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A COMPARISON OF CONSTRUCTION RELATED REWORK IN UGANDA AND MOZAMBIQUE

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ABSTRACT

The realisation of the expected minimum client quality requirements in both the products and processes in the construction industry remains challenging. The effects have been increased wastage and value loss through rework in both public and private sector initiatives providing social services in developing countries. The purpose of the research was to compare the impact of construction related rework on project budgets and schedule in public building construction in both Uganda and Mozambique, being examples of developing countries. The objective of such comparison is to document where focus should probably be placed in ensuring that quality requirements in construction are achieved. Case study approach was adopted and separate case study protocols prepared. The scope of study in the Ugandan project involved construction of classroom blocks, health centres and staff housing between 2008 and 2011. The scope of study in the Mozambique project involved the construction of 209 public housing units in Mozambique. The units of study were rework-related project budget and schedule overruns with further comparison of rework-related impacts on both project budgets and schedules under study. In Uganda, the mean percentage rework range was 12.45% - 15.58% of the construction contract scope. It was determined that the mean percentage of rework-related impact on project budget and schedule was 4.53% and 8.42% respectively. In Mozambique, the mean percentage rework range was 3.35% - 4.40% of the construction contract scope. It was determined that the mean percentage of rework-related impact on project budget and schedule was 0.56% and 12.0% respectively. Acknowledging the differing cultural contexts of both countries where the study was conducted, these findings could improve governance and strengthen the regulatory framework on quality management in both Uganda and Mozambique.

Keywords; Mozambique, Public Construction, Rework, Uganda

1. INTRODUCTION

The quality of a construction project is measured by its conformance to a quality plan designed to meet client quality requirements (Arditi and Lee, 2004). The realisation of the expected minimum client quality requirements in both the products and processes in the construction industry remains challenging. As Haupt and Whiteman (2004) posit, the construction industry has been slow in embracing a philosophy that seeks continual improvement of quality management in construction; only seeking to implement aspects that provide them with a competitive edge and improved financial performance. The effects have been increased wastage and value loss through rework in both public and private sector initiatives providing social services in developing countries. Emerging economies and developed countries are not the exception much as this seems more formidable with developing countries. For instance, quality failure related costs in residential construction projects were found to be 4% (Mills et al., 2009) of construction contract value in Australia and 0.7% (Abdelsalam and Gad, 2009) in the United Arab Emirates. Suffice it to note that developed countries and emerging economies are a significant step ahead because of the research and industry initiatives that ensure considerable collection and publication of ordinal data on quality achievement in construction. Unfortunately, this is not so for developing countries and because of this, it is not easy to establish inherent quality failures and related costs not only in construction but also in the operation and maintenance of constructed facilities. Kazaz et.al (2005) and Kakitahi et.al (2013) acknowledge that much as public sector provision of services is noble, it should be noted that it is the end-users that are likely to be encumbered with operation-related rework costs.

Notably, quality costs are incurred when rework, a quality failure attribute, occurs; affecting productivity, requiring more construction resources and leading to budget and schedule overruns (Low and Yeo, 1998, Love and Li, 2000, Love and Mandal, 1999). Furthermore, where rework impact mitigation measures are not instituted in developing countries particularly, research even shows an increased preference for expatriate contractors since they seem to provide better workmanship and quality materials, and an environment where less costs are incurred on rectifying defects (Idoro, 2010). Both private and public sector clients, therefore, need to be more pragmatic in their efforts to have stipulated quality requirements in construction achieved. As initiators of these projects, clients, particularly, in developing countries should ensure an adequate understanding and related publication of the causality of quality failures in construction. Suffice it note, though, that this in itself is insufficient because it does not provide a thorough understanding of the mechanics and complex correlations among other causes of quality failures (Aljassmi and Han, 2012). Yet, there still remains insufficient concern and purposeful action being raised on the issue in developing countries. This could be attributed to the mind-set regarding quality attainment in construction where public sector entities, for example, perceive the benefits of providing social services as far outweighing quality failure related costs in construction. The private sector is also considered to have similar attitudes because as Love et al. (2011) found out, for example, there was a perception that revenue from production with regards to off-shore projects far exceeded any incurred quality failure related costs.

The paper, therefore, sought to compare the occurrence of construction related rework in two African developing countries; Uganda and Mozambique. These two countries were considered a convenient representation of similar economies within the East, Central and Southern African continent. The objective of such comparison is to document where focus should probably be placed in ensuring that quality requirements in construction are achieved. The variables for comparison are causality and related impacts on project budget and schedule of construction-related rework. This involved studying schedules and costs of two public sector projects that focused on the provision of education and health sector facilities in Uganda and mass residential housing in Mozambique.

2. HOW CLIENTS CAN IMPROVE QUALITY IN CONSTRUCTION

A pragmatic client, particularly for the public sector, is a prerequisite for quality achievement in construction. Suffice to note that some client-based initiatives are presently already being utilised. For example, the mandatory requirement in Singapore for contractor selection on the basis of their application of ISO9000 –based quality management systems (Palaneeswaran et al., 2006). These initiatives notwithstanding, clients have been noted as primary contributors to an inefficient construction process through delayed payment of contractors, inadequate support of requisite skills training and development and inability to regularly keep track of project developments (Alinaitwe, 2008). Yet, clients are the significant entity that draw up the minimum expected quality requirements and influence the contractual environment which ensures that quality in construction is achieved. Clients can also ensure that at project inception, the processes in the selection of contractors and consultants are based on sound procurement and project management principles. Additionally, quality auditing can be incorporated as an evaluation tool that determines whether or not expected quality requirements have been achieved and implemented effectively (Arditi and Lee, 2003). Such audits would provide feedback to the construction process which could lead to increased adoption of best building practices and the minimal use of low quality building products. It should be understood that the effective involvement of clients and the efficient use of quality management tools are key tenets of a holistic total quality management framework. Notably, the construction industry has been found to be resistant to the adoption of such a framework due to; product diversity, organisational stability, contractual relationships and overall teamwork and management behaviour (Sommerville and Robertson, 2000). These could, however, be long term strategies and yet, impacts from quality failures need to be addressed, particularly in developing countries. Client-initiated interventions could place prominence on understanding causality and impact of quality failures through studying attributes such as rework. Documentation of such interventions would create awareness of the need for improved quality management in construction, which as Wells (1993) put it, "is not easy to enforce, particularly in African conditions".

3. A BRIEF ON THE CASE STUDIES IN UGANDA AND MOZAMBIQUE

The case under study in Uganda was phase one of the Peace Recovery and Development Programme (PRDP I) located in Northern Uganda.

The programme that was being studied involved the construction of classroom blocks, health centres and staff housing and it was directly supervised by the Office of the Prime Minister. The PRDP I was the first phase of the US$606 million programme and it covered the financial period 2007/8 – 2009/10 in the Northern Uganda sub-regions of Abim, Adjumani, Amuru, Apac, Gulu, Kaabong, Kitgum, Lira and Pader. The programme was designed to ameliorate social services in the region following a protracted 20 year war between the government and rebels of the Lord's resistance army. In Mozambique, the case under study was the construction of 5,000 public mass residential housing units located in Intaca, Municipao da Matola and implemented by FFH/Henan Gouji Development Company; a partnership established as a contractual arrangement between the Mozambique government and the Chinese company, Henan Gouji Industry and Development Company that formed the client entity. The focus of study under the Mozambique project was the Projecto De Construcao De Uma Habitacao Tipo 3 which involved the construction of various design types of housing under the project.

4. RESEARCH METHODS

The research compares the outcome from two independent case study researches conducted in Uganda and Mozambique. The units of study were rework-related project budget and schedule overruns. It further compares rework-related impacts on both budgets and schedules for public projects in Uganda and Mozambique. In Uganda, for the provision of education and health services; while for Mozambique, for the provision of mass residential housing. Case study research approach was adopted and the case study protocols prepared included a checklist, observation schedules and an interview guide. Sample selection under the PRDP I programme was from contracts that involved construction of classroom blocks, health centres and staff housing between 2008 and 2011. The sample size considered for the study was the construction of 140 classroom blocks, 30 health centres and 30 staff housing units. The scope of study in the Mozambique project involved the construction of 209 type 3 public housing units from which the construction of 48 type 3C and 11 type 3B houses constituted the sample size. The project categorised various housing design types and these included types 3C and 3B of housing design type 3 that was selected for study. Within the parameters of the 95% confidence Interval, the sample sizes directly relate to the overall works under both programmes. Rework related impacts on budget and schedule arising from materials quality, workmanship and design changes were measured and quantified. A building elemental breakdown was adopted for subsequent data input and analysis. The elemental breakdown included; sub-structure, building frame, wall, doors, windows, finishes, floor, roof, lighting and electrical, fixtures and installations. The cost of rework for different building elements was obtained by taking the value of works in the contractor's bill of quantities and comparing with the rework-related cost in the contractor's monthly claims for payment and approved interim payment certificates. The percentage budget overrun attributable to rework was then computed and also tabulated across the building elements and the mean percentage re-work related costs subsequently determined.

The percentage schedule overrun attributable to rework was computed by extracting related information from project progress reports and the schedule overruns were tabulated across the building elements, from which the mean percentage rework related schedules were obtained. Mean percentage variations and standard deviations were calculated across building elements and the corresponding standard deviations were determined. To ensure validity of documented data and in ensuring consistency with case study research rigour suggested by Yin (2010), interviews were conducted, using observation checklists, with representatives of the client entity in Uganda and with the contractors in Mozambique using observation checklists.

Data showing cost and time related impact on the total project budget and schedule respectively were collected. The mean percentage rework-related budget and schedule overruns was determined, as was similarly done by Oyewobi et al. (2011). All the data were then collated and analysed in MS Excel by categorization into those related to; design changes, materials quality and workmanship.

5. FINDINGS

A summary of the findings from both case studies is summarised in table 1. The table highlights the key factors that contributed to construction-related rework, the building elements found to have the highest frequency of rework and the mean percentage rework-related impact on project budgets and schedules.

Table 1: Comparing construction related rework in Uganda and Mozambique

Description	**PRDP (Phase I) – Uganda**	**Projecto De Construcao De Uma Habitacao Tipo 3 – Mozambique**
Construction Related Rework attributed to;	• Design omissions • Bad workmanship • Inadequate contractor supervision	• Bad workmanship • Substandard building materials • Incorrect design information
Building elements with highest rework frequency	• Lightning conductor installations • Electrical installations • Roofing installations	• Wall and ceiling • Finishes • Roof structure • Piping installations
Mean Percentage of rework related impact on; Project Budget	4.53%	0.56%
Mean Percentage of rework related impact on; Project Schedule	8.42%	12.0%

Under the PRDP-I in Uganda, from the 140 sample units taken from a population of completed classroom blocks, the mean percentage rework range was 12.45% - 15.58% of the construction contract scope. Additionally, the mean percentage rework range was 10.83% - 13.97% and 7.90% - 10.30% respectively for the 30 health centres and 30 staff housing units. The rework-related impact on project schedule was 5.19%, 13.03% and 7.04% respectively for the classroom block, health centre and staff housing construction. The reasons for this level of rework-related impact on project schedule were; client instructions that increased work scope, delayed payment by the client and delayed handover of sites to the contractors. With regards to rework-related impact on project budget it was 3.53%, 8.02% and 2.04% respectively for the classroom block, health centre and staff housing construction. The reasons for this level of rework-related impact on project budget were; unacceptable workmanship on floor and wall finishes, roofing installations and windows, and inadequate and incorrect design information. It was determined that the mean percentage of rework-related impact on project budget and schedule was 4.53% and 8.42% respectively.

Under the Projecto De Construcao De Uma Habitacao Tipo 3 in Mozambique, from the 59 sample units taken from a population of 209 completed type 3 public residential housing units, the mean percentage rework range was 3.35% - 4.40% of the construction contract scope. Additionally, the mean percentage rework range was 3.35% - 3.85% and 3.55% - 4.40% for the 48 type 3C and 11 type 3B houses respectively. The rework-related impact on project schedule was 10.75% and 13.25% respectively for the type 3C and type 3B respectively. The reasons for this level of rework-related impact on project schedule were; making good defective fascia boards to roofing structure and incorrect piping installations. With regards to rework-related impact on project budget it was 0.65% and 0.47% respectively for the type 3C and type 3B respectively. The reasons for this level of rework-related impact on project budget were; unacceptable workmanship on wall and ceiling finishes and replacing substandard materials used in piping installations; and incorrect design information related to doors. It was determined that the mean percentage of rework-related impact on project budget and schedule was 0.56% and 12.0% respectively.

6. DISCUSSION

It is acknowledged that the comparative study is limited in scope and generalisable to the African sub-continent but what it does is highlight three requisite tenets of effective construction quality management: improved supply chain management, efficient design management and adequate supervision of works.

Fostering improved supply chain management requires the anterior step of defining supply chain; which has been defined as the integrated process of various business entities working together to acquire and transform raw materials and deliver value added products to consumers (Beamon, 1998). For the construction industry in developing countries, it requires a concerted effort to see that the processes of manufacturing, delivering and installing building materials focus on value addition and client satisfaction.

This not only requires certification with national and international quality management organisations such as the ISO, but also encourages localised research and development into appropriate building technologies and products. Notably, the use of locally-produced building materials and labour intensive construction techniques, for example, should not obscure other factors affecting effective construction project management in developing countries. The construction industry could subsequently benefit by extending cost of quality measurement techniques to entire supply chains within the construction and not to just the internal entity systems (Castillo-Villar et al., 2012).Within such a framework, as Briscoe et.al (2004) suggest, clients can sufficiently influence the degree of supply chain integration, develop sustainable long term relationships and reduce the detrimental preference for competitive price tendering.

Incorrect design information within contract documentation is presumed to lead to rework that adversely impacts organisational performance and public financial expenditure; and it is a system of dysfunctional organisational and managerial practices prevailing within the construction industry (Love et al., 2012). Models such as those discussed by Love et al. (2012) could be utilised in providing insight into the interdependencies and behaviour between variables that contribute to incorrect design information, and they emphasise the notion that the degree of rework required is dependent on how long the latent incorrect design information remains undetected.

Effective design management minimises post contract design changes from various project stakeholders and rework arising from design omissions. The cost benefits could be substantial because even for construction projects considered successful, about 5 – 8% of construction budget overruns arose from post contract design changes (Cox et al., 1999).This brings to the fore the importance of adequately planning pre-contract award activities to ensure all quality requirements in the client brief have been incorporated in the project designs. These activities should be well-defined as this is the most important planning process that significantly influences project success (Zwikael, 2009).

Adequate supervision of works should be the priority of competent project stakeholders that ideally include; clients and end-users, consultants, contractors and suppliers of materials. In developing countries where stakeholder societies are considered more inclusive, two stakeholder management principles could be adopted; participatory decision making and a sustainable fiduciary relationship between the stakeholders and the project (Newcombe, 2003).To enrich the stakeholder participatory process, increased skills training and development could be prioritised, especially vocational skills such as building and concrete practice, welding and metalwork, and electrical installations and fittings. With these increased competencies, project stakeholders would ably translate client quality requirements into expected building products and improved construction processes.

Relatedly, the adoption of quality costing techniques could improve the contractor's site management abilities with the primary benefit being attitudinal changes that subsequently create an increased consciousness of non-conformance events and their impact on project budgets and schedules (Abdul-Rahman, 1996). These quality costing techniques require that accurate sets of comparative data across projects be collated with rework costs being a key component.

The rework costs include items such as rework, material waste and warranty repairs (Josephson et al., 2002). Rework during construction would be documented and related costs determined bearing in mind that related costs from material waste and warranty repairs might be more complex to ascertain especially since warranty repairs could occur after the buildings are handed back to the clients. This would ably track rework-related impacts on project budgets, in particular, but to do the same for project schedules, contracts could require contractors to incorporate rework into existing scheduling tools with the aim of calculating revised project duration that considers rework in project delay analysis and devises corrective actions (Hegazy et al., 2011). A quantitative mechanism by Hegazy et al. (2011) surmises the three steps necessary in a contractor's quantitative analysis of rework impact on a project's schedule as being;

- Recording all progress events that includes rework and calculates expected project delay;
- Analysing project delay, including identifying schedule overruns to project stakeholders; and
- Analysing options that determine the least costly action that recovers schedule overruns.

7. CONCLUSION

Public sector entities in developing countries have seemingly remained intransigent in adopting processes that continually improve public procurement and quality in construction management (Kakitahi et al., 2013, Kam and Tang, 1997, Rwelamila et al., 1999). Subsequently, the construction industry has continued to utilise unsuccessful traditional processes which as, Lenferink et al. (2014) suggest, leads to implementation gaps because the project entities are focused on concluding the respective project phases (design and construction) than on the overall objective of delivering the end-product; buildings built to established client quality requirements within budget and schedule.

Contractors, on their part, have had to also show their capability to improve their performance due to higher end-user requirements, environmental awareness and limited resources (Enshassi et al., 2007). However, as Palaneeswaran et al. (2006) discusses, much as contractor performance and project outcomes are the primary contributors to client satisfaction, there is no sufficient data for project participants to use in evaluation of compliance to client quality requirements. Nevertheless, contractors should be continually encouraged to minimise wastage and value loss through strict conformance to specifications in order to overcome disputes, schedule, budget and quality management challenges (Enshassi et al., 2007). Garvin (1987) discusses this conformance as the degree to which a product's design and operating characteristics meets established standards. In the construction industry, the products are the buildings and the established standards are the client quality requirements. The context in which both the buildings and the established client quality requirements should be considered is the whole life value of the buildings (Kakitahi et al., 2013).

Now, whether or not it is a public or private sector development, it remains that quality attainment in construction is a challenge in developing countries. Firstly, contractors should focus on the quality of their products and processes, a corporate quality culture, because in so doing they would realise high productivity and profitability as the quality of their operations and services improve (Yasamis et al., 2002). Furthermore, the other contractual entity, the client would realise improved conformance to their stipulated quality requirements. By comparing construction related rework in two African developing countries the study has documented quality failures and their impact on project budgets and schedules, something that could eventually highlight the subsequent influence it has on public sector expenditure on social service provision. Acknowledging the differing cultural contexts of both countries where the study was conducted, these findings could improve governance and strengthen the regulatory framework on quality management in both Uganda and Mozambique.

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