ESTABLISHING THE COST AND TIME PERFORMANCES OF PROJECTS EXECUTED BY SOUTH AFRICAN CONSTRUCTION COMPANIES USING DIFFERENT PAYMENT SYSTEMS

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The poor performance of construction projects and organisations is a global phenomenon. Inappropriate payment systems often impact the successful delivery of projects to client requirements and dispute avoidance. This study investigates the different payment systems employed and the performance of construction projects in South Africa. The study used a quantitative research approach employing questionnaires randomly distributed to construction companies. The researchers analysed eighty-eight projects comprising heavy construction, building maintenance, and commercial, industrial, institutional, and residential buildings. The study found that thirty-seven projects have cost underrun, with the highway maintenance project having the highest percentage of cost underrun using the interim project payment system. Based on these findings, the study concludes that heavy construction and commercial building projects executed using an interim payment system and payment on completion will experience underrun. Therefore, it is recommended that clients consider the project type in their choice of the payment systems.

Keywords: cost performance, payment systems, time performance, South Africa

INTRODUCTION

Clients expect that the construction project is finished at a specific estimated cost that is within budget and on time (Windapo *et al.,* 2017). However, this has not been the case. The poor performance of construction projects has been recognised internationally (Kazimu, 2012). Project success is a critical obstacle to the construction industry's performance (Danuri *et al.,* 2006). Oke *et al.,* (2016) established that construction projects are faced with numerous simple to complex difficulties ranging from late payments to litigation. One of the significant factors answerable for this is inappropriate payment system. Moreover, an inappropriate payment system has been cited as contributing to global failed projects (Kenley, 2003).

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While Sherif and Kaka (2003) indicated that achieving an excellent financial performance of any construction project depends on the appropriateness of the chosen payment system to the project qualities and client requirements, Suhaini (2005) viewed inadequate payment systems as a severe problem that needs to be identified and solved. Njie *et al.,* (2005) submit that when there is insufficient money to continue with construction project activities as planned, it results in mistrust amid supply chain teams and leads to a reduction in project performance in all ramifications. Furthermore, according to Danuri *et al.,* (2006), payment has always been the main subject of disputes, which leads to financial adversity if these disputes result in arbitration or litigation (Bob, 2005). Davis and Seah (2000) note that construction payment problems have a domino effect on the payment chain of a construction project. When delays occur in the payment of a contractor from the client, such delay affects the payment due to the subcontractor or supplier bound in a contract with the construction company.

The difficulties with the flow of cash down the chain of beneficiaries have been acknowledged as early as the 1960s in the UK when the Banwell report (1964) noted the significance of prompt payments and the call for a practice to have the proper flow of money, after that, followed by the Latham (1994) and Egan (1998) reports. Previous studies have revealed that many countries, including Malaysia, Australia, New Zealand, Singapore, and the United Kingdom, have included payment systems in the construction industry as part of their construction-specific constitutional policy of payment procedures/legislation arrangement to purge inadequate payment systems and to support continuous construction project activities (Danuri *et al.,* 2006). In South Africa, the cidb recommends modification to the policy that inculcates prerequisite for "prompt payment" (CIBD, 2012).

This underscores the importance of payment system on project cost and time performances. However, none of the previous studies has holistically examined the reliant effect of project payment system on cost and time performance. Construction companies must comprehend their choice of project payment systems that suit and are appropriate to business and project environments. Thus, this study aims to establish the cost and time performances of projects executed by South African construction companies using different payment systems.

The interim or progress payment system is the most used payment method in the contract condition (Ansah, 2011). Interim payment system serves as payment terms that aim to speed up the completion of a detailed contract section on the condition that the contractor has incentives for goal achievement on or before a specified date (Omopariola and Windapo, 2018b). Interim payments are suitable for functional elements of larger projects such as ramps, intersections, or bridges, structural and reinforcement steel, retaining walls, and materials to a site such as excavation and backfill, concrete and asphalt (Maritz and Robertson, 2012). The features that made the interim payment system suitable for the construction project environment include consideration of limiting factors in decision making and project activities about the functional elements of larger projects in terms of project environment (Omopariola and Windapo, 2018a). Previous researchers (see Gary *et al.,* 2010) have shown that an interim payment system allows the overall project schedule to be maintained in cases where there are sequential contracts, supports proactive and creative approaches by contractors and strives to complete the project on time, enhances safety and assist in the reduction of the amount of administrative requirement by the parties involved. Though it has its related drawback and risks, as identified by Gary *et al.,* (2010), an

increase in costs due to accelerated construction requires innovative methods and materials and more work hours.

Advance payment system, stage payment system, milestone payment system, and payment on completion are the other payment systems that have been mentioned in the literature. Kaka and Lewis (2003) refer to advance payment as the amount of money remunerated to the contractor by the employer at the early start of work on site. This is done to aid the contractor in commencing the work when due and fund the contract without having to look externally for funds. Ansah (2011) posited that this payment system is mostly used in public works projects. Aje *et al.,* (2017) depict advance payment as a strategy to lower projects' outturn costs. According to Omopariola and Windapo (2018b) stage payment system reduces administration time and cost of design and preparing interim payments, allowing the reliable project stakeholder to embark on productive project performance.

Milestone has been described as payment made to the contractor upon attaining different construction activities or after all work items have been effectively completed (Cheng *et al.,* 2009). Cheng *et al.,* (2009) note that the flexibility of milestone payment is open for abuse if it is not administered correctly. From the contractors' point of view in the work of Olatunji *et al.,* (2017), payment on completion is the preferred choice for settlement of payment for work carried out, but this is done in exceptional cases where the contract is based on drawing and specification, i.e., where the project is relatively small and to be executed within the range of client's financial budget to pay without stress at once. Payment on completion as a type of payment could lead to poor financial, practical, productivity, managerial efficiency, profitability, and not meeting client and employee satisfaction because the contractor is solely responsible for funding the project and unless the phase is attained and certified by the contract administrator before the contractor can be remunerated.

METHOD

A questionnaire survey was conducted to collect quantitative data for this study. The questionnaire survey was internet-based due to the geographical location of the construction companies comprised in the study (Saunders *et al.,* 2009). Before the questionnaire survey, the complete list of the construction contractors with their full contact details was requested and obtained from the construction industry development board (cidb) head office. In this list, only grade 7, 8, and 9 (high level of viability) contractors were selected for the study. This was done because of the need for credible and verifiable financial information.

The criteria for verifying the financial credibility of the contractors include the availability of financial statements, stamped business bank statements, proof of financial sponsorship, audited financial statements, financial track records, financial history, the financial capability of R40million and above, annual turnover of R20million and above, work capability of R9million and above, and available capital of R4million and above. Next, an invitation letter was sent to the targeted contractors' contact details in the selected regions to inform them of the questionnaire link and to participate as they received the email invitation, expecting a higher response percentage. The chosen proportional size was based on non-response bias using a calculating smallest sample size method (Ankrah, 2007).

Though, there were problems with low response rates when collecting data through online surveys, as posited by (Archer, 2008). However, the enormous benefits of web-based surveys cannot be underestimated. For instance, it strengthens the investigative knowledge of either the researcher or the respondents, simplifies the administration of questionnaires together with reminders, wider accessibility of survey strategy and design, and application tool, not expensive and established features that make data cleaning easier (Boyer *et al.,* 2010). Therefore, this study used an online survey (Survey Monkey: www.surveymonkey.com) to collect data for the research. At the end of the survey, a total of 155 respondents out of 216 respondents completed the questionnaire survey, which is a response rate of 71.76%. The data collected were analysed using the Chi-Square test.

FINDINGS

Frequency distribution and percentage of the respondents were determined to determine the distribution of the respondents' profiles. The distribution includes the educational background of the respondents, designation of respondents, the profession of the respondents, and years of experience. Concerning the educational background of the respondents, 55.15% (75) of the respondents have a bachelor's degree, 24.26% (33) have a higher diploma, 16.18% (22) have a diploma with Grade 12, and 5.88% (8) have N4-6/NTC 4-6 Certificate. Table 1 revealed that respondents in the Director Cadre accounted for 67.63% (94) of the response rate. Respondents closely follow this in the Management Cadre, which accounted for 26.62% (37) of the response rate. Only 2.88% (4) of the respondents are Technical Officers. About the profession of the respondents, construction managers accounted for 40.58% (56), Engineers accounted for 23.91% (33), Quantity Surveyors accounted for 12.32% (17), and Architects accounted for 1.45% (2) of the total respondents. Regarding the year of experience of respondents, 42.03% (58) of the respondents have gathered 1-29years of working experience, 36.23% (50) have gathered 30-49 years of working experience, and 25.36% (35) have gathered 50-69 years of working experience. This result suggests that the respondents possess the knowledge, qualifications, and experience to understand the questions raised in the questionnaire and provide useful information.

Analysis of the characteristics of projects executed by construction companies using different payment systems in the last five years was carried out and presented in Table 1. These include the client for the project procurement method used for the project, conditions of contract for the project, and payment systems for the project. Questions such as 'kindly specify the project type (e.g., Residential, Building, Institutional, Commercial, Industrial, Specialised industrial, Highway, and Heavy Construction Project) and indicate the estimated cost, final cost, construction start date, estimated duration, and final duration for the specified projects' were used to elicit this information. As concerns the clients for the projects executed by the construction organisations, the results show that the local government-owned 51.85% (70) of those projects, 32.59% (44) by private clients, and 24.44% (33) by the national government. More than half of these projects, 68.38% (93), were executed under the traditional procurement method, while 17.65% (24) and 16.91% (23) were executed under the management procurement method and integrated (design and build) procurement method.

The general condition of the contract was found to be the most common (50.75%:68) conditions of contract used for the projects executed by the construction organisations. This is closely followed by the Joint Building Contract Committee (41.04%:55), New

Engineering Contract (19.40%:26), and International Federation of Consulting Engineers (11.19%:15). The most significant number (77.04%:104) of these projects were executed using an interim payment system. This is closely followed by payment on completion (14.81%:20), milestone payment system (11.85%:16), stage payment system (9.63%:13), and advance payment system (8.15%:11). This result suggests that the projects will provide relevant and practical information for this research. Eighty-eight (88) projects were analysed for cost and time performance. Seventeen of these projects are heavy construction projects, 20 are commercial buildings, four are industrial buildings, 12 are residential buildings, 13 are highway projects, two are specialised industrial projects, six are building maintenance projects, and 14 are institutional buildings.

Altogether, 37 projects were found to have costs underrun. The highway maintenance project had the highest percentage of cost underrun (20% cost underrun). The commercial building project had the highest cost overrun percentage (140% cost overrun). The project with the lowest percentage of cost overrun is a residential building project (1.25%), while 21 projects were found to have zero per cent cost overrun. The project with the highest percentage of time underrun was heavy construction project (33.33%) and commercial building project (33.33%). Heavy construction projects had the highest percentage of time overrun (300%). In total, 45 projects were found to have had time overrun. Concerning the project with the least percentage of time overrun highway construction was found to have 0.08% time overrun. Table 2 analyses these projects' cost and time performance regarding the payment systems utilised. The cost and time performance of these projects were assessed using time overrun and underrun as well as cost overrun and underrun. Information such as project type, estimated cost, final cost, construction start date, estimated duration, final duration, and payment system used were elicited from the respondents.

As explained in Table 2, 37 projects with a cost overrun and 13 projects with cost underrun were executed using an interim project payment system. Thirty-eight projects with time overrun and two projects with time underrun were executed using an interim payment system. This made the interim payment system have the highest number of projects with cost and time overruns. Interestingly, the interim payment system also has the highest number of projects with cost and time underrun. This indicates that the interim payment system could be the most popular in South Africa or effective with characteristics that are useful in specific projects. Table 2 revealed that the advance payment system has the least number of projects with a cost overrun (two) and underrun (zero). Payment on completion closely followed the interim payment system, with six projects having cost overruns. In contrast, milestone payment has the highest number of projects (six) after the interim payment system with time overrun.

These results imply that it is difficult to determine the impacts of payment systems on project cost and time performance because clients favour only the use of interim payment systems. The results suggest that payment systems affect project cost and time performance because using an interim payment system was evident in projects with cost and time overruns and underrun. The results also suggest that the choice of interim payment system must be determined based on the expectations of clients on cost and time performance as well as the type of projects. Heavy construction projects show compatibility with the use of an interim payment system. This further confirms that project type must determine the choice of the payment system.

A chi-square test of independence was performed to examine if there are significant differences in project cost and time performance due to different payment systems used. The results in Table 2 show that the differences in project cost and time performance due to the usage of different payment systems were insignificant [x2 (DF=2, N=88) =5.893, p>0.05]. The Chi-square statistic is 5.893. The p-value is 0.921. The result is not significant at p<0.05.

Table 1: characteristics of projects executed by construction companies using different payment systems

Answer Choices	Response Percent	Responses
Clients for the project		
Local Government	51.85%	70
Private	32.59%	44
National Government	24.44%	33
Procurement method used for the project		
Traditional	68.38%	93
Management	17.65%	24
Design and Build/Integrated	16.91%	23
Conditions of contract for the project		
GCC - (General Conditions of Contract)	50.75%	68
JBCC - (Joint Building Contract Committee)	41.04%	55
NEC - (New Engineering Contract)	19.4%	26
FIDIC - (International Federation of Consulting Engineers)	11.19%	15
Payment systems for the project		
Interim/Progress Payment	77.04%	104
Payment on Completion	14.81%	20
Milestone Payment	11.85%	16
Stage Payment	9.63%	13
Advance Payment	8.15%	11

Table 2: Significant differences in the cost and time performance of projects as a result of different payment systems used

Payment system used	Number of projects with a cost overrun	Number of projects with cost underrun	Number of projects with time overrun	Number of projects with time underrun
Interim/Progress Payment	37	13	38	2
Payment on Completion	6	2	4	1
Milestone Payment	5	2	6	0
Stage Payment	3	0	2	0
Advance Payment	2	0	2	1
Chi-square value: 5.893				
p-value: 0.921				

To investigate the cost and time performance of projects executed by construction organisations using different payment systems, the respondents were requested to

identify familiar construction projects undertaken by their organisations in the last five years. The respondents used the details of these familiar construction projects to indicate the project client, procurement method used for the projects, the project type, standard condition of contract used for the projects, form of project payment used for the projects, estimated and final cost for the projects, as well as estimated and final duration for the projects. This information was used to determine these projects' percentage cost overrun, percentage cost underrun, percentage time overrun, and percentage time underrun. This was in line with the argument by Nguyen *et al.,* (2004) that a construction project succeeds when executed within budgetary cost and time schedule.

The results in the Tables reveal that clients prefer interim payment systems, making it difficult to determine the impact of different payment systems on project cost and time performance. Ansah (2011) concurred that the interim payment system is the most popular payment system employed by clients. This finding only provides insight into the impact of the only interim payment system on project cost and time performance. The information on other project payment systems was insufficient to provide the basis for comparing the impact of interim payment systems and other types of project payment systems on project performance. Projects with overruns and underrun of time and cost were found to be executed using an interim payment system. This corresponds with the conclusion by Adjei, *et al.,* (2018) and Gary *et al.,* (2010), which revealed that cost and time overrun are highly associated with the use of an interim payment system.

It must be noted that time and cost overruns are unavoidable for a specific type of construction project due to their complexities and variations. Therefore, the occurrence of time and cost overruns on projects where the interim payment system was used cannot be entirely attributed to the impact of the interim payment system on these projects. Likewise, time and cost underrun of projects could result from other project success factors. Therefore, it will be erroneous to conclude that the interim payment system was solely responsible for the time and cost underrun of these projects. Project performance or success is broader than the determination of time and cost underrun for projects. Hence, the time and cost underrun of projects executed using an interim payment system is not a reasonable basis for concluding the success of these projects.

CONCLUSIONS

A valid observation from the findings implies that project type and expectations must determine the choice of the payment system. This indicates that project expectations must measure project performance and must be based on project type. Following this strategy, it will be easier to base the choice of the interim payment system on the project type and evaluate its impact on project performance. It is important to note that the use of an interim payment system by clients puts pressure on construction organisations to complete projects within the estimated time and cost because if the construction organisations renege on the contract conditions, the clients will not complete the payment.

The finding of this study is important because it provides information on the importance of project payment systems to project performance. It also provides insights into assessing the impacts of project payment systems on project performance. This seems to be the only logical explanation for an interim payment system's impact on the improved time and cost performance of construction projects.

The limitation of this study is that the accuracy of the scheduling and costing processes used by the respondents were not ascertained, and these may contribute to the over / under run for both time and cost on a project. Also, this study did not consider the impacts of poor scheduling, inaccuracy in cost determination on cost, Key Performance Indicators, and project management systems on time and cost over/underrun of projects. Future studies on the impact of project payment systems on project performance should be tailored towards the characteristics of different project payment systems. This should be linked to the project expectations and characteristics. This will provide insights into matching project payment systems with different projects.

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