
Original Article

Methods of coordination in managing the design process of refurbishment projects

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ABSTRACT Building refurbishment is an important sector in the Malaysian construction industry, and has become an important economic driver. High demand for refurbishment projects mainly contributed by an increase in the number of building renovation, alteration, extension and extensive repair works. However, refurbishment projects are more difficult to manage because of uncertainty factors inherent in the projects. The uncertainty of refurbishment projects is reflected in the difficulty of obtaining design information during the design process. As a result, most refurbishment projects end up with high amounts of design changes during the construction stage. The performance of refurbishment design, however, could be improved by increasing the use of coordination methods among the key design participants in the projects. Therefore, this paper identifies effective coordination methods that could be used in managing the refurbishment design process. The data were obtained from a literature review, semi-structured interviews with 21 architects and a questionnaire survey, which involved 234 respondents. The analysis of the results concludes that methods of coordination were used extensively by architects in obtaining design information with scheduled meetings, and that direct formal contacts were more predominant.

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INTRODUCTION

The refurbishment sector has grown rapidly, and has become an important economic driver in some developed countries such as the United Kingdom and the United States (Rahmat *et al*, 2003). For instance, in the United Kingdom, almost 50 per cent of total construction output was contributed by this sector (CCCIS, 2005). This trend has spread

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

Refurbishment in this study is defined as a work on existing buildings that comprises rehabilitation, modernisation, renovation, improvements, adaptation, additions, repairs, renewal and retrofitting, carried out on existing buildings, but excluding routine maintenance and cleaning work (Young *et al*, 1996). Many construction management writers agree that refurbishment projects are more risky and complex than new-build projects and that this makes them more difficult to manage (Construction Industry Research & Association, 1994). There is consensus that significant problems in refurbishment projects are because of the existence of uncertainty in managing the projects (Rahmat, 1997). The uncertainty of refurbishment projects is reflected in the difficulty of obtaining and channelling design information to project organisation during the design process. According to Baldwin *et al* (1999), the design process is a process that is performed in a series of iterative steps to conceive, describe and justify increasingly detailed solutions to meet the needs of the client. Egbu *et al* (1998) discovered that only 10 per cent of refurbishment projects had more than 75 per cent of the design completed before the project started onsite. Similarly, Rahmat (1997) found that about only 20 per cent of the refurbishment projects in the United Kingdom started work onsite with more than 60 per cent of the design complete. These studies show that in the majority of refurbishment projects, a high proportion of the design information could only be obtained during the construction stage. Incomplete design could contribute to poor project performance such as the incidence of more design changes occurring during the construction stage (Andi and Minato, 2003), higher design cost and time variances because of design rework (Daoud, 1997).

Type of procurement method dictates the participants involved and their role during the design process. Different procurement systems would lead to different communication lines and authority of project participants. Bowen *et al* (1999) noted that one of the principal reasons contributing to the poor performance of the construction industry is the inappropriateness of selection of procurement method. This indicates the effect of using different types of procurement methods in project delivery. For instance, the design and build approach integrates the design and construction process, whereas in the traditional method the two processes are separate.

The involvement of multiple parties from different organisations involved in the design process could lead to a communication gap. This could delay the process of decision-making and completion of design. Ineffective collaboration and limited understanding of the complexity and uncertainty, in addition to the interdisciplinary nature of the design process, contributed to this problem (Chiu, 2002).

The fragmented nature of the construction industry always invites criticism of the way it is managed (Kagioglou *et al*, 2000). The differentiation and fragmentation in refurbishment projects are consequences of the high degree of specialisation in design and construction. The participants involved in the project tend to make decisions in their specialised areas without coordinating with other key participants. This causes disintegration of their tasks in the construction projects, which leads to uncertainty in information used and incomplete design during the construction stage.

The growing importance of the refurbishment sector, poor design completeness before work started onsite and the lack of coordination in refurbishment projects

provide impetus to improve the management of uncertainty in the refurbishment design process, especially concerning the aspect of coordination.

COORDINATION IN THE DESIGN PROCESS

Seven parties are normally involved in the design process of the refurbishment projects (Ali *et al*, 2008). They are architect, civil and structural engineer, specialist, client, mechanical engineer, quantity surveyor and main contractor. Uncertainty in design requires coordination of multidisciplinary professions, activities and information, which are dynamic during the design process. The lack of coordination among building designers is a major problem in the construction industry (Hegazy *et al*, 2001). This has contributed to the lack of integration of design information, which leads to unnecessary time variations and design changes in the construction projects. Complete and accurate design information is crucial for the architects to produce complete and error-free drawings. The problem is that often the design information in refurbishment projects is uncertain, scattered and comes from various sources.

To overcome this problem, greater task uncertainty requires a greater amount of design information that must be processed in order to achieve an acceptable performance level (Galbraith, 1973). Where the nature of work has a high level of certainty, less information-processing capacity is needed to perform the task. More coordination among the team members is needed in order to improve the speed and accuracy of design information. Coordination in the design process might be viewed as an activity to handle the uncertainty and to synchronise the flow of design information. It is also about synchronising the collection processing, storage and transmission of information, which is essential for an effective design process (McGeorge, 1988).

Therefore, to enhance coordination in the design process, Rahmat (1997) suggested that it could be processed effectively through structured collaboration for sharing design information. This could be achieved by implementing appropriate coordination methods in the design process. The use of coordination methods such as meetings and contacts was important in improving the information processing capacity. In refurbishment projects, the design team's members are required to have regular communication among each other and to share and exchange related design information. The latest information is critical to the designers in order to increase the accuracy and completeness of the design. Some of the potential benefits to improve project performance such as project cost, safety and reduction of variation claim is by using coordination methods (Mitropoulos and Tatum, 2000).

METHODS OF COORDINATION

The design process involves many parties and large amounts of design information flow. This requires interactions among all participants in order to distribute the information on time. One way to improve the problem is for a project organisation to step up information processing capacity by implementing coordination (Bennett, 1991). By using this approach, the participants could bypass the line of authority in a project organisation. Coordination induces all design problems to be settled among the related key participants locally, and overloads to be removed from the organisation's hierarchy. In addition, greater flexibility could be achieved when coordination methods are used in the design process. The degree of coordination used for any projects depend on the problems that might arise and the amount of information communicated in an organisation (Bennett, 1991). Two coordination methods have been identified as appropriate to be used in the design process, namely, direct contact and meetings.

Direct contact

Direct contact has been identified as the simplest form, and one that involves minimal cost among the methods of coordination (Galbraith, 1973). Two types of direct contacts are used in projects: direct formal contact and direct informal contact. Each method encompasses different approaches in gathering useful information. A combination of these methods could send reasonably accurate messages quickly in all directions, and could be able to deal with all the major uncertainties that arise within the project organisation. Because of the iterative nature of the design process, the number of participants and the fragmentation of building systems, the increased use of direct contact is critically required.

Direct formal contact

Direct formal contact refers to the documented information that could be obtained by letters, memos and reports. This approach is more formal, and is widely used as a means of communication among the different organisations that are involved in a project. Direct formal contact has been identified as one of the means used by designers for obtaining design information.

In managing a risky project, proper documents are always needed to protect the participants involved. Formal documents could be used for litigation or as evidence in any contract dispute, such as variation claims in projects. Therefore, it is important to use direct formal contact in handling uncertainty in the refurbishment design, such as in design changes.

Direct informal contact

Any information obtained using informal conversations such as telephone calls or discussions is categorised under direct informal contact (Bennett, 1991). As the design process has a large number of participants and a high degree of interdependence of building design, the demand for informal contact is increased (Pietroforte, 1997). The uncertain nature of refurbishment projects requires an approach that is more flexible.

One of the advantages of using direct informal contact is that information can be gathered quickly without the need for any formal procedure. Informal contact provides clearer information in a short time, and hence is useful in confirming certain issues pertaining to the design process. The refurbishment design process involves a large amount of information flow. Therefore, direct informal contact could resolve the problem of inefficiency in flow of design information, especially when design changes occur during the construction stage.

Meeting

The purpose of meetings is to keep key participants informed, and to handle shared problems arising in the projects (Laufer *et al*, 1992). Meetings are one way to increase the amount of information in construction projects, as a meeting mostly covers the current issues of the design. All the feedback and comments from the design team's participants could be discussed instantly in the meeting. The design process normally involves participants from different organisations, who form a group known as a design team. Meetings are seen as a medium to increase interaction among the design team members. There are two types of meetings in construction projects: scheduled and unscheduled meetings (Conhenca-Zall *et al*, 1994). Both types are important in achieving better integration in the management of the refurbishment design process.

Scheduled meeting

Scheduled meetings for the design process are conducted at intervals of one a week to report on the progress of the design work and to discuss any issues that arise. The scheduled meeting for design diminishes slowly once the construction stage starts. A scheduled meeting can transform into an unscheduled meeting if any problems crop up during the construction stage. The functions of a scheduled meeting are to coordinate and to act as a means of conveying information about current progress of work and recent design changes (Perry and Sanderson, 1998). In a construction project, the scheduled meeting is an appropriate venue and suitable time for the project participants to discuss any issues related to the project. Problems in design could be discussed and finalised during the meeting, which could lead to a reduction in design errors during the construction stage.

Unscheduled meetings in the design process

An unscheduled meeting would be held if there was any urgent need to solve current issues related to design. This type of meeting normally takes over from a scheduled meeting in the design process when work has started onsite or between the intervals of scheduled meetings. Problems arising onsite, such as discrepancies in drawings that need to be solved urgently, are typical situations when an unscheduled meeting would be called. However, the need to attend unscheduled meetings requires the participants in refurbishment projects to be flexible and responsive (Rahmat, 1997). They may need to forgo their routine activities in order to attend unscheduled meetings for refurbishment projects. The allocation of time and overhead cost for refurbishment design works tends to increase if there are many unscheduled meetings during the construction stage. The need for unscheduled meetings increases during the construction stage, as many unknown items start to be discovered. The unscheduled meeting is probably suitable to cater to the uncertainty of design information in refurbishment projects. The unscheduled meeting would be least important if there were no urgent decisions to be confirmed. Minor design problems that arise could be discussed at the next scheduled meeting of the project.

RESEARCH METHODOLOGY

A combination of quantitative and qualitative data collection methods was used in this study. The first stage was a literature review, followed by data collection involving semi-structured interviews and archiving of documentation for the second stage. The purpose of this stage was mainly to refine the research problem. The third stage was the postal questionnaire survey, which aimed to collect data to form a database for the purpose of statistical analysis.

The postal questionnaire survey was of a short and simple design that did not require a long time for the respondents to answer. The respondents for this study consisted of professional architects who are registered with the Board of Architects Malaysia. In Malaysia, architects are normally the professionals who are involved in the design process of refurbishment projects, beginning from inception, schematic design phase, detailed design, submission of drawings for approval from relevant authorities and contract preparation to implementation onsite. Architects were selected as the appropriate respondents in this study because they play important roles as the design team's leader, who controls and monitors all design activity information. Furthermore, all required data with regard to this study could be obtained from the architects.

A questionnaire was sent to 243 architects with refurbishment design experience. Ninety-six completed questionnaires were returned. Filtration was undertaken to

scrutinise the questionnaires that could be used to form a database for the final data analysis. Eighty-two questionnaires, or 36 per cent, were identified as appropriate to be used for the data analysis. The result shows that 82 per cent of the respondents had handled at least five refurbishment projects. The remainder indicated that they had been involved in between one and four refurbishment projects. This indicates that the respondents had sufficient experience and knowledge in the area of refurbishment projects. Therefore, it is believed that the data could produce reliable findings.

For data analysis, the frequency distribution method has been used to present the profile of the responses obtained in the postal questionnaire survey. The data are shown in tabulars and graphic forms, which provide a complete view of the profile of the findings, with the percentage of responses given to each point on the Likert scale. Liaw and Goh (2002) have stated that descriptive analysis could provide a general overview of the research findings. To rank some of the variables, calculation of central tendency using the mean was carried out. The five-point scale used in the questionnaires was transformed to mean readings to determine the ranks of each variable.

DATA ANALYSIS AND DISCUSSION

Four methods of coordination were investigated in this study. These were scheduled meetings, unscheduled meetings, direct formal contacts and direct informal contacts. All the questions asked pertaining to the use of lateral relations used a scale from ‘very small’ to ‘very large’ extent. The results for the methods of coordination are presented below.

Scheduled meeting

The respondents were asked to indicate the frequency of scheduled meetings conducted at four different stages in the design process. The results are shown in Table 1.

The results indicate that scheduled meetings were extensively used during the construction stage and design development stage. Almost 80 per cent of the refurbishment projects used scheduled meetings as a means of conveying information in the design process during the construction and design development stage, and around 65 per cent during the schematic and contract documentation stage. The results obtained more or less supported the findings of Perry and Sanderson (1998), who mentioned the importance of scheduled meeting in construction projects.

The plausible reasons why the architects preferred to use this approach is that probably they were more comfortable using a formal channel rather than an informal channel for the flow and sharing of design information. The greater amount of design information exchange occurs during the design development stage, when designers need information from many other sources to complete their design. The interfacing of interdisciplinary design that takes place in this stage requires documented evidence for any decisions made. Similarly, for the construction stage, the changes of design could occur several times, and action taken to rectify it requires proper records, because of high risks such as variation claims from the contractors.

Table 1: Obtaining information using scheduled meeting

<i>Stages in design process</i>	<i>Mean (N=82)</i>	<i>Percentage: large and very large extent</i>
Schematic design	3.80	65.3
Design development	4.07	77.5
Contract documentation	3.73	62.0
Contract implementation	4.17	77.7

Table 2: Obtaining information using unscheduled meeting during the design process

<i>Stages in design process</i>	<i>Mean (N=82)</i>	<i>Percentage: large and very large extent</i>
Schematic design	3.28	46.5
Design development	3.29	48.6
Contract documentation	3.04	33.4
Contract implementation	3.31	49.5

In the semi-structured interviews, five architects in Kuala Lumpur revealed that they were more likely to use scheduled meetings as a venue to validate some of the decisions made informally through verbal discussions or through any informal channel. Scheduled meeting normally took place weekly or bi-monthly, depending on the complexity of the projects. Any informal decisions made would be validated at the next scheduled meeting. The decision made through informal sources would be converted to documented evidence that could be used in any litigation matters. Therefore, most of the architects in the interview argued that in the refurbishment projects more scheduled meetings would be used. Flexibility in managing the projects still could be achieved, and this is vital in order to ensure that the flow of refurbishment projects was not disrupted and that they could run smoothly.

Unscheduled meeting

The result for frequency of unscheduled meeting use in obtaining design information is shown in Table 2.

In general, frequencies of ‘large’ and ‘very large’ extent of less than 50 per cent were recorded at all stages for the use of unscheduled meetings in the refurbishment design process. The result indicates that unscheduled meetings were used less frequently in all stages of the design process than scheduled meetings, as previously discussed. Compared with the results of scheduled meetings, none of the stages exceeded the frequencies obtained for the scheduled meetings.

However, the pattern in this study shows that the frequencies of unscheduled meetings increased during the construction stage. It implies that although the architects use this method less, the frequency of unscheduled meetings increased when unexpected problems or new site discoveries occurred during the construction stage, and they required urgent decisions to be made. In addition, even though the extent of unscheduled meetings used is relatively lower than scheduled meetings, they are still widely used. This is therefore an indication of the importance of unscheduled meetings, which reflects the need for flexibility.

In the semi-structured interviews, about two-thirds of the selected principal architects in Klang Valley revealed that unscheduled meetings would be extensively used if a good relationship among the key design participants was established. If the contractor and consultants had a history of working together, the degree of trust would be enhanced, and thus fewer scheduled meetings would be required. Some of the respondents in the interview mentioned that the advantage of this approach was that it could save a lot of project time, and decisions could be made faster.

Direct formal contact

Table 3 describes the frequencies of direct formal contact used in the design process of refurbishment projects.

Table 3: Obtaining information using direct formal contact during the design process

<i>Stages in design process</i>	<i>Mean (N=82)</i>	<i>Percentage: large and very large extent</i>
Schematic design	3.79	66.2
Design development	3.77	63.9
Contract documentation	3.69	57.8
Contract implementation	3.96	73.2

Table 4: Obtaining information using direct informal contact during the design process

<i>Stages in design process</i>	<i>Mean (N=82)</i>	<i>Percentage: large and very large extent</i>
Schematic design	3.43	49.3
Design development	3.58	52.1
Contract documentation	3.41	47.9
Contract implementation	3.70	59.1

The result suggests that direct formal contact was extensively used in three out of four stages in which the percentages of 'high' and 'very high' extent recorded more than 60 per cent. The results are similar to the results of the scheduled meeting, and these are both formal channels of communication in the refurbishment projects. The use of this method was minimal during the contract documentation stage, probably because most of the information required for documentation purposes was almost complete during the schematic design and design development stage, when the frequencies of contact were high. Thus, the minimum amount of direct formal contact was found to be made in the contract documentation stage.

The frequencies of direct formal contact drastically increased in the construction stage, most probably to provide the written evidence of any information that transpired between key participants. It is believed that many decisions need to be made during the construction stage, when changes of design for several reasons start to take place.

The present results indicate that the architects preferred to use formal channels for the flow of design information. If there was any decision made in an informal discussion, the architect normally would issue a letter or 'site instruction' to the contractor for further action. Formalisation is important in providing evidence for any contractual matters and for the purpose of reference, especially when the client requests it. It also relates to the accountability of the architects, particularly when the decision made involves any additional cost.

Moreover, during the semi-structured interviews, 10 principal architects in Kuala Lumpur pointed out that much of the correspondence was for the purpose of confirmation of decisions that had been made during discussions held onsite. Normally these items involved implications to the project cost. For those items that did not have any cost implication, verbal confirmation was sufficient, and a letter would not follow the matter up. Furthermore, the majority of the contractors would not proceed with new amendments to the design without paper evidence, because of the low degree of trust between the clients and the consultants.

Therefore, it could be concluded that even though formalisation was practiced in the management of refurbishment projects, the architects still used informal channels of communication with the design team's members, thus increasing flexibility in the management of the projects. Some of the direct formal contact was made for the purpose of confirmation in certain issues, and not to explain any new information.

Direct informal contact

Table 4 shows the frequencies of direct informal contact recorded during the design process of the refurbishment projects.

The result suggests that direct informal contact is not used as frequently in any of the design processes, compared with formal contact. Similar to the situation for meetings, the architects prefer to use formal contact rather than informal contact.

The results contradict studies carried out by Driskill and Goldstein (1986), who emphasised the importance of informal communication for the purpose of improving efficiency in managing design works and faster decision-making. The result implies that probably the architects tried to reduce the cost of having informal contacts. The use of telephone lines and Internet could increase overhead cost to the architect's firm, and the informal discussions demand a high consumption of time. Thus, architects preferred to discuss the matter in a formal written form. The preliminary questionnaire survey results revealed that the majority of architectural firms involved in refurbishment projects are small, with a relatively small labour capacity. Therefore, time is very valuable for these firms in other projects. Furthermore, the results of the preliminary questionnaire survey also indicate that the size of refurbishment projects and the fees obtained can be considered low. Because of this, it is believed that architects would eliminate all the unnecessary overhead costs concerned with the refurbishment projects.

The results suggest that direct informal contact is often used in the design development and construction stages. More than 50 per cent of the respondents said that this method helped them to a 'large' and 'very large' extent in obtaining design information. This indicates that most probably more information is required during the design development stage when the architect is starting to develop a detailed design, and that this must be integrated with interdisciplinary designs. Therefore, many informal discussions and telephone calls will be made among the key participants to seek confirmation in certain aspects of design. Because of the risky and uncertain nature of refurbishment works, many new discoveries occur onsite, and many confirmations and information needs arise during the construction stage, which encourage the use of direct informal contact at this stage of the design process.

The results also show that there were low levels of trust among the key design participants in the refurbishment projects. All the required information was conveyed by the architects through formal channels such as letters, faxes and memos. This implies that there is a low degree of teamwork in the refurbishment design team. Teamwork is critically important in managing refurbishment projects because of the large amount of information exchange required in the design process (Construction Industry Research & Association, 1994). In the semi-structured interview, 10 principal architects indicated that one of the reasons for the low level of teamwork among the design team members was the unreasonable fees distributed by the architects. In small projects, such as refurbishment, the client would normally pay a lump sum service fee to the architects; it would be up to the architects to distribute the fees among the other consultants. Low service fees paid by the architects would influence the time and commitment provided by the other consultants.

To be clearer, Figure 1 shows the trend lines for lateral relations, that is, scheduled meetings, unscheduled meetings, direct formal contacts and direct informal contacts used at different stages in the design process.

The chart is presented in mean values, which can be categorised into three – high, medium and low importance – as suggested by Rahmat (1997). A mean reading of less than 1.66 is rated 'low', 1.67–3.33 is rated 'medium' and 3.34–5.0 is rated 'high'.

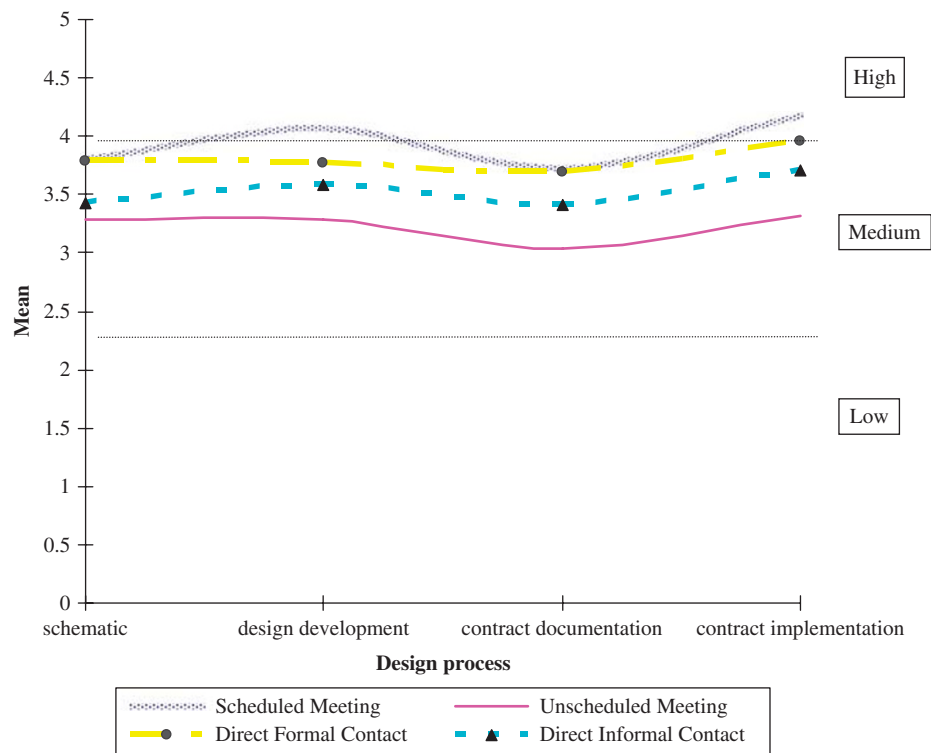


Figure 1: Trend for the application of coordination methods in the design process.

The patterns indicate that scheduled meetings are the most important coordination methods for obtaining information during the design process of refurbishment projects, whereas unscheduled meetings are the least important among all methods of establishing coordination methods. In general, however, coordination methods were highly used at all stages of the design process, except for unscheduled meetings, which were slightly lower, and fell to the ‘medium important’ level. The pattern also shows that more integration was required during the design development and the construction stage, during which the use of coordination methods was high.

The Kruskal–Wallis technique employed in the present study found that there is a significant difference between formal and informal methods of coordination in the refurbishment projects. Hence, it is concluded that the use of scheduled meetings and direct formal contact is more preferred by the architects in managing the refurbishment projects.

The correlation test was employed between methods of coordination and design performance. Design performance is measured by the completeness of design before work starts onsite, cost and time variances. The results of the correlation test are shown in Table 5.

Table 5 shows that scheduled meetings are significantly correlated with completeness of design before work starts onsite. Scheduled meetings were conducted weekly or bi-weekly for a project. This is useful for the key design participants to discuss progress and share their design information. The more the key design participants meet, the more opportunity there is for them to share information. This helps the designers to produce a more complete design. On the other hand, direct formal contact also produced a significant correlation with completeness of design before work started onsite.

Table 5: The correlation matrix between coordination devices and design performance

<i>Lateral relations</i>	<i>Completeness of design before work started</i>	<i>Time variance</i>	<i>Cost variance</i>
Scheduled meeting	-0.348**	0.048	-0.012
Unscheduled meeting	-0.128	0.044	0.005
Direct formal contact	-0.219*	0.002	0.144
Direct informal contact	-0.183	0.063	-0.022

*Correlation at 5 per cent significance level

**Correlation at 1 per cent significance level

Direct formal contact is a means of communication using letter and memos that convey design information for key design participants. This helps in providing documented evidence throughout the design process. The results show that formal contact was used in conveying and exchanging design information to complete the design before work started onsite.

It is quite surprising that there was no significant correlation recorded for the informal channels such as unscheduled meetings and direct informal contacts. This contradicts Rahmat (1997), who said that flexibility of unscheduled meetings or direct informal contacts is needed in managing refurbishment projects.

The results imply the need to frequently use formal communication in the refurbishment design process. This form of communication is preferred by the designers when exchanging design information. Accountability and high risk in the management of refurbishment design, such as variation claims and project time delays, could be obstacles to the architects extensively using the informal channel.

CONCLUSION

In conclusion, it could be said that all coordination methods tested in the study were used extensively by architects in obtaining information during the design process of the refurbishment projects, with formal interaction being more predominant. Formal channels, that is, scheduled meetings and direct formal contacts, were preferred by architects to obtain design information. The correlation test indicates that the use of the formal method of coordination could improve the design performance in refurbishment projects.

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