AN ASSESSMENT OF PROJECT RISK MANAGEMENT IN THE CONSTRUCTION OF TELECOMMUNICATION TOWERS

by

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DECLARATION

I, hereby declare that this submission is my own work towards the Commonwealth Master of Business Administration Degree Award and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgements has been made in the text.

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ABSTRACT

This academic research aims at examining how telecommunication operators identify, measure and manage risks in cell site construction projects in Ghana. The specific objectives are to determine how cell sites are constructed; the risks involved and examine how project implementers have managed the risk forms in tower construction projects. The study makes use of field data sourced from major telecommunication operators in Ghana through administered questionnaires delivered to respondents . Fifty-six (56) questionnaires were administered but due to a high non-response rate, thirty-two (32) were obtained, representing 62% of the total respondents. There were 19 respondents from Millicom Ghana (tiGo); 6 from MTN; 4 from Vodafone; 2from Airtel and 1 from Espresso. Findings in this study indicate that tasks such as site feasibility assessment, survey, and marking; finalization of specifications for equipment, works in consultation with technical and commercial teams are critical in the construction process. Financial and market leadership loss risks are also most crucial to their success. Project implementers transfer financial risk by use of insurance over inclusion of indemnity clauses in contracts. The expected net present value (ENPV) and expected monitory value (EMV) are the most prevalent quantitative techniques used to identify and measure risks as "rule of thumb" is used qualitatively. Collaboration among project parties is fundamental to achieve cell site project goals. Recommendations include attention to feasibility assessment and a fair representation of individuals with various backgrounds for an evaluative oversight for minimal deviation in standards, capital budgets and consumer centric factors.

DEDICATION

I dedicate this academic piece first to the Almighty God; then to my dear wife Mrs Esther Gyimah Tetteh and Bernard Narkotey who provided much support, as well as all my family and friends. Thank you all and God richly bless each one of you.

This work is also dedicated to my CEMBA Study Group Members; Annor, Tony, Cynthia, Augustina, Ike, Prince and Eric.

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This academic piece has been completed with the profound contributions of personalities who directly and indirectly encouraged me to achieve this aim. My initial reference goes to my supportive supervisor, Dr. Isaac Owusu-Dankwa. I unreservedly acknowledge his effective supervision for the successful completion of this work.

On a good note, I also wish to appreciate the efforts of various lecturers of the Kwame Nkrumah University Of Science and Technology-Kumasi in the Department of Distance Learning for the insightful enlightenment on my course of pursuit. In fact most of the knowledge gained in class gave me the confidence to put such compositions like this together.

Finally, I wish to state that I am indebted to colleagues and course mates who through their encouraging words, enabled me to complete this work. Again, I acknowledge my dear wife Mrs. Esther Gyimah Tetteh and all my family members who have contributed in diverse ways to the success of this work.

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LIST OF ABBREVIATIONS

ARPU - Average Revenue per User

BTS - Base Transceiver Station

CAPM - Capital Asset Pricing Model

CDMA - Code Division Multiple Access

CII - Construction Industry Institute

EMV - Expected Monitory Value

ENPV - Expected Net Present Value

GSM - Global System for Mobile Communications

MIS- Management Information System

MNP - Mobile Number Portability

MOU - Minutes of Use

NCA - National Communications Authority

NOC - Network Operations Centre

PMBOK - Project Management Body of Knowledge

PMC - Project Management Centre

PPE - Personal Protective Equipment

RF- Radio Frequency

RFI - Radio Frequency Interface

TDMA - Time Division Multiple Access

UMTS - Universal Mobile Telecommunications System

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Every project has risk components. There are high levels of risk associated with High-tech projects, and these are due to their variability. Every project varies objectively in a significant way in comparison to other projects although there may be similarities between different projects. The fast pace of changes in technology may create highly significant differences between two or more projects. This is however not so with other projects other than technological.

In recent years, intensive research and development has been done in the area of project risk management. It is widely recognised as one of the most critical procedures and capability areas in the field of project management (Artto, et al. 2005). Voetsch, et al. (2000), found a statistically significant relationship between management support for risk management processes and a reported project success. Project risk management is undertaken primarily to improve the chances of a project achieving its objectives. While there are never any guarantees, broader awareness of common failure modes and ideas that make projects more robust can significantly improve the odds of success. The literature on project risk management clearly indicates that the primary goal of project risk management is to develop a credible foundation for each project, and also to examine the feasibility of the project. Construction projects are characterized as very complex projects, where uncertainty comes from various sources (Miller and Lessard 2001). Thus, such projects are associated with a high level of risk.

Risk is defined as the exposure to the chance of occurrences of events adversely or favourably affecting project objectives as a consequence of uncertainty (Al-Bahar, 1990). Dias and Ioannou (1995) concluded that the two types of risks are pure risk and the speculative. A myriad of risk and risk-related definitions are applied to construction projects, and no standard definitions or procedures exist for what constitutes a risk assessment. In the construction industry, risk is often referred to as the presence of potential or actual threats or opportunities that influence the objectives of a project during construction, commissioning, or at time of use (RAMP 1998).

Construction Industry Institute (CII) definitive work on construction risks (CII, 1988) uses classic operations research literature to distinguish the concepts of risk, certainty, and uncertainty, and is consistent with the literature (ASCE 1979; CIRA 1994; Kangari 1995; Hastak and Shaked 2000; PMI 2001; Smith 2001) on what is considered as the sequential procedures for construction risk management: identification, assessment, analysis of impact, and management response.

Risk for the purpose of this study is defined as an uncertain event or condition that results from the network form of work, having an impact that contradicts expectations. An event is at least partially related to other actors in a network (Artto, 2005). The handling of risk in the construction of telecommunication towers varies considerably. This depends on the nature and location of the work, the network operator and contractor involved and the prevailing contracting climate. Each of these varies over time and there are also outside influences such as banks, government's regulations and the insurance market. This study therefore, would look at the various types of risks and how they are managed in the construction of telecommunication towers in Ghana.

1.2 Statement of the problem

Mobile phones and other ICT facilities are vital communication tools for both business and societal development. The growing demand for mobile services has necessitated the increase in communications' infrastructure such as towers; which are needed to ensure that there are adequate network coverage and access that guarantee minimum Quality of Service. However, the very support structures required to enhance the quality of service have also raised public concerns; specifically, issues related to health, aesthetics and safety. The question therefore is; "What are the various risks associated with telecommunication towers and how is risk managed during and after the construction of telecommunication towers?" Construction projects generally face various levels of risks. These are namely; market risks, technology risks, personnel risks, funding risks, organizational risks, process risks, competition risks and regulatory or standards risks. However, in relation to the construction of a telecommunication tower, little or no empirical evidence exists to highlight the associated risks and how they are managed. A better understanding is needed of how contractors manage risk, especially in relation to the construction of the telecommunication towers. Therefore, this research is essential in filling that needed knowledge gap regarding risk management in the construction of telecommunication towers.

1.3 Objective of the Study

The general objective of the study is to find out how risk is managed during the construction of the telecommunication towers in Ghana.

1.4 Specific Objectives

The specific objectives of the study are as follows:

- **i.** To determine how telecommunication towers are constructed in Ghana.
- **ii.** To find out the types of risks associated with the construction of telecommunication towers in Ghana.
- **iii.** To find out how project implementers have managed the associated risks of telecommunication tower construction.

1.5 Research Questions

Further to the problem stated above, the following questions are asked:

1. How are telecommunication towers constructed in Ghana?

2. What are the types of risks associated with the construction of telecommunication towers?

3. How have project implementers of the construction of telecommunication towers managed the associated risks?

1.6 Significance of the study

More importantly, this study would add to existing knowledge on the subject matter. It is hoped that a careful explanation of previous works as well as exploration of new works on tower construction project risks management, would unfold new levels of thinking, dimensions and the outlook on the subject matter.

More knowledge would be built through conscious considerations of prospective paradigms on the issue of the project risk management in tower construction in Ghana. The findings of the study would then provide a wide stock of information for use not only in academia but also by corporate practitioners and other telecommunication sector players in their bid to developing sustainable business climate and risk management techniques. The findings of this study on project risk management modalities are expected to shape the level of thinking and practice of these project risk managers in the telecommunication sector.

The research would also sharpen the skills of both the researcher and other prospective researchers that want to revisit the subject matter. As tangible quantitative and methodology techniques would be explored, an in-depth study of the necessary research tools would in turn improve on the research design skills of the researcher. This would serve as a foundation block for further research work and even a possible research career.

1.6 Scope and limitation of the study

This study is limited to only the Ghanaian setting and to the six (6) major telecom operators in the country, mainly composed of: Glo, MTN, Airtel, Vodafone, Millicom(tiGo) and Espresso. It is of major concern whether limiting this study to only the Ghanaian economy and the six (6) major firms provide enough grounds for generalization and validation of the consistency of this research with other previous works. As Yin (1994) puts it, adopting case study in research is generally accepted. However, generalizing findings, using case study also comes with limitations. Thus restricting the case study to only the Ghanaian economy may not provide a representative sample for generalizing on the issue of "tower construction project risk management in the telecommunication sector". However, this approach simplified and met the academic requirements; Moreover, enough control was gained over the elements (or variables) and the data being observed and analyzed in the study.

Again, data validity issues could be read into the research as a result of the use of questionnaires to sample data for this research. This is a general limitation with the dependence on questionnaires as the main source of primary data for research. During the questionnaire administration, information was sourced from respondents who largely expressed their judgements, beliefs and values in providing answers to the questions presented to them. There was a likelihood of respondents providing unreliable information that could distort the outcomes of the research. Some of the people did not grant any audience at all.

As rightly stated earlier, it is expected that the judgments, beliefs and values of participants would form the source and basis for discussions and measurements in the research. As much as possible, an attempt was made to control subjectivity in the presentations of arguments before drawing conclusions. Information or evidences gathered were objectively examined to avoid possible researcher biases that would affect the validity and reliability of the findings.

1.8 Organisation of the study

The research is organized into five chapters as follows:

i. Introduction.
ii. Literature review.
iii. Methodology.
iv. Results, Analysis and Discussions of Findings.
v. Summary, Conclusions and Recommendations.

Chapter One (1) presents an overview of the research. The chapter covers areas such as the background of the research area, the research problem, objectives, the significance of the study; and the scope and limitations of the study.

Chapter Two (2) covers a discussion of literatures on the topic. Conscious effort shall be made to explain the conceptual frameworks and theories of tower construction risk management in the telecommunication sector.

Chapter Three (3) discusses in detail the methodology that shall be employed in conducting the research; the design and methods used for data collection as well as the approach adapted in analyzing data gathered.

Chapter Four (4) brings out the findings of the research. Data is analyzed and discussed in this chapter through a conscious use of the analytical tools enumerated in the methodology. Finally, chapter five (5) presents a summary of the findings of the research for conclusions and recommendations to be drawn.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the study attempts to provide a comprehensive overview of the relevant existing literature on this subject of study. The study is primarily focused on examining how tower construction project risks are managed in the telecommunication sector. The aim of this literature review is to present previous studies on the subject matter to form the basis of arguments and assertions in the study. Various viewpoints expressed by previous researchers on the subject matter are presented and discussed. Below are definitions of some terms in the study:

Projects

In this study, the definition for a project is aligned with Gido and Clement (2009), who best define the subject as an undertaking meant to accomplish a specific objective through unique sets of interrelated tasks and the effective utilisation of available resources. Any project, whichever form or shape it takes, has well defined objectives or goals clearly stated in terms of scope, schedule and costs. Gido and Clement (2009), affirm in their literature that in most cases, projects evolve when a need is identified by a customer and the business sets out to meet this need.

Project Risk and Project Risk management

Again, for the purpose of this study, the definition and framework of risk and its management is aligned with the earlier submissions of the Project Management Institute. According to the Project Management Institute (2004), a project risk is an uncertain event or condition that, if occurs, has a positive or a negative effect on at least one project objective such as time, cost, scope, or quality (i.e. where the project time objective is to deliver in accordance with the agreed-upon schedule; etc.).

This same literature from the institute further defines project risk management as processes concerned with planning, identification, analysis, response monitoring and control of the uncertainties (risks) surrounding a project. The objectives of Project Risk Management are to increase the probability and impact of positive events, and decrease the probability and impact of events adverse to the project (PMI, 2004). Chapman et al (2003) also specifies the scope of project risk management to involve effective and efficient approaches geared at all the sources of uncertainties being events, conditions, or circumstances that may impact the level of performance of a project. Hence, the practice is not just about managing perceived threats to the success or outcomes of a project but also the sources of these possible uncertainties as well.

Telecommunication towers

According to the Wikipedia (2012), the term telecommunication tower could be used interchangeably as radio mast or simply tower; and it typically refers to tall structures designed to support antennas (also known as aerials) for telecommunications and broadcasting, including television. They are among the tallest man-made structures. In this study, the term cell site, tower and masts are assumed to basically refer to the same item.

2.1 The Telecommunication in Ghana

In recent times, the Ghanaian telecommunication sector has experienced some appreciable boost in investment activities and financial flows considering the observable trends in deals across both fixed and mobile platforms bringing some of the biggest operators in the world to the West African state. The National Communications Authority (NCA) affirms in the latest MNP in Ghana First Year Report (2012) that between 1992 and 2008, six companies were granted license to provide mobile communication services in Ghana. These players in the sector include Millicom (tiGO) Ghana, MTN, Glo Mobile, Airtel and Vodafone Ghana. The report also highlighted that from approximately 2005 onward; growth in the total number of active mobile numbers demonstrated that the telecom market had become competitive and that Ghanaians had come to view mobile telephony as a necessity rather than a luxury (National Communications Authority, 2012). The latest development in the market is the introduction of the Mobile Number Portability Programme in July 2011 by the National Communication Authority, being the major regulatory body in the sector. The Mobile Number Portability (MNP) is a system which allows mobile subscribers to change from one network to another without changing any part of their mobile number (NCA, 2012) According to the published literature by the regulatory body, the first year of MNP operation, experienced over 370,107 mobile numbers having been successfully ported by customers in Ghana representing 1.6% of the total active mobile numbers in Ghana. Inferentially, some objectives of these programmes are towards the creation of a competitive business environment to drive product innovations and consumer satisfaction.

2.2 Telecommunication Towers

Telecommunication towers are the building blocks on which telecommunication thrives. Their cost forms a high part of the Property, Plant and Equipments cost of telecommunication companies.

According to Wikipedia (2012) a **tower** is, typically, a tall structure designed to support antennas (also known as aerials) for telecommunications and broadcasting, including television. They are among the tallest man-made structures.

A cell site is a term used primarily for a site where antennas and electronic communications equipment are placed to create a cell in a mobile phone network (cellular network). A cell site is composed of a tower or other elevated structure regular and backup electrical power sources, and sheltering (Cranfield et al., 2003). A synonym for "cell site" is "cell tower". However, In GSM networks, the technically correct term is Base Transceiver Station (BTS), and in colloquial British English it is termed "base station". The term "base station site" might better reflect the increasing co-location of multiple mobile operators, and therefore multiple base stations, at a single site (Repacholi et al., 1997). Depending on an operator's technology, even a site hosting just a single mobile operator may house multiple base stations, each to serve a different air interface technology (CDMA or GSM, for example).

2.2.1. Tower site selection

According to Mer Telecom (2012), Cellular tower locations are the result of an engineering field called Radio Frequency Engineering or RF, for short. RF engineers work closely with the marketing departments to determine areas where the placement of a new tower will accomplish one (or more) of three goals (Akdag et al., 1999):

- **i.** Expansion: The tower site provides coverage over areas that do not currently have coverage.
- **ii.** Capacity: The tower site provides additional capacity for the carrier to handle more calls in areas where existing towers are overloaded.
- **iii.** Quality: The tower fills in a hole or an area where customer calls are frequently dropped or call service is poor.

According to Vertical Consultant (2012), Cell tower locations are the result of a cell phone carrier working with their internal engineering staff to satisfy specific needs that a company has in certain locations throughout the country. The engineering aspect is classified as “Radio Frequency Engineering” or RF Engineering for short. RF engineers must act in concert with their company’s site development and construction staff to optimize any cell tower site development and related construction projects they may have scheduled.

A cell tower company has a purpose in mind for each cell tower previously built and that will be built in the future. A vast majority of times a tower development project is for the purpose of either meeting the present needs of its cell phone customers or to help increase those same customers' (as well as future customers') usage of their cell phone, internet and other wireless services. So how does the construction of a new cell tower improve a wireless carrier's customer service. The following are some of the ways by which a customer is enriched:

■Signal Strength/Coverage: Cell towers are built to eliminate those locations were that cell phone company's services are lacking, also known as the hated "Dead Spot". RF Engineers determine where there are high rates of service interruptions due to either interference or cell phone signal issues and a new cell tower will be selected and developed to eliminate these dead areas.

■Data Usage Capacity: Cell phones are being used for an increasing amount of purposes, i.e. phone calls, text messaging, data transfer, internet research etc. and other devices like laptops, tablets and even televisions are now using wireless signals. These are the main reasons that new cell tower locations are being constructed to meet these growing data usage needs and requirements.

■Call Clarity & Network Speed: The telecom industry is a complex industry but like most industries it relies upon getting new customers and satisfying the needs of its existing customers. If a cell phone carrier's customers can't make calls or retrieve data, it will not be in business very long. So cell towers must be constructed to make sure the customer needs are met.

Cellular tower locations are the result of an engineering field called Radio Frequency. The tower must serve a specific purpose. The majority of the times, the purpose is to increase the number of minutes that people talk or receive/send data on their phones. The industry refers to this as “Minutes of Use” or MOUs. The main way of increasing MOUs is by placing cell towers or sites in locations that have high daytime working populations. Most carriers have wireless plans that provide cheap or free "off time" rates, so the emphasis is daytime calling minutes which are typically the most expensive (Akdag et al., 1999). To provide coverage for people traveling between particular urban/suburban areas, highways, state roads, and higher traffic zones, local roads are covered by towers as well. Placement of towers at strategic intersections of major roads is often preferred.

Lately, carriers have been adding cell sites in rural areas as well in an attempt to provide ubiquitous coverage (an unobtainable goal for at least 5 years). Sites are located near a major roadway. Rarely do wireless carriers build towers in the middle of nowhere due to the fact that cellular sites must meet one or more of the three goals listed above. Building a tower to cover rural farmland where no one lives for example, does not serve any of these goals (Akdag et al., 1999).

The marketing departments of the wireless carriers are constantly reviewing potential and uncovered areas to determine where to place new towers. Because carriers have capital budgets, the marketing departments and RF engineering departments work together to prioritize those sites that they believe will provide the most benefit to the company in terms of MOUs or quality of service.

2.2.2. Location of cell site

According to Vertical Consultant (2012), the following factors are items that are taken into consideration by a site acquisition agent/cell tower company:

1. **Construction Limitations**– A site acquisition agent will conclude if a site has suitable access and space necessary for construction of a tower. An optimal site will have level terrain with minimal or no ground or airwave obstructions (i.e. tree cover); as the more obstacles the more expensive it is for a tower company to construct on a site. A tower company/carrier will sometimes be willing to pay higher rent for a more suitable site in order to avoid more expensive construction costs on a similar site.
2. **Zoning/Permitting Restrictions**– Prior to a cell phone carrier/tower company getting approval to build on a site they must first get a conditional use permit or special use permit to construct their facility. Most local governments have permitting requirements that will establish parameters on where a tower may be constructed; therefore one property may be able to skate through the approval process while other very similar properties in the same immediate area may not.
3. **Access to Power and Telephone Service**– All tower locations need utility and telephone service. As a result, the farther the distance to telephone service and power, the higher the price tag to the cell tower developer.
4. **Ground Elevation**– Elevation is important, but not the most important factor by far as cost will always outweigh elevation. If you have the highest point in the city or county, that is not a guarantee you will be chosen. The cell phone carrier/tower company always has the option to build a taller cell tower at a lower evaluation as it may be extremely expensive at the end of the day.

5. **Cell Tower Site Alternatives**– All cell phone carriers build tower sites to fit inside their network. Cell towers are very similar to pieces of a puzzle that, at the end of the day, have to fit together. The cell towers are set up to "transfer traffic" from one cell tower to the other. The cell phone carriers have an exact "search ring" that they use when constructing a cell tower, so that it will be able to easily transfer phone traffic. These search ring areas can be as small as 0.25 mile to as large as 5 miles.

A site should be large enough for a cell tower—normally (but not always) this is a parcel double the size of the height of the tower. So if a tower is 100 ft tall, the parcel must be 200' x 200'. Sites must have easy and cheap access from a public road. The site must be suitable from a zoning perspective. In many jurisdictions, towers are only allowed on commercially or industrially zoned parcels. Some areas allow towers on agriculturally zoned sites, and most do not allow towers on residential or forest land and restricted areas (Laurence et al., 2000; AGNIR, 2001).

Sites must not have conditions that would make constructing a tower unduly expensive. These conditions can include wetlands, poor or rocky soil conditions, significant distance to the cell tower site from the main road, lots of trees, possible hazardous waste on the property and high voltage power lines (Laurence et al., 2000; AGNIR, 2001). Landowners must be willing to lease the site at rates acceptable to the wireless carrier. One thing to note is that, contrary to public belief, the ground elevation is not the most important factor. Just because you live on the tallest or second tallest hill in the area or county does not mean that your location is preferred from a wireless perspective, unless the location is in a "Search Ring." Generally, in areas where there are enough cell sites to cover a wide area, the range of each one will be set to (Laurence et al., 2000; AGNIR, 2001):

i. Ensure there is enough overlap for "handover" to/from other sites (moving the signal for a mobile device from one cell site to another, for those technologies that can handle it - e.g. making a GSM phone call while in a car or train).

ii. Ensure that the overlap area is not too large, to minimize interference problems with other sites.

In practice, cell sites are grouped in areas of high population density, with the most potential users. Cell phone traffic through a single cell mast is limited by the mast's capacity; there are a finite number of calls that a mast can handle at once. This limitation is another factor affecting the spacing of cell mast sites. In suburban areas, masts are commonly spaced 1–2 miles (2–3 km) apart and in dense urban areas, masts may be as close as ¼-½ mile (400–800 m) apart. Cell masts always reserve part of their available bandwidth for emergency calls (Smash, 2012).

The maximum range of a mast (where it is not limited by interference with other masts nearby) depends on the same circumstances. Some technologies, such as GSM, have a fixed maximum range of 40km (25 miles), which is imposed by technical limitation. As a rough guide, based on a tall mast and flat terrain, it is possible to get between 50 km to 70 km (30-45 miles) (Cranfield et al., 2001; Di Carlo et al., 2002). When the terrain is hilly, the maximum distance can vary from as little as 5 km to 8 kilometres. The concept of "maximum" range is misleading, however, in a cellular network. Cellular networks are designed to create a mass communication solution from a limited amount of channels (slices of radio frequency spectrum necessary to make one conversation) that are licensed to an operator of a cellular service (Zunia, 2012).

In order to overcome this limitation, it is necessary to repeat and reuse the same channels. Just as a station on a car radio changes to a completely different local station when you travel to another city, the same radio channel gets reused on a cell mast only a few miles away. To do this, the signal of a cell mast is intentionally kept at low power and in many cases, tilting downward to limit its area. The area sometimes needs to be limited when a large number of people live, drive or work near a particular mast; the range of this mast has to be limited so that it covers an area small enough and does not to have to support more conversations than the available channels can carry (Cranfield et al., 2001; Di Carlo et al., 2002).

2.2.3. Managing the Cell Tower Projects

Specific to telecommunication projects, project management consists of managing all the activities of a given project right from site survey to site integration. This helps an operator/client in having optimum man-power and relying on the Project Management in executing the project successfully in time. Almost all sites are unique with regard to the building process, vagaries of weather, unforeseen risks, remote area problems, and lack of communications. It entails basic functions of planning, scheduling, monitoring and control (Zunia, 2012).

Figure 2.0– A figure showing a typical cell site that has an RF surge protection and a power distribution panel (Adopted from www.idirect.net)

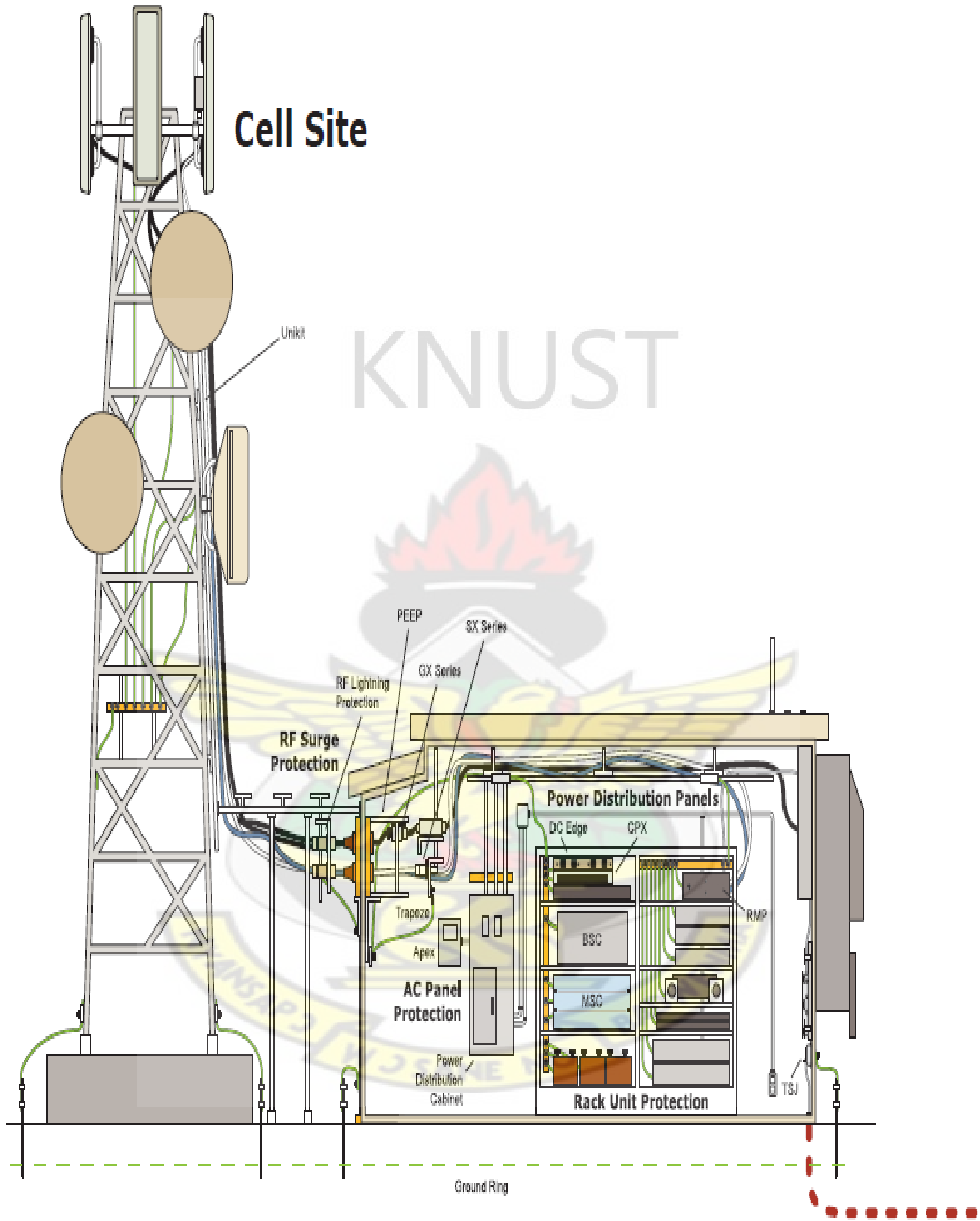
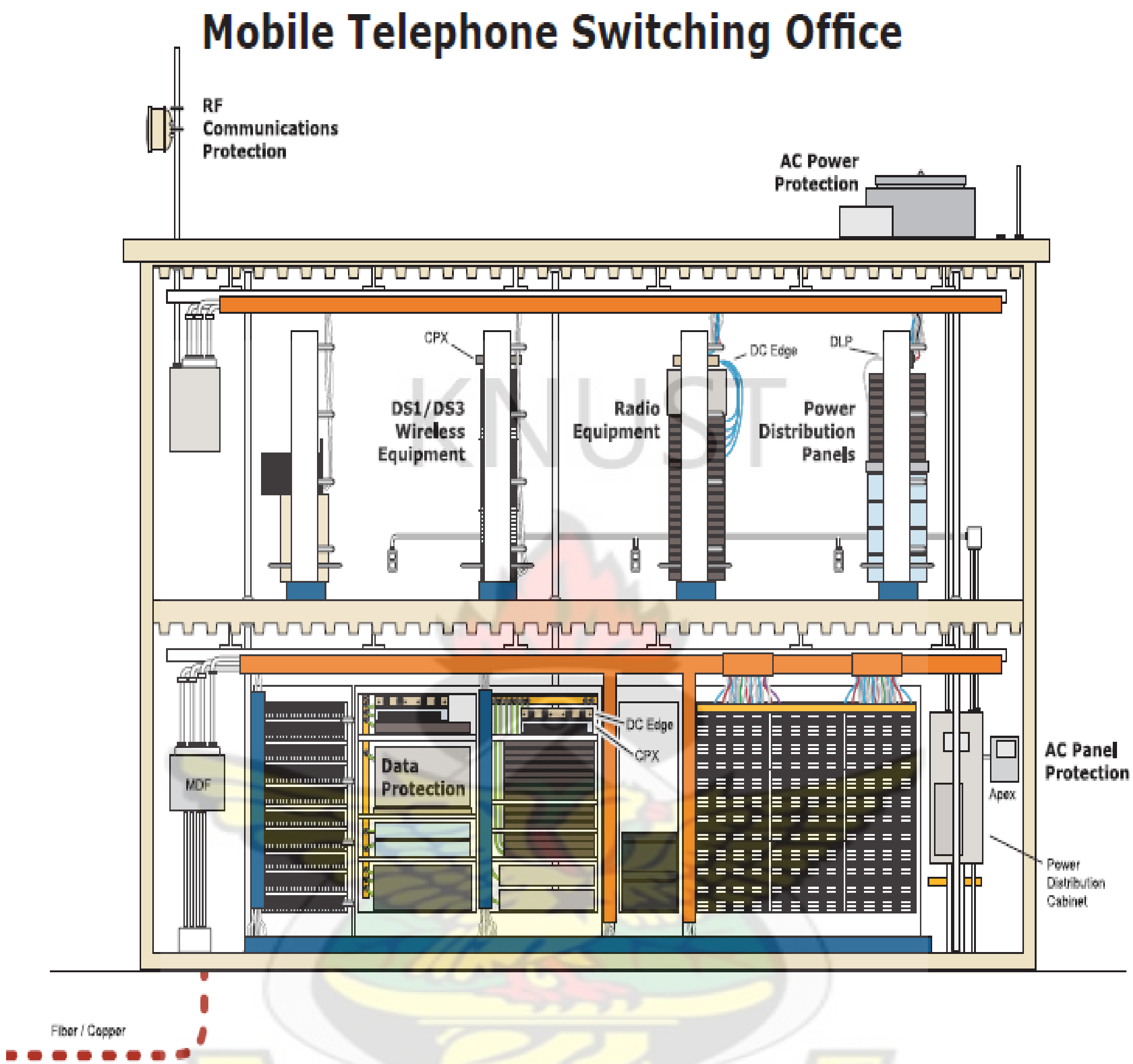


Figure 2.1- A figure showing a typical cell site that has a mobile phone switching office (Adopted from www.idirect.net)



The planning function involves listing of all tasks essential in the completion of the project. Scheduling consists of sequencing of tasks according to their precedent time and expected times (Di Carlo et al., 2002). Monitoring and control is the review and correction of the difference between the schedule and actual work performance of the activity. Monitoring and control involves four steps:

i. Measuring: Tells us the status or the progress of work package during the construction.

ii. Reviewing: Measuring or progress leads the construction management to plan again and reschedule to make a more efficient action plan.

iii. Reporting: The progress report and revised action plan is reported to senior management for their approval and study. A proper scientific method is adopted in reporting, which is popularly known as management information system (MIS). The success or failure of a project largely depends upon the extent of efficiency of MIS. This is the controlling lever of construction management.

iv. Action; Action is taken as per revised plan by the project office. It controls four Ms i.e. Money, Manpower, Machinery and Material. And also, time and quality.

2.2.3.1. Scope of Work

The scope of work on the construction of a telecommunication tower has to do with every process that must be followed from the conception of the idea to construct a tower until the tower is up for use.

Scope of Work according to the business dictionary (2012), is 'the division of work to be performed under a contract or subcontract in the completion of a project, typically broken out into specific tasks with deadlines'. Scope of work includes design, supply & installation of telecom towers, monopoles and construction of boundary walls & chain link fencing with allied works Oman (2012).

Scope of work consists of following activities (Di Carlo et al., 2002) :

i. RF and site survey

ii. Site Lay-out & Marking

iii. Obtaining no objection certificate for setting up cell site

iv. Liaison with State Electricity Boards for obtaining required power

v. Contracting and identifications of risks

vi. Soil testing ,structural design and layout of ground based sites

vii. Structural analysis of existing buildings and layout of roof top sites

viii. Finalization of specifications for equipment, works in consultation with technical and commercial teams

ix. Preparation of bill of quantities and bill of services.

x. Preparation of schedules in co-ordination with all suppliers.

xi. Plan & scheduling of equipment and inform to warehouse & logistics department

xii. Monitoring all the activities on daily basis and reporting through a MIS (including critical area and critical activity analysis).

xiii. Warehouse management

xiv. Provision of Security at Site.

xv. Supervision of Civil, Electrical, Tower and other equipment installations

xvi. Quality inspections and punch points

xvii. Site RFI

xviii. Co-ordination with all suppliers and Subcontractors for liquidation of punch points

xix. Documentation

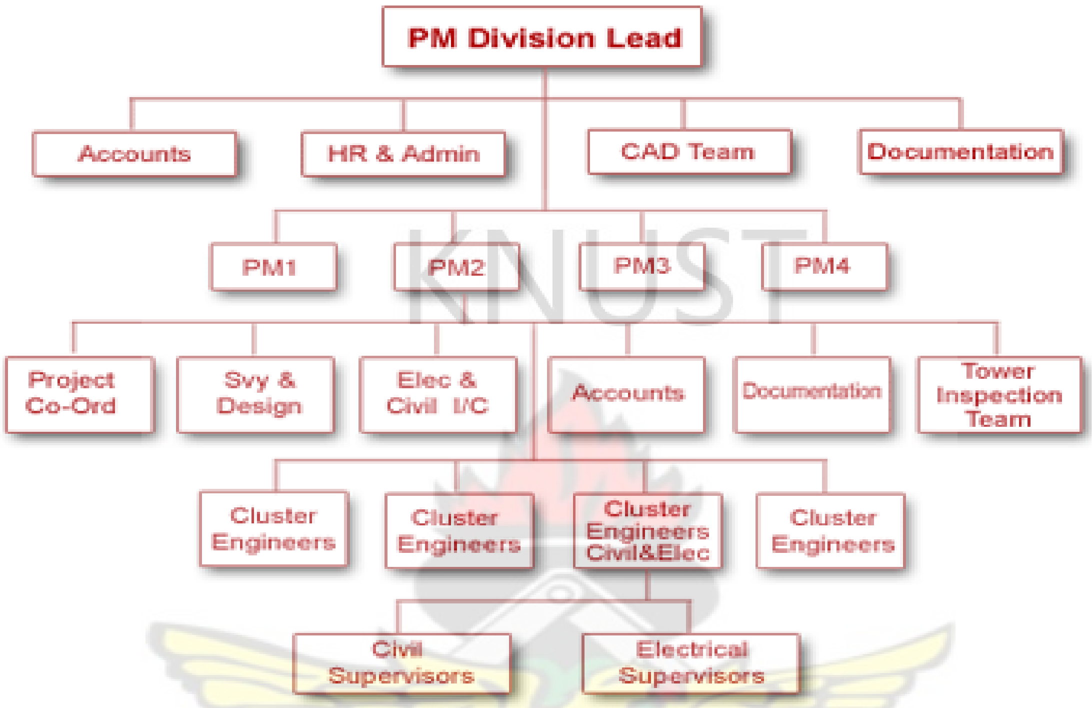
xx. Final inspection & Handing over of site

xxi. Bills verification and certification

2.2.3.2. Project Team Organization Structure

The project management team is organized to cater for various activities covered in the scope of project management of cell sites as per the customer requirements. Project management structures can take varied forms to suit the demand of specific projects. The PMC general organization structure is as follows as identified in Leszczynski et al., (2002).

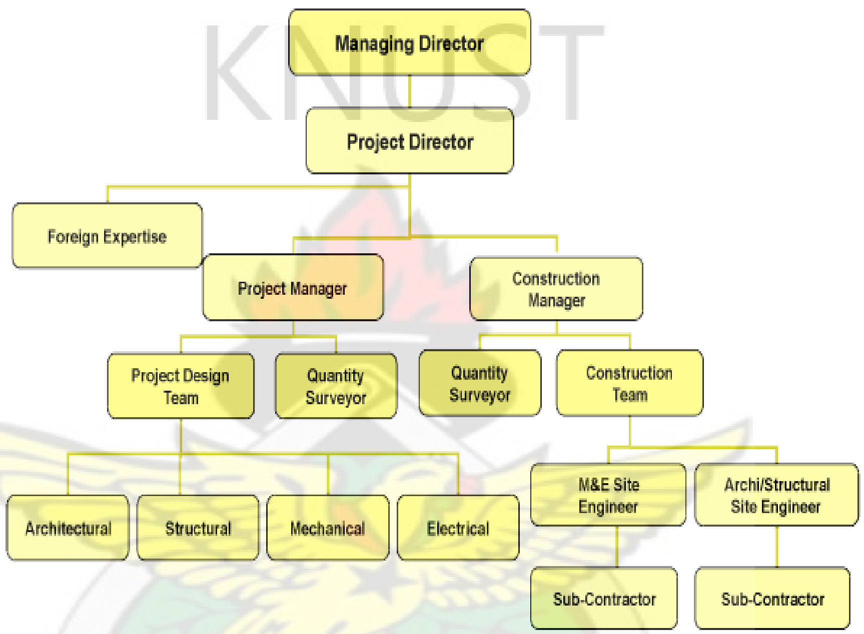
Figure 2.2 A Chart showing an organisation structure for a typical communication tower construction organisation (Adopted from Satyanarayana, 2008)



Another typical structure is that of ACP Construction PTE Ltd.

Figure 2.3 A Chart showing project management structure-Design and Build Teams for ACP Construction (2009).

Management of Projects - Structure of Design and Build Teams



2.2.3.3. Radio Frequency (RF) and Site Survey

Radio Frequency transmission is dependent on the location of a cell site tower. Site survey is therefore, undertaken in order to determine the ideal site for the construction of a telecom tower.

Cellular tower locations are the result of an engineering field called Radio Frequency Engineering or RF, for short (Laurence et al., 2000; AGNIR, 2001). RF engineers at the various wireless companies work closely with their marketing departments to determine areas where the placement of a new tower will accomplish one (or more) of three goals:

i. Expansion: The tower site provides coverage over areas that do not currently have coverage.

ii. Capacity: The tower site provides additional capacity for the carrier to handle more calls in areas where existing towers are overloaded.

iii. Quality: The tower fills in a hole or an area where customer calls are frequently dropped or call service is poor.

2.2.4. The benefits of RF Optimization

i. Network quality resulting in higher speech quality index

ii. Satisfied customers resulting in low churn.

iii. Efficient network utilization resulting in reduced investment cost.

Figure 2.4 A process map for the construction of a communication tower (Adopted from Satyanarayana, 2008)

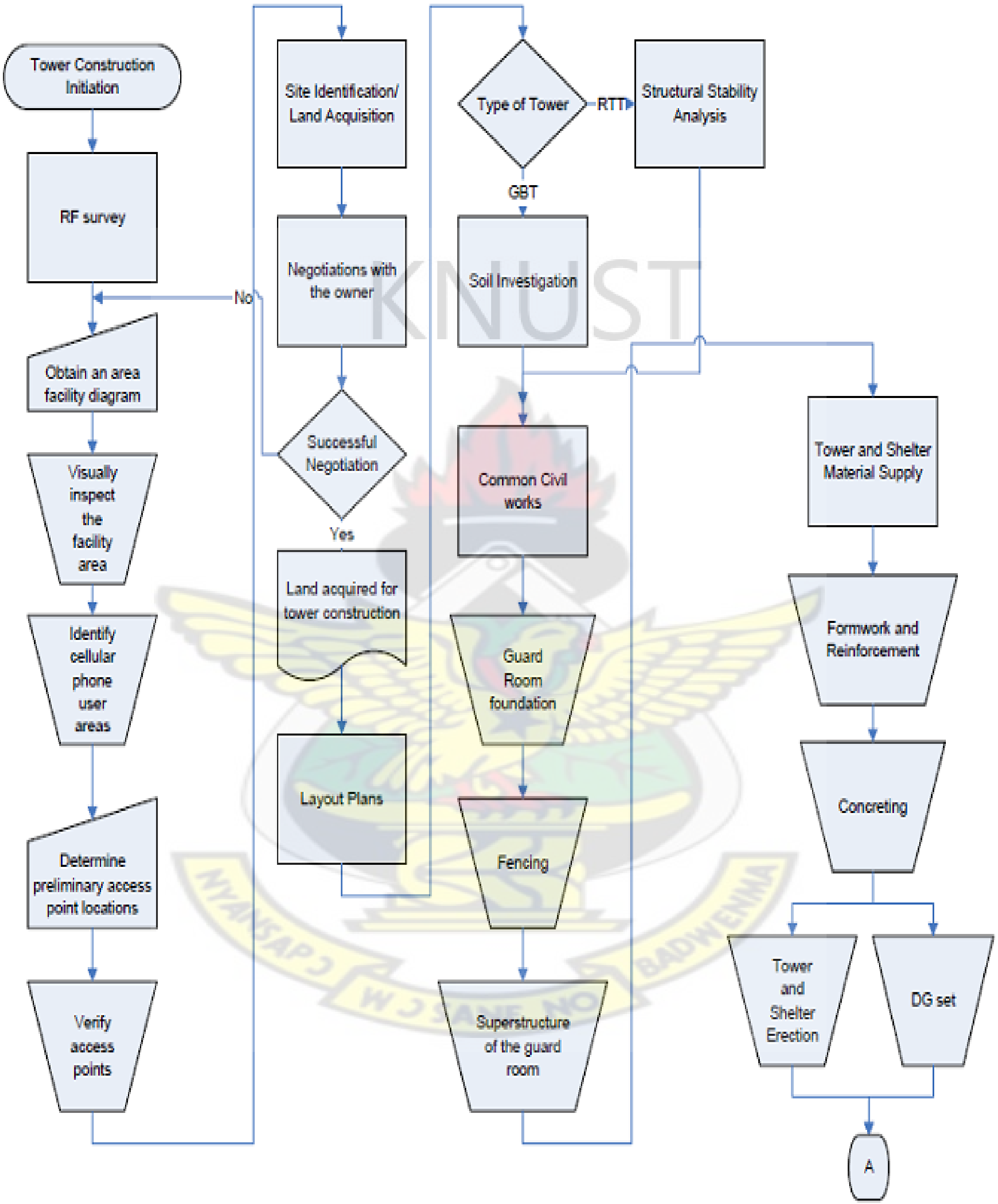
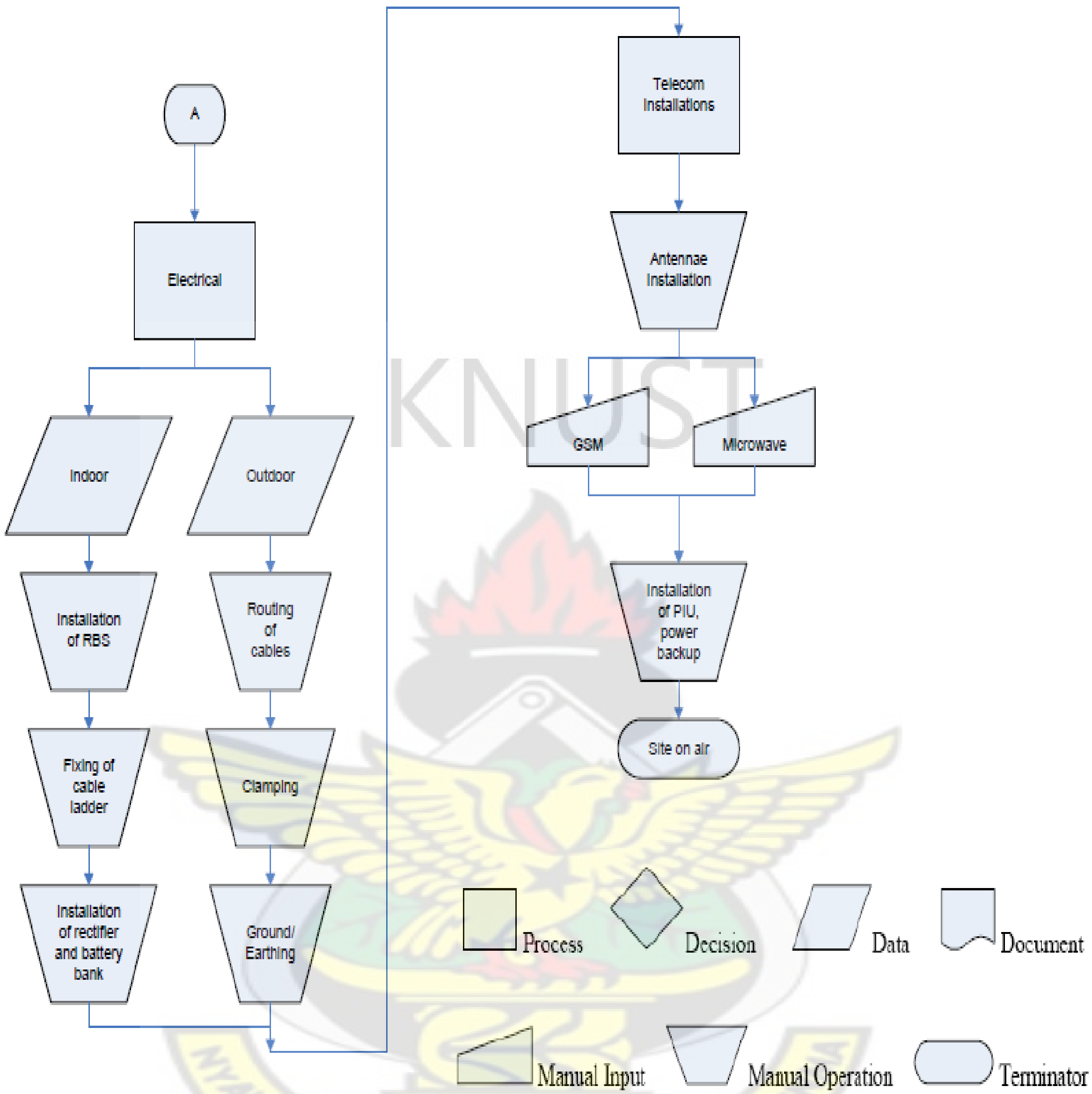


Figure 2.4 A continuation of the process map for the construction of a communication tower (Adopted from Satyanarayana, 2008)



2.3.0. The Cell Site Installation Process

Most network operators follow the same process when rolling out or expanding their network. Complex radio planning tools are used to analyse the area to be covered. These import large databases of geographical information including the topology of the landscape including hills, buildings and vegetation. A simulation is run which identifies the best locations for cell sites to be added. Operators have two separate targets for their plans: coverage (i.e. being able to use your phone in any part of the country, including inside buildings, cars, moving trains etc) and capacity (i.e. ensuring there are enough traffic channels for everyone in an area to make and receive calls) Chambers (2008).

2.3.1. Site build-up process

Site build-up process constitutes every step undergone in order to select a site for the construction of a telecommunication tower. This is a role performed by RF engineers.

The comprehensive site acquisition and installation process helps to deliver high quality and cost effective services to the customers. Based on a rollout plan and requirements of respective companies, potential sites are located. Site acquisition teams narrow down the best feasible locations through RF planning tools, field survey, real estate agents, references, and existing cell site owners (Laurence et al., 2000).

Thereafter, internal technical department comprising planning, civil & acquisition team to assess the suitability in terms of radio coverage, soil & structural suitability and optimal site shares opportunities with other potential service providers is put in place (AGNIR, 2001). Based on the clearance report from the internal technical department, a suitability survey is again carried out by RF Transmission & Electrical teams to assess the suitability from the point of view of Line of Sight & Electrical Requirement, including back up power through DG sets.

After the site is technically selected, commercial negotiations are initiated with the property owner. The commercial negotiation includes cost/ rent, advance, security deposit etc. It will also include due diligence of property documents, period of lease/ rent, escalation conditions and 24 hour accesses to the site to carry out routine and emergency maintenance. Other risks like institutional land, defense area, land for religious purpose, land use rights etc. will also be considered during the due diligence and a risk mitigation strategy will be appropriately developed Zunia (2012).

Once commercial terms and conditions are finalized with the site owner and internal approval is obtained, Network Operating Centre (NOC) is required to be collected from site owner to ensure that he does not pose any resistance while integrating the cell sites (AGNIR, 2001).

In addition to other terms, NOC contains the following essential clauses:

- Owner is the legal heir of the property and the same has not been mortgaged or is not under dispute.
- Agrees to give out on lease/rent as per mutually agreed terms and conditions.
- Will not sell the property during the duration of the agreement.
- The company is permitted to undertake and execute all activities required for development of cell site.

After receiving NOC from the site owner, all necessary clearance/ documentation are obtained from legal/ government authorities (AGNIR, 2001). Once all documents are in place, the site is handed over to the site development team to construct the tower and all accessories including shelter, DG, HVAC etc.

2.3.2. Electricity Power Connection

Immediately after the site is handed over to the site development team, action is initiated to obtain power connection from respective state electricity boards. It is essential that the connection is taken expeditiously as operating the site on DG is nearly 30-35% more costly than on power through Electricity boards (Bortkiewicz et al., 2004). Obtaining the connection involves following activities:

- Preparation and submission of applications
- Estimation by the state electricity boards
- Payment of the estimated amount including security deposit
- Release and provision of permanent connection

2.3.3. Contracting and Identifications of Risks

Specific to GSM/CDMA projects where the cell sites are spaced wide apart and located in various types of terrains under different climatic conditions, it is imperative that the contract terms and conditions cater for the site and location specific conditions (Santini et al., 2002).

Thus the need to investigate the project in depth by reliable, committed, financially strong and technically competent construction consortium.

Certain changes are generally found necessary, varying from the quality and nature of work from those agreed upon by the parties. The need is therefore, to resolve these variations before they manifest into disputes. Effective resolutions of variations arising out of variations during the execution of project has been an area of concern as significant number of projects suffer in terms of time, cost and quality performance due to obstruction in project objectives on account of conflicting individual interests (Santini et al., 2002).

2.3.4. Identification of risks

Risk identification according to the Business dictionary.com (2012) is 'determining what risks or hazards exist or are anticipated, their characteristics, remoteness in time, duration period, and possible outcomes'.

The Risk Identification process identifies and documents risks that might affect the project. Project manager, team members, subject matter experts, customers, end users, other project managers, stakeholders, and risk management experts are involved in risk identification PMI (2012).

Risk is an unforeseen event, which is abstract in nature and is difficult to measure with precision or accuracy. It results in loss in terms of time, money, materials, manpower, machinery and other associated activities. Risk will apply to price, weather, inflation, strikes, labor problem and other aspects of projects. Risk can therefore be defined as "exposure to the possibility of economic and financial loss or gain, physical damage or injury or delays as a consequence of uncertainty associated with perusing particular course of action" (Bortkie wicz et al., 2004). Undertaking GSM/CDMA project is fraught with risks and obstacles owing to the very nature and terrain of the project. This results in additional cost of remobilization, reworks, additions and alterations.

Project implementers therefore find it imperative to put in place necessary processes to aid in the identification of project risk.

2.3.5. Documentation

Documentation supports the configuration management of scope control discussed earlier. It makes certain that project design and baseline documentation, including contract drawings, specifications, budget, and schedule, are maintained and revised throughout the design, bid, procurement, construction, and closeout phases of the project with the required standard of security, integrity, quality, and currency. Document control tracks actions to ensure that changes to the baseline documents are evaluated and approved and that the integrity of the baseline documentation is maintained as changes are executed.

The project manager should make certain that the project's document control process identifies who on the project management team has the authority and accountability for ensuring that each of the baseline documents is kept current in compliance with the project's configuration management and document control procedures (Gannett, 2009).

The need to specify the type of documents, the format, and acceptance and certification procedures needs no emphasis. It directly affects the payment terms and thus the cash flow. GSM/CDMA projects demand considerable outlay of funds and therefore it is imperative that the revenue generation is expeditious and procedure for releasing the payment is documented before commencement of the project (Zunia, 2012).

2.3.6. Non-Availability of Sites

Non-availability of site is a situation in which site earmarked for tower construction is either reclaimed by site owners or is rendered not in line with regulatory guidelines or any other reason for which a site cannot be used for tower construction.

Non-availability of sites, cancellation, sites on hold and disputed sites have an adverse effect on the roll out plan. Many a timework has stopped after a major portion has been completed. Remobilization of teams and machinery is not only time consuming but also results in avoidable expenditure (Zunia, 2012).

2.3.7. Change in Specifications.

Change in specification is also known as 'variation orders' in construction projects.

(PAM 98), define variation as an alteration or modification of the design, quality or quantity of the works as shown in the contract drawings and described by or referred to in the contract bills.

Due to the very nature of the project, changes in specifications occur. The need is to investigate the project in department at its pre tender stage in order to avoid changes as repeated changes result in dismantling of existing facilities and executing the new works causing delay and additional cost both directly and indirectly (Zunia, 2012).

2.3.8. Tenancy

This process involves negotiations on rental or leasing periods and fees together with conditions during and after the leasing period.

During the preliminary survey, certain sites are selected based on the anticipated traffic and location. However during the course of construction, priorities or/and the requirement of the service providers change resulting in rescheduling the project or a delay in renting out the cell site, especially in proactive sites (Zunia, 2012).

2.3.9. Integration of supply of material

This process involves the proper monitoring of materials and working capital in order to prevent material unavailability and project delays.

Diverse kinds of material and equipment are supplied by respective agencies and their delivery is coordinated with the progress at respective sites. Any delay in supply of material not only delays the project but also results in idle labor and increase in both direct and indirect costs. To avoid this, it is important that prequalification of vendors are done after in depth verification of their capabilities and financial worthiness. The contractor should have reserve funds to tide over the financial crunch so as to manage working capital cash flow (Zunia, 2012).

2.3.10. Soil Testing

Soil testing involves the assessment of the sub-soil on which a potential site could be built. It is essential to undertake field and laboratory investigations to assess the nature of sub-soil strata and to evaluate the bearing capacity and other parameters suitable for construction of foundations at cell sites (Zunia, 2012).

2.3.11. Design

Tower design is a role performed by RF engineers. It involves developing a sketch of a potential cell site tower to fit into the already existing tower programs.

Design should be simple, flexible executable on ground, standardized as far as possible and should cater for site and location specific constraints and requirements. The commitments and decisions during design phase have a very high level of influence on the project cost as any alterations result in avoidable reworks and disruption of work (Zunia, 2012).

2.4.0. Project Risk Management

Every organization faces a number of risk which could be potential or known. Project risk management involves some form of approach developed to avoid, mitigate or handle potential or known risk.

2.4.1. The concept and formal definitions of project management

Rodrigues (2001) in his work on "Managing and Modeling Project Risk Dynamics A System Dynamics-based Framework", affirms that the current framework for discussing project risk management is that which the latest 2000 edition of PMI's Project Management Body of Knowledge (PMBOK; PMI 2000) considers as the six risk management processes of planning, identification, qualitative analysis, quantitative analysis, response planning, and monitoring and control.

In a similar perspective Duncan (1996) argues that the framework identified by the project management institute interacts with each other. However, a caution was raised by Duncan (1996) that although the processes are presented as discrete elements with well defined interfaces, in practice, they may overlap and interact in deferent other ways altogether. Risk identification and risk quantification are sometimes treated as a single process and the combined process may be called risk analysis or risk assessment (Duncan, 1996).

The discussion on the concept of project risk management is concluded with the definition advanced in literature from the PMI (2004) as the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project; and of which most of these processes are updated throughout the project. It is well noting from the literature that the objectives of Project Risk Management are to increase the probability and impact of positive events, and decrease the probability and impact of events adverse to the project. It is also worthy of note that as earlier affirmed in Chapman et al (2003); the practice of project risk management is not just about managing the perceived threats to the success or outcomes of a project but also the sources of these possible uncertainties as well.

In another more elaborate outlook, project risk management may be considered as "a systematic way of looking at areas of risk and consciously determining how each should be treated. It is a management tool that aims at identifying sources of risk and uncertainty, determining their impact, and developing appropriate management responses" (Uher, 2003). This systematic process of risk management has been divided into risk classification, risk identification, risk analysis and risk response, where risk response has been further divided into four actions, i.e. retention, reduction, transfer and avoidance (Berkeley et al., 1991; Flanagan and Norman, 1993).

It is well noting that the task of project management is so far recognized in literature as involving the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed customers'/clients' needs and expectations from the project. Meeting the need of the client invariably involves balancing competing demands among (Cranfield et al., 2001):

- Scope, time and cost.
- Identified requirements (needs) and unidentified requirements (expectations).

2.4.2. Review of the PMBOK Guide to Project Risk Management – Main Authority on Project Risk Management

The Project Management Institute (2004) has a provision for project risk management (PRM) in it guide. In it is stated that, the objectives of PRM are to increase the probability and impact of positive events, and to decrease the probability and impact of events adverse to the project. The risk identification process, which usually leads to the qualitative risk analysis process, is an iterative process of determining which risks might affect the project and documents their characteristics. The PMBOK guide also outlines inputs, tools, and techniques that may be used to identify and quantify risks.

According to the guide, PRM includes the processes concerned with conducting Risk Management Planning (deciding how to approach, plan and execute the risk management activities of the project); Risk Identification (determining which risks might affect the project and documenting their characteristics); Risk Analysis (see below); Risk Response Planning (developing options and actions to enhance opportunities, and to reduce threats to project objectives); and Risk Monitoring and Control (tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle).

The primary outputs from a risk identification exercise may be entered into a risk register, which typically contains: a list of identified risks; list of potential responses; root causes of risk; and updated risk categories.

According to the PMBOK literature, risk analysis involves two main aspects, namely Qualitative and Quantitative:

i. **Qualitative Risk Analysis:**

Qualitative Risk Analysis covers the methods for prioritizing identified risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact. The tools and techniques for qualitative risk analysis include (1) risk probability and impact assessment; (2) probability and impact matrix; (3) risk data quality assessment; (4) risk categorization; and (5) risk urgency assessment. The inputs required for a qualitative risk analysis are (a) organizational process assets; (b) project scope statement; (c) risk management plan; and (d) risk register.

ii. **Quantitative Risk Analysis**

This technique numerically analyses the effect of risk on overall project objectives of identified risks that have been prioritized by the qualitative risk assessment process. The inputs/information required for a quantitative risk analysis are (1) organizational process assets; (2) project scope statement; (3) risk management plan; (4) risk register; and (5) project management plan. The tools and techniques for quantitative risk analysis include (a) data gathering and representation techniques – interviewing, probability distribution, and expert judgement; (b) quantitative risk analysis and modelling techniques – sensitivity analysis, expected monetary value analysis, decision tree analysis, and modelling and simulation techniques.

2.5.0. Formal and Analytical Risk Models in Construction

Analytical models could best be seen as the framework within which ideas and thoughts are presented on a subject matter. Models are not ends in themselves but are only used to represent thoughts of how the real world works.

2.5.1. Evolution of analytical risk models in construction

Formal risk management, which is the systematic process comprising risk identification, risk assessment (analysis and evaluation) and risk response (monitoring and control) evolved in the 1960s as the best practice theory for successful response to the risks in a project (Edwards and Bowen, 1998). However, a review of leading construction journals such as Construction

Management and Economics (CME), International Journal of Project Management (IJPM) and ASCE Journal of Construction Engineering and Management (JCEM) shows that the proliferation of mathematical risk models actually started in the 1980s.

The earliest analytical propositions were published in the American Society of Civil Engineers' JCEM, for example in Gates (1971), Vergara and Boyer (1977) and Ibbs and Crandall (1982). This journal was first of all known as the Journal of the Construction Division (JCD); the name was changed to Journal of the Construction Engineering Division (JCED), then to its current name. More than 25 of the models examined and classified were identified in this journal alone.

The leading UK journals such as Construction Management and Economics (CME) and International Journal of Project Management (IJPM) both started being published in 1983. The first risk paper to be published in CME was the one by Beeston (1986). Although this paper did not introduce a mathematical model per say, it focus on showing how to combine risks in estimating probably generated interest in the topic prompted the development of techniques that enhance the ability to deal with risks logically, as for example in Al-Bahar and Crandall (1990).

Within the CME journal, more contributions on the topic of risk assessment and pricing came from authors such as Kangari and Riggs (1988) and Skitmore et al. (1989) but it was Birnie and Yates (1991) who first explored the potential of using techniques such as decision trees, utility theory and the Monte Carlo simulation technique to model risks in order to improve human judgement in construction cost prediction. In total, the journal has published over 20 risk models intended solely to help contractors estimate various forms of bidding contingencies.

Before the aforementioned UK journals were introduced in the 1980s, risk publications had long appeared in the much older periodicals of the American Society of Civil Engineers like JCEM for example. However, as Kangari and Riggs (1988) would note, the major application of portfolio theory to risk management in construction projects was by Vergara and Boyer (1977). However, prior to this, Gates (1967) had presented a model for quantifying, in monetary terms, contingencies for bidding mistakes, subjective and objective uncertainties, and chance variations.

In his study, Dressler (1974) discussed how risk factors could be incorporated into the production sequence of segments of a linear site through a projected construction time, while Vergara (1974) supplied a model for monitoring changes in expected cost as a result of varying precision and variation in risk of a project as it progresses. There were further contributions by Spooner (1974) and Neufville et al. (1977). Altogether, over 25 risk models intended to help contractors in estimating various forms of bidding contingencies have been counted in the JCEM alone. These journals came long before others like Engineering, Construction and Architectural Management (ECAM), which was introduced in 1994.

One seminal study in ECAM is a review paper by Edwards and Bowen (1998) on the future directions of risk management theory and applications in construction. Journals in which some other contributions were found include the Journal of Construction Procurement (JCP), CIB Journal of Construction Engineering (JCE) and Journal of Asian Architecture and Building Engineering (JAABE) that published a fault tree analysis-based risk analysis model for building projects by Tsai et al. (2002).

2.5.2. Risk pricing in economics and finance

Economists and financial analysts have traditionally relied on the capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966) to price risk.

Given certain simplifying assumptions, the CAPM states that the rate of return on any security is linearly related to the security systematic risk (or beta) measured relative to the market portfolio of all securities. The CAPM relies on many assumptions. For example, that investors have the same information, and this information is costless to gather and process. In addition, there should be no taxes, transaction costs, or other frictions. It also assumes that investors can borrow and lend at the risk-free rate of interest. The model takes into account of the tendency for an asset to co vary with the market portfolio, and represents the non-diversifiable risk that investors are compensated for bearing, i.e. the unsystematic risk Laryea and Hughes (2009).

The CAPM is appealing in its elegance and logic. However, empirical tests of the model often raise doubts about its underlying assumptions. For example, Brenpan (1970) and Litzenberger and Ramaswamy (1979) relaxed the “no tax” assumption. Breeden (1979) and

Merton (1973) made further extensions to the CAPM. Ross (1976) developed an entirely new model called the Arbitrage Pricing Theory. Clearly, the model's focus on the market rather than total risk is a good way of thinking about the usefulness of assets in general. But it is unknown precisely how to measure any of the inputs required for using the CAPM. The inputs should all be ex-ante, yet usually only ex-post data is available. Although it may be useful in the finance industry, when we turn to construction, there is often little historical data on projects Laryea and Hughes (2009) .

This situation has been the foundation for the calls to focus risk assessment models on the linguistic data that can more readily be obtained from experts and people with the relevant knowledge (Kangari and Riggs, 1989; Al-Bahar and Crandall, 1990). Outputs of the CAPM are often subject to potentially large errors since historical data for beta coefficients (the actual measure of the risk) vary depending on the time period and the methods used to estimate them.

According to Dubofsky and Miller (2003), one of the methods for managing risk other than just the beta coefficient of portfolios is the use of derivatives. The authors explain that a derivative is a financial contract whose value is 'derived from' or depends on the price of some underlying asset. They go on to say that the value of a derivative changes when there is a change in the price of the underlying related assets. Four of these instruments are defined here: forwards, futures, swaps and options. A forward contract gives the owner the right and the obligation to buy a specified asset on a specified date at a specified price. The seller of the contract must then sell the asset on the date for that specified price. At delivery, ownership of the good is transferred and payment is made. Thus, whereas a forward contract is originated today, and the price is agreed upon today, the actual transaction in which the underlying asset is traded does not occur until a later date. Secondly, a futures contract has a similar arrangement except that rights under such an agreement can be transferred to third parties, and therefore futures are traded on organized exchanges and are more liquid than forwards. Swaps are contracts between two parties to exchange cash flows at future dates according to prearranged formulae. Lastly, an option is a contract entitling the holder to buy or sell a designated security at or within a certain period at a particular price (Rubenstein 1983, Brennan 1986).

However, due to the sophistication of the finance sector, practitioners of the construction sector often use mechanisms such as a fixed single percentage or an overall lump sum based on intuition and experience to price for the risk in construction projects (Baloi and Price, 2003). Similar to shortcomings in the application of the CAPM, Williams (1996) exposes the inaccuracies, despite a general acceptance, of reducing a wide range of potentialities and contingencies down to one measure of project management risk as a function of probability multiplied by impact. Unsurprisingly, the Project Management Institute (2004) also advocates the application of this approach (and a probability and impact matrix) for the quantitative assessment of project risk. The model may not predict accurate forecasts of risk. However, its use is still encouraged in practice.

2.5.3. The fundamental approach for evaluating risk and its limitations

Project management risk is fundamentally evaluated on the basis that one measure of a risk equals its probability times its impact (Turner, 1992). According to Zhi (1995), "…the risk concept is broken down into two main criteria: probability, and impact." However, there are significant limitations associated with the use of the fundamental Profit Impact (PI) risk model. According to Williams (1996), "Calculating 'expected' risk as probability multiplied by impact has limitations and ranking risks according to this figure is misleading. Computerized 'risk lists' thus ranked should not be relied upon. Both probability and impact must be considered at all times."

Thus, it can be seen that the fundamental approach for taking an objective account of project management risk is flawed in a way that Williams (1996) describes clearly. However, this theory is the basis of most analytical risk models. To date, the problem is still not resolved in the project management literature. To little avail, authors like Ward (1999), Williams (1993), Wynne (1992) and Charette (1989) tried to present alternative solutions which minimize the error associated with combining and comparing two or more risks according to the fundamental PI mode.

2.5.4.1. Risk Management Models in Construction

Formal and analytical models developed to help contractors assess and price project risk at the tender stage have existed for over 37 years. Indeed, the first major journal paper identified in relation to risk pricing approaches for contractors was by Gates (1971).

Little attention has been focused on a precise definition and evaluation mechanism for project management risk specifically related to contractors. The Project Management Institute (2004) defines risk as an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality. However, three risk definitions taken from both the construction management and finance literature may help to better understand risk in the context of contractors.

First, in developing a systematic influence diagram-based model for contractors risk analysis at the tender stage, Al-Bahar and Crandall (1990) described risk as "an exposure to the chances or occurrences of events adversely or favourably affecting project objectives as a consequence of uncertainty". Second, a practitioners' textbook prepared on behalf of the Aqua Group by Hackett et al. (2007) defined risk as "the possible loss resulting from the difference between what was anticipated and what finally happened". Third, a financial analysis and management textbook by Fisher and Jordan (1996) defined risk as "the possibility that realized returns will be less than the returns that were expected". Thus, risk may be understood in the context of contractors as a positive or negative deviation to expected profit. This aligns with Chang and Tien's (2006) definition of risk as "a measure of the probability and consequence of not achieving a goal."

Risk is not the same as risks, although the terms are often used interchangeably in the literature. While risk is the deviation to an expected outcome, risks are the actual deviation-causing events, Laryea and Hughes (2009). As explained in a financial analysis textbook by

Fisher and Jordan (1996), forces [risks] that contribute to variations in return constitute elements of risk. Al-Bahar and Crandall (1990), defined risk event as what might happen in favour or in detriment of a project.

In examining the way software practitioners are taught to perform risk management, Pfleeger (2000), stated three criteria for identifying a risk event. First, a loss associated with the event, often called the risk impact. Secondly, risk is the likelihood that the event will occur with a probability often measured with a number between zero (impossible) and one (certain). Third, the degree to which the project team can change the outcome, either by mitigating the risk's causes before they occur or by controlling the risk's effects afterwards. Samuel and Hughes (2009) citing an experiential-based textbook by Park (1979), in their work identified 12 risk events contractors face as: weather, unexpected job conditions, personnel problems, errors in cost estimating/scheduling, delays, financial difficulties, strikes, faulty materials, faulty workmanship, operational problems, inadequate plans or specifications, and disaster.

2.5.4.2. The Types of risk in construction contracts

Risks in construction have been classified in different ways (see for example, Edwards and Bowen's (1998) comprehensive review of risk literature (1960-1997) in construction). However, they significantly have the same meaning, in that authors generally agree that some risks can be controlled whereas others cannot. Murdoch and Hughes (2008) classified risks affecting construction projects under physical works, delay and disputes, direction and supervision, damage and injury to persons and property, external factors, payment, and law and arbitration.

Erikson (1979) classified risks in construction as contractual risk (caused by lack of clarity, absence of communication between parties, problems of timeliness in contract administration) and construction risk (inherent in the work itself). In developing a fuzzy model for contractor's risk assessment at the tender stage, Tah et al. (1993) categorized project risks into external and internal risks (see below). This is similar to the classification in the finance literature where portfolio theory and capital-market theory divides risk into systematic risk (external – overall market risk including unanticipated increases in inflation or interest rates, labour shortages, and economic downturn or recession) and unsystematic risk (internal – independent of any economic, political, or social factors which affect the market in a systematic way, including the risks mentioned by Park (1979).

i. External risks

External risks are those that are prevalent in the external environment of projects, such as those due to inflation, currency exchange rate fluctuations, technology change, major client induced changes, politics, and major accidents or disasters. They are relatively non-controllable and so there is the need to continually scan and forecast these risks and in the context of a company's strategy (Tah et al., 1993).

ii. Internal risks

According to Tah et al. (1993), internal risks are relatively more controllable and vary between projects. They include the level of resources available, experience in the type of work, the location, and the conditions of contract. Some of these risks are local to individual work packages or categories within a project, whilst others are global to an individual project and cannot be associated with any particular work package. The local risks cover uncertainties due to labour (availability, quality, and productivity), plant (availability, suitability, and productivity), material (availability, suitability, supply, wastage) and subcontractor (availability, quality, productivity, and failure) resources and the site (ground conditions, accessibility, type of work, complexity of work). They are considered for each work package in the case of bill of quantities.

According to Laryea and Hughes (2009), because the world operates on a global platform, global risks are often generally allocated to projects. They further explained that these global risks cover areas relating to the performance (management experience, availability of partners, relationship with client, workload commitment), contract (contract type, contractual liabilities, amendments to standard form), location (head office, project) and financial (cash flow, funding, economic conditions) aspects of the project.

2.5.4.3. Risk and price relationship in construction management

The following four cases in the construction management literature show that risk apportionment could influence prices by up to 17% of a bid price. First, a bid simulation experiment by Neufville and King (1991), in which 30 US contractors were involved showed that contractors add significant premiums, around 3% of the total value of a project, to their bid mark-ups to compensate for risk and their lack of enthusiasm to do a job. However, there was no account of how contractors behave when they do indeed need the work.

The second case is an interview study of 30 specialist contractors in the US by Shash (1993) which showed that they would generally increase their prices by 5-10% if they were uncertain about a main contractor with whom they had no previous experience. The third case is represented by another interview study of 12 US contractors by Smith and Bohn (1999), showing that risk analysis generally has no impact (0%) on bids during times when contractors have a high need for work and competition is high.

In the final case, Atkinson (2007) reported a situation involving problems caused by risk on a specific design and build project won by Balfour Beatty – the final link of the M60 outer ring road around Manchester from Medlock to Irk. The works involved cut-and-fill of 2 million m^3 of excavation and 1.8 million m^3 of deposition. Blackwell, who won the fixed-price job to carry out the earthworks under a subcontract to Balfour Beatty, performed a formal risk analysis and included 17% of the subcontract price for unseen ground conditions and weather. Therefore, risk analysis and apportionment may have a significant impact on tenders.

Another area of literature is about factors that influence contingencies. Several surveys have been carried out on this topic. In an interview of 30 US contractors, Neufville and King (1991) found that the following factors affect bidding contingencies: project complexity, identity of client, quality of design, identity of consultants, site conditions, logistics, project duration, and safety hazards. On the same topic, Smith and Bohn (1999) interviewed 12 U.S. contractors and identified the following factors: workload, contract size, project complexity, number of bidders, owner's reputation, bidder's mentality, clarity of contract documents and bidding period.

A study of 38 contractors in Hong Kong by Wong and Hui (2006), showed that project characteristics, client's identity, consultant's identity, contractor-related issues, contract documents, contract administration, bidding situation and economic environment affect contingencies. The findings are significantly similar, especially given the time elapsed between the different studies.

2.5.4.4. Contractors and Risk Pricing Mechanisms

The literature review identified nine methods that contractors use to price risk in bids. These methods were identified in studies by Neufville and King (1991), and a discussion of Liu and Ling's (2005), fuzzy logic-based artificial neural network mark-up estimation model by Connolly (2006). Two are described in the former study, three in the latter. Neufville and King's experimental and interview-based study of 30 contractors in the US showed that the contractors quantified risk by comparing the amount of labour they carried out on a project to the total project cost and varied their mark-up based on the size of this ratio. The two main methods they used to compensate for risk in bids were:

- To develop a standard cost estimate (not considering risk) before varying the mark-up for risk.

- To develop a cost estimate (that adjusts productivity factors or contingencies based on the risk of each estimated item) before applying a standard mark-up to the risk-compensated estimate.

Connolly (2006) used his practical experiences to describe three of the ways in which contingencies are priced in practice as:

- The cost of the works (calculating the work quantities (materials, labour and equipment) before using a historical database to calculate a margin of error around the accuracy of the quantities. A probability range is then used to decide a contingency on the cost of works).
- The cost of risk (the risk attributes can alternatively be analysed using probability functions or another approach).
- The price of profit (allocating a contingency for the risk).

A survey of seven U.K. contractors by Tah et al. (1994) showed that contractors may apportion bidding contingencies as:

- A percentage in the profit margin.
- A separate percentage in all the costs.
- A lump sum in the entire preliminary bill.
- A percentage in one bill if the risk is in that bill alone.

2.5.4.5. Contractors and risk management practices

Contractors have often been portrayed to be poor at managing risk by for example authors such as Baloi and Price (2003), Ahmed et al. (2002) and Kangari and Riggs (1989). In developing an analytical model for modelling global risks, Baloi and Price (2003) said: "…many contractors are unfamiliar with these risk factors and do not have the experience and knowledge to manage them effectively. As a consequence, conflicts, poor quality, late completion, poor cost and business performance. Contractors have traditionally used high mark-ups to cover risk but as their margins have become smaller this approach is no longer effective. Contractors rarely use these techniques and tools in practice. More often than not, construction contractors and other practitioners rely on assumptions, rules of thumb, experience and intuitive judgement which cannot be fully described by prescriptive or normative models. Individual knowledge and experience, however, need to be accumulated and structured to facilitate the analysis and retrieval by others."

According to Ahmed et al. (2002): "The construction industry has a poor reputation in coping with risks, with many projects failing to meet deadlines and cost targets." Kangari (1989), said: "…the construction industry has a very poor reputation for coping with risk. Risk analysis is either ignored or done subjectively by simply adding a contingency. As a result many major projects fail to meet schedule deadlines and cost targets with attendant loss to both contractors and owners."

However, these assertions may not be true generally. Contractors have had their own ways of dealing with risk since the early part of the 19th century (Hughes and Hillebrandt, 2003). A questionnaire survey of 19 contractors in Australia by Bajaj et al. (1997) identified five of the ways used by contractors for identifying risk at the tender stage of projects:

- Risk review (by senior staff at the start of the tender pricing);
- Contact (discussions with subcontractors, architect and client);
- Research (ascertaining information about subcontractors, client, consultants, economic climate, etc);
- Site visit (visiting site to ascertain the access situation, location, obstructions, etc); and
- Finance (issues regarding payment and financial obligations).

However, the study also exposes some of the weaknesses of questionnaire-based research: contractors were asked nine 'yes' or 'no' questions about risk identification techniques that the researchers had in mind, apparently, before the study based on their knowledge and opinion. Eventually, the authors concluded that 53% of contractors use scenario building to identify risk, 5% (influence diagram) and 58% (questionnaire and checklist). Again, none of these methods were actually indicated by any of the contractors in the five methods that they themselves had used to describe their risk identification procedures. Therefore, it is difficult to understand the extent to which the latter findings are valid given the study design. For example, it seems that little effort was made in isolating the measurement of the variables of interest from other effects. Hence, for example, it is not possible to determine the number of firms that are combining two or more risk identification approaches. Most of the firms routinely identify risks through the opinion of one or two experienced persons within the company. Under the above-mentioned risk identification mechanisms, contractors may also identify risks through the following five ways: circulating the tender information to persons in the company; using only the judgement of the estimator; a departmental tender review meeting; brainstorming; and using the opinion of external consultants.

Akintoye and MacLeod (1997) used a questionnaire survey to elicit the opinions of 30 contractors and 13 project management consultants about risk perceptions and risk management practices in the United Kingdom. An open-ended question about the meaning of risk produced a wide variety of responses, but most respondents included some reference to the occurrence of adverse events, relating to time, cost or quality, in their descriptions of risk. Respondents were also asked to rate (from 'high' to 'low') the extent of risk premium they would attach to different risks. For both subgroups, financial risks rated highest, with legal and economic risks close behind. Adverse weather, a natural risk, was rated lowly by both groups.

As far as risk management techniques are concerned, about a third of contractor respondents in the study by Akintoye and MacLeod (1997) used risk premiums (contingency allowances); about half used sensitivity analysis; while 20% of them knew about Monte Carlo simulation, only 3% ever used it. Project managers were more familiar with probabilistic techniques than contractors, and tended to use them more, but not by an enormously large degree.

Tah et al. (1994), in a survey of the estimating practices of seven contractors, found that all of them classified risk as either ‘quantifiable’ or ‘unquantifiable’ (it is not clear how the survey instrument posed this question). For quantifiable risks, estimators included the costing in the estimate; while for unquantifiable risks an amount, based upon management perception of the situation, is added to the estimate either by increasing the profit mark-up or by including a lump sum in the preliminaries cost estimates. None of the respondents reported using statistical techniques to analyse risk.

Using a questionnaire, Mok et al. (1997) surveyed the risk perceptions and practices of 52 building services engineers in Hong Kong. They found that fewer than 30% of respondents possessed a comprehensive understanding of the meaning of risk; and fewer than 20% used probabilistic techniques of risk analysis. More than 75% of respondents most frequently used deterministic single-figure estimates, and more than 85% simply added a contingency sum to allow for risks. Less than 10% of respondents frequently used sensitivity analysis to check the validity of their risk allowances. On the other hand, more than 60% of respondents agreed that the establishment of probabilities constituted an inherent problem in quantitative risk analysis; while more than 50% agreed that interpreting the outcomes of risk analysis was difficult.

2.6.0. Health and Safety Management Issues in Cell Site Construction Projects

Managing safety and health is not only good for safety reasons; it also makes good business sense. Ignoring safety can result in accident and ill-health which not only eat into the profits but can also go to the extent of crippling the whole company, Rozario (2012).

2.6.1. Site health and safety in construction

The main health and safety site requirements in construction relate to tidy sites and decent welfare, falls from height, manual handling, and transport on site. Site operatives are normally required to plan and organise their operations, ensure that they are trained and competent and know the special risks of their trade and raise problems with their site supervisor or safety representative (HSE, 2009). The main personal protective equipment (PPE) in construction (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety. PPE should be regarded as a 'last resort' when considering control measures. Other methods should be considered and used that will reduce or eliminate risk to injury. However, where PPE is the only effective means of controlling the risks of injury or ill health, then employers must ensure that PPE is available. PPE should be worn at all construction sites. A typical construction site may require workers to wear a hard hat, coveralls, safety footwear, gloves, eye protection and high visibility vest. These must be provided to all employees (HSE, 2009).

2.6.2. Construction health and safety responsibilities

Construction health and safety should be of primary concern to employers, employees, governments and project participants (Kheni, 2008). Thus the main parties responsible for construction health and safety are the client, main contractor, regulatory agencies and employees. Health and safety duties of state and regulatory agencies: Government regulatory agencies often enact regulations to help ensure that a construction project is safe to build, safe to use, and safe to maintain and delivers you good value. Good health and safety planning also helps to ensure that a project is well managed and that unexpected costs and problems are minimised. Health and safety duties of employer: Clients have a big influence over how work is done. Where potential health and safety risks are low, clients are required to do little. Where they are higher, clients need to do more. Employers must assess the work being undertaken and the environment their employees will operate in when determining the appropriate PPE to be worn.

2.6.3. Health and safety problems on construction sites

There are health and safety problems on almost all construction sites which relate to reporting accidents, employing and subcontracting. Employing: all personnel who are employed to carry out construction work on site must be trained, competent and fit to do the job safely and without putting their own or others' health and safety at risk; properly supervised and given clear instructions; have access to washing and toilet facilities; have the right tools, equipment, plant and protective clothing; educated about health and safety issues with them (or their representatives); have arrangements for employees' health surveillance where required.

Accidents or work-related illness should be reported to the appropriate authorities within a reasonable or stipulated timeframe. Subcontracting: main contractors should ensure that they check the health and safety performance of the subcontractors they plan to use; give subcontractors the health and safety information they need for the work; talk about the work with them before they start; make sure that you have provided everything agreed on (e.g. safe scaffolds, the right plant, access to welfare, etc); and check their performance and remedy shortcomings (M&G, 2007) .

The study by Kheni (2008) on health and safety practices among construction SMEs in Ghana revealed serious problems. The main problems identified included lack of skilled human resources, inadequate government support for regulatory institutions and inefficiency in institutional frameworks responsible for health and safety standards. Another problem highlighted was the significance of the Ghanaian socio-cultural value systems particularly, the extended family system and traditional religious value systems in health and safety management within Ghanaian construction SMEs. The research also provided insights into difficulties posed by the internal environment of SMEs to the effective management of health and safety. Kheni (2008), provides a broad understanding of health and safety in the construction sector in Ghana.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0. Introduction

This chapter presents the method used for the intuitive analysis conducted in the successive chapter (four) of this study. The methodology is devoted to developing the research analytical framework in line with the theoretical framework that has been systematically built in the literature review.

3.1. Type of Research - Research Design

This research being more of an applied research, takes on a more exploratory and descriptive approach in assessing the subject of project risk management practices in the construction of cell sites in the telecommunication sector. Leedy and Ormrod (2005), point out that descriptive research examines a situation as it is; it does not involve changing or modifying the situation under investigation, nor does it intend to detect cause-and-effect relationships. This is the reason for the choice of method. Again, the research is more quantitative in nature though descriptive methods are imported to explore the subject.

3.2. The Population

The target population for this study mainly involves individuals such as engineers, contractors, project management experts and finance professionals in the Ghanaian telecommunication and mast construction or installation service sector. These are individuals with at least six (6) months affiliation to the organisation who are directly or indirectly engaged in project implementation in their organisation. The Ghanaian telecom industry has six (6) major companies with each having a handful of staff base being directly or indirectly involved in construction projects or cell site related projects execution and administration.

3.3. Sample and Sampling Technique

The non-probability sampling technique being specifically the purposive sampling technique is used in identifying the key respondents used in this study. As asserted by Neuman (2007), using this approach allows the researcher to select the specific cases or data sources that are especially informative; selected groups of highly specialised and difficult to reach group within the population. In this situation, major project departments or units in the identified population composed of mobile companies are targeted as sample destinations for sourcing the respondents.

Nonetheless, the sampling frame used does not place restriction on respondents in the population with the requisite project management experience but without affiliation to a construction or cell site project execution unit. In probability sampling, the decision as to whether a particular element is included in the sample or not, is governed by chance alone. Purposive sampling which is an example of the non-probability sampling technique was used in identifying the key respondents in the project departments of the various organisations who were capable of answering the questionnaire.

3.4. Data Collection

3.4.1. Data type and source

Data for the research included data sourced from both primary and secondary sources. The primary data was obtained from questionnaires administered to telecommunication and construction industry stakeholders. The secondary data was obtained from the internet, journals, library books, conference papers, theses, magazines and newspapers. The type of data used for this study was ordinal. This data served as a basis for establishing the theory and criteria against which empirical research of the primary data was measured.

3.4.2. Data Collection Instrument - Questionnaire design

The questionnaire was designed to consist of four main sections geared at covering the research objectives. The first section consisted of questions pertaining to the respondent's demographic background. In the second section, aspects relating to the awareness of risk management were covered. The third section investigated the management of risk from inception to completion of cell site construction projects; while the final section investigated collaboration and communication between the parties associated with construction projects in terms of risk. This is in line with what this study aims to achieve as stated in the objective in chapter one.

Closed and open-ended questions were asked. The closed questions had a selection of choices which offered the respondents the opportunity of selecting answers that they felt were (most) appropriate. Closed ended questions are advantageous, especially when a substantial amount of information on a subject exists and the response options are relatively well known (Walliman, 2006). The use of closed ended questions considers the fact that respondents are usually busy and this method enables the researcher to obtain responses promptly.

3.4.3 Instrument Validity

According to Neuman (2007), reliability which refers to consistency and validity that also point to how well researcher's idea about reality "fits" with actual reality, forms an essential part of a research and that the absence of validity occurs when there is a poor fit between the constructs such as instruments (e.g questionnaire) that the researcher uses to describe, theorise or analyse the real world and what actually occurs in the real world.

In the endeavour to avoid such a possible research error, a careful cursory of previously designed questionnaires that directly and indirectly relate to the risk management subject were reviewed for consistency. Furthermore, prior to the finalisation of the content and administration of the questionnaire, there were preliminary interactions and discussions with selected experts in project management practice and theory to test the relevance of the sections outlined in the questionnaire. These were done in a more objective way to avoid biases and unbalanced judgements.

3.4.4. Instrument Structure to meet Research Objectives

The main objectives of this research are to determine how tower projects are executed; find out the types of risks involved; and also how project implementers have managed these risks. In order to align with these research objectives, the questionnaire is organised in a manner of sections, as elaborated earlier in this chapter that is aimed at generating relevant data for an elaborate analysis that would touch on all the stated objectives. Summarily, the sections of the questionnaire cover issues relating to the awareness of risk management; the management of risk from inception of tower construction projects to their completion as well as the collaboration and communication between the parties associated with construction projects in terms of risk.

3.5. Procedure for Data Collection

The questionnaires were delivered to the respondents mainly by hand delivery and e-mail, in the case where the e-mail address of an identified project management professional is available and pre-delivery enquiries have duly been made. The one day interval provided some ample time for respondents to complete and submit the completed questionnaire. The respondents therefore had enough time to put across their propositions under a stress-free condition and demanding timeframe. This procedure is hoped to source quality responses for analysis.

3.6. Method of Data Analysis

The analytical framework for this research is mainly a combination of quantitative and qualitative techniques such as the use of summary statistics and explanations to organise data gathered on the risk measurement variables specified in the questionnaire. The analysis in the successive chapter of this study was conducted using Excel. An overview of the structure of the analysis designed to cover the research objectives is outlined below:

- *To determine how telecommunication towers are constructed in Ghana* – scales rankings of the specified cell site construction activities are ordered to reflect the majority views expressed by the respondents on how critical the stages are compared to each other. At the end, a precise process on how tower construction is done would be achieved.

- *To find out the types of risks associated with the construction of telecommunication towers in Ghana* – Summary statistics in the form of frequency tables, graphs and charts where necessary would be used to present responses on identified risk types in the questionnaire. This relates to the use of averages, maxima or minima to summarise the frequency of responses on risk variables. A qualitative summary of other risk forms specified by the respondents would also be presented.

- *To find out how project implementers have managed the associated risks of telecommunication tower construction* – A qualitative summary as well as summary statistics where necessary would be used to present responses on this area captured in the questionnaire. The frequency of expressions of views on questions raised in this area would be accordingly analysed quantitatively.

CHAPTER FOUR

RESULTS, ANALYSIS AND DISCUSSIONS OF FINDINGS

4.0. Introduction

This chapter of the study presents an in-depth analysis on the sample data gathered on the research topic, “assessment of project risk management in the construction of telecommunication towers”.

4.1. General information on sample firms

This study expected responses from all participating companies of the target population; composing of six (6) major telecommunication service providers: MTN, Glo, Airtel, Millicom (tiGo), Vodafone and Espresso. Among these six operators, it is Vodafone and Airtel that are known to provide fixed line services in addition to mobile telephony.

4.1.1. Vodafone Ghana, formerly known as Ghana Telecom and member of the Vodafone Group which has representations in Europe, the Middle East, Africa, Asia Pacific and the United States is both a fixed and mobile telephony provider with 4,671,999 subscribers as at May 2012, representing 21% of the total market share according to the NCA (2012) literature. After the $900m sale of the former company to the Vodafone Group the Government of Ghana now retains a 30% share while Vodafone group holds a 70% stake in the company.

Vision and Mission

The researcher's quest to know the mission and vision of Vodafone Ghana could not be made available since staff do not know if the company has one. A search on the company's website proved unsuccessful.

4.1.2. MTN Ghana is a South Africa-based multinational mobile operator, with representations in many African and Middle Eastern countries. Its head office is in Johannesburg. According to the NCA (2012) literature, this telephony provider was the market leader with a subscriber base of 10,644,804 representing 47% of the total market share. MTN has its vision and mission statements on the MTN Website (2012) as follows:

Vision:

To be the leading telecommunications service provider in emerging markets.

Mission:

Building shareholders' value by ensuring maximum customer satisfaction through providing latest telecommunication services, at the most economical rates while meeting its social responsibilities as a good corporate citizen and providing growth prospects for its employees.

4.1.3. Glo Mobile Ghana is also a subsidiary of Globacom International - a Nigerian-based telecommunication giant. The NCA reports that the operator holds a 468,508 subscriber base representing 2% of the total market share as at May 2012.
The service provider's coverage is about 85% of the Ghanaian land mass and this covers one thousand (1,000) cities and towns in Ghana (Mensah, 2012).

Vision and Mission

The researcher's quest to know the mission and vision of Vodafone Ghana could not be made available since staff do not know if the company has one. A search on the company's website proved unsuccessful.

4.1.4. Millicom Ghana Limited, also known as Tigo, is a mobile phone network provider with its corporate roots in Luxembourg. The company provides mobile services in 13 countries with operations across Central America, South America, South-east Asia, and Africa, using GSM, CDMA and TDMA on Africa and Asia, GSM and UMTS over Central America and South America. Millicom is also the owner of Amnet, a company that provides cable television and broadband internet services in Costa Rica, Honduras and El Salvador. According to the NCA (2012) market data, the operator had a 3,457,427 subscriber base representing 15% of the market. Tigo has its vision and mission statements on its Website (2012) as follows:

Vision

Our objective is to provide people in emerging markets the freedom to access today's world. To make this happen we create 'A world where mobile services are affordable, accessible and available everywhere and to all' (Millicom, 2012).

Mission

We provide services for people who want to stay in touch, to belong to communities and to be informed and entertained, enabling them to express their emotions and enhance their lives. We deliver the 3 A’s, Affordability, Accessibility and Availability; providing affordable services, good coverage and ease of purchase AND use. We focus on consistently meeting and exceeding customer’s expectations and developing an inspirational brand (Millicom, 2012).

Values

Integrity–Respect–Passion–Performance is a matter of integrity, respect and passion…Focusing on all three values together is essential to create sustainable success. We treat the Company as if it is our own (Millicom, 2012).

4.1.5. Bharti Airtel Limited, operating in Ghana under the corporate name Airtel, is an Indian telecommunications company with other operations in 20 countries across South Asia, Africa and the Channel Islands. It operates a GSM network in all countries, providing 2G, 3G and 4G services depending on the country of operation. Airtel is the world's fourth largest mobile telecommunications company with over 246 million subscribers across 20 countries as of March 2012 (Wikipedia, 2012). In Ghana, the NCA (2012) reports that as at May 12, this operator controlled 14% of the total market share representing 3,015,499 subscribers in all. The company has a submarine cable landing station at Chennai, which connects the submarine cable between Chennai and Singapore.

Airtel has its vision and mission statements on the Website of scribd inc. (2012) as follows:

Vision

To be globally admired for telecom services that delight customers.

Mission

Customer service focus

Empowered employees

Innovative services

Cost efficiency

4.1.6. Espresso formally known as Kasapa is a Dubai based mobile telephony provider. In July 2008, Espresso Telecom acquired 100% of the share of the latter company. According to the cited literature on the operator's corporate webpage, the operator embarked on more operational transformation projects and network expansion programmes soon after acquisition and it has seen the company increase its coverage from 40% to nationwide coverage. The company later re-branded into Espresso, following on from the network expansion and upgrade in November 2010. The NCA literature indicates that this operator as at May 2012 had a total subscriber base of 95,670 representing 1% of the total market share.

Vision and Mission

To achieve this, our mission is to develop industry leading products and services for all our communities and customers. As a leader in innovation we will extend our reach within Africa by ensuring we deploy the best products and services for our customers, which also serve and protect our planet.

Key facets of our approach are:

- Leaders in innovation
- Supporting and developing our communities
- Environment friendly solutions

"We understand that getting rural and remote communities connected is a challenge. As a leader and the largest provider of innovative, open access solutions and networks, we are unlocking the potential of these communities" (Abdelsalam, 2011).

4.2.0. Data Presentation and Analysis

This section covers a detail and intuitive analysis of the information gathered from the responses of the questionnaire.

4.2.1. General Characteristics of Respondents

In all, a total of fifty-six (56) questionnaires were distributed to respondents but due to a relatively high non-response rate, only thirty two (32) were returned by the respondents representing 62% of the non- response rate. The same research limitation (high-non response rate) is observed in Lyons and Skimore (2004) who set out to examine project risk management in the Queensland construction industry: a survey. Survey questionnaire was administered by mail in March 2002 to a random sample of the 200 organisations involved. In total, 44 useable responses were received, representing a response rate of only 23% but the researchers' decision was to make use of the data available on grounds of it being useful.
As at the time of assembling the questionnaires from respondents, several calls and physical visits were made. However, with some indicating that they had been heavily engaged and others promising to submit later, the final decision taken is to use what is available for this analysis. The thirty two (32) respondents unevenly emerged from five (5) telecom operators currently in the industry with the exception of Glo Mobile whose respondents promised to submit in due course.

In all, there were nineteen responses (19) from Millicom Ghana (tiGo) representing 60% of the total; six (6) responses from MTN; four (4) from Vodafone; two from (2) Airtel and only one (1) respondent from Espresso. There were seven (7) Radio Network Quality Engineers, five (5) Project Officers, two (2) Technical Officers; four (4) Network Optimisers, four (4) Telecom Roll Out Specialists, one (1) Project Management Trainee and nine (9) others who simply defined their roles as being Engineers. 41% of these respondents are managers, 31% supervisors, 19% officers and about 5% defining their positions in their organisation as being specialists.

Table 4.1 presents information extracted from the administered questionnaire. From the table below, it could be observed that most of the practising respondents hold a first degree as their highest qualification. Again a larger proportion of these respondents are male and generally in leadership roles as well.

Table 4.0 General Characteristics of respondents extracted from questionnaire

Variable	Freq.	Percent	Cum.
Gender of entrepreneur:			
Female	3	9.38	9.40
Male	29	90.63	**100.00**
Respondent's age			
18-28	11	34.38	34.38
29-39	15	46.88	81.25
40-50	4	12.50	93.75
51 – Above	**-**		

Age undisclosed	2	6.25	**100.00**
Respondent's educational level			
HND/Diploma	2	6.25	6.25
First Degree	19	59.38	65.63
Masters Degree	7	21.88	87.50
Professional qualification	-	-	87.50
other	4	12.50	**100.00**
Total	**32**	**100.00**	
Respondent's Position in organisation			
Manager	13	40.63	40.63
Supervisor	10	31.25	71.88
Specialists	3	9.38	81.25
Other	6	18.75	**100.00**

Source: Field data, 2012 - *Extracted from researcher's self-administered questionnaire*

More importantly, most respondents indicated that their companies engaged in over ten (10) cell site construction projects over the past three (3) years and of which over 87.5% indicated that they were directly or indirectly related in at least one of the stages of planning; scheduling; contract bidding and award; on-site project-execution or post-execution activities. 59.4% indicated that they have been actively involved in the planning and pre-implementation activities while 21.9% indicated that they were involved in the on-site project execution activities.

4.2.2. Determining how telecommunication towers are constructed in Ghana

In order to determine the standard procedures involved in the construction of cell sites, a series of general cell site construction stages have been selected from a cursory look at existing literature, and respondents were asked to assign how in their view, one task is critical from the other based on these levels. The stages outlined below are the outcome of the examination, after averaging the levels of scoring weightings of the stages assigned by the respondents in the order of levels indicated as follows : 1)- Not critical; (2) - Less critical; (3)- Critical; (4) - Very critical; (5)- Most critical.

From Table 4.2., it is evident that respondents on the average consider the various stages identified from existing literature as being critical to the successful completion of a cell site project. Key among the observations about critical tasks include site feasibility assessment, survey and marking; and the finalization of specifications for equipment, works in consultation with technical and commercial teams.

Table 4.1 Counts of respondents views on the tasks in cell site construction

		Number/Count of respondents				
Task in cell-site construction	***Average weights***	***Not critical***	***Less critical***	***Critical (3)***	***Very critical***	***Most – critical***

		(1)	(2)		(4)	(5)
Site feasibility assessment, survey, and marking	4	0	0	2	12	16
		0.0%	0.0%	6.7%	40.0%	53.3%
Obtaining “no objection certificate” for setting up cell site	4	1	1	8	12	7
		3.4%	3.4%	27.6%	41.4%	24.1%
Liaison with state electricity boards for obtaining required power	3	2	6	7	10	5
		6.7%	20.0%	23.3%	33.3%	16.7%
Contracting and identifications of risks	4	0	4	6	11	9
		0.0%	13.3%	20.0%	36.7%	30.0%
Soil testing , existing buildings analysis; structural design and ground layout	4	0	2	5	8	15
		0.0%	6.7%	16.7%	26.7%	50.0%
Finalization of specifications for equipment, works in consultation with technical and commercial teams	4	0	0	8	12	10
		0.0%	0.0%	26.7%	40.0%	33.3%
Preparation of bill of quantities and bill of services	4	0	0	3	17	9
		0.0%	0.0%	10.3%	58.6%	31.0%

Equipments and logistics planning and scheduling	*4*	*0*	*0*	*6*	*16*	*7*
		0.0%	*0.0%*	*20.7%*	*55.2%*	*24.1%*
Activity monitoring on daily basis and reporting through a MIS (including critical area and critical activity analysis)	*4*	*0*	*3*	*7*	*14*	*5*
		0.0%	*10.3%*	*24.1%*	*48.3%*	*17.2%*
Provision of Security on site and warehouse management	*4*	*0*	*2*	*13*	*9*	*5*
		0.0%	*6.9%*	*44.8%*	*31.0%*	*17.2%*
Supervision of civil, electrical, punch points and other equipment	*4*	*0*	*3*	*5*	*14*	*7*
		0.0%	*10.3%*	*17.2%*	*48.3%*	*24.1%*
Final inspection & handing over of site	*5*	*0*	*0*	*0*	*9*	*20*
		0.0%	*0.0%*	*0.0%*	*31.0%*	*69.0%*

Source: Field data, 2012 - *Extracted from researcher's self-administered questionnaire*

53.3% of the total respondents believe that activities involved in site examination and survey to ensure its feasibility for the construction of the cell site is the most critical. There were more than half (50%) of total respondents who also hold the view that activities involving finalizing the specifications for equipment; as well as consultative activities with technical and commercial teams are very important to achieving the objectives of the cell-site projects. Further, more of the respondents hold the view that completion inspection to ensure that all construction specifications are met is also very necessary. This in itself is a necessary thing the organisation has to do especially in the case where most of the on-site project execution activities are undertaken by external contractors/technicians or professionals.

4.2.3. Risks associated with the construction of telecommunication towers

The result on the ranking of various identified risks by the respondents is pictorially indicated in Table 4.2 and Chart 4.0 below. The volume of responses for the first category ranking is also presented in Table 4.3. From the observations, a larger percentage (30.8%) of the total respondents' rank financial related risks to cell site construction as what is most critical when presented with the choice to rank the risk forms in the first category. Market and technical risks also gained a second and third level of attention; while political risks was not really considered by the respondents as critically impacting a project's implementation success. Regulatory risks are also ranked higher compared to environmental and political risks.

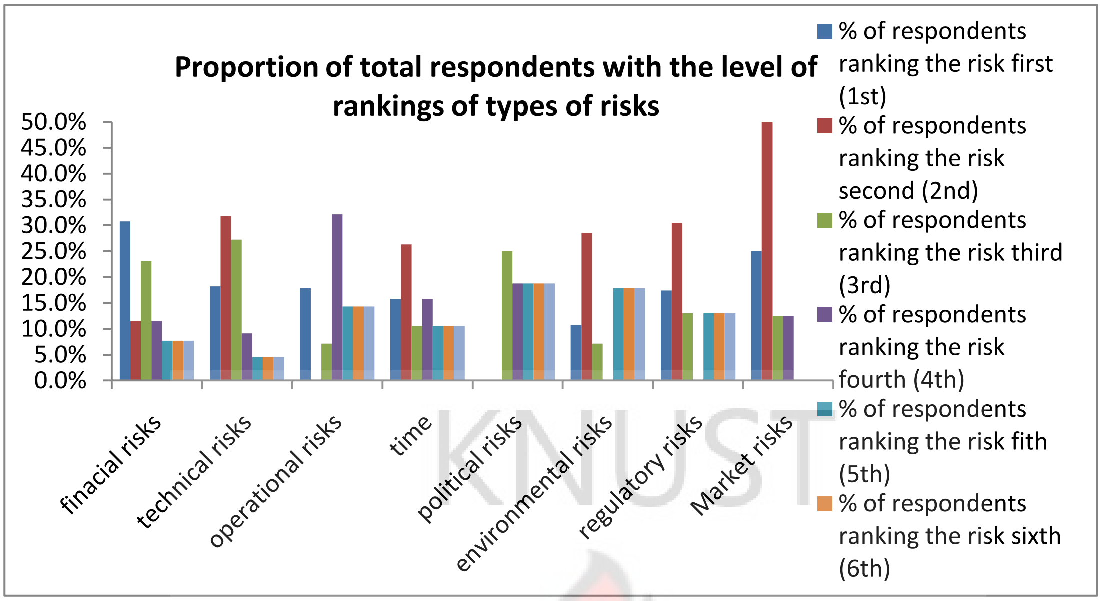
Table 4.2 Risk ranking based on respondent's response.

Risks	*Count of respondents in the First category of risk ranking*
Financial risks	*30.8%*
% of respondents	
Market risks	*25.0%*

%	
Technical risks	*18.2%*
%	
Operational risks	*17.9%*
%	
Regulatory risks	*17.4%*
%	
Time	*15.8%*
%	
Environmental risks	*10.7%*
%	
Political risks	*0.0%*

Source: Field data, 2012 - *Extracted from researcher's self-administered questionnaire*

Figure 4.0 Proportions of total respondents with their levels of risk rankings



Source: Field data, 2012 - *Extracted from researcher's self-administered questionnaire*

The graph above illustrates a stratified ranking of the risks at a specific risk level. This reflects the observation in Table 4.2 above that on the whole respondents rank market risks as second most critical compared to financial risk in their project risk identification approaches. Respondents tend to consider the potential pay-offs from cell sites locations in areas that would provide the intended network coverage and meet customers' call transmission and termination needs. Table 4.3 below also provides a summary of the absolute counts of the respondents as captured from the questionnaire.

Table 4.3 ***Number of counts of respondents and their respective level of rankings***

	Total number of counts of respondents and their respective level of rankings						
Types of Risks	***1st***	***2nd***	***3rd***	***4th***	***5th***	***6th***	***7th***
Financial risks	*8*	*3*	*6*	*3*	*2*	*2*	*2*
	30.8%	*11.5%*	*23.1%*	*11.5%*	*7.7%*	*7.7%*	*7.7%*
Technical risks	*4*	*7*	*6*	*2*	*1*	*1*	*1*
	18.2%	*31.8%*	*27.3%*	*9.1%*	*4.5%*	*4.5%*	*4.5%*
Operational risks	*5*	*0*	*2*	*9*	*4*	*4*	*4*
	17.9%	*0.0%*	*7.1%*	*32.1%*	*14.3%*	*14.3%*	*14.3%*
Time	*3*	*5*	*2*	*3*	*2*	*2*	*2*
	15.8%	*26.3%*	*10.5%*	*15.8%*	*10.5%*	*10.5%*	*10.5%*
Political risks	*0*	*0*	*4*	*3*	*3*	*3*	*3*
	0.0%	*0.0%*	*25.0%*	*18.8%*	*18.8%*	*18.8%*	*18.8%*
Environmental risks	*3*	*8*	*2*	*0*	*5*	*5*	*5*
	10.7%	*28.6%*	*7.1%*	*0.0%*	*17.9%*	*17.9%*	*17.9%*
Regulatory risks	*4*	*7*	*3*	*0*	*3*	*3*	*3*
	17.4%	*30.4%*	*13.0%*	*0.0%*	*13.0%*	*13.0%*	*13.0%*
Market risks	*2*	*4*	*1*	*1*	*0*	*0*	*0*
	25.0%	*50.0%*	*12.5%*	*12.5%*	*0.0%*	*0.0%*	*0.0%*

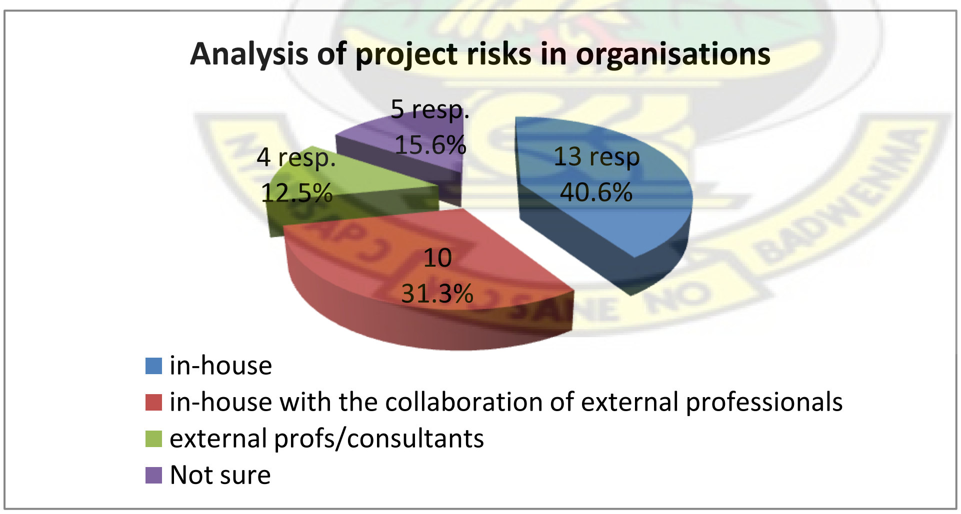
Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

4.2.3. How project implementers have managed the associated risks of telecommunication towers construction

4.2.3.1. Company ability to identify risk

On the enquiry on whether risk identification and analysis are done internally within the organisation or externally, 40.6% indicated that risk analysis in their organisation is conducted in-house whiles 31.3% showed that the task is performed by in-house officials in collaboration with external professionals; and 12.5% also indicated that exclusively external professionals are tasked with this function. 15.6% were not sure of this. A summary of these observation is presented in as graphical and tabular form as indicated below:

Figure 4.1 Graphical representation on whether risk analysis is conducted internally within the organisation or externally.



Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

Figure 4.4 Tabular representation on whether risk analysis is conducted internally within the organisation or externally.

Project risk assessment modalities		
Mode	**Number of respondents**	**%**
in-house	13	40.6%
in-house with the collaboration of external professionals	10	31.3%
external profs/consultants	4	12.5%
Not sure	5	15.6%
TOTAL	32	100.0%

Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

Generally, twenty two (22) of the respondents representing 88% believe that their company has an active response in relation to risk identification in cell site construction projects. 31.3% demonstrated their belief in their organisation being more neutral towards projects risk management-meaning their organisation could settle for project options that offer a 70% chance of profit and 30% chance of loss. However, 28.1% and only 9.4% respondents showed that their organisations are risk averse and risk seeking respectively. The risk averse organisations in this study refer to organisations that would usually settle for cell sites projects that offer a 90% chance of profit; while risk seeking companies would endorse those that offer a 50% chance of profit and 50% chance of loss.

A summary observation on the risk profiling of the organisations are detailed out in the table below.

Table 4.5 Organisational risk profiling

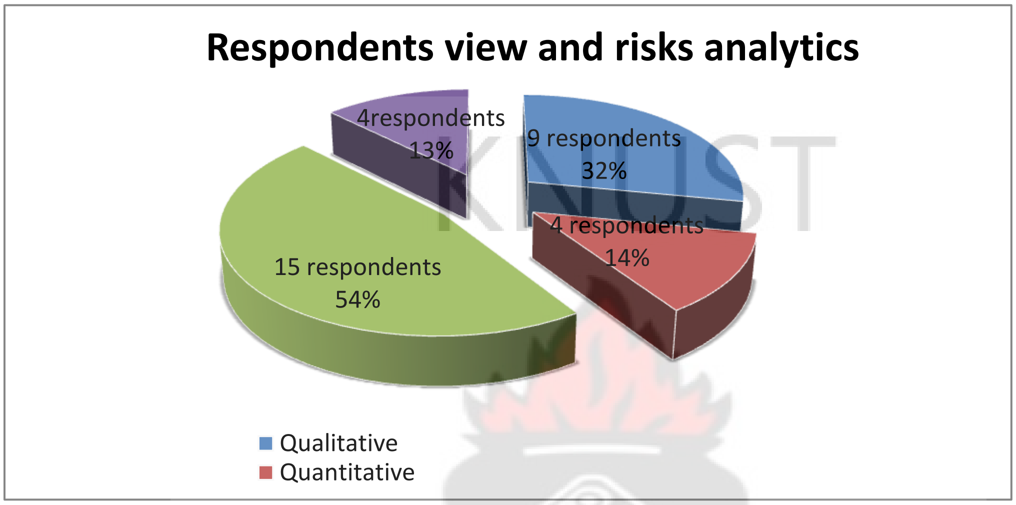
Organizational risk profiling			
Risk criteria		***No. of resp***	***%***
Risk identification	Active	22	88.0%
	Passive	3	12.0%
	Note sure	0	0.0%
Total		25	100%
Risk averseness	risk averse - 90% profit chance	9	28.1%
	risk neutral- 70% chance of profit	10	31.3%
	risk seeking - 50% chance of profit	3	9.4%
	None of the above	10	31.3%
Total		32	100%

Source: Field data, 2012 - *Extracted from researcher's self-administered questionnaire*

4.2.3.2. Cell site risk management approaches/techniques

In all the responses, there exist a high proportion of the respondents that believe their organisations employ both qualitative and quantitative approaches to risk identification, assessment, measurement and management. This is illustrated in the pie-chart below. The choice of which specific quantitative and qualitative approaches have been employed by the respondents organisations are also summarised in this section by Figure 4.2

Figure 4.2 Percentage of respondents indicating their organisational risk management approaches



Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

As presented in the table below (Table 4.6) it is obvious that in the case of quantitative risk management approaches, most of the respondents (54.2%) representing thirteen (13) respondents, indicated that their organisation usually employ the Expected Net Present Value (ENPV) in most cell site project risk assessment and management. The use of Expected Monitory Value (EMV) was also cited by 45.5% of the respondents as being prevalently used by their organisation.

It is important to note that on the average, the EMV and ENPV are used often while the use of Decision tree, Delphi peer group and Scenario based analysis are not popular. The

Scenario based analysis and Risk adjusted discount rate techniques are seldom used in cell site risk analytics. How successful or unsuccessful these quantitative approaches are have also been investigated in the sampling of data.

Table 4.6 Counts of views of use of risk assessment techniques

Company approach to risk management	*Total number of counts of respondents and the frequency of use of quantitative risk approaches*					
A) Quantitative Approaches Frequency of use	***Average ranking***	***Not certain -1***	***Never-used -2***	***Seldom -3***	***Ocassionaly -4***	***Always-5***
**Expected monitory Value*	*4*	*2*	*4*	*3*	*3*	*10*
		9.1%	*18.2%*	*13.6%*	*13.6%*	*45.5%*
** Expected net present value*	*4*	*5*	*1*	*3*	*2*	*13*
		20.8%	*4.2%*	*12.5%*	*8.3%*	*54.2%*
** Decision tree*	*2*	*5*	*6*	*8*	*3*	*0*
		22.7%	*27.3%*	*36.4%*	*13.6%*	*0.0%*
**Breakeven analysis*	*2*	*6*	*8*	*3*	*6*	*1*
		25.0%	*33.3%*	*12.5%*	*25.0%*	*4.2%*
**Scenario based analysis*	*3*	*2*	*8*	*7*	*1*	*3*
		9.5%	*38.1%*	*33.3%*	*4.8%*	*14.3%*
** Using Delphi peer group*	*2*	*9*	*7*	*3*	*3*	*0*
		40.9%	*31.8%*	*13.6%*	*13.6%*	*0.0%*
** Risk adjusted discount rate*	*3*	*4*	*7*	*7*	*0*	*4*
		18.2%	*31.8%*	*31.8%*	*0.0%*	*18.2%*
** other, please specify*						
B) Quantity methods approaches level of success	***Average ranking***	***Not certain -1***	***Unsuccessful -2***	***Low-3***	***High-4***	***Extremely high-5***
**Expected monitory Value*	*3*	*5*	*1*	*5*	*5*	*5*
		23.8%	*4.8%*	*23.8%*	*23.8%*	*23.8%*
** Expected net present value*	*3*	*5*	*4*	*1*	*6*	*5*
		23.8%	*19.0%*	*4.8%*	*28.6%*	*23.8%*
** Decision tree*	*3*	*6*	*3*	*5*	*6*	*1*
		28.6%	*14.3%*	*23.8%*	*28.6%*	*4.8%*
**Breakeven analysis*	*3*	*6*	*5*	*5*	*1*	*4*
		28.6%	*23.8%*	*23.8%*	*4.8%*	*19.0%*
**Scenario based analysis*	*2*	*9*	*3*	*6*	*1*	*2*
		42.9%	*14.3%*	*28.6%*	*4.8%*	*9.5%*
** Using Delphi peer group*	*2*	*12*	*4*	*2*	*1*	*2*
		57.1%	*19.0%*	*9.5%*	*4.8%*	*9.5%*
** Risk adjusted discount rate*	*2*	*8*	*2*	*7*	*1*	*3*
		38.1%	*9.5%*	*33.3%*	*4.8%*	*14.3%*

* other, please specify	

C) Qualitative methods frequency of use	Average ranking	Not certain -1	Never-used -2	Seldom -3	Ocassionaly -4	Always-5
*Percentage contingencies from historical data	3	12	0	1	4	6
		52.2%	0.0%	4.3%	17.4%	26.1%
* Interviewing (risk analysis and experts)	3	6	4	10	1	2
		26.1%	17.4%	43.5%	4.3%	8.7%
* Brainstorming	3	6	0	6	4	7
		26.1%	0.0%	26.1%	17.4%	30.4%
* Personal and corporate experience	3	6	0	2	9	6
		26.1%	0.0%	8.7%	39.1%	26.1%
* Rule of thumb or engineering judgments	3	8	0	1	1	13
		34.8%	0.0%	4.3%	4.3%	56.5%
* other, please specify						

D) Qualitative methods approaches level of success	Average ranking	Not certain -1	Unsuccessful -2	Low-3	High-4	Extremely high-5
*Percentage contingencies from historical data	3	10	0	2	11	1
		41.7%	0.0%	8.3%	45.8%	4.2%
* Interviewing (risk analysis and experts)	3	6	0	12	5	1
		25.0%	0.0%	50.0%	20.8%	4.2%
* Brainstorming	3	6	0	3	11	4
		25.0%	0.0%	12.5%	45.8%	16.7%
* Personal and corporate experience	3	6	1	5	7	5
		25.0%	4.2%	20.8%	29.2%	20.8%
* Rule of thumb or engineering judgments	3	6	4	2	7	5
		25.0%	16.7%	8.3%	29.2%	20.8%
* other, please specify						

Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

It is obvious to deduce from the above table that the use of the Expected Net Present Value (ENPV) and Expected Monitory Value (EMV) as popular quantitative methodologies on a whole have also yielded above average success levels expected by cell site project executors. In terms of qualitative approaches, the use of "rule of thumb or engineering judgements" appears to be the most popular method as over 56.5% (13) of the respondents endorse the use of the approach in their organisations; contrary to the findings in Baloi and Price (2003) that uphold the use of corporate experience and intuition as basis for measuring risk levels in the construction industry. In this study however, the use of personal and corporate expertise is found to be occasionally employed rather than being what is always used in project risk assessment or measurement.

Brainstorming on the potential level of risk involved in any project is also a common technique indicated by the respondents as being used in their organisation. About 30.4% have indicated the prevalence of use of this technique though its success level to risk management had been relatively low compared to the use of Rule of Thumb and Personal and Corporate Experience Approaches. It is also worth noting that 43.5% of respondents indicated the practice of Interviewing of Experts is seldom used as it showed with time to have yielded low level of success as affirmed by 50% of the respondents.

Moreover, it is well noting that the use of insurance and provision of exclusion clauses in contract specifications has been one of the common procedures through which cell site project implementers have reduced and transferred identified financial risks. 43.8% (14) of the respondents asserted that their organisations prefer the use of insurance as effective means of risk transfer; while 34.4% (11) indicated the inclusion of indemnity clauses in contract specifications as means of identified risk impact minimisation. Though Lyons and Skimore (2004) in their study also find that risk reduction is the most frequently used risk response method followed by risk transfer; they however conclude that risk elimination and risk retention—with the use of contingencies and contractual transfer was preferred over insurance. Table 4.7 below provides the details of observations from the respondents on risk transfer approaches commonly adopted by organisations.

Table 4.7 Approaches adopted by organisations in cell cite construction risk transfer

Organizational risk transfer approaches		
	No. of respondents	%
Insurance	14	43.8%
Indemnity clause	11	34.4%
Not sure	7	21.9%
Total	32	100.0%

Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

4.2.3.3. Risk management through collaboration with project parties

In order to achieve a comprehensive assessment on how telecom firms have managed risk through effective coordination of major stakeholders of the cell site projects, various responses have been gathered on how key groups have teamed up to ensure a fair representation of objectives of all segments of the organisation in the execution of cell site projects.

From the responses, respondents noted that key participants whose representation is important in the processes of tower construction projects include: the Technical team, Network Optimisation Team, Radio Network Engineering Team, Network Quality Team, Project Management Team, Marketing/Commercial team, Financial analysts, Procurement/Logistics and Supply Team, Site acquisition and Civil work team, Tax planning team, as well as holders of land tenure/ownership rights. The views of the respondents immerged from the need for collaboration among these stakeholder teams and the fostering of clear communication lines to achieve a high project success.

On a whole, most of the respondents 65.6% (21) provided responses that their organisation puts in the effort to ensure collaboration among parties in the execution of cell site projects. However, the claim by 25% (8) of respondents that they were not sure of a fair representation of all key stakeholders like the commercial and finance teams also raises an alarm.

Summary of the observations on the responses captured on the issue of representation and collaboration among project parties is presented in the tables and figures below:

Table 4.8 Tower projects representation and collaboration among parties

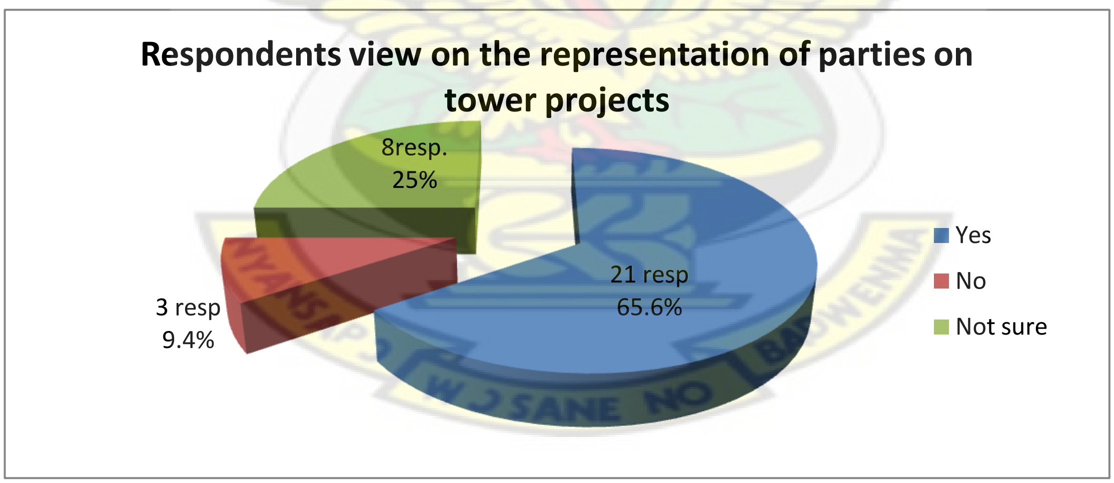
Tower projects implementation and representation of others from other units in the organization		
Response	***No. of resp.***	***%***
Yes	21	65.6%
No	3	9.4%

Not sure	8	25.0%
Total	***32***	***100%***

Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

From the table 4.8 above, it is evident that more than half of the respondents demonstrated that their organisations places more premium on involving all various units of their departments in the implementation of tower construction projects.

Figure 4.3 Representation of respondents views on the representation of other units on cell site construction projects



Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

Table 4.9 Tower projects representation and collaboration among parties

Telecom business unit	***Counts by respondents***	***% of counts***
Engineering/technical team	11	16%
Civil/site acquisition	12	17%
Network Optimization team/quality	3	4%
Radio Network engineering team	7	10%
Project management team,	2	3%
Marketing/Commercial team,	16	23%
Financial analysts,	7	10%
Procurement/Logistics and Supply team,	4	6%
Tax planning team,	1	1%
land tenure/ownership rights holders	3	4%
Experts/Consultants	4	6%
TOTAL	***70***	***100%***

Source: *Field data, 2012: Extracted from researcher's self-administered questionnaire*

4.3.0. Discussion of Research Findings

This section covers a detailed review of the findings as discovered from the research data analysis process. The section discusses the research findings in relation to other similar research papers and or similar literatures.

4.3.1. How telecommunication towers are constructed

In the previous literature Di Carlo et al (2002) indentified that planning, scheduling, monitoring and control of cell site construction activities forms an essential aspect of the whole task of cell site construction. Radio frequency and site survey, site Lay-out & Marking; obtaining no objection certificate for setting up cell site; Liaison with State; electricity boards for obtaining required power; contracting and identifications of risks; soil testing, structural design and layout of ground based sites; structural analysis of existing buildings and layout of roof top sites; finalization of specifications for equipment, works in consultation with technical and commercial teams; preparation of bill of quantities and bill of services through to the co-ordination with all suppliers; subcontractors on the execution and final inspection & handing over of site were some of the activities innumerate as constituting the processes on how towers are constructed.

In this study as well as in consistence with the existing literature by Di Carlo et al (2002), it is established that key among the critical tasks performed in the construction of cell sites in Ghana include; site feasibility survey and assessment; and the finalization of specifications for equipment works in consultation with technical and commercial teams. In this latest study we identify that site examination and survey to ensure feasibility for the construction of the cell site is the most critical. There were more than half of the total respondents who held the view that those activities involving finalizing the specifications for equipment; as well as consultative activities with technical and commercial teams are very important to achieving the objectives of the cell-site projects.

The site feasibility observation goes to establish the findings by Akdag et al. (1999), who in their study also attest that the placement of towers at strategic points that provides the intended coverage for people within a particular urban/suburban areas, highways, state roads, and higher traffic zones, local roads are paramount to achieving the major objectives of tower construction. Akdag et al. (1999) further emphasizes that locating cell sites in feasible areas would improve MOUs-minutes of usage and enhance network quality.

Other activities identified in this study include Obtaining “no objection certificate’’ for setting up cell site, soil testing; existing buildings analysis; structural design and ground layout; liaison with state electricity boards for obtaining required power; preparation of bill of quantities and bill of services; equipments and logistics planning and scheduling; activity monitoring on daily basis and reporting through a MIS (including critical area and critical activity analysis); and the provision of Security on site and warehouse management.

4.3.2. Risks associated with the construction of telecommunication towers

This section discusses various risks associated with a tower construction and how they are managed.

4.3.2.1. Risk classification in cell site projects

The literature review in the earlier chapters of this study have well established diverse risk forms that impacted the level of success of cell site or construction related projects. Popular among such works are Tah et al. (1993) as well as Baloi and Price (2003) referenced earlier in this study. This study finds that generally, the various risk forms associated with cell site construction or any other construction-related project could be best categorised into financial, market, technical, operational, regulatory, time, environmental and political. Further, the study finally establishes with deductions from the responses of the respondents that cell site construction project implementers give higher attention to financial loss and market leadership related risks more than the other identified risk forms.

The results in this study run consistent with some previous works but also have some departures with others in terms of the types of risks discovered in the course of the research. For example Murdoch and Hughes (2008) classified risks affecting construction projects under physical works, delay and disputes, direction and supervision, damage and injury to persons and property, external factors, payment, and law and arbitration; while Erikson (1979) also classified risks in construction as contractual risk (caused by lack of clarity, absence of communication between parties, problems of timeliness in contract administration) and construction risk (inherent in the work itself).

4.3.3. How project implementers have managed the associated risks of telecommunication tower constructions

The Project Management Institute (2004) literature covers various techniques employed in the analysis of identified risks in projects. According to the literature, qualitative risk analysis usually prioritises risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact. Quantitative risk analysis approaches on the other hand, numerically analyses the effect on overall project objectives of identified risks. In line with the various methods identified in the Project Management Institute (2004) literature, this study categorises risk analytic approaches into quantitative and qualitative.

In a previous work, Lyons and Skimore (2004) studied risk management in the construction industry and were able to establish that qualitative methods of risk assessment are used most frequently ahead of quantitative and semi qualitative methods. This study on the contrary does not lay emphasis on ranking the order of use of the approaches but rather steps-up to determine the frequency of use of the types of techniques in these categories of risk management. Categorising risk approaches into quantitative and qualitative in this study has no departure from the findings in Tah et al. (1994) who in a survey of the estimating practices of seven contractors in the construction industry, found that all of them classified risk as either ‘quantifiable’ or ‘unquantifiable’.

The results of this research shows that the Expected Net Present Value (ENPV) and Expected Monitory Value (EMV) are the most prevalent quantitative techniques used in cell site construction project risk analysis. The observations on the use of ENPV and EMV in this study appear unique; as a cursory look at existing literature do not have much submissions on these quantitative approaches in the construction industry.

Significant among other existing works are the findings in the study by Baloi and Price (2003), that outline that due to the sophistication of the finance sector, practitioners of the construction sector often use mechanisms such as a fixed single percentage or an overall lump sum based on intuition and experience to price for the risk in construction projects. The results of this study defer with Baloi and Price (2003) in the degree of the most frequently used technique being the rule of thumb rather than using personal and corporate experience. The result shows that in terms of qualitative approaches, the use of “rule of thumb” appears to be the most popular method as over 56.5% (13) of the respondents endorse the use of the approach in the analysis of risk in their organisations. The use of “personal and corporate experience approaches” was endorsed by 39.1% (9) of respondents as being occasionally used in their organisation; nevertheless yielding a relatively high rate of success upon use.

This study also establishes the use of insurance and provision of exclusion clauses in contract specifications as common routes to minimising identified financial risks inherent in any cell site construction project. Respondents largely express their preference of insurance over inclusion of indemnity clauses in contracts to minimise the impact of foreseeable risks. This finding is a sharp departure from that of Lyons and Skimore (2004) who conclude in reverse that inclusion of indemnity clauses in contracts is more preferred by organisations compared to insurance in most construction projects.

4.3.3.1. Risk management specifically through collaboration among parties

Managing risks in the cell site construction project through the collaboration of project related parties have been found in this study as being fundamental to the realisation of goals of cell site projects. A key risk management strategy identified in Akdag et al. (1999) as critical in cell site construction is the dedication of parties to effective collaboration between the technical project implementation teams and the marketing and capital budgeting teams. The finding in this study identifies that consultative activities with technical and commercial teams are sure ways of effectively managing potential risks relating to deviations from standards, budgets allocations, corporate policies and objectives of acquiring high returns on cell site construction projects.

About half (50%) of the entire respondents assert that the task of effective communication and representation of other functional supports of the business such as the commercial/marketing team is very vital. The marketing team is able to bring on board considerations that would ensure that the potential towers provide customers with network quality and also enhance MOUs so as to drive ARPUs and a consequential payback on the capital invested into the tower project.

4.4. Conclusion

In concluding on the results of this study, it is well noting that site feasibility assessment, survey, and marking; and the finalization of specifications for equipment, works in consultation with technical and commercial teams form a vital part of the cell site constructing process; possible financial loss and market leadership related risks are the common risks identified to be more considered by project implementers than the other forms of risk in this study. Finally, a high need for consultative and collaborative interfaces between the project technical teams and the commercial/market, capital budgeting teams at all stages of the cell site project implementation is essential to ensure its success.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0. Introduction

This chapter of the study forms the concluding part of this academic research work. In this chapter, a summary of all the discussions held in the analytical sections of the study is presented with conclusions drawn accordingly. Again, as required in any academic research, policy recommendations are forwarded in this chapter. Areas that could be explored in further outlook on the subject matter are also presented in this concluding chapter of the study.

5.1. Summary

This study primarily sets out to examine how risk is identified, assessed and managed in the construction of cell site towers in the telecommunication industry. The specific objectives were to: determine how telecommunication towers are constructed in Ghana; the types of risks involved; and finally to find out how project implementers have managed the associated risks of telecommunication tower construction. The outcomes of this study were expected to serve cell site construction projects implementers with the requisite knowledge on the possible risk associated with this kind of project and how to manage the risks accordingly.

A cursory search on existing literature on the subject matter indicates that popular among the various types of risk identified by previous writers are physical works, delay and disputes, direction and supervision, damage and injury to persons and property, external factors, payment, and law and arbitration. Classification of risk also encompassed contractual risk - caused by lack of clarity, absence of communication between parties, problems of timeliness in contract administration and construction risk – which is inherent in the work itself.

The Project Management Institute (2004), being a major source of authority on this subject matter, also puts together in their literature that two of the major categories of risk assessment and measurement techniques include the quantitative or qualitative approaches. The literature accordingly emphasises that qualitative risk analysis usually prioritises risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact. Quantitative risk analysis approaches on the other hand numerically analysis the effect on overall project objectives of identified risks.

This study primarily makes use of field data sourced through questionnaires administered in six major telecom operators in Ghana. In all, a total of fifty-six (56) questionnaires were distributed to respondents but due to high non-response rate, only thirty two (32) were returned by the respondents representing 62% of the non- response rate. The thirty-two (32) respondents unevenly emerged from five (5) telecom operators currently in the industry with the exception of Glo Mobile whose respondents had not yet submitted their responses as at the time of the analysis and concluding on the findings of the study. There were nineteen responses (19) from Millicom Ghana (tiGo) representing 60% of the total; six (6) responses from MTN; four (4) from Vodafone; two from (2) Airtel and only one (1) respondent from Espresso.

The responders were mainly composed of seven (7) Radio Network Quality Engineers, five (5) Project Officers, two (2) Technical Officers; four (4) Network Optimisers, four(4) Telecom Roll Out Specialists, one (1) Project Management Trainee and others who simply defined their roles as being Engineers. 41% of these respondents are managers, 31% supervisors, 19% officers and about 5% defining their positions in their organisation as specialists.

5.2. Conclusion

In drawing a conclusion on the various submissions on how towers are constructed in this study, it is worth establishing that tasks such as site feasibility assessment, survey, and marking; and the finalization of specifications for equipment, works in consultation with technical and commercial teams form a vital part of the process of constructing cells sites stands. These two major tasks are paramount and must be granted the necessary attention by project managers in the telecommunication sector.

On the various types of risks associated with the construction of cell sites in the telecommunication sector, financial, market, technical, operational, regulatory, time, environmental and political are the forms of risks worth considering. However, the study finally establishes with deductions from the responses of the respondents that cell site construction project implementers give higher attention to financial loss and market leadership related risks than to the other identified risk forms.

On the modalities of how project implementers have identified and managed the associated risks of telecommunication tower construction, it was realized that a mix of quantitative and qualitative techniques are employed in the assessment of risk. In this regard, the results show that the expected net present value (ENPV) and expected monitory value (EMV) are the most prevalent quantitative techniques used by project implementers in the identification of risks. The results also show that in terms of qualitative approaches, the use of "rule of thumb" appears to be the most frequently used and popular method compared to "personal and corporate experience approaches" though being occasionally used in respondents organisations also yields a relatively high rate of success.

More emphatically, managing risks in the cell site construction project through the collaboration of project related parties have been found in this study as being fundamental to the realisation of goals of cell site projects. It is established that there is a high need for consultative and collaborative interfaces between the project technical teams, the commercial/market and capital budgeting teams at all stages of the project implementation. There is an effective management and control of deviations from standards, budgets allocations, corporate policies and the organisational objectives of acquiring high returns on the cell site project when this is done.

5.3. Recommendations

From this study, I propose to stakeholders to employ all due diligence in the assessment of the feasibility of locations for the installation of cell sites prior to commencement of on-site works. In the face of recent competition in the telecommunication industry of Ghana, operators need to be very strategic in the placement of cell sites in only areas that would serve the prime purpose of providing customers or end users with the intended network quality so as to drive their MOUs, ARPUs and returns on investment.

There is the need to create the platforms in corporate settings that foster an effective interface among the various units within the organisation especially among the commercial or marketing teams and the project technical teams in an efficient manner that enhances the bringing on board of ideas pertaining to good cell site locations and satisfaction of customer mobile communication needs. A fair representation of individuals with various backgrounds to also have evaluative oversight on any cell site project to be constructed would go a long way to enhance the achievements of cell site construction objectives.

These competitive business times would not reward organisations that rely solely on the prerogatives of its top management or corporate governing body regarding the feasibility of the implementation of any slated cell site projects without considering the competing views or interest of stakeholder groups in any cell site construction project.

REFERENCES

Aalto, P., Jarvinen, P. and Tuovinen, M, (2003) *Management of Uncertainty*, Espoo, p. 157

Accenture (2003) *Building the Future of Construction*: *Performing at High Value*, Accenture Consulting, Inc., (Online) Copy available at: http://www.accenture.com/xdoc/en/industries/products/industrial/insights/construction.pdf. Accessed on: August 23, 2003.

ACEC/AGC, (1992) *Owners Guide to Saving Money by Risk Allocation*, American Consulting Engineers Council and Associated General Contractors of America.

ACP **(2009),** *Management of Projects - Structure of Design and Build Teams***,** available at: http://acplcpl.com/management.html**, (**cited on 6th August, 2012**).**

AGNIR (2001) ELF electromagnetic fields and the risk of cancer, Report of an Advisory Group on Non-ionising radiation. Doc NRPB, Vol.12, pp.1-179

Airtel (2011) *Saba Tower 1,level 31, Jumeirah Lake Towers*, Dubai, United Arab Emirates http://www.expressotelecom.com/en/african-presence/ghana/,(Cited on: 6th August, 2012)

Akdag MZ, Celik S, Ketani A, Nergiz Y, Deniz M, Dasdag S (1999) Effect of chronic low-intensity microwave radiation on sperm count, sperm morphology, and testicular and epididymal tissues of rats. Electro- Magnetobiology, 18: 133-145.

Akintoye, A.S. & MacLeod, M.J., (1997) 'Risk analysis and management in construction', *International Journal of Project Management*, Vol. 15(1), pp.31-38.

Al-Bahar, J., and Crandall, K. (1990) ‘Systematic Risk Management Approach for Construction Projects,’ *ASCE Journal of Construction Engineering and Management*, Vol. 116, No 3, pp. 533-546.

American Society of Civil Engineers (1979) *Construction Risk and Liability Sharing*. Proceedings of the Construction Risk and Liability Sharing Conference. Vol.I and II. ASCE, New York.

Artto, K., Kähkönen, K. and Pitkänen P.J., (2005) *Unknown Soldier Revisited: A Story of risk Management*, Project Management Association Finland, Helsinki, p. 114.

Ashely, D., and Bonner, J. (1987) 'Political Risks in International Construction', ASCE *Journal of Construction Engineering and Management*, Vol. 113, No. 3, pp. 447-467.

Baccarini, D. and Archer, R., (2001) 'The risk ranking of projects: a methodology', *International Journal of Project Management*, 2001, Vol. 19, pp.139-145.

Bajaj, D., Oluwoye, J., and Lenard, D. (1997) 'An Analysis of Contractor Approaches to Risk Identification in New South Wales, Australia', *Construction Management and Economics*, Vol. 15. pp. 363-369.

Balmori A (2005) 'Possible effects of electromagnetic fields from phone lasts on a population of white stock (*Ciconiaciconia*)', *Electromagnet. Biol. Med.*, Vol. 24, pp209-219.

Baloi, D. and Price, A.D.F. (2003) 'Modelling global risk factors affecting construction cost performance', *International Journal of Project Management*, Vol. 21, pp. 261-269

Batchelor, C. (2000) 'Construction: Global Growth in Civil Engineering to Top 6 Percent. *Financial Times*11/02/2000.

Beach, R., Webster, M. and Campbell, K.M. (2005) 'An evaluation of partnership development in the construction industry', *International Journal of Project Management*, Vol. 23, No. 8, pp. 611

Beeston, D. (1986) 'Combining risks in estimating', *Construction Management and Economics*, Vol. 4(1), pp. 75-9.

Birnie, J. and A. Yates (1991) 'Cost prediction using decision/risk analysis methodologies', *Construction Management and Economics*, Vol. 9 (2), pp. 171-186.
Bon, R. (2000) *The Future of International Construction*, Thomas Telford, London.

Bortkiewicz A, Zmy Blony M, Szyjkowska A, Gadzicka E (2004) 'Subjective symptoms reported by people living in the vicinity of cellular phone base stations: *Review. Med. Pr.* Vol. 55, No. 4; pp 345-351.

Breeden, D., (1979) 'An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities', *Journal of Financial Economics*, Vol 7, pp. 265–296.

Brenpan, M. J., (1970) *Investor taxes, market equilibrium and corporation finance*, Unpublisbed Pb.D. Dissertation (Massacbusetts Institute of Tecbnology, Cambridge, Mass.).

Business Dictionary (2012) *Scope of work, (online) available at*: http://www.businessdictionary.com/definition/scope-of-work.html#ixzz22qNrrFAr, (cited on 6th August, 2012).

Carlo GL (2000) *Wireless telephones and health: WTR Final Report*, Presented to the French National Assembly. June 19.

Chapman, C. (1997) 'Project risk analysis and management- PRAM the generic process', *International Journal of Project Management*, Vol. 15, No. 5, pp. 273-281

Chapman, C. and Ward, S. (2004) 'Why risk efficiency is a key aspect of best practice projects', *International Journal of Project Management*, Vol. 22, pp. 619-632

Chapman, C. and Ward, S., (2002) *Managing Project Risk and Uncertainty*, John Wiley & Sons, ltd., Chichester, p. 498

Chapman, C. B., Ward, S, Ward, C.S. (2003) *Project Risk Management: Processes, Techniques and Insights*, Second Edition, Jon Wiley and Sons Ltd, The Altium, Southern Gate, Chichester,West Sussex England., *(Online)* Copy of the material could be obtained from: http://books.google.com.gh/books?hl=en&lr=&id; (Cited: July 21st , 2012)

Chapman, R.J., (2001) 'The controlling influences on effective risk identification and assessment for construction design management', *International Journal of Project Management*, Vol. 19, No. 3, pp. 147-160

Construction Industry Institute (CII) (1988) *Risk Management in Capital Projects*, CII Source Document 41.Authored by James Diekmann, Edward Sewester, and Khalid Taher.

Construction Industry Institute (CII) (1993) *The Future Needs of the Construction Industry's Worldwide Customers*. CII Source Document 30.

Construction Industry Institute (CII) (1997) *Alignment During Pre-Project Planning. Implementation* Resource 113-3.

Wong, J.T.Y., & Hui, E.C.M. (2006) 'Construction project risks: further considerations for constructors pricing in Hong Kong', *Construction Management and Economics*, Vol. 24, pp. 425 - 438.

Cranfield CG, Wieser HG, Al madam J, Dobson J (2003) 'Exposure of magnetic bacteria to simulated mobile phone-type RF radiation has on effect on mortality,' *IEEE Trans*. Nana Biosci., Vol. 2, pp 146-149.

Cranfield CG, Wieser HG, Al madam J, Dobson J (2003) Exposure of magnetic bacteria to simulated mobile phone-type RF radiation has on effect on mortality. *IEEE Trans. Nana Biosci*., Vol.2; pp 146-149.

Cranfield CG, Wieser HG, Al madam J, Dobson J. (2003) 'Preliminary evaluation of nanoscale biogenic magnetite-based ferromagnetic transduction mechanisms for mobile phone bio effects,' *IEEE Trans.Nana Biosci*., 2: 40-43.

Cranfield CG, Wieser HG, Al madam J, Dobson J. (2003) 'Preliminary of nanoscale biogenic magnetite-based ferromagnetic transduction mechanisms for mobile phone bioeffects,' *IEEE Trans. Nana Biosci.*, Vol 2: 40-43.

Cranfield CG, Wood AW, Anderson V, Menezes KG. (2001) 'Effect of Mobile phone type signals on calcium levels within human leukamic Tcells Jurkat cells', *Int. J. Radiat. Biol*., Vol.77, pp. 1207-1217

Cranfield CG, Wood AW, Anderson V, Menezes KG. (2001) 'Effect of Mobile phone type signals on calcium levels within human leukamic T ells Jurkat cells). *Int. J. Radiat. Biol.*, Vol., 77; pp. 1207-1217.

David Chambers (2008) *Outdoor Cell site Installation*, (online) available at: http://www.thinksmallcell.com/Operation/outdoor-cellsite-rollout-scenario.html, (cited on 6th August, 2012)

Di carlo A, White N, Guo F (2002) Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. *J. Cell. Biochem.*, Vol. 84, pp. 447-457.

Dias, A., and Ioannou, P. (1995) 'Debt Capacity and Optimal Capital Structure for Privately Financed Infrastructure Projects,' *ASCE Journal of Construction Engineering and Management*, Vol. 121, No. 4, pp. 404-414.

Dubofsky D.A. and Miller, Jr. T.W. (2003) Derivatives*: Valuation and Risk Management. New York*, Oxford: Oxford University Press.

Duncan, W. R (1996) A guide to the project management body of knowledge, (Online) Copy available at: http://www.citeulike.org/group/14887/article/9008974 (Cited: July 31, 2012)

Edwards, P.J. and Bowen, P.A. (1998) 'Risk and risk management in construction: a review and future directions for research', *Engineering, Construction and Architectural Management*, Vol. 5 Iss: 4, pp.339 - 349

Eriksson, P.E. (2003), 'Long-term relationships between parties in construction projects: A way to increase competitive advantage', Article from Luleå University of Technology

Fenelle, C. (1996) Partnerships- Mirage or Reality?, (current news), Risk Management, Vol. 43, No. 5, pg. 55

Eriksson, P.E. (2003), Procurement and governance of construction projects; Atheoretical model based on transaction cost economics, Article from Lulea University of Technology webpages

Gannett Fleming, Inc.(2009), Construction Project Management Handbook, Federal Transit Administration, Report Number FTA-CA-26-7077-2009.1 ,available at:

http://www.fta.dot.gov/documents/FTA-CONSTRUCTION-PRJT-MGMT-HDBK2009.pdf, (cited on 6th August, 2012)

Ghana News Agency (2011) *Globacom to launch Glo Mobile network*, Modern Ghana Site, Article posted: January 19, 2011 (Online) Cited: July 31, 2012, Copy available at: http://www.modernghana.com/news/368699/1/globacom-to-launch-glo-mobile-network-on january-1.html

Gido, J. and Clements, J.P. (2009) *Successful Project Management*, Fourth Edition, South-Western Cengage Learning Natorp Boulvard, Mason OH 45040, USA.

Hackett, M., Robinson, I. & Statham, G. (eds.) (2007) The Aqua Group Guide to Procurement, Tendering & Contract Administration. Oxford, Blackwell Publishing.

Hastak, M., and Shaked, A. (2000) 'ICRAM-1: Model for International Construction Risk Assessment,' *ASCE Journal of Management in Engineering*, Vol. 16, No. 1, pp. 59-69.

HSE (2009) *Health and Safety Induction for Smaller Construction Companies*, Site Safe Scotland, (online) copy available at: http://www.hse.gov.uk/construction/induction.pdf, cited on: 31st July, 2012.

Hughes, W.P. and Hillebrandt, P.M. (2003) 'Construction industry: Historical overview and technological change', In: Mokyr, J. (ed.) The Oxford Encyclopedia of Economic History. Oxford University Press, Oxford, pp. 504-512. ISBN 9780195105070

Ibbs, C.W. and Crandall, K.C. (1982) 'Construction risk: Multi-Attribute approach', *Journal of Construction Engineering and Management*, Vol. 108(2), pp. 187-200.

Jarrard LE, Okaichi H, Steward O, Goldschmidt RB (1984) 'The role of hippocampal connections in the performance of place and cue tasks: comparisons with damage to the hippocampus', *Behav. Neurosci*., Vol. 98, pp. 946-954.

Kangari,R. and Riggs, L.S. (1989), 'Construction risk assessment by linguistics', *IEEE Trans. Eng. Manag*., Vol. 36 No. 2, pp. 126-31.

Kesner RP, Exans RB, Hunt MA (1987) 'further evidence in support of the neurological basis of an attribute model of memory: role of hippocampi,' *Int. J. Neurosci*., Vol. 21-22, pp. 184 196.

Kheni, N.A., Dainty, A.R.J. and Gibb, A.G.F. (2008) 'Health and safety management in developing countries: a study of construction SMEs in Ghana', *Construction Management and Economics*, Vol. 26(11), pp. 1159-1169.

Laurence JA, French PW, Lindner RA, McKenzie DR (2000) 'Biological effects of electromagnetic fields- mechanism for the effects of pulsed microwave radiation on protein conformation,' *J. Thor. Biol*., Vol. 206; pp. 291- 298.

Laryea, S. and Hughes, W. (2009) *How contractors in Ghana include risk in their bid prices.* In: Dainty, A. (Ed) Procs 25th Annual ARCOM Conference, 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, pp. 1295-1304.

Leszczynski, D, Joenvaara S, Reivinen, J. (2002) *Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells*: Molecular mechanism for cancer- and blood – brain barrier- related effects, Differention, Vol. 70, pp.120 129.
Lintner, John. (1965) 'The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets,' *Review of Economics and Statistics*, Vol. 47, No. 1, pp13–37.

Litzenberger, R. H. and K. Ramaswamy (1979) 'The effects of personal taxes and dividends on capital asset prices: theory and empirical evidence', *Journal of Financial Economics, Vol.* 7, pp.163-195.

Low Power FM (2012), *Tower Specification,* available at: http://monsterfm.com/tech/tower/towerspecs.htm, (cited on 26th August, 2012).

Lyons,T and Skitmore, M. (2004) 'Project risk management in the Queensland engineering construction industry: a survey', *International Journal of Project Management* Vol 22, pp 51–61.

M&G (2007), *Health and Safety Policy, Safe Working Policy-Construction*, available at: http://www.mandgjoinery.co.uk/pdf/safe_working_policy.pdf, (cited on 6th August, 2012).

Marshal Rozario (2012), *Construction Safety*, available at http://miosh.net/articles/Occupational%20Safety/CONSTRUCTIONSAFETY.doc, (cited on 6th August, 2012)

Mer Telecom (2012) *How to select a good cellular site?* http://www.scribd.com/doc/25367460/Selecting-a-Site-for-Telecom-Towers

Merton, R., (1973) 'An Intertemporal Capital Asset Pricing Model', *Econometrica*, Vol. 41, pp. 867–887.

Merton, Robert C., (1973) 'An inter temporal capital asset pricing model', *Econometrica*, Vol 41, pp.867-887

Miller, R. and Lessard, D. (2001) Understanding and managing risks in large engineering projects, International Journal of Project Management, Vol. 19, pp. 437-443

Millicom Ghana Limited (2012) *Mission and Vision*, available at: http://www.tigo.com.gh/

Mobile Telecommunication Network (MTN) (2012) About Us, (online), available at: http://mtn.com.gh/Default.aspx?pageid=298 (Cited on: 6th August, 2012)

Mohammad1, N, Che Ani1, A.I. and . Rakmat1, R.A.O.K, Yusof, M.A. (2010) 'Investigation on the causes of variation orders in the construction of building project-A case in the state of Selangor, Malaysia', *Journal of Building Performance*, Vol. (1), pp.73-82 available at: http://www.ukm.my/jsb/jbp/files/paper06.pdf, (cited on 6th August, 2012)

Mossin, J. (1966) 'Equilibrium in a Capital Asset Market." *Econometrica*, Vol. 34, pp.768–783.

Murdoch, J & Hughes, W. (2008) *Construction contracts –Law and Management*, Fourth edition. London, Taylor & Francis.

Musab Tagelsir Abdelsalam (2011), *Mission and Vision Statement*, available at: http://www.expressotelecom.com/en/our-digital-world/, (cited on 6th August, 2012).

National Communications Authority (2012), *Mobile Number Portability in Ghana First Year Report,* pp. 1-15 *(Online)* Copy available at: http://www.nca.org.gh/73/34/News.html?item=259 (Cited: July 18th, 2012)

Neuman, W.L (2007), *Basics of Social Research, Qualitative and Quantitative Approaches*, Second Edition, Pearson education, Inc.

Oman Telecommunications Company (S.A.O.C) (2012) *Design, and Installation of Telecom Towers* http://www.constructionweekonline.com/tenders-2303-design-supply-installation-of-telecom-towers/, ITP Business Publishing Ltd.

Project Management Book of Knowledge PMBok, (2000) *A Guide to the Project Management Body of Knowledge*, 2000 edition, Project Management Institute, Pennsylvania, p.216

PMI PMBok (2012) Risk Identification Process, (online) available at: http://www.robustpm.com/processes/tech_enabled/process_risk%20Id.aspx, (cited on 6th July, 2012).

Project Management Institute – PMI (2000), *A Guide to the Project Management Body of Knowledge*, Project Management Institute, North Carolina.

Project Management Institute – PMI (2004) *A Guide to the Project Management Body of Knowledge*, Third Edition (PMBOK® Guide), Project Management Institute, Newton Square, Pennsylvania. PMI Europe 2001, London UK, June 2001 *(Online)* Copy available at: http://thiqaruni.org/pharmacy2/16.pdf

RAMP (Institute of Civil Engineers and the Faculty and Institute of Actuaries). 1998. *Risk Analysis and Management for Projects*. Thomas Telford, London.

Repacholi MH, Basten A,Gebski V, Finnie J, Harris AW (1997) Lymphomas in E mu-Pim1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields. Radiat. Res., 147: 631–640.

Rodrigues, A. G. (2001) *Managing and Modelling Project Risk Dynamics A System Dynamics-based Framework*, Presented at the Fourth European Project Management Conference, pp. 6-7 *(Online)* Copy available at: http://www.pmir.com/html/pmdatabase/file/articles/rodrigues.pdf (cited: July 18th 2012).

Ross, Stephen A., (1976) 'The arbitrage theory of capital asset pricing', *Journal of Economic Theory*, Vo1. 3, pp 341-360.
Santini R, Santini P, Danze JM, Le Ruz P, Seigne M (2002). Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex. (Paris). Pathol. Biol., 50(10): 621-629.

Scribd Inc. (2012) *Misson & Vission of Airtel* (online) available at: http://www.scribd.com/doc/20441240/Misson-Vission-of-Airtel, (Cited on: 6th August, 2012)

Sharpe, William F. (1964) 'Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk." *Journal of Finance*, Vol. 19, no. 3:425–442.

Shash, A. A. (1993) 'Factors Considered in Tendering Decisions by Top UK Contractors', *Construction Management and Economics*, Vol. 11 (2), pp. 111-118.

Skitmore, M. and Lyons, T. (2004) 'Project risk management in the Queensland engineering construction industry: a survey', *International journal of Project Management*, Vol. 22, No. 1, pp. 51-61

Skitmore, R.M., S.G. Stradling and A.P. Tuohy (1989) 'Project Management Under
SMASH Wireless (2012) How Cell phone Towers Work- The cell site, SMASH Wireless, Inc.http://store.smashwireless.com/howce htowo.html, /,(Cited on: 6th August, 2012)

Smith, G.R. and Bohn, C.M. (1999) 'Small to medium contractor contingency and assumption of risk', *Journal of Construction and Engineering Management*, Vol. 125(2), pp. 101-108.

Smith. N. (2001) *Managing Risk in Construction Projects*, Blackwell Science, Oxford.

Tah, J.H.M., Thorpe, A. and McCaffer, R. (1993) 'Contractor project risks contingency allocation using linguistic approximation', *Computing System in Engineering*, Vol. 4 No. 2-3, pp. 281-293.

Turner, J.R., (1999) *The Handbook of Project-Based Management: Improving the processes for achieving strategic objectives*, 2nd edition, McGraw-Hill, London, p529

Uher, T.E. and Toakley, A.R., (1999) ‘Risk management in the conceptual phase of a project,Uncertainty', *Construction Management and Economics*, Vol. 7(2) pp. 103-113.

Uzzi, B. (1997) 'Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness', *Administrative Science Quarterly*, Vol. 42, No. 1, pp. 35-67

Vergara, A. J., and Boyer, L. T. (1977) 'Portfolio theory: Applications in construction', *J.Constr. Div.*, ASCE, Vol.103(1), pp. 23–38.

Vertical Consultants (2012) http://www.vertical-consultants.com/landowners/cell-tower-development-how-are-cell-tower-locations-selected/,(Cited on: 6th August, 2012)

Voetsch, R.J., Cioffi, D.F. and Anbari, F.T. (2004) *Project Risk Management Practices and their Association with Reported Project Success*, Proceedings from IRNOP

Walliman, N. (2006) *Social Research Methods*, London: Sage.

Ward, S., Chapman, C., (2003) ‘Transforming project risk management into project uncertainty management,’ *International Journal of Project Management*, Vol. 21, pp. 97-105

Wikipedia (2012) *Radio Masts and Towers*, (online) available at: *http://en.wikipedia.org/wiki/Radio_masts_and_towers*, (cited on 6th August, 2012).

Wong, J.T.Y., & Hui, E.C.M. (2006) 'Construction project risks: further considerations for

Yin, R. (1994) *Case Study Research and Design and Methods*, 2nd Edition, Thousand Oaks, Calif: Sage Publications.

Zaghloul, R. and Hartman, F. (2003) ‘Construction contracts: the cost of mistrust,’ *International Journal of Project Management*, Vol. 21, No. 6, pp. 419-424

Zunia (2012) *Project Management in Telecom Project-A Case* , (online) available at: http://openeducation.zunia.org/, (cited on 6th August, 2012).

APPENDICES

Kwame Nkrumah University of Science and Technology

Research Questionnaire

"An Assessment of Project Risk Management in the Construction of Telecommunication Towers"

Dear respondent, this questioner is administered solely for academic work purposes. It is for a comprehensive research towards an award of a Master of Business Administration. Information provided herein shall therefore be held confidential and not be used for any other purpose other than intended. Compliance to general standards of research ethics shall be adhered. Further. It is hoped that on the average, at most twenty-six (26) minutes would be spent on this Questioner. Thank you for the anticipated co-orporation.

Respondent's Bio-Data & Organizational/Network Company Characteristics

1. Which of these best describe you in terms of :

a) Gender : Male ☐ Female ☐

b) Age: 18-30 31-40 41-50 51-60 61-70 71-above (underline age range)

c) Educational level:

I. Tertiary Education
II. Senior High School
III. Junior High School
IV. Basic education
V. Other, please specify…………………(circle choice of educational level)

2. What is your role/level of position in your organization?
a) Manager b) Supervisor c) Subordinate d) other, please specify……………………..

3. When was your company established /state the age of the company …………………….

4. Please, have you been ever been involved in any cell site roll out project, being its pre-paratory or executory sections?
a) Yes b) No

5. If yes above, then at which of the following general stages of cell site construction project management was your participation envisaged?

a) Planning
b) Scheduling
c) Contract bidding and award
d) On-site project execution activities
e) Post-execution activities

6. Did you in any way at any of the stages above measured, identified, or cross examined possible risk foreseeable in the tower construction project?

a) Yes b) No

<u>Cell-Site Construction Projects- processes, scheduling and task management</u>

7. In your own estimation, how many cell site construction projects have your company undertaken over the past three years ………………………… … … ……………………………………….

8. Annually, how many constructed cell sites get de-commissioned ….........and how many usually require major revamp works…………………………………………………………………..

9. Task planning, scheduling, process flow designs before physical construction phase are done by:

a) In-house human resource base
b) Externally contracted professionals/consultants
c) Other, please specify……………………………………………………………….

10. On site physical construction works are executed in your company by:

a) In-house human resource base
b) Externally contracted professionals
c) Other, please specify……………………………………………………………….

11. In your own view estimate the completion and commissioning success of all planned cell site completion projects in your company over the past few years……………………(%)

12. **Instruction**: *Kindly assess how vital or trivial the following tasks/stages in cell sites construction is to your organization by assigning weights on the scales of 1-5 giving cognizance to how critical they are towards the successful execution, completion and achievement of the goals of tower projects:*

(I) Site feasibility assessment, survey, and marking a) 1 b) 2 c) 3 d) 4 e) 5

(II) Obtaining "no objection certificate" for setting up cell site a) 1 b) 2 c) 3 d) 4 e) 5

(III) Liaison with state electricity boards for obtaining required power a) 1 b) 2 c) 3 d) 4 e) 5

(IV) Contracting and identifications of risks a) 1 b) 2 c) 3 d) 4 e) 5

(V) Soil testing , existing buildings analysis; structural design and ground layout a) 1 b) 2 c) 3 d) 4 e) 5

(VI) Finalization of specifications for equipment, works in consultation with technical and commercial teams a) 1 b) 2 c) 3 d) 4 e) 5

(VII) Preparation of bill of quantities and bill of services a) 1 b) 2 c) 3 d) 4 e) 5

(VIII) Equipments and logistics planning and scheduling a) 1 b) 2 c) 3 d) 4 e) 5

(IX) Activity monitoring on daily basis and reporting through a MIS (including critical area and critical activity analysis). a) 1 b) 2 c) 3 d) 4 e) 5

(X) Provision of Security on site and warehouse management a) 1 b) 2 c) 3 d) 4 e) 5

(XI) Supervision of civil, electrical, punch points and other equipment a) 1 b) 2 c) 3 d) 4 e) 5

(XII) Final inspection & handing over of site a) 1 b) 2 c) 3 d) 4 e) 5

13. Please. If there is anything you would like to expound on how cell sites projects are executed in your company, you can briefly do in the space provide below:
………

Various forms/types of risks associated to cell sites projects execution

14. From your own point of view, kindly rank the following possible risks associated to cell site projects in the other of importance; use 1st, 2nd, 3rd,etc

a) Financial risks
b) Technical risks
c) Operational (logistics) risks
d) Time
e) Political risks
f) Environmental
g) Regulatory risks
h) Market risks

15. Do you think adaptability to future changes in technological trends is a major concern in the implementation of tower projects by telecom companies?

a) Yes b) No c) not certain

16. Please indicate some common risks involved in cell site projects

I. …………………………………………….
II. ……………………………………………
III. …………………………………………….
IV. …………………………………………….
V. ……………………………………….........
VI. …………………………………………….

<u>Management of risks in the telecommunication sector cell site construction projects</u>

17. Possible cell site project risks assessment analytics are done:

a) In-house
b) By external professionals/consultants
c) In-house with the collaboration of external professionals
d) Nor sure

18. How do you assess your company in the identification of cell site construction related risks

a) Active
b) Passive
c) Not sure

19. Which of the following do you think your company would be most likely to opt for in identifying possible cell cite project risks:

a) 90% chance of a profit – meaning your company is risk averse
b) 70% chance of gaining a profit but a 30% chance of losing – meaning risk neutral
c) 50% chance of gaining a profit but a 50% chance of losing – meaning risk seeking
d) None of the above

20. What is your company policy on responding to cell site project risk? In a case where your company has a combination these, then please tick appropriately:

a) Risk transferee ☐
b) Risk retention ☐
c) Risk reduction ☐
d) Risk elimination ☐
e) Other please specify……………………………………………………….

21. If your company is financially transferring any identified risk in a cell site project, which of the following approaches is most likely to be deployed?

a) Insurance
b) Exclusion or indemnity clauses in the construction contracts.
c) Company retains costs
d) Employees involved in the cell site project implementation are held responsible
e) Other method, please specify………………………………………..

22. Please, beyond what financial limits or commitments involved in any cell site project would your company likely use insurance?

a) My company insure against all risks
b) Insurance is specific between projects costing ……………..and………………
c) My company is not mindful of the financial commitment in any cell site project.
d) Not sure

23. In your own estimation, how much percent of any cell site project does your company spend on or set aside for the risk identification and management activities?

a) No spending
b) Less than 1%
c) Between 2-5%
d) Between 5-10%
e) Beyond 10%
f) Not sure

24. How do you find your company dealing with cell cites construction risks management?

a) Quantitatively b)Qualitatively c) a combination of the two

25. (a). If quantitative approaches are used then please ***a) how often and b) how successful*** are the following methods used in the achieving a thorough and comprehensive analysis of risks:

I.	Expected monitory value (EMV)	a) 1 2 3 4 5	b)1 2 3 4 5
II.	Expected net present value(ENPV)	a) 1 2 3 4 5	b)1 2 3 4 5
III.	Decision tress	a) 1 2 3 4 5	b)1 2 3 4 5
IV.	Breakeven analysis	a) 1 2 3 4 5	b)1 2 3 4 5
V.	Scenario based analysis	a) 1 2 3 4 5	b)1 2 3 4 5
VI.	Using a Delphi- peer- group	a) 1 2 3 4 5	b)1 2 3 4 5

VII. Risk adjusted discount rate approach a) 1 2 3 4 5 b)1 2 3 4 5

VIII. Other, please specify……………………………

(b). If qualitative methods are used then please ***a) how often and b) how successful*** are the following methods used in the achieving a thorough and comprehensive analysis of risks:

I. Percentage contingency form historical data a) 1 2 3 4 5 b)1 2 3 4 5

II. Interviewing (risk analysts and experts) a) 1 2 3 4 5 b)1 2 3 4 5

III. Brainstorming a) 1 2 3 4 5 b)1 2 3 4 5

IV. Personal and corporate experience a) 1 2 3 4 5 b)1 2 3 4 5

V. Rule of thumb or engineering judgments a) 1 2 3 4 5 b)1 2 3 4 5

VI. Other, please specify……………………………………………………

<u>Cell-site project risk management through collaboration among parties</u>

26. Are tower projects undertaken with a fair representation of all individuals from all the various units of your organization?

a) Yes b) No c) not certain

27. Please, kindly list possible key groups of individuals whose participation are paramount towards the achievement of cell cite construction projects objectives and associated risk management e.g. engineering team etc,

a) ……………………………………………………………………..
b) ……………………………………………………………………..
c) ……………………………………………………………………..
d) ……………………………………………………………………..
e) ……………………………………………………………………..
f) Other, please specify…………………………………………………….

28. Please, in your own view kindly estimate the level of coordination between technical teams executing any cell site project and commercial, finance or project management units of your organization from the preliminary stage of planning to competition

a) Very high b)High c) Low d) Not certain

29. All due diligence are undertaken to ensure that all possible certifications and compliance with all regulatory requirements are met before any cell site construction project is executed.

a) Yes b)No c) Not certain

30. The marketing team is usually given a faire chance to evaluate the location advantages in respect of coverage provision to existing and potential customers prior to execution of cell site projects

a) Often b) Not often c)Not at all d) Not certain

31. Please, if you have anything to say on how to ensure collaboration among tower project implementation parties, kindly briefly use this space provided:

………

"End of Page"! Thank You for Your time!