RISK MANAGEMENT PRACTICES AT MOGLE BOTTELED WATER MANUFACTURING SEBETA, ETHIOPIA.

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LIST OF ACRONYMS

RM – Risk Management

RMP – Risk Management Process

PMBOK – Project Management Body of Knowledge

PMI – Project Management Institute

FTA – Fault Tree Analysis

ETA – Event Tree Analysis

CPM – Critical Path Method

PERT – Program evaluation and review technique

PLC – Project Life Cycle

WBS – Work Breakdown Structure

RBS – Risk Breakdown Structure

COS – Committee Oversight

ERM – Enterprise Risk Management

RMS – Risk Management System

ERMS – Effectiveness of Risk Management System

ICO – Internal Control

MIS – Management Information System

RID – Risk Identification

RIM – Risk Measurement

RIMO – Risk Monitoring

VAR – Value at Risk

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ABSTRACT

In order to examine how risk and risk management process is perceived in the manufacturing sector, a case study of a Bottled Water Manufacturing company called Mogle bottled water manufacturing factory is chosen. All analyses were based on a theoretical background regarding risk and risk management process in the manufacturing sector.

The purpose of this study was to investigate the current risk management practices and the risk management system that is adopted by the chosen company. The study used both primary and secondary data. The primary data were collected through questionnaires and interviews and secondary data were compiled from documents, reports, company website, and so on.

The result revealed that the company has a risk management structure in place and it has developed written policies and procedures for risk management. The study also revealed a number of weaknesses in risk management like lack of capacity in understanding risk management policies and procedures at all levels. The current tools that are used to identify, measure, monitor, and control risks are not satisfactory to properly manage their risks and tools are not reviewed periodically. The difficulties the company is facing in managing its risks are: weak management information system, lack of competent and experienced staffs, and lack of exposures to risk circumstances.

Keywords: Risk; Risk management; Risk management process; Risk management methods.

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Risk management (RM) is a concept which is used in all industries, from IT related business, automobile or pharmaceutical industry, to the construction or manufacturing sector. Each industry has developed their own RM standards, but the general ideas of the concept usually remain the same regardless of the sector. According to the Project Management Institute (PMI, 2004), project risk management is one of the nine most critical parts of project commissioning. This indicates a strong relationship between managing risks and a project success. While RM is described as the most difficult area within the manufacturing sector (Winch, 2002; Potts 2008) its application is promoted in all projects in order to avoid negative consequences (Potts, 2008).

One concept which is widely used within the field of RM is called the risk management process (RMP) and consists of four main steps: identification, assessment, taking action and monitoring the risks (Cooper et al., 2005). In each of these steps, there are a number of methods and techniques which facilitate handling the risks.

Many industries have become more proactive and aware of using analyses in projects. Likewise, RM has become a timely issue widely discussed across industries. However, with regard to the manufacturing industry, risk management is not commonly used (Klemetti, 2006). More manufacturing companies are starting to become aware of the RMP, but are still not using models and techniques aimed for managing risks. This contradicts the fact that the industry is trying to be more cost and time efficient as well as have more control over projects. Risk is associated to any project regardless the industry and thus RM should be of interest to any project manager. Risks differ between projects due to the fact that every project is unique, especially in the manufacturing industry (Gould and Joyce, 2002). However there are still many practitioners that have not realized the importance of including risk management in the process of delivering the project (Smith et al., 2006). Even though there is an awareness of risks and their consequences, some organizations do not approach them with established RM methods.

The manufacturing industry operates in a very uncertain environment where conditions can change due to the complexity of each project (Sanvido et al., 1992). The aim of each organization is to be successful and RM can facilitate it. However it should be underlined that risk management is not a tool which ensures success but rather a tool which helps to increase the

probability of achieving success. Risk management is therefore a proactive rather than a reactive concept.

1.2. Statement of the Problem

Management is simply defined as identifying, analyzing and managing the uncertainties in a project -both positive (opportunities) and negative (threats). The benefits of risk management are instrumental to a project's success. By proactively addressing uncertainties, in combination with a strong project management program, problems within the project can significantly decrease.

The main challenges facing management are to estimate the level of risk by the position holder, also to estimate whether the management is aware of the risk and are they implying their knowledge in the avoiding of risks. Top management should investigate various types of risks facing its business, and how to manage the risk via education or past experience and other sources; also we can know how risk can affect the success degree of projects.

Many previous studies (Klemetti, 2006; Lyons and Skitmore, 2002; Zou et al. 2006) have been conducted within the field of RM but each presents a different approach to this concept. This research focuses on the manufacturing industry, especially at Mogle Bottled Water manufacturing plant and explores how the subject is being practiced in the everyday operation.

This thesis evaluated how the risk management process is used in the manufacturing industry and how the practitioners are managing risks in everyday situations. The theory of the risk management process is compared to the actual practice in order to investigate similarities and differences. In other words, the main idea is to see if the manufacturing industry is working with risk management as it is described in the literature regarding the methods and techniques presented.

Among others, the following are some of the problems observed at Mogle bottled water manufacturing:

- Lack of trainings in the field of risk management
- Lack of responsibility and accountability among staff members
- Many of the company employees are unskilled and less experienced in the field of risk management
- Employees are not capable of foreseeing the risks involved in their day to day activities

Thus, this research will set sights on how project risk management is being practiced and will introduce the impact of risk management on projects success in the factory as well as in the manufacturing sector.

1.3. Research Questions

In order to achieve the purpose, the following research questions have been formulated:

- How are risks and risk management perceived in projects at mogle bottled water manufacturing?
- How is RM used in practice in the factory?
- What is the management awareness of RM at the factory?
- What is the application extent of risk management and risk management process at mogle bottled water manufacturing?

1.4. Objective of the Study

The main objective of this research is to critically assess project risk management practices at Mogle bottled water manufacturing plant and. The study also aims at:

- Assessing how risks and risk management are perceived in projects at mogle bottled water manufacturing
- Investigating how risk management is being used in practice at the factory.
- Investigating management awareness of risk management, and applying their knowledge while managing these projects.
- To evaluate the application extent of risk management and risk management process in the industry

1.5. Definition of Terms (Source Cooper et. al (2005))

- **Risk:** is the potential of gaining or losing something of value. Values (such as financial, physical health, social status, emotional well-being or financial wealth) can be gained or lost when taking risk resulting from a given action or inaction, foreseen or unforeseen. Risk can also be defined as the intentional interaction with uncertainty. Uncertainty is a potential, unpredictable, and uncontrollable outcome; risk is a consequence of action taken in spite of uncertainty.
    - **Risk management:** Risk management is the process of identifying, assessing and controlling threats to an organization's capital and earnings. These threats, or risks, could

stem from a wide variety of sources, including financial uncertainty, legal liabilities, strategic management errors, accidents and natural disasters.

Risk management is a method of controlling the uncertainties in a project, that is, anything that may stop the project from achieving its goals. The aim of risk management is to minimize uncertainties and ensure that the project is delivered on time. Project and risk managers must allocate resources to mitigate those risks with a high probability of occurrence. The gain from the use of these resources should exceed any consequences of inactivity.

- **Risk management process:** Risk Management process is "the systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analyzing, assessing, treating, monitoring and communicating" (AS/NZS ISO 31000:2009).
- **Risk management methods:** Are the methods used to manage risks. All risk management processes follow the same basic steps, although sometimes different jargon is used to describe these steps. Together these 5 risk management process steps (Identify the Risk, Analyze the risk, Evaluate or Rank the Risk,Treat the Risk,Monitor and Review the risk) combine to deliver a simple and effective risk management process.
- **Project life cycle:** The Project Life Cycle refers to a series of activities which are necessary to fulfill project goals or objectives. Projects vary in size and complexity, but, no matter how large or small, all projects can be mapped to the following life cycle structure:
  - ✓ Starting the project
  - ✓ Organizing and preparing
  - ✓ Carrying out project work
  - ✓ Closing the project

1.6. Significance of the Study

The importance of this research stems from the essence of risk management itself, for the reason that risk management has been identified as one of the most important tools in determining any project success; yet, few studies investigate the nature of this relationship (Fewings, 2005). As a result, this research will drive the attention to the importance of a high level of awareness to risk management

problems. In addition, studying the relation between risk management and project's success is important because most of projects are operating in a very dynamic and rapidly changing environment not always fixed circumstances and uncertainty factors are surrounding the firm, in such environment adopting changes very quickly is a must for the project overall to grow or even survive. Adopting overall project changes can't be applicable without the management ability to adapt model in risk management and make the new changes. Accordingly, the results of this research may help the managers to better evaluate the risks around them and better respond to these risks, and present them methods that may enhances their projects risk management.

In general the research study will attempt to provide the following benefits:

- ✓ The study will be used by researchers to get enough knowledge in research activities
- ✓ The study will suggest better and effective risk management methods and processes
- ✓ The study will find possible solutions that is deemed to improve RMP and methods
- ✓ It will give full understanding about how RM is being implemented in the selected area

1.7. Scope and Limitations of the Study

This research work is limited to at Mogle Bottled Water Manufacturing, Sebeta, Ethiopia. The limiting factors are the similarity of projects in the manufacturing sector and the possibility to get representative data from such huge factory.

Other important limitation specific to the researcher are researcher's financial conditions and shortage of time.

1.8. Organization of the study

- Chapter One: Introduction

This chapter contained background of the study, statement of the problem, basic research questions, objective of the study, definition of terms, significance of the study, and delimitations/scope of the study.

- Chapter Two: Review of related literature

This chapter deals with the literature relevant to the study.

- Chapter Three: Methods of Study:

Under this chapter, the type and design of the research; the subjects/participant of the study; the sources of data; the data collection tools/instruments employed; the procedures of data collection; and the methods of data analysis used are described.

- Chapter Four: Results and Discussions

This chapter summarizes the results/findings of the study, and interprets and/or discusses the findings. Here, the literature review will be extensively used.

- Chapter Five: Summary, Conclusions, and Recommendations

This chapter comprises four sections which include summary of findings, conclusions, limitations of the study and recommendations

- Summary of findings is drawn from the results discussed under chapter four.
- Conclusion is drawn from the summary of findings.
- Practical recommendations are given.

CHAPTER TWO: LITERATURE REVIEW

The relevance to the topic and newness of the literature are the two acceptance criterions that were applied to select the respective literatures for this chapter.

Accordingly, this chapter contains the following sub-categories:

a. Definition of risk;

b. The risk management;

c. The risk management process; and

d. Managing risk in different industries.

2.1. Definition of Risk

Although project risk management has been known and developed to a certain degree of maturity, there is yet to be a common definition for the term “risk”, as is still being debated by the risk community. To most people, risk is viewed in terms of a negative effect and quite surprisingly, some national standard-setting bodies such as the International Organization for Standardization (ISO) ISO/IEC 27005:2008 also uses the negative definition of risk.

Based on “What is risk?” towards a common definition” by Hillson (2002a), it clearly identified that there are two options towards the definition of “risk”. Firstly, risk is defined as an umbrella term which consists of two elements where risk with positive effects is known as opportunity while threat is risk with negative effects.

Secondly, the word “uncertainty” is an overarching term to express risk solely representing negative effects or threat and refers opportunity to be an uncertainty that have positive effects. It is observed that option one seems to be the current trend being widely accepted by many practitioners and researchers of risk management. According to Heldman(2005), most of us often overlooked the other side of the picture, thus tend to think of risk in terms of negative consequences. Although risks are potential events that cause threats to projects, they are also potential opportunities embedded in risk. It is an obstacle preventing a project, either positively or negatively, to be delivered based on goals being set.

In contrast to the perspective of viewing risk as an event that results in a positive or negative effect on the project objective if it occurs, is viewed as uncertainty. Uncertainty was defined as an unknown probability of occurrence of an event that derives from three principal sources, external factors, change of business strategies and ill-defined methods for project realization as mentioned by Jaafari (2001). The unknown probability of impact and multiple variables with various levels of uncertainties within the context of a rapid changing environment creates “complexity” to manage project. A slightly different view was developed by Chapman (1997) where risk is an uncertain effect rather than as a cause of an effect on project performance such as cost, time and quality. Thus, the term uncertainty as risk includes “variability” in terms of performance measures and “ambiguity” which is closely connected with the lack of clarity due to various factors. The three key areas of uncertainty are associated with estimates, project parties and phases of the project life cycle.

In contrast to several perspectives of risk illustrated above, Dowie (1999) argued persuasively to abandon the term “risk”. He illustrated that the word itself contains multiple usage that consistently creates confusion and ambiguity in order to perform identification and evaluation on available facts that support the decision making process as well as elicit and process quality judgments. Thus, it makes it difficult to integrate both distinct types of inputs in a logical and transparent manner.

It doesn't matter how the term "risk" is classified since the decision consist of both opportunities and threats that are equally important elements influencing project success as mentioned by Hillson (2002b). Thus, both needs to be managed proactively and effectively through risk management approach which is covered in the next category of this literature review. 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 2.1.

Table 2.1 Definitions of risk and uncertainty

Author:	**Risk definition**	**Uncertainty definition**
Winch (2002)	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 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.
Cleden (2009)	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.	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 even be aware of
Smith *et al.*	Risks occur where there is some	There might be not enough

(2006)	knowledge about the event.	information about the occurrence of an event, but we know that it might occur.
Webb (2003)	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.	Uncertainty is a situation with an outcome about which a person has no knowledge.
Darnall and Preston (2010)	Risk is a possibility of loss or injury.	
Cooper *et al.* (2005)	Risk is exposure to the consequences of uncertainty.	

All risk definitions complied in Table 1 describes 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 Cleden (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 1 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.

2.2. The Risk Management

Many explanations and definitions of risks and risk management have been recently developed, and thus it is difficult to choose one which is always true. Each author provides his own perception of what risk means and how to manage it. The description depends on the profession, project and type of business (Samson, 2009). Risk management in general is a very broad subject and definitions of risk can therefore differ and be difficult to apply in all industries in general. For the purpose of this thesis one definition of risk and risk management will be chosen, in order to have a clear understanding of these concepts in manufacturing industry.

2.2.1. A Concept of Risk Management

Smith et.al (2006) provides a comprehensive description of the concept of RM and how it can be used in practice. According to the authors, risk management cannot be perceived as a tool to predict the future, since that is rather impossible. Instead, they describe it as a tool to facilitate the project in order to make better decisions based on the information from the investment. In this way, decisions based on insufficient information can be avoided, and this will lead to better overall performance. In the literature, RM is described as a process with some predefined procedures. The scope of its definition differs among the authors; however the core information is the same. From a number of definitions which can be found in the management literature Cooper et. al. (2005) explanation brings the essence of this concept:

The risk management process involves the systematic application of management policies, processes and procedures to the tasks of establishing the context, identifying, analyzing, assessing, treating, monitoring and communicating risks (Cooper et al., 2005).

Risk management process (RMP) is the basic principle of understanding and managing risks in a project. It consists of the main phases: identification, assessment and analysis, and response (Smith *et al.* 2006) as shown in Figure 3. All steps in RMP should be included when dealing with risks, in order to efficiently implement the process in the project. There are many variations of RMP available in literature, but most commonly described frameworks consist of those mentioned steps. In some models there is one more step added, and the majority of sources identify it as risk monitoring or review. For the purpose of this paper the model of RMP

described by Smith *et al*. (2006) will be used for further analysis and will be further explained in the following section.

Figure 2.2 the Process of managing risks

Source: (Smith et al. 2006)

Source: Smith et al. (2006)

2.2.2. Benefits of 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).

2.2.3. 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).

2.2.4. Risks in the Manufacturing Sector

Manufacturing is an industry of great diversity. This is because there are a large number of different products produced and there are many systems and manufacturing practices which vary according to different resources in different parts of the world. Consequently any attempt to produce a simple framework for the identification of the most common risks is not easy, even within genera of food or non-food products. For example, the risks of bottled water production in Denmark are substantially different from those in Ethiopia; and the risks for Automobile manufacturing in Scotland are different from those in our country Ethiopia.

The following framework summarizes the principal areas of risk faced by the manufactures in the pursuit of profitability in the manufacturing industry. They are separated into (A) business risks, that is, risks directly related to the business of manufacturing; and (B) pure risks, that is, the risks of life and business in general.

Table 2.2 Manufacturing risks

A. Business risks	
1. Production risks	
(i) Operational risks	Risks which interrupt the production cycle, such as mechanical failure, failure of technical processes, procedure, system, policy late delivery of supplies and services
(ii) Technological risks	Risks associated with lack of adequate technology, such as lack of technical information and expertise
(iii) Financial risks	Risks due to government financial policies, use and dependence on government policy instruments, terms of credit, changes in operational costs
(iv) Social risks	Risks due to actions of special interest groups, such as environmentalists and conservationists
2. Market-related risks	Risks due to loss of product quality, lack of market information, actions of third party (the marketing middleman)
3. Consumer-related risks	Risks due to loss of consumer appeal, health regulations, actions of third party (the consumer)
B. Pure risks	
1. Physical risks of nature	Risks due to extreme climatic and meteorological conditions (wind, flood, drought, earthquake, volcanic action)
2. Social and political risks	Risks due to theft, malicious damage, and fraud

3. Liability	Risks due to legal actions against the manufacturer

Source: FAO.Org (2012)

The examples are far from exhaustive but they indicate the principal types of risk for each process which are important for manufacturers in the manufacturing industry to consider. In their own right, each area is worthy of identification and should be given appropriate thought in the context of the particular operations of each individual manufacturer, its location, the market system, and the target consumers of the product. To neglect this exercise possibly creates a third risk category, namely management risks, which would identify elements of poor planning and poor business control.

2.3. The Risk Management Process

As mentioned above, an RMP described by Smith et al. (2006) has been chosen for the purpose of this paper. This section will further explain the RMP, its four stages and how it can be used in managing risks.

2.3.1. Risk Identification

Winch (2002) claims that the first step in the RMP is usually informal and can be performed in various ways, depending on the organization and the project team. It means that the identification of risks relies mostly on past experience that should be used in upcoming projects. In order to find the potential risks, an allocation needs to be done. This can be decided and arranged by the organization. In this case, no method is better than another, since the only purpose is to establish the possible risks in a project.

Risks and other threats can be hard to eliminate, but when they have been identified, it is easier to take actions and have control over them. If the causes of the risks have been identified and allocated before any problems occur, the risk management will be more effective (PMI, 2004). RM is not only solving problems in advance, but also being prepared for potential problems that can occur unexpectedly. Handling potential threats is not only a way to minimize losses within the project, but also a way to transfer risks into opportunities, which can lead to economical profitability, environmental and other advantages (Winch, 2002).

The purpose of identifying risks is to obtain a list with potential risks to be managed in a project (PMI, 2004). In order to find all potential risks which might impact a specific project, different techniques can be applied. It is important to use a method that the project team is most familiar

with and the project will benefit from. The aim is to highlight the potential problems, in order for the project team to be aware of them. Authors describe many creative alternative methods. To systematize this process, all the methods which can be found in the literature have been put together in Table2.3. (Smith et al. 2006; Lester, 2007; PMI, 2004)

Table 2.3 Risk identification techniques

Information gathering methods	Workshops
	Brainstorming
	Interviews
	Questionnaires
	Benchmarking
	Consulting experts
	Past experience
	Delphi technique
	Risk breakdown structure
	Visit locations
Documentation	Databases, historical data from similar projects
	Templates
	Checklists
	Study project documentation (plan, files etc.)
	Study specialist literature
Research	Stakeholder analysis
	Research assumptions
	Research interfaces

Source: Smith et.al. (2006)

Lists with potential problems are created on different bases and are tailored for a certain project individually. In the literature, examples of risks can be found which can be used in creating those compilations. Possible risks which can be found in the literature are combined in Table2.4. (Smith et al. 2006; Potts, 2008; Lester, 2007; Bing, et al, 2005; Webb, 2003; Darnall and Preston, 2010; Edwards, 1995; Jeynes, 2002)

Table 2.4 Risk categories divided into groups

Risk categories	
Groups	**Risks**
Monetary	Financial
	Economical
	Investment
Political	Legal
	Political
Environment	Environmental
	Natural, physical
Technical	Technical
Project	Contractual, client
	Project objectives
	Planning, scheduling
	Construction
	Design
	Quality
	Operational
	Organizational
Human	Labor, stakeholder
	Human factors
	Cultural
Market	Market
Safety	Safety
	Security, crime
Materials	Resources
	Logistics

Source: Smith et.al. (2006)

2.3.2. Assessment/Analysis

Qualitative or quantitative?

Risk assessment is a topic that researchers have emphasized on recently. The definition found in the ISO 31000 (2000) is that risk assessment comprises of risk identification, risk analysis and risk evaluation. Risk identification is the step where the organization should identify sources of risk, areas of impacts, events and their causes and respective potential consequences. It is clearly stressed by Forsberg et al (2005) that risk analysis is not the same as a technical risk assessment foremost to a risk management plan. The risk analysis is the procedure of an upward insight of the risk. The purpose of risk evaluation is to support decision makings, focused on the risk analysis results, concern with those risks that required management attention and to prioritize treatment implementation. The PRAM provided by Chapman (2001) is divided into two sub-stages: a qualitative analysis sub-stage that focuses on identification together with risk assessment while the quantitative analysis sub-stage focuses on risk evaluation. In addition, the PMBOK Guide (PMI, 2004) clearly differentiates the qualitative risk analysis from the quantitative risk analysis in Chapter 11.

Although the PMBOK Guide Section 11.3 defines that qualitative analysis as risk prioritization, Thompson and Perry (1992) define the qualitative risk analysis as the process of two objectives: the risk identification and the initial risk assessment. This initial phase is essential because it gives substantial benefits in project understanding. This is further supported by Heldman's (2005) comments that the purpose of the qualitative risk analysis process is to determine the consequences that the identified risks may have on the project objectives. It involves determining the probability that the risks will occur and risks are ranked according to their effect on the project objectives. In her opinion, the qualitative risk analysis is the most commonly and probably the easiest method for analyzing risks. In this sense, Chapman and Ward (1997) added that the qualitative analysis and its documentation can also help to capture corporate knowledge in an effective manner, for use in both current and future projects where an explicit corporate culture management can pay major dividends. Restrepo (1995) avowed that 'majority of decisions are based on the qualitative risk assessment results than the quantitative ones', thus, Patterson (2002) explain that the qualitative assessments are generically easier and less costly to complete than utilizing the quantitative simulation techniques. Nevertheless, as a result of this,

qualitative assessments can contain more uncertainties and potentially less accurate information than quantitative analysis methods.

The quantitative risk analysis is defined as the process of evaluating and quantifying risk exposure by assigning numeric values to the risk probabilities and impacts as illustrated by Heldman (2005). However, some of the quantification techniques are closely related to qualitative techniques because it required the overall score that needs to be obtained through the application of the probability and impact scales. The PMBOK Guide Section 11.4 defines quantitative risk analysis as the numerical analysis of the risk effect on the project. For Thompson and Perry (1992), the quantitative analysis frequently includes complex analysis methods, regularly with the need of computer programs as a large formal feature of the whole process requiring estimates of uncertainty and probabilistic combination of individual uncertainties. Cooper et al (2005) acknowledged that the quantitative analysis uses numerical ratio scales for likelihoods and consequences, rather than descriptive scales. The value of quantitative analysis is to facilitate in distinguishing between targets, expectations, and commitments, the pursuit of risk efficient ways of carrying out a project, and related culture changes according to Chapman and Ward (1997).

The risk management process described in the BS 6079-3:2000 is applicable for each aspect of the business activity with a focus at each level of decision making which includes the business and project objectives, the risk identification, the risk analysis, the risk evaluation and the risk treatment. In the case of the PMBOK Guide Chapter 11, the process consists of risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning and risk monitoring and control. These processes interact with each other and with the processes in other knowledge area too. The SHAMPU framework by Chapman and Ward (1997) contains nine phases which embraces the identification of the qualitative analysis through identification, structuring, clarification of issues and adding the quantitative analysis that includes the estimate variability and the evaluation of implications. In recent years, the project cash flow model by Caron et al (2007) which is an event oriented analysis used with the typical risk management methods such as risk identification, qualitative analysis and the planning of response actions, gives as a result the data for the variation oriented analysis, conformed by a quantitative analysis including the model of the project, probability distribution of model parameters, simulation and the Net Present Value (NPV) distribution.

The most commonly used risk identification and analysis techniques are divided into qualitative and quantitative approaches as shown in Table 7 based on the PRAM proposed by Chapman (2001). The table was created by referencing to various sources such as Kliem and Ludin (1997), Kendrick (2009) and PMBOK Guide (PMI, 2004). The qualitative techniques cover the two stages of the risk management process, namely the risk identification and risk analysis. In the case of risk identification, the PMBOK Guide (PMI, 2004) and Kerzner (2009) recommend the use of documentation reviews, information gathering techniques such as brainstorming, SWOT, checklist analysis and assumptions analysis as well as diagramming techniques such as the cause and effect diagramming. In contrary, the risk probability and impact matrix, risk categorization (e.g. risk breakdown structure) and heuristics are commonly used techniques to perform risk analysis. The quantitative techniques which are widely used to perform risk analysis comprise of earned value monetary, simulation and modeling techniques. For example, the commonly known decision trees analysis, Monte Carlo simulations, CPM and PERT analysis. In addition, Vose (2008) illustrated the benefit and advantages of using Monte Carlo analysis especially integrating with the Primavera software. However, it is surprisingly to know from the study by Besner and Hobbs (2008) that this technique is low in application in the practical field and quantitative techniques of risk assessment are mostly found to be applied in big organizations especially for high technology projects.

Risk analysis can also be described as the second stage in the RMP where collected data about the potential risk are analyzed. It is short listing risks with the highest impact on the project, out of all threats mentioned in the identification phase (Cooper *et al.* 2005). Although some researchers distinguish between terms risk assessment and risk analysis and describe them as two separate processes, for the purpose of this paper, this part of RMP will be consistent with the model provided by Smith et al. (2006) and described as one process.

In the analysis of the identified risk, two categories of methods – qualitative and quantitative – have been developed. The qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale from high to low level. The quantitative methods are used to determine the probability and impacts of the risks identified and are based on numeric estimations (Winch, 2002). Companies tend to use a qualitative approach since it is more convenient to describe the risks than to quantify them (Lichtenstein, 1996). In addition, there is also one approach called semi-quantitative analysis, which combines numerical values from

quantitative analysis and description of risk factors, the qualitative method (Cooper *et al.* 2005). However, this approach will not be further addressed in this paper.

Within the quantitative and qualitative categories, a number of methods which use different assumptions can be found, and it may be problematic to choose an appropriate risk assessment model for a specific project. The methods should be chosen depending on the type of risk, project scope as well as on the specific method's requirements and criteria. Regardless of the method chosen, the desired outcome of such assessment should be reliable (Lichtenstein, 1996). Perry (1986) mentions that the selection of the right technique often depends on past experience, expertise, and nowadays it also depends on the available computer software.

Lichtenstein (1996) explains a number of factors that can influence the selection of the most appropriate methods in the risk assessment for the right purpose. It is up to each organization to decide which of these factors are the most critical for them and develop the assessment accordingly. In a survey conducted by Lichtenstein (1996), many factors were discovered, and the most important ones are listed below.

- Cost of using the method, both the employment cost and the method itself
- Adaptability, the need of adapting to the organization's requirement
- Complexity, how limited and simple the method is
- Completeness, the method needs to be feasible
- Usability, the method should be understandable to use
- Validity, the results should be valid
- Credibility

Below is a brief description of various risk analysis methods. All of these methods are used in the manufacturing industry (Azari, 2010).

2.3.2.1. Quantitative Methods

Quantitative methods need a lot of work for the analysis to be performed. The effort should be weighed against the benefits and outcomes from the chosen method, for example smaller projects may sometimes require only identification and taking action on the identified risks, while larger projects require more in depth analysis. The quantitative methods estimate the impact of a risk in a project (PMI, 2009). They are more suitable for medium and large projects due to the number of required resources such as complex software and skilled personnel (Heldman, 2005).

Scenario technique - Monte Carlo simulation

The Monte Carlo method is based on statistics which are used in a simulation to assess the risks. The simulation is used for forecasting, estimations and risk analysis by generating different scenarios (Mun, 2006). Information collected for the simulation is, for instance, historical data from previous projects. The data represent variables of schedule and costs for each small activity in a project, and may contain pessimistic, most likely and optimistic scenarios (Heldman, 2005). The simulation can be presented as a basket with golf balls, as Mun (2006) explains the process. Data (the golf balls) are mixed and one of them is picked each time the simulation is done. The chosen unit is an outcome which is recorded and the ball will be put back into the basket. The simulation is then redone a number of times and all outcomes are recorded. After completing the simulations required number of times, the average is drawn from all of the outcomes, which will constitute the forecast for the risk (Mun, 2006). The result from this method is a probability of a risk to occur, often expressed in a percentage (Darnall and Preston, 2010).

The most common way of performing the Monte Carlo simulation is to use the program Risk Simulator software, where more efficient simulations can be performed. This analysis can be also done in Microsoft Excel where a special function is used to pick the data randomly, but the results can be very limited (Mun, 2006).

Modeling technique - Sensitivity analysis

The purpose of a sensitivity analysis is to establish the risk events which have the greatest impact or value. Those events are later weighed against the objectives of the project. The higher the level of uncertainty a specific risk has the more sensitive it is concerning the objectives. In other words, the risk events which are the most critical to the project are the most sensitive and appropriate action needs to be taken. (Heldman, 2005)

The result from the analysis can be presented in a spider diagram, Figure 2, which shows the areas in the project which are the most critical and sensitive. Moreover, one disadvantage with this analysis is that the variables are considered separately, which means that there is no connection between them (Perry, 1986 and Smith *et al.* 2006).

Figure 2.2 this figure shows how a sensitivity analysis can look like.

Source: Heldman (2005), p# 112

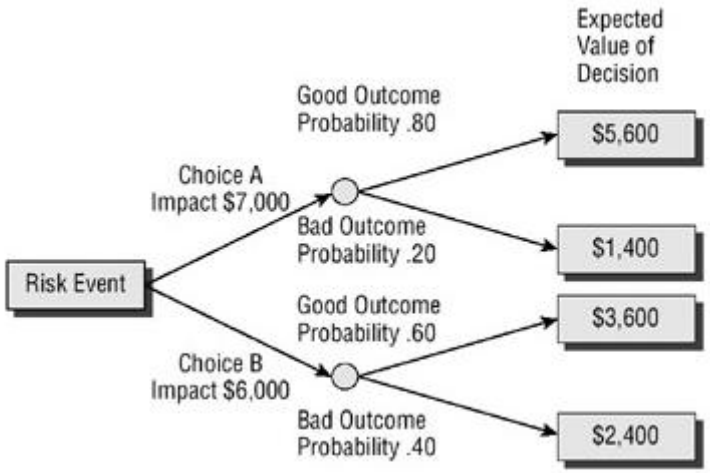
The method requires a model of project in order to be analyzed with computer software. According to Smith *et al.* (2006), the project will benefit if the method is carried out in the project's initial phases in order to focus on critical areas during the project.

Diagramming technique

Decision tree analyses are commonly used when certain risks have an exceptionally high impact on the two main project objectives: time and cost (Heldman, 2005). There are two types of decisions trees; called Fault tree analysis (FTA) and Event tree analysis (ETA).

The FTA method of analysis is used to determine the probability of the risk and is used to identify risks that can contribute or cause a failure of one event (Cooper *et al.* 2005). The purpose is to find the underlying causes to this event. It is usually drawn up as a sketch of a tree. The branches are the causes to the problem, and the starting point of the tree is the problem itself. Each branch has its own sequence of events and possible outcomes. The problem could depend on some causes that are interrelated with each other, or simply random causes (Cooper *et al.* 2005). By having many branches, the tree provides an opportunity to choose which branch to follow and base decisions on, see Figure 5 (Heldman, 2005).

Figure 2.3 an example of a decision tree



Source: Heldman (2005), p# 209

Fault tree analysis (FTA) and a similar analysis called event tree analysis (ETA), are simple methods which can be used as a structured model to identify causes and effects of a single event, but present different approaches (White, 1995).

As explained, ETA is very similar to the FTA, but what differentiates the methods is the outcome. ETA is also drawn as a tree but in an opposite approach than the FTA. According to White (1995), failure generally does not have its roots in a single cause. It is rather described as a chain of causes and consequences in a sequence which can end up in major damage for the project. The tree consists of branches which represent the consequences that can be followed by that main event that this method is analyzing. Every branch has its own focus on a specific type of causes, which is why the importance is so great to create a risk assessment. (White, 1995)

In both FTA and ETA, cause-effect skills are required including the possibility to understand how failure could occur and see which failure modes can arise from the situation respectively. Therefore it is preferable to have an analyst within the field of risk management in the project team (White, 1995).

2.3.2.2. Qualitative Methods

Qualitative methods for risk assessment are based on descriptive scales, and are used for describing the likelihood and impact of a risk. These relatively simple techniques apply when quick assessment is required (Cooper *et al*. 2005) in small and medium size projects (Heldman, 2005). Moreover, this method is often used in case of inadequate, limited or unavailable numerical data as well as limited resources of time and money (Radu, 2009). The main aim is to prioritize potential threats in order to identify those of greatest impact on the project (Cooper *et al*. 2005), and by focusing on those threats, improve the project's overall performance (PMI, 2004). The complexity of scales (Cooper *et al*. 2005) and definitions (PMI, 2004) used in this examination reflect the project's size and its objectives. During the phases of the PLC, risks may change, and thus continuous risk assessment helps to establish actual risk status (Cooper *et al*. 2005).

Limitations of qualitative methods lie in the accuracy of the data needed to provide credible analysis. In order for the risk analysis to be of use for the project team, the accuracy, quality, reliability, and integrity of the information as well as understanding the risk is essential.

Qualitative methods are related to the quantitative methods, and in some cases constitute its foundations (PMI, 2004).

PMI (2004) identifies four qualitative methods for risk assessment: Risk probability and impact assessment, Probability/impact risk rating matrix, Risk Categorization and Risk Urgency Assessment. These methods are briefly discussed below.

Risk probability and impact assessment

By applying the method called risk probability and impact assessment, the likelihood of a specific risk to occur is evaluated. Furthermore, risk impact on a project's objectives is assessed regarding its positive effects for opportunities, as well as negative effects which result from threats. For the purpose of this assessment, probability and impact should be defined and tailored to a particular project (PMI, 2004). This means that clear definitions of scale should be drawn up and its scope depends on the project's nature, criteria and objectives (Cooper *et al*. 2005). PMI (2004) identifies exemplary range of probability from 'very unlikely' to 'almost certain';however, corresponding numerical assessment is admissible. The impact scale varies from 'very low' to 'very high'. Moreover, as shown in Table 5, assessing impact of project factors like time, cost or quality requires further definitions of each degree in scale to be drawn up. Each risk listed under the identification phase is assessed in terms of the probability and the impact of its occurrence (PMI, 2004).

Table 2.5 Definition of Impact Scales for Four Project

Objectives

Defined Conditions for Impact Scales of a Risk on Major Project Objectives
(Examples are shown for negative impacts only)

Project Objective	Relative or numerical scales are shown				
	Very low /.05	Low /.10	Moderate /.20	High /.40	Very high /.80
Cost	Insignificant cost increase	<10% cost increase	10-20% cost increase	20-40% cost increase	>40% cost lincrease
Time	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time iIncrease	>20% time increase
Scope	Scope decrease barely noticeable	Minor areas of scope affected	Major areas of scope affected	Scope reduction unacceptable to sponsor	Project end item is effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires sponsor approval	Quality reduction unacceptable to sponsor	Project end item is effectively useless

This table presents examples of risk impact definitions for four different project objectives. They should be tailored in the Risk Management Planning process to the individual project and to the organization's risk thresholds. Impact definitions can be developed for opportunities in a similar way.

Source: PMI (2004), p# 198

Risk impact assessment investigates the potential effect on a project objective such as time, cost, scope, or quality. Risk probability assessment investigates the likelihood of each specific risk to occur. The level of probability for each risk and its impact on each objective is evaluated during

an interview or meeting. Explanatory detail, including assumptions justifying the levels assigned, are also recorded. Risk probabilities and impacts are rated according to the definitions given in the risk management plan. Sometimes, risks with obviously low ratings of probability and impact will not be rated, but will be included on a watch-list for future monitoring (Ritter, 2008).

Probability/impact risk rating matrix

Probability and impact, which were assessed in the previous step, are used as basis for quantitative analysis and risk response which will be explained further in the paper. For this reason findings from the assessment are prioritized by using various methods of calculation which can be found in the literature (PMI, 2004). Westland (2006) computes the priority score as the average of the probability and impact. The range of priority score, the rating and color are assigned to indicate the importance of each risk (Westland, 2006). In order to set priorities, impact is multiplied by probability. The compiled results are shown in the matrix in Table 6 (PMI, 2004). Such combination of factors indicates which risks are of low, moderate, or high priority. Regardless of the calculation method chosen, such a combination of data shows priority of previously identified risks by use of i.e. corresponding colors or numerical system and helps to assign appropriate risk response. For instance, threats with high impact and likelihood are identified as high-risk and may require immediate response, while low priority score threats can be monitored with action being taken only if, or when, needed (PMI, 2004).

Table 2.6 Probability and Impact Matrix

Probability and Impact Matrix

Probability	Threats					Opportunities				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
	0.05	0.10	0.20	0.40	0.80	0.80	0.40	0.20	0.10	0.05

Impact (ratio scale) on an objective (e.g., cost, time, scope or quality)

Each risk is rated on its probability of occurring and impact on an objective if it does occur. The organization's thresholds for low, moderate or high risks are shown in the matrix and determine whether the risk is scored as high, moderate or low for that objective.

Source: PMI (2004), p# 204

Risk categorization, and Risk Urgency Assessment

Two methods mentioned by PMI (2004) are not as commonly used as probability and impact. Risk categorization is a way of systematizing project threats according to e.g. their sources, in order to identify areas of the project that are most exposed to those risks. Tools which can be used in this method are work break down structure (WBS) or risk breakdown structure (RBS),

and their role is to develop effective risk response (PMI, 2004). WBS breaks down large activities into small, manageable units and creates linked, hierarchical series of independent activities (Maylor, 2005). RBS categorizes risks and shows their dependencies (Dallas, 2006). The role of the second method, Risk Urgency Assessment, is to prioritize risks according to how quick response they require.

Lists with risks prioritized by applying qualitative methods, can be used to bring attention to significant problems to the project. Problems that are classified as a medium level risks can be a subject of a quantitative analysis to have better control over them. The threats that are assessed as low impact can be placed on a watch list and monitored. It will allow the project team to focus on more important issues. Risk categorization helps reveal the weak links in the project organization where more attention should be directed (PMI, 2004).

Table 2.7 the most commonly used qualitative and quantitative techniques

Qualitative Techniques	**Quantitative Techniques**
□ Documentation Reviews (e.g. lesson learned documentation of past projects) □ Brainstorming □ Root Cause Identification (e.g. Ishikawa fishbone) □ Strengths, weakness, opportunities and threats (SWOT) □ Delphi technique □ Checklist analysis □ Assumptions analysis □ Risk categorization (e.g. Risk breakdown structure) □ Probability and impact Matrix □ Heuristics (Rule of thumb)	□ Critical Path Method (CPM) □ Program, evaluation and review technique (PERT) analysis □ Expected monetary value analysis (e.g. Decision tree analysis) □ Sensitivity Analysis □ Variance trend analysis □ Numerical approximations □ Monte Carlo analysis

Source: Cooper et al. (2005)

2.3.3. Risk Response

This third step of the RMP indicates what action should be taken towards the identified risks and threats. The response strategy and approach chosen depend on the kind of risks concerned (Winch, 2002). Other requirements are that the risk needs to have a supervisor to monitor the development of the response, which will be agreed by the actors involved in this risk management process. (PMI, 2004)

Winch (2002) claims that the lower impact the risk has, the better it can be managed. Most common strategies for risk response are: avoidance, reduction, transfer and retention (Potts, 2008). Beyond those types of responses, Winch (2002) describes that sometimes it is difficult to take a decision based on too little information. This may be avoided by waiting until the appropriate information is available in order to deal with the risk. This way of acting is called "Delay the decision" but this approach is not appropriate in all situations, especially when handling critical risks. Those need to be managed earlier in the process.

2.3.3.1. Avoidance/Prevention

If the risk is classified as bringing negative consequences to the whole project, it is of importance to review the project's aim. In other words, if the risk has significant impact on the project, the best solution is to avoid it by changing the scope of the project or, worst scenario, cancel it. There are many potential risks that a project can be exposed to, and which can impact its success (Potts, 2008). This is why risk management is required in the early stages of a project instead of dealing with the damage after the occurrence of the risk (PMI, 2004).

The avoidance means that by looking at alternatives in the project, many risks can be eliminated. If major changes are required in the project in order to avoid risks, Darnall and Preston (2010) suggest applying known and well developed strategies instead of new ones, even if the new ones may appear to be more cost efficient. In this way, the risks can be avoided and work can proceed smoothly because strategy is less stressful to the users.

Cooper *et al*. (2005) list some activities that can help to avoid potential risk:

- More detailed planning
- Alternative approaches

 Protection and safety systems
 Operation reviews
 Regular inspections
 Training and skills enhancement
 Permits to work
 Procedural changes
 Preventive maintenance

2.3.3.2. Reduction/Mitigation

By having an overview over the whole project it is easy to identify problems which are causing damage. In order to reduce the level of risk, the exposed areas should be changed (Potts, 2008). This is a way of minimizing the potential risks by mitigating their likelihood (Thomas, 2009). One way to reduce risks in a project is to add expenditures that can provide benefits in the long term. Some projects invest in guarantees or hire experts to manage high-risk activities. Those experts may find solutions that the project team has not considered (Darnall and Preston, 2010).

Mitigation strategies can, according to Cooper *et al.* (2005), include:

 Contingency planning
 Quality assurance
 Separation or relocation of activities and resources
 Contract terms and conditions
 Crisis management and disaster recovery plans

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

2.3.3.3. Transfer

If a risk can be managed by another actor who has a greater capability or capacity, the best option is to transfer it. Potts (2008), p# 67 states that, "The risk should be transferred to those who know how to manage it". The actors that the risks can be transferred to are, for example, the client, contractor, subcontractor, designer etc., depending on the risk's character. As a result this could lead to higher costs and additional work, usually called risk premium (Potts, 2008). It must

be recognized that the risk is not eliminated; it is only transferred to the party that is best able to manage it (PMI, 2004). Shifting risks and the negative impacts they bring is also an option when the risks are outside the project management's control, for example political issues or labor strikes (Darnall and Preston, 2010). The situation may also consist of catastrophes that are rare and unpredictable in a certain environment. (Winch, 2002) Such risks that are beyond the management's control should be transferred through insurance policies.

2.3.3.4. Retention

When a risk cannot be transferred or avoided, the best solution is to retain the risk. In this case the risk must be controlled, in order to minimize the impact of its occurrence (Potts, 2008). Retention can also be an option when other solutions are uneconomical (Thomas, 2009).

2.3.4. Monitoring

This final step of RMP is vital since all information about the identified risks is collected and monitored (Winch, 2002). The continuous supervision over the RMP helps to discover new risks, keep track of identified risks and eliminate past risks from the risk assessment and project (PMI, 2004). PMI (2004) also states that the assumptions for monitoring and controlling are to supervise the status of the risks and take corrective actions if needed.

PMI, (2004) suggested tools and techniques used to risk monitor and control may be:

- Risk reassessment – Is identification of new potential risks. This is a constantly repeated process throughout the whole project.
- Monitoring of the overall project status – are there any changes in the project that can effect and cause new possible risks?
- Status meetings – Is discussions with risk's owner, share experience and helping managing the risks.
- Risk register updates

By managing the whole RMP, the process can be evaluated. This is a method of creating a risk register where all risks and their management can be allocated in order to facilitate future projects (PMI, 2004). This is also a way to improve the project work, since the advantages and disadvantages will be brought up.

2.4. Managing Risk in Different Industries

Besides looking into the project types that impact the style of managing risk, it is worthwhile to view how risk management takes place in different industries such as construction, engineering,

information technology, business and research and development. Generally, manufacturing, construction, and engineering industry tend to be dealing with mega projects that involve high investment expenditure, substantial uncertainty and having a certain degree of impact on the environment. It is observed that financial risk is the key focus of such projects before go-no-go decision is made due to the fact that pattern of risks inherent in projects is largely influenced by the financial structure of the projects based on studies by Lam (1999) on infrastructure development projects. Moreover, Bruzelius et. al. (2002) found that cost overruns, inaccurate forecasts and often over-optimistic forecasting of project viability are common problems of mega projects. Thus, risk management and analysis are found to be applied way before the project is initiated, usually during the feasibility study.

According to Miller and Lessard (2001), large engineering projects often carry with it substantial commitments which are binding, high probabilities of failure as well as reward structures that are skewed even in successful cases irregardless of the success or failure of the project. They stated that risks are essentially broken down into categories like market-related, completion and institutional, thereafter, decision theoretic approaches and managerial approaches are applied in order to manage them.

On the other hand, Flyvbjerg (2006) noticed a high percentage of inaccuracy of cost forecasts for the transportation infrastructure projects such as rail, roads, bridges and tunnels and this has not improve over the past 70 years based on available cost data. This is because most individuals and organizations are applying the conventional and intuitive way of thinking about complex projects by focusing on the project itself rather than its details. Thus, inaccurate forecasts of the project such as costs and demand become a major source of risk in project management. He then proposed the application of reference class forecasting to mitigate such risk in terms of any type of human bias (including strategic bias) and strategic misinterpretation. This approach was applied in the Edinburgh Tram Line 2 project in 2004 that helped to improve risk management of the project. This method coupled with measures of accountability is necessary in order to achieve more accurate forecasts. The measures of accountability were found to be applied in the feasibility study of the link across the Baltic Sea connecting Scandinavia and Germany project. The four specific measures that were applied to increased accountability are transparency, performance specifications, explication of regulatory regimes and involvement of risk capital as mentioned by Bruzelius et al (2002).

The manufacturing technology projects can be found in our daily life, from the food processing factories to advanced technology military and civil aircraft manufacturing. These kinds of projects are defined by Charette (1991) as part of the new technologies trend that organizations and governments are spending on to improve our life. Unfortunately, it is found that 5 to 15 percent of the projects that are initiated were either stopped before completion of the projects or fail to deliver the project's requirements and objectives. Some of the projects require reworking, shifting their scopes or will not completely fulfill the customer requirements. This is due to several problems, but in a study by Boehm (1991), the lack of interest in the process of identifying and determining high-risk elements is one of the main issues faced by many practitioners. In a recent survey carried out by Charette (2006), the results shows that 80% of the organizations in the manufacturing sector declared that they are practicing risk management but the continuous exercise of risk management has only matured by approximately 25% along this period. The result of this survey indicates that the three highest weaknesses areas faced are the difficulty in getting an accurate estimate of the level of risk encountered, the difficulty of getting organizational buy-in, and the difficulty in separating risk management based on traditional risk management. Following the same trend, the Bakker et. al. (2009) study encountered that risk management is not being conducted in order to be effective, where risk management can only be effective in some specific project situations.

Risk management has been accepted as an issue of particular significance in this industry. Nevertheless, some difficulties have been identified by Nosworthy (2000) beside the implementation process where there is an apparent lack of real effective approach and the incurring of excessive costs. In fact, the risk approach of this sector defined by Boehm (1991) is only applying the traditional method where risk exposure is used to detect the unsatisfactory effects. This is done with the use of decision-trees as a method for designation of project exposure while another technique applied is the sensitivity analysis, which is used with the finality of take strategy decisions.

On the other hand, the business process re-engineering (BPR) projects defined by Remenyi and Headfield (1996), which are a subset of the IT industry, are focusing mainly on five main components of risk: business, financial, technology, corporate culture and organization structure. They identified a suitable framework of risk management for these types of projects which consist of risk categories identification (using the weighted and scoring techniques), risk

evaluation, risk control and financial risk. Part of their study highlighted that risk management is an on-going process through the project lifecycle.

The importance of the risk management for Charette (2005) is the ability to help and assist software managers gauging problem situations and in the formulation of practical solutions. A good example is the key risk management concept of risk exposure. Risk, after all, reflects economic change and human ingenuity. Thus, there are undoubtedly new types of risk being created in every moment that will require new thinking (and terminology) on how they are approached according to Charette (2006).

The completion of reviewing on ways risks are managed in different industries in this category has triggered us to undertake further review focusing in risk assessment being the next category of this chapter.

2.5. Theoretical Framework

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Research Design

This descriptive study examined the practice of project risk management at Mogle bottled water manufacturing factory. A Likert scale survey was employed to measure the dependent variable of project success and the independent variable of Risk Management

3.2. Sample and sampling techniques

The total population is 320 employees in Mogle bottled water manufacturing located some 21 kilometers away from Addis Ababa which purifies and bottles water in different sizes including 0.4L, 0.6L, 1L, 1.5L, 2L, & 20L with a production capacity of sixteen thousand bottles per hour. In this study the researcher will try to achieve reliable data by finding respondents who are well informed about the topics included in the questionnaire. In order to get valid data and maximize quality of information, purposive sampling is used to choose 56 target respondents whose work is believed to be involved with risks and who has clues about how to deal with risks. Thus, the survey focused on lower, middle, and top managers responsible to risk management in the company including, operations managers, purchasing and supply managers, marketing managers, information technology officers, and others. 56 questionnaires were distributed to 56 managers, middle managers, and supervisors in the company, mainly to the middle line managers since they are the executors of the strategic decisions, implementers of risk management systems, and they interact with top managements in lying out the risk management plans.

Questionnaires were distributed and collected personally by the researcher to ensure confidentiality.

In order to maximize the response rate, to the extent possible, data providers were given adequate time to provide useful and accurate data and close monitoring was done by encouraging respondents time to time until they fill the questionnaires and return them.

3.3. Source and tools/instruments of data collection

The data for this research will be collected via primary and secondary sources. The primary data were collected through questionnaires. Secondary data were gained from books, specialized International Journals, publications and the World Wide Web; also the researcher made use of what was written in the literature in similar fields.

3.4. Methods of data analysis

Collected data were analyzed using descriptive statistics (mean, median, correlation, etc.).
The instrument in the form of questionnaire was designed based on the constructs so that respondents were asked to indicate their choice using a five point Likert scale (1 = strongly disagree, 2 = disagree, 3 = undecided 4 = agree, & 5 = strongly agree). In line with previous research in the field of Risk management, this study also measures Risk management practice using the respondents' perception of performance in relation to major industry competitors.

To elicit information on risk management performance variable in particular, respondents were asked to indicate their choice using a similar five-point Likert scale, their company's Risk management performance relative to that of major industry competitors in terms of overall product quality, delivery performance, cost reduction and responsiveness, and supply chain management. Some other questions including demographic information were also presented in the questionnaire.

3.5. Description and Measurement of Variables

According to John (2009), the variables need to be specified in a research so that the research gives clear picture to readers. Risk management is usually measured by internal and external factors. Internal factors are factors related to risk management structure (Including appropriate staff level, staff qualification, and efficiency), committee oversight, risk management process including risk identification, analyze the risk, evaluate or rank the risk, treat the risk, and monitor and review the risk. External factors include legal environment, regulatory changes, business trends, etc. In this paper only internal variables were used to investigate the determinants of risk management in the factory.

In order to interpret the collected data, the questions to be any of value must be measured. The researcher basically used nominal and ordinal scales to measure questions. The Likert type ordinal scale was used to measure the attitude of the respondents to determine to what degree they agree or disagree with the close-ended questions which vary from strongly agree to strongly disagree. The researcher also assigned score or weights to the alternative responses which are

coupled to values from 1 to 5. Accordingly, values will be assigned as: 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 = strongly agree. The Likert scale which is used to determine the attitude of the respondents is used in accordance with the arithmetic mean to reach conclusion regarding the various responses.

3.6. Validity & Reliability Test

Generally, since the questions are extensively derived from the problem statement, the measures are considered to have content validity.

For the purpose of this study, the cronbach alpha test of reliability was employed using software called Minitab and a result of **0.8565** was found, accordingly, any number between **0.5** and **1** show that the test instrument is reliable.

3.7. Ethical Consideration

Respondents were informed about the purpose of the study. Confidentiality was maintained throughout the study by not disclosing the respondents' name on the questionnaire and research reports. No identifying information was entered on the questionnaires.

CHAPTER FOUR: RESULTS AND DISCUSSION

In chapter three the research methodologies as well as the development of the questionnaire used for this research are described. This chapter deals with the analysis and interpretation of the data gathered through questionnaire and secondary sources. Primary data collected from the company's managers are presented, analyzed, and discussed in this chapter. Mean values are used to rank the respondents' perception about risk management practice of the company.

This chapter also presents the discussion of results of the study which include descriptive statistics of variables and correlation results for dependent and explanatory variables.

4.1. Results

A total of 56 questionnaires were distributed to personnel in the company who were believed to be involved in different risks directly or indirectly. And, 47 questionnaires were returned which represent 84% response rate. All targeted respondents were presented with the questionnaire, although there were few unreturned questionnaires from some employees.

4.1.1. Characteristics of Sample Respondents

The current position of respondents (see table 4.1) indicates that mostly department manages were involved in responding to the questionnaires and their level of education is considerably high. Work experience of respondents shows that they all have been in the factory for at least for five years.

Table 4.1 Background characteristics of respondents

Background Characteristics of Respondents					
Current Position of Respondents		**Level of Education of Respondents**		**Work Experience of Respondents**	
Positions	**Frequency**	**Level of Education**	**Frequency**	**Experience**	**Frequency**
Department heads	8	Master's Degree	2	5 – 10 years	27
Engineering department	6	First Degree	33	10 – 15 years	13
Sales	6	Diploma	12	Above 15	7

Department				years	
Finance Department	7	**Total**	**47**	**Total**	**47**
Quality Department	4				
Marketing Department	4				
Production Department	7				
Others	5				
Total	**47**				

Source: Own survey, 2016

To simplify the statistical analysis, questions with similar underlying construct are grouped into seven descriptive items namely: Risk management structure, Committee oversight, Risk identification, Risk measurement, Risk monitoring, internal control, and effectiveness of the risk management. The grouping of the items ensures that the various questions relating to specific topic are combined together. This in turn contributes to a more structured analysis of the research data. The statistical analysis of the responses contained in the completed questionnaires is presented as follows:

4.1.2. Risk Management Structure and Culture

The aim of this section is to determine the establishment of formal risk management structure, adequacy of the structure, availability of risk management policies and procedures, as well as the awareness level of performers and managers on these guiding documents.

According to the responses, 100% of the respondents indicated that their company has an established formal risk management structure, 95.7% of the respondents responded that the established organizational structure is adequate for effective risk management. 100% of the respondents indicated that their company has a written risk management policy and procedure. The response rate confirms the importance of establishing a formal risk management structure and the significance of developing written policies and procedures for effective risk management.

According to the arithmetic means of the responses (see table 4.2), respondents agreed that roles and responsibilities for risk management is clearly defined, the company comply with its risk management policies and procedures as well as it allocate necessary resources to support the risk management process. However, the arithmetic mean of the respondents indicates that respondents are neutral whether risk management policies and procedures are well understood at

all levels or not. Unless the risk management policies and procedures are well understood by the concerned staff of the company, it would be difficult to comply with the risk management policies and procedures. This also indicates that there is a limitation in allocating the necessary resources like training and education.

Table 4.2 Responses on Risk management structure and culture

Respondents (N=47)						
Responses	**Scale**					
	1	2	3	4	5	Mean
The roles and responsibilities for risk management is clearly defined	_	2%	2%	49%	47%	4.04
The risk management policies and procedures are well understood by all staff of the factory	_	30%	38%	26%	6%	3.09
Your factory complies with its risk management policies and procedures	_	6%	9%	72%	13%	3.91
Your factory allocates appropriate resources to support the risk management process	_	11%	15%	57%	17%	3.81

Source: Own survey, 2016

Stank et. al. (1994) believes that organizational structure involves an organization's internal pattern of relationship, authority, and communication. Structure is comprised of formal lines of authority and communication and the information as well as data that flow along these lines. Thus, organizational structure defines the lines of authority and communication, serves to allocate tasks and resources and provides a means of coordination. Hunter (2002) supports the idea that organizational structure provides the authority to predetermine the way employees work. Structure and process of an organization are most effective when their design functions match their environment and have a positive impact upon the organization's strategies.

Therefore, one of the most important aspects for effective risk management is organizational structure. Organizational structure provides the concept, guideline, direction, and support to the employees. Organizational structure must be reviewed regularly and adjusted to adapt to changing financial environments. The committee's role is to recommend policies and procedures

for managing risk, the management role is to review and approve them, and it is the committee's role once more to implement them and report back on their operation.

51% of the respondents (see table 4.3) indicated that the company apply context dependent risk mitigation options to manage the risks attached to their business. As indicated in the literature review, there are four types of risk mitigation options namely: Risk avoidance, Risk reduction, Risk transfer, and Risk acceptance. Therefore, the respondents' responses indicate that their company uses theses different risk mitigation options depending on the assessment of the level of risk and its impact.

Table 4.3 Responses on attitude of people towards risk management

Responses	**Frequency**	**Valid percent**
Missing response	4	8.5
Risk taking	5	10.6
Risk avoiding	13	27.7
Context dependent	24	54.1
Not known	1	2.1
Total	**47**	**100.0**

Source: Own survey, 2016

4.1.3. Risk Committee

The responses and the arithmetic means (see table 4.4), show that respondents agreed in all questions raised in relation to committee oversight role. According to the respondents, committee members understand the risk profile of the company, they understand the tools to manage risks and tolerance limits set for each risk and they believe that they are playing effective oversight role in the risk management process.

Table 4.4 Response on risk committee

Respondents (N=47)						
Responses	**Scale**					
	1	2	3	4	5	Mean
The committee members understand the risk profile of the factory	_	_	19%	70%	11%	3.91

The members understand the tools used to manage risks	_	6%	45%	36%	13%	3.55
The members understand tolerance limits set for each risk	_	2%	23%	62%	13%	3.85
The committee is playing effective role in the risk management process	_	6%	21%	60%	13%	3.79

Source: Own survey, 2016

According to the risk management guideline of the factory, the committee is responsible for crafting strategies and policies, set out tolerance limits for each risk, clearly define responsibilities and authorities, ensure that various risks related to the business are adequately measured, monitored, and controlled, periodically review strategies and policies and ensure compliance with all relevant laws, regulations, policies, and procedures. Therefore, since the company enforces the committee to play effective role, the respondents' response is expected to be positive.

4.1.4 Risk Identification

Questions in this section were designed to know whether the company regularly identify risks inherent to their business, the responsible body for risk identification, the type of tools used to identify risks, effectiveness of risk identification tools and the major risks that the business is exposed to.

Responses indicated that the company regularly identifies its risks using various risk identification tools. The survey focused six methods which can be used to identify risks. These are auditing/physical inspection, process mapping, workshops, brainstorming, product portfolio analysis and examination of past experiences. The most recognized method used to identify risks is auditing or physical inspection followed by product portfolio analysis. Examination of past experiences is recognized as third most important method. Although brain storming, process mapping and workshops were rated lower, they were all recognized as methods of identifying risks, there were no additional methods identified in the open ended questions. Therefore, according to the respondents, it can be deduced that the above mentioned methods be regarded as the tools that the company is using for risk identification.

According to the respondents, the responsibility for identifying risks lies on the risk committee, executive management team, line managers, and middle level managers. Majority of the responses (see table 4.5) indicates that respondents are neutral with regard to the effectiveness of the risk identification tools used by the company.

Table 4.5 Responses on the effectiveness of risk identification tools

Response	**Frequency**	**Valid percent**
Strongly disagree	2	4.3
Disagree	5	10.6
Neutral	24	51.1
Agree	12	25.5
Strongly agree	4	8.5
Total	**47**	**100**

Source: Own survey, 2016

Risk identification is the basic step of risk management. This step reveals and determines the potential risks which are highly occurring and other events which occur very frequently. Risk is investigated by looking at the activity of organizations in all directions and attempting to introduce the new exposure which will arise in the future from changing the internal and external environment. Correct risk identification ensures risk management effectiveness (Tcankova, 2002). Unless the risk identification tools are effective, the company may not properly identify its risks and if the first basic step is missed, other risk management processes will also be affected negatively.

Effective risk identification should consider both internal factors (such as the organizational structure, the nature of activities, quality of human resources, organizational changes, and employee turnover) and external factors (such as changes in the industry, and technological advances) that could adversely affect the achievement of the company's objectives (Reserve bank of Malawi, 2007).

The completed questionnaire showed that the primary risks in the manufacturing company in order of severity is Operational risks, Technological risks, and Market-related risks.

4.1.5. Risk Measurement

The aim of this section was to assess the tools that are currently being used by the company to measure risks, the effectiveness of the tools, and how frequent they are tested to make sure their accuracy

98% of the responses indicated that the company has a risk measurement system to control its risks. According to the respondents, their company uses a combination of quantitative and qualitative tools to measure risks. As indicated in the risk measurement literature, there are five types of risk measurement tools, namely, statistical tools, analytical tools, scenario analysis, value at risk, and using experience and intuition. Respondents indicated that experience and intuition tools are the most important tools used by their company to measure risks followed by scenario analysis. VAR and statistical tools are seldom used from quantitative tools. There is no other risk measurement tool indicted in the open ended question.

According to the arithmetic mean of the responses (see table 4.6) respondents were neutral on the effectiveness of the risk measurement tools and whether risks are assessed in terms of likelihood and impact or not. 55% of the respondents responded that risk measurement tools are periodically tested to make sure their accuracy while the remaining 45% of the respondents answered they are not tested.

Table 4.6 Responses on risk measurement

Respondents (N=47)						
Items	**Scale**					
	1	2	3	4	5	Mean
Risks are assessed in terms of likelihood and impact	17%	9%	38%	23%	13%	3.16
The risk measurement tools are effective to properly manage risks	4%	11%	51%	26%	8%	3.23

Source: Own survey, 2016

4.1.6. Risk Monitoring and Review

98% of the response indicated that the company has a regular reporting system that provides the senior management with risk exposure of the company. The types of risks reported are operational, technological, and market related. Frequency of reports ranges from weekly to

quarterly depending upon the management requirements. According to the responses obtained (see table 4.7), majority of the respondents are neutral on the timelines and informative nature of risk reports to monitor risk position of the company.

Table 4.7 Responses on timelines and informative nature of risk reports

Responses	**Frequency**	**Valid percent**
Missing	1	2.1
Strongly disagree	3	6.4
Disagree	6	12.8
Neutral	23	48.9
Agree	9	19.1
Strongly agree	5	10.6
Total	**47**	**100.0**

Source: Own survey, 2016

Accurate, timely, and complete data is a foundation for effective risk management. Risk management reports should cover all material risk areas within the company.

4.1.7. Internal Control

The intention of this section was to evaluate the adequacy of risk management policies and procedures, the appropriateness of risk limits set for each type of risk, and to know whether risk management policies and procedures are reviewed periodically or not.

According to responses obtained (see table 4.8), 72% of the respondents replied that the risk management policies, procedures, and limits are adequate to identify, measure, monitor, and control risks of the company. Around 92% of the response revealed that the company has risk limits that serve as a means to control various risks associated with its business. 77% responded positively by saying policies and procedures are reviewed on a regular basis to incorporate best practices, processes, and new regulations. However, the arithmetic mean of the response

indicated that respondents are neutral on the appropriateness of the risk limits set for each type of risk. The responses obtained seem to be controversial. If policies, procedures, and limits are reviewed on a regular basis and the current policies and procedures are adequate, the risk limits should have been appropriate for each type of risk.

Table 4.8 Response on internal control

Responses	Are policies, procedures, and limits adequate		Does the company have risk limits		Are policies and procedures reviewed regularly	
	Frequency	Valid percent	Frequency	Valid percent	Frequency	Valid percent
Missing	8	17	1	2.1	-	-
Yes	34	72.3	43	91.5	36	76.6
No	5	10.7	3	6.4	11	23.4
Total	**47**	**100.0**		**100.0**	**47**	**100.0**

Source: Own survey, 2016

4.1.8. Perceived Effectiveness of Risk Management

This section seeks information on the competency level of the staffs responsible to risk management, the level of risk management system, the availability of risk management function and its major duties and responsibilities, the trend of the level of risk and the challenges that the company is facing in managing risks.

Respondents believe that the staffs responsible for risk management have the appropriate level of competency and experience. Effectiveness of risk management system used by the factory (see table 4.9) was rated as poor by 43% and it was rated as good by 40% of the respondents.

Table 4.9 Responses on the effectiveness of risk management system

Responses	**Frequency**	**Valid percent**
Missing	1	2.1
Poor	20	42.6
Good	19	40.4
Very good	7	14.9

Total	**47**	**100.0**

Source: Own survey, 2016

Respondents said that risk management function has been established to manage the overall risk of the factory. According to respondents, the major duties of the risk management function are measuring risks, comparing the results with the set limit and reporting to the concerned bodies.

57% of the responses (see table 4.10) showed that the level of risk has increased during the last year. The respondents' justifications for the increasing trend of risk among others are: business expansion, stiff competition, and introduction of new products. According to respondents, the most difficult situations that the factory is facing in managing risks are: lack of adequate data, weak information management system, lack of competent and experienced staffs, and lack of awareness about the concept of risk management due to its newness.

Table 4.10 Responses on level of risks in the last year

Responses	**Frequency**	**Valid percent**
Missing	1	2.1
Increased	27	57.4
Decreased	16	34.0
Not changed	2	4.3
Not sure	1	2.1
Total	**47**	**100.0**

Source: Own survey, 2016

From the given response we can observe some inconsistencies. On the one hand they responded that staffs responsible for risk management have the appropriate level of competency. On the other hand, they explained that lack of competent and experienced staff is one of the difficulties that the factory is facing in managing its risks. The existence of risk management structure along with policies and procedures alone do not result in effective risk management system unless these components of risk management system are backed by competent and experienced personnel.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

In this chapter the major findings of the study are summarized, conclusions are drawn based on the findings, and recommendations are forwarded for concerned bodies.

5.1. Conclusions

The main objective of this study was to investigate the current risk management practices and the risk management systems that are adopted by Mogle bottled water manufacturing factory to control its risks. The main conclusions are grouped under seven items according to the questions with a similar construct namely: risk management structure and culture, committee oversight, risk identification, risk measurement, risk monitoring, internal control, and effectiveness of risk management. The main conclusion for each item is summarized as follows.

i. Risk Management Structure and Culture

Results show that the factory has a formal risk management structure in place and the established structure is adequate for effective risk management. It has also developed written policies and procedures for risk management. A formal risk management structure and documented policies and procedures could be regarded as a prerequisite for the effective management of risk exposure. However, there is a limitation in understanding policies and procedures developed for risk management. This clearly indicated the existence of lack of proper training and communication which could impede the risk management process.

ii. Risk Committee

Responses obtained from the selected respondents indicates that the committee has the understanding of risk profiles, risk management tools, tolerance limits set for each type of risk. If there is a gap in understanding risk profiles, risk management tools, and tolerance limits, they would fail to ensure risks related to their business are properly identified, adequately measured, monitored and controlled.

iii. Risk Identification

Responses show that the committee regularly identifies the risks using various risk identification tools. The current most widely used methods to identify risks are audit/physical inspection,

product portfolio analysis, and examination of past experiences. However, the respondents are neutral with regard to the effectiveness of currently used risk identification tools. Effective risk identification should include both internal factors (such as the factory structure, the nature of activities, quality of human resources, organizational changes, and employ turnover) and external factors (such as changes in the industry and technological advancement) that could adversely affect the achievement of the company's objectives.

iv. Risk Measurement

The factory has a risk measurement system to control its risks. Respondents are neutral on the effectiveness of the currently used risk measurement tools. According to the respondents, the risk measurement tools are not periodically tested but risk measurement tools should be tested periodically to make sure their accuracy.

v. Risk Monitoring

The factory has a regular reporting system that provides information for the management about the risk exposure of the factory. Despite a regular reporting system in place, information technology is in its infant stage in the company to support risk management process. Reports are compiled manually. Respondents are neutral on the timeliness and informative nature of the risk reports. The company lack to aggregate risk exposures. Simply compiling risk reports from the committee do not allow senior managers to see the relationship between the various risk exposures as well as their multidimensional effect on the company.

The risk report should provide a forward looking assessment of risk and shouldn't just rely on past data. The report should contain forecasts or scenarios for key market variables and the effects on the company so as to inform the management of the likely trajectory of the company's risk profile in the future. Accurate, timely, and complete data is foundation for effective risk management.

vi. Internal Control

One of the major tools for managing risk is the well-established internal control system, which includes segregation of duties, clear management reporting lines, and adequate operating procedures. Respondents believe in the adequacy of the existing risk management policies and procedures to manage risks but they have doubt on the appropriateness of the risk limits set for each type of risk. Some also say that the company does not comply with its own policies and procedures and policies and procedures are not reviewed on a regular basis.

vii. Effectiveness of Risk Management

The respondents have different ideas on staff competency and experience level. Some of the respondents claim that staffs responsible for risk management have the required level of competency and experiences, while others say they do not. The level of risk in the industry has increased during last year because of business expansion and the effect of competition.

The most difficulties that the company is facing in managing its risks are: lack of adequate data, weak information management system, lack of competent and experienced staffs, and lack of awareness about the concept of risk management due to its newness in the industry.

5.2. Recommendations

To conclude this study, the researcher proposes the following recommendations to enhance the risk management practice in the sector:

- As the concept of risk management is not yet fully understood in most manufacturing industries in Ethiopia, it is important to develop and implement a formal training program for risk management and periodic updating of employees. This will enhance the awareness of risk management in the companies and stimulate the interest in its management.
- Companies should strive to strengthen their risk management process: risk identification, risk measurement, risk monitoring, and internal control to effectively manage their risks.
- There is a need to develop an integrated system which ensures a systematic and comprehensive approach to manage risks.
- The company should invest on its IT system and human resources to get accurate, complete, and timely data to manage its risks effectively.

5.3. Direction for Future Works

The followings are likely to be future noteworthy research areas:

- Research is needed to come out with a valid risk management model related in the bottled water manufacturing industry.
- Many foreign investors are eyeing the sector and sooner or later many investors will join the business and the risk exposure will change. In order to be competitive and remain in the market, the company capacity to manage its risks should be strengthened. Thus, a

compressive research including all other companies in the sector is required to fortify the risk management process in all of them.

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DECLARATION

I, the undersigned, declare that this thesis is my original work prepared under the guidance of my advisor Teklegiworgis Ayele (Asst. Prof.). All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

_____

Name, Signature, & Date

ENDORSMENT

This thesis has been submitted to St. Mary's University school of graduate studies for examination with my approval as a university advisor.

_____

Advisor's signature & date