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DECISION MAKING IN THE DESIGN PROCESS OF REFURBISHMENT PROJECTS

A. Azlan Shah
Tutor, Building Surveying Department, Faculty of Built Environment, University of Malaya
Kuala Lumpur, Malaysia

R. Ismail
Associate Professor, University Teknologi MARA Shah Alam, Selangor, Malaysia

N. Noorhashimah
Associate Professor, University Teknologi MARA Shah Alam, Selangor, Malaysia

Abstract
The increasing number of ageing building, limited space for new development and financial constraints are the main factors that contributed to the importance of refurbishment sector in the Malaysian construction industry. The complexity of design process for refurbishment requires the involvement of many specialist participants with varying knowledge and orientation. This requires them to be integrated in the process through involvement in decision making. This study analyses the relationship between the degree of involvement of key participants in decision making process and the design process performance. This study concludes that the involvement of some key participants in the design process of refurbishment projects could improve the performance of the projects.

Keywords
Decision making, involvement, refurbishment, design process

1. Introduction

Refurbishment sector is one of the most important sectors in many developed countries. This sector is becoming an important economic driver in the Malaysian construction industry due to the existence of high number of ageing buildings and the rapid changes of technology used.

Refurbishment refers to upgrade, major repairs work, renovations, alterations, conversions, extensions and modernization of existing building, but exclude routine maintenance and cleaning work (Quah, 1988). Refurbishment project is one of the most risky, complex and uncertain within the construction industry (Egbu, 1996; Rahmat, 1997; Rayers and Mansfield, 2001). Even though they difficult to manage, it has grown rapidly in UK and Europe for the last 30 years and the trend is now spreading over to this country. Unpublished data by CIDB Malaysia shows that refurbishment and maintenance works increased to about 13% of total the construction output in the year 2005 from only 2% in the year 2002. This indicates the growing importance of refurbishment sector and calls for greater understanding and knowledge in managing them.

One of the major problems identified in managing refurbishment projects is to determine the appropriate levels of involvement of the various parties at the different stages of the design process. Their involvement in decision-making is important, because the key information needed to design is scattered among them. The availability of design information would influence the quality of decision made. Any decisions made at the early stage of design had major influence on the overall project performance such as cost and time.

The fragmented and uncertain condition of existing buildings in refurbishment projects always limit in the availability of design information. Some of the information is difficult to obtain especially during the initial stage of design. Due to that, the designers would not be able to complete the design tasks before work commence on site. The development of design for refurbishment most likely depends on designer's endeavours to gather information from the exiting building (CIRIA, 1994). To handle this situation, it is suggested the designers to integrate all information from the key participants who involved in the projects. This helps the designers making correct decision and reduces from making any assumptions in the design. Therefore, the degree of involvement of design key participants in all stages of design process is important to produce good decision for the refurbishment design.

2.0 The Design Process

Design process is as a multi-disciplinary process, performed in a series of iterative steps to justify total solutions that is of value to the client starting from schematic design to contract implementation and management stage.

Chua et al. (2001) argues that success of construction is influenced by the success of the design process. However, the design process is extremely dynamic and complex but it needs to be managed cautiously because the implication to project efficiency is great. Due to poor feedback from the participants in a design team contributes to the uncertainty in the design process. Therefore, the feedback in design process is important because it ensures the communication amongst the design team's members flow smoothly.

There is no standard design process universally accepted by all the designers so far. The most commonly used for building design process is form RIBA plan of work (RIBA, 1973). However, in Malaysia, the architects are required to follow PAM 'basic service work' the guideline of design process as mentioned in the 'Architects Act 1967, Act 117 and Rules' (2004). This procedure is abstracted from the RIBA plan of work model and being modified in order to suit with local projects environment.

Generally, PAM basic services described the design process comprises of 4 main stages:

- Schematic Design Phase
- taking project brief, conceptual design and submission for planning department approval.
- Design Development Phase
- upon planning approval, developing schematic & working design and submit for building approval.
- Contract Documentation Phase
- get approval on estimate construction cost, prepare tender document, analyse and award
- Contract Implementation and Management Phase
- provide information to contractor, inspecting work, applying CFO and prepare as build drawings

The standard stages in the design process could provide compressive design that required in all construction projects. However, more coordination amongst the design key participants is required in refurbishment projects. This is due to difficulties in gathering design information for the existing buildings. Therefore, in order to minimize problem in coordination, the degree of involvement of key participants need to be stepped up. This would help to narrow down the uncertainty during the implementation of the refurbishment projects.

3.0 Involvement of Design Key Participants in Decision Making

In construction projects, any decision made have implications to cost, quality, durations and resource allocation of the projects. In producing good decisions, quality and amount of information are considerably critical to support and as a basis for decision made. A good decision making requires informative formulation, clear evaluation and quick re-formulation of alternatives. Without sufficient amount of data, it is impossible for the design team to have good decisions. The situation is more critical during the schematic stage of design where the amount of information available is limited.

Design process is the particular stage where many key decisions are made (Sanvido and Norton, 1994). Due to the decision made commit a large percentage of project funds, adequate and accurate information are needed in a timely manner. Decision making is considering complex, inter-connected and a dynamic process. The complexity in building design decisions arises from the effects of each decision depends on large number of other decisions (Papamichael, 1999). The decision making frequently involves more than one decision makers and also large number of interdependent factors. Due to the complexity nature of refurbishment projects, the degree of involvement of key participants in decision making is varies, depending on the stages (Egbu et al., 1996).

The design key participants include the architect, engineer, main contractor, client, quantity surveyor and specialist contractor. In the design process of refurbishment projects, involvement of design key participants in refurbishment designs is crucial in order to ensure high degree of completeness of drawings before work commence on site. With out high input from participants such as contractors, client and others consultant designers, it is probable the data available is not sufficient. This creates adverse effect to the completeness of drawings. Therefore, key participants in design process need to have greater team spirit so that sharing and flow of information among them easier.

The concept of involvement in new built projects is not appropriate to be implemented in refurbishment projects. The high degree of uncertainty in refurbishment projects demand more flexibility in managing it and required high capacity of information processing along the design process. Due to the uncertainty and limited availability of design information, it is likely that the involvement of the design key participants should constantly continue until the end of refurbishment projects. It is anticipated that many changes could be arises from new information discovered from the site. Therefore, the amount of decisions related to the design works that need to be made during the contract implementation stage is great.

4.0 Research Methodology

This research designed with quantitative approached and postal questionnaires survey has been employed for data collection method. In order to get high response rate, the questionnaire was designed short and simple that did not take long time for the respondent to answer. The respondents for this study consisted of professional architects who are registered with Board of Architect Malaysia. After preliminary survey is made, 243 architects with refurbishment experience found to be appropriate to participate in the survey. A questionnaire was send to the final list of 243 architects. After filtration made of 98 replied questionnaires, 83 questionnaires were found useful for analysis that giving response rate approximately 36 percent. Almost two-third of the respondents was principal architects. It was also found that nearly ninety-five percent of them had more that 10 years experience in construction industries. The descriptive and inferential statistics such as associative test were used for data presentation and analysis.

5.0 Result and Discussion

The respondents were asked to rate on the degree of involvement of design key participants in their refurbishment projects. Four points scale was used from no involvement to high involvement. The answers were converted to relative important index (RII).

Table 1: The RII reading for the degree of involvement of the design key participants

Key participants	Design Process Stages			
	A	B	C	D
Architect	0.98	0.98	0.90	0.97
Client	0.90	0.81	0.70	0.77
M&E Engineer	0.70	0.82	0.80	0.83
C&S Engineer	0.66	0.75	0.72	0.78
QS	0.67	0.70	0.88	0.78
Contractor	0.37	0.38	0.46	0.97
Specialist	0.46	0.55	0.54	0.63

Legend: A= schematic design; B=design development; C=contract documentation; D=contract implementation

Table 1 shows the RII readings for the degree of involvement of design key participants in four different stages in design process. The higher were the readings the greater is the involvement of the design key participants in the design decision making. For the purpose of the analysis, the readings were interprets low for readings less than 0.33, 0.34 to 0.67 as a medium and 0.68 to 1.0 as a high involvement.

In schematic design stage, three key participants identified domain were the architect, M&E engineer and the client. In this stage, main issues discuss were the concept of the design and project brief. A good architect would be able to advise the client in all aspects with out the present of other participants. This however depends on the agreed scope of work in the projects. If the majority of the works comprise engineering scope, it probably would involve discipline engineers to explain and made further clarifications on certain matters to the client. In the finding, the majority of involvement in the schematic design stage would be between the clients and architects. It implies the ability of the architects in handling the situation alone or it could be the majority of refurbishment projects in the study, the scope of work more on the building designs, rather than engineering and specialist designs.

In design development stage, generally the wheel of dominance took over by the architect, C&S engineer, M&E engineer and quantity surveyor and the client. These participants were rated highly involve in this stage. Architects maintained their important role in the second stage of design process while the client roles reduced slightly a bit. The role of M&E engineer more dominant compared with the previous stage most likely the services scope of work is higher for the refurbishment projects in this study. A lot of sharing in design information, interfacing of interdisciplinary design and coordination took place in this stage. Many meetings, contacts and transmitting of design documents happened in this stage where all the key participants involved were trying to complete their design with highly accurate. In this stage, other key participants such as C&S engineer, quantity surveyor and specialist show improvement on the degree of involvement compared during the schematic design stage.

In contract documentation stage, the wheel of dominance maintained with five participants found to be highly involved. The reading shows slightly lower compared with previous stage except for the quantity surveyors. This indicates the importance function of quantity surveyors in this stage. It is expected that the role of quantity surveyor become important since the preparation of tender document and final estimate on project cost took place in this stage. The quantity surveyors liaise mostly with the architect, in determining the contents of the tender document. The other key participants remained their involvement probably to complete their detail designs which to be attached in the tender document.

For contract implementation and management stage, all key participants were highly involved in decision making except for the specialist contractors. The architects and contractor found to be the most actively involved with the RII reading shows equal values of 0.78. It is expected that contractor roles would be

important since the construction commenced. The architects' role remained important in this stage as a design team's leader to monitor and report the progress and the quality of refurbishment works on site. Other key participants show increment of the degree of involvement where it is expected many changes of the design occurred with more new site discovery. Degree of integration found to be higher in this stage in contrast with new built projects. The changes of site condition increased work load and interaction amongst those key participants in the refurbishment projects.

To have better picture, the trend line for the degree of involvement for design key participants in the refurbishment projects illustrated in figure 1. Architect, M&E engineer and client maintained highly involved in all stages along the design process where as specialist constantly in medium segment. The result implies the importance function demonstrated by the participants. Architects could be acted as a design leader who coordinate and manage the overall design works, where as the M&E engineers manage the services parts of design which likely complex task especially when the services content to contract value is substantial. The clients highly involved in the refurbishment projects implies supportive role where it to ensure the projects running smoothly.

In overall, the involvement pattern contradicted with arguments by Brown (2002) and Gray and Huges (1994) who mentioned the degree of involvement of design participants would be highest during schematic design stage and decrease during design development, tendering and contract implementation stage as noted by the RIBA plan of work. Both studies imply low integration of design participants during contract implementation stage in new built projects. Most of the design works had been completed before contract documentation stage. This however not happened in refurbishment projects. In this study, the result indicates that the degree of involvement for the majority of key participants especially the designer group increased in the contract implementation stage. This signifies more works need to be done in this stage. It also shows integration of key participants is higher in refurbishment design.

The result also contradicted with Gray and Huges (1994) argument who mentioned about the functional relations of the key participants in every stage for the design process. The present result indicates that the relationships were integrated and the processes were iterative and not flow in one direction. Majority of the design works likely were carried out during contract implementation stage. This implies that the roles of design participants were much required in the final stage of design process where many amendment and variation to the design documents took place. The result also provides indication that the RIBA plan of work is more appropriate to be used for the guideline of new build projects and not likely suitable for refurbishment projects.

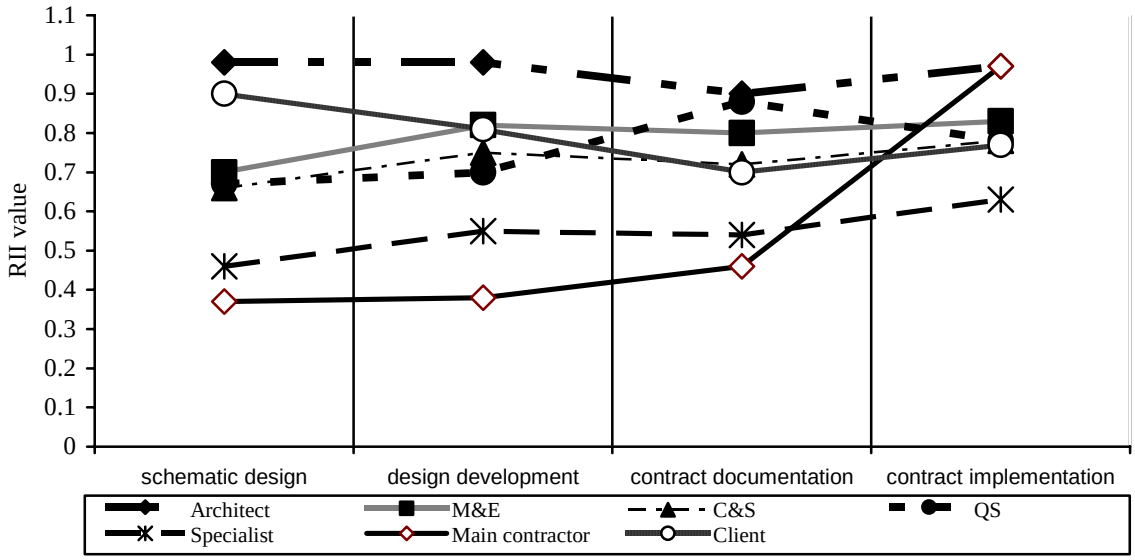

Figure 1: The degree of involvement of the key participants in the design process

The finding could contribute to some implication to the refurbishment design. First, the payment of fees made by the client to the architects could not follow the payment schedule provided by the Board of Architect Malaysia. As stated in the architect act (1967), the clients need to pay 70 percent progress fees after the completion of contract documentation stage. This schedule is inappropriate to be used for refurbishment projects since there are many design works need to be amended during contract implementation stage. It could involved total changes of the design when the contractor revealed major new discovery on the building site. The design and construction work could be done parallel based on availability of new design information. For instance, the new additional foundation for extension work could be shifted to new location since the proposed location is found to be unsuitable after excavation work carried out. The shifting of the foundation could lead to total adjustment for the arrangement of the new building elements. Hence, it is recommended the distribution of payment for the architect services need to be amended so that the amount of the fees paid up to contact documentation stage would be reduce from 70 percent to more reasonable figure. Second, since the pattern of involvement shows continuous design work need to be carried out by the designers, it is fair to have highest scale of fees for refurbishment works.

The next step is to identify statistically weather the degree of involvement could significantly affects the performance of the refurbishment design process. For the associative test, the spearman's rank correlation coefficient had been employed to detect any relationship between the variables. Three performance variables were used to indicate the performance of refurbishment design process. The variables are percentage of completeness of design before work started, time variance and cost variance.

In schematic design stage, there is no significant correlation detected for all variables. This indicates the involvement of the key participants in this level would not affect the performance of the design process. The result is expected where in schematic design stage the clients and the architects likely to discuss on the brief and concept design. It still in initial stage and not many decisions could be made.

A significant positive correlation detected during design development stage between the involvement of M&E engineer and the percentage of completeness of design before work started on site. The result indicates the important role of M&E engineer in design development to achieve higher percentage of completeness of design before the commencement of refurbishment work. It also could be said that majority of refurbishment projects in this study comprised higher content of services work to contract value. Due to that, many interfacing works need to be done with other interdisciplinary designs. Hence, the decision made in this stage must involve the M&E engineer.

In contract documentation stage, the involvement of M&E engineer shows two significant correlations toward the performance of refurbishment design process. The correlations detected are:

- The higher involvement of M&E engineer the greater the percentage of completeness of design before work started on site could be achieved
- The higher involvement of M&E engineer the lower is the time variance for refurbishment design

Second correlation described that the involvement of M&E engineer in contract documentation probably would ensure their design more accurate before work started on site. The substantial amendment made in order to achieve high accuracy in M&E design probable lead to this result.

For contract implementation stage, the involvement of M&E engineer shows a significant negative correlation. This suggests the higher involvement of M&E engineer the lower time variance for refurbishment design projects. This probably could minimize rework during the installation of M&E parts. Second, it is more likely that the involvement of M&E engineer would eliminate problem on constructability or difficulties in installation of M&E items. Third, it could be the services item which in provisional is already confirmed that need the M&E engineer to amend their design. Therefore, the availability of M&E engineer could help the contractor in their decision making process and also guides the installation of M&E parts.

Table 3: Schematic Design Stage

	% Completeness of design before work started	Time variance	Cost variance
Architect	.064	.083	.076
M&E Engineer	.074	.036	.068
C&S Engineer	.042	.107	.108
Quantity Surveyor	.171	-.015	-.094
Specialist	-.063	.224	.172
Contractor	-.072	.382	.770
Client	.011	.104	.387

Table 4: Design Development Stage

	% Completeness of design before work started	Time variance	Cost variance
Architect	.072	.354	.906
M&E Engineer	.307**	.003	.068
C&S Engineer	.079	.228	.452
Quantity Surveyor	.193	.968	.073
Specialist	-.026	-.046	.109
Contractor	-.038	-.069	-.053
Client	-.075	-.099	.094

Table 5: Contract Documentation Stage

	% Completeness of design before work started	Time variance	Cost variance
Architect	-.032	.053	.046
M&E Engineer	.325**	-.279*	-.235
C&S Engineer	.051	-.159	-.094
Quantity Surveyor	.132	-.167	-.004
Specialist	.043	-.050	.133
Contractor	-.114	-.046	-.114
Client	.096	.001	.186

Table 6: Contract Implementation and Management Stage

	% Completeness of design before work started	Time variance	Cost variance
Architect	.077	-.064	-.002
M&E Engineer	.189	-.277*	-.099
C&S Engineer	.093	-.185	-.024
Quantity Surveyor	.272*	-.155	-.201
Specialist	.023	.014	.255
Contractor	.176	.049	.183
Client	.073	.035	.031

Legend: * Correlation at 5% significant level
** Correlation at 1% significant level

The involvement of quantity surveyor found to be significant to the percentage of completeness of design before work started on site. The unexpected association happened could be more variation claims made by the contractor during this stage due to many changes occurred. Although the percentage of completeness was claimed higher, it is probably indicates that the percentage of provisional sum to

contract value also substantial. Thus, once the provisional items had been confirmed, the contract price would be revised concurrently, that implies more work need to be carried out by the quantity surveyor.

6.0 Conclusion

The fragmented nature in refurbishment projects demands more information to assists in the decision making process. Greater involvement of key participants is one of the ways to obtain more information thus increase integration in the design process. The RII readings show at least three participants were highly involved in each stage of the design process. Highest involvement found in contract implementation stage which implies more tasks need to be done.

The associative test indicates significant correlation for M&E engineer in last three stages. Quantity surveyor shows a correlation in contract implementation stage. The result implies the important role of M&E engineer to improve the performance of refurbishment design process. However, no significant correlation recorded during the schematic design stage.

It could be concluded that the pattern of involvement in refurbishment projects is different from new build projects. The degree of involvement basically varies in all stages. It likely depends on the scope and nature of work in the contract. The study shows more integration by high involvement of design key participants in all stages of the design process. High involvement of certain key participants could improve the performance of design process in refurbishment projects. More detail study need to be carried out to suit with the different degree of uncertainty laid in refurbishment projects.

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