Risk Management Practices of Construction Projects in the Mining Sector

by

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university at Kwame Nkrumah University of Science and Technology, Kumasi, or any other educational institution, except where due acknowledgement has been made in the thesis.

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ABSTRACT

In Ghana the importance of mining in the economy cannot be underestimated. Mining, especially gold mining, started several centuries before the arrival of the white man and during the colonial period the country was named "Gold Coast" to reflect such an importance. The aim of this thesis is to explore risk management practices of construction projects in the mining sector with three objectives being: To establish the critical risk factors associated with construction projects in the mining sector; To ascertain the risk mitigating factors attendant with construction projects in the mining sector; and to explore risk management practices of construction projects in the mining sector. Quantitative research method was adopted in which survey questionnaires were administered to respondents to gather primary data. Descriptive and Inferential analysis was conducted. Descriptive tools included standard deviation, mean scores, percentages and frequencies. One-Sample T-test and Relative Important Index was the inferential analytical techniques that were adopted. The findings of the research indicated that: Unavailability and accuracy of preliminary geo-scientific information; Instability of foreign currency exchange rate; High Inflation rate; Unstable and unpredictable fiscal regime; and fraud were critical risk factors associated with construction projects in the mining sector. It was recommended that construction project risk management stakeholders in mining industry ensures regular review and updating of risk management systems. Moreover, mining companies should take creative and innovative approaches to access new talents through training and education programs and retain existing skilled workers.

Keywords: Risk management, Risk Management Practices, Construction Project, Mining Sector.

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DEDICATION

This dissertation is dedicated to the Almighty God for his mercies, my parents who laid the foundation for my education, all my family members, friends and loved ones.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 INTRODUCTION

This chapter of the study intended to provide a broader view of the research in relation to background of the research study. Further, emphasis was made on the research problem statement which gave rise to the conduct of the research. It also presented the aim and objectives, research scope, significance and summarized methodology which was adopted for data collection. The organizational structure of the study was also presented in this chapter.

1.1 BACKGROUND OF THE STUDY

Mankind's existence on earth largely depends on minerals. Minerals are used in wide variety of areas from chemical industry, manufacturing, and other industrial uses. Minerals are obtained from mining activities which are sets of operations aimed at the exploration, discovery, and extraction of mineral of economic value (Hammond *et al*., 2011). Some nations and cities such as Johannesburg in South Africa and San Francisco in North Carolina (USA) own their prestige to successful mining activities (Eggert, 2010). In Ghana the importance of mining in the economy cannot be underestimated. Mining, especially mining of gold, began several centuries before the white man came in place and during the colonial period the country was named "Gold Coast" to reflect such an importance.

The reward of successful mining activities can be very great for both the investor and host governments. For the investor it leads to increased profits; for local communities or nation, well-paying jobs, increase in revenues of government which can further be invested in social main concerns which include, health care, alleviation of poverty and education (Akabzaa and Darimini, 2001; Eggert, 2010; Ghana Chamber of Mines, 2014). These benefits cannot be achieved if all mining stakeholders, especially the country and the mining companies were not able to successfully manage the numerous risks associated with the industry. It is an accepted fact that all business endeavors comport some level of risks. But mining is so unique that Miroux *et al*. (2007) consider it as the riskiest business venture.

According to Aven (2014) the word risk is, probably, derived from the early Italian “risicare” which means “to dare” and is commonly used to express a certain probability that, an unwanted event will occur. In every industry the concept of risk management is used, ranging from pharmaceutical industry to automobile, the construction industry and IT businesses. Also, regardless of the sector of industry, the general ideas of risk management remain the same though every industry develops their own risk management standards. In commissioning of a project, risk management is among the nine most essential measures. This portrays an inter-relationship between risk management and the success of a project (PMI, 2004). Risk management application is promoted in all projects in order to avoid negative consequences (Potts, 2008). Moreover, risk management is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives (PMI, 2007).

Mining as an occupation consists of extraction from the earth of mineral resources. It is performed in tunnels and shafts network intended in connection with geological drilling data acquired (Gostudy.net, 2016). The activities carried out in the mining industry impose a lot of risk in its operations. Risk and uncertainty can potentially have damaging consequences for projects (Flanagan, 2006).

The risks in the mining sector are exacerbated by the unique characteristics of the industry such as the capital intensiveness, the long lead period (or long pre-production period), the exhaustibility of the asset (that is the mineral resource), the uncertainty associated with the discovery and evaluation of the resource and the volatility of the mineral price (Poliquin, 2007). It is therefore, obvious that the importance of risk management of mining projects in general cannot be underestimated. In doing so, most mining investors give particular consideration to the business environment of the host countries in which they intend to invest because the result of their undertaking is affected by the social, economic and political environment of the country (Roe and Samuel, 2007). Studies articulated to explore risk management concerns in the mining sector have always been applauded by both academics, industry and governments, hence the necessity of this study.

1.2 STATEMENT OF THE PROBLEM

Construction projects are always unique and risks raise from a number of the different sources. Construction projects are inherently complex and dynamic, and involving multiple feedback processes (Zou *et al*., 2007). A lot of participants; individuals and organizations are actively involved in the construction project, and their interests may be positively or negatively affected as a result of the project execution or project completion (PMI, 2008). Different participants with different experience and skills usually have different expectations and interests. This naturally creates problems and confusion for even the most experienced project managers and contractors. Further, construction projects can be unpredictable. Managing risks in construction projects has been recognized as a very important process in order to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability (Klemetti, 2006; Zou *et al*., 2007). Project risk management is an iterative process: the process is beneficial when is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion.

According to PMI (2007) risk management is probably the most difficult aspect of project management. A project manager must be able to recognize and identify the root causes of risks and to trace these causes through the project to their consequences. Mining is a hazardous operation and consists of considerable environmental, health and safety risk to miners (Chu *et al*., 2017). Unsafe conditions in mines lead to a number of accidents and cause loss and injury to human lives, damage to property, interruption in production etc. (Cox, 2008). Nevertheless, the mining industry has for many years focused on injury prevention at the workplace through procedures and training, and has achieved considerable success (Paithankar, 2011). However, the statistics on major accident events such as fatalities and reportable incidents has not shown the corresponding levels of improvement.

In addition, many sectors are beginning to become conscious of the RMP, according to Smith et al. (2006), but are still not using risk management models and methods. This contradicts the reality that the sector is attempting to be more cost-effective, more time-efficient and more project control. Risk is connected with any project irrespective of the sector and therefore RM should be of concern to any project manager. Because every project is unique, particularly in building, the risks vary between projects. However, there are still many practitioners that have not realized the importance of including risk management in the process of delivering project. Even though there is an awareness of risks and their consequences, some organizations do not approach them with established RM methods (Smith *et al*., 2006).

Lots of previous studies have been conducted within the risk management field but each presents a different approach to the concept of risk management. For instance (Klemetti, 2006; Zou *et al*., 2007; Cavignac, 2009) focused their research on the cost of risk in construction projects. Solomon (2012), on his part devoted most of his work on the negative effects political risk factor present to the mining sector in Ghana. Also, KPMG (2014) studied into the economic risks that mining industry in Ghana presents to investors. However, to the best knowledge of the researcher there is little knowledge on risk management practices of construction projects in the mining sector in Ghana. This has left a knowledge gap, which this study tended to fill by making awareness of the practices to manage risk and enhance successful operations in the mining sector.

1.3 RESEARCH QUESTIONS

1. What are the critical risk factors associated with construction projects in the mining sector?
2. What is the risk mitigating factors attendant with construction projects in the mining sector?
3. What are the risk management practices of construction projects in the mining sector?

1.4 AIM AND OBJECTIVES OF THE STUDY

1.4.1 Aim of the Study

The main aim of the study was to explore risk management practices of construction projects in the mining sector.

1.4.2 Specific Objectives of the Study

1. To establish the critical risk factors associated with construction projects in the mining sector.
2. To ascertain the risk mitigating factors attendant with construction projects in the mining sector.
3. To explore risk management practices of construction projects in the mining sector.

1.5 SIGNIFICANCE OF THE STUDY

The reward of successful mining activities can be very great for both the investor and host governments. For the investor it leads to increased profits; for local communities or nation, well-paying jobs, new infrastructure, increased government revenues that can in turn be invested in social priorities such as education, health care, and poverty alleviation (Eggert, 2010). These benefits cannot be achieved if all mining stakeholders, especially the country and the mining companies were not able to successfully manage the numerous risks associated with the industry.

The study provided the risk associated with poor project management and the causes of risk in construction projects in the mining sector. Further, risk management practices of construction projects in the mining sector will be explored.

In addition, the study provided a chance to conduct more studies on risk management procedures in the mining sector to improve mining investment. The results served as a reference material for those interested in acquiring expertise in mining risk management.

1.6 SCOPE OF THE STUDY

The assessment was limited to the Asanko Gold mines located in the Ashanti Region of Ghana. The selection of the Asanko Gold mines is due to its ease of access to the scientist, thus improving the economic hardships that the study experienced in terms of information collection, as well as facilitating the questionnaire retrieval. Also, the mining company's decision was due to its huge contribution on the Ghanaian market to the mining sector.

Contextually, this research focused on the mining industry's risk management of works specifically targeting mining industry professionals including supervisors, geologist, mining engineers, and mining surveyors. The reward of successful mining activities can be very great for both the investor and host governments. For the investor it leads to increased profits; for local communities or nation, well-paying jobs, new infrastructure, increased government revenues that can in turn be invested in social priorities such as education, health care, and poverty alleviation (Eggert, 2010). Therefore, the relevance of improving mining operations for successful project management is in the right direction.

1.7 RESEARCH METHODOLOGY

Research philosophy refers to a system of beliefs and assumptions about the development of knowledge (Saunders *et al*., 2009). Positivism as a research philosophy will be adopted in this research. Epistemology is about how we ‘know’ what we claim to know. Epistemologically, positivist would emphasis on determining observable and quantifiable facts and are of the view that credible and meaningful data can only be obtained from phenomena that can be observed and measured (Crotty, 1998).

The quantitative research strategy was used in this study since positivism depends on quantifiable observations that lead to statistical analysis (Dawson *et al*., 2006). The deductive approach was adopted based on the argument by Cacioppo *et al*. (2004) that as a general rule, positivist studies usually adhere closely to the deductive approach. The survey-based research design was espoused for primary data collection which relates to the positivism philosophy. Surveys enablde the researcher to obtain data about practices, situations or views at one point in time through questionnaire or interviews.

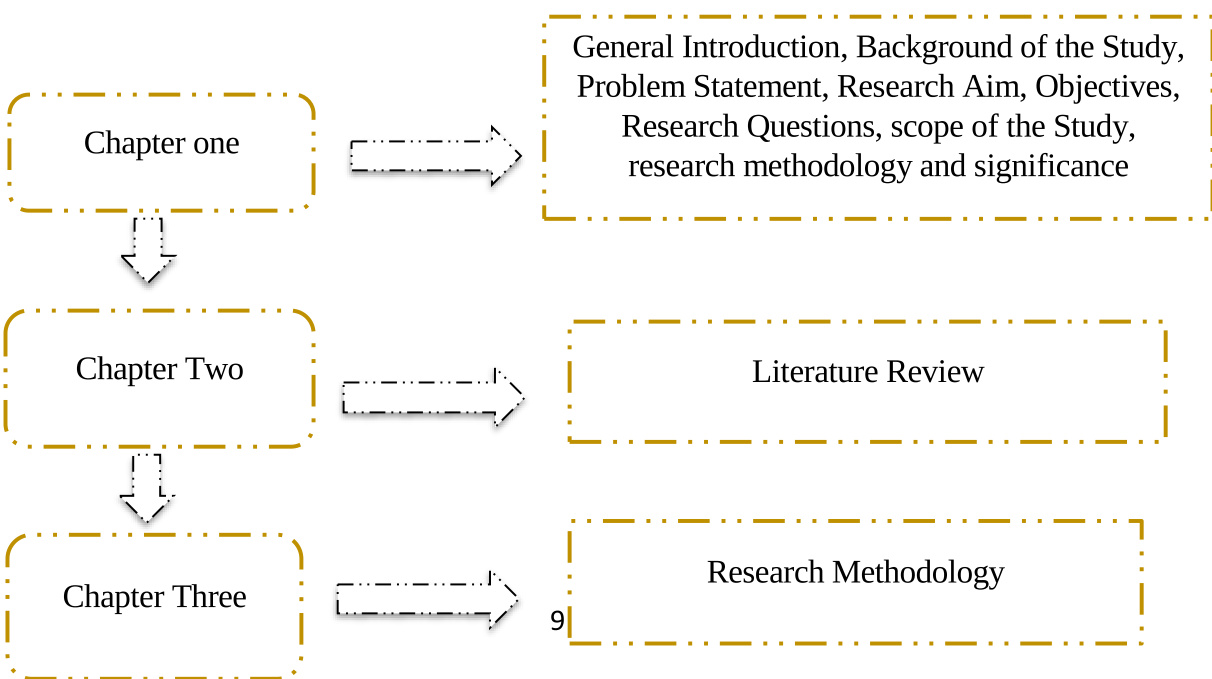
As per Kothari (2004) 'Population' means the total of items about which information is desired. For this research, the population were mining professionals, including supervisors, geologist, mining engineers, and mining surveyors. Purposive sampling technique was employed in this study. The purposive sampling technique will be used in selecting only the practitioners in the mining site engaged in risk management in their operations. Purposive sampling will be adopted because according to Tongco (2007), Purposive sampling technique is a non-probability sampling used when the researcher decides on what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience. The survey questionnaire was administered via e-mail and personal delivery to a sample size of 50 respondents. According to Bernard (2002), there is no strict rule on how many respondents should make up a purposive sample, as long as the needed information is obtained.

The research used primary data as well as secondary data source. The secondary sources of data included appropriate books, journals, and online sources, whereas the primary data was collected through the design of structured survey questionnaires. Therefore, the data collection instrument was a structured survey questionnaire. The questionnaire was employed because of its relatively inexpensive way to reach out to a wider range of respondents (Trochim and Donnelly, 2008).

The completed questionnaires were coded and entered into the Statistical Package for Social Sciences (SPSS). Descriptive and Inferential analysis were conducted. Descriptive tools included standard deviation, mean scores, percentages and frequencies. One-Sample T-test and Relative Important Index were the inferential analytical tools that was adopted.

1.8 RESEARCH ORGANIZATION

This research comprised of five chapters with chapter one which provides the background of the study, the statement of the problem, aims as well as objectives, significance and methodology. Chapter Two provided the theoretical and empirical review of literature relevant to the topic of risk management practices of construction projects in the mining sector. Chapter Three discussed the research methodology adopted. Chapter four and five analysed the data with the study's overview, findings and suggestions.



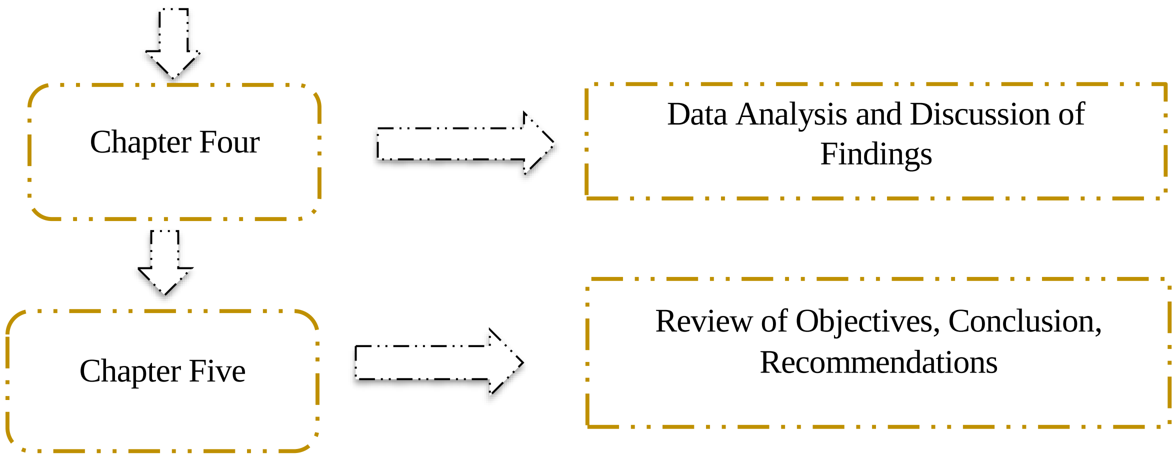


Figure 1. 1:Research Flow Diagram

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

In this chapter, the component of the literature review is divided into four sections. A description of a project and project management was given in the first chapter which is the conceptual review. It was aimed to provide general data about a building project and its management to a reader. The second chapter, the theoretical review, presented the notion of risk and risk management and defined the terms used in this process. The third section which is the empirical review provided a critical review of key works under themes which addressed the objectives of the study which are: critical risk factors associated with construction projects in the mining sector, risk mitigating factors attendant with construction projects in the mining sector and risk management practices of construction projects in the mining sector. The final section of the literature review which is the conceptual framework gives an illustration and discussion on how the various variables above interact to make sense of the work.

2.1 CONCEPTUAL REVIEW

2.1.1 Project

Gary and Larson (2008) defined project as "a complex, non-routine, one-time effort limited by time, budget and resource, and performance specifications designed to meet customer needs. Further, according to PMI (2008) A project can be described as having limitations (generally focused on time and resources, but also all process and result elements). A project described in the fifth edition of PMBOK, "it is a temporary endeavor undertaken to create a unique product, service, or result". Temporary meaning the project has a beginning and an end (PMI, 2007). In general, projects also begin with a goal or a specific outcome in mind. It always has a set period of time and can work on a project with one or many individuals. In the view of Wysocki and McGary (2003), "A project is a sequence of unique, complex and connected activities having one goal or purpose and that must be completed by a specific time, within budget, and according to specification".

According to PMI (2008) a project is characterized by the following key features: A project is unique, that is, a one-off or non-repetitive undertaking, where each one is different from the others; it is temporary, which means, there should be a beginning and an end; it utilize resources; have time constraints; have specific pre-defined objective to be achieved; it is subject to uncertainty; need for integration; and beneficial change, i.e. improving outcome.

According to smith *et al*. (2006), A project is an undertaking in which human, material and economic resources are structured in a new manner; to conduct a distinctive scope of job of the specified specification, within time and cost limitations, in order to attain unitary, useful change, by delivering quantified and qualitative goals. The definition indicates three main project goals, i.e. time, quality and cost, to be focused on when the project is undertaken. It also shows the significance of effective resource organisation to attain a good end outcome.

2.1.2 Project Management

Project management is, according to Gray and Larson (2006), a job derived from an organisation that allows skilled project executives to use their abilities, instruments and expertise to plan, implement and control a distinctive project within a restricted lifespan by meeting the organization's specification criteria. Munns and Bjeirmi (2008) also described project management as a mechanism used to regulate the project goals by using the organizational structure and resources to handle a project using instruments and methods without disrupting the company's daily procedure. In addition, project management was described as "the process by which projects (unique, complex, non- routine, one-time effort limited by time, budget, and resources) are defined, planned, monitored, controlled and delivered such that the agreed benefits are realized" (APM, 2006).

Moreover, project management is the activity of organizing and managing project resources and constraints with the aim of producing a successful completion and achievement of specific project goals and objectives (Scwalbe, 2008). Westland defines project management as a set of skills, tools and processes needed to undertake a project successfully (Westland, 2007).

Nevertheless, project management is the discipline of managing all the different resources and aspects of the project in such a way that the resources will deliver all the output that is required to complete the project within the defined scope, time, and cost constraints. However, these are agreed upon during the project initiation stage and by the time the project begins all stakeholders and team members will have a clear understanding and acceptance of the process, methodology and expected outcome (APM, 2006).

2.1.3 General Overview of Risk Management

In today's post-crisis economy effective risk management is a critical component of any winning management strategy. Risk management is one of the nine knowledge areas propagated by the Project Management Institute (PMI). The PMBOK Guide recognizes nine knowledge areas typical of almost all projects which includes: Project integration management; Project scope management; Project time management; Project cost management; Project quality management; Project human resource management; Project communications management; Project risk management; Project procurement management (PMI, 2008).

However, although these knowledge areas are all equally important from a project manager's point of view, in practice a project manager might determine the key areas which will have the greatest impact on the outcome of the project. According to PMI (2007) risk management is probably the most difficult aspect of project management. A project manager must be able to recognize and identify the root causes of risks and to trace these causes through the project to their consequences. Therefore, the use of risk management from the early stages of a project, where major decisions such as choice of alignment and selection of construction methods can be influenced, is essential (Eskesen *et al*., 2004). Risk management process advantages include: cost identification and analysis, enhancement of building project management procedures, and efficient resource utilization.

In addition, the parameters of achievement for any project are completed in time, within the particular budget and results required (technical requirement). Changing the project environment is the primary obstacles to their accomplishment. The issue multiplies with the project size as uncertainties increase with the size of the project result (Dey, 2011). Because of such variables as planning, design and construction complexity, the existence of different interest groups (owners, consultants, contractors, vendors, etc.), large building projects are subjected to uncertain surroundings; resources (funds, equipment, materials, manpower) availability, environmental factors, the economic and political environment and statutory regulations (Dey, 2011).

Furthermore, risk cost is a notion that many building businesses have never considered despite being one of the biggest expenditure products (Cavignac, 2009). Risk management enables main project stakeholders: customer, contractor or developer, advisor, and provider fulfill their obligations and minimize adverse effects in terms of price, time, and quality objectives on building project performance. Practitioners have traditionally tended to associate project success with these three aspects of time, cost and quality outcomes.

Nevertheless, construction projects can be unpredictable. Managing risks in construction projects has been recognized as a very important process in order to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability (Zou, *et al*., 2007) Project risk management is an iterative process: the process is beneficial when is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion.

2.1.4 The Concept of Risk

The PMBOK Guide (PMI, 2008) defines a project risk as "an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective". Risk also can be defined as a characteristic of a situation, action, or event in which a number of outcomes are possible, the particular one that will occur is uncertain, and at least one of the possibilities is undesirable (Yoe, 2000). Zayed and Chang (2002) defined risk as the presence of potential or actual constraints that could stand in the way of project performance, causing partial or complete failure either during construction or at time of use.

Furthermore, risk according to Kartam (2001) can be defined as the probability of occurrence of some uncertain, unpredictable and undesirable events that would change the prospects for the profitability on a given investment. There are many possible risks which could lead to the failure of construction project, and through the project, it is very important what risk factors are acting simultaneously. As stated by Raz *et al*. (2002), too many project risks as undesirable events may cause construction project delays, excessive spending, unsatisfactory project results or even total failure. Risks and uncertainties, involved in construction projects, cause cost overrun, schedule delay and lack of quality during the progression of the projects and at their end (Wysocki, 2009; Wang and Chou, 2003; Simu, 2006). As stated by Baloi and Price (2001), risks involved in construction projects cause poor cost performance of construction projects.

2.1.5 The Concept of Risk Management

Risk management is an essential tool for eliminating or mitigating the consequence of risk in construction projects. Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives (PMI, 2007). According to Bijl and Hamann (2002), risk management is a methodical and iterative process that identifies, assesses, mitigates and controls the risk so as to optimize the performance of a project. Simon *et al*. (2000) defines risk management as the process designed to remove or reduce risks which threaten the achievement of project objectives.

Furthermore, risk management is the formulation of management responses to the risks and can involve identifying preventive measures to avoid a risk or to reduce the effects; establishing contingency plans to deal with risks if they should occur; initiating further investigation to reduce uncertainty through better information; considering risk transfer to insurers; considering risk allocation in contracts and setting contingencies in cost estimates etc (Borge, 2001).

Furthermore, risk management (RM) enhances a project's future opportunities by identifying uncertainties and probabilities (Borge, 2001). It is described as a systemic method through which all project-related hazards are recognized and assessed by quantifying them to take a sound risk management choice (Zou et al., 2007). Risk Management Institute (IRM) defines two dimensions of risk: positive and negative. Positive risks could have positive effects on a project's success, and negative risks are associated with potential project failures (IRM, 2002).

However, the benefits from RM are not only reserved for the project itself, but also for the actors involved. The main incentives are clear understanding and awareness of potential risks in the project. In other words, risk management contributes to a better view of possible consequences resulting from unmanaged risks and how to avoid them (Thomas, 2009). Another benefit of working with risk management is increased level of control over the whole project and more efficient problem-solving processes which can be supported on a more genuine basis. Risk management also provides a procedure which can reduce possible and sudden surprises (Cooper *et al*. 2005).

However, effective risk management ensures that: employee and public health, safety and well-being are not compromised; business financial performance is protected; a business earns its social license to operate in the eyes of local communities, regulators and other performance-based stakeholders; and a business reputation is strengthened (Cooper et al., 2005).

2.1.6 The Mining Industry

Mining is an old occupation that has long been acknowledged as arduous to expose workers to injuries and diseases (World Coal Institute, 2007). Burgess-Limerick and Steiner (2006) reaffirmed that mining has been accepted as a hazardous profession worldwide, involving ongoing workforce conflict with unforeseeable natural forces. Mining is an occupation involving mining of earth's mineral resources. It is carried out in a network of shafts and tunnels to be engineered on the basis of geological information from drilling (Burgess-Limerick and Steiner, 2006).

However, shafts in the mines must be designed to withstand the desired amount of air in order to create an atmosphere permissible to world standards and manage the total tonnage of mined minerals, materials and men. Consequently, mining as a profession is unique and brings together various professionals. Mining industry professionals include mining engineers, mechanical and electrical technicians, geologists, registrants, mining surveyors, miners, subterranean employees, and managers (Jankani, 2016). All of these professionals have specific mine functions to make it safe. The mining engineering work, for instance, is accountable for developing the best mining technique for any particular ore body. He makes comprehensive use of the recent computer technology to design the safest and most cost-effective technique of mining.

The electrical and mechanical engineers also guarantee the efficiency of the mine's design, building and maintenance of machinery and facilities, while the geologist draws conclusions from the mine's cores. The geologist utilizes delicate instruments to identify the existence of certain minerals by applying principles such as electromagnetism, shock waves and radioactivity. He or she may also use sensory equipment scanning the earth from an orbiting satellite to make inferences. The mining surveyor is the mine expert and is accountable for measuring, representing and managing mining-related information. He or she is also responsible for marking, measuring and keeping direction on the mining site for all surface and underground work (Jankani, 2016).

The surveyor also conducts surveys of surface and underground mining operations, tunnels and subway sites, and underground storage facilities to control the direction and extent of mining. Matriculants are experts from various scientific backgrounds who are trained to work for whatever ability they are recruited. They worked to protect the mine for a favorable working setting and productive mineral extraction. They depend on advanced contemporary systems to collect all the data necessary for mine operation (Crystalrugged.com, 2016).

2.1.7 Evolution of Mining Industry in Ghana

The exact beginning of gold mining in Ghana has been poorly documented and the few available early records only indicated that the forest peoples of modern Ghana used to mine gold several centuries before the Portuguese arrived at the Gold Coast in the fifteenth century, more precisely in 1471 (Mensah and Ababio, 2011). Dumett (1979) mentioned Gyaman, Adanse, Akyem Abuakwa, Denkyira, Wassa states as the main gold-rich localities. At that time the traditional way of winning gold was most commonly washing or panning for alluvial gold along stream and river banks and ocean shores.

Moreover, according to him, Gold was also obtained through shallow-pitting in ancient river beds and deep-shaft for reef gold. Workers were often organized on family basis with women, adolescent girls and young men doing the panning while men carried out the digging. There were no general policies that governed the industry and only individual traditional states dictated their own strict traditional customary rules and regulations of the work. For example, in Wassa state the work was to be done only on Tuesdays, Thursdays and Fridays (Dumett, 1987). Special days were also put aside during which the whole community worked together to produce gold for the kings in their respective states (Mensah and Ababio, 2011).

Furthermore, Mensah and Ababio (2011) stated that during that pre-colonial period, mining in Ghana was fully the work of indigenous Ghanaian people who supplied Europe with large quantities of gold. Junner (1935) reported that this continued until apparently early 1600s when Portuguese and other European traders became involved in alluvial mining along the Ankobra River, Komenda, west of Elmina, and east of the mouth of the Pra River. But their involvement in the industry at that time was not substantial and the industry was still the monopole of local people with their rules and regulations (Griffis *et al*., 2002).

Griffis *et al*. (2002) explained that soon after Gold Coast became a British colony in late 1874, a drastic change took place in the gold mining industry. This change was the "direct involvement in the exploration and development of deeper mines by groups of foreign promoters and engineers who introduced new mining technologies that were being developed in other gold mining districts" all over the world (Griffis *et al*., 2002). However, despite this change there was still no direct involvement of the state to regulate the industry. Mining lease acquisition terms were directly negotiated with local chiefs to whom relatively modest amounts of money were paid representing exploration and development, royalties and net profit interests (Griffis *et al*., 2002).

Mining in Ghana at that time might then be less risky for an investor in terms of fiscal regime and other regulatory constraints such as environmental issues. Currently, the structure of the mining industry in Ghana can be divided into: Large-scale mining largely dominated by foreign companies which are involved in the exploration and production of such minerals as gold, diamond, Bauxite and manganese. Few private Ghanaian companies are also actively involved in the exploration of mainly gold; Small-Scale mining sector, which is restricted to only Ghanaians miners, contributes significantly to alluvial gold and diamond productions. The small-scale sector also produces to a lesser extent such industrial minerals as limestone, silica sand, kaolin, stone and salt; and even though the artisanal "galemsey" operations are illegal, they exist in the country and should not be ignored (Akabzaa and Darimani, 2001).

2.1.8 Risk Implications of Mining in Ghana

The favorable geological environment for mineralization in Ghana is an advantage for the development of mining industry in the country. This also has some geological, environmental as well as social risk implications. Gold is the major mineral produced and exported in Ghana. Generally, according to Alexander (2003) gold is low grade in ore as compared to other minerals such as iron or copper. The consequence of this is that tens of tons of waste materials are produced to obtain one ounce (oz) of gold. It raises the issue of waste disposal. In case the mineralization is the near surface type, as it is often the case in Ghana, surface mining method is usually used. As a result, large portions of agricultural lands, forests are destroyed taking livelihoods from local people (Alexander, 2003).

Furthermore, gold in Ghana often occurs in association with sulphides minerals such as pyrite, chaocopyrite. When the tremendous rock waste piles resulting from mining are exposed to oxygen or water, the sulphides produce sulfuric acid and leach other metals which may eventually contaminate surface (streams, rivers, lakes etc) and groundwater water (Mensah and Ababio, 2011). Moreover, the negative impacts of the contamination on aquatic and human life cannot be overlooked. Managing these issues is often a challenge for mining companies and therefore causes resentment among the affected mining communities. The resentment sometimes results in violent confrontation between companies and local populations. The destructive nature of mining operations and its associated environmental and social issues is often the reason why Non-Governmental Organizations and Civil Society Organizations come into the scene. Their intervention often complicates the situation for companies (Mensah and Ababio, 2011).

However, the risk for companies is delay in project realization and in the worst-case project cancelation. When this happens, it will cause huge financial lost to the company. Properly managing this waste issue necessitates construction of appropriate tailing storages and others which implies increasing capital costs and therefore reduction of profitability for the company (Alexander, 2003).

2.2 EMPIRICAL REVIEW

According to Poliquin (2007) risks in mining sector are exacerbated by the unique characteristics of the industry such as the capital intensiveness, the long lead period (or long pre-production period), the exhaustibility of the asset (that is the mineral resource), the uncertainty associated with the discovery and evaluation of the resource and the volatility of the mineral price. It is therefore, obvious in general that the importance of risk management of mining projects cannot be underestimated. In doing so, most mining investors give particular consideration to the business environment of the host countries in which they intend to invest because the result of their undertaking is directly related to the social, economic and political environment of the country (Roe and Samuel, 2007). Studies articulated to explore risk management concerns in the mining sector have always been applauded by both academics, industry and governments.

2.2.1 Risk Factors Associated with Construction Projects in the Mining Sector

Risk level is always associated with the complexity of the project (Darnall and Preston, 2010). The fact that in building there are so many dangers that can be recognized can be clarified by the size and complexity of the projects. The larger the project, the more future risks it may face (Darnall and Preston, 2010). In addition, multiple factors may stimulate the occurrence of risk. The most frequently cited in the literature are economic, environmental, time, design, and quality (the project's environment, place, and general laws). The level of technology used and the risks of the organization are other influences on the occurrence of risk (Gould and Joyce, 2002). Cleden (2009) also argues that complexity is a factor that can limit a project; the larger and more complex a project is, the more resources it requires. In addition, the project team must remember that there may be more threats when all potential risks have been identified.

The project team should therefore not only concentrate on managing the recognized hazards, but should also be alert to any fresh future hazards that may occur. According to him, RM should be used as an instrument for discovering most hazards, and a project manager should also be ready to manage uncertainties that are not included in an RM scheme (Cleden, 2009).

The Project Management Institute, (2004) defines risk as “uncertain event or condition that, if it occurs, has positive or negative effects on at least one project objective, such as time, cost, revenues and profits” and in the mining industry, the uncertainties may include social and environmental, political, geological, engineering, long lead and capital intensive venture, economical and exhaustibility (Conrad-Mulherin, 2012).

2.2.1.1 **Geological Risk Factors**

Geological risks, which have to do with the probability that exploration works might not result in the discovery of minerals of commercial quantity or host government might not provide accurate and up to date preliminary geological information (Ernest and Young Global Limited, 2014). Also it involves the uncertainty concerning the availability and quality/accuracy of preliminary geo-scientific information. For example, scale and quality of existing geological maps, geophysical and soil geochemical data (Hoffman, 2007). However, according to Conrad-Mulherin (2012) even if the above mentioned geo-scientific information exits there is still the probability that they might not easily be accessible from mining institutions due to lack of geological database; corruption; excessive bureaucracy etc. or from the internet. Furthermore, geological risk factors may include uncertainty concerning availability of reports of previous exploration and mining activities in the host country as provided by previous companies to governmental geological agencies such as Geological Survey Department and Minerals Commission (Conrad-Mulherin, 2012).

2.2.1.2 ***Economic/Commercial Risk Factors***

Conrad-Mulherin (2012) also gave more detail on economic/commercial risk factors in the mining industry. Concerning the category of economic/commercial risk, he identified such factors as: Instability of foreign currency exchange rate which affects foreign company's ability to meet its domestic needs such as paying debts and taxes, buying mining equipment's; Inflation rate (high inflation will increase operation and capital costs which will in turn reduce profitability); and Currency transfer and convertibility restrictions such as profit repatriation, tariff and non-tariff barriers. It also has the effects of hindering company's ability to meet its domestic needs. McGill (2005) identified fiscal regime as economic risk factor in the mining industry which includes royalty rates and tax liabilities. According to him unstable and unpredictable fiscal regime leads to unreliable cash flow analysis and this can be detrimental to project viability given the capital intensity and the long lead period of mining projects. He further stated input cost escalation, changes in demand or price for the product as inherent economic risk factors in mining industry.

2.2.1.3 **Political Risk Factors**

Political risk is defined as uncertainty over the actions not only of governments and political institutions, but also of minority groups and separatist movements (McGill, 2005). According to Gentry and O'Neil (1984), political risk factors associated with the mining industry includes: Corruption and fraud which can result from high poverty level and can be observed at national, institutions and corporate levels. An example is unofficial facilitation fees paid to have routine work done; Weak institutions (sometimes resulting from duplications of tasks i.e. many institutions performing similar functions) that cannot adequately enforce rules and regulations; Excessive government bureaucracy which usually causes corruption and delay in obtaining mining licenses, environmental permits etc. The ultimate effect is cost increase for companies; and

Poor governance at the national and mining institutions levels; Conflicting interests of local governments and traditional authorities (such as preservation of traditional cultural areas).

In addition, Wilson *et al*. (2014) identified this category of risk includes such component factors as: Expropriation and resource nationalism which can take the form of direct seizure of mine assets or indirect through gradual punitive exorbitant taxes; Political violence including terrorism, war, civil disturbances; NGOs and Civil Society militancy (mining is generally viewed as destructive to the environment and for that matter some NGOs and civil society organizations are strong opponent and determined to stop any mining activities; Political and regime instability characterized by frequent change of regime which often leads to change in previous agreements and resource nationalism; and Concession and license risk, is the risk that license and concession will be cancelled because of lack security of tenure, declaration of ecological conservation zones, agricultural lands and other land use.

2.2.1.4 Environmental Risk Factors

Environmental Law Alliance Worldwide (ELAW) provides a detail study about environmental and social impacts/risks factors of mining projects. Among the most important risk factors considered were impacts on water resources which includes acid mine drainage and contaminant leaching, erosion of soils and mine wastes into surface waters, impacts of tailing impoundment waste rock, heap leach and dump leach facilities, and impacts of mine dewatering (ELAW, 2010). Conrad-Mulherin (2012) added the impacts on air quality such as particulate matter from excavations, blasting or gas emission from combustion of fuels and processing plants. He further stated noise and vibration resulting from vehicle engines, loading and unloading of rock into steel dumpers, chutes, power generation, and other sources as environmental risk factors in the mining industry.

Moreover, ELAW (2010) identified the following as environmental risk factors associated with construction projects in the mining industry: Incidental release of mercury especially in gold mining; Impacts on wildlife (mining removes vegetation and topsoil resulting in the displacement of fauna, habitat loss and fragmentation); Impact on soil quality through soil contamination affecting agricultural activities; and Impacts on climate change (CO2 emitted by machines and by processing ore into metals) (ELAW, 2010). Also, according to Wilson *et al*. (2014) environmental risk factors may include loss of water from natural sources (due to mining activity), arable land degradation, deforestation, impacts from tailings dams, and acid drainage.

2.2.1.5 Technical/Operational Risk Factors

In the view of Conrad-Mulherin (2012), component factors which constitute technical/Operational risks are those that affect the general operation of a mining project include such elements as: Risk associated with lack or poor transportation networks such as roads, rails, air travel capabilities, seaports. The risk in this regards is that companies may be obliged to develop these facilities; resulting in cost increase; Risk associated with lack or insufficiency of public utilities such as power/energy, water, information and communication technology etc with the same cost increase effects; Risk associated with lack or poor service sector (including banking system, insurances); and Skilled labor shortage. This is becoming a global trend and in Ghana some companies complained about the difficulties they have in recruiting local qualified technical workers. Furthermore, McGill (2005) stated the following as operational risks which includes mistake in pit design, choice of the appropriate mining method, plant construction etc during mine development.

2.2.1.6 Social Risk Factors

Another related risk category identified by McGill (2005) which was later detailed by other author's concern social issues. For instance, KPMG International (2014) combined social issues with environmental ones and mentioned the following component factors: Cultural diversity risk (many conflicting cultural interests/values based on ethnic, tribal, age, gender groups). The significance of changes that a project may bring to various cultural heritages (including cultural practices, believes, languages, dance, music and physical things such as buildings, landscapes, artifacts) will differ from one cultural group to the other; High poverty level, especially in the rural areas. This can fuel social tensions and encourage corruption and fraud; Risk associated with local content requirements (mandatory community development programs such construction of hospitals, schools; local purchasing, indigenous employment); Risk associated with high wage demands/requirements as a result of high inflation (increasing poverty and corruption) which in turn results in increasing costs for company; Environmental permitting requirement risks. Exorbitant environmental permitting requirements tremendously increase costs. Requirements that are conform to international standards such as World Bank's; Equator Principles are preferable as they facilitate project realization.

Also, according to Mensah and Ababio (2011) Social risks are related to environmental risks because the latter cause resentment among local communities where mining takes place and when they are not properly resolved, they could result in conflicts or even violent confrontations between the two parties causing project delay or even cancelation. According to them, there have often been reports of such resentments and confrontations in Ghana.

2.3.1.7 Legal Risk Factors

Legal risks are described by Conrad-Mulherin, (2012) as changes to the judicial, regulatory or legal framework in the jurisdiction the project is being developed. Hoffman (2007) identified the following factors as part of the broad legal risk category: Risk associated with mechanisms for dispute resolution. Disputes can arise between the various mining stakeholders and mechanisms provided by host country to resolve them may not adhere to international treaties for international arbitration; Risk associated with legal culture. The issue here is the inability of the legal system (the organization of the legal/judiciary system) to enforce contracts if the company needs to seek redress for a breach; Instability of legislative environment (stability in this regards is necessary for reliable discounted cash flow analysis given the long lead periods of mining projects; for predictability purposes).

However, in conclusion a report published by Ernest and Young Global Limited. For the years 2014 and 2015 the company identified top ten (10) business risks factors facing mining industry and ranked them according to their weight. These risk factors, in the order of decreasing weight, are as follows: decrease in productivity; capital dilemmas (allocation and access to capital); Social License to Operate; resource nationalism; capital projects; price and currency volatility; infrastructure access; sharing the benefits (among stakeholders), balancing talents needs and access to water and energy (Ernest and Young Global Limited, 2014).

2.2.2 Risk Mitigating Factors Attendant with Construction Projects in the Mining Sector

A project can be subjected to many health risks that can impact its success (Potts, 2008). That's why risk management is needed at the early phases of a project rather than dealing with the damage after the risk occurs (PMI, 2004). It is easy to identify problems that cause damage by having an overview of the entire project. The exposed areas should be changed to reduce the amount of risk (Potts, 2008). By mitigating their likelihood, this is a way to minimize possible risks (Thomas, 2009). In a project, one way of reducing risks is to add expenditure that can provide long-term benefits. Some projects invest in high-risk operations in guarantees or hire experts. These specialists may discover alternatives not regarded by the project team (Darnall and Preston, 2010). From Cooper et al. (2005) the following are general mitigation strategies that can be implemented on a project: Contingency planning; Quality assurance; Separation or relocation of activities and resources; Contract terms and conditions management; and Crisis management and disaster recovery plans.

Furthermore, those risks which should be reduced can also be shared with parties that have more appropriate resources and knowledge about the consequences (Thomas, 2009). Sharing can also be an alternative, by cooperating with other parties. In this way, one project team can take advantage of another’s resources and experience. It is a way to share responsibilities concerning risks in the project (Darnall and Preston, 2010).

2.2.2.1 Political Risk Mitigating Factors

In terms of mitigation, UNCTAD (2003) and Wilson *et al.* (2014) suggested that these political risk factors are globally covered by Political Risk Insurance (PRI) provided by insurers such as Export Development Canada, Overseas Private Investment Corporation, the World Bank through Multilateral Investment Guarantee Agency (MIGA). Companies also review the constitution and the other related mining legislation of a host country in order to determine how these will protect mining investment. In addition International Investment Agreements; Social License to Operate; portfolio diversification (investing in other mineral commodities or other mining jurisdictions); prominent victims (members of consortia such as World Bank, major aid providers that are important to host government); lobbying and employment of well politically connected country experts; security management; Joint Venture with government and local enterprises are also widely used by mining companies around the world as risk mitigation factor (UNCTAD, 2003; Wilson *et al.*,2014).

2.2.2.2 Economic/Commercial risk mitigating factors

In order to mitigate these risk factors, the global practices include hedging mechanism contracts, reviewing of host country's mining laws in comparison with international treaties, consulting/employing local counselor, including stability agreements in contracts documents, sourcing funds from local capital market, International Investment Agreements (IIA), undertake cost reduction programs, discounted cash flow modeling (Rudenno, 2009).

2.2.2.3 Technical/Operational risk mitigating factors

According to Hoffman (2007) and Wilson *et al*. (2013), the above mentioned technical/operational risk factors can be adequately mitigated if companies should take creative and innovative approaches to access new talents through training and education programs; motivate, engage and retain existing skilled workers; leverage technology through research and development; opt for foreign services; undertake on-site energy generation; use renewable energy; use of less energy and water intensive processes, initiate sustainable cost reduction programs; participate in joint venture infrastructure development projects. Companies can also take property and business interruption insurance or operational mining insurance (Hoffman, 2007; Wilson *et al*., 2013).

2.3.2.4 *Social Risk Mitigating Factors*

Rio *et al*. (2011) and Downing *et al*. (2001), completed the issue about the social/environmental risk factors by suggesting useful mitigation measures. According to these authors, these measures may require that companies conform to international, national and local protocols for protecting cultural heritage; obtain Social License to Operate/ corporate social responsibility aimed at reducing poverty; adhere to the Extractive Industry Transparency Initiative (EITI) reporting systems to ensure equity in benefits sharing; comply with all regulatory requirements (Rio *et al*., 2011; Downing *et al*., 2001).

2.3.2.5 *Legal Risk Mitigating Factors*

According to Hoffman (2007), the global practices in mitigating these factors are the reviewing of constitution of host country and other related mining laws in comparison with international treaties that the country has ratified; companies employ high qualified local counselors/ lawyers who are well acquainted with the legal system of the country; seek for international arbitration and International Investment Agreements or develop good relation with governmental authorities (Hoffman, 2007).

2.3.2.6 *Geological Risk Mitigating Factors*

Mitigation measures for these geological risks suggested by Strongman (1992) to both governments of host country and mining companies include assembling and interpreting geo-scientific information from major geological repositories of colonial masters such as the British Geological Survey (BGS), the German Geological Survey (BGR). He argued that this should be done because a lot of reliable information about Africa were collected by various colonial masters during colonial periods and kept in their geological institutions. Common other mitigation measures are reviewing of available geo-scientific information from local institutions; reliance on international geological ranking, engaging independent qualified and reliable geologists for accurate data collection. Companies can also assist local institutions in generating information using more sophisticated modern techniques that they possess; undertake geographic and portfolio diversification (investing in other mining jurisdictions or other mineral commodities); build and maintain good relations with sector institutions and consult other private mining institutions (Strongman, 1992).

2.2.3 Risk Management Practices of Construction Projects in the Mining Sector

Risk management is inherently about the management of unplanned events. Unplanned events which occur on a mine site, or within the surrounding environment or community, have the potential to impact on the viability of a mine or community. The process of assessing and managing these risks is aimed at reducing the likelihood that these negative events will occur and increasing the likelihood that positive outcomes will be realized. Risk management is a key component of sustainable development. The three pillars of social, financial and environmental sustainability pose different hazards and thus provide a complicated and often inter-related combination of hazards and possibilities to be addressed by mining firms.

However, Galitz (1994) suggested the following as efficient risk management methods in mining: consulting stakeholders and stakeholders in identifying, assessing and managing all important social, health, security, environmental and financial effects connected with all activities; ensuring periodic evaluation and updating of risk management schemes;

In addition, Taylor (1991) recognized the following as risk management procedures in the mining sector, including: location studies, laboratory and pilot plant tests, identification of opportunities to invest, resource and factory supply surveys, preliminary selection of projects, market surveys, analysis of project options, feasibility studies and pre-feasibility studies.

2.2.3.1 Restructuring Net Operating Costs

According to Tinsley (1995), by maximizing manufacturing rates, Metals and mining operations reduce net operating costs to a minimum. This could lead to an exacerbation of the cycle by the reality that increased production outcomes in inventory increases and a concomitant fall in commodity prices. Companies also tend to increase grades to decrease the unit cost of metal generated. The greater yield results in a greater production rate of metal as the capability of concentration is fixed. By establishing a two-tier cost framework, the cost issue can be addressed. Lower expenses can therefore be acquired on the portion of the production of the equipment, even though greater expenses are involved in the production equilibrium (Tinsley, 1995).

Furthermore, an interruptible power strategy can be used to decrease energy costs as power utilities, to replace plant development with interruptible power supplies, to defer both capital investment and the operation of more expensive generating facilities and to decrease tariffs for cooperating clients. By putting higher dependence on subcontractors, the reorganization of labor costs allows the avoidance of the expenses of severance connected with own labor. By curtailing manufacturing, labor costs can be decreased (Tinsley, 1995).

2.2.3.2 Entering into Risk-Sharing Arrangements with Suppliers and Customers:

According to Downing *et al*. (2001), Risk sharing involves making arrangements with suppliers, customers, employees and host governments to share in the commodity price cycle the' pain' associated with troughs. An excellent instance is the aluminum sector where the raw material (alumina) is; sold as a straight proportion of the prevailing metal price; bartered or exchanged for metal at an exchange rate; and tolled for fixed and variable charges.

2.4 CONCEPTUAL FRAMEWORK

Risk in construction projects in the mining sector arise as a result of uncertainties from factors such as Social, Geological, Legal, Technical/Operational, Economic/Commercial, Political and Environmental factors. The severity or the level of its impact is in relation to the size or complexity of the project. Thus, the bigger the project, the higher the magnitude of risk associated with the project and vice versa. The amount of danger is always linked to the complexity of the project, According to Darnall and Preston (2010). The fact that in building there are so many dangers that can be recognized can be clarified by the size and complexity of the projects. The greater the number of prospective hazards that can be confronted, the greater the project. Cleden (2009) further adds that complexity is a factor that can limit a project; the bigger and more complex a project is, the more resources are required to complete it in which these resources also pose some level of risk as they a required in large quantities.

In addition, several variables can enhance building danger. Financial, environmental (the surroundings of the project, place and general laws), social, political, time, design and quality are the most frequently cited in literature. The amount of technology used and the hazards of the organization are other influences on the incidence of danger (Gould and Joyce, 2002). However, according to Cleden (2009) the project team must remember that there may be more threats when all prospective hazards have been recognized. The project team should therefore not only concentrate on managing the recognized hazards, but should also be alert to any fresh future hazards that may occur. He further stated that risk management should be used as a tool to discover the majority of risks and a project manager should be also prepared for managing uncertainties not included in a risk management plan.

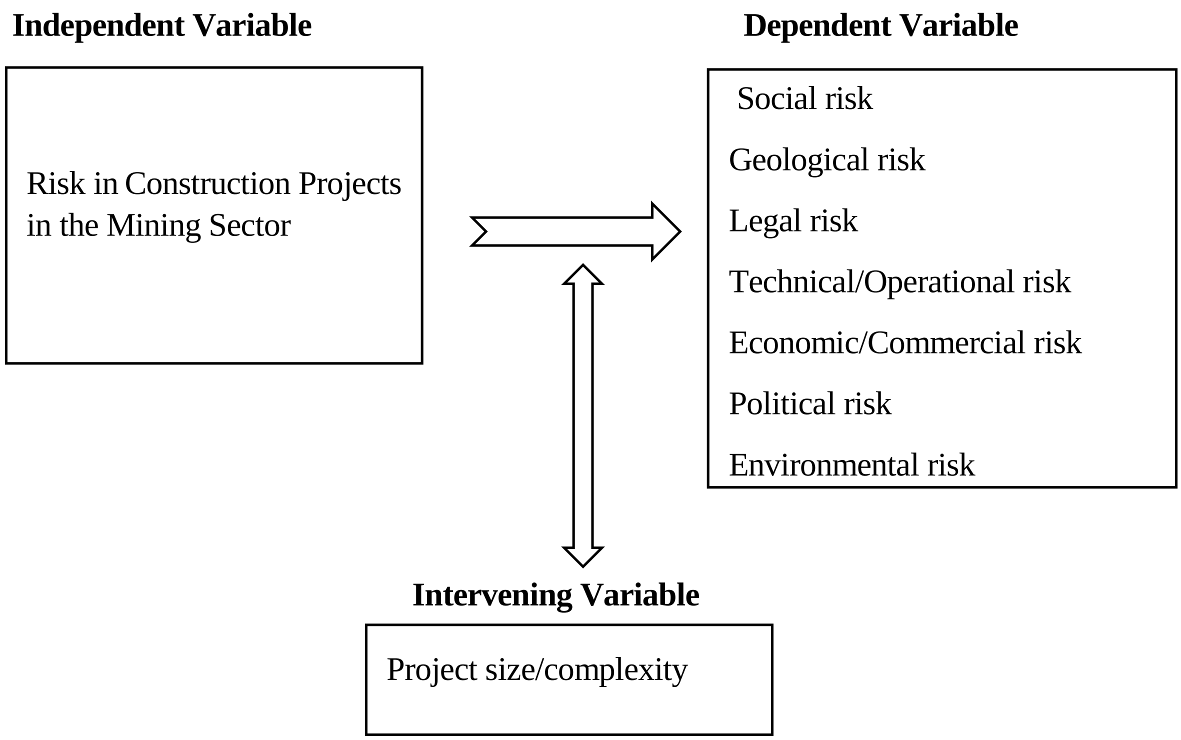


Figure 2. 1: Conceptual Framework

Source: Researcher (2019)

In conclusion, when individuals required to store their harvest for future use and when forts and fences were constructed to safeguard villages and property, risk management has existed since the start of civilization. Another instance is when a merchant manages his danger by shifting products from one location to another by requiring the customer pay the seller a security deposit to be returned once the customer gets the products in good condition, so if the merchant encounters any disasters during his trip, he will be compensated.

Effective risk management in the mining sector guarantees that: employee and government health, security and well-being are not compromised; company economic performance is protected; company earns its social license to function in the eyes of local communities, regulators and other performance-based stakeholders; and business reputation is reinforced.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter delved into the research methodology of the study. The chapter documented the research approach, design and methods as well as the collection, analysis and presentation of primary data retrieved for the purpose of addressing the key issues raised by the, aim and specific objectives. It described how data was collected and treated. It also described the technique of information assessment used to analyze the information collected from participants, how the population as well as sample size was determined. In short, it aimed to define the whole strategy taken to tackle the goal of studies, particular goals and issues.

The purpose of the methodology and research design, according to Burns and Grove (1998), is to provide direction in the planning and implementation of the study in a way that is most likely to achieve the intended objective. The methodology for conducting the research is a blueprint. Similarly, it is referred to by Polit and Hungler (1999) as the method of following measures, processes and strategies to collect and analyze information in research study studies. Methodology involves methods of design, setting, sampling, information collection and evaluation in a research, according to Burns and Grove (1998). It is the know-how to acquire valid understanding of science methods and techniques used. Christou et al. (2008) described methodology is the way we acquire world knowledge, attempting to find out how to undertake the assignment of figuring out what we think is true.

3.1 PHILOSOPHICAL CONSIDERATION

Bryman (2004) recognized two major social research philosophical positions, including epistemology and ontology. Ontology concerns the views of the researcher regarding the nature and knowledge of the social world (Bryman, 2004). Whether or not social truth occurs independently of human notions and interpretations; whether there is a prevalent, shared, social reality or just various context-specific reality; and whether or not social conduct is regulated by' legislation' that can be seen as immutable or generalizable. Saunders *et al*. (2009) defined ontology as comprising two extreme positions: relativist and realist positions. It described the realist position as that, the external world consists of pre-existing hard and tangible structures. These they indicated exist independently of an individual's ability to acquire knowledge. The relativist position is described as holding the multiple existences of realities as subjective constructions of the mind. In that, the perception of reality is directed by socially transmuting terms and varies according to language and culture.

On the other hand, Epistemology focuses on ways of understanding and learning about the social world and on problems such as: how to learn about reality and what the reality is. foundation of understanding is (Saunders et al., 2009). Simply put, it is concerned with the question of knowledge acceptable in a discipline. Panas and Pantouvakis (2010) identified Positivism and Interpretivism as the two main paradigms of the epistemology philosophy. The positivist view is concerned with quantitative approach and that of interpretivist leans towards the qualitative approach. According to Saunders *et al*. (2009) the positivist approach verified facts established through scientific study in an objective manner for replication. Very important to the positivist is the idea that the social world can create verifiable understandings from the use of scientific tools.

Interpretivist, on the other hand, believes that the researcher and the society interact with each other such that what is believe to be facts are not static and lacks objectivity as they are subjected to the ideas of the research (Saunders *et al*., 2009). It relies on the interaction and the experience of the researcher and the social world to understand the phenomena.

3.1.1 Research Philosophy Adopted for the Study

This research leaned towards the realist position at the ontological approach. This was because, in the mining sector, risk management exists as internal facts beyond the researcher's reach and impact. These dangers are objective realities in the mining sector and not the researcher's structures. Also, this study leaned towards the positivism paradigm of the epistemological approach since it is guided by objective evaluation and predictions. According to Bryman (2004), a study that requires an objective evaluation and prediction lean towards the positivism paradigm for its epistemological stance.

3.2 RESEARCH STRATEGY

Selecting a research method is a critical significant choice for the investigator to study the methods to understand which of them will meet the study's goals and fit with the accessible data and the necessary data. Research methods have many approaches, such as quantitative and qualitative methods, as well as the deductive and inductive method, and both are interrelated. Induction thinking is usually described as "moving from the specific to the general," meaning going from observation to patterning the attempt and ending with theory. While deduction is "starting with the general and ending with the particular" which is supposed to be the other way around, it starts with the theory going to the hypothesis then to observation and ending with conformation (Creswell, 2013).

Qualitative and quantitative study are two of the primary study schools, both techniques have advantages and disadvantages, but study is more helpful than studies. Quantitative methods are used to predict and evaluate the final course of action, while qualitative methods are used to comprehend ideas, views and build a foundation for decision-making. The choice to follow any particular strategy depends on the purpose of the study, the type and availability of information for the research (Naoum, 2002).

3.2.1 Research Strategy Adopted for the Study

This research followed a quantitative strategy by the utilization of survey questionnaires to elicit data from respondents. The quantitative strategy was suitable for this research because of the desire of the researcher to measure the opinions of respondents using scientific basis (positivist) approach.

3.3 RESEARCH APPROACH

Research approach refers to the step by step procedures and action plans adopted for a research from the stage of general assumption up to data interpretation (Creswell, 2013). Two main approaches have been identified and named as the Deductive and Inductive research approach. The Deductive approach deals with what is already known as existing theories or ideas about a subject by identifying the theory and testing through observation to confirm the theory (Creswell, 2013). This approach involves a top-down approach in the formulation of the theory and testing of hypothesis while maintaining the independence of the researcher. That is to say that, the process starts from the identification of the relevant theories and the use of scientific study through observations to confirm these theories. The research is therefore used to test specific propositions (Creswell, 2003).

On the contrary, the inductive approach used mainly in theory building begins with the study of specific instances of societal issues, through the identification and development of patterns from the analysis of data gathered (Creswell, 2013). It employs a down-up approach where through the study of specific issues to the broad generalization of the specific situation. According to Saunders *et al*. (2009), the inductive approach most often relies on the collection of qualitative data. They also emphasized that theories are derived from the generalization of the specific phenomenon in the inductive reasoning.

3.3.1 Research Approach Adopted for the Study

This research was based on deductive approach as it involved the use of already existing theories together with quantitative methods to make inference into mergers and acquisition. That is the study first reviews literature as a theoretical guide, and then collects data from participants. Hereafter, statistical techniques were used to draw diverse meanings and interpreted within the context of the already existing theoretical framework. The results of this deductive method were observations and findings unlike the inductive, which will have been theories.

3.4 RESEARCH DESIGN

This addresses the framework for information gathering and assessment; the structure that guides the execution of information gathering and evaluation method that connects empirical information with its findings in a logical sequence to the study's original research issue (Bryman, 2004; Yin 2003). Research design involves experimental, survey, case study and action research (Burney, 2008).

3.4.1 Research Design Adopted for the Study

This study took on a survey design that precedes a thorough evaluation of the literature. Due to the need to generalize results across the sector, a survey questionnaire is chosen. Oppenheim (2003) assessed that observational accuracy and duplication as a result to the intrinsic consistent measurement and sampling methods (Oppenheim, 2003).

3.5 POPULATION OF THE STUDY

Defining the population for a research is a crucial component of each research. The specific interest group(s) in a research is known as the population of the research. The target population is the "full aggregation of respondents who fulfill the criteria set" (Burns and Groove, 1998). The study population is all components of a specified class of chosen individuals, items, locations or activities as they are applicable to your research questions. Among other things, a survey population can also consist of institutions, documents, villages. For this research, the target population is restricted to Asanko Gold mines located in the Ashanti Region of Ghana. The choice of the Asanko Gold mining company is due to its massive contribution to the mining industry in the Ghanaian market. This makes the company a source of data more credible and coherent. Information received from their human resource department indicates 23 total number of employed Geologists, 15 Surveyors and 26 Engineers which gives a total population of 64.

3.5.1 Sampling Technique and Sample Size

For the purpose of this research, purposive sampling technique was used to obtain a representative sample size of thirty-nine (39) respondents. Having determine the sampling frame for this study, the researcher adopted the Kish formula (Kish, 1965) which gives the formula for the sample size given a confidence interval of 95 percent as follows:

$$n = \frac{N}{1 + N(a)^2}$$

Where:

n= the sample size,

N= the sample frame (64)

α= the margin of error (5%).

The sample size was determined as follows: $$n = \frac{64}{1 + 64(0.1)^2}$$

$$n = 39.02$$

Hence, Sample Size, n = 39.

Therefore, 39 respondents were the appropriate sample size for the study. However, 64 questionnaires were circulated. achieve a 95% confidence interval.

The purposive sampling technique which is an example of probability sampling technique was used in identifying the key respondent namely Geologist, Surveyor and Engineer. This was because the researcher required certain categories of respondents who had been involved in a lot of mining construction projects and therefore had experience in managing risk in these projects, to answer the questionnaires. Using the purposive sampling resulted in selecting respondents who are actively involved in risk management in the Asanko Gold mines located in the Ashanti Region of

Ghana since the researcher believed that they were representative to the population of interest and could give practical and convincing answers to the questions asked.

Further, the snowball sampling technique was adopted in selecting the respondent for the research. The snowball sampling is a technique for locating respondents who are very visible for administration of questionnaires at first instance and based on a network from these initial respondents' other key respondents are located for questionnaire administration. The reason for engaging the snowball sampling technique is as a result of the inability of the researcher to easily locate the key respondents namely Geologists, Surveyors and Engineers of the company and also whose office or places of work cannot be located by the researcher with ease.

3.6 DATA COLLECTION

According to Fadhley (1991), the approach for data collection involves desk survey and field survey. The desk survey (literature review) forms an essential aspect of the research since it sets the pace for the development of questionnaire. The field study deals with empirical information collection. For the purposes of this study, a quantitative approach to information collection involving survey questionnaires was adopted. Desk survey culminated into the identification of key variables in risk management in construction projects in the mining industry, which were used in the development of questionnaires which were administered to respondents to collect data for analysis.

3.6.1 Questionnaire Development

First of all, it was crucial to create the data to be collected in order to request appropriate questions (Oppenheim, 2003). The questionnaire format was driven by factors of appeal to respondents and ease of reading and providing the necessary information so that during information collection the time of the research participant was not wasted. The questionnaires were intended to include the closing of issues and the scaling of answers. The Likert reaction scale of 1 to 5 was used to evaluate the view of the respondent's strength or intensity. The diction of the questionnaire was simple as jargons and other technical terms were very minimal in the crafting of the questions. Similarly, the numbers of questions were kept minimal to encourage respondents to answer the questions. The questionnaire consisted of four (4) sections: the purpose of the first section was to inquire the profile of respondents. Three questions were asked to determine respondent profession, educational background and years of experience of respondents. The last three sections asked questions to ascertain respondents view on risk management under the research objectives.

3.6.2 Questionnaire Distribution

Sixty-four (64) questionnaires were evenly distributed among respondents. Out of this forty-two (42) questionnaires A total of 65.62% were completed and used in the analysis. The response rate is the percentage of completed questionnaires in the complete number of eligible participants and literature assumes that greater reaction rates show validity of the results of the research (Coffey et al., 1996). This statement shows that the 65.62 percent response rate was sufficient for the assessment.

The high response rate was attributed to strict adherence to the techniques used to distribute the questionnaires and persistent follow-ups for the questionnaires to be retrieved. It took about six weeks to finish the entire survey process.

3.7 DATA ANALYSIS

The retrieved questionnaires were prepared by coding and fed into the Statistical Packages for Social Sciences (SPSS) for data aggregation and subsequent analysis. An analytical tool choice depends on a thorough evaluation of the analytical and statistical instrument available. The choice of test depends on the type of variables you have, i.e. whether the variables are ordinal or interval, whether they are categorical, and whether they are distributed normally. Both descriptive and inferential statistics were used in this research to analyze the interrelationships between the large number of problems identified in the literature. According to Ryan (2004), descriptive statistics consists of methods for presenting and summarizing data. The descriptive statistics in the analysis of data as a priority to easy digestion and understanding of large quantities of data; and provision of opportunity to communicate the research results to others (Ryan, 2004). This study therefore employed percentages for the analysis of the background information while the mean scores as a measure of central tendency and standard deviation as a measure of the dispersion were used in the measurement of the variables identified.

Inferential assessment also aims to generalize from a sample to the broader population (Gabrenya, 2003). Inferential assessment mainly focuses on the application of statistical techniques to test hypothesis in order to derive study consequences (Kolawole, 2001). One-sample T-test was used in the study's third goal to analyze the recognized variables.

According to Baddie and Halley (1995), the one-sample t-test is usually used to determine whether the mean of a sample is considerably different from the hypothesized mean. Therefore, the one-sample t-test was used to determine the comparative importance of the factors.

Relative Important Index was used in the analysis of the identified variables in the first and second objectives of the study. According to Soofi *et al*. (2000), the relative importance index refers to quantities that compare the contribution of individual explanatory variables to a response variable. Carpio *et al*. (2007) asserted that the relative importance index is used for determining the relative significance of attributes in a decision maker's choice of one out of several alternatives in the revealed preference setting. Carpio *et al*. (2007) opined that the determination of the relative importance of attributes is required for the construction of an index summarizing the overall effect of a group of attributes; the calculated indexes are then used to compare and rank the attributes.

3.8 RESEARCH ETHICS

Ethical issues relating to confidentiality, informed consent and respect for respondents were adhered to. Firstly, consent was requested from the respondents before providing them with the questionnaires. Second, while none of the respondents voiced reservations about participating in the study, they were assured that they would be free to rescind their decision to participate whenever they feel like doing so. Third, they were assured that their responses would not be used for any other purpose than reporting the outcomes in this academic work. These assurances were given, without saying, ensured that they would be accessible to the investigator.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSION OF RESULTS

4.0 INTRODUCTION

This section recorded the analysis and discussion of the primary data collected from the 42 participants at Asanko Gold mines in Ghana's Ashanti region. The first part of the analysis deals with the respondents ' profile and the impact on the research of such characteristics. The second part captures the thorough assessment of the study's particular goals. Relative Important Index (RII) was used in the analysis of the identified variables in the first and second objectives of the study which involves the critical risk factors associated with construction projects in the mining sector; and the risk mitigating factors attendant with construction projects in the mining sector. One-Sample T-test was used in analysis of identified variables in the third objective of the study which involve risk management practices of construction projects in the mining sector. Of the 64 questionnaires distributed, however, 42 questionnaires were finished and collected, representing 65.62% percent. There were no missing values from the participants in the finished questionnaires. The constant questionnaire follow-ups led in the elevated response rate.

4.1 PRESENTATION AND DESCRIPTIVE ANALYSIS OF DEMOGRAPHIC DATA

The aim of the analysis of respondent profile was to help in providing understanding of respondent characteristics. Knowledge of the background of respondents ensures confidence in the reliability of data collected. Table 4.1; 4.2; and Figure 4.1 presents results of the data analysis of respondents' background.

4.1.1 Profession of Respondents

Respondents were asked to indicate their profession to be affirmed that questionnaires distributed were completed by actual targeted respondents. The respondents who were targeted were of only three profession namely, the Geologist, Surveyor and Engineer. The results of the analysis indicated that, Geologists were 19 out of the total respondents surveyed which makes up a percentage of 45%, Surveyors were 8 out of the total respondents surveyed which makes up a percentage of 19% and Engineers were 15 which forms the remaining respondents surveyed which makes up a percentage of 36%. The results of the findings implied that Geologist dominates Engineers and Surveyors in the Asanko Gold mines located in the Ashanti Region of Ghana. Table 4.1 gives a summary of respondent profession involved in the survey conduct.

Table 4. 1: Profession of Respondents

Type	***Geologists***	***Surveyors***	***Engineers***	***Total***
% response	*45*	*19*	*36*	*100*
Number	*19*	*8*	*15*	*42*

Source: Researcher's Survey (2019)

4.1.2 Educational Background of Respondents

Respondents were asked to indicate their educational background to affirm that questionnaires distributed were completed by targeted respondents who are knowledgeable in project risk management. The results of the analysis of respondents educational background indicated that, respondents with master's educational background were 23 out of the total respondents surveyed which makes up a percentage of 55%, respondents with bachelor's educational background were 14 out of the total respondents surveyed which makes up a percentage of 33% and respondents with HND educational background were 5 which forms the remaining respondents surveyed which makes up a percentage of 12%. The results of the findings implied that respondents engaged in the field survey have acquire enough education and a credible conclusion therefore is that respondents are knowledgeable in project risk management. Table 4.2 gives a summary of respondent educational background involved in the survey conduct.

Table 4. 2: Educational Background of Respondents

Type	***Master's***	***Bachelor's***	***HND***	***Total***
% response	*55*	*33*	*12*	*100*
Number	*23*	*14*	*5*	*42*

Source: Researcher's Survey (2019)

4.1.3 Years of Experience of Respondents

Respondents were asked to indicate their years of experience to affirm that questionnaires distributed were completed by targeted respondents who have gain enough experience in project risk management. The results of the analysis of respondents years of experience indicated that, respondents with years of experience between 1-5years were 13 out of the total respondents surveyed which makes up a percentage of 31%, respondents with years of experience between 6-10years were 18 out of the total respondents surveyed which makes up a percentage of 43% and respondents with years of experience over 10years were 11 which forms the remaining respondents surveyed which makes up a percentage of 26%. The results of the findings implied that respondents engaged in the field survey have reasonable experience and a credible conclusion therefore is that respondents are experienced in construction activities in mining industry. Figure 4.1 gives a summary of respondent years of experience involved in the survey conduct.

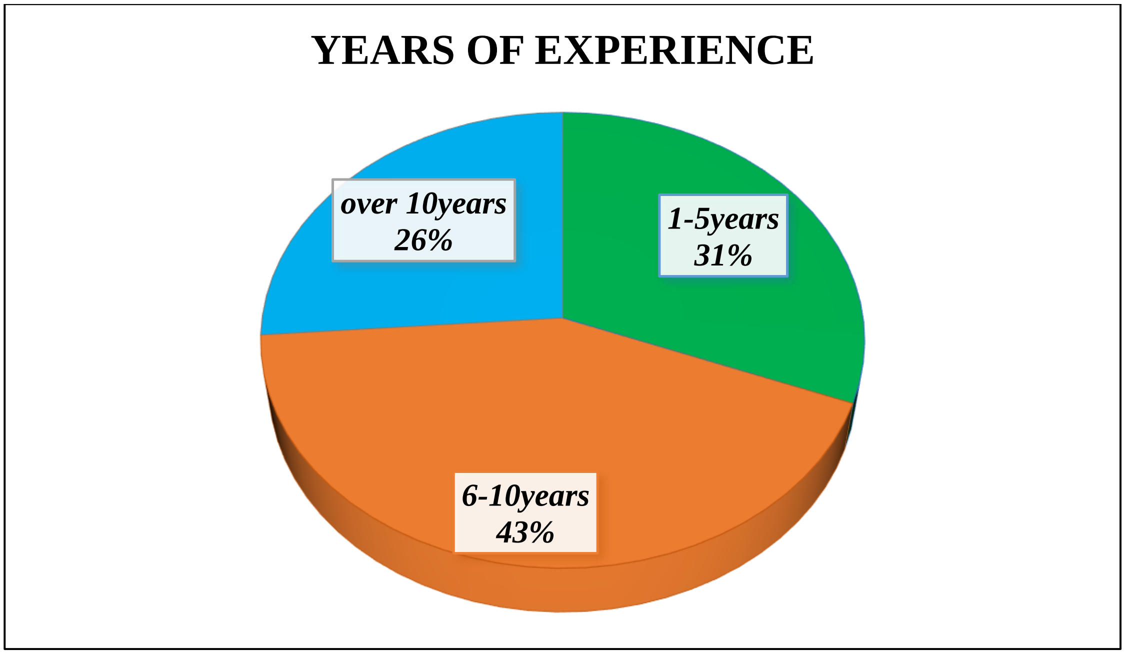

Figure 4. 1: Years of Experience of Respondents

Source: Researcher's Survey (2019)

4.2 OBJECTIVE 1: CRITICAL RISK FACTORS ASSOCIATED WITH CONSTRUCTION PROJECTS IN THE MINING SECTOR

This section presents the analysis of the first objective of the research study. To establish the critical risk factors associated with construction projects in the mining sector, questionnaires were administered to respondents to collect data in other to ascertain that variables identified in literature review are considered by respondents as critical risk factors associated with construction projects in the mining sector. To gain knowledge in this area, respondents were asked to rate the variables identified in the literature review in terms of their agreement to these variables from a Likert scale of 1 to 5 where one (1) is Strongly Disagree; Two (2) is Disagree; Three (3) is Neutral; Four (4) is Agree; and Five (5) is Strongly Agree. The summary of the analysis conducted is shown in Table

4.3 below which evaluate the responses from the respondents on the identified variables based on their mean scores, standard deviation and Relative Importance Index (RII).

Risks in mining sector are exacerbated by the unique characteristics of the industry such as the capital intensiveness, the long lead period (or long pre-production period), the exhaustibility of the asset (that is the mineral resource), the uncertainty associated with the discovery and evaluation of the resource and the volatility of the mineral price. It is therefore, obvious in general that the importance of risk management of mining projects cannot be underestimated. In doing so, most mining investors give particular consideration to the business environment of the host countries in which they intend to invest because the result of their undertaking is directly related to the social, economic and political environment of the country. Table 4.3.1 examines the critical risk factors associated with construction projects in the mining sector and it is clear from the table that in these category of variables, "*Unavailability and accuracy of preliminary geo-scientific information*" had the highest RII=0.9333 and therefore was ranked first (1st) which can be confirmed in a study done by Ernest and Young Global Limited (2014) into Geological risk factors in the mining industry. According to them, Geological risk factors have to do with the probability that exploration works might not result in discovery of minerals of commercial quantity or host government might not provide accurate and up to date preliminary geological information. Also, Hoffman (2007) affirms that it involves the uncertainty concerning the availability and quality/accuracy of preliminary geo-scientific information. For example, scale and quality of existing geological maps, geophysical and soil geochemical data. However, according to Conrad-Mulherin (2012) even if the above mentioned geo-scientific information exits there is still the probability that they might not easily be accessible from mining institutions due to lack of geological database; corruption; excessive bureaucracy etc. or from the internet.

Table 4. 3: Critical risk factors associated with construction projects in the mining sector

Critical risk factors associated with construction projects in the mining sector	N	SUM	Mean Score	Std. Deviation	RII	Ranking
Unavailability and accuracy of preliminary geo-scientific information	42	196	4.667	0.4771	0.9333	1st
Changes in demand or price for the product	42	195	4.643	0.4850	0.9286	2nd
High Inflation rate	42	194	4.619	0.4915	0.9238	3rd
Choice of the appropriate mining method	42	192	4.571	0.5009	0.9143	4th
Mistake in pit design	42	191	4.548	0.5038	0.9095	5th
Corruption and fraud	42	188	4.476	0.5055	0.8952	6th
Lack or poor transportation networks	42	187	4.452	0.5038	0.8905	7th
Lack or insufficiency of public utilities such as power/energy, water, information and communication technology.	42	186	4.429	0.5009	0.8857	8th
Excessive government bureaucracy	42	185	4.405	0.4968	0.8810	9th
Instability of foreign currency exchange rate	42	184	4.381	0.4915	0.8762	10th
Mandatory community development programs	42	183	4.357	0.4850	0.8714	11th
Shortage of skilled labor	42	180	4.286	0.5537	0.8571	12th
Erosion of mine wastes into surface waters	42	177	4.214	0.6063	0.8429	13th
Unstable and unpredictable fiscal regime	42	174	4.143	0.6077	0.8286	14th
Conflicting interests of local governments and traditional authorities	42	172	4.095	0.6555	0.8190	15th
Instability of legislative environment	42	170	4.048	0.6608	0.8095	16th
Particulate matter from excavations	42	166	3.952	0.6608	0.7905	17th

Source: Researcher's Survey (2019)

Further, the following variables "*Changes in demand or price for the product*", "*High Inflation rate*" and "*Choice of the appropriate mining method*" were ranked second (2^{nd}), third (3^{rd}) and Fourth (4^{th}) respectively by respondents with a RII of 0.9286; 0.9238; and 0.9143 respectively.

However, the variable "Particulate matter from excavations" was ranked seventeenth (17^{th}) with a RII of 0.7905. In literature Conrad-Mulherin (2012) identified impacts on air quality such as particulate matter from excavations, blasting or gas emission from combustion of fuels and processing plants as environmental risk factors associated with construction projects in the mining industry.

Moreover, considering the mean scores of the variables all scored above the average mean score of 2.5 (3.952 – 4.667) which reflects that variables identified were rated by respondents above the level of "Three (3) = Neutral" from Likert scale which confirms that respondents at least are in neutral agreement to the fact that identified variables in literature are critical risk factors associated with construction projects in the mining sector.

Despite this, it is important to draw attention to the factors found in table 4.3.1 below which suggests that all variables had a normal deviation of less than one (0.4771 – 0.6608) which suggests that there is little variation in the information.

4.3 OBJECTIVE 2: RISK MITIGATING FACTORS ATTENDANT WITH CONSTRUCTION PROJECTS IN THE MINING SECTOR

This section presents the analysis of the second objective of the research study. To establish the risk mitigating factors attendant with construction projects in the mining sector, questionnaires were administered to respondents to collect data in other to ascertain that variables identified in literature are considered by respondents as risk mitigating factors attendant with construction projects in the mining sector. To gain knowledge in this area, respondents were asked to rate the variables identified in literature review in terms of how critical the variables are as risk mitigating factors attendant with construction projects in the mining sector from a Likert scale of 1 to 5 where one (1) is Not Critical: Two (2) is Moderately Critical: Three (3) is Critical: Four is Very Critical:

and Five (5) is Extremely Critical. The summary of the analysis conducted is shown in Table 4.4.1 below which evaluate the responses from the respondents on the identified variables based on their mean scores, standard deviation and Relative Importance Index (RII).

A project can be subjected to many prospective hazards that can affect its achievement. That's why risk management is needed in the early stages of a project rather than dealing with the damage after the risk occurs. It is simple to define issues that cause harm by getting an overview of the entire project. Table 4.4 examines the risk mitigating factors attendant with construction projects in the mining sector and it is clear from the table that in these categories of variables, "*Engaging independent qualified and reliable geologists for accurate data collection*" had the highest RII=0.9571and therefore was ranked first (1^{st}).

Further, the following variables "*Review of constitution and the other related mining legislation of host country*", "*Reviewing of available geo-scientific information from local institutions*", "*Development of good relation with governmental authorities*" and "*Obtaining Social License to Operate*" were ranked second (2^{nd}), third (3^{rd}), Fourth (4^{th}) and Fifth (5^{th}) respectively by respondents with a RII of 0.9476; 0.9381; 0.9238; and 0.9095 respectively. However, the variable "Employing high qualified local counselors/ lawyers well acquainted with the legal system of the country" was ranked fourteenth (14th) with a RII of 0.6810.

According to Strongman (1992) the following are general mitigation measures that can be implemented on a project which includes reviewing of available geo-scientific information from local institutions; reliance on international geological ranking, engaging independent qualified and reliable geologists for accurate data collection. He further stated that portfolio diversification (investing in other mining jurisdictions or other mineral commodities); building and maintaining good relations with sector institutions and consulting other private mining institutions are risk mitigating factors attendant with construction projects in the mining sector.

Table 4. 4: Risk mitigating factors attendant with construction projects in the mining sector

Risk mitigating factors attendant with construction projects in the mining sector	N	SUM	Mean Score	Std. Deviation	RII	Ranking
Engaging independent qualified and reliable geologists for accurate data collection	42	201	4.786	0.41530	0.9571	1st
Review of constitution and the other related mining legislation of host country	42	199	4.738	0.44500	0.9476	2nd
Reviewing of available geo-scientific information from local institutions	42	197	4.690	0.46790	0.9381	3rd
Development of good relation with governmental authorities	42	194	4.619	0.49151	0.9238	4th
Obtaining Social License to Operate	42	191	4.548	0.63255	0.9095	5th
Engaging and retaining existing skilled workers	42	184	4.381	0.69677	0.8762	6th
Training and education programs	42	177	4.214	0.78198	0.8429	7th
Building and maintaining good relations with sector institutions and consulting other private mining institutions	42	164	3.905	0.79048	0.7810	8th
Undertaking cost reduction programs	42	156	3.714	0.74197	0.7429	9th
Portfolio diversification (investing in other mineral commodities or other mining jurisdictions)	42	153	3.643	0.69217	0.7286	10th
Joint Venture with government and local enterprises	42	150	3.571	0.70340	0.7143	11th
Conformance to international, national and local protocols for protecting cultural heritage	42	149	3.548	0.70546	0.7095	12th
Political Risk Insurance	42	147	3.500	0.70711	0.7000	13th
Employing high qualified local counselors/ lawyers well acquainted with the legal system of the country	42	143	3.405	0.62701	0.6810	14th

Source: Researcher's Survey (2019)

Moreover, considering the mean scores of the variables all scored above the average mean score of 2.5 (3.405– 4.786) which reflects that variables identified were rated by respondents above the level of “Three (3) = Critical” from Likert scale which confirms that respondents at least finds the variables identified as risk mitigating factors attendant with construction projects to be critical in the mining sector.

Despite this, it is important to draw attention to the factors found in table 4.4.1 below which suggests that all variables had a normal deviation of less than one (0.41530–0.78198) which suggests that there is little variation in the information. Standard deviation values below one (1.0) also indicate consistency between participants in agreement.

4.4 OBJECTIVE 3: RISK MANAGEMENT PRACTICES OF CONSTRUCTION PROJECTS IN THE MINING SECTOR

This section of the questionnaire was presented as part of the data collection to provide a chance for participants to demonstrate whether the recognized variables are risk management practices of building projects in the mining industry by stating on a 5-point Likert scale. The participants were told to rate the factor level between 1 and 5 where one (1) is not important: two (2) is less important: three (3) is of moderate importance: four (4) is important: and five (5) is of great importance. In another, the one-sample t-test was used to determine the relative significance of the variables. Usually one sample t-test used to determine whether the mean sample is significantly different from the hypothesized mean (Ahadzie, 2007). The mean of the test group, the degree of test freedom (approximating the sample size), the t-value (indicating the strength of the test) and the p-value (i.e. the probability value that the test is significant) are commonly reported in a typical one-sample test (Ahadzie, 2007).

A statistical t-test of the mean performed to determine if a specific variable was deemed significant or otherwise by the population. Each variable's mean ranking was tabulated to assist convey the consensus that the participants achieved. Table 4.5.1 presents the mean for each variable, including the associated standard deviation and default error.

The null hypothesis for each variable was that the variable was meaningless (Ho: U= Uo) and the alternative hypothesis was that the criterion was meaningful (Ha: U > Uo), where Uo is the average population. Uo therefore represents the critical ranking above which the criterion deemed important. The greater scores of 4 and 5 were selected as significant and very significant respectively for the rating scale in this study while the Uo was set at 3.5.

The level of importance was also set at 95 percent according to the level of danger. That is, based on the five-point Likert scale score, if it had an average of 3.5 or more, a success variable is considered significant. This is because if 5= very important, and 4= significant, it should have a mean above neutral point 3 if a variable is to be deemed constantly agreed. The hypothesized mean was therefore set at 3 to 4, i.e. 3.5. All the above 3.5 means are regarded by the research participants to be continuously agreed upon. Where two or more variable has the same mean, the smallest standard deviation variable has allocated the highest meaning rating (Ahadzie, 2007).

According to Ahadzie (2007), the standard error is the standard deviation of sample means and a measure of how likely a sample is to represent the population. Therefore, a large standard error (relative to the sample mean) shows that there is a lot of variability between different means of sample (ibid). The least standard error indicates that most sample means are equal to the mean population, so the sample is likely to be a precise reflection of the population (Field, 2005; Ahadzie, 2007). The standard deviation of all the variables were below one as indicated in Table 4.5 below., indicating that there exists consistency in agreement between respondents' interpretations. This is probably because the respondents understood these factors very well. Moreover, all the factors had means greater than the hypothesized mean of 3.5 and their standard error means were also close to zero indicating that there was great consistency among agreement between the respondents that is the sample chosen is an accurate reflection of the population.

Table 4. 5: Ranking of One Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Resources and factory supply studies	42	4.2545	.58431	.07879
Location studies	42	4.3091	.63458	.08557
Environmental impact assessment	42	4.4909	.50452	.06803
Pre-feasibility and feasibility studies	42	4.7455	.43962	.05928
Economies of scale studies	42	4.0182	.75745	.10214
Appraisal and investment report	42	4.1091	.65751	.08866
Identification of investment opportunity	42	4.5818	.62925	.08485
Informing potentially affected parties of significant risks from mining minerals and metals operations	42	3.6182	.89217	.12030
Market studies	42	4.3818	.70687	.09531
Ensuring regular review and updating of risk management systems	42	3.6909	.71680	.09665
Analysis of project alternatives	42	4.3091	.74219	.10008

Source: Field survey (2019)

4.4.1 Ranking of One-Sample Statistics

The summary shown in table 4.6 below indicates that *Pre-feasibility and feasibility studies* occurred as the highest ranked significant criterion whilst *Informing potentially affected parties of significant risks from mining minerals and metals operations* occurred as the lowest. *Identification of investment opportunity*; *Environmental impact assessment*; *Market studies*; *Location studies*; *Analysis of project alternatives*; *Resources and factory supply studies*; *Appraisal and investment report*; *Economies of scale studies*; and *Ensuring regular review and updating of risk management systems* were ranked 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 6^{th}, 7^{th}, 8^{th}, 9^{th} and 10^{th} respectively.

Risk management is a key component of sustainable development. The three pillars of social, economic and environmental sustainability present different risks and thus provide a complex and often inter-related mix of risks and opportunities to be addressed by mining companies. However, Galitz (1994) proposed the following as effective risk management practices in mining: consulting stakeholders and stakeholders in identifying, assessing and managing all significant social, health, safety, environmental and economic impacts associated with all activities; ensuring regular review and updating of risk management systems.

In addition, Taylor (1991) identified the following as risk management practices in the mining industry, including: identification of investment opportunities; analysis of project alternatives; selection of preliminary projects; pre-feasibility and feasibility studies; assessment and investment report; and market studies. Resources and Factory Supply Studies; Laboratory and Pilot Plant Tests; Location Studies; Environmental Impact Assessment; and Scale Studies Economies are risk management practices that enhance successful mining operations.

Table 4. 6: Ranking of One-Sample Statistics

	Mean	Std. Deviation	Std. Error Mean	Ranking
Pre-feasibility and feasibility studies	4.7455	.43962	.05928	1st
Identification of investment opportunity	4.5818	.62925	.08485	2nd
Environmental impact assessment	4.4909	.50452	.06803	3rd
Market studies	4.3818	.70687	.09531	4th
Location studies	4.3091	.63458	.08557	5th
Analysis of project alternatives	4.3091	.74219	.10008	6th
Resources and factory supply studies	4.2545	.58431	.07879	7th
Appraisal and investment report	4.1091	.65751	.08866	8th
Economies of scale studies	4.0182	.75745	.10214	9th
Ensuring regular review and updating of risk management systems	3.6909	.71680	.09665	10th
Informing potentially affected parties of significant risks from mining minerals and metals operations	3.6182	.89217	.12030	11th

Source: Researcher's Survey (2019)

4.4.2 One Sample T-test

All the factors had t-values (the strength of the test) that were positive indicating that their means were above the hypothesized mean 3.5. Almost all of the factors had a p-value (significance of the test) less than 0.05 and this implies that the means of these variables are not significantly different from the hypothesized mean of 3.5.

However, the variables *Informing potentially affected parties of significant risks from mining minerals and metals operations* and *Ensuring regular review and updating of risk management systems* had p-values of 0.330 and 0.053 respectively which are greater than 0.05 indicating that

Table 4. 7: One Sample T Test

	Test Value = 3.5					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Resources and factory supply studies	9.577	54	.000	.75455	.5966	.9125
Location studies	9.456	54	.000	.80909	.6375	.9806
Environmental impact assessment	14.566	54	.000	.99091	.8545	1.1273
Pre-feasibility and feasibility studies	21.010	54	.000	1.24545	1.1266	1.3643
Economies of scale studies	5.073	54	.000	.51818	.3134	.7230
Appraisal and investment report	6.870	54	.000	.60909	.4313	.7868
Identification of investment opportunity	12.750	54	.000	1.08182	.9117	1.2519
Informing potentially affected parties of significant risks from mining minerals and metals operations	.982	54	.330	.11818	-.1230	.3594
Market studies	9.252	54	.000	.88182	.6907	1.0729
Ensuring regular review and updating of risk management systems	1.975	54	.053	.19091	-.0029	.3847
Analysis of project alternatives	8.085	54	.000	.80909	.6084	1.0097

Source: Field survey (2019)

their means are significantly different from 3.5. Furthermore, the 95% confidence level interval estimates the difference between the population mean weight and the test value (i.e. 3.5). For example, the variable Resources and factory supply studies is estimated to have a mean weight difference of 0.75455. It therefore has 0.5966 and 0.9125, lower and upper values respectively.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 INTRODUCTION

This research study inaugurated with the aim to explore risk management practices of construction projects in the mining sector. It has become relevant to conduct this study due to little knowledge area on the risk management practices of construction projects in the mining sector unlike a lot of research attention given to risk management in construction industry. The four chapters previously undertaken presents the introduction of the study. It also provided a review of the relevant literature on the basis of the study's goals and goals. In the third section, the methodology used for the behavior of the studies was also delved into. The fourth section presents in the field study the assessment of information collected from participants.

Throughout the study, this chapter concluded the research effort by discussing only the primary points. It started by reviewing the study goals, conclusions, suggestions, and research constraints. The culmination of this research study has been taken from this research study on the future research agenda.

5.1 REVIEW OF RESEARCH OBJECTIVES

The principal aim of this research study was to explore risk management practices of construction projects in the mining sector. To attain this research aim, three research objectives were set to actively drive the research agenda as follows:

Objective 1: To establish the critical risk factors associated with construction projects in the mining sector

Risk management is an essential tool for eliminating or mitigating the consequence of risk in construction projects. Construction projects can be unpredictable. Managing risks in construction projects has been recognized as a very important process in order to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability. Project risk management is an iterative process, the process is beneficial when is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion.

Critical issues concerning the risk factors associated with construction projects in the mining sector were reviewed which led into identification of variables from the review as risk factors associated with construction projects in the mining sector. To affirm these identified variables from literature, questionnaires were designed and administered to respondents who are engaged in project risk management in the mining industry namely, Geologist, Surveyor and Engineer to seek their views. Their responses were analyzed using the Relative Important index as the analytical tool.

This research study explored the risk factors associated with construction projects in the mining sector and found, *Unavailability and accuracy of preliminary geo-scientific information; Instability of foreign currency exchange rate; High Inflation rate; Unstable and unpredictable fiscal regime; Changes in demand or price for the product; Corruption and fraud; Excessive government bureaucracy; Conflicting interests of local governments and traditional authorities; Lack or poor transportation networks; Lack or insufficiency of public utilities such as power/energy, water, information and communication technology; Shortage of skilled labor; Mistake in pit design; Choice of the appropriate mining method; Mandatory community development programs; Instability of legislative environment; Erosion of mine wastes into surface waters; and Particulate matter from excavations* as critical risk factors associated with construction projects in the mining sector.

Objective 2: To ascertain the risk mitigating factors attendant with construction projects in the mining sector

Risk management is inherently about the management of unplanned events. Unplanned events which occur on a mine site, or within the surrounding environment or community, have the potential to impact on the viability of a mine or community. The process of assessing and managing these risks is aimed at reducing the likelihood that these negative events will occur and increasing the likelihood that positive outcomes will be realized.

Issues concerning risk mitigating factors attendant with construction projects in the mining sector were reviewed which emanated into the identification of variables from the review as risk mitigating factors attendant with construction projects in the mining sector. To affirm these identified variables from literature, questionnaires were designed and administered to respondents who are engaged in project risk management in the mining industry namely, Geologist, Surveyor and Engineer to seek their views. Their responses were analyzed using the Relative Important index as the analytical tool.

This research study explored the risk mitigating factors attendant with construction projects in the mining sector and found, *Review of constitution and the other related mining legislation of host country; Political Risk Insurance; Joint Venture with government and local enterprises; Portfolio diversification (investing in other mineral commodities or other mining jurisdictions); Undertaking cost reduction programs; Training and education programs; Engaging and retaining existing skilled workers; Conformance to international, national and local protocols for protecting cultural heritage; Obtaining Social License to Operate; Employing high qualified local counselors/ lawyers well acquainted with the legal system of the country; Development of good relation with governmental authorities; Reviewing of available geo-scientific information from* *local institutions; Engaging independent qualified and reliable geologists for accurate data collection; and Building and maintaining good relations with sector institutions and consulting other private mining institutions* as risk mitigating factors attendant with construction projects in the mining sector.

Objective 3: To explore risk management practices of construction projects in the mining sector

Issues concerning the risk management practices of construction projects in the mining sector were reviewed which emanated into the identification of variables from the review. To affirm these identified variables from literature, questionnaires were designed and administered to respondents who are engaged in project risk management in the mining industry namely, Geologist, Surveyor and Engineer to seek their views. Their responses were analyzed using the One Sample T- test as the analytical tool.

This research study explored the risk management practices of construction projects in the mining sector and found, *Ensuring regular review and updating of risk management systems; Identification of investment opportunity; Informing potentially affected parties of significant risks from mining minerals and metals operations; Pre-feasibility and feasibility studies; Market studies; Analysis of project alternatives; Location studies; Economies of scale studies; Appraisal and investment report; Environmental impact assessment; and Resources and factory supply studies* as risk management practices of construction projects in the mining sector.

5.2 RECOMMENDATIONS

The reward of successful mining activities can be very great for both the investor and host governments. For the investor it leads to increased profits; for local communities or nation, well-paying jobs, new infrastructure, increased government revenues that can in turn be invested in social priorities such as education, health care, and poverty alleviation. These benefits cannot be achieved if all mining stakeholders, especially the country and mining companies were not able to successfully manage the numerous risks associated with the industry. It is an accepted fact that all business endeavors comport some level of risks. But mining is so unique that it is considered as the riskiest business venture.

The risks in the mining sector are exacerbated by the unique characteristics of the industry such as the capital intensiveness, the long lead period (or long pre-production period), the exhaustibility of the asset (that is the mineral resource), the uncertainty associated with the discovery and evaluation of the resource and the volatility of the mineral price. It is therefore, obvious importance of risk management of mining projects in general cannot be underestimated.

In view of the research findings, it deems appropriate to make recommendation on relevant issues for consideration by project team members and other stakeholders in the mining industry as far as risk management is concern. The following are the recommendations to this study:

- It is important that construction project risk management stakeholders in mining industry ensures regular review and updating of risk management systems.
- Also, mining companies should review the constitution and other related mining legislation of a host country in order to determine how these will protect mining investment.
- Further, mining companies should take creative and innovative approaches to access new talents through training and education programs; motivate, engage and retain existing skilled workers.

- In addition, mining companies must build and maintain good relations with sector institutions and consult other private mining institutions.
- Moreover, it is imperative for mining companies to consult with interested and affected parties in the identification, assessment and management of all significant social, health, safety, environmental and economic impacts associated with all activities.

5.3 LIMITATIONS OF THE STUDY

This research study experienced some limitations similarly to other research. Limitations in this study is expected to give the basis for other future research work that will be explored. The study limits its scope to Asanko Gold mines located in the Ashanti Region of Ghana. Moreover, literatures that were published were engaged in the analysis of the study and conclusions that were made on this research study was based on data and results retrieved from respondents using questionnaires.

5.4 FUTURE RESEARCH AGENDA

This research study has its own shortcomings as it cannot cover all aspects of risk management practices of construction projects in the mining sector. Therefore, it is suitable to transform these deficiencies into future studies to be carried out; these future studies have developed from the assessment and debate of the research outcomes which includes:

- A future research to explore factors influencing project risk management performance in the mining industry;
- The effect risk management have on construction project performance in mining industry;
- Identifying possibilities to improve environmental risk factors associated with the mining industry; and

- Exploring hazards mitigation practices in the mining industry.

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APPENDIX

QUESTIONNAIRE DESIGN

TOPIC: RISK MANAGEMENT PRACTICES OF CONSTRUCTION PROJECTS IN THE MINING SECTOR.

I wish to seek your views on the above-mentioned topic. Please kindly respond to the questions by ticking the appropriate box for each item. The information provided would be treated confidential and used specifically for academic purposes. The information would be key for identifying critical risk factors associated with construction projects in the mining sector; risk mitigating factors attendant with construction projects in the mining sector; and risk management practices of construction projects in the mining sector.

Section A. Respondent Profile

1. Please indicate your profession:
   a. Geologist
   b. Surveyor
   c. Engineer

2. Please indicate your educational background:
   a. MSc
   b. BSc
   c. HND

3. Please indicate your years of experience:
   a. 1 – 5 years
   b. 6 – 10 years
   c. Over 10 years

Section B: To establish the critical risk factors associated with construction projects in the mining sector.

Kindly rank the following factors with respect to the above heading in section B. Use a Likert scale of 1 - 5 where One (1) is Strongly Disagree: Two (2) is Disagree: Three (3) is Neutral: Four (4) is Agree: and Five (5) is Strongly Agree.

No.	Risk Factors	1	2	3	4	5
1	Inavailability and accuracy of preliminary geo-scientific information					
2	Instability of foreign currency exchange rate					
3	High Inflation rate					
4	Unstable and unpredictable fiscal regime					
5	Changes in demand or price for the product					
6	Corruption and fraud					
7	Excessive government bureaucracy					
8	Conflicting interests of local governments and traditional authorities					
9	Lack or poor transportation networks					
10	Lack or insufficiency of public utilities such as power/energy, water, information and communication technology.					
11	Shortage of skilled labor					
12	Mistake in pit design					
13	Choice of the appropriate mining method					
14	Mandatory community development programs					
15	Instability of legislative environment					
16	Erosion of mine wastes into surface waters					
17	Particulate matter from excavations					

Section C: To ascertain the risk mitigating factors attendant with construction projects in the mining sector.

Kindly rank the following factors with respect to the above heading in section C. Use a Likert scale of 1 -5 where one (1) is Not Critical: Two (2) is Moderately Critical: Three (3) is Critical: Four is Very Critical: and Five (5) is Extremely Critical.

No.	**Risk mitigating factors**	**1**	**2**	**3**	**4**	**5**
1	Review of constitution and the other related mining legislation of host country					
2	Political Risk Insurance					
3	Joint Venture with government and local enterprises					
4	Portfolio diversification (investing in other mineral commodities or other mining jurisdictions)					
5	Undertaking cost reduction programs					
6	Training and education programs					
7	Engaging and retaining existing skilled workers					
8	Conformance to international, national and local protocols for protecting cultural heritage					
9	Obtaining Social License to Operate					
10	Employing high qualified local counselors/ lawyers well acquainted with the legal system of the country					
11	Development of good relation with governmental authorities					
12	Reviewing of available geo-scientific information from local institutions					
13	Engaging independent qualified and reliable geologists for accurate data collection					
14	Building and maintaining good relations with sector institutions and consulting other private mining institutions					

SECTION D: To explore risk management practices of construction projects in the mining sector.

Kindly rank the following factors with respect to the above heading in section D. Use a Likert scale of 1-5 where one (1) is Not Important: Two (2) Less Important: Three (3) is Moderately Important: Four (4) is Important: and Five (5) is Very Important.

No.	Risk management practices	1	2	3	4	5
1	Ensuring regular review and updating of risk management systems					
2	Identification of investment opportunity					
3	Informing potentially affected parties of significant risks from mining minerals and metals operations					
4	Pre-feasibility and feasibility studies					
5	Market studies					
6	Analysis of project alternatives					
7	Location studies					
8	Economies of scale studies					
9	Appraisal and investment report					
10	Environmental impact assessment					
11	Resources and factory supply studies					