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THE EFFECT OF DESIGN KNOWLEDGE TOWARDS THE PERFORMANCE OF REFURBISHMENT PROJECTS IN MALAYSIA

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ABSTRACT

The uncertainty of refurbishment project is reflected in the difficulty of getting accurate design information during the design process. One of the factors contributed to uncertainty in refurbishment projects is degree of design knowledge that an architect have. The knowledge of the designers in refurbishment design could influence the completeness of the design before work starts on site. This could cause project delays and cost overruns due to adjustments that need to be made to design in order to comply with the new design requirements. Therefore, the main objectives of this paper are to present the difficulties that contributed by the limited design knowledge of an architect for refurbishment projects and show how it affects the overall performance of refurbishment projects. Quantitative technique is used for research methodology, which consists of review of literature and postal questionnaire survey that involved 234 respondents. From 234 questionnaires sent out, 62 questionnaires found to be suitable to form a database for analysis. Descriptive and inferential statistics are used in data analysis. The result concludes that complexity in refurbishment projects in Malaysia contributed by uncertainty of knowledge by the designers. The associative test indicates that performance of refurbishment projects suffered from the uncertainty knowledge of refurbishment projects designers.

***Keywords**: designer, knowledge, refurbishment, Malaysia*

INTRODUCTION

The design knowledge of an architect in a refurbishment project could influence the performance of the design process. The World Bank Guideline [1], for examples pointed out that an individual architect is the person who ultimately determines the quality of performance of a project, not his or her organization. Ling [2] in their empirical studies highlighted the importance of design knowledge among the architects who provide service to the clients, since it is believed that the architects could bring the knowledge of acceptable practices and customs. Knowledge on such matters as material specifications, legislation, constructability in design and contract management were found to be important for architects in the design process. This view was supported by Graves [3] who mentioned that one of the factors in selecting the right architects were their qualification and their knowledge of the codes and special expertise in their area. Furthermore, Cooper and Press [4] highlighted the need for having design knowledge and education. This could encourage significantly more inspiration, experimentation with ideas, solutions to design and construction problems and concern with creative thinking, which could lead to significant design solutions. Meanwhile, Boyle [5] emphasized that the nature of design such as work overloaded requires that the design personnel have sufficient design knowledge, education and creativity in their work. Without proper knowledge, it is difficult for the designers to mitigate error in their design works.

The knowledge of the designers in refurbishment design would influence the completeness of the design before work commences on site. Atkin [6] pointed out that often when the designers have little knowledge of how to produce accurate designs for refurbishment works, the contractors have to come up with the design. This is a waste of resources because the client loses the opportunity of using the architects' expertise in developing good designs.

Daoud [7] pointed out that design works in refurbishment projects were unique in many ways and should be approached cautiously by designers. This is because the job knowledge of the designers required in preparing refurbishment design is different since the design relies on the existing building's condition, in contrast to new-build projects.

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Dowson [8] pointed out that design works demand the integration of differentiated skills from many parties involved in the process. Manavazhi Xunzhi[9] supported the view that design projects pass through a series of complex steps involving individuals with varying technical and social skills. The architects, as design team leaders should have sufficient design knowledge in order to manage the team. This would also ensure the architects could wisely utilize the appropriate knowledge of other design team members as required.

Many design errors occur due to lack of design skill and knowledge on the part of the architects. Josephson [10] said that the insufficient design knowledge of the designers was a factor contributing to rework and design changes. Furthermore, Curtis [11] said some causes of design fault, such as misinterpretation of client's needs, poor communication between designers, using incorrect or out-of-date information, producing inadequate specifications and misinterpretation of design standards were due to the designer's lack of knowledge. Designers with insufficient knowledge would put more assumptions in the design. This influences the amount of the provisional sum allocated in the contract. Okoroh [12] said that estimators an important element of a design team, often make decisions based on incomplete and imprecise information during tender preparation. This increases the risk of the refurbishment projects.

Similarly, Andi [13] in their study entitled 'Representing causal mechanism for defective designs: a system approach considering human errors' explained that human error had three types; namely skilled-based error, rules-based error and knowledge-based error and the main source of errors in design is from human error. The study highlighted the fact that the factors that influence design failures were the lack of design knowledge, inadequate skills for checking of design input, inadequate belief and carelessness during the design process. One of the designers' problems is the lack of construction knowledge and inability to carry out proper site inspections. This view is supported by Coles [14] who mentioned that the use of inexperienced and under qualified staff, who lack technical knowledge, could also lead to design errors.

Friedman [15] stressed that designers need to have knowledge and understanding of materials, the history and the function of the existing buildings for effective renovation design. Since the nature of works for refurbishment projects requires interfaces between old materials and proposed new materials, most of the time the design team has to work when buildings are still occupied and operational. With unknown building conditions, it requires extensive knowledge on the part of the designers before the buildings could be approached. Young [16] said that due to the risk and uncertainty of refurbishment projects, a higher level of management skill and knowledge is required compared to new-build projects. The education and training background of the designers needs to be explored because it influenced the degree of involvement and understanding about refurbishment works. Bibby [17] said that the frequency of occurrence of errors and omissions contributed by the designers could be reduced through appropriate regular training.

The above literature has highlighted the need for appropriate design knowledge by the architects who are involved in the design process of the refurbishment projects. Knowledgeable architects could reduce the problems such as limited design information in the refurbishment design process and at the same time could improve design performance. However, to what extent job knowledge in refurbishment design is important is still vague. Thus, this paper attempted to establish the influence of job knowledge on design performance.

MATERIALS AND METHODS

This paper designed with quantitative and qualitative approaches. Semi-structured interview was implemented for qualitative part and postal questionnaire survey was used for quantitative data collection method. In order to get a high response rate, the questionnaires were short and simple and did not take much time for respondents to answer. The respondents in this study were designers and architects who are directly involved in getting approval from respective local authorities. A set of questionnaire sent to the final list of 234 respondents. After filtration made from 71 replied questionnaires, 62 questionnaires found to be useful for analysis, giving a response rate of around 30 percent. The replied questionnaires represent 62 different refurbishment projects that the minimum contract value is RM 500,000. Demographic profile of the respondents shows in Figure 1. The profile shows more than two-third of the respondents was principal architects with more than 10 years working experience. This indicates that data collected are reliable and quality.

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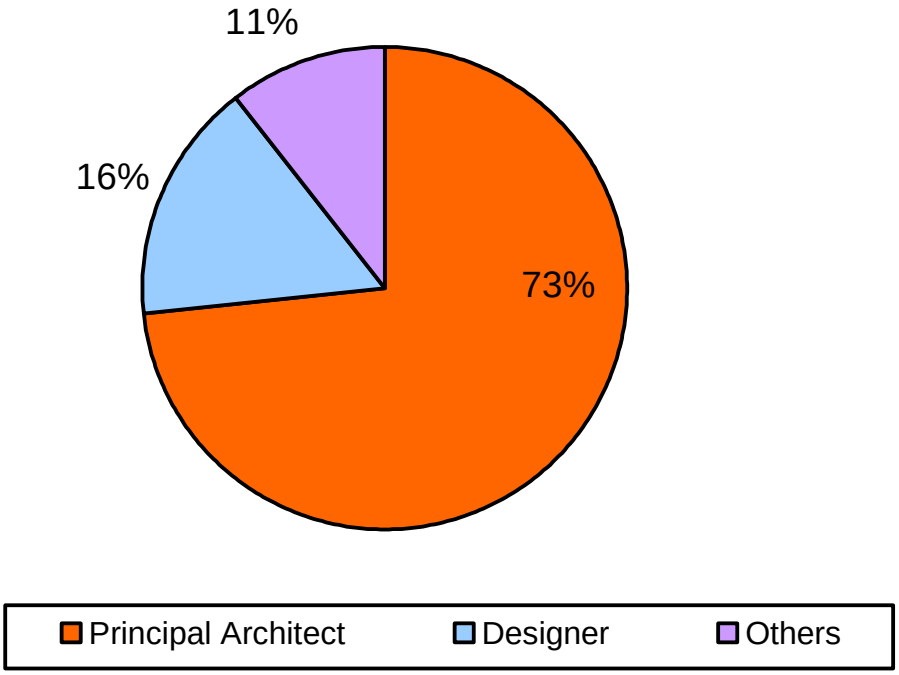

Figure 1: Job Title of the Respondents (n=62)

RESULTS AND DISCUSSIONS

The second attribute investigated was the job knowledge of the architects. For that purpose, the respondents were asked three questions. The questions were the record of formal training attended measured on a dichotomous 'yes' or 'no' scale, specialisation of the architects, measured by the kind of projects from which they drew more or less than 50 percent of their income. The third question was on the architects' knowledge of assessing the condition of a building, which was measured using a five-point scale. The discussion and results of the survey are presented in Tables 1 to 3.

Formal training refers to training that given by the authorised training bodies such as CIDB, CIOB, RISM, universities and colleges. The results of the questionnaire about respondents whether had attended formal training related to refurbishment are shows in Table 1.

Table 1: Attended Formal Training on Refurbishment

Scale	**Percentage (N=62)**
No	85.4
Yes	14.6
Total	**100.0**

Table 1 indicates that majority of the respondents had not attended any formal training concerning refurbishment projects. Only about 15 percent claimed that they had attended formal training. The training mainly came from a post-graduate programme. This shows that the majority of architects who were involved in refurbishment projects had minimum formal knowledge about such projects. The result obtained contradicted the statement of Ling [2] who said that job knowledge is important in design works. The result probably indicates that the architects believed the knowledge of refurbishment projects is more appropriate to be gained through on-the-job

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training rather than formal training. Second, it could be that not many opportunities were available to attend courses conducted on refurbishment, since more emphasis is given to new-build projects. As a result, most of them had used their knowledge about new-build projects to obtain experience on refurbishment projects.

However, the architects could be mistaken in thinking that the approach to managing refurbishment is the same as managing new-build projects. It is generally agreed that refurbishment projects differ in many significant ways compared with new build projects [7]. Every refurbishment projects is different in the way its problems and difficulties are processed. The failure to differentiate between these two types of projects could end up with lack in clarity in the approach used, which could influence the performance of refurbishment projects.

In the semi-structured interviews, ten principal architects in Klang Valley indicated that the majority of the architects believed that the formal training they obtained during the first-degree course is sufficient to provide knowledge to handle refurbishment projects. Therefore, it was not considered necessary for architects to attend formal training in refurbishment projects in order to gain the required knowledge.

The Mann Whitney-U test was employed to check significant difference in architects' attributes, between those who had attended formal training in refurbishment projects and those who had not. The results of the test indicate there were two significant differences for the architects' characteristics as follows:

- The knowledge of assessing the condition of a building
- Initiatives to make suggestion to improve the client's brief

The result shows that architects who attended formal training would have better knowledge, particularly on the aspect of assessing the condition of a building. The ability to assess the condition of a building is critically important in refurbishment project especially to detect any defects, repair work that needs to be done, advice on statutory requirements and to advise the client on the overall condition of a building before a new design could be adopted.

Secondly, for the difference in the initiative of the architects to give suggestions for design improvement, it is likely that the architects who had attended formal training would be more proactive in making suggestions to improve the client's brief. The architects probably had more understanding and awareness of the problems that could arise in a refurbishment project. Thus, by making appropriate suggestions to the client, it would help to minimize the occurrence of problems during the construction stage.

Table 2: Architects' Income from Refurbishment Project

% of income	**Percentage (N=62)**
<50% (general architects)	92.7
>50% (refurbishment architects)	7.3
Total	**100.0**

Table 2 shows the percentage of architects' income obtained from refurbishment projects. Almost 93 of architects said that less than 50 percent of their incomes were obtained from refurbishment projects, which indicates that refurbishment projects were not a core business for them. The result also suggests that the majority of architects did not considered refurbishment projects as a specialized area. Due to that reason, the level of skills and knowledge for the majority of the architects in refurbishment area is considered low.

In the semi-structured interviews, thirteen interviewees offered their opinion that refurbishment projects were a supplementary activity for the architects firm, due to low contract value; but on the other hand, refurbishment projects had fast turnover. The process of securing larger projects, would normally take a longer time. Therefore, to get some income, refurbishment projects were a good alternative source for architects' firms.

The Mann Whitney-U test was employed to check significant differences between general and refurbishment architects. The result shows that refurbishment architects spent significantly more time on refurbishment projects then general architects did. This could be due to the difficulties in gathering design information, so that more coordination was needed in order to ensure the design information was complete and accurate during the construction stage. General architects, with limited knowledge, would spend a similar amount of time for design as for new-build projects. This could not be accepted logically, since more time is needed in refurbishment projects. The results support the literature that argues refurbishment design consumes more time than design work for new-build projects [7].

Table 3 shows that the majority of architects claimed they had high and very high knowledge (62 percent) about assessing the condition of a building before handling the selected refurbishment project. This supports Daoud [7] who suggested that designers need to have appropriate skills and knowledge before refurbishment could be done, since the works is unique in many significant ways.

Table 3: Knowledge on Assessing the Condition of a Building

Scale	**Percentage (N=62)**
Very low	1.4
Low	7.0
Neutral	29.6
High	45.1
Very high	16.9
Total	**100.0**

The results contradict the frequencies of the architects who attended formal trainings. As mentioned in the semi-structured interviews, the architects believed that some of the skills related to refurbishment projects could be gained from the on-the-job training rather than through formal training. The skill and knowledge gained through the on-the-job training was claimed to be more appropriate and could help them in performing their refurbishment tasks.

However, the result contradicted Cooper [4] argument when they emphasized the need for having formal design education. The absence of formal training could increase the risk of failure to the projects. The designers also tend to be less creative to find solutions for design problems. In the semi-structured interviews, three respondents claimed that formal training sometime could not provide the relevant skill and knowledge to the designers as was required in the market. Since training syllabus sometimes diverted from the market needs, designers preferred to have on-the-job training rather than formal training.

The implication of the result is the syllabus of courses in institution of higher education need to be revised in order to fulfil the market's needs. A survey on the market's need pertaining to job knowledge for refurbishment projects is required so that the training attended could be beneficial to the designers.

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Table 4: The Correlation Matrix between Job Knowledge and Design Performance

	Completeness of design before work started	Changes of design during the construction	Provisional Sum to Contract Value	Time variance	Cost variance	Compatibility of design to existing site
Job Knowledge						
-Formal training	-.036	.142	**.263***	.202	-.057	-.116
-Specialization	-.032	-.024	-.210	.063	.002	-.106
-Assess bldg. condition	-.022	-.095	.111	-.070	-.048	**-.290****

Two significant correlations were detected between architects' job knowledge and design performance. They are:

- knowledge in assessing building condition improve design compatibility to site
- knowledge through formal training not improve amount of provisional sum

It is important that architects have knowledge and understanding about the existing building condition. This helps them to produce an accurate design by having a better understanding of the building systems, material and method of construction used. The significant correlation supports the findings of Andi [13], Cooper [4], who all highlighted the need for having design knowledge that could significantly contribute towards the design solution and minimize discrepancies in the design outcome. The result implies that architects may need to attend training in building assessment. Knowledge in this area can help architects to achieve high accuracy in design for refurbishment projects. Alternatively, the architects could also use qualified building surveyor services to ensure the building condition report is complete with all information required.

However, the survey showed that job knowledge gained by attending formal training did not help designers to reduce the amount of the provisional sum allocated. Formal training refers to courses conducted by an authorised training organization such as a university and CIDB. Other factors such as certainty of client needs and availability of design information are more important determinants the amount of provisional sum. In addition, the semi-structured interviews held with principal architects indicated that refurbishment techniques could more practicably to be gained through on-the-job experience and not from a standard syllabus taught in a formal class. This result supports statements by Friedman [15] who mentioned that refurbishment work is mainly site driven, in which refurbishment design knowledge is normally obtained from the job itself.

CONCLUSIONS

In conclusion, the correlation test's results show knowledgeable designers helps to improve the design performance of refurbishment projects. This indicates that performance of refurbishment projects suffered from the uncertainty knowledge of the refurbishment projects designers.

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