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Effects Of Design And Site Management Factors On The Completion Of Sondu-Miriu Hydropower Project In Kisumu County, Kenya

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Infrastructural projects are successful when competed within scheduled timeframe, allocated budget and specified quality. Delay is a critical challenge world over, leading to cost and time overruns, as well as abandonment of projects. The completion of Sondu-Miriu Hydropower project was scheduled to end in 2005, but was later revised to 2011 due to delay, which periodical reports linked to design and site-related issues, among others. Whereas causes of project delays have attracted many studies, the effects of such delays have not received as much attention. This study attempted to determine the effects of design and site-related delays on the project's completion. A causal-comparative design was adopted and primary data sourced in May 2011 from 39 senior management staff of contractual parties. Relative Importance Index was used to determine the relative importance of perceived effects of design and site-related delays on the project's completion; while Kendell's Coefficient of Concordance was applied to determine the degree of agreement among participants regarding their perceived effects of delays. The study found that design-related delays affected the project's completion by necessitating re-scheduling and re-sequencing of planned activities (84.6%); increasing time-related costs (84.6%); as well as extending time or accelerating works (82.1%). Besides, site-related delays affected the project by causing re-scheduling and re-sequencing of works (61.5%); increasing time-related costs (59.0%); as well as preventing early completion (56.4%). The study recommends the need for sufficient time and budget for pre-design multi-disciplinary consultations, which should subject design approaches to critique, for acceptable, inspirational, durable, efficient and safe infrastructural facilities completed within scheduled timeframe and budget. Besides, there need for sufficient timeframe for negotiation, compensation and transfer of land ownership rights from communities to contractors. Satisfactory compensation of affected community members is important for galvanizing support and nurturing a sense ownership, which are crucial for timely completion of infrastructural projects.

Key words: Infrastructural projects, project design, site management, budget overruns, time overruns

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INTRODUCTION

Infrastructural facilities are vital pillars for achieving economic growth and development world over. As noted by Gutman, Sy and Chattopadhyay (2015), investment in energy plants, railways, ports, irrigation canals, Information and Communication Technology (ICT), roads, schools and hospitals, among others, is important for both economic and social development. Insufficient infrastructure impedes a country's economic growth, social system and competitiveness in the international platform (World Bank, 2006). In this regard, infrastructure is a key measure of a country's position on the global stage; thus, forming the second pillar upon which the World Economic Forum (WEF) determines the competitiveness of a nation (World Bank, 2006).

Nowhere in the world is infrastructural investment as crucial and urgent as in the Sub-Sahara Africa (Gutman et al., 2015). In Kenya, for instance, the national development plan - Vision 2030, underscores the importance of investing in infrastructural projects as an indispensable foundation for attaining the middle-income economy status by the year 2030 (Government of Kenya, 2007). Many SSA countries continue to prioritize infrastructural investment by formulating strategies to attract external financing as well as setting aside considerable proportions of domestic budgets for the construction of infrastructural facilities with a view to spurring socio-economic growth and development as well as improving their competitiveness on the global economic platform.

As noted by Gutman et al., (2015), external financing for infrastructural projects in SSA has tripled between 2004 and 2012, with South Africa, Nigeria, Ghana, Kenya and Ethiopia being the top recipients. Nevertheless, most SSA countries finance about 65% of their infrastructural expenditures from their domestic budgets. In this regard, existing data suggest that budgetary allocations for infrastructural investments have been increasing in the recent past (World Bank, 2010; 2011; Price Waterhouse Coopers, 2013; Institute of Economic Affairs, 2014). In Kenya, for instance, budgetary allocation for infrastructural development has been increasing over the years. most recently, the allocation increased from KES 186 billion in the 2012/13 financial year (FY) to KES 213.7 billion in the 2013/14 FY to KES 255.7 billion in the 2014/15 FY. On average, the sector takes about 17% of the national budget (Institute of Economic Affairs, 2014).

Infrastructural projects are considered successful when delivered within scheduled duration, allocated budget and specified quality (Majid, 2006; Owolabi, Amusan, Oloke, Olusanya, Tunji-Olayeni, Owolabi, Joy & Omuh, 2014). Delay is one of the most critical challenges to infrastructural investments world over, leading to increased construction costs due to time extension or acceleration; as well as loss of productivity; disruption of work, loss of revenue through lawsuits between contractual parties, as well as contract termination or abandonment (Sambasivan & Soon, 2007; Owolabi et al., 2014).

Despite consistent investment in infrastructural development, many SSA economies experience losses amounting to billions of dollars as a result of delayed completion of infrastructural projects (Gutman et al., 2015). Similarly, Alnuaimi and Al Mohsin (2013), point out that delay in the completion of infrastructural projects is expensive due to accumulation of interest on borrowed capital, maintenance of management staff whose expenses are time-dependent, as well as continuous escalation in wages and material prices. On the same note, Kerzner (2004) affirms that infrastructural project delays often deny beneficiaries timely utility and leads to budget overruns, which incidentally affect the quality of deliverables.

Existing literature suggest that delay in the completion of infrastructural projects is a global phenomenon, which however, appears to be more common in developing than developed countries (Aziz, 2013). For instance, De Souza (2009) reports that by the end of 2008, about 2000 infrastructural projects in Canada were expected to experience delay in completion due to various factors, including reduced funding by sponsors, communication breakdown, delayed disbursement of funds, poor site management by contractors and tedious legislative procedures. More still, a pipeline project connecting Florida State and Bahamas delayed for two years due to design changes in line with stakeholders' preferences, which the original contract had overlooked (SNL Financial, 2010). In the United States, Baldwin and Manthei (1971) found significant relationships between project delays and weather vagaries, labor supply and poor management of sub-contractors.

In India, a government Infrastructure Delay Report of 2006 indicated that a rail project in West Bengal had delayed for 32 years, and so was a coal project, which started about 24 years earlier. The report attributed the delays to slow design processes and late disbursement of project funds. The report further stated that out of 742 infrastructural projects in multiple sectors, 269 showed time overruns, while 216 reported cost overruns (Government of India, 2006). In Qatar, a Public Works Report of 2009 indicated that about one-third of infrastructural projects in the country had delayed due to low capacity of the contractors, increase in construction material prices, land compensation disputes which hampered site possession and access, deferral of payments due to design issues; as well as legislative bottlenecks for the importation of materials and tedious overseas procurement procedures (Government of Qatar, 2009).

Sambasivan and Soon (2007) identified ten causes of infrastructural project delays in the Malaysian construction industry, including contractor's improper planning, poor site management; inadequate experience, inconsistent flow of payments for completed work, poor management of sub-contractors, inconsistent communication between parties, as well as shortage of materials, equipment and labour.

In South Africa, a government report linked infrastructural project delays with changes in project design, inconsistent flow of financial resources and contractor's lack of capacity to deliver (Government of South Africa, 1999). In Ghana, Frimpong, Olowoye and Crawford (2003) identified monthly payment difficulties from agencies, poor contractor management, delays in material procurement, poor technical performances and escalation of material prices, as key factors accounting for about 80% of delays in project completion.

In Kenya, Talukhaba (1999) found a significant relationship between delays of construction projects and causal factors such as poor financial management by clients; inadequate designs and poor management of the construction process by contractors. These are compounded by poor management of materials and equipment by contractors; inadequate recognition and response to risks emanating from the physical and socio-economic environments, as well as inadequate regard for stakeholders' needs (Talukhaba, 1999). Another study, which focused on factors influencing completion of road projects in Kenya, reported significant correlation between project delays and factors such as management support (r=0.625), design specifications (r=0.836), contractor's capacity (r=0.567) and supervision capacity (r=0.712). Design specifications had the strongest statistical correlation with delays in the completion of road projects in Kenya (Ondari & Gekara, 2013).

Furthermore, Abiero (2010) notes that the implementation of infrastructural projects in Kenya has often been characterized by delays, leading to loss of both time and possession utility of the projects. Some of the cases that have taken too long to complete, which have also been highlighted in the media; include the Kisii-Chemosite Road whose design and construction took over 15 years and the Nyanza Provincial Headquarters Building whose design and construction took more than 2 decades (Abiero, 2010).

Sondu-Miriu Hydropower Project (SMHP) is one of the infrastructural projects initiated in the recent past by Kenya Electricity Generating Company Limited (KenGen) at an estimated cost of KES 18 billion. The project is located in Kisumu County and is financed by the Government of Japan through Japanese International Corporation Agency (JICA) under Overseas Development Agency (ODA) Loans (JICA, 1985). The project's goal is to inject additional 80 Mega Watts of electricity into the national grid. The construction of SMHP began in 1999 and was scheduled to end in 2005; covering a number of facilities, including a headrace pressure tunnel, a surge tank, access roads, schools, and a base camp, a penstock line, a power station and an outlet channel. Additional facilities included hydro-mechanical works, generating equipment, transmission line and substations (Nippon Koei, 2008). Due to delay, the project's completion date was revised to November 2011. Factors that contributed to the delay were linked to the project's design as well as site access and management (Nippon Koei, 2008; Abiero, 2010).

According to Alarcón and Mardones (1998), design is a critical step in the construction of infrastructural projects. This is where clients' requirements, constructive aspects and standards of quality are defined through technical drawings and specifications (Aziz, 2013). Design-related factors that are likely to cause delay in the completion of construction projects are as diverse as the contexts in which they have been documented by previous studies. They include design complexity, changes in client requirements, design errors and omissions, inadequate experience among design teams, printing mistakes in design documents, misunderstanding of clients' requirements by design engineers, limited use of design software tools, as well as unclear or inadequate details in drawings (Al-Momani, 2000; Sambasivan & Soon, 2007; Aziz, 2013; Alnuaimi & Al Mohsin, 2013; Owolabi et al., 2014). The Society of Construction Law (2004) points out that any element of design, whether architectural, structural, mechanical or electrical, if flawed, can lead to delay in project completion, because correcting defects requires time.

Site management involves daily running of construction work and related activities. Effective site management is essential for timely completion of construction projects (Aziz, 2013). The process involves addressing issues arising, fitting daily activities into project's timeframe and budget; quality control; managing resources and communications, as well as health and safety checks. Issues such as poor site management, mistakes during construction stages and inaccurate site supervision, among others, have featured in the works of authors such as Mansfield, Ugwu and Doran (1994); Chan and Kumaraswamy (1997); Sambasivan and Soon (2007); as well as Aziz (2013), just to mention a few.

Existing literature suggest that delay is a common form of risk encountered in the construction of infrastructural projects, particularly in developing countries (Aziz, 2013). Whereas causes of delays in the construction of infrastructural projects have attracted many studies, particularly in developing economies, the effects of such delays have not received as much attention (Sambasivan & Soon, 2007; Aziz, 2013; Owolabi et al., 2014). More specifically, few studies such as Sambasivan and Soon (2007) have focused on effects of design and site management causal factors on the completion of infrastructural projects. Similarly, the SMHP project's progress reports reveal that the delay was analyzed more from the perspective of causes than effects. Although the study covered a set of contractual delay factors, this paper focuses on the effect of design and site-related delays on the completion of SMHP project.

METHODOLOGY

The study adopted a causal-comparative design which permitted the application of quantitative approaches in data collection, processing and analysis. Causal-comparative designs employ natural selection principles, rather than manipulation of dependent variables to predict relationships (Oso & Onen, 2005). Self-administered questionnaires were issued to management staff of the contracting parties to source information on causes and effects of contractual delays, as well as mitigative measures. Primary data were supplemented with secondary data, which were sourced from the project archives.

The study targeted senior management staff of SMHP project, affiliated to all contracting parties, including KenGen (the Employer); Nippon Koei Company Limited (the Engineer); Sinohydro (the Contractor); and JICA (the Financier). Senior management staff members were targeted because contractual issues form part of their responsibility. A sampling frame of all senior management staff was prepared using organizational management charts of each contracting party and the process identified 54 eligible participants, who were all included in the sample to avoid the risk of sampling error.

Table 1: Sampling frame

Contracting partner type	Frequency	Percent
Employer	15	27.8
Contractor	20	37.0
Engineer	15	27.8
Financier	4	7.4
Total	**54**	**100.0**

Self-administered questionnaires were used to source the information, particularly because they provided the flexibility that targeted participants would require, considering their complicated itineraries. The approach enabled participants to provide the requisite data at their convenience. One module of the instrument was applied across the board to permit comparison of perspectives from different contracting parties. The instrument, which had both closed-ended and open-ended questions, captured information on contractual delay typology, perceived causes and effects as well as mitigative measures.

The instrument was pre-tested at the Kisumu Airport Expansion Project, which had a similar contractual management structure. The pre-testing was important for testing reliability of the instrument, validity and feasibility of data collection approaches. Primary data were collected in May 2011 after obtaining necessary approval from University of Nairobi, National Council of Science and Technology, as well as KenGen. Questionnaires were delivered to targeted participants and follow-ups were made through e-mails and telephone calls. Of the 54 targeted participants, 39 (72%) successfully completed and returned the questionnaires. Table 2 shows the questionnaire return rate for each category of participants.

Table 2: Questionnaire return rate

Contracting partner type	No. targeted	No. of participants	Return rate (%)
Employer	15	14	93.3
Contractor	20	12	60.0
Engineer	15	10	66.7
Financier	4	3	75.0
Total	**54**	**39**	**72.2**

Primary data were listed, coded, digitalized and cleaned for logical inconsistencies and misplaced codes. The methods used included descriptive, factorial comparative and rank analyses, to develop relative importance of causes and effects of contractual delay on the project's completion. Relative Importance Index (RII) was computed using the formula below.

$$\text{RII} = \frac{\Sigma W}{A*N} \quad (1)$$

Where W is the weighting assigned to each response on a scale of 1 to 5 corresponding with lowest to highest, A is the highest weight, and N is the total number of participants. RII yielded values in the range of $0 < x \geq 1$. The higher the value of RII, the more important the identified factor on contractual delays. This ranking enabled cross comparison of the relative importance of the factors as perceived by the four categories of participants. RII is a non- probabilistic rank statistic derived from ordinal data; hence, its accuracy is non-dependent on sample size or the population (Kometa, Oloimolaiye & Harris, 1994).

Furthermore, Kendell's Coefficient of Concordance was applied to determine the degree of agreement among the four categories of participants with respect to their ranking (Frimpong et al., 2003). The Coefficient states that the degree of agreement on a 0 to 1 scale is given by *W, such* that:

$$W = \frac{12U - 3m^2n(n-1)^2}{m^2n(n-1)} \quad \ldots\ldots\ldots\ldots(2)$$

Where:

$$U = \Sigma_{j=1 \ldots n} (\Sigma R)^2 \quad \ldots\ldots\ldots\ldots(3)$$

Where n is the number of factors; m is the number of groups; j represent the factors *1, 2, 3 … n.* As noted by Frimpong et al., (2003), Kendell's Coefficient of Concordance is strong on both probabilistic and non-probabilistic distributions because it is not sensitive to sampling error. In addition, Chi-Square statistic was used to determine whether there was a significant difference in the ranking of contractual delay factors perceived to be influencing delays in the project's completion. The Statistical Package for Social Scientist (SPSS) and Microsoft Excel were used to analyze the data.

RESULTS

This section presents findings of the study, which have been organized, interpreted and discussed under five thematic areas, including participants' profile, forms of delays, components of contractual delay, effects of design delays as well as effects of site management delays on the project's completion. Details are presented and discussed in the following sub-sections.

Participants' professional and work experience

The findings of this study were derived from engagement with 39 senior management staff of the contractual parties through self-administered questionnaires, including 14 (35.9%) from KenGen; 12 (30.8%) from Sinohydro; 10 (25.6%) from Nippon Koei and 3 (7.7%) from JICA. The study sought to establish the distribution of work experience among participants in construction project management, as well as work experience at the project. The duration of professional and work experience is an important factor in successful management and administration of construction projects. Table 3 shows average length of work experience across the contractual parties.

Table 3: Professional and work experience

Contractual party	Frequency	Average experience (years)		Relative weighted management
		Construction projects	*Sondu-Miriu HP*	
Employer	14	2.6	2.3	0.9
Contractor	12	2.1	1.7	0.7
Engineer	10	3.0	2.1	1.0
Financier	3	2.0	1.3	0.6
Total	**39**	**2.4**	**1.9**	

The results show that the average experience of the Employer's staff was 2.6 years in the management of construction projects and 2.3 years in the management of SMHP project. The Contractor's staff reported an averaged experience of 2.1 years and 1.7 years in the management of construction projects and in the management of SMHP project, respectively. Engineer's staff reported an average experience of 3.0 and 2.1 years; while the Financier's staff reported the least experience of 2 years in the management of construction projects and 1.3 years in the project.

The results suggest low variability of experience among participants. The average experience was 2.4 years in management of construction projects and 1.9 years in management of the project. The Engineer's staff was the most experienced with a relative weight of 1 compared to the Employer's 0.9 and the Contractor's 0.7. The least relative management experience was noted among the Financier's staff, which was weighted at 0.6. Low variability further suggests that the participants were relatively homogenous in terms of professional experience and therefore, provided reliable information with negligible internal deviation of ±0.03 years.

The study found that KenGen set a minimum professional experience in managing construction projects at 3 years. Based on this, the results show that this threshold was met by the Engineer's staff only. Projects which are managed by highly experienced personnel have a relatively lower risk of experiencing contractual delays due to the management's ability to proactively assess and mitigate potential risk factors. In view of this, the staff of most contractual parties reported a professional experience, which is lower than the threshold set by KenGen, which might have contributed to the contractual delay of SMHP project.

The study sought to confirm, from the perspective of participants, whether SMHP project was on time or in delay. In this regard, participants were requested to indicate their views on the project's status *vis-à-vis* the contractual timeframe. Table 4 presents participants' views across the contractual parties, where out of the 14 staff of the Employer, 11 (78.6%) reported that the project was not on schedule. Contrastingly, all the staff members of the Contractor (12), the Engineer (10) and the Financier (3) indicated that the project was not on schedule.

Table 4: Perception on the timeliness of the project

Contractual partner type	**Yes**		**No**	
	Frequency	*Percent*	*Frequency*	*Percent*
Employer	3	21.4	11	78.6
Contractor	0	0.0	12	100.0
Engineer	0	0.0	10	100.0
Financier	0	0.0	3	100.0
Total	**3**	**7.7**	**36**	**92.3**

Overall, 36 (92.3%) participants across the contractual parties affirmed that the project was not on schedule, while 3 (7.7%) expressed contrary opinions; suggesting that some project management staff were either not involved in project planning and scheduling or did not have sufficient experience in project's delay aspects. Nonetheless, the proportion of participants (92.3%), indicating perceptions that there was contractual delay, is a clear indication that the project's completion was behind schedule.

Forms of Delay in Sondu-Miriu Hydropower Project

The study sought to identify common forms of delay experienced at the project. In this regard, the three main forms of project delays (contractual, stakeholder and *force majeure*) were listed in the questionnaire and participants requested to indicate their opinion regarding the frequency of occurrence on a five-point integer scale ranging from 1 to 5 and corresponding to 'very low', 'low', 'medium', 'high', and 'very high'. A mean statistic, indicating convergence among groups, was computed to establish agreement among participants on the frequency of occurrence. Table 5 provides a summary of the findings.

Table 5: Forms of delay at SMHP project

Contractual partner type	Contractual delay		Stakeholder delay		Force Majeure	
	Mean	*Category*	*Mean*	*Category*	*Mean*	*Category*
Employer	3.8	High	3.8	High	1.8	Low
Contractor	2.8	Medium	2.3	Low	2.9	Medium
Engineer	3.8	High	1.5	Low	1.5	Low
Financier	3.7	High	2.1	Low	1.7	Low
Convergence	**3.5**	**High**	**2.4**	**Low**	**2.0**	**Low**

The results show that the most common form of delay was contractual, scoring an average of 3.8 (high) among the Employer's staff, 2.8 (medium) among the Contractor's staff, 3.8 (high) among the Engineer's staff and 3.7 (high) among the Financier's staff. Overall, the analysis obtained a convergence of 3.5 (high) across all the groups. Regarding the Stakeholder form of delay, the analysis obtained a mean score of 3.8 (high) among members of the Employer's group, 2.3 (low) among members of the Contractor, 1.5 (low) among members of the Engineer, and 2.1 (low) among employees of the Financier. The overall convergence was 2.4 (low) across all the groups, which is an indication that the frequency of Stakeholder delay was low.

The results in Table 5 further show that *force majeure* was the least common form of delay with scores of 1.8 (low) for the Employer, 2.9 (medium) for the Contractor, 1.5 (low) for the Engineer, 1.7 (low) for the Financier and a convergence of 2.0 (low) across all the groups. This also implies that the frequency of this form of delay was low in the context of SMHP project. These statistics indicated relative importance and hence, agreement among contractual parties that the most frequent form of delay at the project was contractual delay, followed by stakeholder and *force majeure* forms of delay. These findings revealed the importance of contractual delays at the project.

Components of contractual delays: Design and site possession

Contractual delay is a responsibility issue constituted by failure of the parties involved to perform their obligations under the contract. These obligations include components such as designing works in time to allow for scheduled works to progress, as well as ensuring timely site access, possession and management. In view of this, the study sought to establish perceptions of the management staff regarding the occurrence of design and site-related contractual delays. In this regard, participants were requested to state at a nominal scale of 'yes' or 'no', whether design or site-related components of contractual delay had occurred during the project's implementation, the results of which are presented in Table 6.

Table 6: Components of contractual delay at the project (%)

Components of delay	Employer		Engineer		Contractor		Financier		Overall		RII
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	
Design	57.2	42.8	79.9	20.1	92.3	7.7	100.0	0.0	82.4	17.6	0.8
Site possession	56.7	43.3	9.8	90.2	58.0	42.0	0.6	99.4	31.3	68.7	0.3

The results in Table 6 suggest that both the design and site-related contractual delays were experienced during the project's construction. Overall, 82.4% of the managers across all groups affirmed that the project experienced design-related delays, while about one-third (31.3%) affirmed that site-related delays were experienced. The analysis obtained Relative Importance Index (RII) for each form of contractual delay to facilitate ranking in terms of seriousness. The results show that design-related delays were more serious with an RII of 0.8 than site-related delays (0.3).

Effects of design-related delays on the project's completion

Design of works is a responsibility of both the Engineer and the Contractor, depending on the type of contract. In the project, responsibility for design of civil works was shouldered by the Employer through the Engineer, while the design of Installation works was undertaken by the Contractor. This study sought to establish the effects of design-related delays on the project's completion. In view of this, a list of design-related effects was provided in the data collection instrument, and participants requested to identify the ones that were common features of the project. Design-related effects that were listed in the instrument included prevention of early completion, extension of time and acceleration, loss of productivity and efficiency, rescheduling and re-sequencing, as well as increase in time related costs and abandonment.

The results presented in Table 7 show that of the 39 participants 33 (84.6%) indicated that design delays had resulted to rescheduling and re-sequencing of implementation activities. A similar proportion (84.6%) associated design delays with increase in time-related costs; while 32 (82.1%) participants affirmed that design delays had resulted to extension of implementation time and acceleration. In addition, 29 (74.4%) participants associated design delays with prevention of early completion; 21 (53.8%) cited loss of productivity and efficiency, while 8 (20.5%) participants linked design delays with the risk of abandonment.

Table 7: Effects of design on the completion of the SMHP project (%)

Design-related effects	Employer		Contractor		Engineer		Financier		Total	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Prevents early completion	71.4	28.6	83.3	16.7	80.0	20.0	33.3	66.7	74.4	25.6
Extends time & acceleration	78.6	14.3	91.7	8.3	80.0	30.0	66.7	33.3	82.1	17.9
Loss of productivity & efficiency	28.6	50.0	75.0	25.0	70.0	30.0	33.3	66.7	53.8	38.5
Re-scheduling & re-sequencing	85.7	7.1	83.3	16.7	90.0	10.0	66.7	33.3	84.6	12.8
Increase time related costs	92.9	7.1	91.7	8.3	80.0	20.0	33.3	66.7	84.6	15.4
Abandonment of project	50.0	35.7	8.3	91.7	10.0	90.0	0.0	100.0	20.5	71.8

Based on this, the study found that the most common effects of design delays, included rescheduling and re-sequencing of works, increase in time related costs, as well as extension of time and acceleration. These were closely followed by prevention of early completion, and loss of productivity and efficiency. A similar study conducted in Malaysia by Sambasivan and Soon (2007) reported the occurrence of time overruns, which led to re-scheduling and re-sequencing of works, as the key effect of delays in the preparation and approval of drawings. Furthermore, the study reported that design-related delays did not necessarily lead to abandonment. In this study, although the design-related delays had led to re-scheduling and re-sequencing of works, only one-fifth of the participants believed that the risk of abandonment had increased.

The results suggest that the main effect of design-related delays is the re-scheduling and re-sequencing of planned activities, implying a complete overhaul of construction schedules, with deep implications on planning. Design is critical in project implementation due to its ripple effects on the implementation schedule. The perceived linkages between design-related delays and effects such as re-scheduling and re-sequencing of works (84.6%), increase in time-related costs (84.6%), extension of time or acceleration (82.1%) and prevention of early completion (74.4%), is an indication of the potential effects of project design on the timely completion of infrastructural projects. Project design issues may have far-reaching financial implications to contracting parties and stakeholders.

In their study, Sweis, Sweis, Abu-Hammad and Shboul (2008) reported significant relationship between project design consistency and budget overruns as well as time overruns. The authors emphasized the need for Contractors and the Engineers, as holders of design responsibility, to ensure timely conclusion of design issues, including technical drawings and specifications; variations and critical tolerances to avoid loss of resources due to budget and time overruns.

Effects of site-related delays on project completion

The Employer has the contractual duty to hand over possession and management of all sites, where works are to be executed, to the Contractor. Handing over the rights to possess and manage construction sites should be expedited to ensure that activities stay within project schedule. Taking cognizance of this, the study sought to establish the effect of site possession on the project's completion. A list of potential effects was included in the data collection instrument and participants requested to identify those that were commonly experienced in the project's implementation. Table 8 shows that re-scheduling and re-sequencing of works was as the most prominent effect of site-related delays, as indicated by 61.5% of the participants.

Table 8: Effects of possession and access the completion of the SMHP project (%)

Effect	Employer		Contractor		Engineer		Financier		Total	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
Prevents early completion	50.0	50.0	83.3	16.7	30.0	70.0	66.7	33.3	56.4	43.6
Extends time & acceleration	35.7	64.3	83.3	16.7	20.0	80.0	33.3	66.7	46.2	53.8
Loss of productivity & efficiency	28.6	71.4	83.3	16.7	20.0	80.0	0.0	100.0	41.0	59.0
Rescheduling & re-sequencing	64.3	35.7	91.7	8.3	40.0	60.0	0.0	100.0	61.5	38.5
Increase time related costs	50.0	50.0	91.7	8.3	50.0	50.0	0.0	100.0	59.0	41.0
Abandonment of project	14.3	85.7	0.0	100.0	0.0	100.0	0.0	100.0	5.1	94.9

The results further show that 23 (59.0%) participants reported that site-related delays affected the project's completion by increasing time-related costs; 22 (56.4%) indicated that site-related delays prevented early completion; while 18 (46.2%) associated delays with extended time and acceleration. Other effects identified by participants included loss of productivity and efficiency (41.0%) as well as the risk of abandonment (5.1%).

The effect of site-related delays on project abandonment was envisaged by the project's baseline survey (Kapiyo, 2008). However, in this study less than one-tenth of the participants indicated that abandonment was likely to occur as a result of delays in site possession and access. Delays in the transfer of site possession and access rights to the Contractor were attributed to delays in reaching agreement with community members and effecting compensation for land. The Employer also bears the responsibility of handing over project sites to the Contractor without burdens, cautions or encumbrances. Third party claims on land ownership and/or access is likely to slow down project construction, leading to cost and time overruns.

CONCLUSIONS

The objective of this study was to determine the effects of design and site-related delays on the completion of SMHP project, from the perspective of senior management staff of the contractual parties, including the Employer, the Engineer, the Contractor and the Financier. The study was purposed to raise awareness among project stakeholders, which in turn, should lead to appropriate corrective actions targeting design and site-related issues that contributed to the project's delay.

The findings suggest that design-related delays affected the project's completion mainly by necessitating the re-scheduling and re-sequencing of planned activities (84.6%); increasing time-related costs (84.6%); extending time or accelerating works (82.1%); preventing early completion (74.4%); as well as leading to loss of productivity and efficiency (53.8%). Re-scheduling and re-sequencing planned activities marks the onset of project delays. No matter how much effort is put in undertaking re-scheduled or re-sequenced works, time lost can never be compensated for without cost implications. Delay in project completion has a direct effect on the budget by increasing time-dependent costs such as maintaining contractual staff, meeting overhead costs and servicing loans. More still, acceleration of work plans heightens the risk of construction works not meeting quality standards, which may affect durability of infrastructural facilities, maintenance costs, operational efficiency, profitability and safety.

Project design is a critical step in the development of infrastructural facilities, which has far-reaching ripple-effect on the construction process, operation and maintenance of facilities. Consequently, planners need to allocate sufficient time and budget for pre-design collaborations and engagements, which should begin as early as possible. During the pre-design phase, design team should ensure multi-disciplinary consultations with stakeholders, including the client, the design team, technical experts, architects and landscape designers, the community, as well as environmental and planning authorities, to inject their views and requirements into the design process. By including a broad spectrum of expertise and subjecting the design and engineering approaches to critique, project owners can achieve inspirational infrastructural facilities within the scheduled timeframe and budget that also meet the aspirations and needs of all stakeholders. Pre-design engagement processes are fundamental for timely identification and correction of defects to avoid re-scheduling and re-sequencing of activities, time-related costs, as well as time extension and acceleration of work plans, among other negative effects of delay.

Site-related delays appeared to be insignificant, but still very important for timely completion of infrastructural projects. Site-related delays affected the completion of SMHP project by causing re-scheduling and re-sequencing of works, as indicated by 61.5% of the participants; increasing time-related costs (59.0%); preventing early completion (56.4%); as well as extending construction schedule and accelerating works (46.2%). The most common form of site-related delays experienced at SMHP was the untimely transfer of land possession and access rights from the Employer to the Contractor; which, was also delayed by prolonged negotiations and compensation of community members, whose lives and livelihoods were disrupted by project.

Matters touching on the compensation of community members for disruptions caused by infrastructural projects are typically complex, controversial in many communities, and may take a long period of negotiations. Regardless of the adopted principle, the process has a high risk of pushing infrastructural projects into time and budget overruns. It is imperative that project sites be handed over to contractors without burdens, cautions or encumbrances. Third party claims on land ownership and/or access is likely to slow down construction activities, leading to cost and time overruns. Nonetheless, success of the compensation process is an important element for galvanizing support and ownership by community members, which is crucial for timely completion of infrastructural projects. In view of this, planners should allocate sufficient timeframe for negotiations, compensation and transfer of land ownership rights.

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