# Influence Factors on Cost and Time Overruns in Mozambicans Construction Projects: Preliminary Findings

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# Abstract

Cost and time overruns are typical problems in many construction projects. In Mozambique, the underlying causes related to this issue are not well understood. This study is a first attempt to determine the influence factors of cost and time overruns in this context. This ongoing research aims to categorize the influence factors that contribute to the occurrence of cost and time overruns, and to establish their criticality in Mozambican construction projects. A survey has been designed to collect preliminary data from construction managers in Mozambique, seeking to find out the critical influence factors related to cost and time overruns. Results will provide perceptions and guidance into the managerial needs of practitioners to overcome typical cost and time overruns in Mozambicans construction projects.

Keywords: Cost overrun, time overrun, delay, construction, Mozambique

## Introduction

Cost and time overruns are common problems occurring in construction projects. Several studies conducted on causes and factors of cost and time overruns in construction projects have been published and cover a large geographical and contextual diversity. There are several studies on this topic, however only a small number of these investigations sought to categorize and classify these factors, in order to provide a more holistic understanding of the subject. Specifically in Mozambique, no studies were available showing the specific causes of cost and time overruns in construction projects.

This ongoing research aims to identify the influence of cost and time influence factors that best fit in the Mozambican context through regional analysis of other published studies. For this purpose, a Systematic Literature Review (SLR) about costs and time overruns in construction projects was performed to find categories and respective influencing factors for this problem. From these factors, pre-questionnaire survey was applied to seek the causes which may serve as the basis for a larger study in Mozambique.

This study represents the first step in determining cost and time overruns and related influence factors. The results will provide the first basis for obtaining the critical factors in construction projects in Mozambique. To deepen the discussion on theoretical models and methods to avoid cost and time overruns is beyond the scope of this paper. For a

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comprehensive overview of constraint project scheduling and related discussion based on time and cost, please refer to Brucker et al. (1999).

## **Research Method**

SLR is rooted on the evidence based paradigm (Kitchenham et al. 2009), so "the best evidences" of any topic are sought by means of literature searching. In this research, the selected databases were Scopus, Science direct and Web of Knowledge. Initially, 92 studies were obtained through SLR. Factors were obtained, which were evaluated and grouped into categories according to their content (Table 1). These factors were the basis for the development of the pre-questionnaire survey.

The first stage of the research was based on the SLR method. The SLR is a secondary study, which means to identify, evaluate and interpret the available primary research in relevant studies for a specific research question (Kitchenham et al. 2009). The objective of an SLR is to extract specific details of published articles relevant to the topic (Brereton et al. 2007). It was intended to collect information and integrate available research evidence with expertise (Kitchenham et al. 2009).

In the second stage, a survey questionnaire was prepared to examine the factors that affect cost and time overruns in Mozambique. This instrument was validated using a preliminary test to know whether it was possible to apply it to a wider sample. The survey questionnaire is usually applied when there is a need to get opinions from a group of people on a particular subject. This method requires a statistical analysis to evaluate the results. The application of a questionnaire is seen as a very useful tool for reducing costs and time on research (Martins; Ribeiro, 2011).

In the studies analyzed, cost and time overruns were defined as follows:

- The difference between the original cost and the cost at completion (Avotos, 1983);
- Time overrun is the time to complete work after the date specified in the contract (Ramanathan; Nakayana; Idrus, 2012).

From 92 studies of SLR, some of them have made proposals for categorization in relation to the main factors triggering cost and time overruns, which are described in the form of its determinants (e.g. González et al, 2013; Long et al., 2004; Assaf; Al-khalil; Al-hazmi, 1995; Le-hoai et al., 2008; Sugiharto; Hampson, 2003). In this research, 11 new categories were proposed for the sake of grouping the factors according to the SLR (Table 1).

Through the literature effort, 697 factors were identified and, because there are factors that may have different terminology in different studies, they were stratified to homogenize the best grouping factors within the 11 categories. Therefore, classifications performed reduced the number of factors of 697 to 95 factors distributed into categories. These factors were the basis for designing the pre-questionnaire.

The pre-questionnaire was designed seeking to obtain evidences in relation to the factors and the level of importance, which managers could choose for each factor in relation to cost and time overruns. The importance of factors varied between not relevant, minor relevance, moderately relevant, relevant and very relevant (Table 2). The pre-questionnaire analysis was separate in factors groups. The relevant averages of one factor were calculated following the attributed values 0-4 for the categories of "not relevant" to "very relevant", and then calculated a weighted average. For instance, if everyone answered "Not relevant", average relevance is 0, and if all answered "very relevant", average relevance is 4. The influence in cost and time were also examined. For each factor, the interviewee would have to choose which factor was more influential in relation to overruns.

The pre-questionnaire data were then descriptively analyzed. Only factors that reached their relevance greater or equal 2.5 were considered and presented in Table 2. This filtering process allowed to reduce and apply only moderate relevant factors to the final questionnaire for the sake of providing a less extensive questionnaire and easiness of comprehension to respondents.

#### **Results and Discussion**

Table 1 presents the 11 categories and their respective determinants that provide the grouping from the SLR synthesis. The determinants represent groups of causes within the same context.

Category	Determinants
Governmental relations	Factors related to licenses, laws, governmental bureaucratic
	procedures.
Contractual issues	Factors related to obligations of contracts, contractual
	constraints, inadequate contracts.
Organization	Factors related to supervision, leadership, relation between
	different parties in project.
Management	Factors relating to the resource management and
	development, communication, coordination of work.
Financing	Factors related to unreasonable constraints to owner,
	funding shortage.
Design and documentation	Factors related to quality of project, delays related to
	problems with project design and documentation work.
Schedule and control	Factors related to planning, scheduling and commitment.
Scope changes	Factors related to change orders and rework, repair and
	modification of the initial scope.
Environment and economy	Factors related to social, environmental and economic
	effects.
Materials	Factors related to shortages of materials, fluctuations in the
	price of materials, lack of assessment in relation to location
	and local suppliers.
Labor and equipment	Factors related to performance skills of the workforce, job
	instructions, constructions, methods, tools and equipment.

Table 1. Grouping category of cost and time overruns factors in construction.

After the pre-questionnaire design, a pretest and a pilot survey were designed mainly to check the accuracy of the instrument for data collection. The questionnaire was sent by email for 10 project managers of major construction firms in Mozambique. Hundred percent of the questionnaires returned. The interviewees understood all the formulated questions and suggested that the number of factors should be reduced to make the process easier.

Using statistical analysis, the values of importance also were considered in a severity index and calculated from the percentage sum of evaluation indices important and very important. Then the relevance average equal or greater than 2.5 was applied, resulting in 53 relevant factors to be included in the final questionnaire.

 Table 2. Categories (11) and related cost and time overruns factors (53) in construction projects and citations

*I-Influence; T-Time; C- Cost; T/C - Time and cost; Nr- Not relevant, Mir-Minor relevance, Mor-Moderately relevant R-Relevant; Vr- Very relevant; Ra-Relevance average.* 

Categories	Factors	Nr	Mir	Mor	R	Vr	Ra	Ι
	<b>NI 111 1 11</b>	<u>(%)</u>	<u>(%)</u>	<u>(%)</u>	<u>(%)</u>	<u>(%)</u>	2.6	<b>T</b> /O
	Delay in delivering material to	0	0	10	20	/0	3.6	T/C
	construction sites	0	0	10	<b>C</b> 0	20	2.2	
	Monopoly of materials by some	0	0	10	60	30	3.2	T/C
	suppliers and escalation of							
	materials prices	0	10	20	20	20	2.0	
Materials	Types of construction materials	0	10	30	30	30	2.8	T/C
	availability at the local market,							
	Problem with imported materials	10	0	20	10	60	0.1	
	Using inadequate specification by	10	0	20	10	60	3.1	1/C
	international consultant	0	0	60	20	20	2.6	T /C
	Lack of consultant's knowledge	0	0	60	20	20	2.6	I/C
	of available materials	0	0	40	20	40	2.0	T/C
Environment	I ransportation delays	0	0	40	20	40	3.0	I/C
and economy	Low moductivity Doon work	0	10	40	20	20	26	T/C
	Low productivity, Poor work	0	10	40	50	20	2.0	I/C
	Mistolica economica during the	0	0	50	20	20	27	T/C
	Mistakes occurrence during the	0	0	30	50	20	2.1	I/C
Labor and	Equipment unovailability and	0	10	20	40	20	27	T/C
equipment	foilure	0	10	30	40	20	2.1	I/C
	Door toobaical parformance	0	0	60	10	20	27	T/C
	Construction cost underestimation	0	10	20	10 50	50 10	2.1	1/C
	Look of onginooring experience	0	10	30 20	50	10	2.0 2.7	1/C
	Mathada of navmanta for	0	10	20	00	10	2.1	T/C
	completed work	0	0	10	0	90	5.0	I/C
	A appleted work	0	0	20	40	40	30	T/C
	Monthly payment difficulties	10	10	20	40 20	40 30	$\frac{5.2}{2.5}$	1/С Т/С
	from agencies	10	10	50	20	50	2.5	1/C
Financing	Delayed payments on contracts	0	0	0	0	100	1	T/C
	Financial problem funds and	0	10	10	20	70	36	T/C
	associated auxiliaries not ready	0	10	10	20	70	5.0	1/C
	Cash flow problem/cash problem	0	0	10	20	70	36	T/C
	during construction	U	U	10	20	70	5.0	1/0
	Change design	0	0	11.1	44.4	44.4	33	T/C
	Errors and omission in design	0	11.1	11.1	11.1	66.7	3.3	T/C
Design and	incomplete drawings.	~					2.0	2, 0
documentation	inappropriate design							
	Delay in preparation and approval	11.1	0	33 3	333	22.2	2.6	T/C
	2 cm, in proparation and approval		0	20.0	22.2			-, <b>C</b>

	of drawings							
	Conflicts in design between	0	22.2	22.2	33.3	22.2	2.6	Т
	nominated subcontractor,							
	structure, civil and architectural							
	drawings							
	Improvements to standard	0	0	33.3	11.1	55.6	3.2	Т
	drawings during construction							
	stage							
	Poor site management	0	10	20	30	40	3.0	T/C
	Unreasonable estimation and	0	0	30	20	50	3.2	T/C
	adjustment of the project cost							
	No practical use of the earned	10	0	20	20	50	3.0	T/C
	value management system							
	Lack of cost planning/monitoring	0	10	10	20	60	3.3	T/C
	during pre and post contract stage							
Management	Shortage of subcontractors and	0	10	20	30	40	3.0	Т
	specialist firms							
	Poor communication and	10	10	30	20	30	2.5	T/C
	coordination between parties							
	Slowness related to the decision-	0	0	20	40	40	3.2	Т
	making process							
	Lack of control of time and cost	0	10	10	10	70	3.4	T/C
	inputs							
	Conflict among project's	0	20	20	40	20	2.6	Т
	participants, major disputes and							
	negotiations							
	Consequences of decision making	0	0	30	60	10	2.8	T/C
Organization	Lack of knowledge, experience	0	0	20	30	50	3.3	T/C
Orgunization	and bad leadership							
	Problem with subcontractor and	0	0	40	0	60	3.2	Т
	relation between different							
	subcontractors schedules in the							
	execution of the project							
	Change schedule	0	10	0	40	50	3.3	T/C
	Lack of commitment	0	10	40	10	40	2.8	T/C
	No supervision method and	0	20	20	10	50	2.9	Т
	Incapable inspectors							
	Stoppages because of work being	0	10	10	60	20	2.9	T/C
Schedule and	rejected by consultant							
control	The distance between each	0	20	20	30	30	2.7	Т
	project site posed challenges in							
	logistic planning to distribute							
	resources							_
	Ineffective planning and	0	22.2	0	11.1	66.7	3.2	Т
~	scheduling		• •	•	1.0	10		m (a
Governmental	Bureaucracy in bidding	0	20	30	10	40	2.7	T/C
relations		0		10	<u> </u>	20	0.0	m/C
Contractual	Aggressive competition at tender	0	0	10	60	30	3.2	T/C
issues	stage							

	Conflicts between contract documents	0	10	30	60	0	2.5	Т
	Unrealistic contract durations	20	10	10	10	50	2.6	Т
	Contractor selection methods	0	30	20	20	30	2.5	T/C
	Lowest bid price	0	20	10	0	70	3.2	T/C
	Insufficient time for preparation	12.5	0	0	12.5	75	3.4	T/C
	of contract documents							
	Underestimation of time for	0	10	0	30	60	3.4	T/C
	completion of projects							
	Scope and specifications changes,	0	0	0	30	70	3.7	T/C
	changes interests, lack of clarity							
	in project scope							
	Frequency variations, change	0	0	0	60	40	3.4	T/C
Scope changes	orders							
	Rework, repairs and repetition of	0	0	10	20	70	3.6	T/C
	work							
	Additional works, extra work,	0	0	10	20	70	3.6	T/C
	increase in scope of the work							

In Table 3, factors and their respective references of 92 studies analyzed in SLR are presented.

Categories and factors	Autors
Materials	
Delay in delivering material to construction sites	Al-Momani (2000); Aziz (2013b);
Monopoly of materials by some suppliers and escalation of	Shane et al. (2009); Rahma et al.
materials prices	(2013b);
Types of construction materials availability at the local	Kaming, Peter et al. (1997b); Ogunlana
market, problem with imported materials, Shortage and lack	et al. (1996); Koushki; Kartam (2004);
in quality of material, inadequate material	Nutakor (2007); Ramanathan et al.
	(2011).
Lack of consultant's knowledge of available materials	Hwang et al. (2013);
Using inadequate specification by international consultant	Enshassi et al. (2010a).
Environment and economy	
Transportation delays	Manavazhi; Adhikari (2002);
Labor and equipment	
Low productivity, Poor work execution, Shortage of	Semple et al. (1994); Josephson;
laborers	Hammarlund (1999); Muya et al. (2013);
Mistake occurrence during the construction stage	Alaghbari et al. (2007).
Equipment unavailability and failure	Kaming, Peter et al. (1997a);
Construction cost underestimation	M Dlakwa; F Culpin (1990);
Poor technical performance, lack of skills	Frimpong et al. (2003
Lack of engineering experience	Akintoye; MacLeod, (1997);
Financing	
Methods of payments for completed work.	Okpala; Aniekwu (1988);
Acceleration costs.	Nega (2008).
Delayed payments on contracts.	Abd El-Razek et al. (2008);
Monthly payment difficulties from agencies	Arditi et al. (1985); Mansfield et al.
	(1994); Marzouk; El-Rasas (2014)

Table 3. Factors and cited references

Financial problem, funds and associated auxiliaries not ready.	Assaf; Al-Hejji (2006); Sweis et al. (2008); Zou et al. (2007);
Cash flow problem/cash problem during constructions.	Rahman et al. (2013a); Rahman et al. (2013b); Shehu et al. (2014).
Design and documentation	
Change design, changes in drawings, design modifications.	Love et al. (2010); Olawale; Sun (2010);
Delay preparation and approval drawings.	Assaf et al. (1995); Potty et al. (2011);
Conflicts in design between nominated subcontractor,	Lo et al. (2006); Aziz (2013a).
structure, civil and architectural drawings.	
Errors and omission in design, incomplete drawings,	Iyer; Jha (2005); Le-Hoai et al. (2008);
inappropriate design.	Long et al. (2004)
Improvements to standard drawings during construction	Adnan et al. (2009);
stage.	
Management	
Poor site management.	Chan; Kumaraswamy (1997); Chan;
Upressenable actimation and adjustment of the project cost	Kumaraswamy (1996); L $_{20}$ (2008)
Officasoffable estimation and adjustment of the project cost.	Lee (2008).
No practical use of the earned value management system.	Lee (2008).
Lack of cost planning/monitoring during pre and post	Adnan et al. (2009);
contract stage.	
Shortage of subcontractors and specialist firms.	Olawale; Sun (2010); Ogunlana;
	Olomolaiye (1989).
Poor communication and coordination between parties.	Iyer; Jha (2006); Mahamid (2013);
Slowness related to the decision-making process.	Sugiharto; Hampson (2003).
Lack of control time and cost inputs.	Nega (2008).
Organization	
Conflict among project participants, major disputes and	Iyer; Jha (2005); Al-Najjar (2008).
negotiations.	Wana (2011)
Look of knowledge, experience and had loodership	wang; Yuan (2011). Lyam the $(2006)$ :
Problem with subcontractor and relation between different	Sambasiyan: Soon (2007): Assaf at al
subcontractors schedules in the execution of the project	Samoasivan, Soon ( $2007$ ), Assar et al. (1995): Hamzah et al. ( $2011$ ):
subcontractors senedules in the execution of the project.	Pourrostam: Ismail (2012
Scheduling and controling	1 our ostani, 10mur (2012
Change schedule.	Nega (2008).
Lack of commitment.	Doloi et al. (2012).
No supervision method and Incapable inspectors.	Soekiman et al. (2011);
Stoppages because of work being rejected by consultant	Al-Najjar (2008).
The distance between each project site posed challenges in	Lo et al. (2006); Mañelele; Muya (2008);
logistic planning to distribute resources	Kamanga; Steyn (2013);
Ineffective planning and scheduling.	Odeh; Battaineh (2002); Elinwa; Buba
	(1993);
Governmental relations	
Bureaucracy in bidding.	Aziz (2013a).
Contract	L II (2005)
Aggressive competition at tender stage.	Iyer; Jha (2005). Enchancient of $(2010h)$
Contractor selection methods	Ensnassi et al. (2010b).
Contractor selection methods	ranannejau (2013).

Insufficient time for preparation of contract documents	Oladapo (2007).
Underestimation of time for completion of projects	Fugar; Agyakwah-Baah, (2010).
Unrealistic contract durations.	Motaleb; Kishk (2010).
Lowest bid price.	Mahamid et al. (2012).
Changes and scope	
Scope and specifications changes, changes interests, lack of	Kaliba et al. (2009); Dominic; Smith
clarity in project scope.	(2014); Oladapo (2007),
Frequency variations, change orders.	Koushki et al. (2005); Rosenfeld (2014).
Rework, repairs and repetition of work.	Orangi et al. (2011);
Additional works, extra work, increase in scope of the	Makovšek et al. (2012).
work	

## Conclusion

According to the evidences, avoiding cost and time overruns still poses a huge challenge in construction projects worldwide. This research contributes to better organize evidences of primary research by means of a SLR effort, identifying and categorizing factors that trigger cost and time overruns. Furthermore, this framework further help to identify the most relevant factors accountable in different situations.

This initial data collection effort was mainly intended for validating the data collection instrument. For the sequence of this research, a larger sample will be devised for finding's generalization purposes.

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