An Investigation of Factors Causing Schedule Overrun in Telecommunication Projects in Zambia

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Abstract

The aim of this research was to investigate the causes of time overrun in telecommunication projects in Zambia. To achieve this goal a multi-mode descriptive study was adopted by using both qualitative and quantitative approaches. A detailed literature review was undertaken in which 34 factors that cause delay in telecommunication projects were identified and verified through interviews. These factors were then categorised into five generic elements using a fishbone diagram framework. A questionnaire containing 34 identified factors was distributed to the rest of the professionals involved in telecommunication projects including network operators, equipment vendors, contractors, telecommunication infrastructure support companies. The results gave a response rate of 78%. Findings showed that eight highest ranked factors were identified with the highest frequency of occurrence and impact on the schedule. Most of the interviewed experts pointed to poor planning as the main cause of project schedule overrun, which affects subsequent project phases. Based on the fishbone framework, it was also found that process-related factors were the major contributors to project delays. These results highlight the need to adopt the Project Talent Triangle to enhance project time performance for telecommunication projects that improves time management processes and is considered and the emerging trend.

Keywords
Root Cause Analysis, Schedule Overrun, Telecommunication Projects, Time Management, Zambia

1. Introduction
Time is one of the major considerations throughout a project management life cycle and can be regarded as one of the most important parameters of a project and a driving force to project success. Information and Communication Technology (ICT) projects, like other infrastructure projects, experience frequent time overruns or schedule slippages. With the telecommunication industry having reached maturity stage in its cycle, bringing better products to markets faster has become more critical not only for revenue but competitive advantage. The ICT industry is one of the fastest evolving sectors influenced by constant technological changes, diverse and constantly changing customer

requirements and shorter product life cycles. Consequently, mobile network operators are placing more emphasis on efficiency throughout the life cycle of the projects.

Despite abundance of knowledge and tools to manage projects effectively, time overrun remains a common phenomenon in infrastructure development projects globally (Tendedziso, et al., 2019; Le-Hoai et al, 2013). Akinsiku and Akinsulire (2012) also observed that project delay is a persistent phenomenon in construction project delivery, and it is branded as the most common, costly and risky problem encountered in infrastructure development projects with a debilitating effect on the parties to the contract. The findings of the study carried out by Azis et al. (2012) revealed that 92% of construction projects were overrun and only 8% of projects achieved completion within contract duration. In the study carried out by Budzier and Flyvbjerg (2011) in the UK, large ICT projects were found to be twenty times more likely to 'run out of control' than other large infrastructure projects and one in six projects reported an average cost overrun of 200% and a time overrun of almost 70%. These studies highlight the extent of the time overrun problem in projects across industries and globally.

Most of available literature concentrate either on the construction industry or in developed countries. There has been little documentation on ICT industry in Zambia, despite the time overrun still being experienced and acknowledged by professionals in telecommunication industry in Zambia. The rationale of this research was therefore to provide informative evidence-based results on the causes of time overrun, so as to assist project managers and policy makers identify root causes of time overruns in the implementation of telecommunication projects in Zambia. The study sought to ascertain the key factors adversely impacting delays in the telecommunication industry, and to establish the relationship by breaking the identified factors into three levels using the fishbone diagram. The study aims to contribute to literature on time overrun by analyzing the delay causal factors in telecommunication projects in Zambia.

The research aim of the study was to investigate factors causing schedule overrun in mobile telecommunication projects in Zambia. To achieve this aim, the following objectives were devised: establish factors that lead to schedule slippage in mobile telecommunication projects; categorise delay factors in mobile telecommunication projects; and evaluate the impact of the delay factors and rank them according to their importance as perceived by the stakeholders.

Due to inadequate available documentation, a holistic approach was adopted using a descriptive multi-mode research methodology after identifying the existing gap on the root cause of project time overrun. By using both qualitative and quantitative methods, a better and deeper understanding of the root causes of delays was obtained. Primary data collection was done using interviews as the tool for qualitative data collection, while a questionnaire survey was used for quantitative data. Purposive and stratified sampling were used for qualitative and quantitative methods respectively, targeting professionals from ICT players that are involved in projects. The data was analysed using Microsoft Excel and Statistical Package for Social Sciences (SPSS).

2. Literature Review

2.1 Project Time Management Processes

Time performance is one of the most important indicators of project success. A successful project is one which has accomplished its technical performance, maintained its schedule, and remained within budgetary costs (Olawale & Sun, 2010, Mambwe et al., 2020). To ensure efficient management of time, the Project Management Body of Knowledge (PMBOK) Guide prescribes processes that govern the planning and control of time during the project life cycle (Project Management Institute (PMI), 2008). There are seven consecutive processes in the Project Time Management Knowledge Area, six of which belong to Planning Process Group and include Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, while Control Schedule belongs to the Monitoring and Controlling Process Group.

2.2 Project Schedule Overrun

Schedule overrun or slippage refers to situations where the actual project duration exceeds the originally planned and agreed completion period. Azis et al. (2012) defined time overrun as late completion of works as compared to the planned schedule or contract schedule. Various studies have been conducted to identify the causes of delays in projects. Financial difficulties rank among the leading causes of project delays (Remon, 2013; Akinsiku & Akinsulire, 2012; El-Rasas & Marzouk, 2014; Memon, 2014; Antwi & Danso, 2012; Acai et. al, 2014; and Kaliba et. al, 2009). Remon

(2013), in his study to rank delay factors in construction projects in Egypt mentioned cites delay in progress payments, as the leading cause of the delays. Akinsiku and Akinsulire (2012), in their research in Nigeria, concluded that in addition to cash flow difficulties experienced by contractors and public agencies, failure by clients to pay for completed works contribute to delays in proceeding with the remainders of the project. Frequent specification/scope changes have been highlighted to equally affect the project schedules (Mambwe et al., 2020; Akinsiku & Akinsulire, 2012; Marzouk & El-Rasas, 2014; Memon, 2014; Danso & Antwi, 2012; Acai et.al, 2014; Kaliba et. al, 2009). Design errors and scope modifications or changes during execution have equally had adverse impact on schedule performance. Other delay factors include slow decision making when changes are required. Marzouk and El-Rasas (2014) cited late revision and approval of design documents by owners, while Acai et al (2014) pointed that delays in assessing changes in the scope of work by the consultant are contributing factors to delay. Other delay factors include, lack of skilled manpower across all phases on the project (Acai et al, 2014; and KPMG India, 2013). The study carried out by KPMG India in conjunction with PMI India (2013) concluded that majority of projects are delayed by factors which can be controlled at the project level through proper planning and project management.

Some researchers have attempted to identify underlying reasons for delays by adopting the root cause analysis (RCA) method, a structured team process that assists in identifying underlying causes of an adverse event. The National Centre for Patient Safety (2011) defines root cause analysis as a process for identifying the basic or contributing causal factors that underlie variations in performance associated with adverse events. Flyybjerg (2011) stated that "the root cause of underperformance is the fact that project planners tend to systematically underestimate or even ignore risks of complexity and scope changes, during project development and decision-making". He concluded that at the most basic level, the underlying causes of project underperformance may be grouped into three categories: (1) bad luck or error; (2) optimism bias by project managers (psychological); and (3) strategic misrepresentation (political) by project owners or clients. Mambwe et al. (2020) in their study on construction delays, reclassified causes as structural, institutional and cultural. They stated that "through the classification of structural, institutional and cultural delay, the construction delay can be treated systematically through organisation structural system, government institutional procedures and construction players' cultural behaviour". This was also affirmed by Aminah and Chai (2013).

Project Time Performance

With the evolved business models in today's competitive global economy, network operators need to invest in key skill sets that look beyond technical skills and adopt competencies that support and sustain long-range strategic objectives. This also improves the business linkages within the organisation and with organisations. To address the identified factors, the PMI Talent Triangle (PMI, 2017) has been recommended to be adopted by the companies to enhance project time performance.

Figure 1. Project Talent Triangle Source: PMI (2017)

Figure 1 shows the talent triangle in which leadership, technical project management and strategic and business management are vital management processes that can be adopted in light of improving performance when it comes to project time. By embedding the talent triangle principles into the organisational culture, employees develop broader perspective of the business resulting in goal congruence across the organisation.

3. Research Methodology

A multi-mode descriptive research approach was adopted by using both qualitative and quantitative in order to gain multiple perspectives through triangulation. A multi-mode approach was adopted as "it provides a trade-off between breadth and depth, and between generalizability and targeting to specific (sometimes very limited) populations and can increase both the validity and the reliability of the data" (National Science Foundation, 2010). The main benefit of using triangulation as described by many researchers is the validation of qualitative results by quantitative studies (Hussein, 2009). For completeness purposes, Hussein (2009) further states that researchers use triangulation to increase their in-depth understanding of the phenomenon under investigation by combing methods and theories. A survey design approach of gathering primary research evidence was chosen to ensure independent and unbiased results. Data from different sources were critically analysed and correlated to the research problem, and then used to draw up conclusions and recommendations.

The obtained results from interviews were used as input into the fishbone diagram framework, by identifying the causal factors and the underlying reason for the delay. Using this framework, the delay factors were categorized into five broad classes:

i. Process – how work is performed, policies, procedures, rules or work instructions;
ii. People – Role of people involved and their impact on the project deployment cycle;
iii. Management – The co-ordination, organizing and controlling functions during the project life cycle and how they affect the schedule;
iv. Equipment – Consideration of all equipment, raw materials and final products that could have a role in non-conformity to project timelines; and
v. Environment – Factors affecting the project boundary, and their impact of the project schedule.

3.1 Data Collection

Interviews with project managers and subject matter experts were done to obtain expert judgement and experiences on the causes of project delays. Interviews with experts were carried out first due to insufficient information on telecommunication projects delays in Zambia. The interview results also enhanced the quality and content of the questionnaire survey. From the literature and interviews, secondary and tertiary causes were identified and categorized as shown in Table 1. A three-tier approach was adopted in which the specific activities leading to delays were mapped to the contributory factors through follow up questions during interviews. These were finally mapped to the five generic root causes of delays according to the fishbone diagram framework in Figure 2. The fishbone diagram framework, a structured brainstorming format focusing on the underlying causes rather than the effect of problem, was used because it is a better tool for management decision-making as it streamlines the problem factors into identifiable control areas.

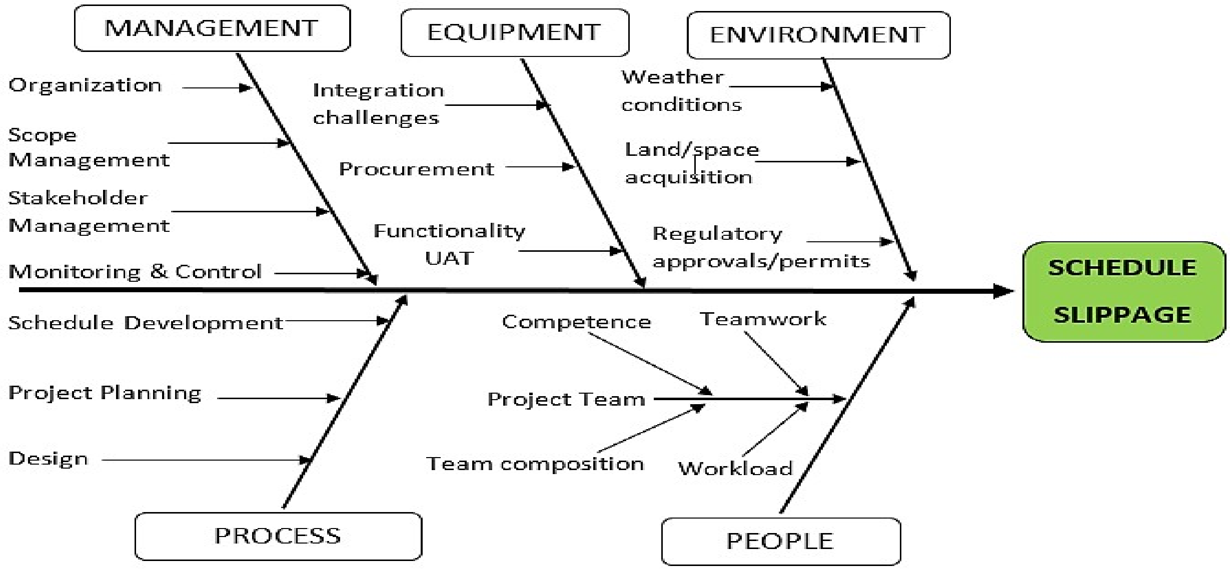

Figure 2. Fishbone Diagram – Identified delay causes

The thirty-four identified delay factors were mapped and categorised into five dimensions of root causes, as shown in Table 1.

Table 1: Mapping of Identified Delay Factors

#	Dimension (Root Cause)	Construct (Contributory)	Variable (Specific Activity)
1.	Management	Scope Management	a) Unclear project scope and deliverables at initiation
2.			b) Scope/Specification changes during implementation
3.		Organisation	a) Organisational chart and responsibility matrix
4.			b) Centralized decision making
5.		Stakeholder Management	a) Poor stakeholder identification and engagement
6.			b) Poor communication among team
7.			c) Stakeholder expectation management
8.		Monitoring and Control	a) Poor project tracking to check progress
9.			b) Lack of performance monitoring/controlling tools
10.			c) Lack of scheduling tools and PM software
11.	Process	Schedule Development	a) Poor activity identification and sequencing
12.			b) Under-estimation of activity duration
13.			c) Over optimistic estimates
14.		Design	a) Lack of project surveys or feasibility studies
15.			b) Lack of or incomplete design document
16.		Project Planning	a) Poor resource planning
17.			b) Poor risk management plan
18.			c) Lack of e2e integration plan
19.			a) Competence of project team

20.	People	Project Team	b) Lack of dedicated project team
21.			c) Cultural and language challenges in project team
22.			d) Information sharing challenges among vendors
23.	Equipment	Integration Challenges	a) Multi-vendor equipment compatibility challenges
24.			b) Access to network/site during integration
25.			c) Rigid processes and procedures
26.		Procurement	a) Procurement approval process
27.			b) Late delivery of project materials by suppliers
28.			c) Customs clearing processes
29.		Functionality UAT	a) Acceptance failure - failure to meet requirements
30.			b) Delay in acceptances testing and sign off
31.	Environment	Weather	a) Adverse weather conditions
32.		Regulatory	a) Statutory approvals and permits
33.		Ready for Integration (RFI)	a) Space acquisition and preparation
34.			b) Support infrastructure availability e.g. power

Further, a questionnaire was developed based on the above thirty-four factors. For each factor, respondents were asked to rate the frequency of occurrence and the impact on the schedule, on a Likert scale of 1 to 5. Table 2 shows the ratings. A combination of an online (using google forms) and self-administered questionnaire methods was adopted.

Table 2: Frequency - Severity Matrix

	Frequency Weighting		**Severity Weighting**	
Scale	Frequency	Weight	Severity	Weight
1.	Never	1	None	1
2.	Rarely	2	Low	2
3.	Sometimes	3	Moderate	3
4.	Frequently	4	High	4
5.	Always	5	Very High	5

3.2 Sampling Method

Purposive sampling was used for interviews, as respondents were selected to conform to this criterion – experience, position of influence or both. The respondents were obtained from the mobile network operators, equipment vendors, contractors, telecommunication infrastructure companies, and the ICT regulatory body (ZICTA). Sixteen professionals with the desired qualities were interviewed. Stratified sampling was used to obtain the quantitative data from the rest of the professionals from the same organisations. Professionals from design, operations and project deployment were sampled. Equation 1 was used to approximate the sample size for questionnaires, as it was not possible to determine the number of telecommunication engineers in Zambia. At confidence level 90%, margin of error of ±10% and standard deviation of 0.5, sample size of 68 professionals was computed. Equation 1 indicates the Sample size by Scott (2013):

$$n=(Z\sigma/E)^2 \qquad \textbf{Equation 1}$$

Where: n is the sample size; Z is the z-score i.e. 1.645; σ is the standard deviation; and E is the margin of error. Source: Scott (2013)

3.3 Data Processing and Analysis

Qualitative data collected using interviews was organised and mapped according to the identified cause, as shown in Table 1. Data collected from the survey was analysed using descriptive statistical techniques by using Statistical

Package for Social Science (SPSS) and MS Excel. To sort and rank the quantitative data, the factor importance index (FII) technique, as used by Megha and Rajiv (2013), was adopted as it combines frequency and impact of the causative factors on the project schedule. The twenty-five possible outcomes of the combinations are shown in Table 3.

Table 3: Factor Importance Index

Factor Importance Index		Frequency				
		0.2 (1)	0.4 (2)	0.6 (3)	0.8 (4)	1 (5)
Severity	0.2 (1)	0.04	0.08	0.12	0.16	0.2
	0.4 (2)	0.08	0.16	0.24	0.32	0.4
	0.6 (3)	0.12	0.24	0.36	0.48	0.6
	0.8 (4)	0.16	0.32	0.48	0.64	0.8
	1 (5)	0.2	0.4	0.6	0.8	1

4. Results

4.1 Interview Results

Of the sixteen interviewed respondents, six were from the mobile network operators (MNO), four from equipment vendors, three from infrastructure support companies, two from contractors and one from the regulatory authority. In terms of roles, there were six (37.5%) from project deployment, six (37.5%) from operations and four (25%) from design. In terms of experience eighty-one (81%) had over eight years of experience in the telecommunication sector and were in middle to top management.

The identified delay factors were ranked based on the number of times the factor was mentioned, without attaching any weighting, as shown in Figure 3. From the interview results, the top four identified causes of schedule slippages in telecommunication projects in Zambia were:

- Procurement – Long approval processes, late delivery of equipment by vendors and customs clearing processes;
- Project planning – Poor resource planning, lack of risk management plan and a lack of end-to-end project integration plan;
- Organisation – Lack of proper organisation chart with clear escalation and responsibility matrices, as well as centralized decision-making due to the managed services operational model used by these telecommunication companies; and
- Stakeholder management – Poor identification and involvement of stakeholder at an early stage of the project, poor communication among project teams and poor stakeholder expectation management by the project manager, especially top management.

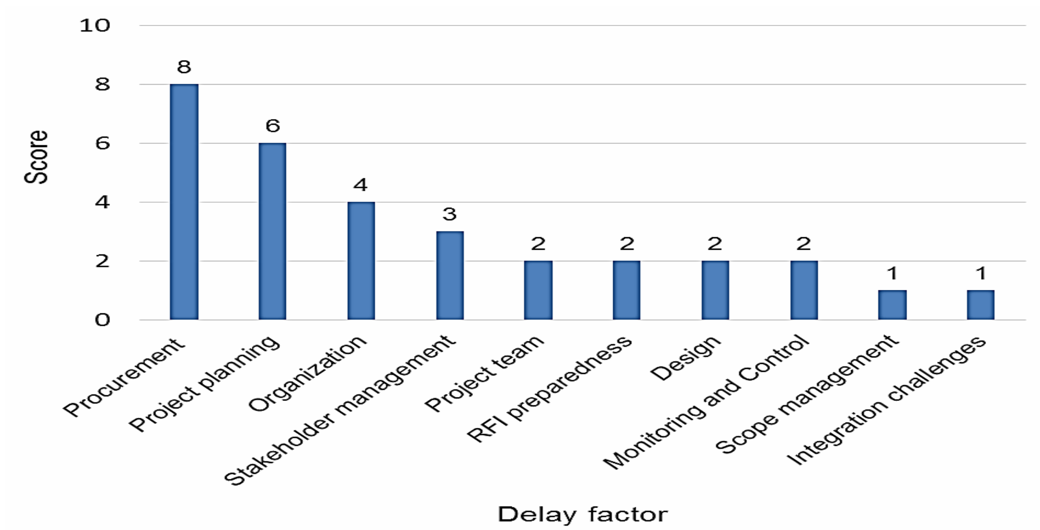

Figure 3. Ranking of schedule overrun causal factors – Interviews

4.2 Questionnaire Results

The average frequency (FI) and severity (SI) scores for the thirty-four causal factors were used to compute the factor importance indices (FII).

Ranking causes of delay

The results on causes of delay indicated that there are eight highest ranked factors, with relative factor importance index of 64%. These have both high frequency of occurrence and impact on the schedule, and they are: (1) Unclear project scope and deliverables at initiation; (2) Poor stakeholder identification and involvement; (3) Under-estimation of activity duration; (4) Over-optimistic estimates; (5) Lack of project surveys or feasibility studies; (6) Lack of dedicated project teams; (7) Procurement approval process; and (8) Late delivery of project materials by suppliers.

The ranking of secondary delay factors is as shown in Figure 4. The highest ranked secondary factor is schedule development process, followed by scope management, design and procurement.

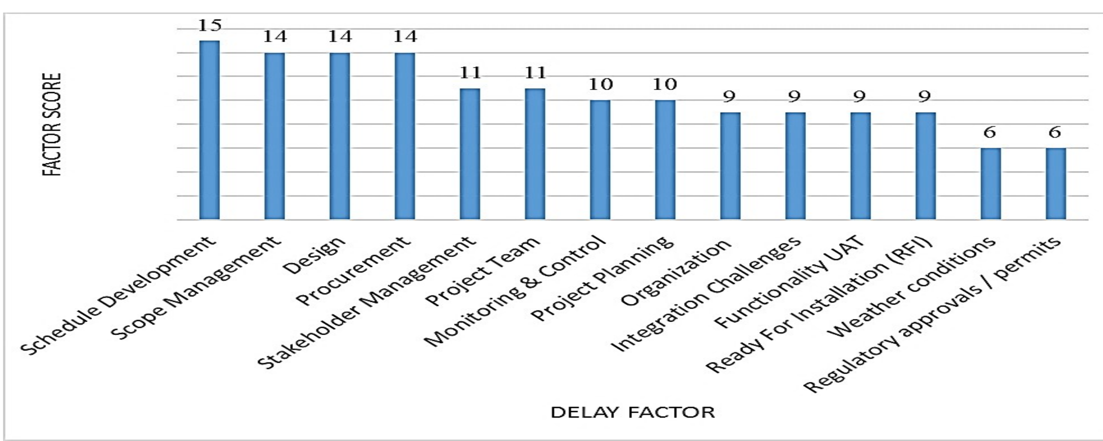

Figure 4. Ranking of delay factors (Secondary)

Primary (root) causes were ranked and the results are as shown in Figure 5 and results showed that “Process” was highest ranked, followed by “Management”, “People”, “Equipment” while “Environment” was ranked lowest.

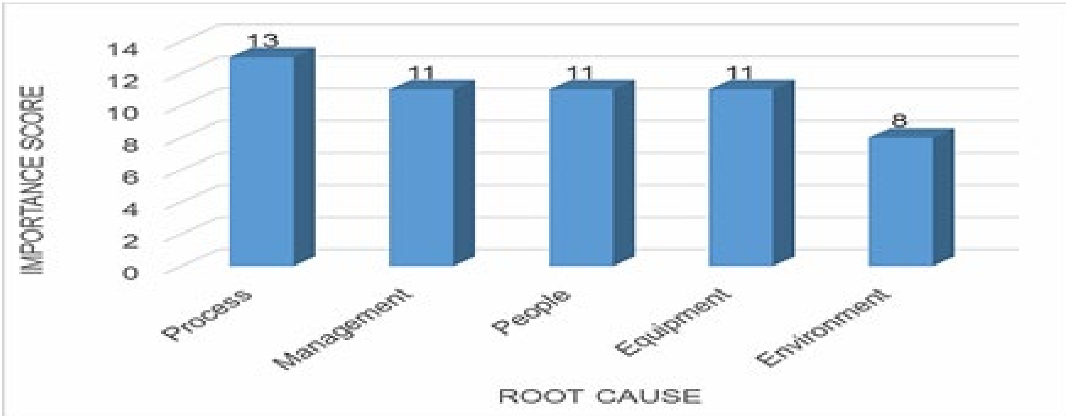

Figure 5. Ranking of delay factors

The tertiary causes were analysed with respect to PMBOK processes in order to identify the cause of failure and possible remedy. Table 4 shows the mapping of the delay factors to the process groups, knowledge areas and the identified process failures. Even though there is strong linkage among the factors, it can be seen from the results that planning accounts for five out of the eight (62.5%) top ranked factors, while initiation, execution and monitoring and control account one each (12.5%).

Table 4. Mapping delay factors to process groups

#	Delay Factor	Identified Failed Process	Knowledge Area	Process Group
1.	Unclear project scope and deliverables at initiation	Plan Scope Management	Project Scope Management	Planning
2.	Poor stakeholder identification and involvement	Identify Stakeholders	Project Stakeholder Management	Initiation
3.	Under-estimation of activity duration at planning stage	Estimate Activity Duration	Project Time Management	Planning
4.	Over optimistic estimates	Estimate Activity Duration	Project Time Management	Planning
5.	Lack of project surveys or feasibility studies	Collect Requirements	Project Scope Management	Planning
6.	Lack of dedicated project team	Acquire Project Team	Project Human Resource Management	Execution
7.	Procurement approval process	Plan Procurement Management	Project Procurement Management	Planning
8.	Late delivery of project materials by suppliers	Control Procurement	Project Procurement Management	Monitoring and Control

5. Discussion

The study aims to contribute to literature on time overrun by analyzing the delay causal factors in telecommunication projects in Zambia. However, due to inadequate availability of documentation, a holistic approach was adopted using a descriptive multi-mode research methodology after identifying the existing gaps on the root cause of project time overrun. From the results, management related delay factors can be directly attributed to the failure by the project manager to effectively superintend over the project. Poor stakeholder identification and involvement and unclear project scope were the highest ranked management related delay causes. The interviewees pointed to a poor stakeholder engagement, especially at an early stage as the cause for poorly developed schedules. According the PMBOK Guide (PMI, 2008), stakeholder identification is the first step of the stakeholder management knowledge area done during project initiation phase. The effect of stakeholder involvement cannot be over-emphasised. Involving the customers and other stakeholders during initiation improves the probability of shared ownership, deliverable acceptance, and, customers and other stakeholder satisfaction (PMI, 2008). There should also be incentives for procurements and works done ahead of schedule, as well as penalties for delays at any project phase.

For process related delays, the results show that a flawed schedule development process and poor information gathering before timelines are decided are the main contributors. Under-estimation of activity duration and over-optimistic estimates both highlight the tendency by project managers and sponsors to overestimate benefits and underestimate negatives. This was pointed out by Flyvbjerg (2011) in his study of root causes of overruns in major projects. Under-estimation of activity duration is a consequence of what he termed "optimism bias", a tendency by managers to make decisions based on "delusional optimism rather than on a rational weighting of gains, losses, and probabilities". Over-optimistic estimates are "principal-agent problems", where top management push for project completion as quickly as possible (Flyvbjerg, 2011). However, the uncontrolled pressure risks the quality of the work, resulting in reworks and failure at closeout (acceptance) stage.

The standout contributor is the lack of dedicated project teams for most of the telecom projects. Aminah and Chai (2013), categorised these as structural causative factors where teams can either be appended, stand-alone or partnership structure. Operations teams are involved in project activities, resulting in, the project manager has no complete control over the team, and relies on the functional managers for availability of the resources; it results in conflicting/competing priorities between operational and project activities. Operations teams tend to rank operational activities higher, as this is their main key performance measure; and the added workload over-stretches the operational teams, resulting in inefficiency of both operational and project activities.

Concerning equipment related factors, late delivery of project materials and a long procurement approval process were cited as the main contributors under equipment related delays. This points to the failure in the "Conduct Procurement" and "Control Procurement" during the project execution and monitoring and control respectively, as guided by PMBOK® Guide (PMI, 2008). Interview results showed that there is usually a disconnect between the project team and the supply chain management (procurement) team, and the two may not attach the same priority to the project. Late delivery of materials was attributed to logistical challenges in shipment of materials, warehousing processes and inefficiencies in the equipment suppliers.

Environment related delay factors

With regards to environmental related delay factors, the results obtained show that environment related factors affect the project schedule the least. This is highlighted in Table 4 where the highest ranked factors are support infrastructure availability and space acquisition and preparation, with score of nine. The low score of environmental factors shows the differences between construction and telecommunication projects, as highlighted by Sherif (2006) and Taylor (2004).

6. Conclusion and Recommendation

Delays are inevitable; however, they can be avoided or minimized when their causes are effectively identified and analysed. This research has identified and, based on the quantified factor importance indices, determined the influence ranks of thirty-four (34) factors causing delays in telecommunication projects in Zambia. The stakeholder perception, through the questionnaire survey, revealed the top eight ranked factors as: (1) Unclear project scope and deliverables at initiation; (2) Poor stakeholder identification and involvement; (3) Under-estimation of activity duration; (4) Over-optimistic estimates; (5) Lack of project surveys or feasibility studies; (6) Lack of dedicated project teams; (7) Procurement approval process; and (8) Late delivery of project materials by suppliers. From the five categories of Management, Process, People, Equipment and Environment, it was concluded that process related factors are responsible for most of the delays experienced in Zambia. From the results, it was identified that either the project managers (PM) do not have the required experience or power to control the activities of the project.

In order to address the project schedule slippages experienced in the telecommunication industry in Zambia, the study recommends that there is need to improve project planning by adopting the bottom-up approach through brainstorming sessions and use of knowledge management practices. Most of the telecommunication projects are similar in nature and learnings from previous projects can be used as valuable input into the planning process. The study also recommends that project activity coordination be improved for competence and experience of project managers, to attain success. The project managers should have enough control to ensure over and under-estimates do not occur during schedule development. Finally, the study implores the adoption of modern approaches such as the Talent Triangle to enhance project time performance.

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Biographies

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Peer Review panels include the Built Environment Conference, International Conference on Infrastructure Development in Africa (ICIDA), South Africa Quantity Surveyor Research Conference, Construction Industry Development Board (CIDB) Post Graduate Research Conference, Association of Schools of Construction in Southern African - Built Environment Conference, West Africa Built Environment Research Conference (WABER) and one of the founders of the International Conference on Infrastructure Development and Investment Strategies for Africa (dubbed DII- Conference - www.diiconference.org).

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