

**RISK MANAGEMENT STRATEGIES EMPLOYED TO
MINIMISE TIME AND COST OVERRUNS: A CASE FOR
BOTSWANA'S PUBLIC SECTOR BUILDING
CONSTRUCTION INDUSTRY.**

By

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DECLARATION

I declare that this research is my own, unaided work, except where otherwise stated.

This treatise is being submitted in partial fulfillment of the requirements for the degree of MSc (Project Management) at the University of Pretoria. It has not been submitted before for any degree or examination at any other University.

Signed:.....

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ABSTRACT

Title of treatise: Risk Management Strategies employed to minimise Time and Cost Overruns: A Case for Botswana's Public Sector Building Construction Industry.

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The objective of this study is to investigate Risk Management Strategies that could be used to minimize time and cost overruns currently experienced in Botswana's Public Sector Building Construction Industry. This is achieved by identifying risk factors that cause time and cost overruns.

The main problem is divided into three sub-problems which form the basis of the questionnaire. The three sub-problems are to:

- Identify the major risks associated with time and cost overruns in the Botswana's Public Sector Building Construction Industry.
- Evaluate how these risks impact on Botswana's Public Sector Building Construction Industry performance with regard to time and cost overruns.
- Assess the applicability of risk management as a management strategy that can be adopted in the management of time and cost overruns experienced in Botswana's Public Sector Building Construction Industry.

Three hypotheses were also set to be tested by the survey data and the hypotheses were as follows:

- The first hypothesis is that there are internal and external risks to Botswana's Public Sector Building Construction Industry which causes time and cost overruns in Botswana's Public Sector Building Construction Industry.
- The second hypothesis is that these risks impact negatively on Botswana's Public Sector Building Construction Industry.
- The third hypothesis is that risk management can be applied in the management of time and cost overruns experienced in Botswana's Public Sector Building Construction Industry.

Chapter one of the study introduces the problem and its sub-problems, the delimitations of the study and the hypotheses to be tested. Chapter two reviews the related literature.

The third chapter describes the research methods used to investigate the problem and its sub-problems. Chapter four is the data analysis and evaluation of the outcome of the questionnaire and the hypotheses are tested in this section.

Chapter five is a case study based on a public sector project chosen at random to assist in understanding the problem and its sub-problems further. This chapter compliments chapters two and four by discussing a past project in the form of case study. Results from the case study are noted and compared with what has been established from the questionnaire.

Chapter six concludes this treatise with the summary, conclusions and recommendations of the study namely that:

- There is need to always determine risk associated with cost and time overruns in the construction industry.
- Participants in BPSBCI should develop skills and aptitudes in risk management.
- Risk management planning should be part of the construction process in BPSBCI.
- There should be change in approach in the use of insurance as a risk management strategy, insurance should be combined with other risk management methods to be effective.
- Risk should be identified, assessed and analysed and responded to.
- Procedures which mitigate risks such as interviews, risk management workshops, decision trees etc should be introduced in Botswana's construction industry.

There are various risks which impact negatively on Botswana's Public Sector Building Construction Industry. These risks are external and internal to the project. There is a need for risk management to be used to mitigate these risks. If risk management strategies were used in Botswana's Public Sector Building Construction Industry, time and cost overruns would be reduced.

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LIST OF ABBREVIATIONS

BPC	Botswana Power Corporation
BPSBCI	Botswana Public Sector Building Construction Industry
BWP	Botswana Pula
BoQ	Bills of Quantities
CSE	Civil and Structural Engineer
CQS	Consulting Quantity Surveyor
CTB	Central Tender Board
DABS	Department of Architecture and Building Services
DEMS	Department of Electrical and Mechanical Services
DWA	Department of Water Affairs
EE	Electrical Engineer
EIA	Environmental Impact Analysis
LCW	Lobatse Clay Works
ME	Mechanical Engineer
MP	Member of Parliament
MFDP	Ministry of Finance and Development Planning
MLGL & H	Ministry of Local Government Lands and Housing
NDP	National Development Plan
NSC	Nominated Sub-Contractor
QS	Quantity Surveyor
RM	Risk Management
RMS	Risk Management Strategy
RMW	Risk Management Workshop
TCO	Time and Cost Overruns
SIM	School of Industry Molepolole
SMM	Standard Method of Measurement
SMM5	Standard Method of Measurement edition 5
SMM6	Standard Method of Measurement edition 6

DEFINITION OF TERMS

1. *Risk*

The possibility of suffering loss or harm and the impact that loss has on the involved party.

2. *Opportunity*

The possibility of realising a favourable outcome and the impact that this outcome has on the party involved.

3. *Uncertainty*

The gap between the information required to estimate an outcome and the information already possessed by the decision maker.

4. *Risk Analysis*

Risk analysis is the process of identifying risk factors and the quantification of those factors.

5. *Risk Mitigation*

Risk mitigation is the process of developing a plan to respond or deal with risk on a project.

6. *Building Construction*

Building construction means the constructing of permanently fixed structure forming an enclosure and providing protection from the elements etc. (e.g. a house, school, office block or factory).

7. *Civil Construction*

Civil construction means, the constructing of roads, bridges, dams etc.

8. *Private Sector*

Private sector is part of the economy free of direct State control.

9. *Public Sector*

Public Sector is that part of an economy, industry etc, that is controlled by the State.

10. *Risk Management*

The means of analysing, evaluating and controlling uncertainties.

CHAPTER ONE: THE PROBLEM AND ITS SETTING

1.1 Introduction

Botswana, as a developing nation needs infrastructure development. Prior to 1966 Botswana was rated as one of the poorest nations in the world. However, in the past three decades there has been tremendous infrastructure development mainly due to the discovery of diamond reserves, which assisted in financing these infrastructure requirements and subsequent development.

The Government has been a leader in these infrastructure developments through its development funds. Government offices, schools, hospitals, recreational facilities and housing have been built in a short period of time all over the country since then.

The bulk of Botswana's budget, as a result, has been spent and continues to be spent on Botswana's Public Sector Building Construction Industry (BPSBCI), than in any other sector of the economy.

During Botswana Parliament's mid-term review debates on the National Development Plan 8, in the first quarter of 2000, it was reported that of the Botswana Pula (BWP) 12 billion allocated for developments in this five-year plan, BWP 11 billion was spent in the first half of the plan, and a large number of developments were outstanding. Accusations were made on the over expenditure without a comprehensive analysis of the situation.

Scott et al 1997 states that, " risks are ever present. Depending on their uncertainties and the consequences, they are accepted routinely, and measures are taken to minimize their consequences." In BPSBCI's case, the consequences have been spiralling Time and Cost Overruns (TCO), which require strategies to minimize them. The Parliamentarians and other commentators failed to realise this phenomena as stated by Scott et al. A strategy of risk management should have been established prior to the growth of the economy and the construction industry to limit the TCO.

There is no attempt in Botswana to develop or adopt risk management strategies, which will reduce the TCO associated with BPSBCI. This is due to concerns raised in the Parliament of Botswana's National Development Plan mid-term review of 2000. Members of Parliament (MPs) were concerned that development projects were never completed on budget and to schedule and contractors at times abandoned projects mid way through the contract period. Amongst projects, which were not delivered on time and within budget, were the National TV station and a number of senior secondary schools. The MPs were concerned that the root causes of the non-delivery of the projects were not found and stakeholders, especially the professionals in the construction industry, were continuing as if the problem of TCO in the construction industry does not warrant their attention.

1.2 The Setting

Botswana Government has, since independence from Britain in 1966, embarked on major infrastructure development, especially with regards to building houses for new ministries, constructing hospitals and clinics, schools, houses for governmental personnel and many other government or public sector buildings. The sums of money for public sector building construction and the building stock required increased tremendously during the 1980s. This was as a result of the country's population expansion and newfound wealth from the discovery of diamonds.

As there were other competing requirements and interests, MPs in their National Development Plan 8 (NDP 8) realised wastage and inefficiency of the public sector building construction and it was unacceptable for industry professionals to continue with the status quo. This resulted in calls for something to be done to contain wastages and inefficiencies. Primarily the wastage and inefficiency of BPSBCI were in the form of rampant TCOs.

The public sector building construction industry stakeholders and specifically MPs became more sophisticated, in the sense that they wanted value for money for any governmental project undertaken; there were calls to halt these

rampant TCOs. It is not uncommon for BPSBCI projects to have contract periods and contract sums, which are double of what was initially agreed. These events challenge those tasked with implementing public sector building construction projects to find ways and means of combating these TCOs.

The construction industry has inherently high levels of uncertainty. There is therefore, a need for risk management strategies to be implemented to minimise time and cost overruns. Construction is all about risk, and these risks could either be external or internal. There is, therefore, a need to identify and assess these risks to have a better understanding of their nature and impact. In a fragile and small economy such as Botswana's, it is of utmost importance to implement and adopt risk management strategies.

There should be a paradigm shift by those tasked with implementing public sector building construction projects from ad-hoc risk management to systematic implementation of risk management processes to control time and cost overruns.

It is from this background that the study of risk management (RM) in BPSBCI was adopted.

1.3 The Problem Statement

The researcher proposes to identify and evaluate RM as a management strategy that can control TCOs that are being experienced in BPSBCI and adopt Risk Management Strategies (RMS) that can reduce TCO.

1.4 The Sub-problems

The investigation of the problem is based on three sub-problems as follows: -

- *The first sub-problem is to find out what are the major risks associated with TCO in the BPSBCI?*

The aim of the first sub-problem is to identify the major risks associated with TCO in the BPSBCI and the following will be undertaken:

Data Source and Sampling Technique:

Industry professionals (i.e. Architects, Engineers, Project Managers, and Quantity Surveyors) and others (Civil Servants, Politicians, end-users, insurance professionals, and academicians) will be solicited for participation. A total of 200 participants will be sought. Of this 200, 75% will be industry professionals and 25% will be the group termed others.

The majority of the survey candidates are industry professionals as they have an in-depth knowledge of the industry therefore their comments would make it easier to reach accurate conclusions. These individuals will be chosen at random to avoid bias. Additionally, a project undertaken recently will be chosen at random to be investigated as a case study.

Data Collection:

Data collection will be by way of a questionnaire sent to participants by post or delivered by hand with stamped envelopes to return the questionnaire to the research. A case study will also be used as a data collection method.

Data Treatment:

The participants will be requested not to identify themselves by name but by profession only. In terms of the case study, reference will only be made to the project at hand rather than include from other projects.

Data Analysis:

Statistical analysis will be used to analyse the data.

- *The second sub-problem is to investigate what are the risks, which impact on BPSBCI performance with regard to TCO?*

The aim of the second sub problem is to evaluate how these risks impact on BPSBCI performance with regard to TCO.

Data Source and Sampling Techniques, Data Collection, Data Treatment and Data Analysis will be undertaken as per the first sub-problem.

- *The third sub-problem to investigate whether RM is applicable as a management strategy that can be adopted in the management of TCO experienced in BPSBCI?*

The aim of the third sub problem is to assess the applicability of RM as a management strategy that can be adopted in the management of TCO experienced in BPSBCI.

Data Source and Sampling Techniques, Data Collection, Data Treatment and Data Analysis will be undertaken as per the first sub-problem.

1.5 The Hypotheses

Three hypotheses are to be tested to resolve the sub-problems stated above.

The hypotheses are as follows:

- The first hypothesis is that there are internal and external risks to BPSBCI which causes TCO in BPSBCI.
- The second hypothesis is that these risks impact negatively on BPSBCI.

- The third hypothesis is that RM can be applied in the management of TCO experienced in BPSBCI.

1.6 Delimitations of the Study

Four delimitations for the study have been identified and are stated below:

- The study will not compare RM with other management strategies which might also reduce TCO experienced in BPSBCI.
- The study will be limited to the public sector building construction industry in Botswana.
- The study will not attempt to compare usage of RM in the public sector and the private sector building construction industries in Botswana.
- The usage of RM in Botswana's civil construction industry to control TCO will not be evaluated.

1.7 Assumptions of the Study

Three key assumptions were made that were important to the survey and they are stated below:

- The first assumption is that outdated RMS are being used in BPSBCI to control TCO.
- The second assumption is that there is no concerted effort by industry professionals to identify, measure, assess and evaluate risks in the BPSBCI to control and monitor the TCO which characterize BPSBCI.
- The third assumption is that RM can improve the performance of BPSBCI regarding TCO.

1.8 The Importance of the Study

The importance of the study is that it endeavours to underpin the strategies which could be used to reduce the TCO which are experienced in the BPSBCI. The public sector construction industry forms a large share of Botswana's national budget and creates employment for many of Botswana's citizens.

From the above, the BPSBCI has to operate efficiently and cost effectively. This can only be achieved by implementing risk management strategies which will reduce the TCO which are currently the norm in BPSBCI.

There has been little or no attempt at all to develop or adopt risk management strategies (RMS) which will reduce the TCO associated with BPSBCI. Skills development on risk management is required for construction industry professionals engaged in public sector building construction.

Notwithstanding the research limitations stated above, the researcher believes RMS are required in other sectors of the economy to improve cost efficiency and projects delivery. A system should be set in motion to facilitate this.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter endeavours to explain risks associated with construction TCO and will also discuss the RMS used by others to eliminated or minimise time and cost overruns. This would be done by way of reviewing related literature.

The construction industry worldwide is synonymous with risks and as a result experience poor results in this sector. There have been efforts through out the world by construction industry professionals and researchers to find risk management techniques (RMT) which will help improve the performance of the construction industry.

Ahmed et al (2003) describes the construction industry as a highly risk-prone industry with a poor track record for coping with risks. The participants in the industry, as a result, have been enduring the agonizing outcomes of failure in the form of unusual delays in project completion, costs surpassing budgeted cost and failure to meet quality standards and operational requirements. Tah & Carr (1999) have noted that construction projects are becoming increasingly complex and dynamic in their nature, and the introduction of new procurement methods means that many organisations are having to rethink their approach to the ways in which risks are treated within the projects as well as within the organisation.

The above findings by the researchers are true for the case of BPSBCI as has been stated by Botswana's Members of Parliament (MP) during the budget mid-term review of 2000, construction industry professionals and other stakeholders. However, there have been no attempts by professionals in the BPSBCI to find remedies for failures in the form of unusual delays in project completion and the costs surpassing budgeted costs as noted by Ahmed et al.

The construction industry has been said to be an engine for growth for many an economy including Botswana's which rightly suggests that the TCO

common in the BPSBCI should be contained. It is therefore imperative that BPSBCI establishes a RMS to minimise TCO. It is a recognised fact that every human endeavour involves risks, as such; the construction industry professionals and other stakeholders in the construction industry should have procedures and strategies which will manage these risks.

In the past, participants in the construction industry have only been transferring the risks prevalent in the industries to other parties. There has not been any effort made to minimise the impact of risks to all e.g. to the project team. Insurance was the only technique used in the construction industry to mitigate against the certain risks. The risks in the construction industry are subsequently made the responsibility of the contractor without spreading the risks fairly among the other contracting parties as the Clients and the project team.

Project risk should, normally, be organised at the highest level of management and with a global vision (Sdtoolkit 2002). This, in other words, means that if ministers and top government officials consider any given project, they should first of all identify the risks, which might be associated with the project. They should be well aware that the risk-scales have opportunities and threats and the nature of risks includes both external and internal risks (the categorisations of these risks will be discussed in detail in the next paragraphs).

Government departments normally do not include appropriate assessment of project risks when they prepare ministerial budgets. Henceforth, decisions to continue with any project are based on incomplete information. RM in the construction industry is a new phenomenon; review of industry journals and articles from the Internet give prominence to a cutting-edge research and information on this subject. The industry journals used are for example construction management and economics journals. However, books on RM will be used as the basis for discussion of the subject because books are always a primary source of information on any subject.

Construction projects are characterised by the multiplicity of people and organisations involved in the execution of the project. This multiplicity of people and organisations is a particularly pervasive source of uncertainty in projects (Chapman & Ward 1997). It is therefore imperative that professionals in the construction industry should be aware of their roles and be skilled in RM so that one timeously identifies the risks and can take appropriate action.

2.2 Definition of Project Risk

Chapman and Ward (1997), describe project risk as, “the implications of the existence of significant uncertainty about the level of project performance achievable”. They go on to describe a source of risk as, “any factor that can affect project performance, and risk arises when this effect is both uncertain and significant in its impact on project performance”. Kerzner (2001), on the other hand describes risk as, “a measure of the probability and consequence of not achieving a defined project goal”.

The uncertainties referred to above are inherent in the construction industry especially in the developing world. These uncertainties cause massive TCO. A project can be time or cost risky if these project parameters i.e. time and cost are set unrealistically at the inception of the project. The unavailability or scarcity of project funds in BPSBCI and the need for projects to be completed in record time because of the expansion of Botswana’s economy makes cost and time parameters or targets to be always stringent. It is always uncertain to achieve targets if they are set unrealistically. It will be incomplete to define risk without defining uncertainty.

Abourizk (2003) describes uncertainty as the gap between information required to estimate an outcome and the information already known by the decision maker. Risks go hand in hand with opportunities, as opportunities are sometimes referred to as positive risks. Opportunity is referred to as the possibility of realising a favourable outcome and the impact this outcome has on the involved party as defined by Abourizk (2003).

Risk can be measured by its severity in the form of a function of occurrence and impact. The severity of risk is captured aptly by Abourizk (2003) in the form of the following equation:

Severity = Likelihood of Occurrence x Magnitude of the Impact (Abourizk 2003)

2.3 Classification of Risks

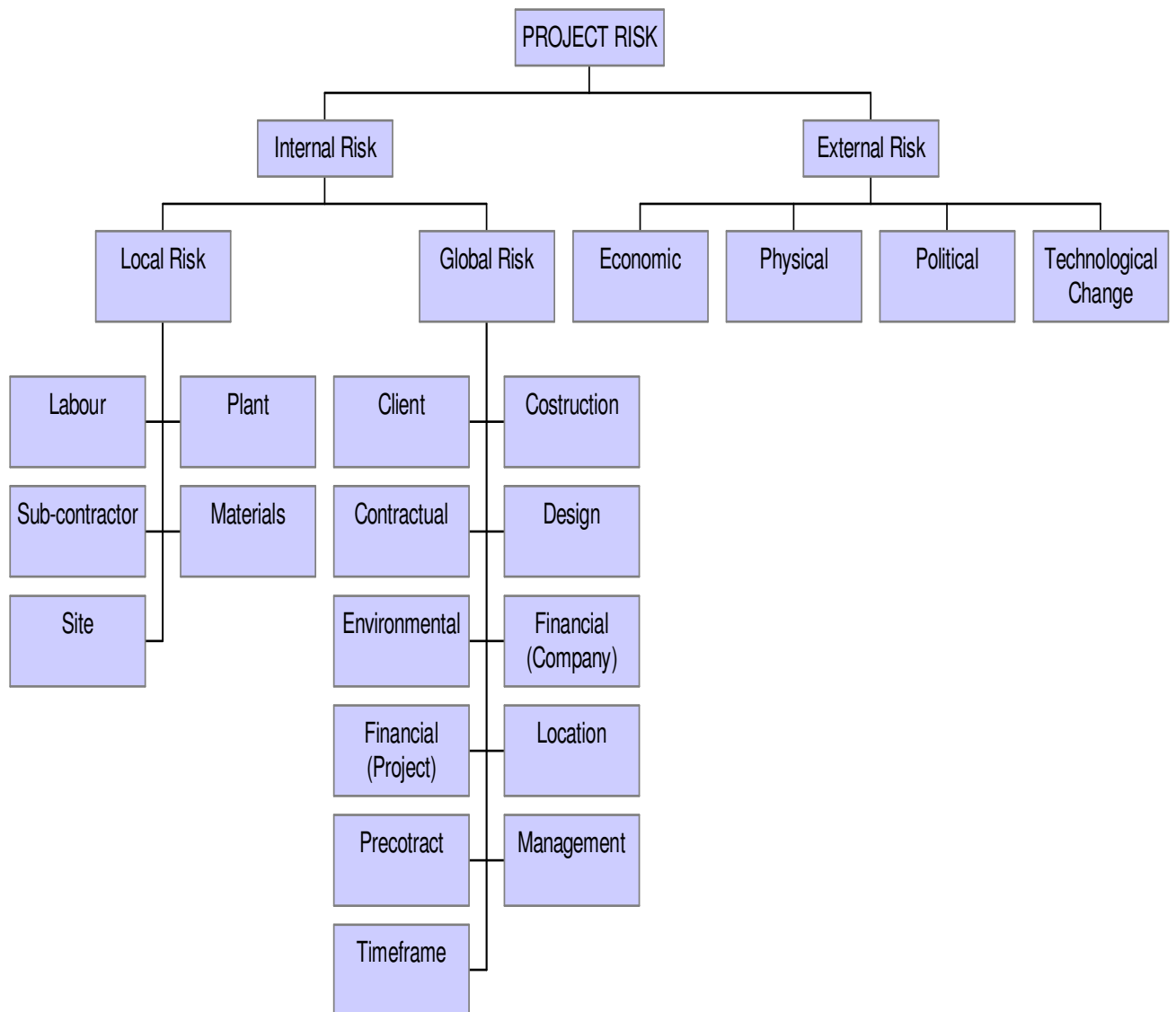
Risks in a construction project can be categorised into two broad categories namely, internal and external risks.

The external risk could be described as those risks that a company as an entity cannot control. These risks are linked to the environment of the project. The sources of external risks could be varied as illustrated in the figure 2.3.1. Internal risks are those risks, related to the management of internal resources. They are mainly associated with the technical solutions of the project (Successful Delivery Toolkit 2004).

The internal and external risks emanating from the construction projects include:

- Inefficient and scarce labour,
- The instability of the economy,
- Difficult soil conditions,
- Inaccurate project financial records,
- Excessive variation orders

Figure 2.3.1: Hierarchical risk breakdown structure



Source: Tah and Carr (1999).

Labour:

- Could be scarce or unavailable and result in unsatisfactory performance resulting time overruns.
- In cases where HIV/AIDS is prevalent, there is likelihood of absenteeism due to ill health and the project will suffer as are result. Botswana's rate of HIV/AIDS infection and deaths is one of the highest

in the World. The contractors are forced to allow time to infected employees for their routine medication.

- Unskilled labour in a country would also make the cost of undertaking a project prohibitive or costly as there would be a need to source labour from neighbouring countries which would be expensive and time consuming, work permits would be required for foreign employees.

Materials:

- Could be difficult to source locally or be unavailable at a given time which will be a risk to the completion of the project on time or within cost because of the resultant resource availability fluctuations. There have been cases of unavailability of basic materials in Botswana as materials are sometimes sourced from politically unpredictable countries like Zimbabwe.
- Materials sometimes used in a project could be expensive and would require specification downgrading and the process is, at times time consuming with resultant schedule overruns. Expensive materials also result in cost overruns.

Site and Location:

- The site could be inaccessible and difficult to work in and make speedy progress unachievable. Botswana soils are mostly collapsible and foundations therefore require expensive designs.
- The bureaucratic red tape in Botswana makes it difficult to have land available the moment a project is conceived. There are always some delays by the Land Boards and the Ministry of Lands which are responsible for the allocation of land in Botswana.

- Countries as large as Botswana sometimes require substantial mobilisation costs from contractors to relocate for a project on the other side of the country.

Plant:

- Spares for construction equipment are often unavailable and expensive and become a source of schedule and cost overruns in a project.
- Plant itself could be unavailable or the plant wrongly chosen for a work activity and therefore resulting in project delays.

Sub-contractors:

- Sub-contractors could be inefficient and unable to meet their contractual obligations and the project would be affected with regard to TCO.
- Some sub-contractors need close supervision to be productive, and their supervision will need extra man-hours on the part of the contractor and the consulting team as a result other activities of the project would suffer delays.

Economic:

- Inflation will make construction prices prohibitive.
- There could be other areas of the economy, which require more urgent attention than the construction activities such as health. At any given time government might be reluctant to spend money on construction.

Political:

- There could be political instability in the country making it difficult to carry out construction activities and construction projects. This instability manifests itself by projects having to be postponed to another period and prices might have increased by then.
- Political situations sometimes result in changes in legislation concerning the construction industry which might have a negative impact on construction.
- Corruption, by those in authority, might have hidden cost implications for a project.

Technological change:

- Changes in technology would need training of the personnel and this would be a cost to the project.
- A technological change could result in finding wrong solutions to a project, as the new technology may not be suitable for the application or conditions intended.

Contractual:

- There could be project communication breakdown and parties would be uncertain as to what is required from them.
- Protracted claims and disputes would make it difficult for project close out and have an impact on the overall cost of the project.

Design:

- There could be design failures and expensive designs which could cause the implementation of a project to result in cost overruns.
- Constant changes in the designs also would make achievement of cost effective project solutions difficult.

Financial:

- Poorly monitored contractor financial controls can result in costly practices and overcharges.
- Inappropriate budgeting principles by the Client might result in a lack of funding for the project when the true amount for the execution of the project is known.
- There are cases in Botswana where contractors use mobilisation loans provided by the government for the projects, for other purposes unrelated to the project.

Management:

- Poor management practices might result in insufficient staffing and processes to deliver projects on time and within budget

Environmental:

- The environment is sometimes a major issue in the construction industry. Other stakeholders might not want a project in a certain location as it might pollute the environment. There would then be a need to have an Environmental Impact Assessment (EIA) which might come at great cost to the project.

- Construction methods and requirements in a sensitive environment are quite often expensive and technically demanding.

Force Majeure (Acts of God):

- Floods and earthquakes could result in the project being destroyed or the project being postponed to a period when materials would be expensive.

Legal:

- Patents rights and licenses for a project might be unavailable when required and create delays.

Timeframe:

- Accelerating project implementation further increases the dangers of time and cost related risks.

Client:

- The Client might be a novice and would not know construction procedures and would have to learn and this may result in delays. The Client's organisation might not be set to undertake a project as there might be no experienced project coordinator within the Client organisation.

The risks factors listed above could be split into those that cause time overruns and those that cause cost overruns. Those that cause time overruns would be risks such as:

- Design changes,

- Poor labour productivity etc.
- Cost overruns will be caused by material cost because of inflationary increases etc.

2.4 Risk Management

PMBOK Guide 2000 describes RM as the systematic process of identifying, analysing and responding to project risk. It includes minimizing the probability and consequences of adverse events to project objectives. On the other hand Barrie and Paulson (1992) view risk management as an organised effort to identify and qualitatively evaluate potential exposures, along with an advanced plan designed to eliminate and mitigate the consequences of risk. RM needs to be comprehensively implemented throughout a life cycle of a project.

Many in the developed world have started to use the processes of identifying project risks, analysing project risks and responding to project risks to tackle the TCOs which plague the construction industries of their countries. This phenomenon is as yet not practised by the construction professionals in the developing world, which Botswana is part of.

Raftery (1994) view RM as constituting three distinct stages i.e. the identification, the analysis and the response to risk. The stages are briefly described below: -

- **Risk Identification:** This is the first stage of RM which involves the identification of potential risks and the determination of what could go wrong.
- **Risk Assessment and Analysis:** The second stage is that of assessing and analysing the identified risks. This involves the

understanding or quantification of the effects of potential risks and it may be quantitative or qualitative in approach.

- **Risk Response:** The last stage is that of risk response. Risk response is responding to the risk after computing the impact of the various types of risks. The risk responses are;
 - a) Reducing the risk.
 - b) Insuring against the risk.
 - c) Transferring all or part of the risk to another party.
 - d) Retaining all or part of the risk.

The Successful Delivery Toolkit 2004 lists the key elements that need to be in place for successful management of risk to include, among others, the following: -

- Nominate senior management individuals to support, own the risk management process and lead on risk management.
- Communicate risk management policies, and the benefits of following them, clearly to all staff.
- Establish and adopt a framework for management of risk that is transparent and repeatable.
- Establish and innovate an organisational culture that supports well thought-through risk taking.
- Embed management of risk into a management process and consistently apply it.

- Manage risk closely in order to achieve set out objectives.
- Explicitly assess and manage risks associated with working with other organisations.
- Monitor risks actively and regularly on a constructive 'no-blame' basis.

If these elements were to be rigorously observed and implemented they will help reduce TCOs in Public Sector Building Construction Industries of Botswana, saving the nation meagre public funds .

Risk includes the probability of both good and bad outcomes as discussed earlier. It therefore, follows that RM, as a principle, can be directed both to limiting adverse outcomes and achieving desirable ones.

The Successful Delivery Toolkit 2004 again lists minimum requirement for a risk management framework as: -

- Existence of the organisation's risk policy.
- Clear identification of main stakeholders.
- Clarification of the main approaches to be used to identify, assess and report on risks, as well as look at actions to be dealt with.
- Clear assignment of responsibilities for managing risks and reporting to senior management, especially risks which cut across activities and organisational boundaries.
- Clear audit trail of decisions to ensure that RM reflects current good practice, with quality assurance knowledge audit.

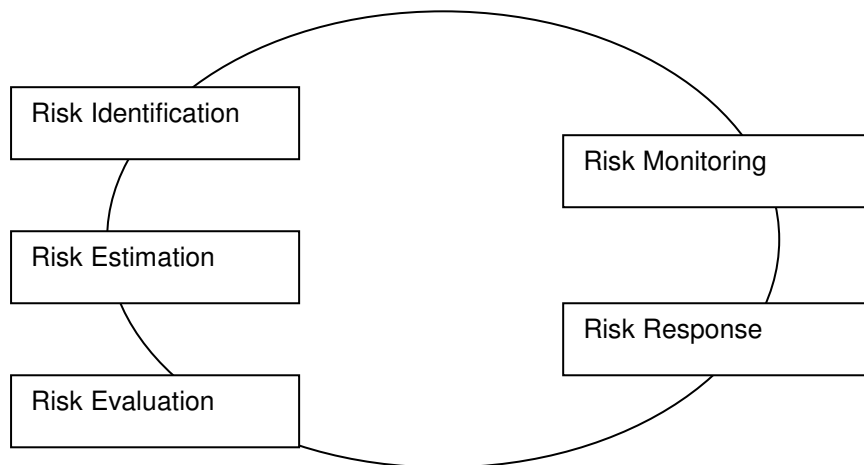
These can be expounded in the context of the risks associated with the public sector construction by the following: -

- Companies should have policies that are geared towards identifying, analysing and controlling risks. The top management should be leading the implementation of RMS.
- Stakeholders should be identified so that where there are duration slippages and cost overruns the structures could be fine-tuned so that these risks are minimized. Role delineation will also be made so that various categories of risk are allotted to relevant professionals and these risks would therefore have minimal impact on the performance of the project. Scope definitions and Work Breakdown Structures (WBS) could be agreed earlier on if the responsibilities and roles of the parties are well defined and consequently risks are minimized.
- Everybody is made aware of what is required to identify, assess, evaluate and control risks.

All these requirements are complimentary to one another and they are intertwined. The system therefore needs to be implemented scientifically and systematically if it is to be successful. In the developing world systems are prescribed in an ad-hoc manner and they never become efficient or serve their useful purpose.

RM as described above is a cyclical process. Figure 2.4.1 below illustrates the cyclic nature of RM.

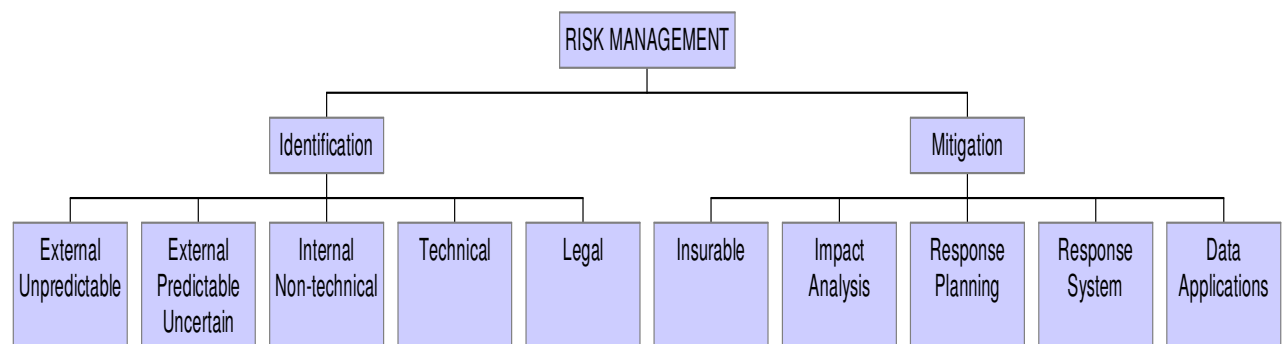
Figure 2.4.1: Risk Management life-cycle



Source: Baker et al., (1997)

This RM cycle can also be elucidated by the five broad RMS categories namely, risk identification, risk estimation, risk evaluation, risk response and risk monitoring and controlling as shown above. Baker et al., (1997) group the stages of risk identification, estimation and risk evaluation under the broader title of risk analysis. Risk analysis and evaluation can also be grouped under risk assessment. Risk response and risk monitoring are grouped under risk control.

Figure 2.4.2: Function Chart of Risk Management



Source: Barrie and Paulson (1992)

Figure 2.4.2 above shows RM as comprising of two broad categories of risk identification and risk mitigation. Risk identification would involve the identification of; external unpredictable risks, external predictable risks, internal non-technical risks, technical risks and legal risks. The mitigation of these risks would be by insurance, impact analysis, response planning, and responses system and data collection.

PMBOK Guide 2000 on the other hand defines RM processes as comprising Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, and Risk Monitoring and Control and the description of the individual process is given below: -

Risk Management and Planning: Deciding on how to approach and plan for the risk.

Risk Identification: - Determining which risks might affect the project and documenting their characteristics.

Qualitative Risk Analysis: - Performing a qualitative analysis of risks and conditions to prioritise the effects on project objectives.

Quantitative Risk Analysis: - measuring the probability and consequences of risks and estimating their implications for project objectives.

Risk Monitoring and Control: - monitoring residual risks, identifying new risks, and estimating the implications in terms of the project's objectives.

The descriptions of risk management process (RMP) by the authors quoted above concur that RMP is a cyclic process.

2.5. Risk Management Strategies in use

There are various risk management strategies which are in use in the construction industry such as, insurance, interviews, workshops, action plans, risk registers, decision trees, simulations, Delphi techniques, network analysis and many others. Some of these strategies are discussed below.

Insurance:

- Insurance forms a major portion in any risk management program to shift designated risks to a financially strong party who, for an agreed premium amount, is willing to assume some or all of the financial responsibility for the loss (Barrie and Paulson 1992). Protection to owners or the Client against failure of the contractor is normally in the form of payment and performance bonds.
- In Botswana, the contractor is required to provide surety and performance bonds often at ten percent of the contract sum. This could be huge amount of monies involved and the contractor would sometimes be burdened with bank debts. The contractor is also required to provide All Risk Insurance and Workman's Compensation Insurance.
- The nature of insurance transfers majority of the risk to the contractor and the Client, who is the originator of the project, would have minimal risks.

Interviews:

- A risk management interview involves interviewing experts on risk management and construction professional on past experience of risks in projects. This could be in the form of on-site interviews or

questionnaires. The Client or any stakeholder will be able to establish risks that might be encountered.

Workshops:

- Risk Management Workshop (RMW) is a form of brainstorming session on risk. The Client can have a RMW during the inception stage of the project to analyse the risks associated with the client's needs. The contractor also could have a RMW prior to the submission of a bid to establish whether to bid or not. The workshop would also be undertaken from time to time during the implementation of the project.

Decision Trees:

- Thompson and Perry (1998) comment on and define decision trees as follows: "In most major projects there are choices in how to achieve the objectives, so that at the start of the project the decision maker is faced with a variety of alternatives. These alternatives can be shown graphically in a decision tree showing the sequence of known choices and their possible outcomes. Decision trees are commonly used to study alternative projects and the effects of design and other choices on project costs. Drawing decision trees can make the solutions obvious. The addition of estimated costs, values of outcomes and probabilities provides a basis for analysing complex problems."

Simulation of Risk:

- Simulation of risk is computer based. PMBOK 2000 defines project simulation of risk as using models that translate the uncertainties specified at a detailed level into their potential impact on objectives that are expressed at the of the total project.

- Simulation of risk is normally undertaken by the use of network-based programs such as Computer Aided Simulation for Project Appraisal Review (CASPAR) and Monte Carlo Simulation. The two programs are similar, therefore only Monte Carlo Simulation will be described and discussed in detail below as a representation of simulation of project risk.
- Monte Carlo Simulation is an attempt to create a series of probability distributions for potential risk items, randomly sample these distributions, and then transform the numbers into useful information that reflects quantification of the potential risks of a real world situation (Kerzner 2001). Monte Carlo Simulation is a quantitative risk analysis strategy and seeks to identify the severity of risk factors. If the severity of risk factors are known, it would then be possible to distribute the risks among the contracting parties evenly or have strategies in place, that will mitigate the impacts well in time.

2.6 Review

The following paragraphs are an overview in the author's words, of what was concluded from the literature review.

2.6.1 Review of risk factors

Risk and uncertainties are ever present in the execution of projects. These risks could be external or internal to the project and affect the delivery of a project in different ways. The risks to a project can cause it to have time or cost overruns.

The risks factors that cause time and cost overruns are among others the following: - labour, materials, site location, plant, sub-contractors, economic

risks, political risks, technological changes, contractual risks, design, financial risks and others highlighted in section 2.3.

Labour could be unavailable and unskilled and it would be difficult to meet its target as of time and cost. Labour in Botswana is mostly unskilled and concentrated in the eastern part of the country and around towns making it difficult to have skilled labour for projects based in remote areas of the country.

Botswana does not produce its own building materials and depends on neighbouring countries for building materials even for basic materials such as face bricks. There is therefore, normally scarcity of materials for construction which affects the delivery of projects.

The site and location of projects has bearing on its performance with regard to time and cost overruns. Bad site conditions such as rocky or collapsible soils would make the execution of a project take long to complete and be expensive.

Contractors would have to pay more for project mobilisation on projects which are far away from their base stations. The problem is regularly experienced because of the large size of the country. Contractors are concentrated in the Gaborone and eastern areas of the country, they quite often have to mobilise projects thousands of kilometres from their bases.

Lack of co-ordination between main contractor and his sub-contractors at times causes delays. Inflationary economies make it prohibitive for construction to be undertaken. Political instability and political interference in construction projects could result in having time and cost overruns. Design and scope changes also affects the performance of a project with regards to time and cost overruns. Financial management by contractors needs to be efficient to avoid project delays.

2.6.2 Risk Management

RM involves the processes of identifying, assessing and analysis and response to risk. The RM process is a cyclic process and the elements of RM are interdependent. RM should be based on the project objectives such as on time and cost. The processes of identifying, assessing and analysing and responding to risk should be made known to all involved with a project. The ownership of risk management should be by all and senior management should lead the implementation of RM. RM should be made a culture of a company in order to ensure successful implementation of a project.

2.6.3. Risk Management Strategies in use

Various RMS exist which could be used to minimise time and cost overruns in building construction. Insurances, risk management interviews, risk workshops, simulation of risk, decision trees and other methods are used to manage risks in the construction industry.

Insurance is commonly used as a risk management technique and it is found to be inadequate as it transfers risks to one party rather than sharing the risks amongst the contracting parties. Risk management interviews could be used to identify risks which might be encountered in a project. Computer modelling such as Monte Carlo Simulation could be used to manage risks in projects. Brainstorming sessions commonly called Risk Management Workshops could be used in the life cycle of a project to manage project risks. The Workshops involves project participants identifying and finding ways of responding to risks.

2.7. Summary

The literature review was an attempt to establish the use of RM by others in the construction industry to control TCO.

There are various sources of risks which impact negatively on a construction projects. These risk factors could be both external and internal to the project and they can also be global and local.

RM is a relatively new phenomenon and it has grown exceptionally in the industrialised world. The literature review has shown that if RM is used holistically in the construction industry, it can reduce the TCO inherent in the construction. Developing countries such as Botswana can benefit from the implementation of risk management.

Focus should not be on the use traditional methods of RM. The traditional methods of RM such as insurance have shown to be inadequate in apportioning risk equitably among the contracting parties. Botswana's construction industry professionals and stakeholders need to introduce risk management processes in their daily activities.

The construction industry professionals and stakeholders in a fragile economy such as Botswana's should use RM tools and skills frequently to ensure an efficient and profitable public sector building construction industry.

The next chapter explains the research methods used to gather information for addressing the problem and its sub-problems.

CHAPTER THREE: RESEARCH METHODS

3.1 Introduction

The researcher looked at various methods of gathering information for a research project namely; literature reviews, case studies, interviews and anonymous questionnaires.

The investigation of the problem was pursued by a combination of literature review, a questionnaire survey and a case study of a past project. The interview was not pursued as it was considered impractical with regards to time. The target population for the study was primarily those directly involved with the BPSBCI. This target group comprised professionals in Architecture, Engineering, Quantity Surveying, Project Management, Building Construction (Contracting), Facilities Management, Real Estate and Civil Servants overseeing the construction of government facilities.

3.2 Literature Review

The literature review is chapter two. The literature review was mainly based on recent industry journals and articles from the Internet. Journals and articles reviewed were those that dealt mainly with RM and TCOs in the construction industry. This was done so that the treatise is in line with recent developments in RM strategies used to minimise TCO. Nevertheless, books on RM were also reviewed and form the basis of the subject.

Even though TCOs were reviewed somewhat, the literature review had an emphasis on RM as the aim of the research was to investigate RMS which might be implemented to minimise TCO in BPSBCI. Literature reviewed was from all different types of economies from developed economies to developing economies. This was due to the fact that the researcher wanted to make comparative analysis of the use of RMS to minimise TCO for situations. Lessons from developed countries (normally ahead on any new technology or

phenomena) would help to make conclusions and recommendations on RMS in order to establish a RMS in a developing country such as Botswana.

3.3 Questionnaire

Data collection for the research was undertaken by way of a questionnaire.

A questionnaire was prepared and distributed to stakeholders in the industry to test the hypothesis as presented by the sub-problems. The questions were set to investigate the sub-problems. A set of questions would then be analysed under the relevant sub-problems in the quest to investigate and gain a better understanding of the problem.

Two hundred (200) questionnaires were sent out to various Architects, Engineers, Quantity Surveyors, Project Managers, Real Estate professionals, Contractors and Civil Servants involved in BPSBCI. The questionnaires, with a covering letter were sent by post with return envelope, fax or by e-mail. Telephone reminders were made to potential respondents on an ad hoc basis.

The questionnaire was designed in such a way as to enable the respondents to add further information they deem relevant to the investigation. Of the two hundred questionnaires sent to the participants, fifty-one (51) were returned. These were deemed adequate to be used for the survey.

The raw data from the questionnaire was analysed to investigate the three (3) sub-problems stated earlier and the findings are discussed in chapter four. Conclusions and recommendations in terms of this study would be made mainly based on the analysis of the data derived from the questionnaire.

3.4 Case Study

Chapter Five describes a case study based on the construction of a School of Industry at Molepolole. The project was chosen at random among the projects the researcher, a quantity surveyor, was involved with.

The chapter encompasses some of the items that have been discussed in the previous chapters. A case study may be especially suitable for learning more about a little known or poorly understood situation (Leedy 2001). The case study was used to have an in-depth understanding of risks and the management threads found in BPSBCI.

3.5 Summary, Conclusions and Recommendations

The last chapter summaries, conclusions and recommendations proposes the way forward.

Summaries, conclusions and recommendations are made from the review of the related literature, analysis of the questionnaire and observations from the case study.

CHAPTER FOUR: DATA ANALYSIS AND EVALUATION

4.1 Introduction

The questionnaire was analysed to answer the questions posed by the sub-problems. Answers to the sub-problem would be found by testing the hypotheses. Conclusions are then made on whether the hypotheses are answered in the affirmative or not.

The first part of the questionnaire was to establish the characteristics of the respondents in the form of professional occupation, educational qualifications and years of experience. The characteristics of the professionals were dealt with under questions one, two and three of the questionnaire.

Question four of the questionnaire would be analysed to answer the first sub-problem, which is to identify the major risks associated with TCO in the BPSBCI. The second sub-problem, which is to evaluate how these risks impact on BPSBCI performance with regard to TCO, will be affirmed or not by analysing question seven of the questionnaire. Lastly questions five and six will be analysed to answer the question raised by the third sub-problem, which is to assess the applicability of RM as a management strategy that can be adopted in the management of TCO experienced in BPSBCI.

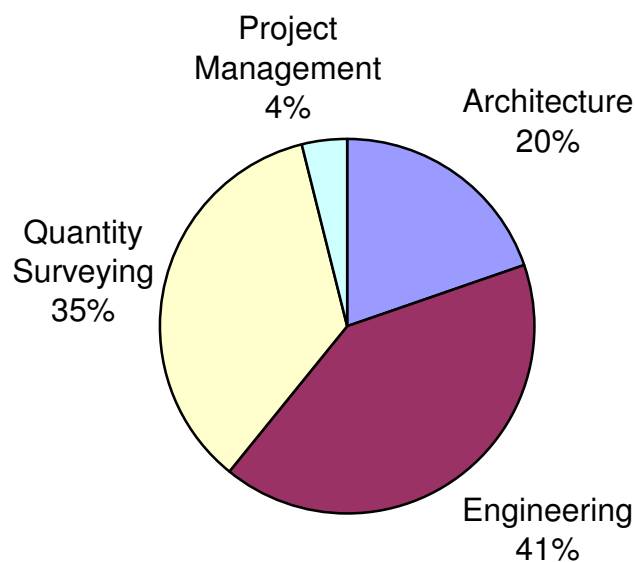
The questionnaire was arranged in simple terms so that the respondents do not have difficulties in answering the questions. The questionnaire had space for respondents to provide additional information that they deemed beneficial to a survey of this nature.

As mentioned in chapter three, two hundred copies of the questionnaire were sent to prospective respondents and fifty-one participants responded. The fifty-one returned questionnaires were adequate for the analysis process.

4.2 Professional Occupation of the Respondents

The respondents were requested to indicate their professional occupation. A list of professional occupations was provided and respondents were required to tick an appropriate box. The question asked was: - *What is your Profession/Occupation?* The results are represented in the pie-chart (Figure 4.2.1)

Figure 4.2.1: Professional Occupation of the respondents



The question sought to establish the profession/occupation of the respondents involved in the BPSBCI. The question provides the calibre of people and their knowledge base in RM. The knowledge tells to what extent RM is known in the industry. 20% of the respondents were Architects, 41%, the majority, were Engineers, 35% of the respondents classified themselves as quantity surveyors, 4% were project managers, while Contracting, Facilities Management, Real Estate, the Civil Service and other did not have respondents.

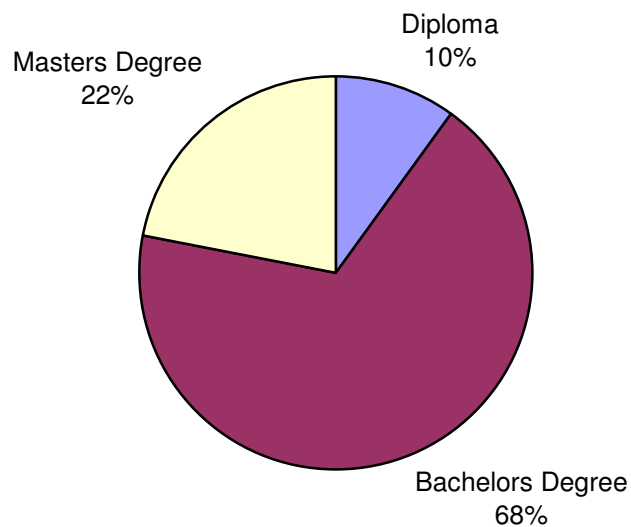
The Contractors and Civil Servants probably indicated their professional occupations as Architecture, Engineering, Quantity Surveying or Project Management, which is their primary professional occupation, rather than have secondary occupations of Contracting or Civil Service as stated professional occupations.

4.3 Educational Qualifications of the Respondents

The question sought to determine the level of educational qualifications of the respondents. The level of educational qualification might be a contributory factor in the use or non usage of RM to control TCO in the construction industry.

The question posed to the respondents was: - *What is your educational qualification?* The respondents were required to tick on an appropriate box against listed educational qualifications.

Figure 4.3.1: Educational Qualification of the respondents

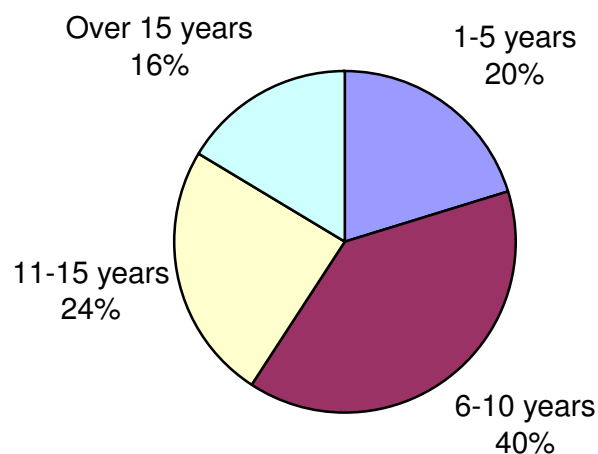


Diploma holders represented 10% of the respondents, 68% of the respondents held bachelor's degrees, 22% had obtained masters degrees. There were no participants with a PhD or other qualifications. The educational qualifications of the respondents are adequate to test the various hypotheses set out earlier. The respondents' educational background also provides some confidence that the respondents have some knowledge of RM and TCO in the construction industry.

4.4 Experience of the Respondents.

The respondents were asked to give their years of experience grouped in five yearly periods to over 15 years. The level of experience would show whether the respondents have encountered TCO and used Risk Management Strategies to minimise them. The question raised was: - *What is your Experience?*

Figure 4.4.1: Experience of the respondents.



The majority of the respondents (40%) had between 6 and 10 years of experience, followed by those in the range of 11 – 15 years experience at

(24%). The 1-5 years range of experience had 20% of the respondents and the over 15 years were 16%.

This pie chart shows that the respondents are highly experienced in construction related works, as the majority had more than 5 years experience.

4.5 Factors that influence TCO in the Public Sector Construction Industry.

A question was posed to the respondents on how they would rank the influence of the factors listed on TCOs in the public sector construction industry. The question asked was: -

- *How would you rank the influence these factors (listed) would have on time and cost overruns in the public sector construction industry?*

The factors were split into two categories in the construction process of a project namely, planning stage and construction stage. Respondents were required to rank the influence of the factors on TCO from low to high and they had to provide any other factor which might cause TCO.

Table 4.5.1: Rank of influence of various factors on time and cost overruns at planning stage.

Causes of TCO	Rank					
	Low		Medium		High	
	No	Perc	No	Perc	No	Perc
Inadequate brief	3	0.56%	13	2.43%	33	6.17%
Inadequate specification	4	0.75%	24	4.49%	20	3.74%
Political expediency	17	3.18%	19	3.55%	11	2.06%
Use of standard documentation	20	3.74%	25	4.67%	3	0.56%
Protracted Client approval periods	5	0.93%	17	3.18%	26	4.86%
Late Consultation with planning authority	22	4.11%	17	3.18%	11	2.06%
Inaccurate estimates	7	1.31%	21	3.93%	20	3.74%
Difficulties in a choice of site	28	5.23%	16	2.99%	4	0.75%
Inexperience of the Consultants	19	3.55%	17	3.18%	12	2.24%
System of Consultant appointment	18	3.36%	17	3.18%	14	2.62%
Changes in key personnel	17	3.18%	26	4.86%	6	1.12%
Other	0	0.00%	1	0.19%	2	0.37%
Subtotal	160	29.91%	213	39.81%	162	30.28%
Total	535					100.00%

Inadequate briefs were found to have the greatest influence on time and cost overruns as 6.17% rank the factor high. Inadequate specification was ranked to have medium effect by 4.49%. Political expediency was found to have medium effect by 3.55%.

Use of standard documentation was found to have medium effect by 4.67% followed by 3.74% who found it to have low impact on time and cost overruns.

Protracted Client approval periods were perceived to have a high influence on TCOs by 4.86%. Late Consultation with the planning authorities was found to have low impact by 4.11% of the respondents even though 3.18% of the respondents found it to have medium influence. 3.93% found inaccurate estimates to have medium influence on TCOs while 3.74% of them found it to have high influence.

Difficulties in choice of site was found to be a low influence by 5.23% of the respondents, while inexperience of the consultants was also found to have

low influence by 3.55%. System of Consultant appointment also featured to have a low ranking at 3.36%.

Changes in key personnel were found to have medium influence by 4.86% of the respondents. Other causes to time and cost overruns were found to have high influence by 0.37% of the respondents. Three of the respondents completed this portion of the questionnaire. The additional causes to time and cost overruns they raised were: -

- The period in which the Client takes to source funds from the Ministry of Finance to its inclusion in the National Development Plan (NDP) and then finally the project award to consultants could be three to five years. This results in an escalation to the initial project sum proposed.
- Another cause was stated as inadequate design, which was ranked high by the respondent.
- Poor co-ordination between consultants and government officials was also noted and ranked as having medium influence by the respondent.

Table 4.5.2: Rank of influence of various factors on time and cost overruns at construction stage

Causes of TCO	Rank					
	Low		Medium		High	
	No	Perc	No	Perc	No	Perc
Unavailability of materials	14	2.36%	25	4.22%	11	1.85%
Unproductive labour	11	1.85%	16	2.70%	21	3.54%
Inclement weather	41	6.91%	9	1.52%	0	0.00%
Underpricing by the contractor	7	1.18%	28	4.72%	14	2.36%
Design Variations	13	2.19%	25	4.22%	12	2.02%
Inflationary material costs	21	3.54%	22	3.71%	6	1.01%
Inaccurate materials estimates	14	2.36%	26	4.38%	9	1.52%
Inadequate prediction of equip.pro.rates	14	2.36%	26	4.38%	8	1.35%
Complexity of project	22	3.71%	12	2.02%	16	2.70%
Contractor's lack of geo. Experience	11	1.85%	31	5.23%	7	1.18%
Contractor's managerial skills shortages	3	0.51%	17	2.87%	30	5.06%
Equipment shortages	12	2.02%	21	3.54%	15	2.53%
Other	0	0.00%	0	0.00%	3	0.51%
Subtotal	183	30.86%	258	43.51%	152	25.63%
Total	593					100.00%

Unavailability of materials was ranked to have medium influence by 4.22% of the respondents. Unproductive labour was found to have high incidence by 3.54% of the respondents. Influence of inclement weather was regarded to be low by 6.91%.

Under pricing by the contractor was of medium influence by 4.72% of the participants. 4.22% respondents said that design variations were of medium influence to the TCOs in the public sector building construction industry. Inflationary materials costs were ranked as having medium influence by 3.71%.

Inaccurate materials estimates were ranked as having medium influence by 4.38% of the respondents. The same percentage found the inadequate prediction of equipment production rates to be of medium influence.

Respondents at 3.71%, found the complexity of the projects to be of low incidence while 5.23% of them said contractors' lack of geographical

experience was of medium influence. Contractors, managerial skills shortages were found to be of medium influence and equipment shortages were ranked as medium influence by 3.54% of the respondents.

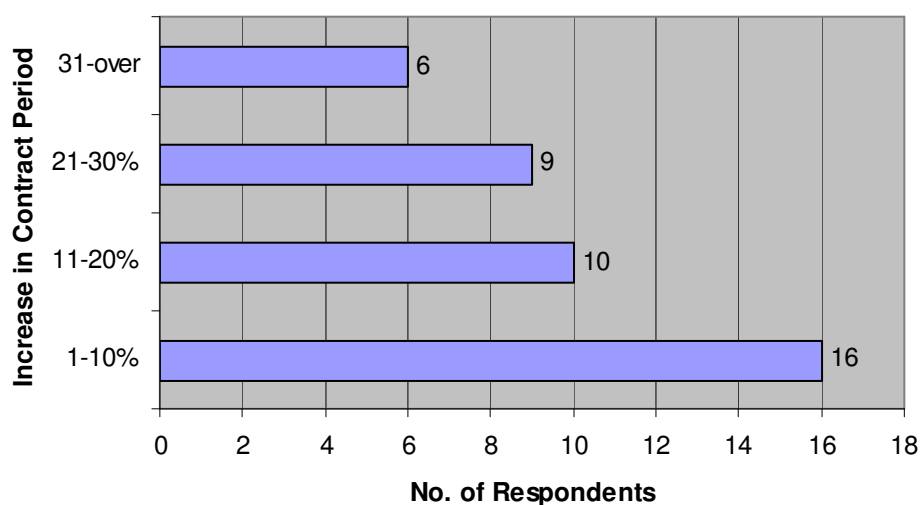
Three respondents filled in the part on any other causes to TCO and they were all found to be of high influence. These other causes were as follows: -

- The adversarial relationship between the Contractor and the Consultants, and
- Financial mismanagement by the contractor.

4.6 Percentage Increases in Contract Periods and Contract Sums

The respondents were asked to state percentage increases of contract periods and contract sums they have encountered during their involvement with public sector building construction. The percentages were grouped in multiples of 10% to over 31%.

Figure 4.6.1: Percentage Increase in Contract Period



The graph shows that sixteen (16) respondents have been engaged in projects with contract period increases in the range of 1 –10%. Ten (10)

respondents experienced contract period increase in the range of 11 – 20% increase while nine (9) respondents experienced contract period increases of between 21% and 30%. Contract period increases of over 31% were encountered by six (6) of the respondents.

Figure 4.6.2: Percentage Increase in Contract Sum

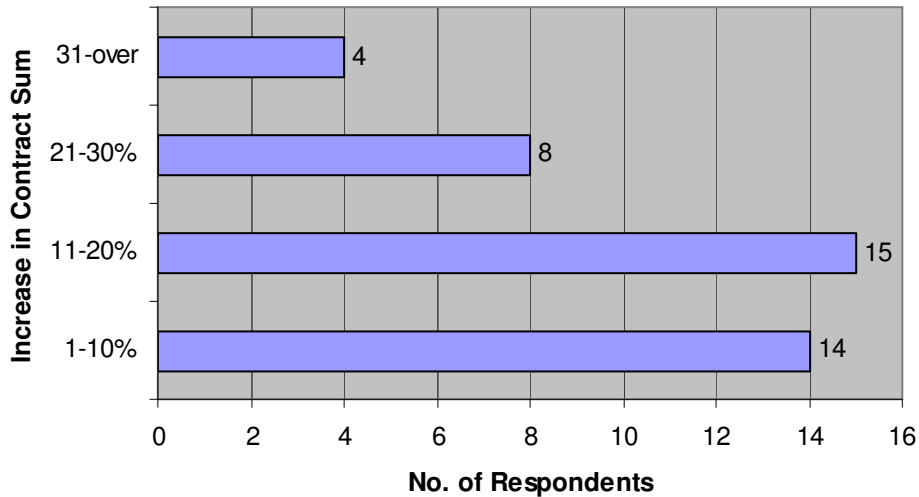


Figure 4.6.2 shows that 14 respondents have encountered contract sum increases in the ranges of 0 – 10% while 15 respondents had contract sum increases of 11 –20%. There were 8 respondents who experienced contract sum increases in the range of 21 – 30% and for contract sum increases of 31% and over there were 4 respondents.

4.7 Respondent’s use of RMS to minimise TCO.

The respondents were asked to rank on the scale of 1(always) – 5(never), the risk management strategies they use to minimise TCOs in public sector building construction. The management strategies, which were suggested were, Risk Identification, Risk Measurement, Risk Assessment, Risk Evaluation and Risk Control and Monitoring. The illustration of their responses is given in the table 4.7.1 given below. The table shows the number of respondents.

Table 4.7.1: Responses to Risk Management Strategies

	Rank				
	Always 1	2	3	4	Never 5
Risk Identification	14	7	13	7	5
Risk Measurement	6	12	7	8	13
Risk Assessment	7	13	6	10	8
Risk Evaluation	8	8	11	10	9
Risk Control & Monitoring	11	8	12	5	10

Table 4.7.1 shows that 14 respondents reported that they always use risk identification methods and 5 respondents never use risk identification methods. The majority of respondents never measure the risks as 13 respondents have ranked risk measurement at 5 and only 6 respondents reported using risk measurement techniques. Twelve (12) respondents reported using risk measurement regularly.

Risk assessment was implemented by 7 of the respondents while 8 never did. The majority of the respondents have used risks assessment as 7 were the always category as compared to 8 in the never category.

Risk evaluation is carried out by 8 of the respondents and 9 never did. Risk control and monitoring was done by 11 respondents compared to 10 who never do.

4.8 Strategies used to eliminate construction TCO

The respondents were asked to rank in a scale of 1 (always) – 5 (never) how often they use listed strategies to eliminate TCOs. The strategies as appears on the questionnaire were derived from the literature review. The strategies noted were as follows: -

- a) Avoiding earthwork and substructure construction activity during rainy season.
- b) Providing facilities and accommodation for workers to avoid or minimise trade absenteeism.
- c) Entering into long-term contracts with construction materials suppliers in order to prevent price increases.
- d) Entering into long-term contracts with subcontractors to ensure availability of equipment and skilled craftsmen.
- e) Keeping an updated historical database of prices and materials.
- f) Keeping an updated historical database of unit prices for work packages.
- g) Keeping an updated historical database of activity production rates.

The alphabetical numbering above is used in the table below to represent strategies used in eliminating TCOs.

Table 4.8.1: Responses on the use of strategies to eliminate time and cost overruns

STRATEGY	RANK				
	Always 1	2	3	4	Never 5
a	5	7	12	9	9
b	3	6	11	7	16
c	8	4	3	7	18
d	6	5	4	9	16
e	8	11	6	3	12
f	11	19	5	2	11
g	10	10	4	3	15

5 respondents have always used strategy **a** while 9 have never used it. Three of the respondents have always used strategy **b** while 16 never did and for strategy **c** 8 respondents always use the strategy while 8 have never used it.

With strategy **d**, 6 respondents use it and 16 have never used it. The table shows that 8 respondents have used strategy **e** while 11 have never used it. 11 respondents have reported using strategy **f** have the same number have reported never using the strategy. And as for strategy **g**, 10 respondents use it and 15 have reported never using the strategy.

The table above illustrates that the majority of participants in Botswana's public sector construction industry seldom use the proposed risk management strategies to eliminate or minimise TCOs in the industry.

It should be noted that the respondents on this section of the questionnaire were not fifty-one, as some did not answer the question.

4.9. Summary

The summary of this chapter entails establishing whether the hypotheses as stated are affirmed or not by the questionnaire data collected and the findings from the literature review.

4.9.1 The First Hypothesis Findings

The objective of the first hypothesis was to determine the internal and external risks to BPSBCI which cause TCO. The first hypothesis will be tested based on the results of the data analysis of question four of the questionnaire.

Question four of respondents to determine the influence of TCOs in the public sector construction industry during planning and construction stages.

The findings on the factors that influence time and cost overruns in public sector at planning stage were as follows: -

Inadequate Brief: The findings shows that the brief prepared by government officials in most cases does not match with what they really want done.

Protracted Client approval periods: The Client's Representatives, as from the findings, are accustomed to taking long to make approvals or make decisions to expedient consultants progress which consequently results in overall project delays.

Changes in key personnel: Constant staff changes in the government department tasked with facilitating building developments for government ministries and departments were found to have influence on the delays in the public sector construction industry.

Use of standard documentation: This factor has great impact as standard documentation does not accommodate scope changes and the pricing would be based on wrong specifications.

Political expediency: The results show that political interference has a great bearing on TCOs. Projects could be implemented as a favour to the electorates to return a certain MP rather than as a necessity.

Inadequate specification: Specifications also are found wanting in the public sector building construction industry as they are mostly done in a hurry and they result in TCOs.

Inaccurate estimates: Inaccurate estimates are of major concern to most respondents.

Late consultation with planning authority: This was found not to be a major factor in the rampant TCOs.

Difficulties in a choice of site: This was found not to be of great concern. It seems there is a lot of land available to government.

Inexperience of consultants: This is an insignificant factor.

System of Consultant appointment: The system of consultant appointment had a low impact as the systems of consultants normally used in the Botswana setting are the rota and bid system.

Other Causes: Other causes of TCOs like poor co-ordination between the consultants and the client were found to be influential in the rocketing overruns.

The findings on the factors that influence TCOs in public sector at construction stage were as follows: -

Contractors' managerial skills shortages: Management skills of most contractors are found to be insufficient.

Unproductive labour: Labour was found to be unproductive as a result of absenteeism because of illness.

Contractor's lack of geographical experience: Botswana is a vast country with concentration of business activity in the eastern part of the country. As a result most contractors would be familiar with the eastern part of the country and they would have difficulties when they are to carry out a project in the western part of the country resulting in TCOs.

Under-pricing by the contractor: the contractors under-price and are unable to complete the projects on time.

Inadequate materials estimates: Material estimates or skills for making material estimates is to be improved.

Inadequate prediction of equipment production rates: Equipment production rates were found to be another problem.

Design Variations: Constant design variations were also problematic. Design variations at times increases the scope or the changes become expensive and cause cost overruns to the project.

Unavailability of materials: Materials were found to be scarce. This is due to the fact that building materials are imported from neighbouring countries like South Africa and Zimbabwe and from overseas and are not readily available in the country.

Inflationary materials costs: Inflationary material costs have negative impacts on TCOs in the public sector construction industry.

Equipment shortages: The industry is bereft with equipment shortages.

Inclement weather: Inclement weather had minimal impact. The weather of Botswana is dry and therefore there are minimal chances of floods which can disrupt the construction process.

Financial mismanagement by contractors: was found to be one of the factors that contribute to TCOs. This could be that the contractors transfers the funds they got from the projects to luxuries that do not have a direct bearing on the progress of the project rather than using them to buy materials for the projects or paying their employees well, to be motivated and become productive.

The researcher concludes that the findings shown above provide strong support for the first hypothesis. The survey shows that TCOs are caused various risk factors both internal and external to the projects in the public sector. The risk factors, which appear to cause greatest TCOs, are:

- Inadequate brief,
- Protracted Client approval periods,
- Contractors' managerial skills shortages,
- Unproductive labour etc.

4.9.2. The Second Hypothesis Findings

The objective of the second hypothesis was to determine the impact of construction risks on BPSBCI. The second hypothesis will be tested based on the results of the data analysis of question seven of the questionnaire survey.

Question seven of the survey asked respondents to state percentage increases in contract periods and contract sums of projects they have been involved with in the public sector building construction projects. The results shows that more than half of the respondents have been engaged in public sector projects which had contract periods and contract sums with increases

of more than 10 percent. The results shown earlier have assisted in proving hypothesis number two to be true. The risks impacted negatively on BPSBCI.

4.9.3 The Third Hypothesis Findings

The third hypothesis entailed finding risk management strategies which could be used to reduce TCOs in BPSBCI. Questions five and six of the questionnaire were used to test the third hypothesis.

Question five asked respondents how often they undertook risk management strategies namely, risk identification, risk measurement, risk assessment, risk evaluation and risk control and monitoring to minimise risks which might cause TCOs in the public sector construction industry. The results above show that even though the majority of the respondents reported that they use risk identification methods, risk measurement, risk assessment and risk evaluation were not undertaken keenly as many reported never having used these strategies.

Question six asked respondents how often they used strategies listed in the questionnaire and section 4.8 above. The results show that most respondents never used the strategies stated.

The limited use of risk management strategies by the respondents proves that if risk management strategies were used, time and cost overruns experienced in BPSBCI could be reduced. The third hypothesis that, RM can be applied in the management of TCOs in BPSBCI is true.

4.10. Summary

This chapter analysed the questionnaire data to assist in resolving the problem and its sub-problems. The next chapter is a case study to investigate the problem further.

CHAPTER FIVE: CASE STUDY – THE SCHOOL OF INDUSTRY

5.1 Brief History of the Project

The School of Industry at Molepolole (SIM) was conceived in the early 1980s as a reformatory to house young offenders. The project consultancy team, comprising the Architect as the lead consultant, the Civil and Structural Engineer (CSE), the Quantity Surveyor (QS), the Mechanical Engineer (ME) and Electrical Engineer (EE) were assembled by the Department of Architecture and Building Services (DABS) for the Ministry of Local Government Lands and Housing (MLGL & H), to execute the project. The project comprised of central administration block, welding and carpentry workshops, kitchen/ dining and boiler room, classrooms, boys hostel blocks, staff quarters and associated external works.

The project was shelved in the 1980s after the design and documentation stage due to the severe drought experienced at the time and funds were transferred to other pressing needs in the country.

5.2 Pre-contract Stage

The project was reconstituted in the late 1990s and the Consultant Quantity Surveyor (CQS) was tasked with the preparation of a new budget and estimate.

DABS categorically instructed the CQS to use the Bills of Quantities (BoQ) for buildings prepared earlier in the 1980s. The Standard Method of Measure (SMM) had change from Standard Method of Measurement edition 5 (SMM5) in the 1980s to Standard Method of Measurement edition 6 (SMM6). In essence the BoQs did not represent the procedure of measuring in the 1990s. This meant that the pricing for some items, whose method of measurement had change, would be difficult for the Tenderers.

The CQS was only tasked to re-measure the external works since the site had changed. The village grew onto the original 1980s SIM site. The design and re-measurement of the external works were delayed because of the rocky nature of the plots, which were being considered for the project as the Client had abandoned the original plots.

Eventually, when a suitable site was found, a new topographical survey and geotechnical survey were prepared. The CQS re-measured and prepared BoQ for the external works.

Tenders were called by open tendering through the Central Tender Board (CTB) as this was a government project financed with public monies. The Tenderers were given a month to price the tender documents. The tender validity was stated as ninety-days after tender opening, as it is the norm with government projects. The CQS was required to prepare the tender report two weeks after tender closing. The preparation of the tender report was duly done within the required two weeks and submitted to DABS. Officials at DABS returned the report after a month of circulation within the department for incorporation of some of the new procedures they deemed necessary. The evaluation report was sent back to DABS, who did not act on it until the tender validity lapsed and the CQS was asked to extend the tender validity by another sixty days. The Tenderers agreed to the extension of the tender validity period, as the construction industry was not vibrant at that stage.

The tender was awarded in July 1998 to a contractor not recommended by the CQS because of his known recalcitrance on other projects. The contractor appointed was of Grade E as per CTB grading. Grade E meant that the contractor in that grade could perform contracts of BWP 8 Million to unlimited amounts.

The CQS did not recommend the contractor who was awarded the contract because the contractor did not price for rock blasting and excavation and the site was set on rocky soils as the geotechnical report shown. Most of the contractor's rates were lower than those of other tenderers. Molepolole village

is commonly known by tenderers to have an inadequate water supply; provision was made in the preliminaries for tenderers to cater for this eventuality. The contract sum was P15, 100,000 and the contract period was 65 calendar weeks

The appointment of the Nominated Sub-Contractors (NSC) for both Mechanical and Electrical installations was made late by DABS hence, co-ordination for the execution of the project at commencement was non-existent between the contractor and his NSC. There was an option in the contract for the main-contractor to reject the appointment of any NSC if the NSC historical performance was known to be questionable by the main-contractor. The main contractor did not object to the appointment of the successful NSC. The NSC had their own tenders under the auspices of the Department of Electrical and Mechanical Services (DEMS)

5.3. Post-contract Stage

The main-contractor had another on-going project in Molepolole which was at completion stage. The contractor took long to complete excavations for foundations of the buildings for the SIM project as they were still tied up at the other project. The contractor had anticipated that he would have completed the other project before the commencement of the SIM project and transfer the workers and machinery to the SIM site. This was not the case as the other project dragged-on. Transferring workers from the other project to SIM was a better proposition at the time as labour was unavailable in Molepolole and other surrounding areas. It would have been expensive for the contractor to source labour from far off places to Molepolole.

The contractor had priced some of his materials, e.g. roofing sheets, to be sourced from neighbouring Zimbabwe. As the project commenced, Zimbabwe started experience economic collapse because of political instability.

There was dispensation from government to encourage those main contractors, who win government contracts to engage small citizen owned

companies as domestic subcontractors. The citizen companies were engaged as domestic subcontractors at the SIM in activities such as, civil works, plastering, painting, tiling etc. It was also a government policy that all face brick for government contracts should be procured from Lobatse Clay Works (LBC) in Botswana rather than from South Africa or Zimbabwe. LBC who were the only manufacturers of face bricks in the country, were unable to meet the face brick demand of the country. The failure by LBC to meet the face brick demand of the country was caused by the fact that there were other on-going government projects of greater magnitude than SIM which required face brick.

As the project progressed, the problem of lack of water for construction purposes in Molepolole surfaced. The contractor had to transport water from Gaborone, fifty (50) kilometres away. The main-contractor did not price for water for the works adequately. This pricing anomaly was noticed by the CQS during tender evaluation and the contractor was asked to confirm his tender which he duly did. The contractor assumed that there would be water in the vicinity of the site. The water pressure was low in the village and tenderers were made aware of this and there was provision in the tender documents for tenderers to check whether water pressure in the village would be adequate for construction. The tenderers were given an option of renting a borehole in the vicinity of the village for construction water. The contractor submitted a claim for transporting water from Gaborone which was deemed unacceptable by the project consultants and DABS since the contractor was given an opportunity to price for a scenario when there is no water for the works in the village and there being a need to transport water into the village. In fact the contractor had confirmed his tender when asked about pricing for water for the works. During excavations for foundations and road works, the contractor encountered hard material and rock. This caused delays to the project and losses to the contractor because he had under priced for hard material and rock. There was no civil works subcontractor willing to work for the rates proposed by the main contractor.

The contractor's interim payments were at times delayed for a month as DABS officials were habitually forgetting to seek project funds from the Ministry of Finance and Development Planning (MFDP) in time.

As the original designs were prepared in the 1980s, there was a need to make variations to some of materials specified in the 1980s because some of the materials manufacturers no longer existed and the building procedures and technologies have changed somewhat. The population of the country had grown which necessitated additional buildings and facilities for the project.

Co-ordination between the contractor and his subcontractors was unsatisfactory. There were disputes about money between the main-contractor and his sub-contractors. The sub-contractors claimed that the main-contractor did not pay them on time. The standard of workmanship for the project was poor because of the different domestic subcontractors and there was a lack of supervision by the main-contractor.

The electricity company, Botswana Power Corporation (BPC), delayed to connect commissioning power and the project could not be commissioned on time. The Department of Water Affairs (DWA) in the village also was unable to provide the main pipe supplying water to the site. There were constant staff changes of project officers from DABS side. These staff changes involved foreign nationals, who apart from being orientated on the details of the project, they needed to be orientated on government procedures as well. The unfamiliarity of the new DABS staff members with the project and procedures made it difficult for communication between the parties for smooth execution of the project.

The problem of scope changes, delays by both the contractor and the utilities companies delayed the completion of the project by one year.

Table 5.3.1: The School of Industry Project Data

Commencement Date	Completion Date	Agreed Contract Period	Contract Sum	Extended Completion Date	Actual Completion Date	Final Account Sum
21.09.98	15.11.99	65 Weeks	15,100,000	04.07.00	07.12.00	17,022,734

Table 5.3.1 shows that the contract sum increased from approximately P15 million to P 17 million an increase of about P2 million. The table also shows that the contract period increased by one year.

5.4. Project Close-out

The contractor could not sign the final account to close the project. He raised a dispute based on his unsuccessful claim for transporting water from Gaborone to Molepolole and the delays caused by the BPC in connecting power for commissioning of electrical and mechanical equipment. The contractor has since notified DABS of his intention to proceed with arbitration.

5.5 Summary

The summary of this chapter entails highlighting what constituted risks to the project and what risk management strategies could have been implemented to control the risks which caused the TCOs experienced in the case study project.

The following were external risk factors which caused TCOs of the project: -

- The reliance for supply of building materials from Zimbabwe had a delayed impact on the project. Zimbabwe had economic crisis and they were unable to supply materials needed for the project timeously.

- Utilities companies such as BPC for electricity and DWA for water were also unable to perform their duties in time and hampered the progress of the project.
- Unavailability of water in the village for construction purposes was also one of the major problems.
- The society at large had changed, females were now offenders, which was unheard of in earlier years or which was a rarity in the past and the designs needed to be changed at late stage to cater for females' needs. There was need to have girls hostels etc.

The following are noted from the case study as risks factors internal to the project: -

- The delay in finding a suitable site for the project contributed to the extended duration and delivery of the project.
- The postponement of the project for about a decade contributed to the general increases in cost of the project. The material prices had increased and inflation in the country had also risen.
- Bad founding soils conditions, hard material and rock, were encountered in the project having to take longer and being costly to excavate for foundations and other external works trenches.
- Constant design changes to accommodate the Client's requirements were a major hindrance to the overall efficiency and profitability of the project.
- Lack of skilled labour in the Molepolole area, and the unavailability of materials contributed to the TCOs experienced on the project.

- Lack of proper co-ordination between the main contractor and his sub-contractors made the construction process inefficient.
- Named suppliers such as the face brick supply were unable to meet the demands by various contractors in the country and consequently the project suffered.
- The contractor did not plan the use of his labour in an orderly manner.

There were classic cases of risks encountered in this case study, which affected the project. The project had tremendous time and cost overruns as shown in Table 5.3.1. The contract period has increased by one year and the contract sub by P2million. The risks were both external and internal to the project. The external risks to the project were such as the directive from government instructing contractors to by facing brick from LCW and yet another government directive to have local domestic subcontractors. Political and economic risks also affected the project's delivery. Some materials were to be procured from Zimbabwe and the procurement of the materials coincided with a period when Zimbabwe was experiencing political and economic crisis. Alternative sources of materials had to be found from neighbouring South Africa and this meant the prices for materials from South Africa were not the same as those quoted for materials to be sourced from Zimbabwe.

The internal risks to the project and the contractor were such as the inability of the contractor to co-ordinate his subcontractors and the rocky nature of the site which made progress slow. The unavailability of site delayed the commencement of the project. Design and scope changes were also experienced and resulted in overall cost increases.

The TCOs experienced in this case study could have been minimised by instituting a risk management strategy. Risks would have been identified earlier and responded to before they impacted negatively on the project.

There should have been a Risk Management Workshop by the Client (DABS) and the Consultants at the beginning of the projects to identify what risks might impact on the project. Had there been a risk management workshop, impact of governmental directives stated earlier could have been avoided by seeking a waiver for the project. Regular risk management workshops could also have assisted the contractor in finding ways of improving communication between him and sub-contractors and improved the efficiency of the parties and henceforth the speedy delivery of the project.

Risk management interviews and a risk management plan, they could have assisted in reducing the TCOs encountered in this project. Essentially there was no concerted effort to identify, measure, assess and evaluate the risks encountered in this project. Only outdated risk management strategies such as insurances and performance bonds were used. These methods can only make sure, to an extent, that the contractor completes the project but they are not a guarantee that a project will be completed on time and within cost.

The next chapter will summarise and make conclusions on the sub-problems. Recommendations from the research will also be made and further research highlighted.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introductions

Risks are ever present. Depending on their uncertainties and the consequences, they are accepted routinely, and measures are taken to minimise their consequences (Scott et al 1997). BPSBCI has been reported in Botswana's Parliamentary debates and other forums as experiencing unacceptable levels of failure in terms of time and cost overruns.

The Parliamentarians and other stakeholders have been asking construction industry professionals and contractors to find and implement strategies to arrest the soaring TCOs. There is a need to introduce risk management strategies to minimise the TCOs which characterise BPSBCI.

6.2 Summary

Chapter one of the study was introducing the study and setting out the problem to be investigated. The problem statement stated in chapter one was to identify and evaluate risk management as a strategy that can control time and cost overruns that are being experienced in BPSBCI. The problem was subdivided into three sub-problems and the sub-problems each had a hypothesis to be tested.

Chapter two of the study was a review of related literature to the problem and sub-problems under investigation. The chapter investigated sources of construction risk, the risk management process and the strategies which could be used to minimise risks. The literature review was based on articles from both the developing world and the developed world as the construction risks and risk management strategies used, have a commonality for both the developing and developed worlds. The discussion on risks and RMS for construction industries for both worlds will assist in establishing realistic conclusions and recommendations for a developing nation such as Botswana.

Chapter three discusses the research methods stating research techniques that were used to investigate the problem set out in chapter one. The investigation of the problem was by a combination of a questionnaire, literature review and a case study.

The fourth chapter entailed analysing and evaluating data from the questionnaire survey and testing the hypotheses in terms of the results of the data analysis. Chapter five was a case study on a project chosen at random to investigate the problem as stated in chapter one.

6.3 Conclusions of each of the sub-problems and hypotheses

6.3.1 The First Sub-problem

What are the major risks associated with TCO in the BPSBCI?

The results from the data analysis have shown the major risks associate with or causing TCOs in BPSBCI at the planning stage of the project by order of significance, from the one with greatest impact to the one with the least impact, are as follows: -

- Inadequate brief,
- Protracted client approval periods,
- Changes in key personnel,
- Use of standard documentation,
- Political expediency,
- Inadequate specification,
- Inaccurate estimates,
- Late consultation with planning authority,
- Difficulties in selecting site,
- Inexperience of consultants, and
- System of Consultants appointment.

Furthermore, the data revealed TCO in BPSBCI at construction stage of a project by order of significance to be: -

- Contractor's managerial skills shortages,
- Unproductive labour,
- Contractor's lack of geographical experience,
- Under-pricing by the contractor,
- Inadequate materials estimates,
- Inadequate prediction of equipment production rates,
- Design variations,
- Unavailability of materials,
- Inflationary materials costs,
- Equipment shortages, and
- Inclement weather.

6.3.2. The First Hypothesis

The first hypothesis is that there are internal and external risks to BPSBCI which causes TCO in BPSBCI.

The data and the literature review have confirmed this hypothesis.

6.3.3. The Second Sub-problem

What are the risks, which impact on BPSBCI performance with regard to TCO?

The results of the analysis of data on contract period and contract sum increases have shown that the majority of respondents normally encounter increases of more than 10%.

6.3.4. The Second Hypothesis

The second hypothesis is that these risks impact negatively on BPSBCI.

The data has confirmed this hypothesis. There have been unacceptable levels of contract period and contract sum increases.

6.3.5. The Third Sub-problem

Is RM applicable as a management strategy that can be adopted in the management of TCO experienced in BPSBCI?

The analysis of data shows that the respondents have experience of using the following risk management processes.

- Risk Identification,
- Risk Measurement,
- Risk Assessment,
- Risk Evaluation, and
- Risk Control and Monitoring.

The participants did not institute these processes in a significant manner. There were a significant number of participants who have never used the risk management processes.

Respondents have also reported using the following strategies to eliminate construction TCO:

- Keeping an updated historical database of unit prices for work packages,
- Keeping an updated historical database of activity production rates,

- Keeping an updated historical database of prices and materials,
- Entering into long-term contracts with construction materials suppliers in order to prevent price increases,
- Entering into long-term contracts with subcontractors to ensure availability of equipment and skilled craftsmen,
- Avoiding earthwork and substructure construction activity during rainy season, and
- Providing facilities and accommodation for workers to avoid or minimise trade absenteeism.

The literature review also revealed some of the strategies which could be used to minimise time and cost overruns and they were namely, insurances, risk management interviews, risk workshops, simulation of risk, decision trees etc.

6.3.6 The Third Hypothesis

The third hypothesis is that RM can be applied in the management of TCO experienced in BPSBCI.

This hypothesis has been confirmed to be true by the data analysis and literature review. The data analysis have shown that the uptake of risk management strategies is low among construction industry professionals in Botswana's construction industry and the failures of the industry reported in Parliament are due to this low uptake. Therefore, RM can be applied in the management of TCO experienced in BPSBCI.

6.4 Recommendations

The following recommendations are suggested:

- There is need to always determine risk associated with cost and time overruns in the construction industry.
- Participants in BPSBCI should develop skills and aptitudes in risk management.
- Risk management planning should be part of the construction process in BPSBCI.
- There should be change in approach in the use of insurance as a risk management strategy, insurance should be combined with other risk management methods to be effective.
- Risk should be identified, assessed and analysed and responded to.
- Procedures which mitigate risks such as interviews, risk management workshops, decision trees etc should be introduced in Botswana's construction industry.

6.5. Further Research.

Research is needed on the systematic introduction of Risk Management on Botswana's construction industry.

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ANNEXURE

**TITLE: RISK MANAGEMENT STRATEGIES EMPLOYED TO
MINIMISE TIME AND COST OVERRUNS: - A CASE
FOR BOTSWANA'S PUBLIC SECTOR BUILDING
CONSTRUCTION.**

1. What is your Profession/Occupation?

Architecture	<input type="checkbox"/>	Engineering	<input type="checkbox"/>
Quantity Surveying	<input type="checkbox"/>	Project Management	<input type="checkbox"/>
Contracting	<input type="checkbox"/>	Facilities Management	<input type="checkbox"/>
Real Estate	<input type="checkbox"/>	Civil Servant	<input type="checkbox"/>

Other (please specify.....).

2. What is your educational qualification?

Diploma	Degree	Masters	Phd
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (Please specify.....)

3. What is your experience?

0 –5 years	6 – 10 years	11 – 15 years	Over 15 years
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. How would you rank the influence of these factors on time and cost overruns in the public sector construction industry?

	Low	Medium	High
PLANNING STAGE			
a. Inadequate brief	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Inadequate specification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Political Expediency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Use of Standard Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Protracted Client approval periods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Late Consultation with planning authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Inaccurate estimates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Difficulties in a choice of site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Inexperience of the Consultants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. System of Consultant appointment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Changes in key personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l Other (please specify.....)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CONSTRUCTION STAGE			
a. Unavailability of materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Unproductive Labour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Inclement weather	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Under pricing by the contractor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Design Variations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Inflationary materials costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Inaccurate materials estimates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Inaccurate prediction of equipment production rates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

i. Complexity of Project	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Contractor's lack of geographical experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Contractor's managerial skills shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Equipment shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Other (please specify.....)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. How often do you undertake the following to minimise risks, which might cause time and cost overruns in public sector building construction?

a. Risk identification

Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never
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b. Risk measurement

Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never
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c. Risk assessment

Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never
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d. Risk evaluation

Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never
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e. Risk control and monitoring

Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Never
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6. How often do you on projects you are involved with use the following strategies to eliminate construction cost and time overruns in the public sector building construction?

a. Avoiding earthwork and substructure construction activity during rainy season.

Always

1		2		3		4		5	
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 Never

b. Providing facilities and accommodation for workers to avoid or minimise trade absenteeism.

Always

1		2		3		4		5	
---	--	---	--	---	--	---	--	---	--

 Never

c. Entering into long-term contracts with construction materials suppliers in order to prevent price increases.

Always

1		2		3		4		5	
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 Never

d. Entering into long-term contracts with subcontractors to ensure availability of equipment and skilled craftsmen.

Always

1		2		3		4		5	
---	--	---	--	---	--	---	--	---	--

 Never

e. Keeping an updated historical database of prices of materials.

Always

1		2		3		4		5	
---	--	---	--	---	--	---	--	---	--

 Never

f. Keeping an updated historical database of unit prices for work packages.

Always

1		2		3		4		5	
---	--	---	--	---	--	---	--	---	--

 Never

g. Keeping an updated historical database of activity production rates.

Always

1		2		3		4		5	
---	--	---	--	---	--	---	--	---	--

 Never

7. How did the following increase in percentage in public sector building construction projects you have been involved with?

	0-10%	11-20%	21-30%	31%-Over
a. Contract period	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
b. Contract Sum	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>