

Full Length Research Paper

Design information in managing refurbishment projects in Malaysia

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Although design cost makes up a small percent of a total project cost, the performance of refurbishment projects are normally considerably affected by design processes. The lack of information in refurbished designs becomes an obstacle for designers to complete tasks successfully during the initial stage of the design process. The objective of this study is to discuss the sources of design information in refurbishment projects. The study has also been extended to demonstrate how different sources of information can affect the performance of refurbishment design. From the results, it is concluded that a site survey was considered the most important method of obtaining design information followed by the client's brief during the design process of refurbishment projects.

Key words: Building survey, information design, design process, Malaysia.

INTRODUCTION

Many construction management authors agree on the importance of the design process towards the success of construction projects. However, most of the time construction projects are hindered by the lack of performance on the design process. In the UK, Bibby et al. (2003) noted that construction performances have continually been reduced by the difficulty of managing the design process. The performance of refurbishment projects is much affected by the design process (Stermen, 1992). Therefore, management in the design process needs to be improved in order to produce an accurate design before starting work on site.

However, the design process is not an easy process to manage. The process involves the integration of technical knowledge and a higher level of interaction among the various participants such as clients, designers, users and contractors. The design process in a construction environment is extremely dynamic and complex, consisting of multiple interacting feedback processes and non-linear relationships (Ogulana et al., 1998). The iterative nature in the design process makes it difficult to coordinate (Stermen, 1992).

Chua et al. (2003) noted the importance of a design process and its contribution to the success of construction projects. However, the success of the design process depends on the quality of available design information

(Choo et al., 2004). Without accurate information, designers tend to make mistakes with regards to the outcome of the design (Beyond, 1990). Any decisions made at the early stage of the design have a major influence on the overall project performance, especially with regards to variables such as cost and time (Baldwin et al., 1999). Decision-making normally involves the allocation of resources, so that information, preference and choice are parts of the 'decision basis' which allows the analysis and appraisal of alternative decisions. The lack of quality in design information results in many problems which include among others incompatible designs that might crop up throughout the design process (Cornick, 1991; Ali, 2009; Sanvido and Norton, 1994).

Refurbishment in this study refers to upgrade, major repairs work, renovations, alterations, conversions, extensions and modernization of existing building, but excludes routine maintenance and cleaning work (Ali and Rahmat, 2009). This classification also mentioned by Quah (1988). In refurbishment projects, the problem in the design process is further compounded by the project uncertainty due to the unavailability of information. Much of the necessary information is not available at the required time. Egbu (1994) and Ali et al. (2008) have provided evidence of the complexity and uncertainty of refurbishment projects. This problem mainly is a product

of the lack of information available to perform a task, especially during the initial stages of the design process. Hence, the objective of this study is to identify effective sources of information that can be used during the design process of refurbishment projects.

The issues and challenges of design information in refurbishment projects

Availability of information is important for the designers to perform a task. However, problems in the design process arise when designers start their work based on inaccurate or incomplete information, and when a different quality of information is used for different design tasks (Lahdenpera and Tanhuanpaa, 2000). Quality information would help the designers to produce accurate and complete designs as required.

Problems in the refurbishment design process arise when designers start their work based on uncertain and inadequate information. The uncertainty of refurbishment projects is an outcome of the unavailability of design information. The availability of information during the design process is important for refurbishment projects because it helps the designers to make wise decisions in the process (Aho et al., 1998). However, refurbishment differs from new-build projects because design in refurbishment projects needs to be matched up to existing building conditions so that it is compatible. Problems arising in the existing building are due to the lack of clarity whereby most of the information is unavailable or difficult to obtain. This situation induces the designers to issue inaccurate designs because much of the information is based on their 'gut feeling' (Quah, 1988). As a result, many modifications of design need to be made by the contractor during the construction stage due to inaccurate information given. Frequently, requests for design changes are made at a very late stage of the design process (Gilleard and Lee, 1998). This situation contrasts with new-build projects where the designers start from fresh, then progressively develop and refine the design.

Rahmat (1997) found that about half of the refurbishment projects started with only 60% of the design being complete. In the majority of the refurbishment projects, a high proportion of design information can only be obtained during the construction stage. Due to incomplete information during the schematic design stage, the designers make more assumptions. When the design information is not available, designers include provisional and contingency cost allocations in their design (Rayers and Mansfield, 2001). This resultant in a large numbers of variation orders allocated during the construction stage.

The uncertainty of design information depends on the condition of the existing building structure. Frequently, there are cases where structural information for the buildings, which are to be refurbished, present in the

archives containing documents such as reports, as-built drawings and manuals are not properly documented, incomplete or missing (Clancy, 1995). Moreover, some of the available data is inaccurate, since the actual design is different from the final as-built configuration because of alterations and modifications made throughout the life cycle of the building, which were not recorded in the documents. Furthermore, limited information about services also contributes to uncertainty in design. The state of existing services is not easy to ascertain. In today's design of commercial buildings, requirements regarding services are very stringent because automation and information communication technology (ICT) have become advanced. This requirement often necessitates complete refurbishment of the existing building. The installation of features such as new workstations and infinite access floors related to ICT stations can be a major cost increasing item as well as presenting problems in incorporating them into old services. McKim et al. (2000) discovered that uncertainty in services information was exacerbated by unforeseen site conditions. Information about building services is normally very limited and is one of the major elements of unforeseen building conditions. This is mainly due to the fact that the majority of services parts such as electrical wiring and piping are embedded in walls or ceilings. In addition, the insufficiency or unavailability of service information often forces the designers to make their decisions based on rules of thumb and personal preferences (Staufner et al., 1987). This could lead to errors such as wrong calculations that result in major design failure.

To get more certain design information, the use of several sources of information in gathering information is required. One of the most popular techniques are building surveys (Aho et al., 1998; Highfield, 2000). Refurbishment projects, which are mainly site driven, demand the building survey to be exercised in order to have a better perspective of the existing building (Egbu, 1997). Other sources of information that have potential to obtain information are client's brief, contractor input, archive document and the physical testing of the building. Ali et al. (2009) and Quah (1988) noted that the building survey exercise is more precise if it is combined with a non-destructive test. This technique increases the accuracy of the survey result and reduces time and cost for the exercise.

RESEARCH METHODOLOGY

This study used the triangulation technique, which consists of quantitative and qualitative approaches. The triangulation technique was used to obtain the required information. This information aided in answering the research objectives. Three stages of data collection methods were used including literature reviews and followed by semi-structured interviews with 21 professional architects who were registered with the Board of Architects, Malaysia. The questionnaire survey which was sent to a list of 243 architects resulted in 82 (36%) responses. In order to get a high

response rate, the design of the questionnaire was short and simple.

Software Package of Social Science (SPSS) version 16.0 was used for analysis and transformation of data. The descriptive method specifically the statistical and correlation test was used to find out any significant correlation between the sources of design information in refurbishment projects. The number of projects involving design and refurbishment projects of the respondents is shown in Figure 1. The profile shows more than 90% of the respondents were involved in more than 15 design projects and more than 60% had been involved in more than 10 refurbishment projects. This indicated that the data collected from the survey is reliable.

In order to rank the most important sources of information, a calculation of the central tendency of mean was carried out. The five-point scale used in the questionnaires was transformed to mean readings to determine the ranks of each variable, following the procedure used by Egbu (1994), Hashim (2004) and Ali (2009) in their studies.

RESULT AND DISCUSSION

Table 1 shows a ranking of priorities based on the means for the various methods of obtaining design information. The results indicate that conducting a site survey was considered the most important method of obtaining design information during the design process of refurbishment projects. In contrast, destructive and non-destructive tests were rated the least important among all the methods of obtaining information during the design process.

The result confirmed the findings from Andi and Minato (2004) who highlighted the importance of conducting site surveys in refurbishment projects. Site surveys are important since they would determine the actual scope of work that had ambiguity in as-built design and also confirm whether the existing building can be adapted for its proposed new uses (Aho et al., 1998). Furthermore, the result supported by Rayers and Mansfield (2001) finding in which they discovered that one of the methods to minimize the problem of unreliable information and unavailability of information was by conducting site surveys.

The client's brief ranked second in the analysis and hence, can be considered an important method of obtaining design information in refurbishment projects. This finding reiterated the statement by Boyle (2003) who said that briefing is one of the factors that contributes to successful design. Refurbishment projects dealing with the existing building require a lot of information from the client who is more knowledgeable about the building than other people. Thus, comprehensive briefings by the client need to be undertaken as incomplete briefings are a major factor in the interference of the production of complete information as well as a comprehensive design for refurbishment projects.

The contractor's input ranked third among the method of obtaining design information. This is a reflection of a lack of integration of the site team's personnel with the

design team in refurbishment projects. This is not surprising since as how most of the refurbishment projects investigated used the traditional procurement system (85%) compared with design-and-build (15%). The contractor's input was considered important as a source of information for refurbishment projects, particularly in some aspects of design such as the constructability of an existing building (Rayers and Mansfield, 2001). The involvement of the contractor enabled early identification of potential conflicts and could prevent major changes to the scope of the work. Post (2000) supported the view that the integration of a general contractor and major sub-contractors during the schematic or conceptual design stage can create more integrated design information. The result also suggests the importance of using an integrated procurement system such as the 'design-and-build' method in refurbishment projects. A higher involvement of the contractor is integral to the design-and-build procurement system but the majority of refurbishment projects in this country did not use this system.

Interestingly, destructive and non-destructive tests were found to be the least important mean of information gathering during the design process of refurbishment projects. This result contradicted some of the studies reviewed, for example those of Quah (1988) and Highfield (2000) who argued that the uncertain nature of refurbishment projects required the use of non-destructive diagnostic techniques that were capable of reducing the time and cost of the survey and at the same time could increase the accuracy of the survey result. The contradictory result indicates that refurbishment projects in this country are less uncertain, in the sense that most of the decisions can be made and confirmed through site observation only. Another possible explanation is that no funds were allocated by the client for the designers to carry out any testing as a means of obtaining accurate information. This is probably because the cost of conducting the test is expensive. Furthermore, this result occurs because the content of structural work is minimal; only one-third of the projects indicated that the structural work was more than 20%. Therefore, no testing was necessary to obtain adequate design information.

The survey result shows the architects obtained a relatively high portion of their design information from the archive documents. The semi-structured interviews revealed that the architects still had to refer to the archive documentation as guidance for their design work due to a variety of reasons. Primarily because some of the clients did not provide any extra fees for the architects to produce new measured drawings and site survey. This was because detail measured drawings are not easy to prepare. For a large building, experienced building surveyors working with some other specialists such as land surveyors, structural engineers and mechanical engineers are required. Due to this limitation, the architects would use the available as-built drawings, records

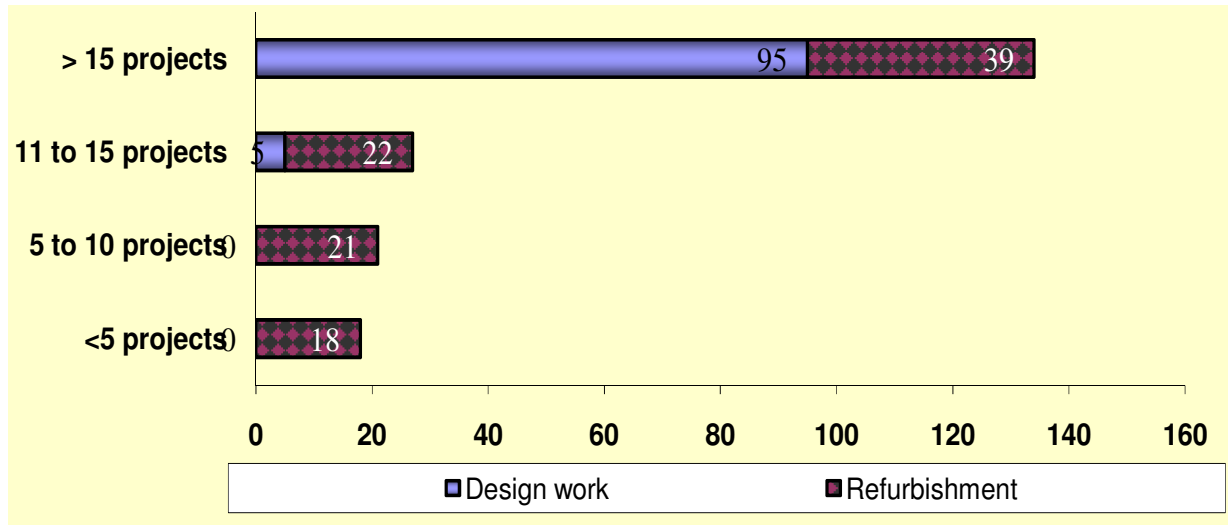


Figure 1. Number of projects involving design and refurbishment projects.

Table 1. Analysis of results based on means for the method of obtaining design information.

Method obtaining information	Mean, n = 82	Standard deviation	Ranking
Site survey	4.31	0.56	1
Client's brief	3.73	0.66	2
Contractor's input	3.33	0.54	3
Design team's input	3.32	0.68	4
Archive document	3.01	0.81	5
Destructive and non destructive test	2.72	0.84	6

or in the worst-case scenario, simple sketches of the building floor plan could be made during the site visits. Any new site discovery and changes would be incorporated in the as-built refurbishment drawings. Second, the time frame given by the client is often insufficient for the architects to do thorough research and come up with reliable measured drawings. The uncertain nature of refurbishment projects implies the need for more time in gathering data for the design works.

It is interesting to note that archive documents score fairly high, in fact higher than the design team's inputs. This result contradicted Clancy (1995) who mentioned that archive documents such as reports, as-built drawings and manuals were not the preferred way for the architects to obtain information in refurbishment projects. It is probable that the information from this source is unreliable and not up-dated. Changes of design due to renovation work throughout the lifecycle are often not incorporated in the as-built design. In addition, for new completed buildings, the as-built drawings do not incorporate changes made during the construction period, which caused incompatibility with the actual design. This reconfirmed Clancy (1995) and Daoud

(1997) statements who claimed that the uncertainty in refurbishment projects was intensified when available documents were not available, reliable and up to date.

To check the relationship between the methods of obtaining information on design performance, an associative test using the Spearman rank correlation coefficient was employed in the analysis. Three variables were identified to measure the design performance. They are time, cost variances and percentage of completeness of design before work started on site. It was hypothesised that the methods of obtaining information affect the design performance. The null (H0) and alternative (H1) hypothesis for the test are:

H0: The methods of obtaining information do not influence the design performance of refurbishment projects.

H1: The methods of obtaining information influence the design performance of refurbishment projects.

The methods of obtaining information were the independent variables, whereas, design performance

Table 2. The Correlation Matrix between methods of obtaining information and performance of design.

Method obtaining information	Cost variance	Time variance	Percentage of design completeness before work started on site
Archive document	.101	.019	.105
Site inspection	-.038	-.038	.058
Client's brief	-.175	-.175	-.175
Design team's input	-.247	.435	.435*
Contractor's input	.270	-.075	.285
Destructive and non destructive test	.070	-.170	.339*

* Correlation at 5% significance level.

variables were the dependent variable. The null hypothesis was rejected at 5% significance level.

The results in Table 2 show that, the variable 'design team's input' and 'destructive and non-destructive test' have significantly correlated with percentage of completeness of design before work started on site. This indicates that the higher design team's input and testing carried out to get design information in refurbishment projects, resulted in a higher percentage of completeness of design before work started on site could be achieved. The result suggests rejecting the null hypothesis and accepting the alternative hypothesis.

However, there is no significant correlation detected for site survey and the client's brief in refurbishment projects. This result contradicted with descriptive result above in which the site survey and the client's brief are the most important methods in obtaining design information. The contradictory result indicates that architects for refurbishment projects in Malaysia, prefer to use simple method such as site survey and client's brief to obtain design information, although it is least accurate. Another possible explanation is that no funds were allocated by the client for the designers to carry out any testing as a means of obtaining accurate information. This is probably because the cost of conducting the test is expensive.

Conclusion

In conclusion, a high degree of uncertainty of the design of the building makes it compulsory for architects to be more diligent in the process of obtaining accurate information for their work design. Knowledgeable architects can reduce the problems such as limited design information in the refurbishment design process and at the same time can improve design performance. The limited information was due to difficulties in obtaining accurate data, and the designers had not properly utilized techniques such as destructive and non-destructive testing. The result of associative test shows that the design team's input and destructive and non-destructive tests had significant correlations with the design performance. However, a descriptive analysis using the

central of tendency of mean revealed that site surveys and client's briefs are the most important methods used by the architects.

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