



Sudan University of Science & Technology
College of Graduate Studies



**THE IMPACT OF RISK MANAGEMENT ON
DECISION – MAKING IN CONSTRUCTION
PROJECTS IN SUDAN**

أثر إدارة المخاطر علي إتخاذ القرار في مشروعات التشييد في السودان

**A dissertation submitted in partial fulfillment of
The requirements for the degree of**

M.S.C in Construction Management

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿فَتَبَسَّ ضَاحِكاً مِنْ قَوْلِهَا وَقَالَ رَبِّ أُوْنِرْ عَنِّي أَنْ
أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِدَيَّ وَأَنْ أَعْمَلَ
صَالِحاً تَرْضَاهُ وَأَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ﴾

صدق الله العظيم

سورة (النمل: 19)

Dedication

I dedicated this work to my husband
for his steadfast support,
understanding
and
patience.

Acknowledgement

I express limitless thank and heartfelt gratitude to ALLAH ALMIGHTY, who makes all things possible.

Then I am heartily thankful to my supervisor Dr. Salah Ajaban for his advices, encouragement, guidance and support during the preparation of this dissertation.

Also it is an honor for me to acknowledge and extend sincere thanks to the management of CETS and Sudan University of Science & Technology for their great efforts that have been exerted to benefit from this program of M.SC.

I transfer my endless appreciations to all those, who have responded to the questionnaire and have offered their experiences. Without them, this dissertation could not be completed.

Lastly, I offer my regards and God blessing to all of those who supported me, and it is most especially to my family.

Abstract

This research concentrates on aspects of risk management to find the significance of how risk management methods can empower the decision-making of the project managers.

According to the experience of the research on the field of construction Industry there is big problem about how to manage risk and how to make decisions, to manage real project, consequently affect the achievement of the base objectives (cost – time – and quality) .

Researchers have worked hard to develop models and decision support systems to assist decision makers in making decisions in the case of uncertainty.

The basic concept of risk management as a process is to take better decisions under conditions of uncertainty remains.

This research is not intended as a definitive monograph on risk but as a Guide for practitioners having to manage real projects.

This research depends on structuring the theoretical frame from reliable references in order to assist in interpreting results, obtained by the research tool (Questionnaire). The research tool is used to collect data from the research population sample shall be selected statistically .The collected data shall be tabulated, analyzed and interpreted Comprehensive discussion in the light of the theoretical part in order to set general recommendations.

المستخلص

نجد ان هذا البحث يهتم بكل جوانب ادارة المخاطر ومدي اهمية طرق ادارة المخاطر في دعم مدراء المشاريع لاتخاذ قرارات صحيحة وفعالة.

وفقا للتجارب والبحوث في حقل صناعة التشييد نجد ان هنالك مشاكل وعقبات كبيرة في كيفية ادارة المخاطر واتخاذ القرارات حتي نتمكن من ادارة مشاريع حقيقية ناجحة , نحققم خلالها الاهداف الاساسية للمشروع (الزمن-التكلفة والجودة).

عمل الباحثون بصورة جادة وقوية لتطوير نظام دعم القرارات حتي يتمكن متخذي القرارات من اتخاذ قرارات صحيحة في ظل عدم التاكيد والرؤية الغير واضحة .

نجد ان الفكرة الاساسية لادارة المخاطر كعملية لاتخاذ قرارات صحيحة فعالة في ظل الظروف الغير واضحة .

يكون كدليل يقود الممارسين ومدراء المشاريع لادارة مشاريع حقيقية ناجحة تتحقق من خلالها اهداف المشروع الاساسية .

هذا البحث اعتمد في انشائه علي الاطار النظري من المراجع الموثوق بها للمساعدة في تفسير النتائج التي تم الحصول عليها عن طريق اداة البحث (الاستبان).

تم استخدام اداة البحث (الاستبيان) لجمع المعلومات بأخذ عينة من مجتمع البحث التي اختيرت احصائيا .

المعلومات التي تم جمعها تمت جدولتها وتحليلها وتفسيرها عبر مناقشة شاملة في ضوء الاطار النظري للتوصل الي توصيات عامة

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Chapter one

INTRODUCTION

Chapter I

1.1 - INTRODUCTION:

All projects are subject to risk. The world is in a state of continuous Change and survival relies on the ability to adapt to these changes. Unfortunately, many project managers have not yet realized that there is a need to include project risk as a key process.

Change is inherent in construction work. For years, industry has had A very poor reputation for coping with the adverse effects of change, with many projects failing to meet deadlines, cost and quality targets, due to incorrect decisions and the omission of risk management principles. Changes cannot be eliminated, but by applying the principles of risk management and effective decision - making, they could be mitigated. This nessesates the improvement of the effective management of this changes.

Construction industry has a very risky and complex nature. Risk is associated with every project, each process and decision throughout the project life cycle. (BS IEC 62198:2001). Along the project life cycle (PLC) there are many decisions to be made. Unfortunately, the most crucial of these decisions are to be made in the early stages where limited precise information is available. Researchers have worked hard to develop models and decision support systems to assist decision makers in making decisions in the case of uncertainty.

The basic concept of risk management as a process is to take better decisions under conditions of uncertainty remains.

It is so essential to find how risk management methods can empower the decision – making of the project manager. However, it is so important to include various concepts in concern with optimal understanding in order to provide the real basis on which effective decisions making depend.

1.2 - RESEARCH PROBLEM:

According to the experience of the researcher on the field of construction Industry there are obvious problems concerning managing risk in projects, and making decisions. These problems impact the achievement of the project basic objectives namely, cost, time and quality.

The research addresses the following questions:

- 1- Are there any local measures or procedures for managing risks in Construction Projects?
- 2- How are the project managers consider expected risks?
- 3- How the risk management process improves decisions making in conditions of uncertainties?
- 4- How dose risk and decision making affect the project objectives?

1.3 - RESEARCH HYPOTHESIS:

The research adopts the following hypothesis:

- 1- Risk management process improves decisions making in construction project.
 - 2- Managing risk to have effective decisions enable project team to achieve its objectives.
 - 3- Many projects fail due to incorrect decisions and omission of risk management principles.
- 1- Risk management is a good process in running projects under conditions of uncertainties.

1.4 - LIMITATION OF THE RESEARCH:

This research is not intended as a definitive monograph on risk but as a guide for practitioners having to manage real projects.

1.5-AIMS & OBJECTIVES OF THE RESEARCH :

- 1- To provide the project manager with the basis for effective decision making.

2- To emphasis the concept of risk management particularly in the stage Of decision– making in order to manage areal project .

3-To clarify the impact of the risks and decisions – making in the objectives of the project.

5- To eliminate the risk before they occur and Supported the decisions by thorough analysis .

1.6- RESEARCH METHODOLOGY:

This research depends on structuring the theoretical frame from reliable references in order to assist in interpreting results, obtained by the research tool (Questionnaire). The research tool is used to collect data from the research population sample shall be selected statistically .The collected data shall be tabulated, analyzed and interpreted Comprehensive discussion in the light of the theoretical part in order to set general recommendations.

Chapter Two
General Principles of Risk
Management& Diction Making

Chapter II

General Principles of Risk Management& Diction Making

2.1- Introduction:

This chapter contains an a literature review on the construction industry and projects management is provided. It mainly covers an introduction to the nature of construction industry, general concepts of risks management, general concepts of decision making and history of projects management.

2.2- Risk Management

If two or more alternatives are to be decided among, in which all the factors of influence cannot be quantified, then decision-making occurs under or uncertainty. A decision is made under conditions of risk if the decision-maker is able to assess rationally or intuitively, with a degree of certainty, the probability that a particular event will take place, using as a basis his information about similar past events or his personal experience.

An example for deciding under conditions of risk defining the load on the foundations. This estimate can be made, with a degree of certainty or a degree of risk, on the basis of existing information about similar structures built under similar ground conditions and on the basis of the estimator's experience. If there is no such information, and if the estimator has no experience with similar structures and ground conditions, then decisions are made under conditions of uncertainty. Risk, therefore, becomes uncertainty when sufficient information or experience to make a mathematical model and predict the probable result are not available.

One of the basic roles of modem businesses management is to maximally reduce the probability of risk, i. e. to gather sufficient information or

experience to turn uncertainty into risk and make it easier to reach a decision.

2.3- Principle of Risk Management

The International Organization for Standardization identifies the following principles of risk management:

- ☐ Risk management should create value.
- ☐ Risk management should be an integral part of organizational processes.
- ☐ Risk management should be part of decision-making.
- ☐ Risk management should explicitly address uncertainty.
- ☐ Risk management should be systematic and structured.
- ☐ Risk management should be based on the best available information.
- ☐ Risk management should be tailor-made.
- ☐ Risk management should take into account human factors.
- ☐ Risk management should be transparent and inclusive.
- ☐ Risk management should be dynamic, iterative and responsive to change.
- ☐ Risk management should be capable of continual improvement and enhancement.

2.4- Project Risk Management (PRM)

"We all consider risk implicitly in our decision making and thinking. However, by discussing each step with other interested parties it becomes a conscious and formal discipline. It provides a mechanism to help ensure that the lessons of the past are taken into account."

Australian Standard – Guidance Manual

‘HB436:2004 (page 22, para 3.3.2)

Possible reasons for lack of project risk management:

- Informal risk management considered by SRO as sufficient
- Incomplete application of project management methodologies
- Lack of risk management skills
- Lack of risk management resources
- General lack of resources
- Lack of managerial support
- Lack of effective risk management tools No 'risk culture

2.5- Benefits of Project Risk Management:

- Increases likelihood of success, fewer surprises!
- SRO obtains greater knowledge of the inherent nature of the project
- Optimises project performance
- Provides SRO with confidence that all strategic risks to the project's objectives have been identified, and are monitored
- Protects reputation of project and department
- Makes life more comfortable !
- Provides a defensible position
- Promotes mutual understanding of the project's objective by all stakeholders
- Risks are allocated to the party which is best suited to carry/manage the risk
- Increases likelihood of funding approval
- Growing of historical data – supports 'lessons learnt'
- Prioritisation of risks enables effective resource allocation

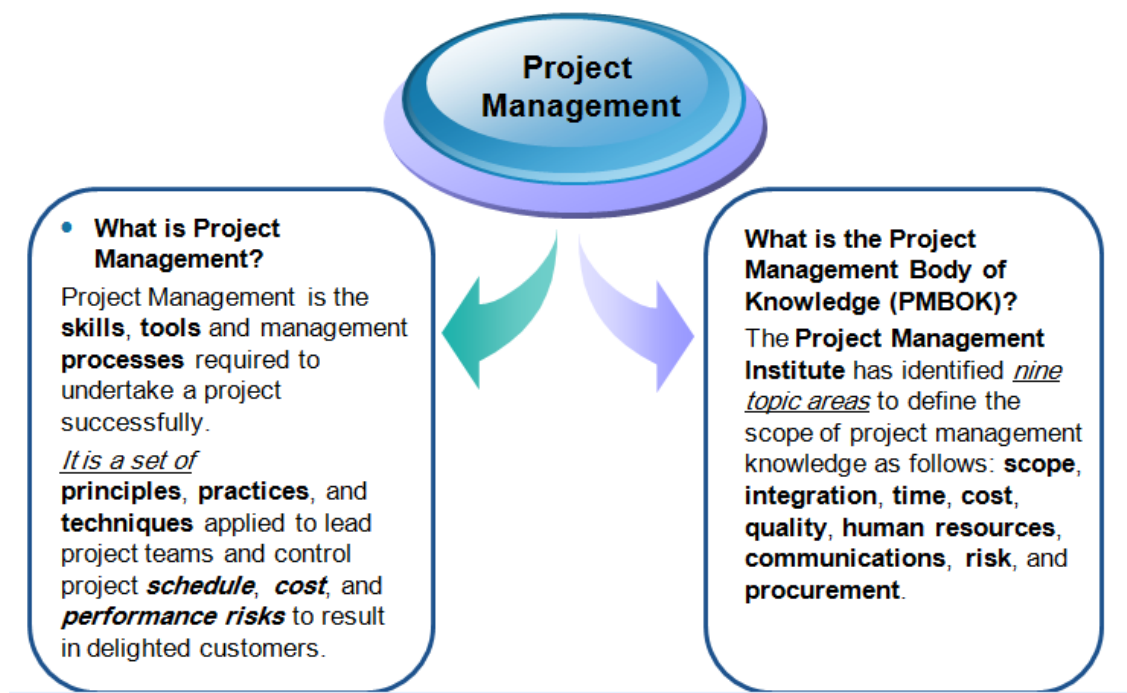


Figure (2)The Different Bettwen Project Management And (PMBOK)

2.6- Limits of risk management:

The level of risk is always related to the project complexity (Darnall and Preston, 2010). The fact that there are so many risks which can be identified in the construction industry, can be explained by the projects' size and their complexity. The bigger the project is, the larger the number of potential risks that may be faced. Several factors can stimulate risk occurrence. Those most often mentioned in the literature are financial, environmental (the project's surrounding, location and overall regulations), time, design and quality. Other influences on the occurrence of risk are the level of technology used and the organization's risks (Gould and Joyce, 2002).

Cleden (2009) claims 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. Moreover, when all potential risks have been identified, the project team must remember that there might be more threats. Therefore, the project team should not solely focus on management of those identified risks but also be alert for any new potential risks which might arise. RM 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 RM plan (Cleden, 2009).

2.7- Risk management strategy:

Most commonly the project owner (e.g. companies , organizations , etc.) has an overall risk management strategy and policy included in the strategic documents and quality management system . Main issues concerning project owner risk strategy are risk ownership (which party owns the risk ; risk exposure and transfer) and risk financing (how to include and use budget risk allowance or contingency).The client's risk management policy includes the risk management procedures or guidelines , responsibilities and reporting .

Both client (employer , promoter) and contractor are concerned with the magnitude and pattern of their investment and the associated risk. They desire to exert control over the activities which contribute to their investment . This type of risk is now covered by the term corporate and project governance .

There are two significant axioms of control :(1) control can exercised only over future events and (2) effective control necessitates prediction of the effects of change . The past is relevant only so far as past performance or events can influence our predictions of the future . The scope for control diminishes as the project proceeds . There are two key events at

which control can be exercised ; (1) selection commitment to a project of particular characteristics and (2) contract award commitment to contractors and major cost expenditure . It should be noted that there will also be opportunity to influence even if direct control cannot be exercised.

It follows that prior to these two commitments clients have great opportunity for control . They make decisions to define the organization and procedures required for the execution of a project . These decisions affect the responsibilities of parties ; they influence the control of design , construction , commissioning , change and risk ; hence they affect cost , time and quality .

2.8- Project Planning:

The control of time cannot be taken in isolation from resources and costs. Project planning methods should be utilized to communicate to all parties in a project , to identify sequences of activities and to draw attention to potential problem areas . The successful realization of a project will depend greatly on careful planning and continuous monitoring and updating . The activities of designers , manufacturers , suppliers , contractors and all their resources must be organized and integrated to meet the objectives set by the client and /or the contractor . In most cases the programme will form the basis of the plan .

Sequences of activities will be defined and linked on a timescale to ensure that priorities are identified and that efficient use is made of expensive and /or scarce resources . Remember , however , that because of the uncertainty it should be expected that the plan will change . It must therefore be updated quickly and regularly if it is to remain as a guide to the most efficient way of completing the project . The programme should therefore be simple , so that updating is straightforward and does not

demand the feedback of large amounts of data , and flexible , so that all alternative courses of action are obvious .

The purposes of planning are therefore to persuade people to perform tasks before they delay the operations of other groups of people , and in such a sequence that the best use is made of available resources and to provide a framework for decision making in the event of change . It is difficult to enforce a plan which is conceived in isolation , and it is , therefore , essential to involve the individuals and organizations responsible for the activities or operations as the plan is developed .

In developing a plan which is to be used for purposes of control , it is vital to distinguish between different categories of change and to fully instigate the monitoring and formal aspect of the project . Typically , the main categories are : adapted , fixed (e.g. for mobilization) ; time related (e.g. for resources and overheads) and quantity – proportional (e.g. for materials) . Their relative importance will differ with the project and it is interesting to note the importance of time – related costs and the implications of delay in plant – intensive construction projects .

Project management information systems (PMISs) should forecast the outcome of a project in terms related to achievement of its objectives . Integrated cost models link time with money . They provide project managers with forecasts to completion in terms of cost , time resource usage and cash flow . Decisions about future actions can be made with the best available forecasts in these terms . Cost models also help to overcome an implementation gap between monitoring systems and the manager's action . Risk management software (RMS) is the term used to denote a specialist software , which can be used to apply one of the many risk assessment methodologies .

Project control and information systems should be conceived and adopted to suit the needs of a particular project . The project should not

be forced to fit the control system ; rather the control system should fit the project . Software needs to be selected with due regard to the resources that will be required to operate it and its data requirements .

2.9- The Decision Process:

- 1- A decision may be defined as ‘a formal judgment ‘ or ‘resolving to carry out a particular course of action ‘ . In a business sense , a decision is usually the result of choosing between uncertainties . Often a decision is taken on the ground of future projections and therefore is subject to uncertainty and risk . In this way it can be seen that the decision – making process is one involving value judgments and risk – taking .
- 2- The earliest management authors (Fayol , Babbage et alia) highlighted decision – making as one of the key differences between management and workers . Henri Fayol (1841 – 1925) included decision – making as one of the main functions of management . This remains true today in that decision – making is still the prerogative of management . Whether a manager is dealing with people , supervising production or quality or clerical staff , or whether he is involved in capital expenditure , it is inevitable that decision – making will be an important part of his job .
- 3- Managers have varying levels of responsibility according to their position in the organization structure . At senior management level, corporate planning decisions will be made while lower levels of management will be involved in operational decisions Foremen , charge hands etc. Will also act as managers in taking decisions within the clearly – defined limits of their authority .

- 4- Managers are expected to act within their responsibilities and to take such decisions as necessary which fall within their scope of authority . Therefore , only matters which cannot be adequately dealt with by a manager should be referred to more senior management . Thus decisions taken at a higher level in a company should be of a senior character and broad in influence .
- 5- The concept of making decisions within the manager's prescribed area of responsibilities is known as the law of principle of exception . This law states that each manager carries out the duties allocated to him and will make such decisions as are necessary which fall within his scope of authority . Only when decisions are required which lie outside his authority would he be expected to call in higher authority. This is extended into the principle of management by exception , whereby a manager is informed when the results do not accord with the plan and some decision or corrective action is necessary . This means that a manager can concentrate on matters requiring attention and not duplicate the efforts of others on matters which are proceeding according to plan.

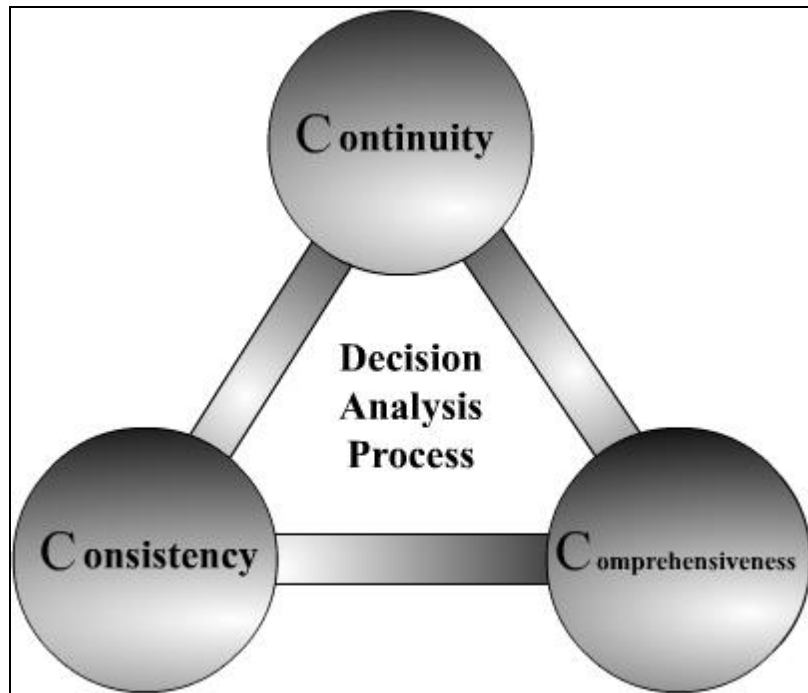


Figure (5): 3D Principle of Decision Analysis

REFERENCE. NO.11

2.10- The Project Environment:

2.10.1 - Projects

Projects do not exist in isolation. They are initiated to fulfill a need or exploit an opportunity. The needs and opportunities exist before the project. They are products of the world at large. Projects are therefore heavily influenced by external factors and they also influence the world outside them to an extent that is largely, but not entirely, dependent upon the size of the project.

These external factors can be termed the project environment. Other names are also given to it such as the project world. Perhaps the single most important influence on any project is whether or not it is carried out by public or private sectors. Public sector projects are those undertaken

by central and local government whereas private sector projects are those undertaken by individual companies or consortia which are usually entirely privately owned . The aims and objectives of these two sectors are different and projects are undertaken by them for different reasons . The main aim , if not the sole aim , of projects undertaken in the private sector is to make a profit , whereas for projects undertaken by the public sector it is whether the project provides a public service and is also of benefit to the community.

In the United Kingdom in recent years , however, this distinction has become blurred . The increasing burden upon the state of large commitments , including publicly – owned enterprises , coupled with significant increases in funding costs , has meant that increasingly the public sector is looking to the private sector to finance projects . This has led to the trend in recent years for projects to be procured under the Design – Build – Finance – Operate (DBFO) alternatively known as Build – Own – Operate – Transfer (BOOT) or Build – Operate – Transfer (BOT) . In the United Kingdom , all projects of these types are now known as public – private partnerships (PPP) or private finance initiative (PFI) projects . This intended to reduce public expenditure on both the capital and running costs by transferring them to the private sector . This is perceived to have the dual advantage of : first , reducing the requirements for public expenditure on capital projects ; and second , producing projects which can be operated more efficiently thereby reducing the requirement for public funding of the operating cost . It is also perceived that such projects have the further advantage of reducing capital cost by reducing the incidence of over specification and overdesign , and by reducing conflict between the various parties to the project by creating a single entity , which combines the consultant , contractors and operators . In such projects , public need is serviced only

where it can generate a profit during the operation phase . In fact , audits have begun to question the value for money and long – term benefits of this approach to procuring projects and concerns have been raised about the long – term commitment the public sector now has to continue payment for the services provided .

Generally speaking , in publicly funded projects , the government or local authorities have taken many of the risks . This has been true in the past of private sector projects too . Recently however , private companies and consortia have sought to transfer more of the risk for the design and construction of their project to the consultants and contractors who design and construct them . This has come about because the private sector is increasingly concerned at the incidence of delayed completion and increased costs brought about by the more traditional ways of procuring and implementing capital projects . The consequence has been the development of a number of alternative types of procurement strategy , the most common of which is some form of turnkey contract where one entity is responsible for both the design and the construction .This is believed to put greater responsibility upon that party and remove some of the potential conflict , thereby reducing the incidence of cost overspend and programme delay .0

This is an example of the transfer of risk from the owner to a contractor . Nevertheless , in such arrangements , the owner would retain the risk of the viability of the project and that of the operating and maintenance cost. Risks to the private sector by combining the designer , contractor and operator into a concessionaire organization .The latter is responsible for raising the capital , managing the project and is then responsible for the operation and maintenance of the asset to a predetermined specification for which it receives some form of fee as income from the public sector or from users , for providing the service .

The importance of distinguishing between these types of project is that they fundamentally determine the attitudes towards risk assessment , risk transfer and risk management which must be adopted in the initiation and implementation of such projects . It should be noted however that the National Audit Office (NAO) now questions whether or not risk transfer has really taken place from the public sector to the private consortia .

2.10.2- Project Organization:

Organization means the way in which the project's implementation team is organized and who the participants are .

Projects can be split in single discipline and multidiscipline . The traditional civil engineering sector has been single discipline , while the building and process engineering sectors have been multidiscipline but as projects have become larger and more complex it is becoming more likely that projects are multidiscipline . For example , many highway projects contain sophisticated traffic signing , information systems and speed cameras . Similarly , the signaling and control systems for rail projects are becoming more sophisticated and expensive . Hence , they are now a larger proportion of the project than they used to be , such that these projects are now clearly multidiscipline .

2.10.2.1- Single Discipline Projects:

By their nature , these projects are annually undertaken by one project team , frequently staffed by one consultant with a single client and executed by a single contractor . The number of interfaces between individuals and organizations are relatively few and easily managed . The most complicated relationships exist between the contractor, his subcontractors and suppliers (i.e. the contractor's supply chain) . However , these relationships and the structure required to manage them

is relatively simple , although in recent years it has been recognized that significant savings can be made by dedicating effort to managing the supply chain . Hence , these projects usually represent a lower risk than multidiscipline projects , even though they can be large and have high values .

2.10.2.2- Multidiscipline Projects:

Despite the greater organizational complexity , projects can be quite small . For example , even quite small building may require :

- civil engineering input if the foundations are complex ;
- a structural engineer for the building superstructure ;
- a building services engineer ;
- an architect to lead the team and prepare the overall design ;
- a mechanical and engineering (M&E) or a process contractor ;
- a fitting out contractor .

Other specialists involved may include telecommunications engineers, lift specialists and cladding specialists . The contractor's organization may be equally complex with specialist trade sub – contractors for civil works , structural works , brickwork , carpentry , plumbing , installation of services , telecommunications and so on . To complicate matters further , the specialist sub – contractors may also have impact into the design process , for example the sizing of lift shafts and machinery rooms .

Traditional procurement methods often split responsibility in an unrealistic and arbitrary way the cuts across work package . For example , the overall design of electrical systems and HVAC (heating, ventilation and air conditioning) may be the responsibility of a design consultant ; the co – ordination of M&E services may be the responsibility of the main contractor ; while the detailed design of the HVAC installation may be the responsibility of a specialist supplier . The structural engineer

meanwhile is responsible for the design of the building frame , although detailing may be the responsibility of the fabricator .

Clearly , this type of organizational structure increases the risks and likely results in poor communications , delays and incorrect information leading to claims and disputes . It is for this reason that clients in the building sector – especially developers – have moved to other forms of procurement including design and build , because , though different discipline are still , they are all part of a single organization .

Increasingly large clients are moving towards partnering arrangements with selected suppliers so that the various disciplines are effectively part of one organization . This is aimed at minimizing the risks described above with the objective of improving the chances of successful delivery of projects, on time, to budget and to specification. Partnering has been successful in manufacturing industry and on projects where the extent of risk is similar to those encountered in construction projects.

One final point that should be made is that organizations are collections of people. And research has shown that groups of people are less risk aware than individuals. It is possible therefore that complex organization are more likely to take risks than smaller less complex organizations.

Chapter Three
Risk Management & Decision Making
In Construction Projects

Chapter III

Risk Management & Decision Making

In Construction Projects

3.1- Introduction:

This chapter reviews literature on the risk management in the construction industry & how the risk management effected on the decision making in construction projects.

3.2- Construction projects:

A risk event implies that there is a range of outcomes for that event which could be both more and less favorable than the most likely outcome. Each outcome within the range has a probability of occurrence. The accumulation or combinations of risks can be considered as project risk. This will usually be calculated using a simulation model. It is important to capture all the potential risks that might confront the project even if they are not strictly events or a calculation of project risk .

In construction projects each of the three primary objectives of cost , time and quality is likely to be subjected to risk and uncertainty .the more realistic estimate is the one which makes appropriate allowances for all kinds of risks and uncertainties. Risks and uncertainties can be anticipated from experience and foresight. Project managers should undertake or propose actions to eliminate risks before their occurrences. They should reduce the effects of this risk or uncertainty by allowing for provisions for their physical occurrence. This is to be done in a cost effective ways. It is vital to recognize the roots of risk causes, and not to consider risks as events that occur almost at random. Risks can frequently be avoided if their root causes are identified and managed before the adverse consequences of its occurrence. They should also ensure that the

remaining risks are allocated to the parties in a manner which is likely to optimize project performance.

To achieve these aims it is suggested that a systematic approach is followed : to identify the risk sources , to quantify their effects (risk assessment and analysis), to develop management responses to risk and finally to provide for residual risk in the project estimates . These four stages comprise the core of the process of risk management .Risk management can be one of the most creative tasks of project management.

The benefits of risk management can be summarized as follows:

- Project issues are clarified , understood and considered from the start;
- Decisions are supported by thorough analysis ;
- The definition and structure of the project are continually monitored ;
- Clearer understanding of specific risks associated with a project;
- Build – up of historical data to assist future risk management procedures .

3.3- Risks in construction projects

Due to the nature of the construction sector, risk management is a very important process here. It is most widely used in such projects which include high level of uncertainty. These types of risk incurred are characterized by more formal planning, monitoring and controlling processes. The easiest way to identify risk is to analyze and draw lessons from previous failed projects. To make sure that the project objectives are met, the portfolio of risks associated with all actors across the project life cycle (PLC) should be considered (Cleland and Gareis, 2006). In the early stages of the project where planning and contracting of work,

together with the preliminary capital budget are being drawn, risk management procedures should be initiated. In later stages, RM applied systemically, helps to control those critical elements which can negatively impact project performance. In other words, to keep track of previously identified threats, will result in early warnings to the project manager if any of the

objectives, time, cost or quality, are not being met (Tummala and Burchett, 1999).

There are a number of risks which can be identified in the construction industry and which can be faced in each construction project regardless of its size and scope. Changes in design and scope along with time frames for project completion are the most common risks for the construction sector. The further in the process, changes in scope or design are implemented, the more additional resources, time and cost, those changes require. Project completion ahead of time may be as troublesome as delays in a schedule. Too quick completion may be a result of insufficient planning or design problems which in fact shorten the completion time but on the other hand lead to a low quality of final product and increased overall cost. Being behind

schedule generates greater costs for both investors and contractors due to non-compliance with contracted works (Gould and Joyce, 2002). And thus it is important to keep a balance in the concept of time-cost-quality tradeoff, which more widely is becoming an important issue for the construction sector (Zhang and Xing, 2010). Depending on the project scope, types of risks may differ among investments.

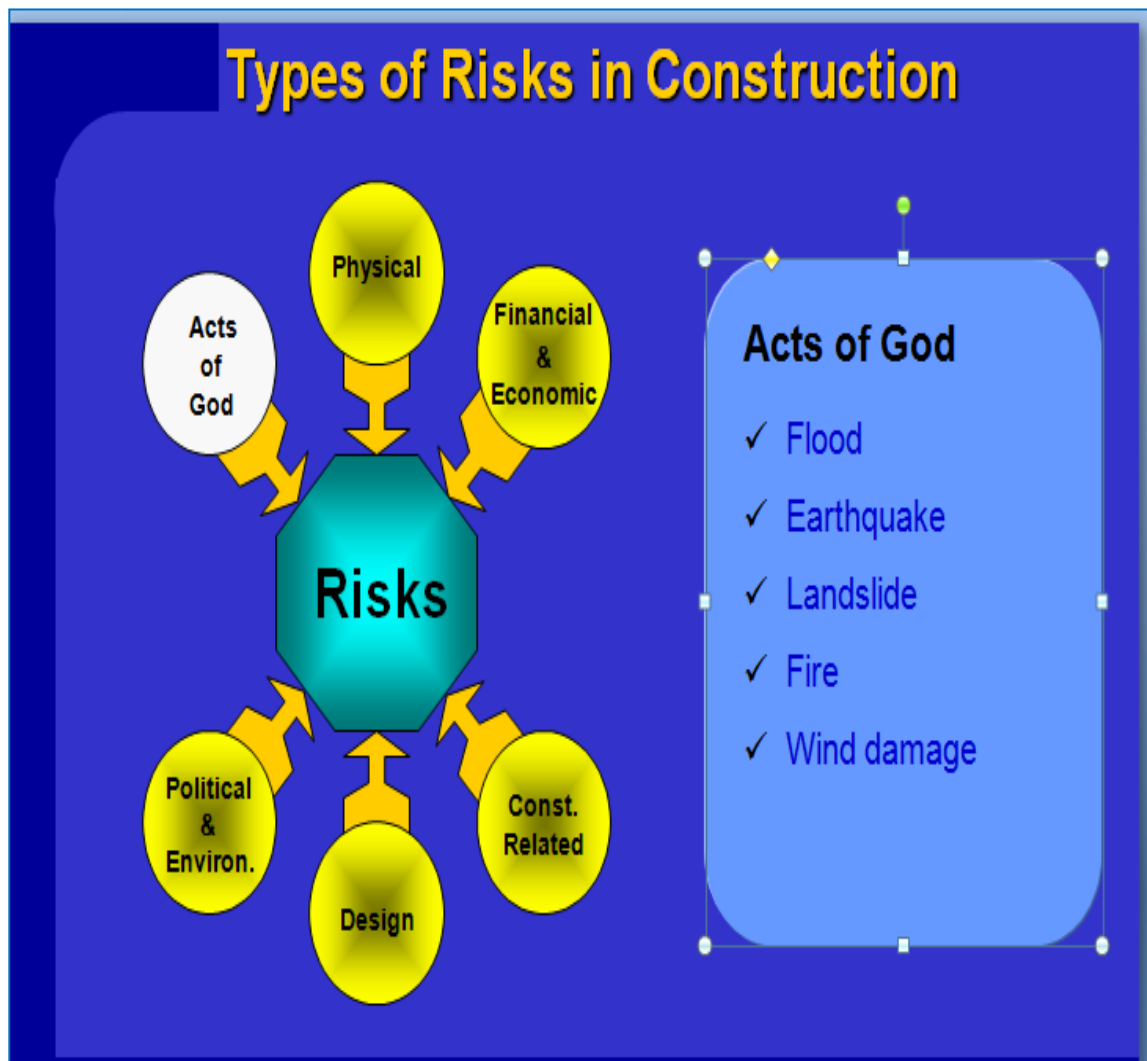


Figure (1) Types of Risk in Construction

REFERENCE. NO.8

Physical

- ✓ age to structure
- ✓ Damage to equipment
- ✓ Labor injuries
- ✓ Fire
- ✓ Theft

Acts of God

- ✓ Flood
- ✓ Earthquake
- ✓ Landslide
- ✓ Fire
- ✓ Wind damage

Financial & Economic

- ✓ Inflation
- ✓ Availability of funds
- ✓ Exchange rate fluctuations
- ✓ Financial default

Political & Environmental

- ✓ Changes in laws and regulations
- ✓ Requirement for permits
- ✓ Law & order
- ✓ Pollution and safety rules

Design

- ✓ Incomplete design scope
- ✓ Defective design
- ✓ Errors & omissions
- ✓ Inadequate specifications

Construction Related

- ✓ Labor disputes
- ✓ Labor productivity
- ✓ Different site conditions
- ✓ Design changes
- ✓ Equipment failure

3.4- Decision Making

Risk management is a particular form of decision making within project management, which is itself the topic of many textbooks and papers .Risk management is not about predicting the future . It is about understanding your project and making a better decision with regard to the management of your project , tomorrow .Sometimes that decision may be to abandon the project .If that is the correct outcome which saves various parties from wasting time , money and skilled human resources , then the need for a rational , repeatable , justifiable risk methodology and risk interpretation is paramount . Nevertheless , the precise boundaries between decision making and the aspects of other problem – solving methodologies have always been difficult to establish .

In essence decisions are made against a predetermined set of objectives, rules and /or priorities based upon knowledge , data and information relevant to the issue although too often this is not the case .Frequently decisions are ill – founded , not based on a logical assessment of project – specific criteria and lead to difficulties later . It is not always possible to have conditions of total certainty ; indeed in risk management it is most likely that a considerable amount of uncertainty about the construction project exists at this stage .

The terms risk and uncertainty can be used in different ways. The word risk originated from the French word *risqué*, and began to appear in England , in its Anglicized form, around 1830 , when it was used in insurance transactions . Risk can be , and has been , defined in many ways and assessed in terms of fatalities and injuries , in terms of probability of reliability , in terms of a sample of a population or in terms of the likely effects on a project . All these methodologies are valid and particular industries or sectors have chosen to adopt particular measures as their standard approach .As this book concentrates on engineering

projects , risk is defined in the project context , and broadly follows the guidelines and terminology adopted by the British Standard on Project Management Bs 6079 , The Association for Project Management Body of Knowledge , The Association for Project Management Project Risk Analysis and Management Guide , the Institution of Civil Engineers and the Faculty of Actuaries Risk Analysis and Management for Projects Guide and the HM Treasury , Central Unit on Procurement Guide on Risk Assessment .

A number of authors state that uncertainty should be considered as separate from risk because the tow terms are distinctly different . Uncertainty can be regarded as the chance occurrence of some event where the probability distribution is genuinely not Known . This means that uncertainty relates to the occurrence of an event about which little is known, except the fact that it may occur . Those who distinguish uncertainty from risk define risk as being where the outcome of a event , or each set of possible outcomes , can be predicted on the basis of statistical probability . This understanding of risk implies that there is some knowledge about a risk as a discrete event or a combination of circumstances , as opposed to an uncertainty about which there is no knowledge .In most cases , project risks can be identified from experience gained by working on similar projects .

Risks fall into three categories ; namely known risks , known unknowns and unknown unknowns . Known risks include minor variations in productivity and swings in material costs . These occur frequently and are an inevitable feature of all construction projects . Known unknowns are the risk events whose occurrence is predictable or foreseeable .Either their probability of occurrence or their likely effect is known . Unknown unknowns are those events whose probabilities of occurrence and effect

are not foreseeable by even the most experienced staff . These are usually considered as force – majeure .

In some situations the term risk does not necessarily refer to the chance of bad consequences , it can also refer to the possibility of good consequences , therefor , it is important that a definition of risk must include some reference to this point .Risk and uncertainty have been defined as :

- Risk exists when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcomes;
- Uncertainty exists when there is more than one possible outcome of a course of action but the probability of each outcome is not known (frequently termed estimating uncertainty).

A particular type of decision making is needed in risk management .

Consider Figure 1.1 which compares the probability of occurrence of an event compared with its impact on the construction project . Events with a low impact are not serious and can be divided into the elements of trivial and expected . For the high impact and low probability , these events are a hazard which could arise but are too remote to be considered. For example , there is a finite probability that parts from an old satellite might re-enter the atmosphere and crash on any building project in the United Kingdom , but very few buildings need to be designed to withstand that even . In project management however , high impact risks should not be ignored even if their probability is low . Fallback and response plans should be put in place even if the financial impact is too large to be covered by contingencies . The use of risk management is to identify , assess and manage those events with both a high input and a high probability of occurrence .

Why is decision-making so complicated ?

- Most problems in project management involve multiple objectives
- Project managers are always dealing with uncertainties
- Project management problems may be very complex
- Most projects include multiple stakeholders

How Decisions Are Made?

No uncertainties – No alternatives

No alternatives – No decisions

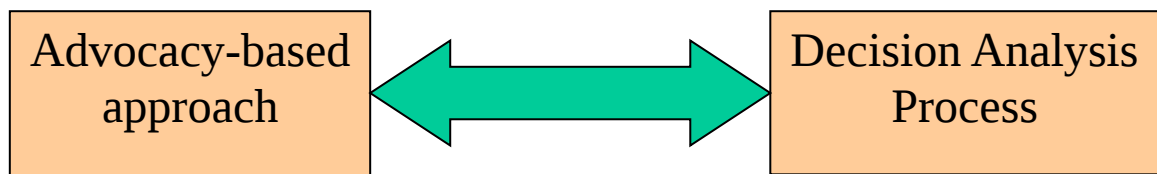


Figure (3):Two decision-making approaches

REFERENCE. NO.11

Risk Analysis

Do We Have a Solution?

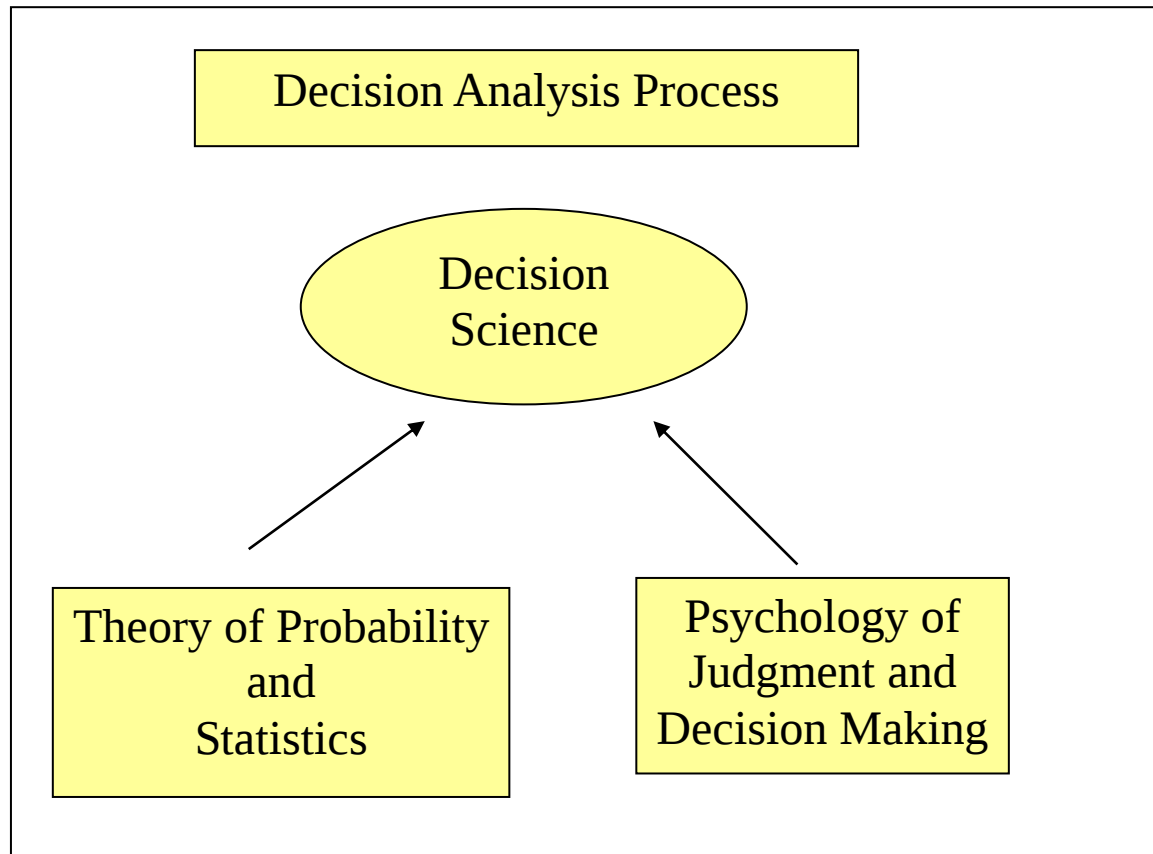


Figure (4): Decision Analysis Manifesto

REFERENCE. NO.11

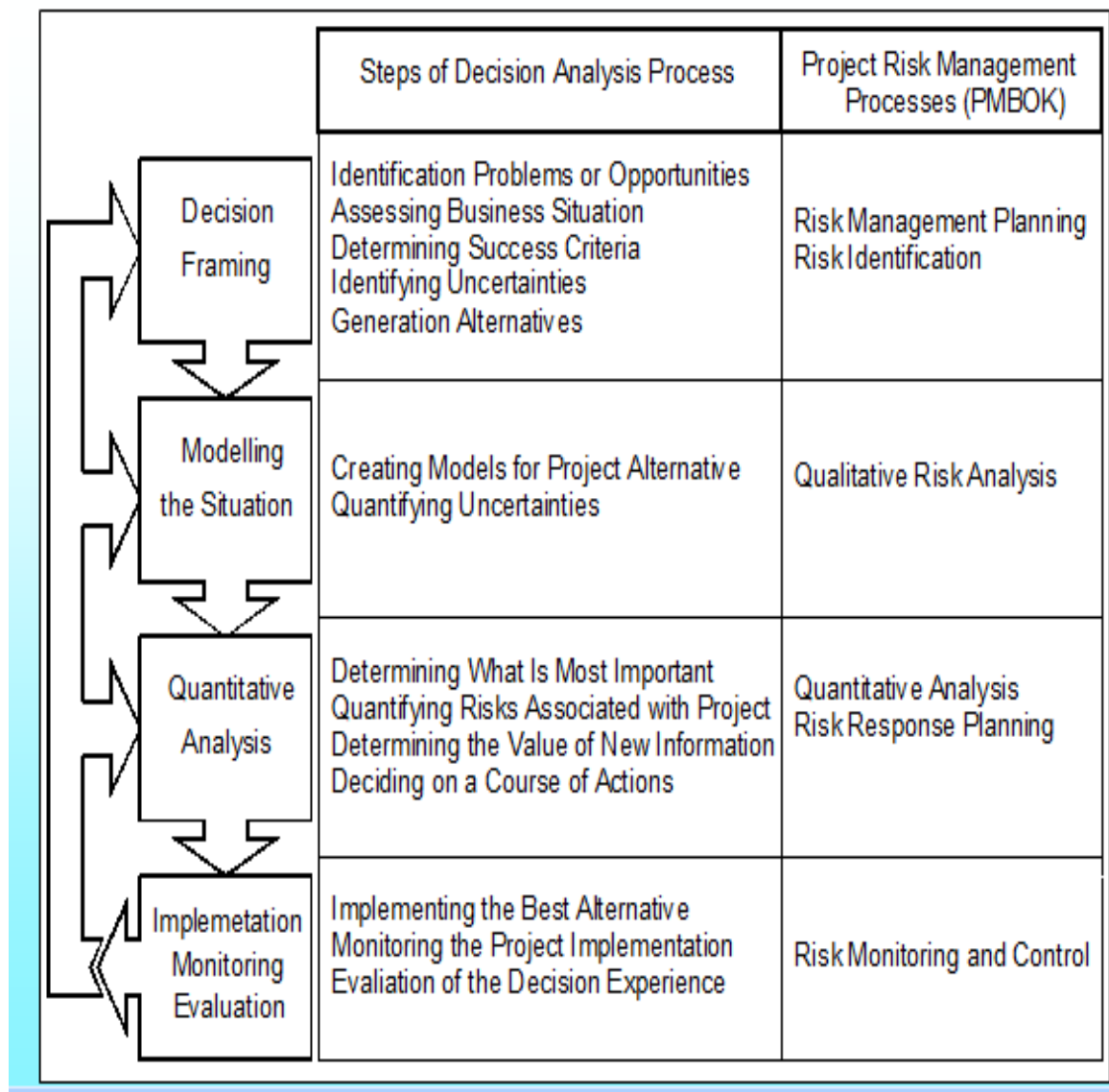
What do we want from decision analysis process?

- **We want the decision to be made rationally.**
- **We want decision-making process to be transparent**
- **We want to have a mechanism to correct mistakes**

Table (1):Decision Analysis Process

REFERENCE. NO.11

Decision Analysis Process



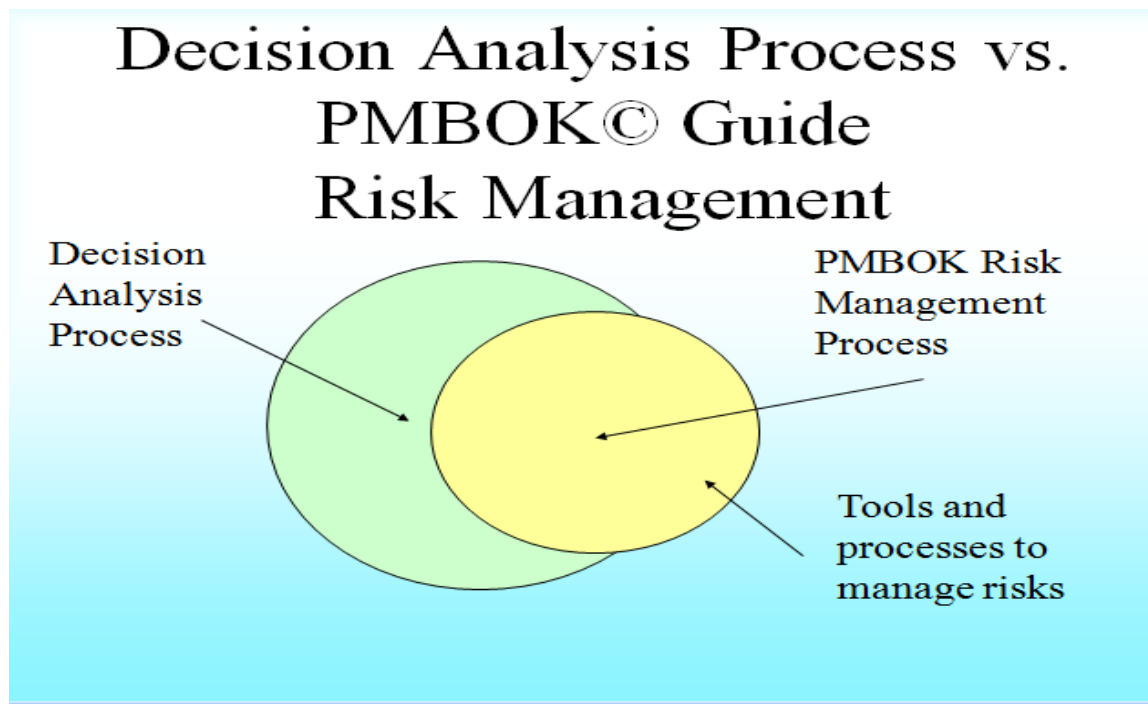


Figure (6) : Decision Analysis Process

REFERENCE. NO.11

Decision policy is a set of principles or preferences used for selection alternatives.

Strong emphasis on profitability;

Low emphasis on the safety of adversaries and a strong emphasis on the security of its own employees with a special concern for management;

Low regard for following legal rules and regulations;

Strong emphasis on organizational structure including clear definitions of roles, responsibilities, and reporting; Strong emphasis on fostering good relationships with the local community .

Rational behavior is behavior that maximizes the value of consequences and based on decision policy

3.5- Classification of decisions:

-There are basically two types of decision – general and specific . There can be a confusion between the two in that a series of specific decisions may add up to a general decision , although this was not originally intended .

For example , a company may decide that the profitability of a certain product is disappointing and look at such areas as raw material mix , advertising strategy , pricing policy etc., making decisions in all these specific areas , but still fail to identify that the product is no longer a ‘bread – winner’ (in directors’ terminology) . The problem is a general one concerning the existence and age of the product as a whole and cannot be cured by decisions in specific areas .

- There are many theories of decision – making which have been proposed by management authors . Basically they fall into two main categories :

- (a) Scientific decisions ; and
- (b) Reaction decisions .

- Scientific decision – making depends on the quantitative techniques of management . in this way , attempts are made to measure and express all viable alternatives . This approach depends upon the view that full complete information will lead to the ‘ideal solution’. It is generally regarded that this is an over – simplification and ignores individual flair or ‘ hunch’ . It should be recognized that many management decisions have to be taken in haste without the luxury of time in which to evaluate alternatives . If the manager were to postpone taking a decision until he obtained further information , he would be

abdication of his responsibility . It is frequently necessary that a speedy decision be taken , otherwise events will continue to evolve and will enforce a decision which may not be the right one . Similarly , subordinates need decisions to be taken speedily or they will be unable to make progress in their areas .

- Reaction decisions theory assumes that once policies and corporate plan are established , decisions that are required follow as a natural result of those plans . In this way , decision – making is regarded as an extension of the process of implementing corporate plans . Decisions therefore are partly predetermined by the detail of the plans .

- In real life situations , both approaches are used , often in unison. Decisions are usually made on the basis of facts but individual judgment will also be a major ingredient.

- The overriding problem facing a business is the determination of the particular decision structure that will achieve the most effective and efficient resource-conversion process necessary to attain its objectives.

- This decision structure can be sub-divided into the following classes :

- (a) strategic decision ;

- (b) administrative decisions ;

- (c) Operating decisions.

- Strategic decisions are concerned with the problems raised by the environment in which the firm operates and the courses of action

open to the firm, specifically relating to product range and market potential, which will best achieve its objectives.

- Decisions must be made concerning expansion, diversification, or a combination of the two. Particular directions and the allocation of limited total resources among alternatives are distinctively strategic decisions.

- Administrative decisions are concerned with the development and structuring of the firm's resources to give effect to the strategic decisions. This involves recognizing the operating needs created by the product-market strategy and providing the necessary framework within which these needs can function. The administrative problem is concerned, therefore, with :

- (a) Organization – the structuring of functional relationships with attendant lines of authority and divisions of responsibility, workflows, information flows, distribution channels and location facilities;

- (b) Resource acquisition and development – the development of raw material sources, personnel training and development, financing and the acquisition of facilities and equipment.

- Operating decisions occupy the greatest part of managerial effort. These decisions tend to be repetitive and are capable of being programmed. Operating decisions are delegated to a large extent to lower management and are concerned with achieving the greatest revenue at the lowest cost within the constraints of the strategic decisions.

- The application of operating decisions relates to:
 - (a) Allocation of resources among functional areas and product lines;
 - (b) Scheduling of operations;
 - (c) Supervision of performance.

3.6- Risk, Certainty And Uncertainty

Decision-making occurs under conditions of certainty, risk or uncertainty. Certainty is a condition in which all the factors of influence can be quantified and where the use of adequate decision-making methods results in an exactly predictable outcome.

This happens very rarely and is met only in closed systems. Construction practically never runs under conditions of certainty.

Uncertainty→ a random chance that something will happen, with no way to control whether it happens

Risk→ an uncertain event or condition that could negatively impact project performance

Each risk has a likelihood, or probability, of occurring and possible outcomes if it does occur

3.7-Project Manager/Project Organization

A construction project is characterized not only by its size and complexity, but also by various events and interactions which take place during the life cycle of a project. The work environment is constantly changing due to the number of participants involved, the project duration and the events along the way (Sanvido et al. 1992).

In the construction industry, the most common way of working is within project teams, which often are only temporary organizations. Winch (2002) describes a project as relying on human and equipment resources.

This constellation will be different in each project, since all projects are unique. Human resources, the actors, working in the project form a project team. The aim of such a group is to achieve the objectives set for the project. Dependencies between members can be compared to a hierarchical structure. In such an organizational form, a formal leadership is executed by a project manager (Winch, 2002) who has the overall responsibility for the project, and organizes its structure and operation (Sears et al. 2008). Within the project team, the tasks are divided among the members, depending on their areas of expertise (Winch, 2002).

The main task for a project manager is to ensure that the project is properly managed in order to complete it in time, within budget and with required performance. These most important project factors are exposed to risks and uncertainties. The project manager should use an RMP in order to ensure that the risks have been identified, analyzed and managed. (Perry, 1986) Some companies have a separate risk management department which is a highly specialized unit within the field of risks. Their role is to assist project managers in handling risk associated to the project. It means that risks are managed in the organization and the responsibilities are shared within the company.

3.8- Decision Making Process From Risk Management Perspective

Each of the phases of the PLC has certain purpose and scope of work assigned. At the completion of each phase there is a decision point where risk assessment takes place. Based on the risk assessment, an appropriate decision is made regarding further actions or proceeding to the next phase (Smith et al., 2006). For project management to be effective, an evaluation should be made including all phases of the PLC. Ward and Chapman (1995) use 'go', 'maybe' and 'no go' options in a decision making process. A 'go' status will constitute a green light for proceeding on to the next phase while 'no go' will stop the project. Evaluation 20

resulting in a 'maybe' decision will lead to return to a previous phase or even phases for further improvements and minimizing risk (Ward and Chapman, 1995). The further on in the stages the 'maybe' decision is made, which takes the process back to the initial phases, the more problems it causes. According to Chapman and Ward (2003) it is possible to go back in phases within a PLC, however this undermines decisions which were made in previous stages and leads to waste of resources, usually both time and money (Chapman and Ward, 2003). Decisions which are made at the end of each stage should be made after a careful study of the possible risks and hindrances which might be encountered.

3.9- Risk Definition

Risk and uncertainty are the two most often used concepts in the literature covering RM field. Although these terms are closely related, a number of authors differentiate between them (Samson, 2009). Also practitioners working with risk have difficulty in defining and distinguishing between these two. Often definitions of risk or uncertainty are tailored for the use of a particular project. To make it more systematized, a literature research was done. The findings of this search resulted in a number of definitions of risk and uncertainties. These have been compiled and are presented in Table 2.

Table(2): Definitions of risk and uncertainty

Uncertainty definition	Risk definition	Table 2 Definitions of risk and uncertainty Author: Winch (2002)
Uncertainty is a part of the information required in order to take a decision. The required information consists of the amount of available information and uncertainty. The level of uncertainty will decrease the further a project is proceeding throughout the lifecycle.	A stage where there is a lack of information, but by looking at past experience, it is easier to predict the future. Events where the outcome is known and expected.	
Uncertainty is the intangible measure of what we don't know. Uncertainty is what is left behind when all the risks have been identified. Uncertainty is gaps in our knowledge we may not	Risk is the statement of what may arise from that lack of knowledge. Risks are gaps in knowledge which we think constitute a threat to the project.	Cleden (2009)

There might be not enough information about the occurrence of an event, but we know that it might occur.	Risks occur where there is some knowledge about the event.	Smith et al. (2006)
Uncertainty is a situation with an outcome about which a person has no knowledge.	Risk is a situation in which he possesses some objectives information about what the outcome might be. Risk exposure can be valued either positively or negatively.	Webb (2003)
Risk is a possibility of loss or injury.	Darnall and Preston (2010) Q	
Risk is exposure to the consequences of uncertainty.	Cooper et al. (2005)	

All risk definitions compiled in Table 2 describe risk as a situation where lack of some aspect can cause a threat to the project. Lack of information and knowledge are those factors which are most commonly mentioned by all the authors as leading reasons for a failure. The description provided by Clenden (2009) will best fit the purpose of this paper; it concerns how risk is defined as a gap in knowledge which, if not handled correctly, will constitute a threat to the project.

Uncertainty is defined in a more abstract way. The descriptions provided in Table 2 are similar to each other and the common factor is again lack

of information and knowledge. The biggest difference by definition is awareness. For the purpose of this thesis, the definition of uncertainty provided by Cleden (2009) will be used. These two chosen definitions best show the difference between risk and uncertainty and help to be consistent with terminology in the paper.

Darnall and Preston (2010) find some of the risks to be predictable and easy to identify before they occur, while the others are unforeseeable and can result in unexpected time delays or additional costs. This statement finds confirmation in the definition provided by Cleden (2009) who uses the same arguments defining uncertainty as rather unpredicted, unforeseeable events, while risk should be possible to foresee. The overview of definitions which can be found in literature regarding those two terms implies that uncertainty is a broad concept and risk is a part of it. This confirms close relation between those two concepts but at the same time distinguishes them.

In the following chapters, the focus is on risk itself and how it should be handled. Uncertainty is not a tangible term and thus will not be further developed in the paper.

3.10- Risks in The PLC

To make sure that everybody connected with a project is aware what a risk is, one common definition should be drawn up for the purpose of the particular project. To quantify identified risks, Westland (2006) uses a tool where likelihood of occurring risk is rated. This method is described later in this paper along with other assessment models, in the section 2.5.2.2. When risk plan is completed the risk management process execution starts, which is a tool to track and control previously identified risks (Westland, 2006).

Risks are associated with every project and should be identified in order to avoid negative impacts on the overall performance. Many problems which are faced in later phases of the PLC result from unmanaged risks from the earlier stage (Chapman and Ward, 2003). This indicates how important it is to carry out accurate analysis especially in an initial phase of a project. Raz et al. (2002) perceive RM as a process which starts at project definition and continues through planning, execution, control and closure phase. However, a study conducted by Lyons and Skitmore (2002) proves that planning and execution are the two phases where RM is most widely used. In contrast, Elkington and Sallman (2002) found that the conceptualization phase is the most important in the RMP.

Westland (2006) identifies project steps where more attention should be directed toward risk management. In the initial project phase, the feasibility study is undertaken, which is a thorough analysis of a project proposal. At this stage, a number of solutions are identified and assessed and the study is conducted to identify potential risks associated with proposed solutions. Further in the planning phase, a risk plan is drawn up where potential risks related to project planning are identified. All the stakeholders should contribute in drawing up this plan to make sure that every potential risk has been identified. In addition to identifying risk, the risk plan assigns the type of action which should be taken in order to respond to a particular problem. Performing this stage in the planning phase aims at mitigating risk before the execution phase, during which any occurring risk is very costly if no action is taken in advance (Westland, 2006).

Westland (2006) suggests that risk assessment should be performed during the review of each phase of the PLC. At the beginning of a project, a high level of uncertainty is expected which decreases along with project progress. Doubts which rise at any point make it necessary to go back and

revise controversial issues from their origin. Such a procedure will require going back to previous steps and discussing them with the new assumptions. While making decisions while moving further in the PLC raises a need for adjustments in previous steps. In other words, decisions made at a certain point of time may result in changing concepts of steps further up in the PLC which were made at the initial phase.

In the execution phase of the PLC, monitoring and control are performed in order to make sure that the process is going according to the plan and all identified risks are being handled. Such monitoring should be done under the whole project process, starting with the point in time when the risks were recognized. At the project closure, where the whole project is summarized, the project's objectives, benefits and deliverables are evaluated. All parties then have a chance to list all activities or risks which were not fully managed within the project. Those unmanaged risks can be a subject of further discussion and be used as warning for next projects (Westland, 2006).

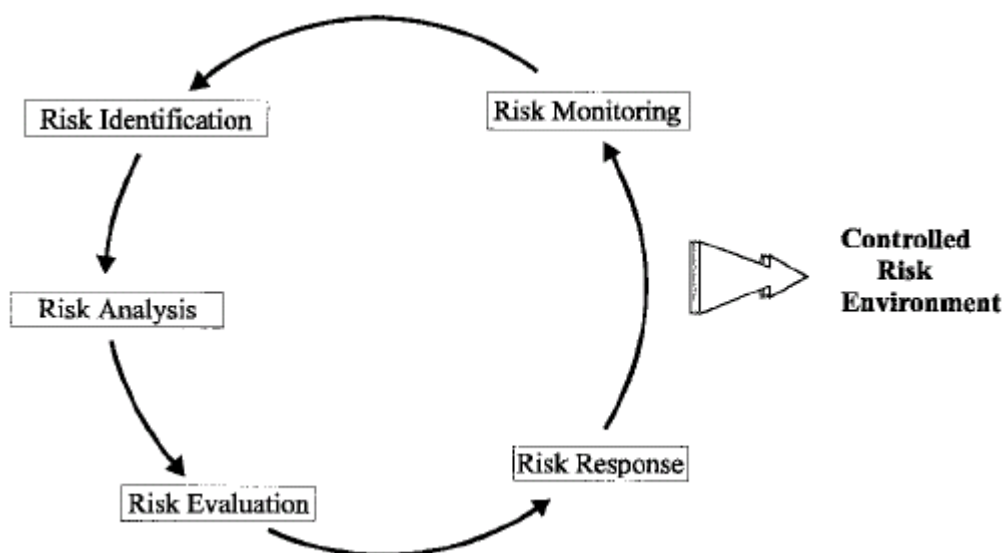


Figure (7): Risk Management Lifecycle

3.11- Benefits With Risk Management

To maximize the efficiency of risk management, the RMP should be continuously developed during the entire project. In this way, risks will be discovered and managed throughout all the phases (Smith et al. 2006). 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. It results from an analysis of project conditions already in the beginning of the project. (Perry, 1986) The risk management also provides a procedure which can reduce possible and sudden surprises (Cooper et al. 2005).

Different attitudes towards risk can be explained as cultural differences between organizations, where the approach depends on the company's policy and their internal procedures (Webb, 2003). Within the RM, three company's approaches can be distinguished.

The first one is the risk-natural firm which does not invest much in risk management but is still aware of the most important risks. The second approach is the risk-averse, where no investments are made in order to reduce the probability of occurrence of risk. The last one is the risk-seeker where the organization is prepared to face all risks and is often called gambler. In the long term, the risk-seeking companies can get a lower profitability compared to risk-natural firms. This is because of the large investments and losses when repeating the risk management processes over and over again to ensure all risks have been managed before the risks actually occurs (Winch, 2002)

3.12- Executive Summary

Risk is defined as an event that has a probability of occurring, and could have either a positive or negative impact to a project should that risk occur. A risk may have one or more causes and, if it occurs, one or more impacts. For example, a cause may be requiring an environmental permit to do work, or having limited personnel assigned to design the project. The risk event is that the permitting agency may take longer than planned to issue a permit, or the assigned personnel available and assigned may not be adequate for the activity. If either of these uncertain events occurs, there may be an impact on the project cost, schedule or performance. All projects assume some element of risk, and it's through risk management where tools and techniques are applied to monitor and track those events that have the potential to impact the outcome of a project.

Risk management is an ongoing process that continues through the life of a project. It includes processes for risk management planning, identification,

analysis, monitoring and control. Many of these processes are updated throughout the project lifecycle as new risks can be identified at any time. It's the objective of risk management to decrease the probability and impact of events adverse to the project. On the other hand, any event that could have a positive impact should be exploited.

The identification of risk normally starts before the project is initiated, and the number of risks increase as the project matures through the lifecycle.

When a risk is identified, it's first assessed to ascertain the probability of occurring, the degree of impact to the schedule, scope, cost, and quality, and then prioritized.

Risk events may impact only one or while others may impact the project in multiple impact categories.

The probability of occurrence, number of categories impacted and the degree (high, medium, low) to which they impact the project will be the basis for assigning the risk priority. All identifiable risks should be entered into a risk register, and documented as a risk statement.

As part of documenting a risk, two other important items need to be addressed.

The first is mitigation steps that can be taken to lessen the probability of the event occurring.

The second is a contingency plan, or a series of activities that should take place either prior to, or when the event occurs. Mitigation actions frequently have a cost.

Sometimes the cost of mitigating the risk can exceed the cost of assuming the risk and incurring the consequences. It is important to evaluate the probability and impact of each risk against the mitigation strategy cost before deciding to implement a contingency plan. Contingency plans implemented prior to the risk occurring are pre-emptive actions intended to reduce the impact or remove the risk in its entirety. Contingency plans implemented after a risk occurs can usually only lessen the impact.

Identifying and documenting events that pose a risk to the outcome of a project is just the first step.

It is equally important to monitor all risks on a scheduled basis by a risk management team, and reported on in the project status report.

3.13- Risk Management Strategy

3.13.1- Risk Identification

A risk is any event that could prevent the project from progressing as planned, or from successful completion. Risks can be identified from a number of different sources.

Some may be quite obvious and will be identified prior to project kickoff. Others will be identified during the project lifecycle, and a risk can be identified by anyone associated with the project. Some risk will be inherent to the project itself, while others will be the result of external influences that are completely outside the control of the project team.

The Interoperability Montana Project Directors (IMPD) have overall responsibility for managing project risk. As the IM Project Manager, Mark Adams has been assigned by Northrop Grumman as the person responsible for administering risk management processes and activities for the IM project.

Throughout all phases of the project, a specific topic of discussion will be risk identification. The intent is to instruct the project team in the need for risk awareness, identification, documentation and communication.

Risk awareness requires that every project team member be aware of what constitutes a risk to the project, and being sensitive to specific events or factors that could potentially impact the project in a positive or negative way.

Risk identification consists of determining which risks are likely to affect the project and documenting the characteristics of each.

Risk communication involves bringing risk factors or events to the attention of the project manager and project team.

The Northrop Grumman project manager will identify and document known risk factors during creation of the Risk Register.

It is the Northrop Grumman project manager's responsibility to assist the IMPD and other stakeholders with risk identification, and to document the known and potential risks in the Risk Register. Updates to the risk register will occur as risk factors change. Risk management will be a topic of discussion during the monthly project IMPD meeting.

The Northrop Grumman project team will discuss any new risk factors or events, and these will be reviewed with the Northrop Grumman project manager.

The project manager will determine if any of the newly identified risk factors or events warrant further evaluation. Those that do will undergo risk quantification

and risk response development, as appropriate, and the action item will be closed. At any time during the project, any risk factors or events should be brought to the attention of the Northrop Grumman project manager using Email or some other form of written communication to document the item. The project manager is responsible for logging the risk to the Risk Register. Notification of a new risk should include the following Risk Register elements:

□ Description of the risk factor or event, e.g. conflicting project or operational initiatives that place demands on project resources, design errors or omissions, weather, construction delays, etc. that the event will occur. For example, a 50% chance that the vendor will not have staff available to pour the cement. Schedule Impact. The number of hours, days, week, or months that risk factor could impact the schedule. As an example, the fires which have resulted in level 3 restrictions are likely to delay installation of the shelter and generator for 2 weeks. Scope Impact. The impact the risk will have on the envisioned accomplishments of the project. Extreme weather conditions may result in a reduction in the number of tower sites that can be completed.

Quality Impact. A risk event may result in a reduction in the quality of work or products that are developed. As an example, lack of funding caused by construction cost overruns may result in the purchase of only one cooling unit rather than the planned number of two □ Cost Impact. The impact the risk event, if it occurs is likely to have on the project budget.

3.13.2- Risk Responsibilities

The responsibility for managing risk is shared amongst all the stakeholders of the project.

However, decision authority for selecting whether to proceed with mitigation strategies and implement contingency actions, especially those that have an associated cost or resource requirement rest with the IMPD. The following tables details specific responsibilities for the different aspects of risk management.

Table (3):Risk Activity Responsibility

RISK ACTIVITY	RESPONSIBILITY
Risk Identification	All project stakeholders
Risk Registry	Project Manager
Risk Assessment	All project stakeholders
Risk Statements	Project Manager(s), IMTC
Risk Response Options Identification	All project stakeholders
Risk Response Approval	IMTC (recommendation) IMPD (approval)
Risk Contingency Planning	Project Manager(s)
Risk Response Management	Project Managers
Risk Reporting	Project Manager

3.13.3- Risk Assessment

Risk assessment is the act of determining the probability that a risk will occur and the impact that event would have, should it occur. This is basically a “cause and effect” analysis.

The “cause” is the event that might occur, while the “effect” is the potential impact to a project, should the event occur.

Assessment of a risk involves two factors. First is the probability which is the measure of certainty that an event, or risk, will occur. This can be measured in a number of ways, but for the IM project will be assigned a probability percentage for 1% to 100%. A risk with no probability of occurring will obviously pose no threat, while a risk of 100% means the risk event has occurred.

The second factor is estimate of the impact on the project. This can be a somewhat subjective assessment, but should be quantified whenever possible. The estimated cost, the duration of the potential delay, the changes in scope and the reduction in quality are in most cases factors that can be estimated and documented in the risk statement and then measured using the standard project management tools (i.e. project plan, budget, statements of work). Rather than detailed impact estimates the Risk Register contains three ratings for impact; High, Medium and Low. This makes it easier to compare one risk to another and assign priorities. For each of the impact categories the impact is assessed as follows:

□ Cost – This impact is usually estimated as a dollar amount that has a direct impact to the project. However, cost is sometimes estimated and reported as simply additional resources, equipment, etc.

This is true whenever these additional resources will not result in a direct financial impact to the project due to the fact the resources are loaned or

volunteer, the equipment is currently idle and there is no cost of use, or there are other types of donations that won't impact the project budget. Regardless of whether there is a direct cost, the additional resources should be documented in the risk statement as part of the mitigation cost.

□ Scope – Whenever there is the potential that the final product will not be completed as originally envisioned there is a scope impact. Scope impact could be measured as a reduction of the number of tower sites, elimination of trunking for a site, or not providing a back-up power source.

□ Schedule – It is very important to estimate the schedule impact of a risk event as this often results is the basis for elevating the other impact categories.

Schedule delays frequently result in cost increases and may result in a reduction of scope or quality. Schedule delays may or may not impact the critical path of the project and an associated push out of the final end date. As an example, a road wash-out for a tower site might delay completion of that site for 3 weeks, but if another site is scheduled to complete after delayed site, the 3 week delay won't impact the final end date.

□ Quality – Quality is frequently overlooked as an impact category and too often a reduction in quality is the preferred choice for mitigation of a risk. “Short cuts” and “low cost replacements” are ways of reducing cost impacts. If not documented appropriately and approved by the project sponsor, mitigation strategies that rely upon a reduction in quality can result in significant disappointment by the stakeholders.

Most risks will be assigned one category, but some might be assigned more than one, or all.

Appendix A - Sample Risk Register

Interoperability Montana - Risk Assessment								
Priority	Title	Description	Probability of Impact	Schedule	Scope	Quality	Cost	Activity Since Last Report
1	Procurement Process	Land use agreements approved by DES Site users agreements NEPAs Pre-award letters.	100%	High	High	High	High	> We currently have no procurement vehicle due to an issue with MCA building code interpretation. This is halting improvements on all IM sites requiring upgrades. > The mitigation strategy for procurement is to move it to DoA.
2	Funding	If delays in procurement occur due to processes and procedures, funding may be lost.	95%	High	High	High	High	> There is not an accurate accounting of the available funding that encompasses all funding sources. > The IMPD and IMTC cannot make decisions about the scope and priorities of the project without an accurate understanding of the available funding. > To mitigate this problem, a spreadsheet has been developed and requests for financial information has been issued to each of the funding sources.
3	Frequency Acquisition	Effective, timely, and managed frequency acquisition.	90%	High	High	High	High	> The Frequency Subcommittee continues to struggle as a funding request for contracted resources has not been approved.
4	Incomplete Governance definition	Confusion among participants of roles and decision-making authority. - DES - PSSB - NG - DOT - MHP Task Team	85%	Medium	Medium	Low	Medium	> The Governance Committee continues to meet regularly. Progress is reported at the monthly IMPD. > Discussions have begun about how to complete the Interoperability Communications Plan which is required by Nov. 1, 2007 > There has not been an official designation of either an interim or permanent Executive Director for the project.
5	Volunteer Workforce	Availability of the right people at the right time, and the fact that so many are volunteers.	75%	High	Medium	Medium	High	> The Frequency Subcommittee continues to struggle as a funding request for contracted resources has not been approved. > The Backbone Design document is completed and being critiqued by the IMTC and others.

Appendix B - Sample Risk Statement Form

NORTHROP GRUMMAN		NORTHERN TIER INTEROPERABILITY PROJECT	
RISK STATEMENT			
Risk ID:	1	Title:	Lead Times for Towers and Shelters
Date Identified:	3/2/2006	Category:	Schedule
Owner:	Adams	Probability:	High
		Schedule Impact:	High
Description:	There is a six to eight week lead time on towers and shelters. This has the potential for causing delays and not meeting scheduled completion dates		
Impacts			
Project Milestones:	For those sites where this is an issue, site completion milestones could be delayed, which could also delay the overall completion of the NTIP.		
Schedule:	If lead times are properly accounted for, any tasks or activities that are dependent on the installation of towers and shelters will be delayed. It is possible, that overall completion delays could be averted through proper planning and redeployment of resources to other tasks during the lead time.		
Mitigation & Contingency Plans			
Mitigation:	1. Identify those sites where this is a potential problem. 2. Plan accordingly, and proceed with ordering towers and shelters if there is minimum risk of doing so. 3. If delays occur, redeploy efforts to other sites. 4. For those sites that may be effected, have contingencies plans in place by knowing what other sites to assign resources to mitigate overall project completion slippages. 5. Explore opportunities for reducing lead times.		
Estimated Mitigation Cost:			
Contingency:	1. Reallocate installation resources to others sites that are in a position to proceed. 2. Execute tasks out of order if dependencies permit.		
Start Trigger:	1. Delivery times extend beyond scheduled start dates for installation. 2. Delays in finalizing design specifications has extended beyond planned order dates.		
Stop Trigger:	1. Schedules revised to reflect new delivery and installation dates. 2. Work is diverted to other sites to offset site delays.		

3.13.4- Risk Response

For each identified risk, a response must be identified. It is the responsibility of the IMPD

to select a risk response for each risk. The IMPD will need the best possible assessment of the risk and description of the response options in order to select the right response for each risk. The probability of the risk event occurring and the impacts will be the basis for determining the degree to which the actions to mitigate the risk should be taken. One way of evaluating mitigation strategies is to multiply the risk cost times the probability of occurrence. Mitigation strategies that cost less than risk probability calculation should be given serious consideration. The possible response options are:

- ☐ Avoidance – Change the project to avoid the risk. Change scope, objectives, etc.
- ☐ Transference – Shift the impact of a risk to a third party (like a subcontractor).

It does not eliminate it, it simply shifts responsibility.

- ☐ Mitigation – Take steps to reduce the probability and/or impact of a risk.

Taking early action, close monitoring, more testing, etc.

- ☐ Acceptance – Simply accept that this is a risk. When choosing acceptance as a response the IMPD is stating that given the probability of occurring and the associated impact to the project that results, they are not going to take any actions and will accept the cost, schedule, scope, and quality impacts if the risk event occurs.

- ☐ Deferred – A determination of how to address this risk will be addressed at a later time.

The results of the risk assessment process are documented in each Risk Statement and summarized in the Risk Register which will be reported on a monthly basis.

3.13.5- Risk Mitigation

Risk mitigation involves two steps:

- ☐ Identifying the various activities, or steps, to reduce the probability and/or impact of an adverse risk.
- ☐ Creation of a Contingency Plan to deal with the risk should it occur.

Taking early steps to reduce the probability of an adverse risk occurring may be more effective and less costly than repairing the damage after a risk has occurred. However, some risk mitigation options may simply be too costly in time or money to consider.

Mitigation activities should be documented in the Risk Register, and reviewed on a regular basis. They include:

- ☐ Identification of potential failure points for each risk mitigation solution.
- ☐ For each failure point, document the event that would raise a “flag” indicating that the event or factor has occurred or reached a critical condition.
- ☐ For each failure point, provide alternatives for correcting the failure.

Cec4

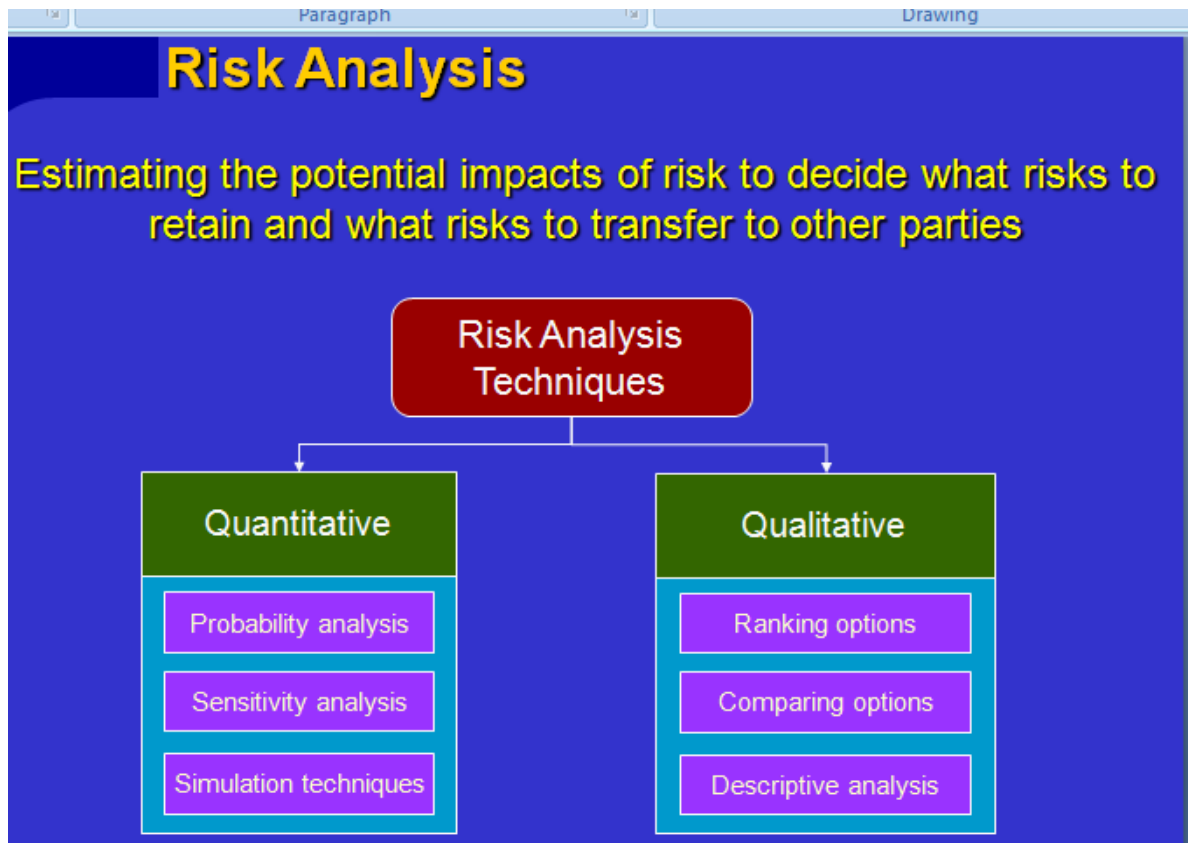


Figure (8) : Risk Analysis Techniques

REFERENCE. NO.8

3.14-Risk Contingency Planning

Contingency planning is the act of preparing a plan, or a series of activities, should an adverse risk occur. Having a contingency plan in place forces the project team to think in advance as to a course of action if a risk event takes place.

- ☐ Identify the contingency plan tasks (or steps) that can be performed to implement the mitigation strategy.
- ☐ Identify the necessary resources such as money, equipment and labor.

- Develop a contingency plan schedule. Since the date the plan will be implemented is unknown, this schedule will be in the format of day 1, day 2, day 3, etc., rather than containing specific start and end dates.
- Define emergency notification and escalation procedures, if appropriate.
- Develop contingency plan training materials, if appropriate.
- Review and update contingency plans if necessary.
- Publish the plan(s) and distribute the plan(s) to management and those directly involved in executing the plan(s).

Contingency may also be reflected in the project budget, as a line item to cover unexpected expenses. The amount to budget for contingency may be limited to just the high probability risks. This is normally determined by estimating the cost if a risk occurs, and multiplying it by the probability. For example, assume a risk is estimated to result in an additional cost of \$50,000, and the probability of occurring is 80%. The amount that should be included in the budget for this one item is \$40,000. Associated with a contingency plan, are start triggers and stop triggers. A start trigger is an event that would activate the contingency plan, while a stop trigger is the criteria to resume normal operations. Both should be identified in the Risk Register.

3.15-Tracking and Reporting

As project activities are conducted and completed, risk factors and events will be monitored to determine if in fact trigger events have occurred that would indicate the risk is now a reality.

Based on trigger events that have been documented during the risk analysis and mitigation processes, the IMPD, or Northrop Grumman project managers will have the authority to enact contingency plans as deemed appropriate. Day to day risk mitigation activities will be enacted

and directed by the project managers. Large scale mitigation strategies will be initiated by the IMPD.

Contingency plans that once approved and initiated will be added to the project work plan and be tracked and reported along with all of the other project activities.

Risk management is an ongoing activity that will continue throughout the life of the project. This process includes continued activities of risk identification, risk assessment, planning for newly identified risks, monitoring trigger conditions and contingency plans, and risk reporting on a regular basis. Project status reporting contains a section on risk management, where new risks are presented along with any status changes of existing risks. Some risk attributes, such as probability and impact, could change during the life of a project and this should be reported as well.

3.16- Processes to Address Immediate Unforeseen Risks

The individual identifying the risk will immediately notify the IMPD and Northrop

Grumman project managers. The individual notified will assess the risk situation.

If required, the IMPD and Northrop Grumman project managers will identify a mitigating strategy, and assign resources as necessary.

The project risk manager will document the risk factor and the mitigating strategy.

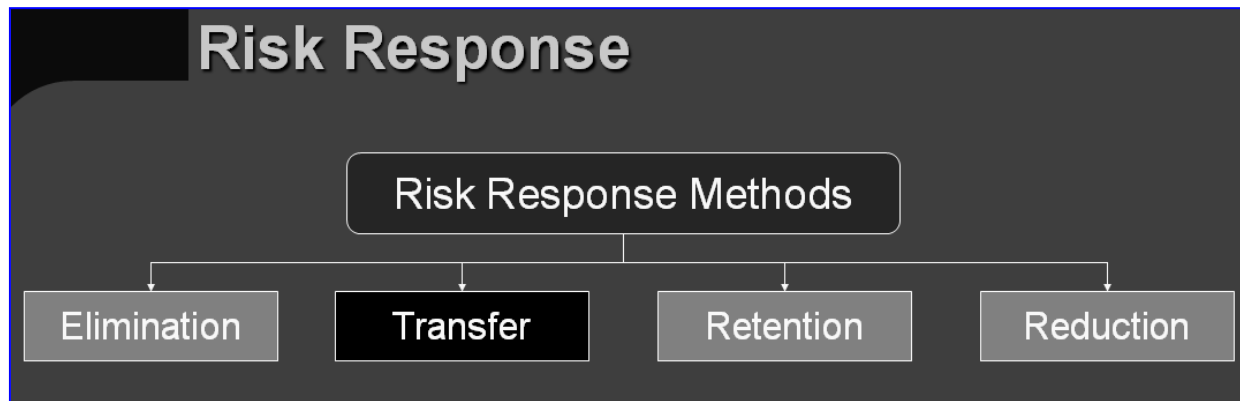


Figure (9) : Risk Response

REFERENCE. NO.8

Risk Elimination Practices

- ✓ Tendering a very high bid
- ✓ Placing conditions on the bid
- ✓ Pre-contract negotiations as to which party takes certain risks
- ✓ Not bidding on the high risk portion of the contract

Risk Transfer

- ✓ Two basic forms.
- ✓ (a) The activity responsible for the risk may be transferred, i.e.
hire a
subcontractor to work on a hazardous process
- ✓ (b) The activity may be retained, but the financial risk transferred, i.e. methods such as insurance.

Risk Retention

- ✓ Handling risks by the company who is undertaking the project.

- ✓ Two retention methods, *active* and *passive*.
- ✓ **Active retention** is a deliberate management strategy after a conscious evaluation of the possible losses and costs of alternative ways of handling risks.
- ✓ **Passive retention** occurs through negligence, ignorance or absence of decision.

Risk Reduction

- ✓ Continuous effort.
- ✓ Related with improvements of a company's physical, procedural, educational, and training devices.
- ✓ Improving housekeeping, maintenance, first aid procedures and security.
- ✓ Education and training within every department .

3.17- Managing RISK

Since the project manager is responsible for project success, he or she can increase the likelihood of success by better managing risks

Risk management is a proactive approach to dealing with uncertainties rather than a reactive approach

Some risks can be disregarded and some can be avoided, but others should be planned for

"No construction project is risk free.

Risk can be managed, minimized , shared, transferred, or accepted

It cannot be ignored."

Risk management - The commercial imperative

Sir Michael Latham 1994

- Project risks include....

- Quality and safety
- Cost management
- Time management (programme / schedule)
- Scope & change management
- Procurement & contracts
- People management
- Information management
- External influences
- What happens if it is ignored?
- Increased costs
- Loss or reduction in profit
- Damage to brand / reputation; and at worst
- Disposal of the business or insolvency
- How do you manage the risks?
- Identification
- Assessment / quantification
- Reduction
- Implementation
- Monitoring

3.18- Project Risk Management

Approach

Project controls

- Project controls
- Policies and procedures to ensure the efficient coordination, monitoring and management of a project
- What do project controls include?
- Communication
- Roles and responsibilities...

Project controls

- Risks change throughout the project lifecycle and the controls need to match
- Risk and uncertainty poses opportunities as well as challenges
- Cost, time and quality impacts need to be considered together
- Can consider them in ‘function’

Groups

- Each area of the project is analysed to identify ...
- Risks
- Control procedures
- Monitoring controls

Project controls – daily project management process

- Risks
- Lack of knowledge of project tracking
- Failure to recognise and develop responses to risk and opportunity
- Lack of timely resolution of issues as raised by various stakeholders
- Claims
- Contract administration
- Lack of compliance with project requirements
- Unnecessary legal liabilities or loss of entitlement
- Control procedures
- Project management plan
- Risk and opportunity registers

- Issues registers
- Clear documentation of contract procedures and the like
- Regular, documented meetings to consider key risks
- Monitoring controls
- Compliance to prescribed policy and procedures
- Regular project status meetings to review action list and responsibilities as agreed
- Regular formal assurance and expediting reports
- Formal up-to-date project management tools incorporating current information/issues and “as built” information

Project controls -summary

- Project risk management is important to your business as a whole
- Project controls provide a framework to manage the project
- Project controls cover a full spectrum including,
 - Risks
 - Cost and schedule forecasting
 - Business needs

Project controls -summary

But are yours comprehensive?

- Will it stand up to Internal

Audit scrutiny by your business?

- Are records suitable for dispute resolution?
- Does the process have the knowledge or is it with the staff?

- Risks

A systematic approach to control the level of risk to mitigate its effects.

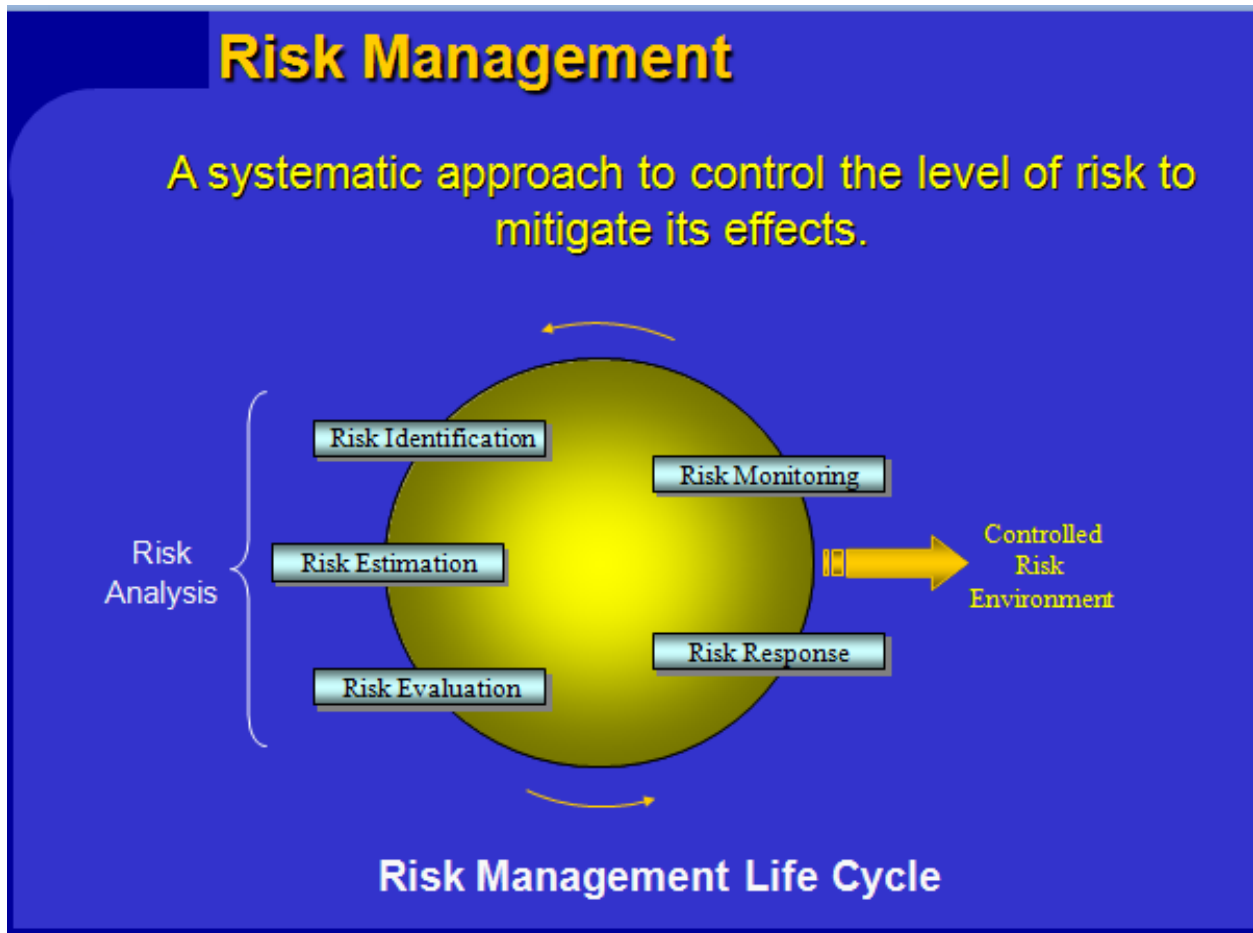


Figure (10) : Risk Management Life Cycle

REFERENCE. NO.8

Risk Managers must monitor activities and processes to determine the accuracy of planning assumptions and the effectiveness of the measures taken to treat the risk.

Methods can include data evaluation, audit, compliance measurement.

Why you should use Risk Management:

The process helps Administrations focus on priorities and in decisions on deploying limited resources to deal with the highest risks.



Figure (11) : Risk in Construction

REFERENCE. NO.8

Chapter Four

Data Analysis

Chapter IV

Data Analysis

4.1- Introduction

This chapter is divided into three parts ; (1,2&3),it analyses the data that explains the different knowledge and experience of the respondents that might have an impact on their answers. This data is represented by the collected from the answers of respondents for questions in sections 1,2 and 3 of the questionnaire.

4.2- Respondents' experience

This section presents general information about respondents of this survey. So its aim is to give an image of the strength of respondents' experience, therefore it indicates the degree of accuracy of the data that provided by them.

1-Part one:

1.1-Academic Qualification:

Chart(1) indicates the number of professionals who participated in this survey. The respondent was asked to select his or her academic qualification .

1.1- Academic Qualification

Frequencies

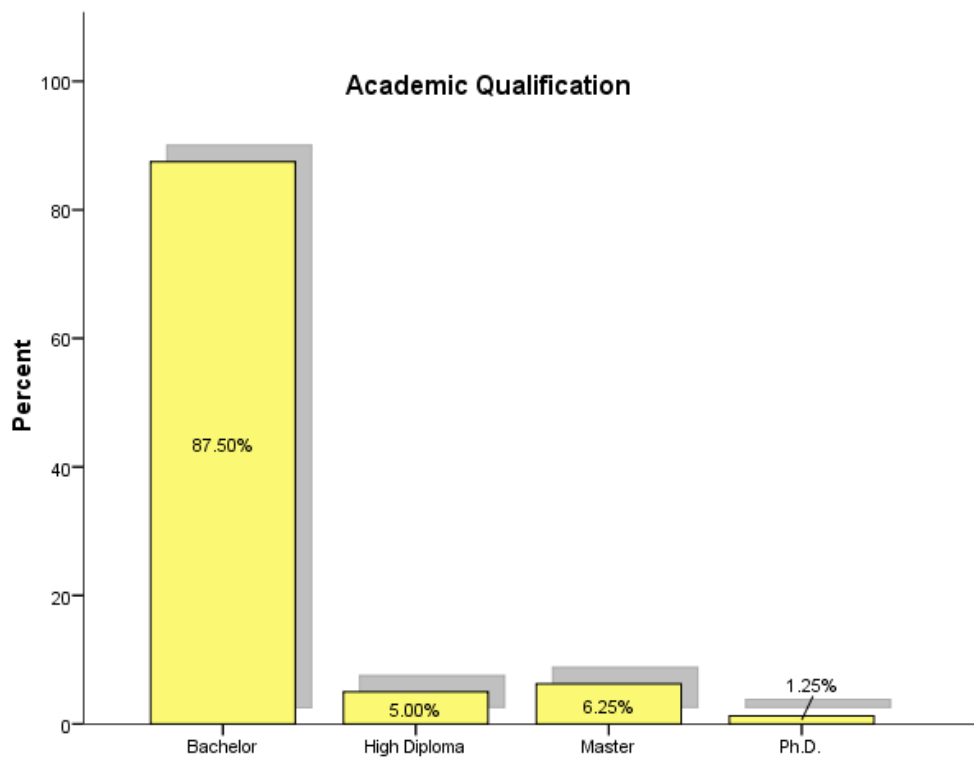
Statistics

Academic Qualification

N	Valid	80
	Missing	1

Academic Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	70	86.4	87.5	87.5
	High Diploma	4	4.9	5.0	92.5
	Master	5	6.2	6.3	98.8
	Ph.D.	1	1.2	1.3	100.0
	Total	80	98.8	100.0	
Missing	System	1	1.2		
	Total	81	100.0		



1.2-Years of experience:

The participants have been asked; How long have you been dealing with construction projects?

The experience of the audience is well distributed so the sample have an experience ranging between 5-15 years which represent a good level of knowledge .

Years of experience

Frequencies

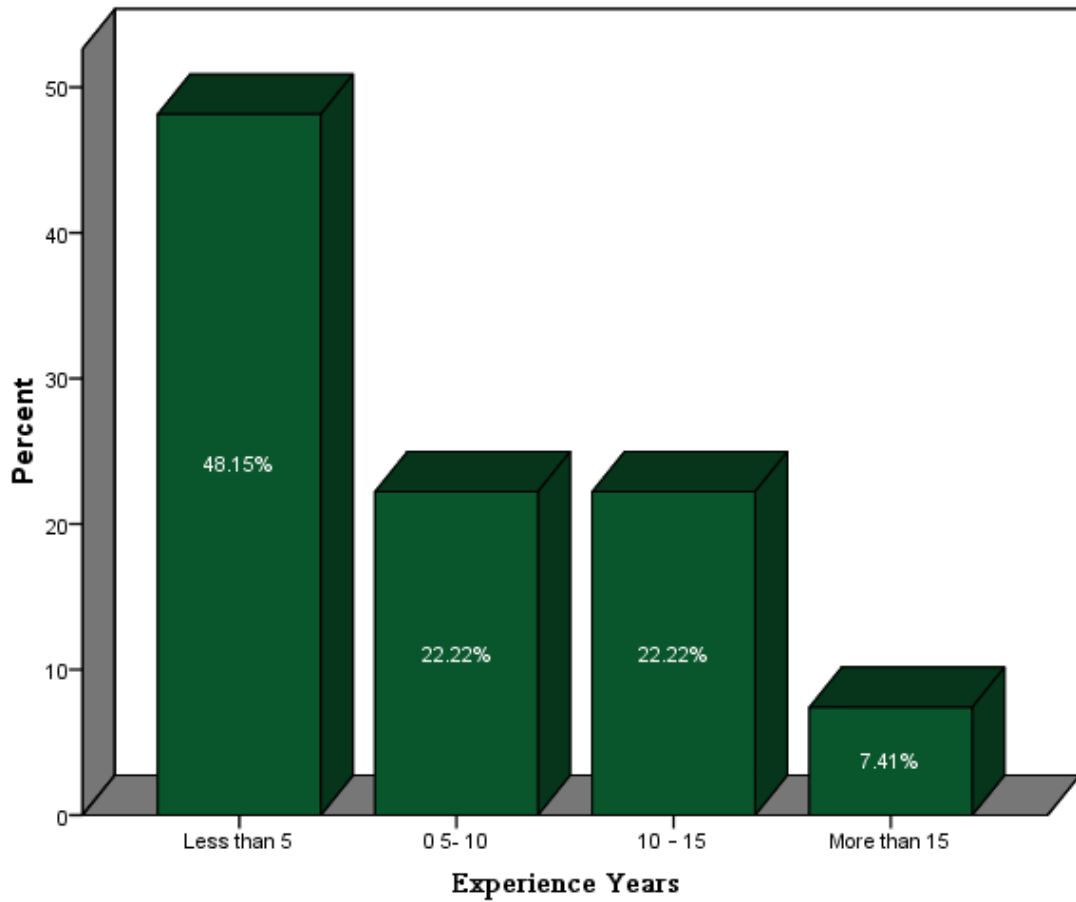
Statistics

Years of experience

N	Valid	81
	Missing	0

Years of experience

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 Year	39	48.1	48.1	48.1
05 – 10	18	22.2	22.2	70.4
Valid 10 – 15	18	22.2	22.2	92.6
More than 15 Year	6	7.4	7.4	100.0
Total	81	100.0	100.0	



The respondents were asked to determine their specialization .chart(3) shows that 45.68% of respondents are civil ,41.98% are architecture and 12.35% other mentioned.

As mostly the construction industry depends on civil and architectural work, the two sectors were represented in the sample adequately

1.3-Specialization

Frequencies

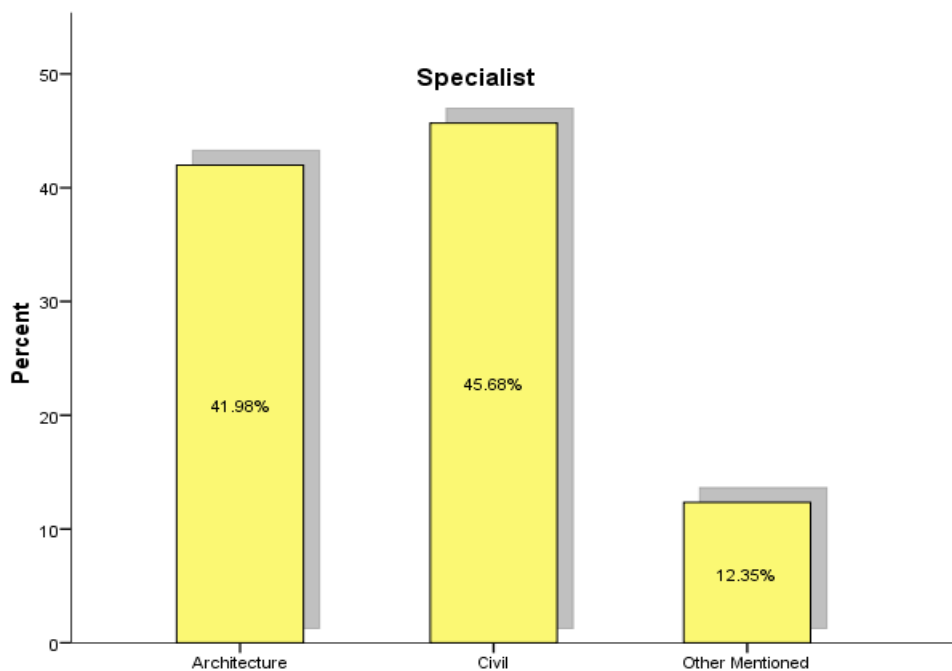
Statistics

Specialist

N	Valid	81
	Missing	0

Specialist

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Architecture	34	41.98	42.0	42.0
Civil	37	45.68	45.7	87.7
Other Mentioned	10	12.35	12.3	100.0
Total	81	100	100.0	



1.4-Occupation:

The respondents were asked to tell the occupation type that they work in. chart (4) shows that 21.25 % of respondents are site Eng, 12.50% are resident Eng , 18.75% are project manager and 47.50% are other mentioned.

1.4. Occupation

Frequencies

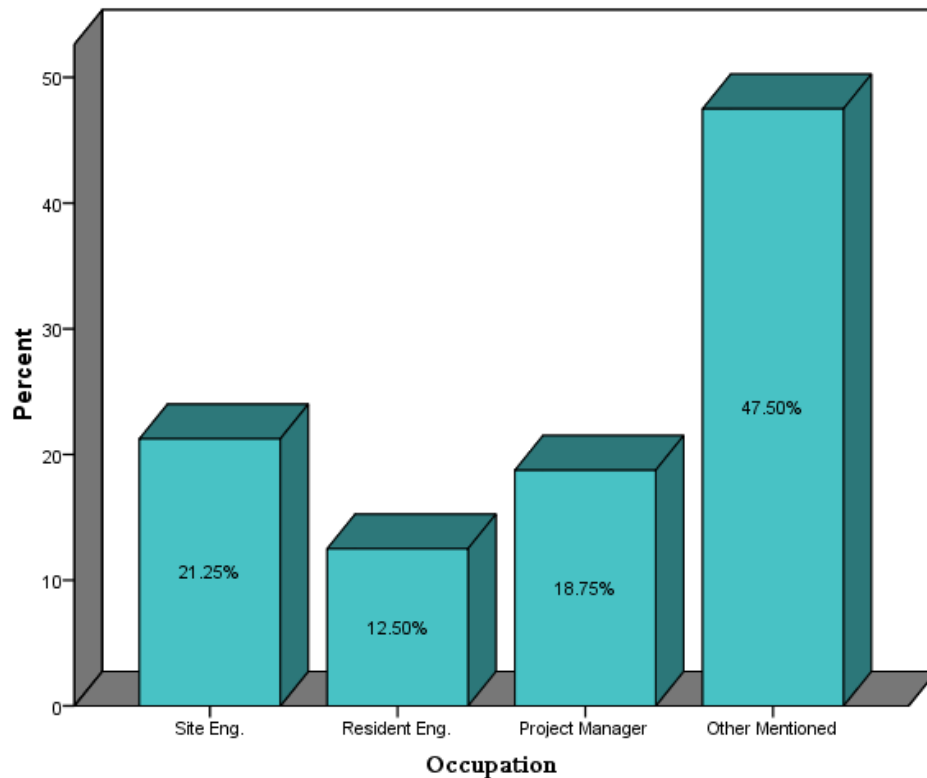
Statistics

Occupation

N	Valid	80
	Missing	1

Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Site Eng.	17	21.0	21.3	21.3
	Resident Eng.	10	12.3	12.5	33.8
	Project Manager	15	18.5	18.8	52.5
	Other Mentioned	38	46.9	47.5	100.0
	Total	80	98.8	100.0	
Missing	System	1	1.2		
	Total	81	100.0		



1.5-Sector type :

The respondents asked to determine the sector type that they work for. Chart (5) shows that 69.14% of respondents are working for the private sector, 29.63% are working for public sector 1.23% are working for both sectors.

The private sector represents the main tool in conducting the construction industry activities, so most of the samples are from this important sector.

Frequencies

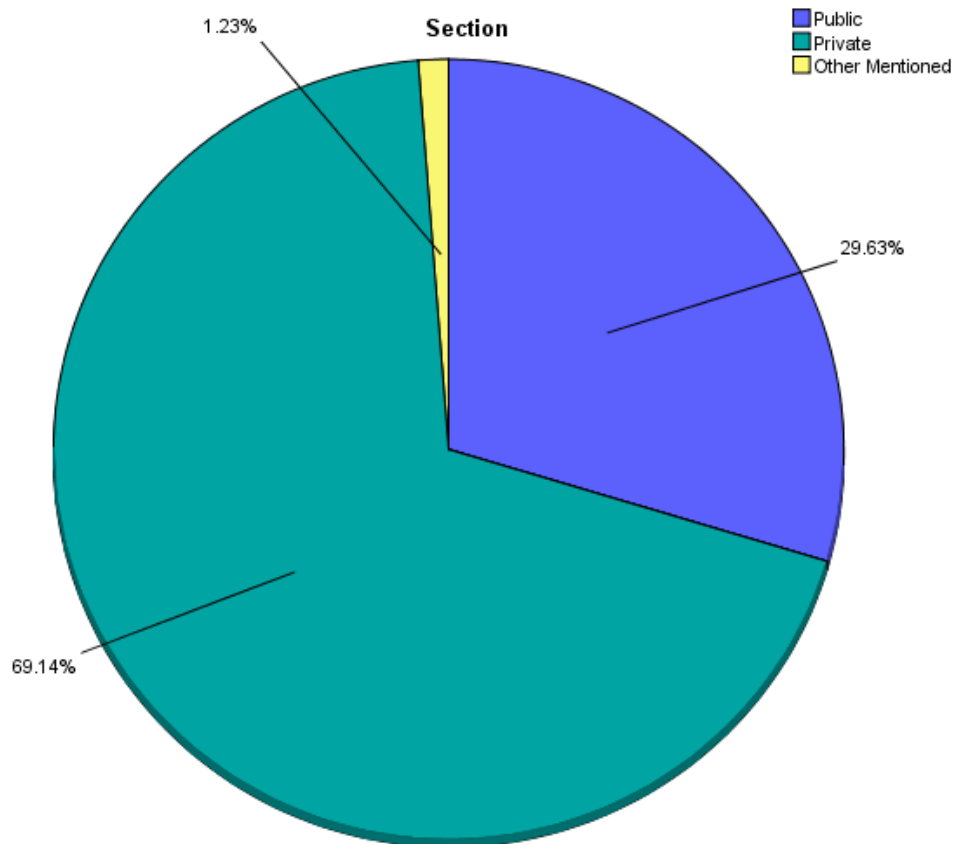
Statistics

Section

N	Valid	81
	Missing	0

Section

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Public	24	29.6	29.6	29.6
Private	56	69.1	69.1	98.8
Other Mentioned	1	1.2	1.2	100.0
Total	81	100.0	100.0	



Part Two:

2.1 -what is the extent of your knowledge about Risk Management Program:

In this part of the questionnaire the respondents were asked ; to mention their extent knowledge about risk management program .chart (6) shows

that 58.02% have weak knowledge ,27.16% have a large knowledge , 7.41% have a very large knowledge and 7.41% don't have knowledge.

The knowledge about risk management is very low which interprets the existence of differences and disputes in this industry. In order to minimize and mitigate this situation the awareness should be increased.

what is the extent of your knowledge about Risk Management Program:

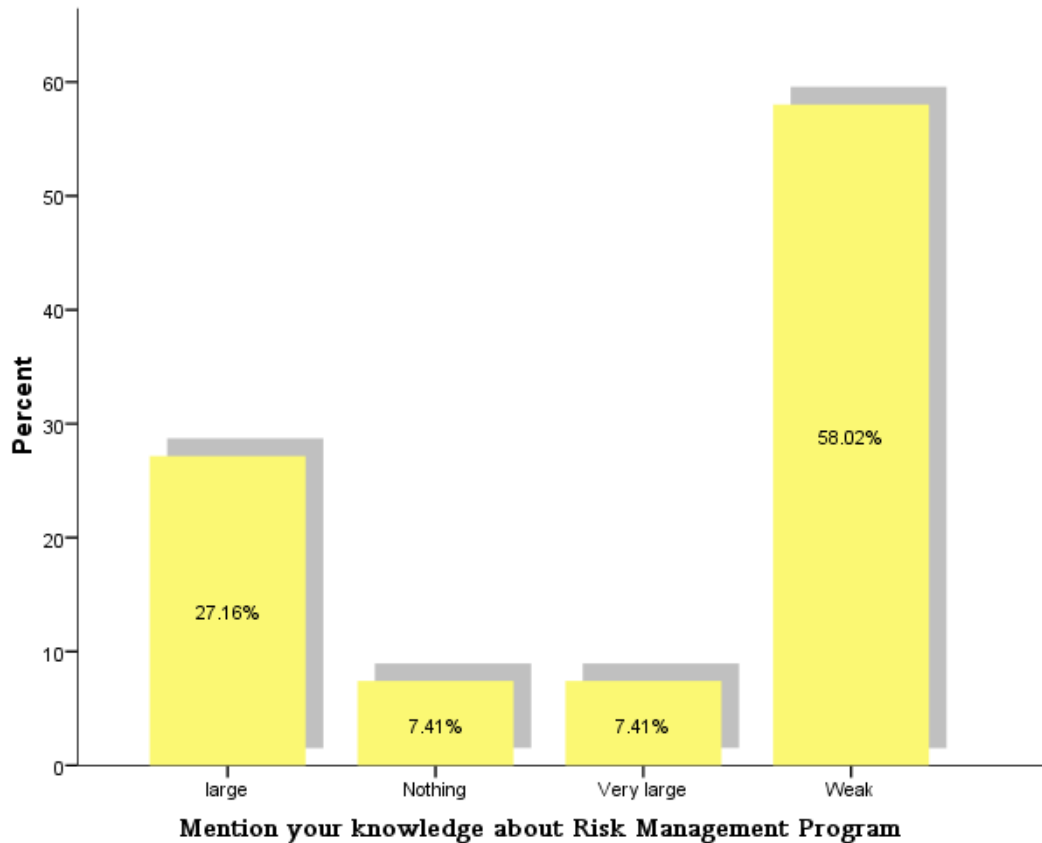
Statistics

what is the extent of your knowledge about Risk management program

N	Valid	81
	Missing	0

what is the extent of your knowledge about Risk Management Program

	Frequency	Percent	Valid Percent	Cumulative Percent
Very large	6	7.41	7.4	7.4
large	22	27.16	27.2	34.6
Valid Weak	47	58.02	58.0	92.6
Nothing	6	7.41	7.4	100.0
Total	81	100.00	100.0	



2.2-Do you think that the projects you participated in, have complexity:

The respondents were asked ; if they think that the projects they participated in ,have complexity .chart (7) shows that 61.73% to some extent ,29.63% agree and 8.64% disagree .

Do you think that the projects you participated in, have complexity:

Frequencies

Statistics

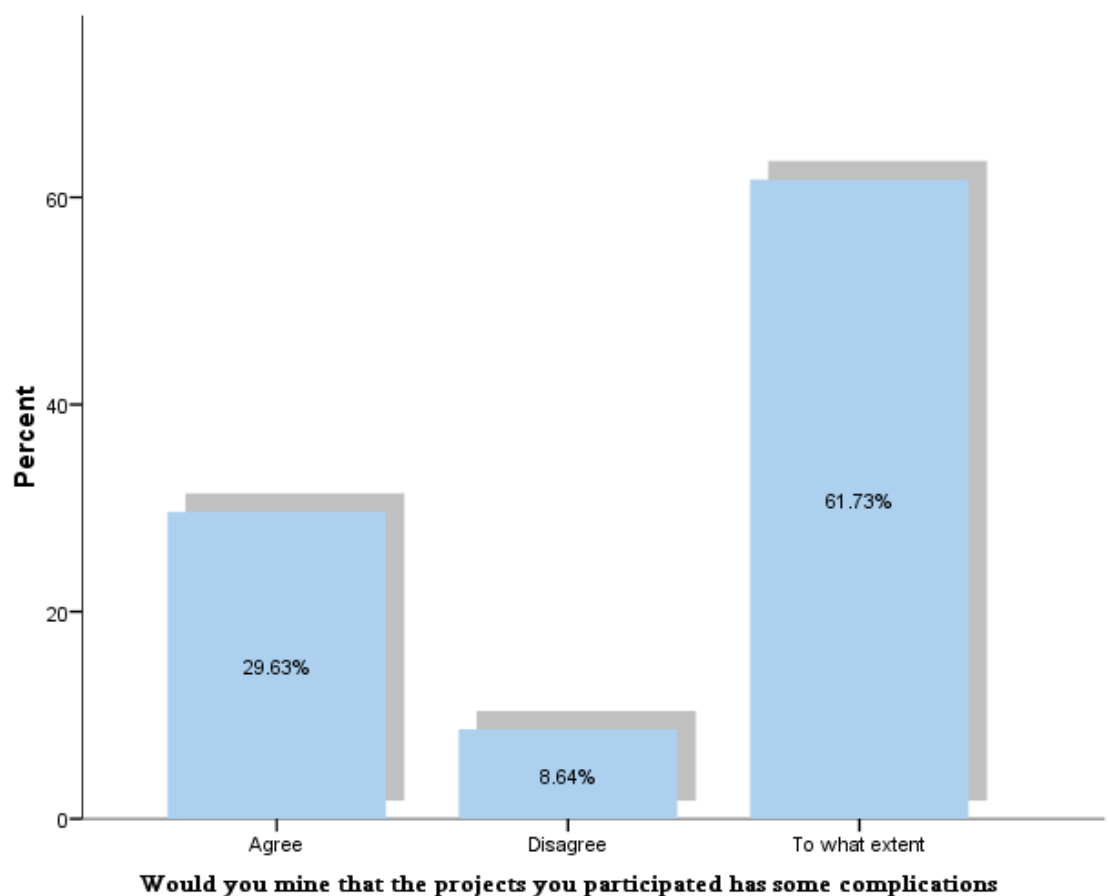
Do you think that the projects you participated in, have complexity

N	Valid	81
	Missing	0

It is a general belief that most of the construction projects are complex. This is highly depends on the way the project documents were presented and the management system applied in the **** project.

Do you think that the projects you participated in, have complexity

	Frequency	Percent	Valid Percent	Cumulative Percent
Agree	24	29.6	29.6	29.6
To what extent	50	61.7	61.7	91.4
Disagree	7	8.6	8.6	100.0
Total	81	100.0	100.0	



2.3-Do you think that risk is considered as a general phenomenon in construction industry in Sudan:

The respondents were asked if they think that risk is considered as a general phenomenon in construction industry in Sudan ; chart (8) shows that the majority of the participants responded about 46.91% strongly agree,29.63% agree , 20.99% to some extent and 2.47% disagree .

This indicates the lake of construction projects in Sudan to the principles of risk management. We found it necessary to apply risk management for effective decisions to achieve projects aims, and this is one of the aims of this research.

As it is agreed that risks are common, it is so vital to adopt suitable principles for managing these risks in order to mitigate their effects on the project outputs.

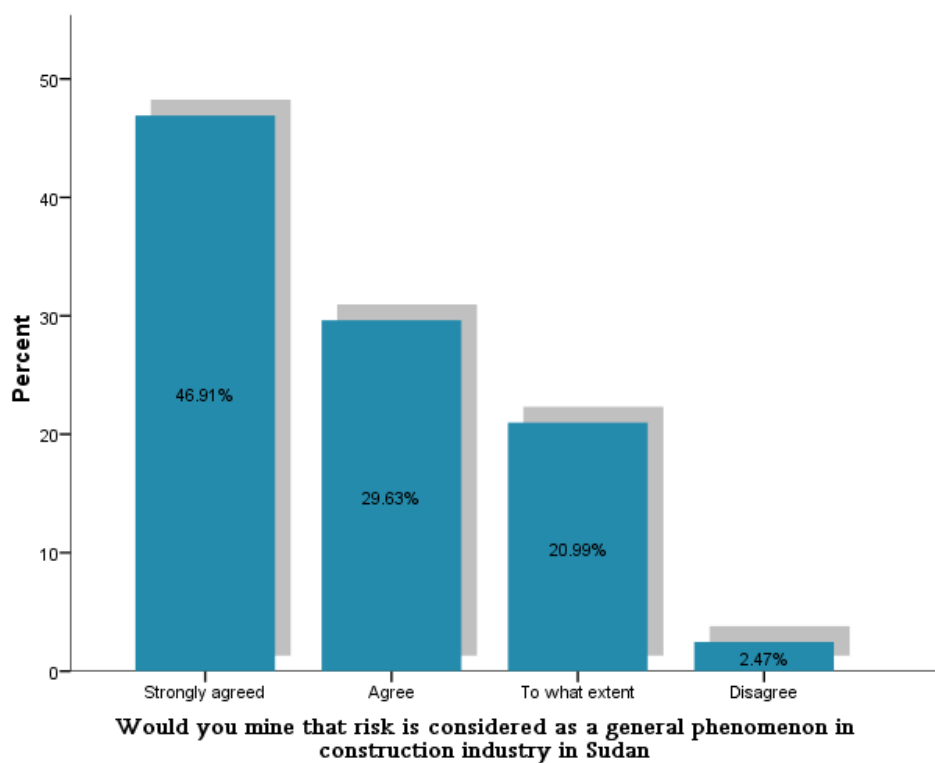
Statistics

Do you think that risk is considered as a general phenomenon in construction industry in Sudan:

N	Valid	81
	Missing	0

Do you think that risk is considered as a general phenomenon in construction industry in Sudan:

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	38	46.9	46.9	46.9
Agree	24	29.6	29.6	76.5
Valid To what extent	17	21.0	21.0	97.5
Disagree	2	2.5	2.5	100.0
Total	81	100.0	100.0	



2.4-Do you think that risk management leads to a reduction and reduce its impact:

The respondents were asked ; if they think that risk management leads to a reduction and reduce its impact .chart (9) shows that the majority of the participants were responded about 62.96% strongly agree ,

28.40% agree, 7.41% to some extent and 1.23% disagree. Therefore, the manager of the project must pay attention to apply the risk management in construction project, to reduce risk effects on the project.

As 80.96% of the audience agree that risk management could lead to a reduction in their effects, it's worth to insure the application of risk management in projects and also in construction entities.

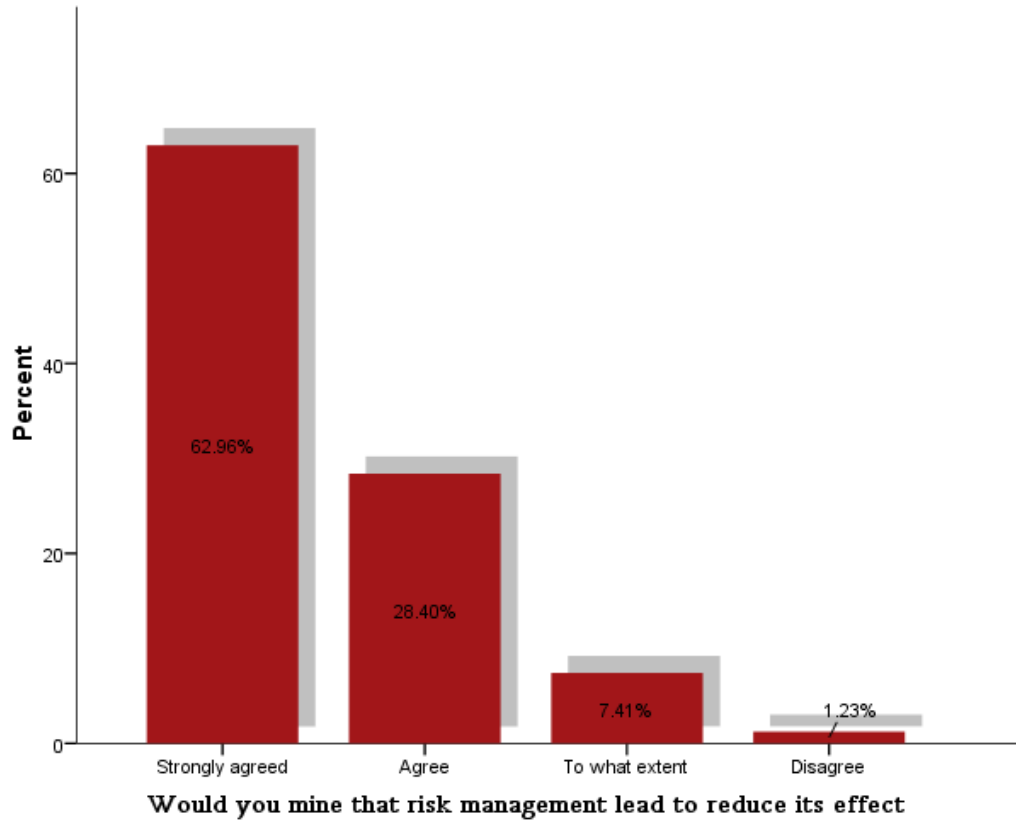
Statistics

.Do you think that risk management leads to a reduction and reduce its impact:

N	Valid	81
	Missing	0

Do you think that risk management leads to a reduction and reduce its impact

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	51	63.0	63.0	63.0
Agree	23	28.4	28.4	91.4
Valid To what extent	6	7.4	7.4	98.8
Disagree	1	1.2	1.2	100.0
Total	81	100.0	100.0	



2.5-Do you agree that there is a strong relation between risk management and making decision.

The respondents were asked ; if they agree that there is a strong relation between risk management and making decision ; chart (10) shows that 45.68% strongly agree ,34.21% agree,9.88% to some extent and 1.23% disagree.

This high percent 79.89% agree there is an existence of relation between risk management and decision making ,this support the hypothesis that has says managing risk for effect decision making .

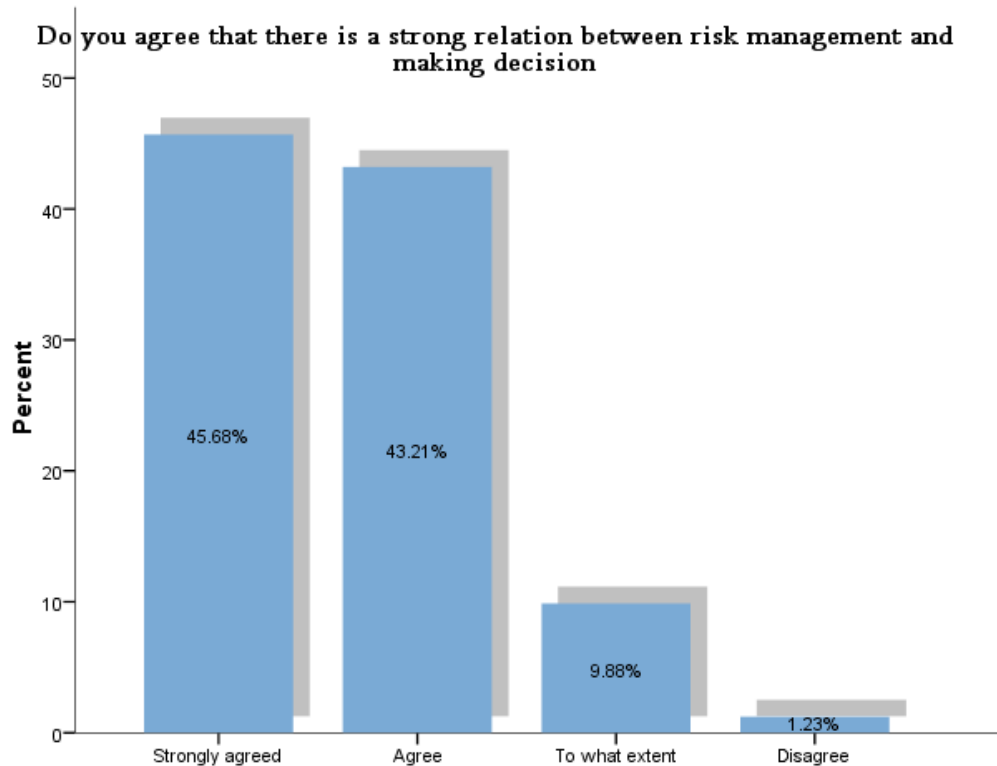
Statistics

Do you agree that there is a strong relation between risk management and making decision

N	Valid	81
	Missing	0

Do you agree that there is a strong relation between risk management and making decision

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	37	45.7	45.7	45.7
Agree	35	43.2	43.2	88.9
Valid To what extent	8	9.9	9.9	98.8
Disagree	1	1.2	1.2	100.0
Total	81	100.0	100.0	



2.6- Do you agree that most projects failed because of bad management:

The respondents were asked ; if they agree that most projects failed because of bad management . chart (11) shows that the majority of the participants were responded positively . A portion of about 60.49% was strongly agree , 28.40% was agree and 11.11%was to some extent .This is generally mean that most of respondent have a good background about construction projects ,this high percentage positively support the hypothesis which leads to the necessarily applying risk management and taking effective decisions to the success of project.

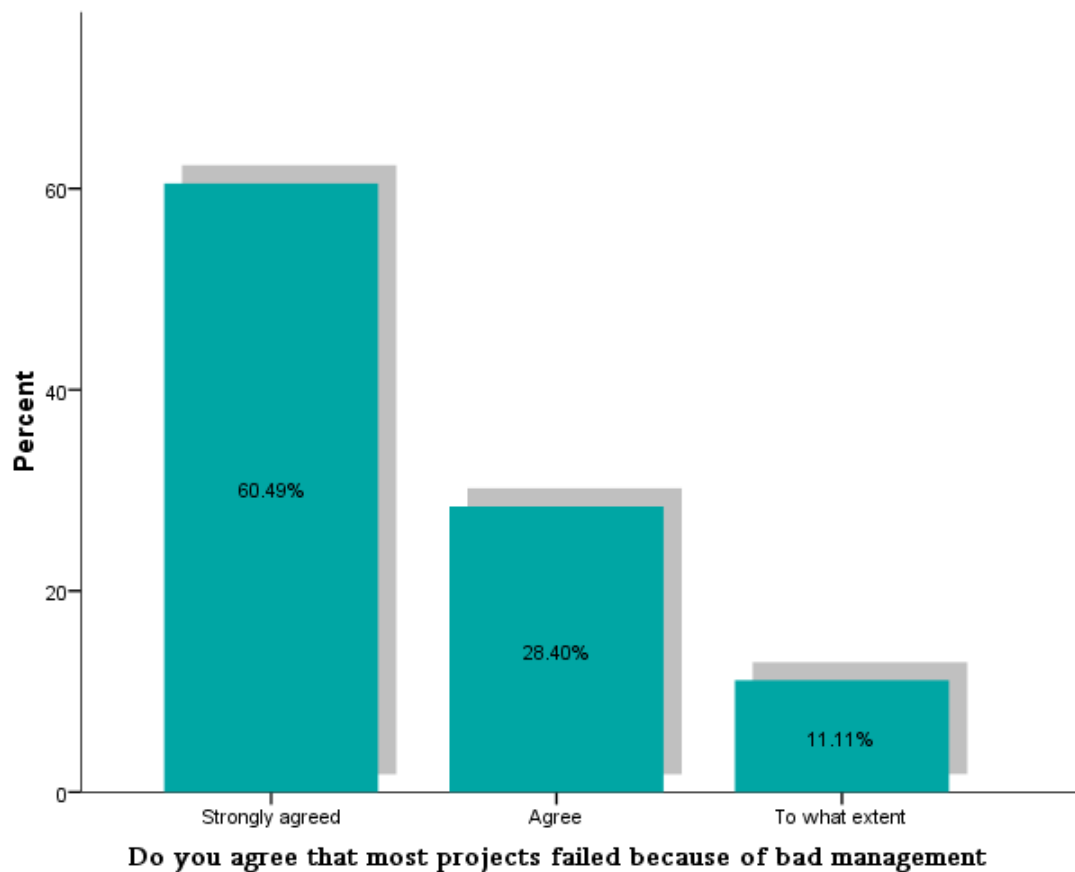
Statistics

Do you agree that most projects failed because of bad management

N	Valid	81
	Missing	0

Do you agree that most projects failed because of bad management

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	49	60.5	60.5	60.5
Agree	23	28.4	28.4	88.9
To what extent	9	11.1	11.1	100.0
Total	81	100.0	100.0	



Experience Years according of knowledge about Risk Management Program

Crosstabs

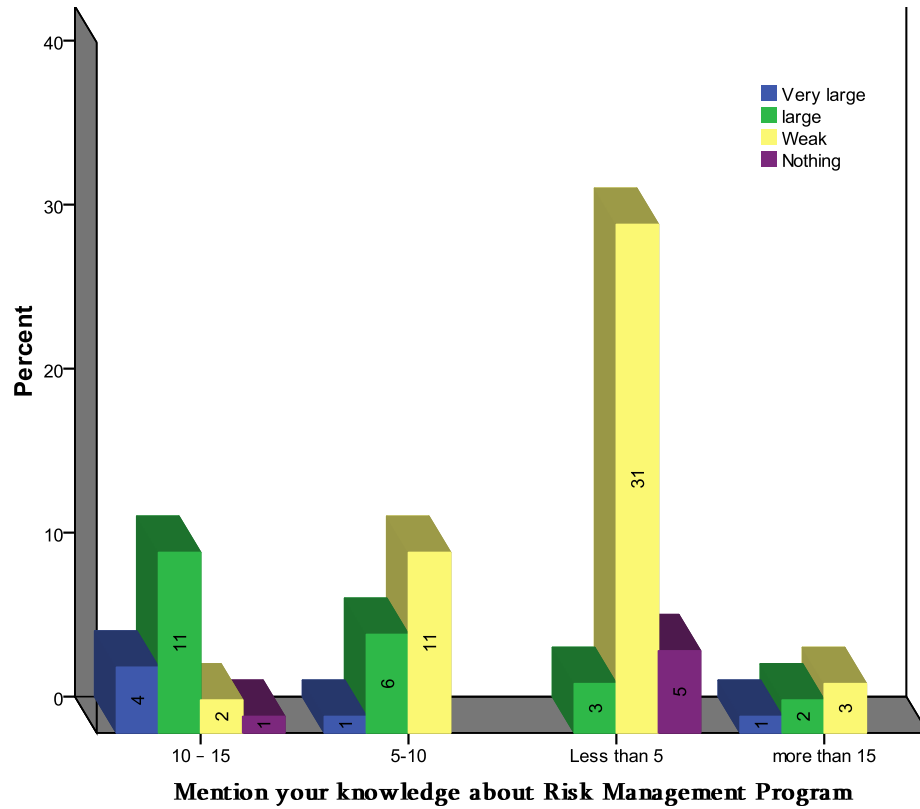
Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Experience Years * Mention your knowledge about Risk Management Program	81	100.0%	0	.0%	81	100.0%

Experience Years * Mention your knowledge about Risk Management Program Cross tabulation

Count

		Mention your knowledge about Risk Management Program				
		Very large	large	Weak	Nothing	Total
Experience Years	Less than 5	0	3	31	5	39
	5-10	1	6	11	0	18
	10 – 15	4	11	2	1	18
	more than 15	1	2	3	0	6
	Total	6	22	47	6	81



Part Three:

This part has a closed relation to the subject of this research. It discusses and analyses the core data about risk management and decision making in construction projects that participants been involved in. It consists of six questions .

3.1-The effect of Risk management on decision making

Frequencies

Statistics

	Management decisions always affect on construction projects	According to your experience is a success management decisions of project	According to your knowledge there is a special administration of risk and project management in the organizing structure of companies in Sudan.	Project managers need to join risk management as a basic operation in project construction
Valid	81	81	81	81
Missing	0	0	0	0
Mean	1.48	1.73	3.27	1.60
Std. Deviation	.573	.742	.775	.646

3.1.1-Administrative decisions always effect on construction projects:

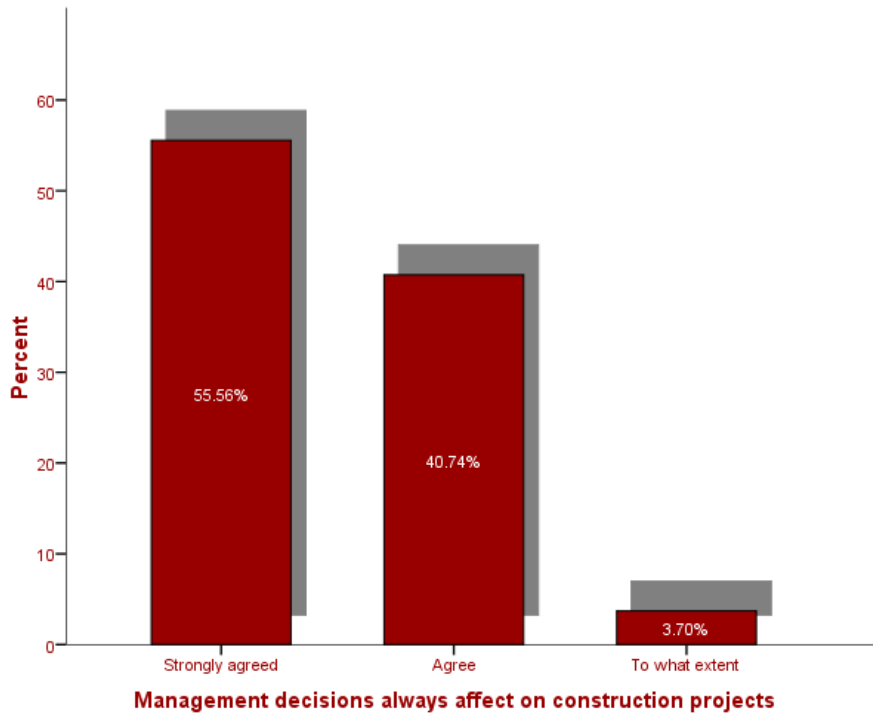
In this part of the questionnaire the respondents were asked if the administrative decisions effect on construction projects. Chart(12) shows that the majority of participants responded about 55.56% strongly agree, 40.74% agree and 3.70% to some extent.

96.30% of the responders are agree that the administrative decisions have a direct effect on construction projects, so these decisions should be based on strong data base particularly in technical issues.

Frequency Table

Management decisions always effect on construction projects

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	45	55.6	55.6	55.6
Agree	33	40.7	40.7	96.3
To what extent	3	3.7	3.7	100.0
Total	81	100.0	100.0	



3.1.2-According to your experience the source of the successful management decision in the project is the Engineer.

The respondents were asked according to their experience if the source of the successful management decision in the project is the Engineer: chart (13) shows that 44.44% strongly agreed, 38.27% agree and 17.28% to some extent.

This high percentage reflects the importance of the technical issues in any project. Engineers should have intensive training in project management and administrative issues.

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	36	44.4	44.4	44.4
Agree	31	38.3	38.3	82.7
To what extent	14	17.3	17.3	100.0
Total	81	100.0	100.0	



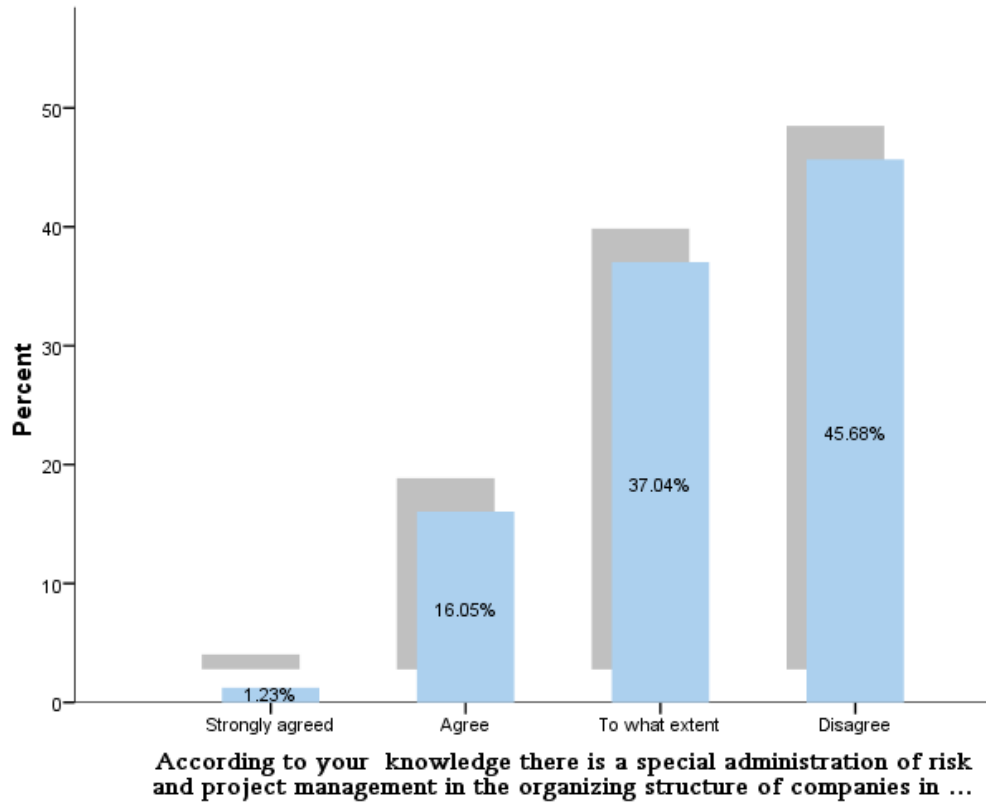
3.1.3- According to your knowledge there is a special administration of risks and project management in the organizational Structure of companies in Sudan.

The respondents were asked according to their knowledge if there is a special administration of risks and project management in the

organizational structure of companies in Sudan; char (14) shows that the participants responded strongly agreed were about 1.23%stronge agree, 16.05% agree, 37.04% to some extent and 45.68% disagree.

The high percentage of disagreement of non existence of administration specialized in risk management within organizational structure of companies ensure the bad situation of these company regarding risk problems that occur frequently.

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	1	1.2	1.2	1.2
Agree	13	16.0	16.0	17.3
To what extent	30	37.0	37.0	54.3
Disagree	37	45.7	45.7	100.0
Total	81	100.0	100.0	



3.1.4-Project's managers need to join risk management as a basic operation in construction's project:

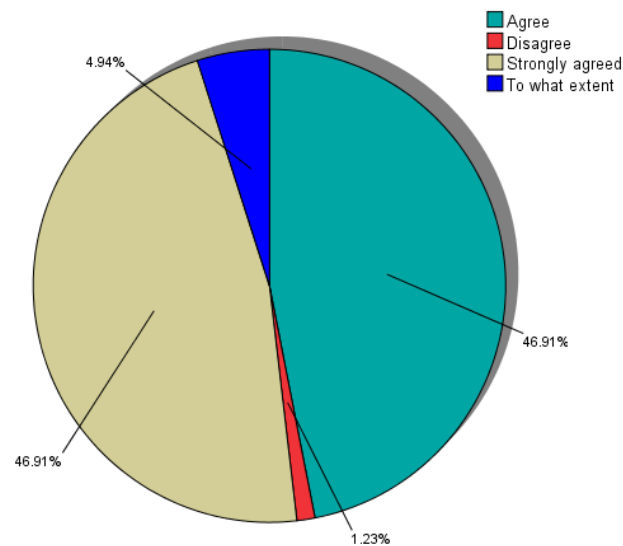
The respondents were asked if the project's manager need to join risk management as a basic operation in construction's project; chart (15) shows that 46.91% strongly agreed, 46.91% agree, 4.94% to some extent and 1.23% disagree.

the project's manager must join risk management as a basic operation in construction's project .that is lead to achieve the goals and success the project.

Theoretically risk management should be incorporated within the project management so managers should consider the project as an integrated plan for all challenges that might affect the achievement of the project objective. This was distinguish expressed by 93.82% of the sample.

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agreed	38	46.9	46.9	46.9
Agree	38	46.9	46.9	93.8
To what extent	4	4.9	4.9	98.8
Disagree	1	1.2	1.2	100.0
Total	81	100.0	100.0	

Project managers need to join risk management as a basic operation in project construction



Descriptive Statistics:

Liker Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagre

3.1	N	Mean	Std. Deviation	Attitude
Management decisions always effect on construction projects	81	1.48	.573	Strongly agreed
According to your experience the source of the successful management decision in the project is the Engineer	81	1.73	.742	Strongly agreed
According to your knowledge there is a special administration of risk and project management in the organizing structure of companies in Sudan.	81	3.27	.775	Disagree
Project managers need to join risk management as a basic operation in project construction	81	1.60	.646	Strongly agreed
The effect of Risk management on making decisions	81	2.0216	.36486	Agree
Valid N (leastwise)	81			

3.2- Project failure

Frequencies

Statistics

	Making decisions is a basic skills that must be provided by all the staff of the project	Is there any standard or measurements to risk management in construction industry in Sudan	Ignoring the principal of risk management lead to project failure
N Valid	80	79	80
Missing	1	2	1
Mean	1.43	2.41	1.91
Std. Deviation	.612	.651	.814

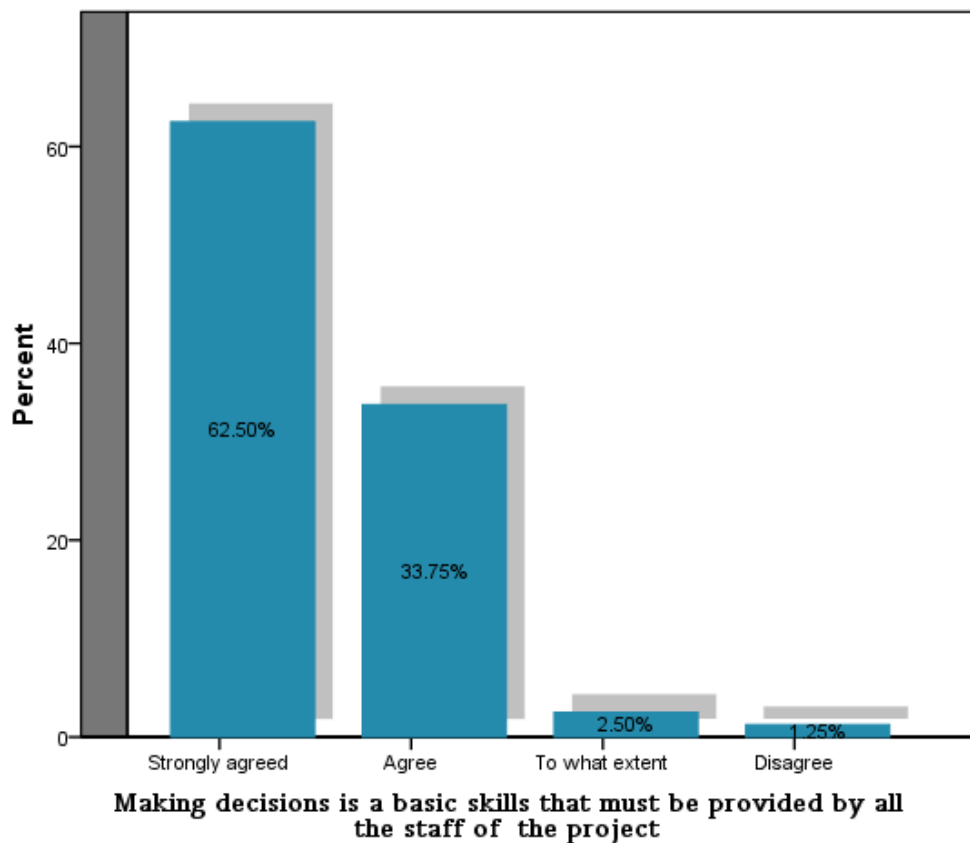
3.2.1- making decisions is a basic skills that must be provided by all the staff of the project

The respondents were asked if making decisions is a basic skills that must be provided by all the staff of the projects; chart (16) shows that 62.50% strongly agree, 33.75% agree, 2.50% to some extent and 1.25% disagree.

From the result we find that the highest percentage of respondents agreed with the need to provide the skill of decision making to the project crew,

Which leads to effective decision making that leads to success of the projects as a whole, as in the hypothesis that at the beginning in this research: If there is available risk management this lead to make the effective decision, thus the project's crew can achieve their goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	50	61.7	62.5	62.5
	Agree	27	33.3	33.8	96.3
	To what extent	2	2.5	2.5	98.8
	Disagree	1	1.2	1.3	100.0
	Total	80	98.8	100.0	
Missing	System	1	1.2		
	Total	81	100.0		

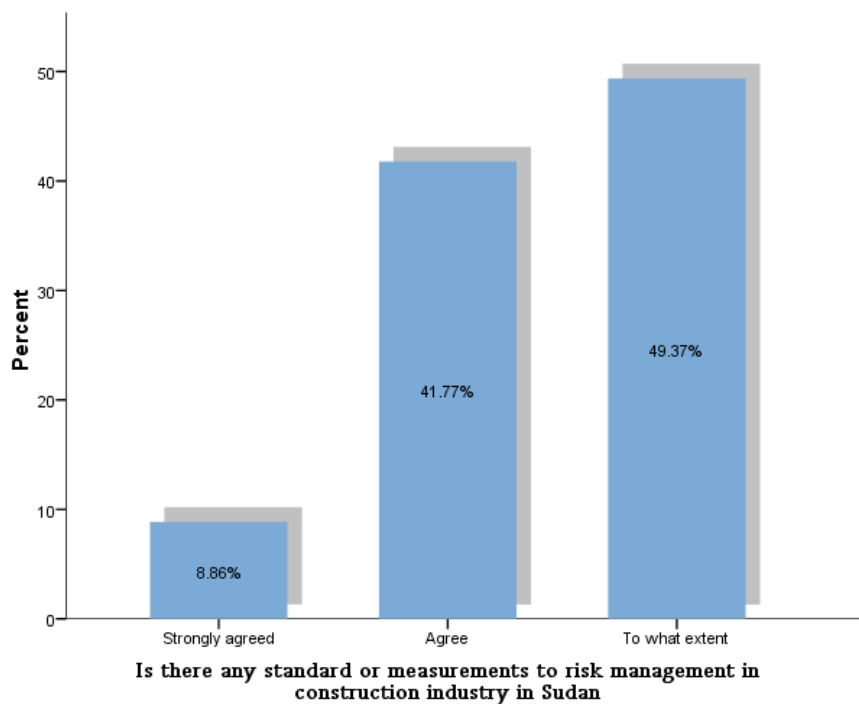


3.2.2-Is there any standard or measurements to risk management in construction industry in Sudan

The respondents were asked if there is any standard or measurement to risk management in construction industry in Sudan; chart (17) shows that the participants strongly agreed is 8.86%, 41.77% agree and 49.37% to some extent.

There are some criteria and standards for risk management in the construction industry in Sudan but it's not ** applied and managed, furthermore. This research intents to include the criteria and standards risk management in this industry in order to be more effective enabling decision maker to achieve the goals and success.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	7	8.6	8.9	8.9
	Agree	33	40.7	41.8	50.6
	To what extent	39	48.1	49.4	100.0
	Total	79	97.5	100.0	
Missing	System	2	2.5		
	Total	81	100.0		

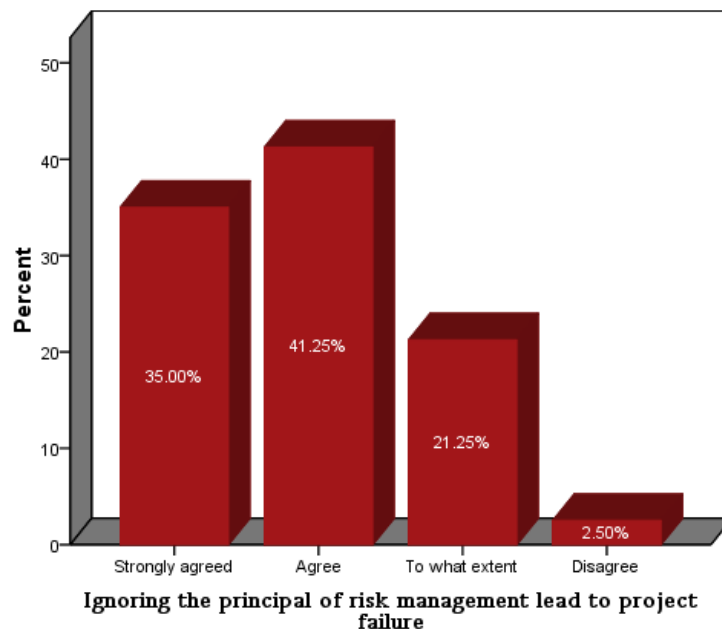


3.2.3- Ignoring the principal of risk management lead to project failure:

The respondents were asked whether the ignorance of the principal of risk management lead to project failure; chart (18) shows that 35.00% strongly agreed, 41.25% agree, 21.25% to some extent and 2.50% disagree.

We find the ignorance of the principles of risk management leads to the failure of the projects and this prove the hypothesis that most projects fail because of incorrect decisions and ignorance the principles of risk management.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	28	34.6	35.0	35.0
	Agree	33	40.7	41.3	76.3
	To what extent	17	21.0	21.3	97.5
	Disagree	2	2.5	2.5	100.0
	Total	80	98.8	100.0	
Missing	System	1	1.2		
	Total	81	100.0		



Descriptive Statistics:

Likert Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagree

3.2	N	Mean	Std. Deviation	Attitude
Making decisions is a basic skills that must be provided by all the staff of the project	80	1.42	.612	Strongly agreed
Is there any standard or measurements to risk management in construction industry in Sudan	79	2.41	.651	Agree
Ignoring the principal of risk management lead to project failure	80	1.91	.814	Agree
Project Failure	80	1.9125	.40995	Agree
Valid N (leastwise)	79			

3.3-the effect of training on the process of making decisions and Risk management operations :

Frequencies

Statistics

	The accumulation of traditional experience is the main factor in risk management	Is there any consideration of training courses in the domain of Risk management in construction sector	Do you agree that there is a lot of obstacles facing training operation
N Valid	80	78	78
Missing	1	3	3
Mean	2.28	3.27	1.69
Std. Deviation	.856	.767	.761

3.3.1-The accumulated traditional experience is the main factor in risk management

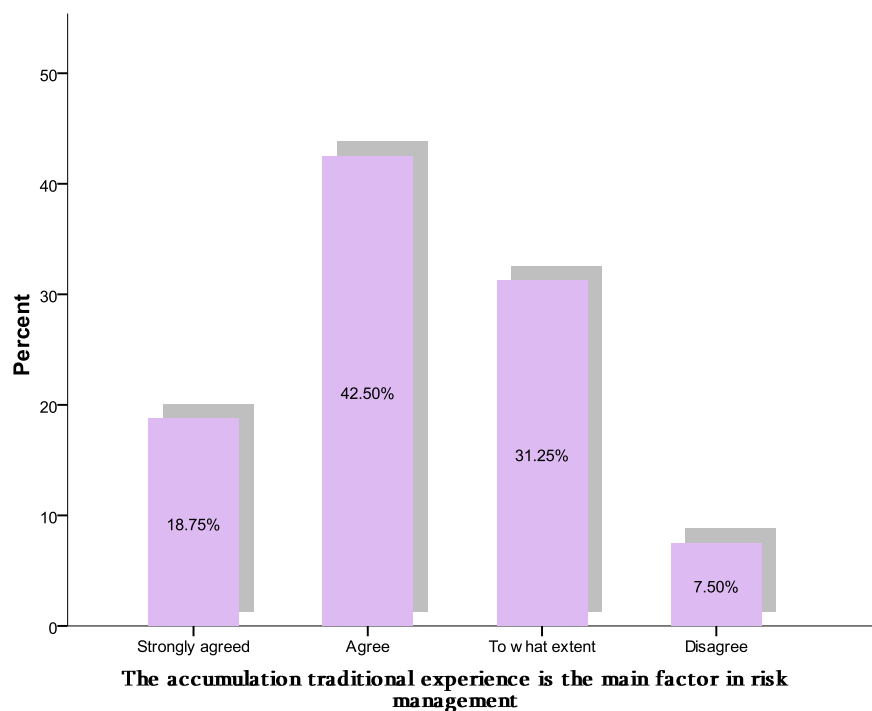
The respondents were asked if the accumulated traditional experience is the main factor in risk management; chat (19) shows that 18.75% strongly agreed, 42.50% agree, 31.25% to some extent, 7.50% disagree.

It is found from the analysis that large proportion of the sample agree that traditional cumulative experience is the main factor in risk management. But it is not enough and must be supported by training and particularly for the new comers in the field of risk management, so as to have effective decisions and achieving goals

Frequency Table

The accumulation traditional experience is the main factor in risk management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	15	18.5	18.8	18.8
	Agree	34	42.0	42.5	61.3
	To what extent	25	30.9	31.3	92.5
	Disagree	6	7.4	7.5	100.0
	Total	80	98.8	100.0	
Missing	System	1	1.2		
	Total	81	100.0		



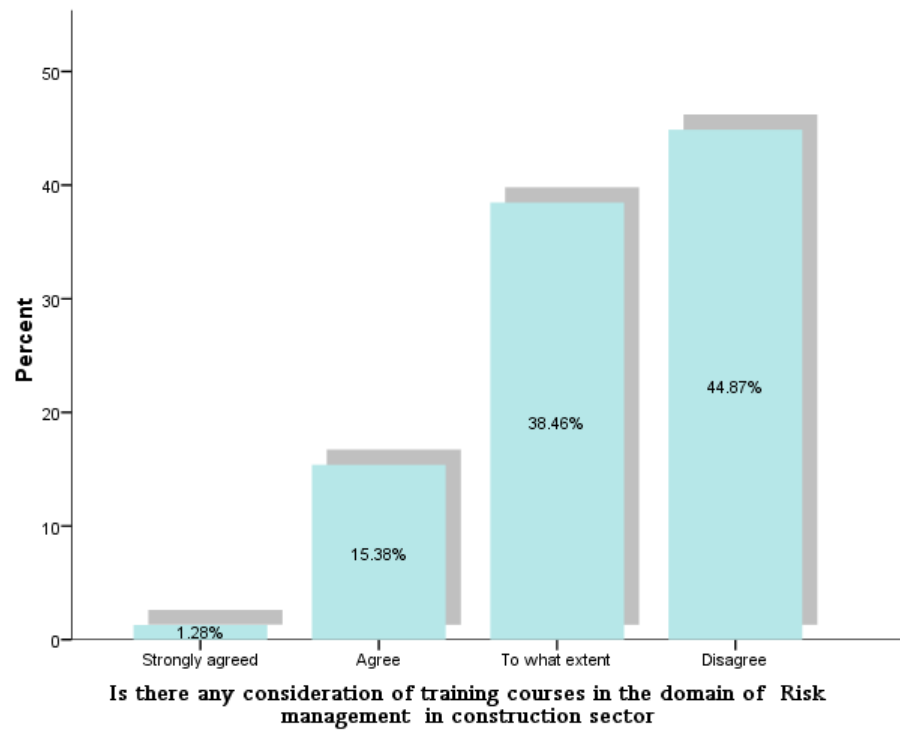
3.3.2-is there any consideration of training courses in the field of Risk management in construction sector

The respondents were asked if there is any consideration of training courses in the field of Risk management in construction sector; chart (20) shows that 1.28% strongly agreed, 15.38% agree, 38.46% to some extent and 44.87% disagree.

The result of the analysis show the largest proportion of respondents denies the existence of interesting training courses in the construction sector which shows the lack of concern in training courses for risk management.

In addition the notified courses might be not suitable for the construction engineers, beside other factors that may affect the desires in taking training courses in the field in general.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	1	1.2	1.3	1.3
	Agree	12	14.8	15.4	16.7
	To what extent	30	37.0	38.5	55.1
	Disagree	35	43.2	44.9	100.0
	Total	78	96.3	100.0	
Missing	System	3	3.7		
	Total	81	100.0		



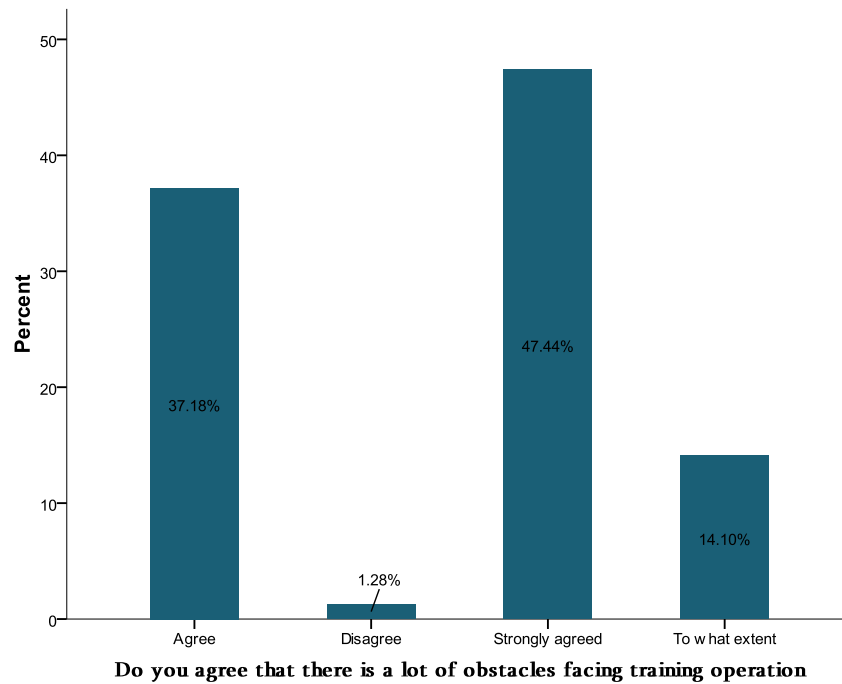
3.3.3-Do you agree that there is a lot of obstacles facing training operation.

The respondents were asked if they agree that there is a lot of obstacles facing training operation; chat (21) shows that 37.18% strongly agreed, 1.25% agree, 47.44% to some extent and 14.10% disagree.

It is found from the result of analysis, the largest proportion of the respondents confirming the existence of obstacles facing the training process. We comment to guide line on this research to remove obstacles of various kinds shaking and increased attention to training courses even be general risk management culture and apply it widely in the construction sector in order to ensure the success of project.

We comment to guide line on this research to remove obstacles of various kinds shaking and increased attention to training courses even be general risk management culture and apply it widely in the construction sector in order to ensure the success of project.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	37	45.7	47.4	47.4
	Agree	29	35.8	37.2	84.6
	To what extent	11	13.6	14.1	98.7
	Disagree	1	1.2	1.3	100.0
	Total	78	96.3	100.0	
Missing	System	3	3.7		
	Total	81	100.0		



Descriptive Statistics:

Likert Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagree

	N	Mean	Std. Deviation	Attitude
The accumulation traditional experience is the main factor in risk management	80	2.28	.856	Agree
Is there any consideration of training courses in the domain of Risk management in construction sector	78	3.27	.767	Disagree
Do you agree that there is a lot of obstacles facing training operation	78	1.69	.761	Strongly agreed
The effect of training on both making decisions and Risk management operations	80	2.4042	.44038	Agree
Valid N (listwise)	77			

3.4- the effect of the contract on both operations of making decisions and risk management

Frequencies

Statistics

		Do you agree that the contract of the project represent a type of risk management?	Do you agree that the condition and the kind of contract may differ at different projects?	Do you agree the standard contract is considered a general aspect of construction industry in Sudan?	If you response is agree that means there is insufficient knowledge of the other types of contract
N	Valid	79	78	76	70
	Missing	2	3	5	11
	Mean	2.09	1.51	2.09	2.41
	Std. Deviation	1.002	.552	.715	.925

3.4.1- Do you agree that the project's contract represents a type of risk management

The respondents were asked if they agree that the project's contract represent a type of risk management; chart (22) shows that 34.18% strongly agreed, 34.18% agree, 20.25% to some extent and 11.39% disagree.

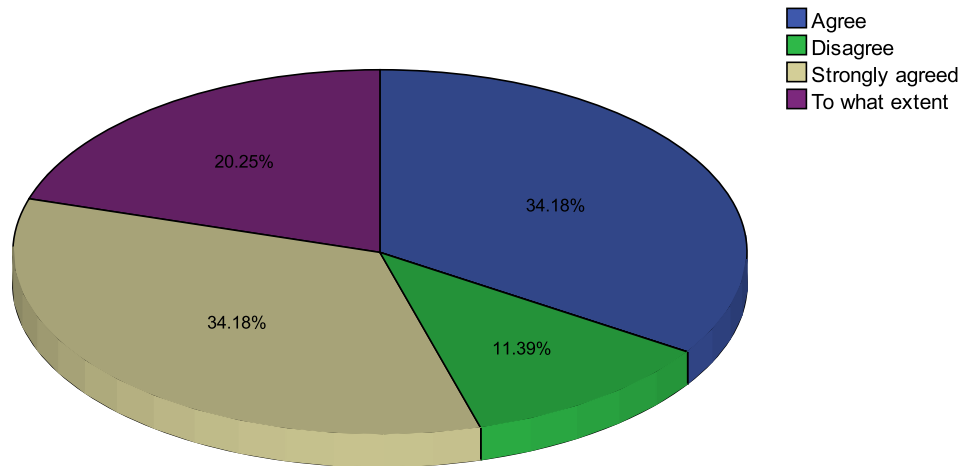
From the results of analysis that the most rate of the subjected persons agree that the contract of the project is one type of risk management, so it should be concerned of contracts of their different types, because that contracts included conditions of the project's success and no way to risk, as well as that the conditions of the contract should be committed , till to ensure the success of the project without risks.

Frequency Table

Do you agree that the contract of the project represent a type of risk management?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	27	33.3	34.2	34.2
	Agree	27	33.3	34.2	68.4
	To what extent	16	19.8	20.3	88.6
	Disagree	9	11.1	11.4	100.0
Total		79	97.5	100.0	
Missing	System	2	2.5		
Total		81	100.0		

Do you agree that the contract of the project represent a type of risk management?



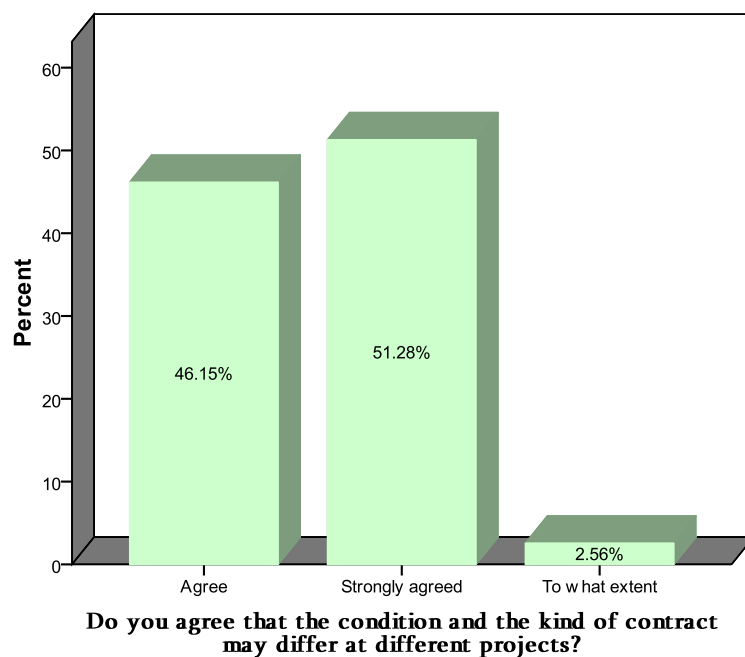
3.4.2. Do you agree that the conditions and the kind of contract may differ at different projects

The respondents were asked if they agree that the conditions and the kind of contract may differ at different projects; chart (23) shows that 51.28% strongly agreed, 46.15% agree and 2.56% to some extent.

From the result of analysis the largest percentage supports the statement of the project contract is a type of risk management. so it has to be managed by contracts of various kind because each project has a unique contract and the condition are different in order to ensure the contract are not exposed to the risk of project failure. Each of the parties **must be** the commitment of **tremor** conditions, then the contract must be ensures rights and duties of each party.

3.4.2- Do you agree that the condition and the kind of contract may differ at different projects?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	40	49.4	51.3	51.3
	Agree	36	44.4	46.2	97.4
	To what extent	2	2.5	2.6	100.0
	Total	78	96.3	100.0	
Missing	System	3	3.7		
	Total	81	100.0		



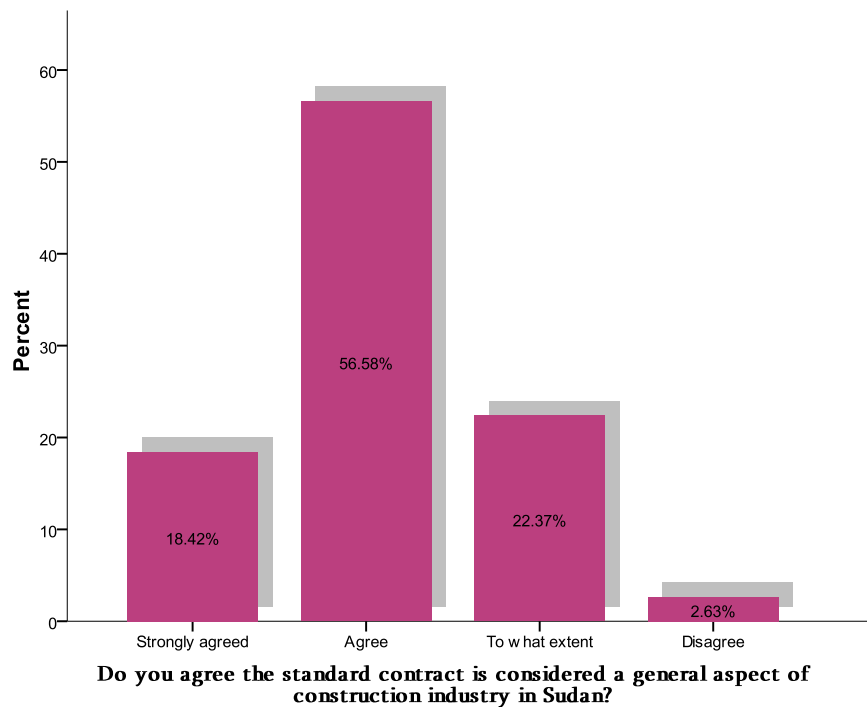
3.4.3-do you agree the standard contract is considered a general aspect of construction industry in Sudan

The respondents were asked if they agree that the standard contract is considered as a general aspect of construction industry in Sudan; chart (24) shows that 18.42% strongly agreed, 56.58% agree, 22.37% to some extent and 2.63% disagree.

We find that the biggest percentage results in favor of the standards contact is an essential feature of the contract construction projects in Sudan and this of the most common mistakes in construction project in Sudan.

Do you agree the standard contract is considered a general aspect of construction industry in Sudan?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	14	17.3	18.4	18.4
	Agree	43	53.1	56.6	75.0
	To what extent	17	21.0	22.4	97.4
	Disagree	2	2.5	2.6	100.0
	Total	76	93.8	100.0	
Missing	System	5	6.2		
	Total	81	100.0		



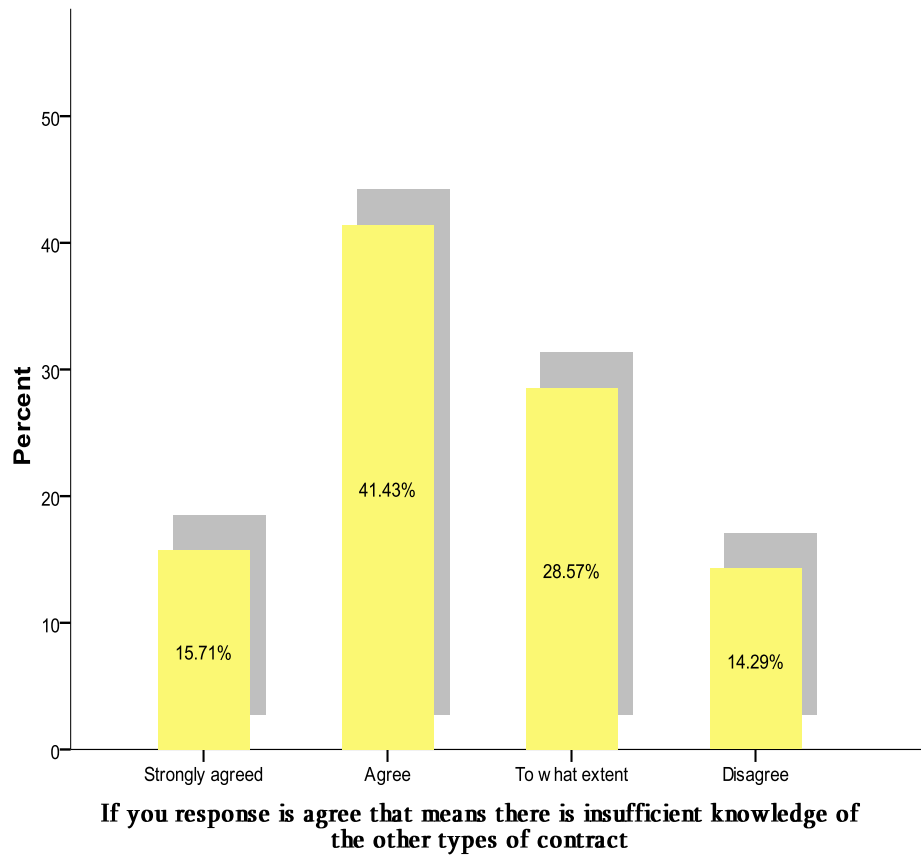
3.4.4-If the answer agreed that means there is insufficient knowledge of the other types of contract?

The respondents were asked if the answer agreed that means there is insufficient knowledge of the other types of contract; chart (25) shows that 15.71% strongly agreed, 41.43% agree, 28.57% to some extent and 14.29% disagree.

From the result, we find that the highest percentage confirms the lack of attention to know about different kinds of contracts and conditions, thus it could be represented a major threat to a large project in the absence of a appropriate choice, for this point the best things the contract must be considering and refined.

if the answer agreed that means there is insufficient knowledge of the other types of contract?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	11	13.6	15.7	15.7
	Agree	29	35.8	41.4	57.1
	To what extent	20	24.7	28.6	85.7
	Disagree	10	12.3	14.3	100.0
	Total	70	86.4	100.0	
Missing	System	11	13.6		
	Total	81	100.0		



Descriptive Statistics:

Likert Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagree

	N	Mean	Std. Deviation	Attitude
Do you agree that the contract of the project represent a type of risk management?	79	2.09	1.002	Agree
Do you agree that the condition and the kind of contract may differ at different projects?	78	1.51	.552	Strongly agreed
Do you agree the standard contract is considered a general aspect of construction industry in Sudan?	76	2.09	.715	Agree
If you response is agree that means there is insufficient knowledge of the other types of contract	70	2.41	.925	Agree
The effect of the contract on both operations making decisions and risk management	79	2.0411	.54054	Agree
Valid N (leastwise)	70			

3.5 -The risk effect on conflict in construction industry:

3.5.1-Do you agree that risk may cause dispute between the parties of the project

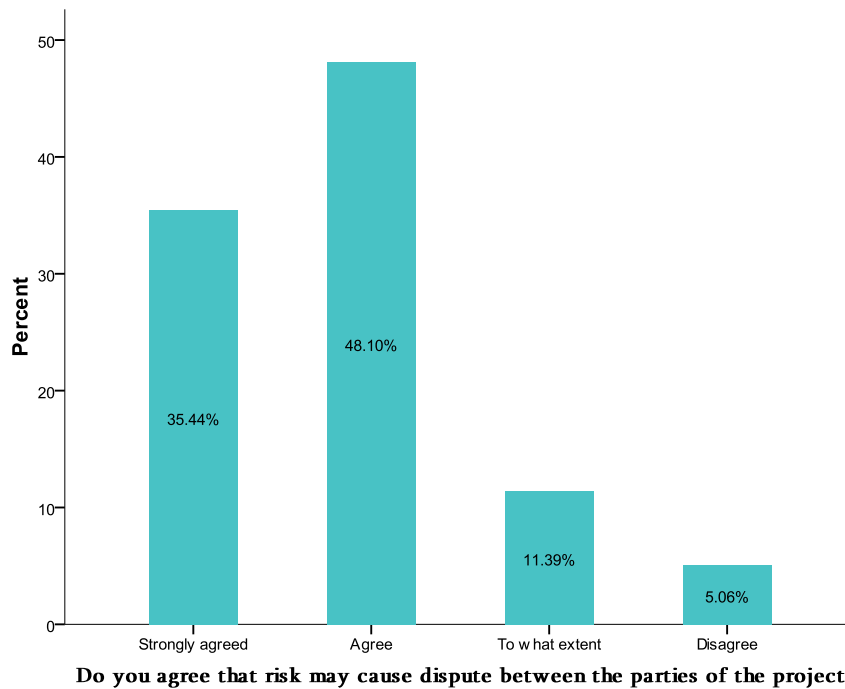
Frequencies

Statistics

	Do you agree that risk may cause dispute between the parties of the project	Do you agree that most of risk caused by the shortening of parties in doing their tasks	Do you agree that risk lead to raise the cost of the project and the implementing time?
N Valid	79	79	79
Missing	2	2	2
Mean	1.86	1.78	1.58
Std. Deviation	.812	.745	.761

The respondents were asked if risk effect on conflict in construction industry; chart (26) shows that 35.44% strongly agreed, 48.10% agree, 11.39% to some extent and 5.06% disagree. The high proportion unanimously confirms that the risk is case of the emergence of a dispute between the parties to the project and in order to avowing conflicts shaking there must be effective management of risk to the project and all necessary action to manage the risk decide possibility with the right decisions for project managers so as to avoid the emergence of risks and the emergence of conflicts. Because this result insure the importance of risk management in all construction projects. each other it will have other reasons to defends about why the project is fail down and they think about other parties.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	28	34.6	35.4	35.4
	Agree	38	46.9	48.1	83.5
	To what extent	9	11.1	11.4	94.9
	Disagree	4	4.9	5.1	100.0
	Total	79	97.5	100.0	
Missing	System	2	2.5		
	Total	81	100.0		



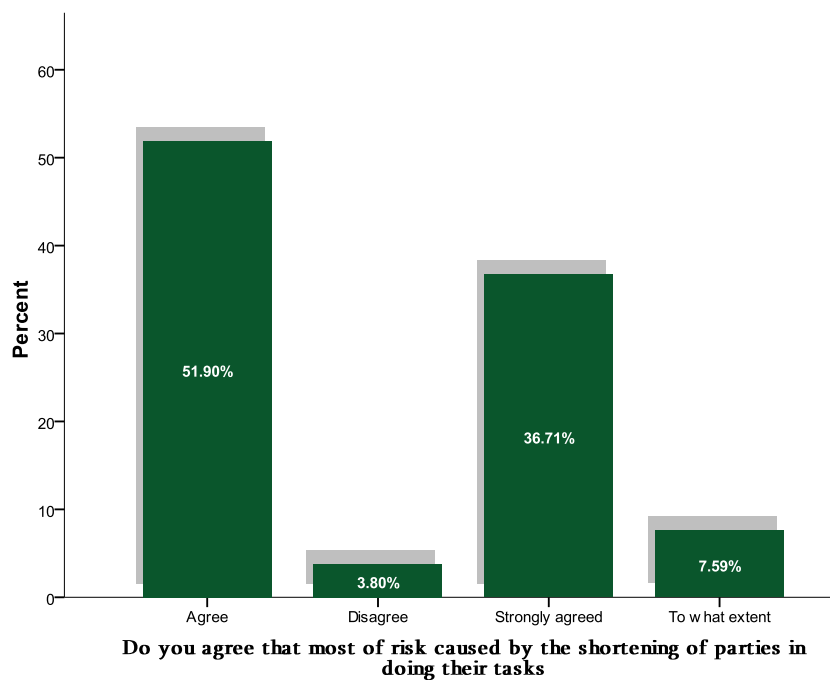
3.5.2- Do you agree that most of the risks are caused by the short comings of parties in doing their tasks

The respondents were asked if they agree that most of the risks are caused by the shortening of parties in doing their tasks; chart (27) shows that 36.71% strongly agreed, 51.90% agree, 7.59% to some extent and 3.80% disagree.

Shaking high rate confirms that most of the risks arising from the failure of the project to abide their duties is necessary to know each of the parties to the project tasks and what should it and abide by it. In order to ensure the success of the project and lack of exposure to the risk and lack of emergence of disputes.

Do you agree that most of risk caused by the shortening of parties in doing their tasks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	29	35.8	36.7	36.7
	Agree	41	50.6	51.9	88.6
	To what extent	6	7.4	7.6	96.2
	Disagree	3	3.7	3.8	100.0
	Total	79	97.5	100.0	
Missing	System	2	2.5		
	Total	81	100.0		



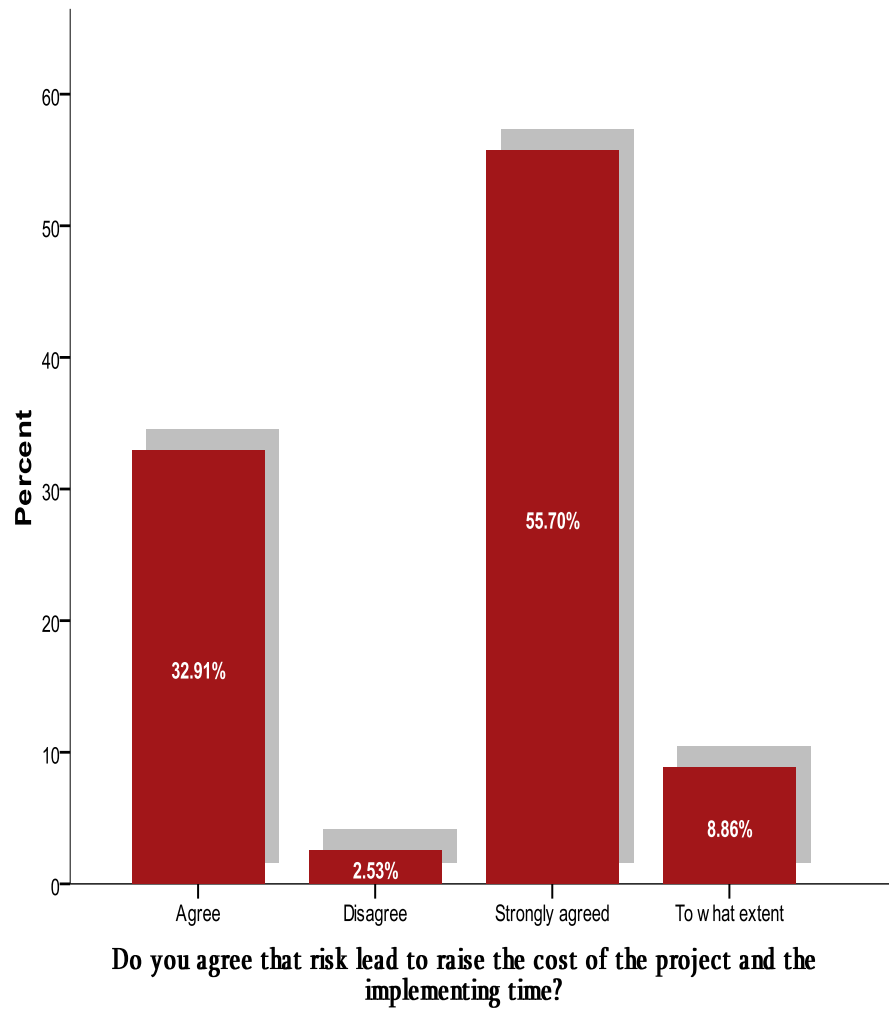
3.5.3- Do you agree that risks lead to the raise of the project's cost and the implementing time:

The respondents were asked if they agree that risk leads to the raise of the project's cost and the implementing time; chart (28) shows that 55.70% strongly agreed, 32.91% agree, 8.86% to some extent and 2.53% disagree.

We find that the highest percentage confirms that the risks lead to higher project cost and time delay. We should care about the management of risk and making good decisions to carry out the project out of the risk, this process it can reduce it the higher costs of the project. Even each as bad planning it could be lead the project in construction company to success and execution in a time estimation of the project.

Do you agree that risk lead to raise the cost of the project and the implementing time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agreed	44	54.3	55.7	55.7
	Agree	26	32.1	32.9	88.6
	To what extent	7	8.6	8.9	97.5
	Disagree	2	2.5	2.5	100.0
	Total	79	97.5	100.0	
Missing	System	2	2.5		
	Total	81	100.0		



Descriptive Statistics:

Likert Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagree

3.5	N	Mean	Std. Deviation	Attitude
Do you agree that risk may cause dispute between the parties of the project	79	1.86	.812	Agree
Do you agree that most of risk caused by the shortening of parties in doing their tasks	79	1.78	.745	Agree
Do you agree that risk lead to raise the cost of the project and the implementing time?	79	1.58	.761	Strongly agreed
The effect of risk on conflict in industry of constructions	79	1.7426	.53095	Strongly agreed
Valid N (list wise)	79			

3.6-The effect of risk on the project budget:

Frequencies

Statistics

	Do you agree that the cost of project must include the expected risk item?	Do you agree that risk effect on the goals of the project (time – cost – quality) directly?
N	79	79
Valid		
Missing	2	2
Mean	1.47	1.42
Std. Deviation	.574	.546

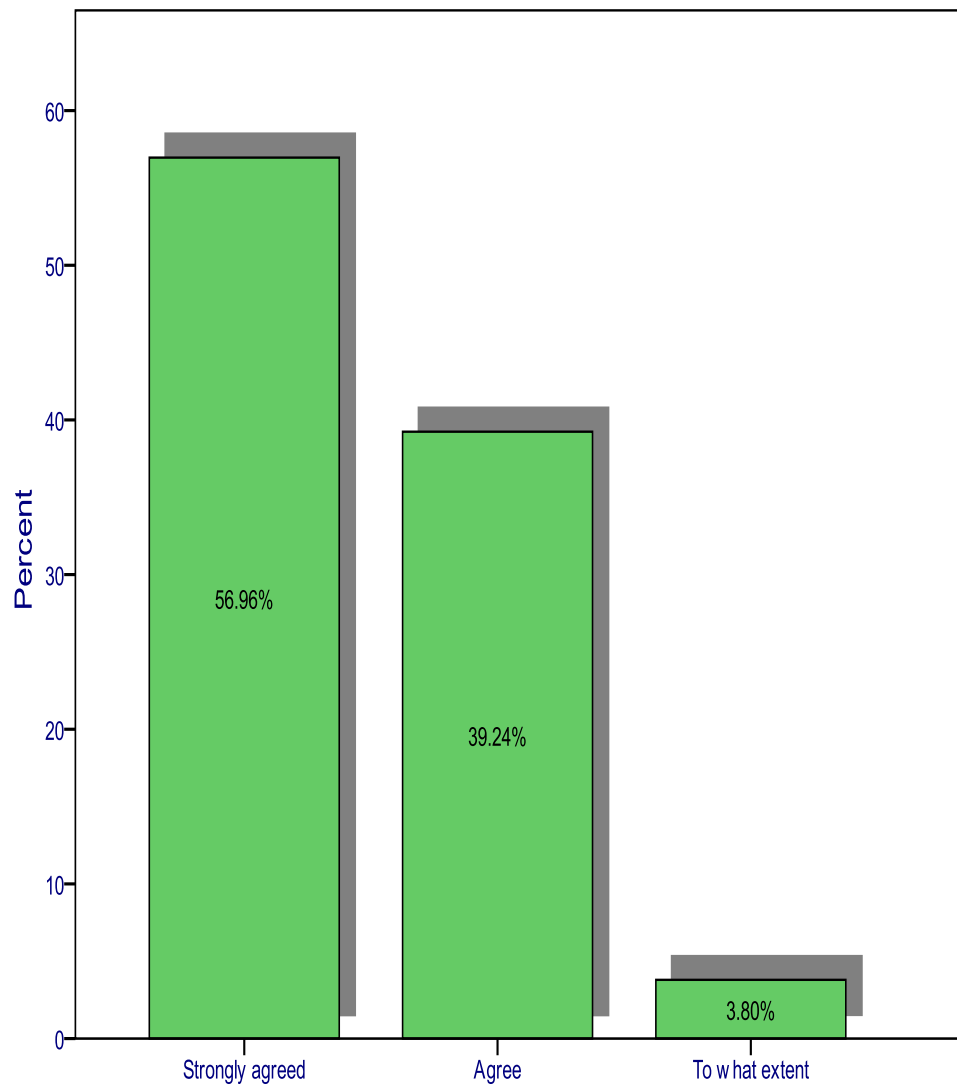
3.6.1-Do you agree that the cost of project must include the expected risk item.

The respondents were asked if they agree that the cost of the project must include the expected risk item; chart (29) shows that 56.96% strongly agreed, 39.24% agree and 3.80% to some extent.

We find that the results of highest percentage must to confirm expected risk of the project to the total cost. (the project manager must should be have a comprehensive feasibility study costs even expected to occur included in the cost of the project shall be subjected to risk even to project failure.

Frequency Table

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Strongly agreed	45	55.6	57.0	57.0
Valid Agree	31	38.3	39.2	96.2
Valid To what extent	3	3.7	3.8	100.0
Total	79	97.5	100.0	
Missing System	2	2.5		
Total	81	100.0		



Do you agree that the cost of project must include the expected risk ...

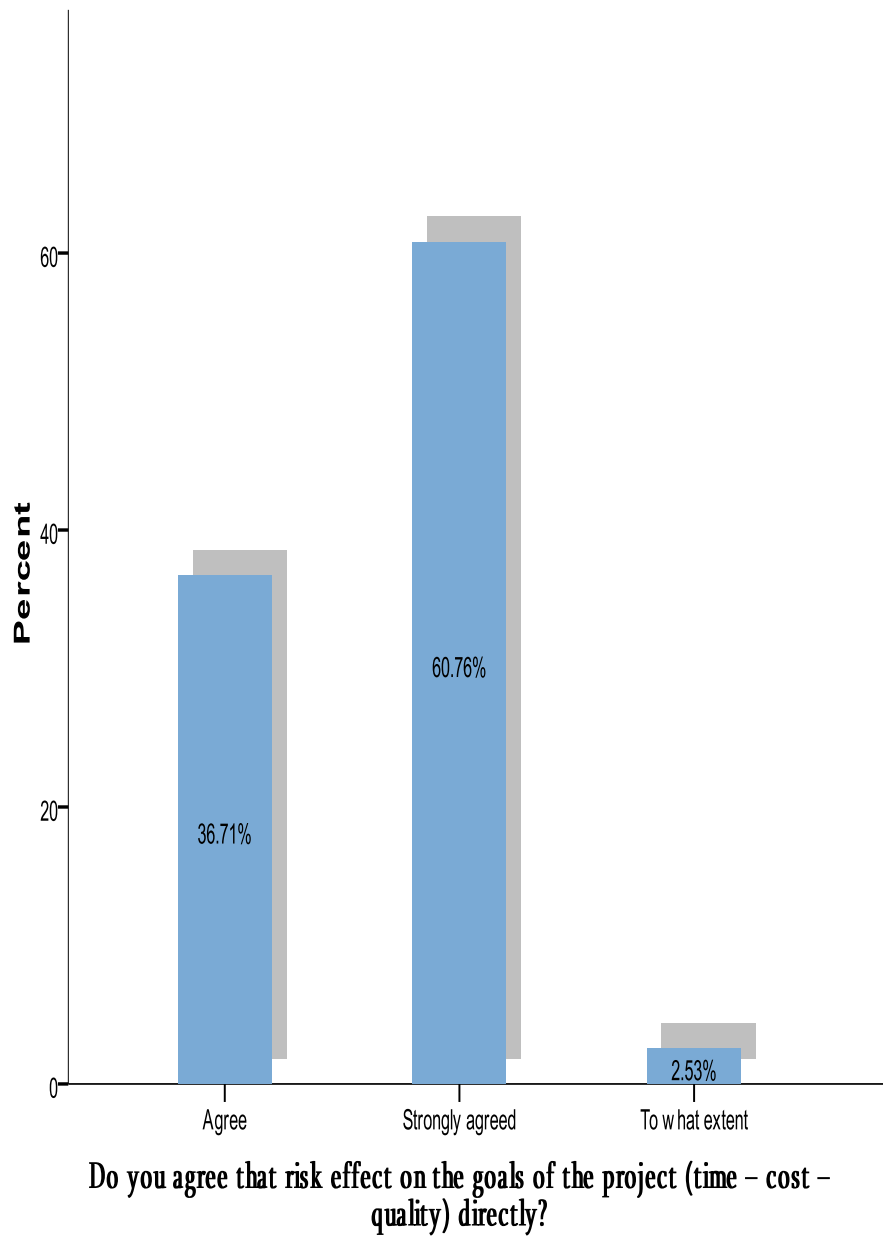
3.6.2-Do you agree that risks effect directly on the goals of the project (time – cost – quality)

The respondents were asked if they agree that risks effect directly on the goals of the project; chart (30) shows that 60.76% strongly agreed, 36.71% agree and 2.53% to some extent.

The highest percentage agreeing that the risk affect the project goals (time-cost-quality).

. Do you agree that risk effect on the goals of the project (time – cost – quality) directly?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Strongly agreed	48	59.3	60.8	60.8
Valid Agree	29	35.8	36.7	97.5
Valid To what extent	2	2.5	2.5	100.0
Total	79	97.5	100.0	
Missing System	2	2.5		
Total	81	100.0		



Descriptive Statistics:

Liker Scale

Weighted Mean Level:

From 1.00 to 1.74	Strongly agreed
From 1.75 to 2.49	Agree
From 2.50 to 3.24	To what extent
From 3.25 to 4.00	Disagree

	N	Mean	Std. Deviation	Attitude
Do you agree that the cost of project must include the expected risk item?	79	1.47	.574	Strongly agreed
Do you agree that risk effect on the goals of the project (time – cost – quality) directly?	79	1.42	.546	Strongly agreed
The effect of risk on the project budget	79	1.4430	.45282	Strongly agreed
Valid N (list wise)	79			

Chapter Five

Conclusion and Recommendation

Chapter V

Conclusion and Recommendation

5.1-Introduction:

This chapter explains the major findings that were discussed in the previous chapter and presents the recommendations that could assist in future researches, concerning the impact of risk management on decision making in construction projects. The findings and recommendations are state below for respondents information.

5.2- Respondents' information

In the first section of the questionnaire, the respondents from different professions gave great support to achieve this research by presenting valuable information about their activities and their related experiences in construction projects management.

-The effect of Risk management on decision making

96.30% of the responders are agree that the administrative decisions have a direct effect on construction projects

from analysis we find that non existence of administration specialized in risk management within organizational structure of companies.

the project's manager must join risk management as a basic operation in construction's project.

- Project failure

From the result we find that the highest percentage of respondents agreed with the need to provide the skill of decision making to the project crew.

This research intends to include the criteria and standards risk management in this industry in order to be more effective enabling decision maker to achieve the goals and success.

We find the ignorance of the principles of risk management leads to the failure of the projects.

-The effect of training on the process of making decisions and Risk management operations :

It is found from the analysis that large proportion of the sample agree that traditional cumulative experience is the main factor in risk management.

The result of the analysis show the largest proportion of respondents denies the existence of interesting training courses in the construction sector which shows the lack of concern in training courses for risk management.

It is found from the result of analysis, the largest proportion of the respondents confirming the existence of obstacles facing the training process.

-The effect of the contract on both operations of making decisions and risk management

The largest proportion of the results of the analysis supports the project contract as a type of risk management.

From the result of analysis the largest percentage supports the statement of the project contract is a type of risk management.

We find that the biggest percentage results in favor of the standards contract is an essential feature of the contract construction projects in Sudan and this of the most common mistakes in construction project in Sudan.

-The risk effect on conflict in construction industry:

The high proportion unanimously confirms that the risk is case of the emergence of a dispute between the parties to the project.

We find that the highest percentage confirms that the risks lead to higher project cost and time delay.

The effect of risk on the project budget:

We find that the results of highest percentage must to confirm expected risk of the project to the total cost.

The highest percentage agreeing that the risk affect the project goals (time-cost-quality).

5.3-Recommendations:

1. must concern by principles of risk management and must applying it for effective decision making to achieve the goals of project.
2. must be attention included the special administration of risks and project management in the organizational structure of companies in Sudan.
3. the project's manager must join risk management as a basic operation in construction's project .that is lead to achieve the goals and success the project.
4. must provide the skill of decision making to the project crew, Which leads to effective decision making that leads to success of the projects as a whole.
5. must focusing to include the criteria and standards risk management in construction industry in Sudan to be more effectiveness manner that enables decisions maker to achieve the goals and success the project.
6. must supporte the traditional cumulative experience by training courses and concern to all the new in the field of risk management so as to have effective decisions and achieving goals
7. must pay attention to the various kinds of contracts ,because the contracts have conditions that ensure the success of the project and that it is not at risk.
8. is necessary to know each of the parties to the project tasks and what should it and abide by it. In order to ensure the success of the project and lack of exposure to the risk and lack of emergence of disputes.
9. should care about the management of risk and making good decisions to carry out the project out of the risk, this process it can reduce it the higher costs of the project. Even each as bad planning it could be lead the

project in construction company to success and execution in a time estimation of the project.

10. the project manager must should be have a comprehensive feasibility study costs even expected to occur included in the cost of the project shall be subjected to risk even to project failure.

5.4- Recommendations for future studies

Through the scientific experiences the researcher carried out in the construction industry in Sudan, it is uncovered that the projects in the construction projects lacked applying the risk management means, as well as the managers of the projects lacked in taking the correct and effective decisions, so the researcher recommends of necessity to concern on the risk management and taking the correct decisions as basic process in the construction projects in Sudan till not be failed and to achieve objectives. The researcher also recommended widening in the dependent studies to the risk management and decision taking because it is one of the important vital issues that effects on the all construction projects in the Sudan.

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303, 6707, Elbow Drive S.W, Calgary, AB, Canada
www.intaver.com

Appendix

APPENDIX- A

COVER LETTER THAT ATTACHED TO THE QUESTIONNAIRE

Dear Sir –Madam,

I am a student of the Center of Engineering & Technical Studies (CETS) and am currently undertaking my Masters dissertation, which deals with the Impact of Management Risk on Decision-Making in Construction Projects.

The aim of my dissertation is:

- 1-To provide the project manager with the basis for effective decision making.
- 2- To emphasis the concept of risk management particularly in the stage of decision– making in order to manage areal project.
- 3-To clarify the impact of the risks and decisions – making in the objectives of the project.
- 4-To eliminate the risk before they occur and supported the decisions by thorough analysis.

I much hope that you will be able to help me with your experience as professional in the field of construction. I would be most grateful if you could spare some of your valuable time to fill in the attached questionnaire. For the purposes of my dissertation individual companies will be treated anonymously.

If you would like , I would be more than happy to send you a short summary of my dissertation including the questionnaire findings, when it is completed, please just choose ' I ' on the last page of the questionnaire.

Thank you for help

Yours Sincerely

APPENDIX- B

Questionnaire

Complementary requirement for the master's degree in construction management

THE IMPACT OF RISK MANAGEMENT ON DECISION – MAKING IN CONSTRUCTION PROJECTS

The aim of this questionnaire is to collect data from construction section in Khartoum State to evaluate the consideration of Risk management and its impact on decision making in construction projects. (These data will remain secrecy)

First part : General questions :

Put (√) on the chosen response on the square given below:

1. Academic Qualification:

Bachelor ☐ High Diploma ☐ Master ☐ Ph.D. ☐

2. Years of experience:

Less than 5 ☐ (5-10) ☐ (10 – 15) ☐ (morethan 15) ☐

3. Specialization :

Architecture ☐ Civil ☐ other mentioned ☐

4. Occupation :

Site Eng. ☐ Resident Eng. ☐ Project Manager ☐ other ☐
mentioned

5. Sector type :

Public ☐ Private ☐ other mentioned ☐

Part Two:

Put (√) on the chosen response on the square given below:

1. What is the extent of your knowledge about Risk Management program:

Very large ☐ large ☐ weak ☐ Nothing ☐

2. Do you think that the projects you participated in have complexity

Agree ☐ to what extent ☐ disagree ☐

3. Do you think that risk is considered as a general phenomenon in construction industry in Sudan

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

4. Do you think that risk management leads to a reduction and reduce its impact:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

5. Do you agree that there is a strong relation between risk management and making decision.

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

6. Do you agree that most projects failed because of bad management:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

Part three :

Put (✓) in front of the suitable response below:

1. The effect of Risk management on making decisions:

a. Administrative decisions always affect construction projects:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

b. According to your experience the source of the successful management decision in the project is the Engineer

c. According to your knowledge there is a special administration of risks and project management in the organizational Structure of companies in Sudan.

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- d. Project's managers need to join risk management as a basic operation in construction's project :

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

2. Project failure:

- a. making decisions is a basic skills that must be provided by all the staff of the project:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- b. Is there any standard or measurements to risk management in construction industry in Sudan?

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- c. ignoring the principal of risk management lead to project failure:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

3. the effect of training on both making decisions and Risk management operations :

- a. The accumulation traditional experience is the main factor in risk management

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- b. Is there any consideration of training courses in the field of Risk management in construction sector.

More exist ☐ exist ☐ to what extent ☐ not exist ☐

- c. Do you agree that there is a lot of obstacles facing training operation.

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

4. the effect of the contract on both operations of making decisions and risk management:

- a. do you agree that the project's contract represent a type of risk management

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- b. do you agree that the conditions and the kind of contract may differ at different projects.

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- c. do you agree the standard contract is considered a general aspect of construction industry in Sudan:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- d. if the response agreed that means there is insufficient knowledge of the other types of contract:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

5. The risk effect on conflict in construction industry:

- a. Do you agree that risk may cause dispute between the parties of the project :

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- b. Do you agree that most of the risks are caused by the shortening of parties in doing their tasks .

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- c. Do you agree that risks lead to the raise of the project's cost and the implementing time:

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

6. The effect of risk on the project budget:

- a. Do you agree that the cost of project must include the expected risk item.

Strongly agreed ☐ agree ☐ to what extent ☐ disagree ☐

- b. Do you agree that risks effect directly on the goals of the project (time – cost – quality) :

Strongly agreed ☐ agree ☐ to some extent ☐ disagree ☐

بسم الله الرحمن الرحيم

استبيان

متطلب تكميلي لنيل درجة الماجستير في ادارة التشييد بعنوان :

اثر ادارة المخاطر على اتخاذ القرارات في مشاريع التشييد

THE IMPACT OF RISK MANAGEMENT ON DECISION – MAKING IN CONSTRUCTION PROJECTS

الهدف من الاستبيان جمع البيانات من قطاع التشييد بولاية الخرطوم لتقييم مدي الاهتمام
بادارة المخاطر وتأثيرها علي إتخاذ القرارات في مشاريع التشييد . (ستظل هذه البيانات
سرية)

القسم الاول : الاسئلة العامة

ضع علامة (√) امام الاجابة المختارة في الشكل المربع :

1-المؤهل الاكاديمي : بكالوريوس ☐ دبلوم عالي ☐ ماجستير ☐ دكتوراة ☐

2-سنوات الخبرة العملية : (اقل من 5) ☐ (5-10) ☐ (10-15) ☐ (اكثر من 15) ☐

3- التخصص : معماري ☐ مدني ☐ اخري حدد ☐

4-الوظيفة : مهندس موقع ☐ مهندس مقيم ☐ مدير مشروع ☐ اخري حد ☐

5-القطاع : عام ☐ خاص ☐ اخري حدد ☐

القسم الثاني :

ضع علامة (√) امام الاجابة المختارة في الشكل المربع :

1-مامدي معرفتك ببرامج ادارة المخاطر :

كبيرة جدا ☐ كبيرة ☐ ضعيفة ☐ لاتوجد ☐

2- في اعتقادك هل المشروعات التي شاركت فيها، بها قدر من التعقيد :

وافق ☐ الي حد ما ☐ لا اوافق ☐

3- هل تعتقد ان المخاطر تعتبر ظاهرة عامة في صناعة التشييد بالسودان :

وافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

4- هل تعتقد ان ادارة المخاطر تؤدي الي التقليل والحد من اثارها :

وافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

5- هل توافق بأن هنالك علاقة قوية بين ادارة المخاطر واتخاذ القرار :

وافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

6- هل توافق ان فشل معظم المشروعات يكون بسبب سوء الادارة :

وافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

القسم الثالث:

ضع علامة (√) امام الاجابة التي تراها مناسبة:

1 - اثر ادارة المخاطر علي اتخاذ القرارات :

أ - القرارات الادارية دائما تؤثر في مشاريع التشييد

وافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

ب- حسب خبرتك فان القرارات الادارية الناجحة في المشروع يكون مصدرها المهندس

وافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

ج - حسب علمك فانه توجد ادارة خاصة بالمخاطر وادارة المشروع بالهيكل التنظيمي للشركات

بالسودان

وافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

د – مدراء المشاريع يحتاجون تضمين ادارة المخاطر كعملية اساسية في مشاريع التشييد ؟

اوافق بشدة ☐ اوافق ☐ الي حد ما ☐ لا اوافق ☐

2 – فشل المشروعات :

أ- اتخاذ القرارات مهارة اساسية يجب توفرها لدي طاقم المشروع

اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

ب- هل توجد معايير ومقاييس لادارة المخاطر في صناعة التشييد في السودان

يوجد ☐ الي حد ما ☐ لا يوجد ☐

ج – تجاهل مبادئ اداره المخاطر تؤدي الي فشل المشروعات :

اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

3 – اثر التدريب علي عمليتي اتخاذ القرارات وادارة المخاطر :

أ – الخبرات التراكمية التقليدية هي العامل الاساسي في ادارة المخاطر :

اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

ب – هل يوجد اهتمام بالدورات التدريبية في مجال ادارة المخاطر بقطاع التشييد ؟

يوجد بكثرة ☐ يوجد ☐ نوعا ما ☐ لا يوجد ☐

ج – هل توافق ان هنالك عقبات كثيرة تواجه عملية التدريب

اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

4 – اثر العقد علي عمليتي اتخاذ القرارات وادارة المخاطر :

أ – هل توافق ان عقد المشروع يمثل نوعا من ادارة المخاطر

اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق ☐

ب – هل توافق ان شروط ونوع العقد يمكن ان تختلف باختلاف المشروعات
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

ج – هل توافق ان العقد القياسي يعتبر سمة عامة بصناعة التشييد بالسودان
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

د – اذا كانت الاجابة بالموافقة فهذا يعتبر مؤشرا لعدم الالمام الكافي بانواع العقود الاخرى
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

5 – اثر المخاطر علي المنازعات في صناعة التشييد :

أ – هل توافق ان المخاطر يمكن ان تكون سببا في نشوء نزاع بين اطراف المشروع
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

ب – هل توافق ان معظم المخاطر تنشأ عن قصور الاطراف بالالتزام بمهامهم
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

ج – هل توافق ان المخاطر تؤدي الي ارتفاع تكلفة المشروع وزمن التنفيذ
☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

6 – اثر المخاطر علي موازنة المشروع :

أ – هل توافق ان تكلفة المشروع يجب ان تتضمن بند المخاطر المتوقعة

☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق

ب – هل توافق ان المخاطر تؤثر بصورة مباشرة علي اهداف المشروع (الزمن-التكلفة-الجودة)

☐ اوافق بشدة ☐ اوافق ☐ نوعا ما ☐ لا اوافق