



Investigating the client-related rework in building projects: The case of Singapore

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Abstract

Rework has become one of the most common concerns in construction projects. This study aims to investigate the client-related rework (CRR) in Singapore-based building projects. To achieve the objectives, a literature review and questionnaire survey was conducted and data were collected from 381 projects performed by 51 companies. The results confirmed that the client contributed most to rework. 41 of the 51 companies (80.4%) experienced CRR, and 226 of the 381 projects (59.3%) experienced CRR, which increased project cost by 7.1% and caused 3.3 weeks' delay on the average. Additionally, "replacement of materials by the client" was the cause with the highest frequency of occurrence, while "change of plans or scope by the client" contributed most to CRR and exerted most impact on project cost, schedule and quality performance. This study expands the literature and provides an in-depth understanding of the CRR in Singapore for both practitioners and researchers.

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1. Introduction

The construction industry has become a key pillar of Singapore's economy. According to the Building and Construction Authority (BCA, 2013), Singapore's construction output is forecasted to be US\$38–41 billion in 2013. As this industry has been plagued with the problem of low productivity (Brooks, 2013), the Singapore's government has launched a national program to raise this. As productivity has been found to be negatively influenced by rework (CII, 1990; Hanna et al., 2002; Love and Edwards, 2004a), it is necessary to investigate rework status in the Singapore construction industry.

Rework was defined as the unnecessary effort of re-doing a process or activity that was incorrectly implemented at the first time (Love, 2002). According to Hwang et al. (2009), terms such as non-conformances, quality deviation, quality failures, and defects have been seen as synonymous with

rework (Abdul-Rahman, 1995; Barber et al., 2000; Burati et al., 1992; Hegazy et al., 2011; Josephson and Hammarlund, 1999; Josephson et al., 2002). Rework has become one of the most common concerns in construction projects. In most cases, rework arises from changes, damages, defects, errors, omissions, and other non-conformances (Palaneeswaran, 2006). Also, rework in construction projects could originate from project players. Arain and Low (2006) identified four project players responsible for rework orders, i.e. the client, consultant, contractor and others, and found that these project players were the sources of design change, design error, design omission, construction error and construction omission, which caused rework in construction projects. As a main project player, the client has been seen as one of the sources of rework because they usually have increasing expectations. Hwang et al. (2009) found that owner change made the second largest contribution to the direct cost of field rework in US-based construction projects.

Research efforts have attempted to identify the root causes of rework and its negative influence on project performance (e.g., Hwang et al., 2009; Love and Edwards, 2004b; Love et al.,

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1999, 2000, 2002; O'Connor and Tucker, 1986; Palaneeswaran, 2006; Thyssen et al., 2010). However, few have focused on client-related rework (CRR), compared the perceptions of different project players on the causes of CRR and investigated the potential influence of these factors on project performance. Thus, the objectives of this study are to (1) investigate the status of CRR in building projects in Singapore; (2) analyze the causes of CRR; and (3) explore the perceived impact of the causes on project cost, schedule and quality performance.

In this study, the term “client-related rework” is defined as the rework that directly originated from clients and clients’ representatives (CRs), such as the project management and quantity surveying (QS) consultancies. The findings of this study can help project players gain an in-depth understanding of CRR in Singapore-based building projects, avoid CRR, and assure project performance. Also, as few studies have focused on CRR this study expands the literature relating to rework by investigating the sources of CRR and their impact on project performance.

2. Background

2.1. Client-related rework

Some previous studies have investigated the causes of CRR. The CRR symptoms resulted from the sources relating to design and construction. The examples were the design changes required by clients and the construction-related changes initiated by clients either after some work had been undertaken on-site, or when a process had been completed (Palaneeswaran, 2006). Actually, change orders have been recognized as the major source of rework in construction projects (Barber et al., 2000; Burati et al., 1992; Hwang et al., 2009; Josephson and Hammarlund, 1999; Love et al., 1999). Arain and Low (2006) identified 53 causes of change orders in Singapore’s institutional building projects and the owner-related ones included owners’ change to plans or scope, owners’ change to schedule, owners’ financial problems, inadequate project objectives, replacement of materials/procedures, impediment in prompting decision making processes, owners’ obstinate nature of owner, and owners’ change to specifications. These eight causes can also contribute to CRR. In addition, Palaneeswaran (2006) listed several causes of CRR, including lack of experience and knowledge of design and construction process, lack of funding allocated for site investigations, lack of client involvement in the project, inadequate briefing, poor communication with design consultants, and inadequacies in contract documentation. Also, Ndiokubwayo and Haupt (2008) indicated that clients were frequently involved in rework orders because they tended to change their minds, lacked clearly defined project requirements, or experienced financial problems. In this study, seven causes of CRR were identified from literature review (see Table 1).

Approximately 75% of problems or reworks on site were induced at the design phase (Mendelsohn, 1997). The lack of communication between the client and design team members can lead to documentation errors and omissions (Love and Edwards, 2004a), and the lack of involvement of clients in the

Table 1
Causes of CRR.

Causes of CRR	References						
	1	2	3	4	5	6	7
Change of plans or scope by the client	✓	✓			✓	✓	
Inadequate/incomprehensive project objectives by the client	✓						
Change in specification by the client	✓	✓					
Impediment in prompting the decision making of the client	✓	✓					✓
Replacement of materials by the client	✓		✓	✓	✓		
Obstinate nature of the client	✓						
Financial problems faced by the client	✓	✓	✓	✓			✓

References: 1. Arain and Low (2005); 2. Love et al. (2010); 3. Chappell and Willis (2010); 4. Ndiokubwayo and Haupt (2008); 5. Fayek et al. (2003); 6. Palaneeswaran (2006); and 7. Gray and Hughes (2001).

early phase of the project could lead to misinterpretation of client values within the design and delivery team (Koskela et al., 2002; Thomson et al., 2003). Client values are important and should be fully understood at the early phase of the project (Thyssen et al., 2010). Thus, the communication and harmonious relationship between clients and their design team and involvement of clients in the design process can significantly reduce design-related rework (Love and Edwards, 2004a).

2.2. Impact of rework on project performance

Rework significantly contributes to project cost and schedule overruns (Hwang et al., 2009; Love and Edwards, 2005) and quality defects (Love et al., 1999). Several studies have attempted to explore the impact of rework on project cost, schedule and quality performance. In Singapore, an early study by the Construction Industry Development Board (CIDB, 1989) reported that contractors wasted 5–10% of the project costs in doing things wrong and rectifying them.

In Australia, Love et al. (2010) investigated 115 civil infrastructure projects, and revealed that the mean direct and indirect rework costs were 5.07% and 5.22% of the contract value, respectively. These rework costs were lower than those in building projects reported by Love (2002), who found that the direct and indirect rework costs were 6.44% and 5.6% of contract value, respectively. Love et al. (2010) also indicated that the extent of rework experienced was correlated with increase in project cost and schedule. Additionally, Love et al. (2011) reported that the rework costs in offshore hydrocarbon projects were estimated to range from 3% to 25% of capital expenditure, and that 10% was seen as an acceptable level of rework.

In Sweden, Nylén (1996) identified 232 failures from four major railway engineering projects. These failures contributed to 10% of project costs, and 72% of the failure costs were attributed to clients. Also, Josephson and Hammarlund (1999) examined the causes and costs of seven building projects and found that the defect cost ranged between 2.3% and 9.3% of the production cost and that 32% of the defect costs came from the early stages of a project, i.e. the interaction between the client and design team.

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