|--------------|----------------|
| 0%-10%       | 20.5           |
| 11%-20%      | 32.5           |
| 21%-30%      | 24.1           |
| 31%-40%      | 8.4            |
| 41%-50%      | 6.0            |
| More than 50%| 8.4            |
| **Total**    | **100.0**      |

The result implies that even though the degree of completeness of design before work starts on site was claimed to be high, the amount of design changes that took place also remained high. This indicates that the designers probably made many assumptions during development of the design in the refurbishment projects. The unique characteristic of refurbishment projects is that the project deals with the existing conditions of a building. This is different from the design of new-build projects, with one of the problems being a lack of clarity of information. In the absence of required information, designers are forced to use their own intuition in order to complete a design. As a result, designs produced by the designers were actually inaccurate, since much of the information was based on guesswork, as mentioned by Quah, (1988).

Second, it could also be the case that the quality of information or the sources of the information were not reliable, resulting in inaccurate design. Clancy (1995) and Daoud (1997) explained that uncertainty in refurbishment projects is intensified, because most of the time the available documents are not reliable or up-to-date. Thus, the use of reliable references influences the amount of changes in design during construction.

The result shows that the majority of refurbishment projects in Malaysia end up with design changes involving both omission and addition. Even though the projects were sometimes completed with no variation in the final contract sum, in actual fact, the changes in design that took place were substantial. For instance, the refurbishment work of an office carried out by the Public Works Department, Malaysia, which was worth about RM1.5 million was completed without any change in contract value. However, in reality its design had been changed from the original by about 50 percent. The pattern of variation is shown in Fig.2.

Fig.2 shows the distribution of the variation in the design for refurbishment projects, which varies from one project to another. The pattern indicates that the majority of refurbishment projects had more variation additions, most of which were more than 10 percent. On the other hand, variation omission indicates mostly less than 10 percent. The huge range of variation in the design of refurbishment projects makes the projects highly uncertain and unpredictable. Cox et al. (1999) found that the direct cost of post-contract design...
changes for new-build projects amounted to 5 to 8 percent of total project cost, for various reasons. This is much lower compared to the percentage of variation shown for refurbishment projects in Malaysia.

The results indicate that more changes in design were recorded for refurbishment projects. The semi-structured interviews with senior and principal architects in the Klang Valley revealed that the majority of changes in refurbishment projects resulted from changes concerning the needs of clients and new discoveries during the construction stage. This implies the need for designers to have an in-depth interview with clients in order to understand their needs, as suggested by (Daoud, 1997). This approach could minimize changes requested by clients. Second, proper techniques need to be implemented, such as building survey and physical testing, during the data gathering process in order to have more accurate information. Besides, interaction among the design participants needs to be improved by having more meetings and contacts so that the design information is available as required.

4.4 Cost Variance

The respondents were asked about design cost variance during delivery of the refurbishment projects, with six choices of answer. The result of the survey is shown in Table 5.

| Ratio  | Percentage (N=79) |
|--------|-------------------|
| 0.00 to 0.80 | 8.8               |
| 0.81 to 0.90 | 0.0               |
| 0.91 to 1.00 | 11.8              |
| 1.01 to 1.10 | 38.2              |
| 1.11 to 1.20 | 15.6              |
| More than 1.20 | 25.5             |
| Total     | 100.0             |

The result shows that in almost 80 of the refurbishment projects, the design cost exceeded the budgeted cost, with almost 40 percent exceeding the cost by more than 10 percent. This indicates that the escalated costs for refurbishment projects resulted from the design.

This implies the need for greater accuracy in the estimation of cost associated with design work. More attention needs to be given to risk and uncertainty during the costing. Overhead costs could easily increase if direct costs to the design work unintentionally rise. Changes in design could contribute to an increased number of meetings, contacts and costs in producing the amended design. Hence, the uncertainty aspect in design information needs to be eliminated by stepping up the information processing capacity of the design team's members.

4.5 Time Variance

Normally, cost and time are interrelated in refurbishment projects. An increase in project cost could contribute to an increase in time as well. Thus, in the final survey the respondents were asked about design time variance, using six multiple-choice scaled points, from less than 0.8 up to more than 1.20 time variance. The results obtained are shown in Table 6 and indicate that almost 80 percent of the refurbishment projects end up with an increase in design time, with more than 55 percent showing an increase of more than 10 percent.

| Time Variance | Percent (N=77) |
|---------------|----------------|
| 0.00 to 0.80  | 2.9            |
| 0.81 to 0.90  | 11.8           |
| 0.91 to 1.00  | 8.8            |
| 1.01 to 1.10  | 20.6           |
| 1.11 to 1.20  | 35.3           |
| More than 1.20| 20.6           |
| Total         | 100.0          |

The figures are slightly lower than the design cost variance, but they are still considered substantial. It is suggested that the majority of refurbishment projects are completed beyond the targeted time. The results confirm Rahmat's (1997) finding that time variance for refurbishment projects in the UK was about 55 percent. Time variance in Rahmat's (1997) study was lower, possibly because companies involved in refurbishment projects in the UK had more experience, since refurbishment projects are more established there than in Malaysia. Lack of experience and understanding concerning the refurbishment design process could be the main factors contributing to the lack of control in design time for refurbishment projects in Malaysia.

Time is normally related to the amount of work that needs to be completed. The result implies the need to have a clear scope of work in the refurbishment design process. The participation of the client and collaboration with the architects could minimize uncertainty concerning the scope of work in refurbishment projects. This could eliminate changes in design initiated by the client, such as mentioned by Love (1999; 2004). The study discovered that design
changes mainly resulted from the client’s requests. Therefore, the functions of the client could be one of the solutions to reducing time overruns.

5. Conclusion
From a review of literature, five indicators were found to be useful in measuring the refurbishment design performance. The indicators are degree of completeness of design before work starts on site; percentage of provisional sum to contract value; percentage of design changes during the construction stage; cost variances; and time variances.

In general, the performance of refurbishment projects in Malaysia is mixed, based on the five indicators used. About three-quarters of refurbishment projects claimed that the percentage of completeness of design before work starts on site was more than 80 percent. Almost half of the refurbishment projects indicated that the incidence of design changes during the construction stage was more than 20 percent of the original. In about 40 percent of refurbishment projects in Malaysia, the amount of provisional sum allocated was more than 20 percent of the contract value. More than three-quarters of refurbishment projects exceeded the targeted design cost and time. A more detailed study needs to be carried out by using different variables in measuring design performance in refurbishment projects.

References
1) Aikivuori, A., (1996) Periods and demand for private sector housing refurbishment, Journal of Construction Management and Economics 14, pp.3-12.
2) Andi and Minato, T. (2003), Representing causal mechanism of defective designs: a system approach considering human errors. Journal of Construction Management and Economics, Vol. 21, pp.297-305.
3) Burati, J.L., Farrington, J.J. and Ledbetter, W.B., (1992). Causes of quality deviation in design and construction. Journal of Construction Engineering and Management Vol. 118, No. 1, pp.34-49.
4) Chan, A.P.C., (2001). Time-cost relationship of public sector projects in Malaysia. International Journal of Project Management, Vol. 19, pp.223-229.
5) Chapman, R.J., (2001). The controlling influences on effective risk identification and assessment for construction design management. International Journal of Project Management, Vol. 19, pp.147-160.
6) CIDB, (2007). Construction quarterly statistical bulletin- fourth quarter 2006. CIDB, Malaysia.
7) CIRIA, Construction Industry Research and Association, (1994). A guide to management of refurbishment, CIRIA report no 133. Construction Industry Research and Association, UK.
8) Clancy, B.P., (1995), New building from old: some views of refurbishment projects. Journal of The Structural Engineer. Vol. 73, No. 2017, pp.341-346.
9) Cox, I.D., Morris, J.P., Rogerson, J.H. and Jared, G.E., (1999), A quantitative study of post contract award design changes in construction. Journal of Construction Management and Economics, Vol. 17, pp.427-439.
10) Daoud, O.E.K., (1997), The Architect/Engineer’s role in rehabilitation work. Journal of Construction Engineering and Management Vol. 123, No. 1, pp.1- 5.
11) Drileo, G., (1990), Altering, extending and converting houses, an owner's guide to procedure. International Thomson Business Publishing.