Problems and solutions of requirements management for construction projects under the traditional procurement systems

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Abstract

Purpose – This paper aims to focus on requirements management of projects constructed under traditional procurement system. It seeks to discuss the requirements management processes highlighting the limitations and addressing the need for a practical framework for facilitating the implementation of requirements management in the construction industry.

Design/methodology/approach – Two research instruments were used in this paper: semi-structured interviews and case studies.

Findings – The literature review introduced a generic process for requirements management practice potentially to be adopted in the construction industry. The research study identified that the processes and limitations of current practice included the lack of a practical framework, misinterpretation of requirements, difficulties in identifying requirements, conflicts between expectation and constraints, complex hierarchy of client’s organisation and communication problems in eliciting client requirements. Recommendations are given that an inclusive project brief and a competent project manager to manage the project requirements are necessary in capturing and tracing the requirements during the project development process. A practical framework is needed to improve the requirements management practice within the construction industry.

Research limitations/implications – The research findings establish the basis for further research to examine the implementation of these potential solutions and development of a systematic framework for RsM. The research is of significant value to the construction industry where value generation is essential and critical, especially in difficult economic and financial situations.

Originality/value – Requirements are the foundation of the projects which are critical to the successful delivery of the projects. Although many guidelines have been published for managing client requirements, the existing practice on requirements management is still considered to be inadequate. This research provides insight for professional practitioners in the construction industry to improve the requirements management practices for development projects.

Keywords Requirements management, Traditional procurement system, Construction projects, Construction operations, Construction industry, Procurement

Paper type Case study

Introduction

Buildings works in Hong Kong have long been delivered using the traditional procurement system when a client will appoint consultants to act on his behalf to produce the design, select the contractor and to supervise the construction phrase. The
traditional method is considered as a sequential process in which the design of the project is largely completed before commencement of work on site (Masterman, 1992). Clients of the construction industry are getting more sophisticated and requiring better project performance with greater customer satisfaction (Yu et al., 2010b). Irrespective of the nature of the project and client organisation, the briefing stage, where client’s requirements are articulated, constitutes an initial phase (or activity) of construction process and provides the link between clients and the industry. The importance of effective briefing is reflected in the many briefing guides (e.g. CIB, 1997; Salisbury, 1998 and Dalziel, 2008). Managing client requirements becomes a complex process which is crucial to the successful delivery of construction projects. The literature exhorts the adoption of Requirements Management (RsM) with reference to a number of long-standing problems that are all too familiar to the construction professionals (Fernie et al., 2003). These problems include unrealistic expectations, incomplete requirements, insufficient resources/schedule, lack of management support, poor planning, changing requirements, and lack of users’ involvement which are common to the traditional procurement systems.

According to Kamara et al. (2002), the client is considered as a “body” that incorporates the interests of the buyer of construction services, prospective users and other group interests. A “client” can be made up of, or may represent, many stakeholders which have vested interests in and different perceptions of the outcome of the facility to be constructed (Kamara et al., 1999). In order to satisfy the client’s expectations and needs, they have to be elicited, understood and identified first. During the early stages of the development of projects, the key objectives should be to capture the client’s needs (either explicit or implicit), to interpret them into requirements and to manage the conformity of technical solutions in different phases of the design and construction (Huovila and Serén, 1998).

Zielczynski (2008) defined a requirement to be “a condition or capability to which a project, product, service or system must conform.” Problems of construction project requirements include: lack of a systematic approach in clarifying and representing requirements; lack of review and feedback to the client brief; clients change requirements and design frequently; needs of end-users not clearly stated; and lack of sufficient time for identifying client requirements (Yu et al., 2005b). As a major recommendation in the report by the local Construction Industry Review Committee (CIRC) in Hong Kong, the clients should “set out the requirements of their project clearly, systematically and comprehensively” in the future so as to set the scene for successful delivery of the construction projects (CIRC, 2001).

Due to the increasing complexity of construction projects and greater expectation of the clients on project performance, the management of client’s needs and requirements becomes a complex process which requires a systematic procedure to tackle it. Although there are various studies on the RsM, especially in the software engineering world and aerospace sector, the application of the principles of RsM in the construction industry is limited (Barrett and Stanley, 1999; Kamara et al., 2002; Fernie et al., 2003; and Yu et al., 2005a). Thus, the existing practices of managing client requirements in the industry are still inadequate in the UK and Hong Kong.

To address this deficiency, an empirical research study, using semi-structured survey and case studies, was conducted to investigate the processes of RsM for construction projects in Hong Kong. The aim of this paper is to present the existing practices,
associated problems and potential solutions of managing construction industry client requirements in the traditional procurement systems. This research therefore seeks to establish the basis for further research to examine the implementation of these potential solutions and development of a systematic framework for RsM of traditional procurement systems in Hong Kong and other countries. The research is of significant value to the construction industry where value generation is essential and critical, especially in difficult economic and financial situations.

**Literature review**

**Problems and solutions of RsM**

The problems and challenges in articulating and specifying requirements relies heavily on the ability to communicate clearly and effectively between groups of project stakeholders who may never meet, and who have quite different viewpoints (Alexander and Stevens, 2002). For example, it may be difficult for the sub-contractors to meet users: since normally, their direct boss is the main contractor of the construction projects. The problems (see Table I) and solutions of RsM based on a comprehensive review are discussed as follows:

1. **Inexperienced clients in RsM** – Kelly et al. (1992) pointed out that inexperienced clients often did not understand the structure of the building industry and the technicalities of buildings. This lack of understanding frequently led to the inappropriate selection of sites, unrealistic expectations of project costs, and a failure to appreciate the roles of various parties in the design and construction process.

2. **Inadequate identification and representation of needs and requirements during the development process** – Inexperienced clients also did not identify and specify their requirements for the construction projects, thus relying on the designers to draw sketches to visualize what they expected. The “wish-list” syndrome aggravated the problem because they did not know their real needs (Kelly and Duerk, 2002).

### Table I. Associated problems of RsM from literature review

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<th>Associated problems of RsM</th>
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**Notes:** 1. Inexperienced clients in RsM; 2. Inadequate identification and representation of requirements during the development process; 3. Unstructured approach for RsM; 4. Misunderstanding and misinterpretation of client needs and requirements; 5. Communication gaps between people in RsM; 6. Insufficient time to work out a good structure for RsM; 7. Inadequate requirements effort throughout the life cycle; 8. Lack of change and feedback for RsM; 9. Lack of users’ participation and feeling
Unstructured approaches for RsM – As identified by the authors in the previous research, there is a lack of a systematic approach for managing the requirements process in the construction industry. The application of value management methodologies may be one of the solutions to solve this problem (Yu, 2007).

Misunderstanding and misinterpretation of client needs and requirements – Some clients could not even appreciate the 2-D drawings and misunderstood the intent of the designers. The emphasis of a solution-based system of the designers for communication may not create this problem. Therefore, using a common language for the client and designers to communicate the design problem may be a solution (Blyth and Worthington, 2001).

Communication gaps between participants in RsM – There are various groups of stakeholders who need to communicate well to make a new project a success. In the construction industry, there are bound to be gaps between developers and marketing managers, users and developers, project participants and clients, designers and contractors, contractors and sub-contractors. Not all relevant parties are involved to contribute at the right time of the projects (Kamara and Anumba, 2000; Yu, 2007; and Yu et al., 2010a).

Insufficient time to work out a good structure for RsM – Getting the requirements structured correctly and precisely takes time because the structure depends on what kinds of users there are, on what each kind of user expects the project to fulfill, and on the nature of the constraints. Time must be allowed for gathering, organising and checking out the requirements both formally and informally (Kelly et al., 1992; Kamara and Anumba, 2000; Yu, 2007 and Yu et al., 2010b). This is not something that can be rushed.

Inadequate requirements effort throughout the life cycle – Some effort on requirements is needed throughout the project because compromise and change are inevitable. An essential element in any acceptable compromise knows how important each requirement is to its “owner”. The issue concerning change of requirements is discussed in the next section. To put some numbers to all this, Alexander and Stevens (2002) suggested to spending about 5 percent of project effort on the requirements and also allow a generous chunk of schedule – up to 25 percent of calendar time – for requirements on shorter projects, but not more than three months on larger ones.

Lack of documentation on changes, and feedback for RsM – The lack of well-documented updates made it difficult to trace the changes in client requirements (Oberg et al., 2003). Changes from outside sources are also inevitable. Every project with a lifetime of more than a few months will experience pressures from competitors, market or operational changes, from new technologies, and from stakeholders to change the requirements and the design. The change of requirements should be able to be tracked back, updated and recorded properly for future use and feedback for subsequent projects.

Lack of users’ participation and lack of a voice – The lack of adequate end-user’s involvement caused failure to manage end-user’s expectations (Kujala et al., 2005; Arayici et al., 2006). The users are the ultimate stakeholders that occupy and perform activities in the building. Their voice toward the requirements
must be heard and should be paid attention to as early as possible during the project development process. Some users may be defensive about giving their opinions, especially if, for instance, they think their jobs may be affected by the project being developed. In that situation, it is essential to gain their trust before trying to start developing the project. It is necessary to consider who will really benefit from the use of the building and project managers should try to achieve a win-win situation between stakeholder groups if possible.

Research methodology

Case studies and semi-structured interviews

In this study, the research methodology adopted in appraising RsM under traditional procurement systems involved data collected from case studies and semi-structured interviews of four construction projects. Yin (1981) defined a “case study” as an empirical inquiry that: examines a contemporary phenomenon and context which is not clearly evident; and incorporates several sources of evidences. Case studies are appropriate to projects that are significant and representative (Yin, 2009). Qualitative information was obtained from relevant documentation and interviews, which were regarded as typical and effective data collection tools for the case study approach (Eisenhardt, 1989).

The case studies involved the analysis of the development process adopted by the project stakeholders that developed, designed and constructed the facilities. The main sources of evidence used in these studies were: semi-structured interviews with the main professionals involved; analysis of documents and drawings relating to the specific projects; and project participants’ satisfaction surveys. The task of mapping the development process with a focus on requirements management was carried out in three stages. Initially, an overall map of the briefing process was produced based on interviews carried out with clients’ representatives. In the second stage, a set of interviews were undertaken involving architectural design offices concentrating on eliciting, identifying, defining and prioritising the client requirements. Finally, a third set of interviews were conducted with the corresponding contractors focused on managing requirements development and changes. These in-depth interviews provided useful insights into how the requirements management process was organised in specific organisations.

The following procedures were adopted in each of the interviews:

- initial contact with target interviewee;
- in-depth face-to-face interview, which were audio-recorded with recorder pen;
- review of relevant project documents supplied by interviewee;
- further discussions over the phone to clarify any ambiguities or difficulties; and
- writing of draft report, solicitation of comments and feedback from interviewee, amendments and confirmation of interview report.

A series of face-to-face interviews with different key project stakeholders were undertaken in 2009 for the case studies. Senior representatives from various major participating organisations (i.e. client, consultant and main contractor) in the four selected construction projects were invited for interview. Each interview took one to two hours and was conducted at the interviewee’s office. Interviewees were assured...
that all the project information and opinions acquired would be solely used for research purposes and their names would not be disclosed to any third parties due to personal privacy and ethical reasons.

Presentation of case studies
For the purposes of this paper, four case studies in Hong Kong were selected to highlight in detail the requirement management processes, associated problems and suggested improvements. The details of the projects involved in the case studies are listed in Table II (see Figure 1), which shows the sector of client and type of project. Table II also presents a summary of the findings on requirements management processes based on these projects and outlines the general procedures adopted, those involved in the RsM processes, the information collection process and some notable observations about the requirements management for each project. It should be noted that these case studies were not intended to be representative of requirements management practices generally, but rather served to provide some indicative insights into the requirements management process within a particular project. In addition, the case study A, for which the most detailed information was collected, was selected for a more detailed investigation and description in this paper.

The client of case study A was an institutional government department. Being the works agent for government facilities development, the Architectural Services Department (ArchSD) was committed to maintain the overall standard in design, construction and maintenance of the project. Their aim was to provide effective professional and technical advice to the government and quasi-government organisations and to oversee subvented, joint-venture and entrusted projects. The professional and technical advice provided by the ArchSD included professional advice on building, engineering and landscaping services as well as planning and development related issues. Their advice would be given to the Government on matters related to building construction costs, practices and standards as well as statutory compliance for government building works on government land; and also advice on matters related to heritage conservation.

The methods used for eliciting client requirements included interviews, survey questionnaire and analysis of existing projects. The minutes and written instructions were used to document the initial client requirements. After approval, the client department would hand over two documents to the ArchSD for the initial design. The first document was the client Brief which states the type of building and accommodation for the project. After confirmation in the client department and obtaining funding, ArchSD would categorise the project into three types: A = approved and with funding, B = able to start working, and C = working (already using the funding). The other document was the Schedule of Accommodation which specifies the room requirements and any special requirements such as building services requirements. This document is usually the collaborative work of the client department and ArchSD which worked out all the required floor space needs. The client provided the net area while the architect helped to calculate other requirements of space such circulation area in order to obtain the most suitable estimate of funding for the project.

The brief handed to ArchSD focuses on physical constraints of the project, as stated by the interviewee; client departments seldom have ambitions on project design and
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<th>Project A</th>
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<tr>
<td>Sector of client</td>
<td>Public</td>
<td>Quasi-public</td>
<td>Quasi-public</td>
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<td>Type of project</td>
<td>Institutional</td>
<td>Institutional</td>
<td>Commercial and residential</td>
<td>Commercial</td>
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<tr>
<td>Initial brief from the client</td>
<td>Client brief</td>
<td>Site constraints</td>
<td>Leasing agreement</td>
<td>Relevant letters</td>
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<td>Schedule of accommodation</td>
<td>Schedule of accommodation</td>
<td>Functional brief</td>
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<td>Elicitation methods used</td>
<td>Interview</td>
<td>Survey questionnaire</td>
<td>Project analysis (picture board)</td>
<td>Interview</td>
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<td>Questionnaire</td>
<td>completed by end users</td>
<td>Prototype – mock up</td>
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<td>Project</td>
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<td>Analysis</td>
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<td>Presentations</td>
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<td>End-user meetings</td>
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<tr>
<td>Capturing of requirements</td>
<td>As above</td>
<td>Interview</td>
<td>Verbal instruction</td>
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<td>Verbal instruction</td>
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<td>E-mail</td>
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<tr>
<td>Updating of the requirements</td>
<td>As per Figures 2 and 3</td>
<td>End-users initiated changes and assessed by Estate Office</td>
<td>Project manager to be the middle man to transfer instruction from client to consultants</td>
<td>Instructions would be given via architect to main contractor</td>
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<td>Estate Office issues verbal instructions to consultants during meetings for amendments</td>
<td>Major changes by e-mails</td>
<td>Changes initiated by architect shall seek consent of client via project manager and contractor would submit samples for approval of changes. Formal variation order followed for confirmation of changes</td>
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<td>Minor changes by verbal instructions following by notes</td>
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(continued)
### Problems with RsM encountered

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<tr>
<th>Project A</th>
<th>Project B</th>
<th>Project C</th>
<th>Project D</th>
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<tbody>
<tr>
<td>Personal suggestions and unprofessional opinions by client</td>
<td>Misinterpretation of requirements</td>
<td>Misinterpretation of requirements</td>
<td>Requirements were difficult to identify</td>
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<tr>
<td>Decision makers and end-users had conflicting requirements</td>
<td>Requirements were difficult to identify</td>
<td>Complex hierarchy of client's organisation</td>
<td>Poor time management of client</td>
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<td>Conflict of expectations and constraints</td>
<td>Diversified goals in client's organisation</td>
<td>Decision making of client was inflexible</td>
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<td></td>
<td>Different goals among stakeholders</td>
<td>Market driven decision making hinder innovation</td>
<td>Slow response of project team in client organisation</td>
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<td>Too many end-users</td>
<td>Wrong prioritization of requirements</td>
<td>Information distortion</td>
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<td>Inexperience client – communication problems</td>
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### Suggestions for improvement

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<th>Project A</th>
<th>Project B</th>
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<tr>
<td>Do not involve clients in all aspects, avoiding over-interference</td>
<td>Appoint a competent project manager to manage requirements</td>
<td>Need a leading person in the project</td>
<td>Sufficient labour input by client and architect</td>
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<td>Provide options for clients to make decisions</td>
<td>Involve stakeholder groups in all stages</td>
<td>Create common goal</td>
<td>Resident architect were required to coordinate all design and construction works</td>
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<td>Planning professional to handle discrepancy before passing information to client and architect</td>
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<td>Using intranet and documentation system</td>
<td>Clear record system</td>
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Figure 1. Requirements management for projects
aesthetic requirements. The architect would add individual preferences to the project design and present it to the client for approval. There were two presentations within the design stage, the preliminary design presentation which focuses on the schematic design of the facility and subsequent presentation of the detailed design, which involves confirmation of working drawings. The project brief, schematic design and working drawings would have to be approved by the Design Vetting Committee (PBDVC) before finally being presented to the client department which gave feedback for the development of the project to proceed. There were also informal meetings with clients and end-users during the project development.

The interviewee opined that the two documents (Brief and Schedule of Accommodation) were sufficient as there should have been little or no change required. There was another department, Government Planning Agency (GPA) which controls the area calculation. Only \( \pm 5 \) per cent of extra area is allowed for those specified in the Schedule of Accommodation. For any other necessary area found to be essential but omitted, the architect would add it in by discretion. In large and complex projects, room data sheets would be used to compile a detailed synthesis of the room requirements such as finishing and equipment needed. However, this survey was not in standard format and it varied from project to project depending on the project characteristics. Occasionally, the architect would fill in the survey in advance to make suggestions to the client department.

Due to the tight control by GPA, there should have been few adjustments on areas of the facility. For major changes in the project, the architect had to make sure those changes were fully entitled under the approved Schedule of Accommodation and obtain approval from the related department. For minor changes, the architect would seek confirmation with the client before coordinating requirements into the design. When there were changes in requirements, the client department would have to obtain approval of such changes and instructions would be given to ArchSD for design amendment. Occasionally, a presentation would be made again for confirmation if necessary. Few problems encountered in the requirements management process and the interviewee rated the satisfaction level of RsM in this project with a score of 4 out of 5, which is highly satisfactory.

**Discussion**

Based on the findings and conclusions of literature review, and research methodology, the problems of RsM in the construction industry are summarised under seven headings as follows:

*Misunderstanding and misinterpretation of client needs and requirements*

From the results of the semi-structured interviews, misunderstanding and misinterpretation of client needs and requirements was the most significant problem of RsM. Most of the respondents agreed that misunderstandings could jeopardize the ultimate project success and client’s satisfaction. Understanding the client requirements is therefore the initial and essential step in the project development process. If this step is not carried out correctly, it is difficult for the following steps to be on the right track, not to say any success of the final outcome of the project. This reflects the findings of many previous studies, that requirements are crucial to every project and are critical to the successful delivery of any project such as within the
domains of system and software engineering, aerospace and defense sectors, as well as the construction industry (Alexander and Stevens, 2002; Fernie et al., 2003; Robertson and Robertson, 2006).

Changing client needs and expectations produced incomplete and inconsistent requirements
Changing client needs and expectations was ranked second in significance of the associated problems of RsM. While changes in every project are inevitable, owing to change of personnel, ideas, economic situation, market conditions, business growth and technology advancement; these are bound to induce changes in the requirements of the development projects. If these changes of requirements are not dealt with properly, incomplete and inconsistent requirements would be produced. Late changes of the requirements during detail design and construction stages would create duplicated efforts in redesign and rework resulting in abortive works in the construction stage (Yu et al., 2005a).

Lack of well-documented updates of client requirements
Lack of well-documented updates of client requirements was ranked as the third significant problem by the respondents of the semi-structured interviews. As mentioned before, since changes of requirements, project participants, etc. are inevitable during the development process, a robust system for updating the client requirements is necessary. The updating work should be carried out by a “requirements manager” to look after the requirements of the client during the whole life cycle of the project. However, the respondents opined that the client’s project manager should be responsible for updating the requirements in the inception and feasibility stage, the architect should be responsible for the design stage, the quantity surveyor should be responsible for the tendering stage and the contractor should update the requirements during the construction stage. The interviewees felt that dividing the responsibility of updating requirements and sharing this between separate parties may cause missing or inconsistent requirements and this job should be carried out by one project participant, such as the client’s project manager, in the case of the lack of a ‘requirements manager’, for the project.

Ambiguity of client requirements including needs and wants
The results and research findings coincide with those of Arayici and Aouad (2005) which stated that one of the problems of RsM is ambiguous and vague requirements. The success of the project involves continuous communication between the clients, users and the design team, each of who have different expectations. Good design arises from well-informed clients who are able to communicate their needs to the design team. In turn, the design team should imaginatively communicate opportunities back to the client in a form that is understandable. The best requirements are succinct and can be tested against the original statement of need (Blyth and Worthington, 2001).

Lack of a thorough knowledge of RsM
The present requirements management practice in building construction is in many ways unsatisfactory (Huovila and Serén, 1998). One of the serious problems is the lack of a thorough knowledge of RsM. Not only the designers and contractors but also the
clients are lacking adequate knowledge and a systematic approach in managing client requirements for construction projects. Some attempts have been made to overcome the problem in the briefing process; however, the RsM process is still inadequate. It seems that even within a project participant group as shown in the case studies (see Table II), they do not have consensus on the processes, problems and solutions of the RsM. This may be attributed to the lack of knowledge in RsM of the clients, designers and contractors.

No mechanism to record, manage and trace change in client requirements and the rationale behind them
The main problem is the lack of traceability. The original requirements are usually unrecorded and so they cannot be traced back afterwards, i.e. there is no notion of why a certain technical solution was originally chosen and which criteria were used as a basis for decisions (Huovila and Serén, 1998). Usually the only documentation left after the building completion is the drawings and specification documents. Normally, even the final as-built characteristics of the building are incomplete and even unrecorded.

Late involvement of end users in the project development process
Arayici and Aouad (2005) identified that failure to manage end-user expectations was one of the problems of RsM. One of the reasons was attributed to the unavailability of the end users in the beginning of the project. They were not yet known or identified. However, even some projects with known end-users, they were not involved in the early stage of the projects to voice out their requirements. According to Brauer (1992), users know the most about the four key aspects such as their people or personnel, equipment, activities and schedule. These four keys, called the PEAS of user requirements method, form the basis of user requirements for a building or facility. By analysing the PEAS and deciding which will be part of a facility, users have a solid basis for defining the characteristic and features of a building that are needed to make the organisation successful. This user requirements method helps bridging the information gap between users and designers and ensures successful building solutions.

Insights from the case studies and semi-structured interviews
Research findings identified both areas of good practice and ongoing issues experienced in relation to Requirements Management. Table III compares the good practice of the case studies with the associated problems that were identified in this research study. Nevertheless, there is still room for improvement in the case studies. The interviewees suggested not involving the client in all aspects in the design stage to avoid over-interference because personal and subjective preferences as well as unprofessional opinions may hinder the design process. Direct conversation between senior client representatives and the senior architect would help lessen the dominance of senior clients. Provision of different options to the client would help him/her to make a better decision. Experience sharing such as overseas visits with client would also help a client learning to accept new ideas and technology. One of the interviewees recommended finding a planning professional to handle discrepancies on requirements before approaching the architect. It is also important to find the right person to make decisions, avoiding unnecessary changes of requirements. Finally, involvement of the
real end-users, who may be the junior staff, is necessary as they would have different expectations such as functional aspects on the facility.

Conclusions
Requirements are a crucial ingredient of any successful project. In this research study, multiple case studies and semi-structured interviews were conducted to investigate the processes, problems and potential solutions of RsM under the traditional procurement systems of the construction industry. The clients, consultants and contractors were asked to give their experience and opinions on these issues. According to the findings of this research study, the most significant problem was “misunderstanding and misinterpretation of client’s needs and requirements.” “Changing client’s needs and expectations” was the second most significant problem. “Lack of well-documented updates of client requirements” was ranked as the third significant problem. These research findings were supported by the conclusions drawn by Huovila and Serén (1998); Fernie et al. (2003); Arayici et al. (2006) and Yu et al. (2007). It is essential to identify the real requirements and control changes to the requirements. Therefore, using effective requirements practices, processes, methods, techniques and tools are vital investment in the requirement process.

As for the potential solutions provided through RsM, it is recommended to “appoint an experienced project participant as the Client Requirement Manager to be responsible for the management of client requirements” and “provide a formal procedure to record, manage and trace changes in client requirements.” A practical framework/requirements plan is also needed to improve the requirements management practice within the construction industry.

Although this paper reported findings based on Hong Kong data, they are useful to other countries for international comparison. As well as this study based on traditional procurement systems, a parallel study on the problems and solutions associated with Requirements Management under the Design and Build Procurement Systems was also conducted for comparison. For future research studies, after identifying the associated problems and potential solutions of RsM in construction projects, a further investigation of a practical framework/requirements plan should be conducted to formulate effective strategies for implementation.
References


Further reading

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