

RISK MANAGEMENT IN A PROJECT ENVIRONMENT

Daan de Villiers

B.Sc., B.Sc. (Honours) (Cum Laude), M.Sc. (Cum Laude) & MBA

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PROMOTER: DR. P.D. PRETORIUS

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ABSTRACT

The work done in this study is based on three dimensions; theory, research and practices.

The objectives of this study are:

Firstly, to determine what the literature says about strategic, project and risk management; Secondly, to establish if project managers use project risk management systems; to determine the maturity level of organizations in terms of risk management in capital projects; and to recommend a model for the improvement of the maturity level of organizations in terms of project management in general and risk management in particular when they implement their goals through projects; Thirdly, to give practical risk studies that can be used as examples by project teams in future.

On the achievement of these objectives the following is applicable:

The literature review on strategic, project and risk management, was achieved because a comprehensive review on these three subjects was undertaken as can be read in chapters three, four and five; Project managers' use of project risk management systems, and the maturity level of organizations in terms of risk management in capital projects, was researched and is given in chapters six and seven; The research recommendation can be read in chapter seven. Practical risk studies are explained in chapter eight.

TABLE OF CONTENTS

CHAPTER 1: NATURE AND SCOPE OF STUDY	1
1.1 INTRODUCTION	1
1.2 PROBLEM IDENTIFICATION AND DEFINITION	5
1.3 OBJECTIVE OF DISSERTATION.....	8
1.4 DEFINING THE SCOPE OF THE STUDY	9
1.5 RESEARCH METHODOLOGY	9
1.6 LAYOUT OF THE STUDY	12
1.7 CONCLUSION	16
CHAPTER 2: RESEARCH OBJECTIVES AND APPROACH...	17
2.1 INTRODUCTION	17
2.2 RESEARCH OBJECTIVES	17
2.3 DATA GATHERING AND ANALYSIS	18
2.4 DATA REQUIREMENTS	20
2.5 VALIDITY OF RESEARCH METHODOLOGY.....	22
2.6 SAMPLE SIZE	25
2.7 RESEARCH APPROACH	26
2.8 CONCLUSION	30

CHAPTER 3: STRATEGY MANAGEMENT	31
3.1 INTRODUCTION	31
3.2 STRATEGY	31
3.3 ELEMENTS OF SUCCESSFUL STRATEGIES	32
3.4 THE STRATEGIC MANAGEMENT PROCESS: AN OVERVIEW ...	34
3.5 IMPLEMENTATION OF STRATEGIES THROUGH PROJECTS	39
3.6 CAPITAL BUDGETTING	47
3.7 PROJECT CLASSIFICATION.....	48
3.8 CONCLUSION	49
 CHAPTER 4: PROJECT MANAGEMENT	 50
4.1 INTRODUCTION	50
4.2 DEFINITION OF A PROJECT	51
4.3 WHAT IS PROJECT MANAGEMENT?	53
4.4 PROJECT LIFE-CYCLE	56
4.4.1 STRAIGHT-FORWARD PROJECT LIFE-CYCLE.....	57
4.4.2 CONTROL-ORIENTED MODEL	59
4.4.3 QUALITY-ORIENTED MODEL	60
4.4.4 RISK-ORIENTED MODEL	62
4.4.5 FRACTAL APPROACH TO PROJECT LIFE-CYCLES.....	64
4.5 PROJECT MANAGEMENT KNOWLEDGE AREAS	68
4.6 RELATIONSHIP OF PROJECT MANAGEMENT TO OTHER MANAGEMENT DISCIPLINES	74
4.7 PROJECT MANAGEMENT MATURITY LEVEL	80
4.8 PROJECT MANAGEMENT COMPETENCIES	86
4.9 CONCLUSION	90

CHAPTER 5: RISK MANAGEMENT.....	92
5.1 INTRODUCTION	92
5.2 DEFINITION OF RISK.....	95
5.3 CATEGORIES OF PROJECT RISK	96
5.4 WHAT IS RISK MANAGEMENT?	101
5.5 RISK MANAGEMENT PROCESS	102
5.6 TIMING OF THE RISK MANAGEMENT PROCESS	107
5.7 RISK MANAGEMENT: TOOLS AND TECHNIQUES	111
5.8 RISK MANAGEMENT COMPETENCIES.....	121
5.9 RISK MANAGEMENT MATURITY LEVELS	124
5.9.1 INTRODUCTION	124
5.9.2 THE RISK MANAGEMENT MATURITY MODEL	126
5.9.3 DETERMINING ORGANIZATIONAL MATURITY LEVEL.....	132
5.10 CONCLUSION	137
 CHAPTER 6: RESEARCH RESULTS.....	 140
6.1 INTRODUCTION	140
6.2 APPROACH USED IN COLLECTING THE DATA	140
6.3 QUESTIONNAIRE DESIGN	141
6.4 RESULTS OF SECTION 1: PROJECT MANAGEMENT INFORMATION	142
6.5 RESULTS OF SECTION 2: OPERATION OF THE RISK MANAGEMENT PROCESS.....	149
6.6 RESULTS OF SECTION 3: RISK INFORMATION	160
6.7 CONCLUSION	163

CHAPTER 7: RESEARCH CONCLUSIONS AND FINDINGS	164
7.1 INTRODUCTION	164
7.2 FINDINGS AND CONCLUSIONS	164
7.2.1 FINDINGS FROM SECTION 1: PROJECT MANAGEMENT	164
7.2.2 FINDINGS FROM SECTION 2: OPERATION OF RISK MANAGEMENT PROCESS	168
7.2.3 FINDINGS FROM SECTION 3: RISK INFORMATION	171
7.3 FINAL COMMENTS	172
7.4 CONCLUSION	174
 CHAPTER 8: PRACTICES OF RISK MANAGEMENT.....	176
8.1 INTRODUCTION	176
8.2 PILOT PROJECT	177
8.2.1 PROJECT DESCRIPTION	177
8.2.2 BACKGROUND AND CONTEXT	177
8.2.3 MOTIVATION FOR THE PROJECT	178
8.2.4 PROJECT SCOPE.....	180
8.3 RISK ASSESSMENTS	181
8.3.1 PROJECT MANAGEMENT RISK STUDIES	181
8.3.2 HEALTH AND SAFETY RISK STUDY	195
8.3.3 TECHNOLOGY AND DESIGN RISK STUDIES	201
8.3.4 CONSTRUCTION RISK STUDY	215
8.4 CONCLUSIONS	221
 CHAPTER 9: STUDY OVERVIEW AND FINAL CONCLUSIONS.....	223
9.1 INTRODUCTION	223
9.2 OVERVIEW OF THE STUDY	223
9.3 EVALUATION OF THE STUDY	224

9.4	CONTRIBUTION OF THE STUDY.....	226
9.5	RECOMMENDATIONS.....	228
9.6	FUTURE STUDY OPPORTUNITIES	228
9.7	OVERALL CONCLUSIONS.....	229
	REFERENCE.....	231
	APPENDIX 1	239
	RESEARCH QUESTIONNAIRE.....	239
	APPENDIX 2	249
	PRESENTATION OF THE STUDY.....	249
	APPENDIX 3	264
	SUMMARY OF STUDY	264
	APPENDIX 4	292
	ARTICLE	292

LIST OF FIGURES

Figure 1: Integrated Management of Projects	4
Figure 2: Model of Research Process	11
Figure 3: Layout of study	15
Figure 4: Learning about risk management through a combination of theory, research and practice	27
Figure 5: Elements of Successful Strategies	33
Figure 6: Strategic Management Process	37
Figure 7: Vision Drives the Project	41
Figure 8: Project Life-Cycle	42
Figure 9: Project Environment	55
Figure 10: Control-Oriented Project Life Cycle Model	60
Figure 11: Project Life-Cycle Model Highlighting Project/Product Quality Matters	61
Figure 12: A Risk-Oriented Project Life-Cycle Model	64
Figure 13: Generic Project Life-Cycle Model	66
Figure 14: Project Management Knowledge Areas	68
Figure 15: The general management-project interface	75
Figure 16: Relationship of Project Management to Other Management Disciplines	77
Figure 17: General Management Process	78
Figure 18: Project Management Process	80
Figure 19: Integrated Model to Increase the Success Rate of a Project	85
Figure 20: Project Manager Competency	88
Figure 21: Competency Framework Structure	89
Figure 22: Risk Event Graph	94
Figure 23: Financial Risk	98
Figure 24: Categories of risk	101
Figure 25: Risk Management Process	105
Figure 26: Cost of changes	110
Figure 27: Process Model	111
Figure 28: Tasks for Risk Management Planning	112

Figure 29: Tasks for Risk Identification	114
Figure 30: Tasks for Qualitative Risk Analysis.....	115
Figure 31: Tasks for Quantitative Risk Analysis	116
Figure 32: Tasks for Risk Evaluation.....	117
Figure 33: Tasks for Risk Response Planning.....	119
Figure 34: Tasks for Risk Communication	120
Figure 35: Risk Management Maturity Model	127
Figure 36: Cause-and-Effect of Not Managing Risks	139
Figure 37: Integrated Project Management Model.....	174
Figure 38: Types of Risk Assessments	177
Figure 39: Examples of Commonly-used Probability Distributions..	
.....	189
Figure 40: Causes and effect of Risk Management	221
Figure 41: Combination of Theory, Research and Practices Model	
.....	224

LIST OF TABLES

Table 1: Different Maturity Models	125
Table 2: Type of organization	143
Table 3: Sector.....	144
Table 4: Main area of application of risk management	145
Table 5: Number of employees	146
Table 6: Average monetary value of projects	147
Table 7: Years experience in project management	148
Table 8: The consistency in the risk management process.....	149
Table 9: Preparation is required for a risk assessment as it is currently operated	150
Table 10: How are risks identified?.....	152
Table 11: How do you describe the severity of a risk?	153
Table 12: What measures do you use to describe the severity of a risk?	154
Table 13: What is the basis for evaluating the severity of risks? .	155
Table 14: How are risks dealt with after being identified?	157
Table 15: Work reviewed	158
Table 16: Continuous improvement of risk management	159
Table 17: Awareness of risk in a project environment	161
Table 18: Awareness of risk in a project environment	162
Table 19: General Risk Study	187
Table 20: Project Budget.....	190
Table 21: Project Budget Percentiles	191
Table 22: Project Milestones	193
Table 23: Project Budget Percentiles	194
Table 24: Health and Safety Risk Assessment	200
Table 25: Recommended Land Use Planning Zones	208
Table 26: HAZOP Nodes and Hazard Checklist	212
Table 27: HAZOP Actions	213
Table 28: Potential Deviation Analysis	220

LIST OF GRAPHS

Graph 1: Overall Project Management Maturity	7
Graph 2: Number of Employees	165
Graph 3: Average Monetary Value	166
Graph 4: Experience as Project Manager	167
Graph 5: Operation of Risk Management Process.....	169
Graph 6: Operation of Risk Management Process.....	170
Graph 7: Awareness of Risk in a Project Environment.....	171
Graph 8: Previous Study: Awareness of Risk in a Project Environment.....	172
Graph 9: Cost Risk Simulation	191
Graph 10: Schedule Risk Simulation	194

CHAPTER 1: NATURE AND SCOPE OF STUDY

1.1 INTRODUCTION

Managing projects is one of the oldest and most respected accomplishments of mankind. We stand in awe of achievements of builders of pyramids, the architects of ancient cities, the masons and craftsmen of great cathedrals and mosques; of the might and labour behind the Great Wall of China and the wonders of the world, Morris (1994:1).

Technology is a key resource of profound importance for corporate profitability and growth. It also has enormous significance for the well-being of national economies, as well as international competitiveness. Effective management of technology links engineering, science and management disciplines to address the issues involved in the planning, development and implementation of technological capabilities to shape and accomplish the strategic and operational objectives of an organization, Ritz (1990: xiii).

In an organizational environment, projects are a means of implementing strategy. Project goals should link directly to the strategic goals of the organization, Kenny (2003:52).

The project approach has long been the style of doing business in the construction industry, United States Department of Defense contracts and Hollywood, as well as at big consulting firms. Now project management is spreading to all avenues of work. Today, project teams carry out everything from port expansions to hospital restructuring to upgrading information systems. The "Big Three" automakers credit their ability to

recapture a significant share of the auto market to the use of project management teams, which quickly develop new cars that incorporate the latest automotive technology, Gray & Larson (1999:3).

Internationally, Project Management (PM) has become the fastest growing form of Management, ProjectPro (1998:6). One of the reasons is that the tools and techniques unique to PM have the capacity of dealing with rapid radical change resulting from fierce international competition and advances in technology.

The past ten years have seen project management continue to grow as a profession through a wide range of projects. The project management body of knowledge has been revised and expanded into nine knowledge areas and employers are increasingly encouraging their managers to gain professional management certification to comply with their quality management system. Project management techniques are now being used outside the traditional project industries and a management-by-projects approach has been adopted by many larger companies in an effort to keep their work small and manageable, Burke (1999:iii).

Project management has grown from the early initiative in the U.S. defense and aerospace sectors in the late 1950s and 1960s into a core competency that is recognized widely across most industry sectors, Morris (2001: 21).

He goes further"... initial formulations of project management – largely the U.S. Department of Defense and NASA – consisted of internally promulgated policies, procedures and practice. Later, books, articles, seminars and training programs explored and expanded project management practices. Much of this centered on the use of tools and techniques such as network

scheduling and performance measurement and organizational issues – particularly middle management ones, such as conflict management and team work.

From the late 1960s to the early 1970s, project management societies began to provide professional forums for communication on the discipline, basically through journals, conferences and seminars. This continued until the mid 1980s when PMI, the U.S.-based Project Management Institute and later APM, the U.K.-based Association for Project Management, embarked on programs to test whether people met their standards of project management professionalism.”

One can, therefore, conclude that project management is not a new subject, but one that has been with us for years and has evolved rapidly over the last few years. It is being used extensively in most sectors to implement the strategies of organizations, be it in public or private sector. In figure 1 a holistic business approach to projects is depicted, it is aligned with the customer, the organization's mission, goals and strategies. The project's objectives must be aligned with the business's mission, goals and strategies to ensure that one achieve what was set out for the business when the strategies were formulated.

Source: Gray & Larson (2000:15)

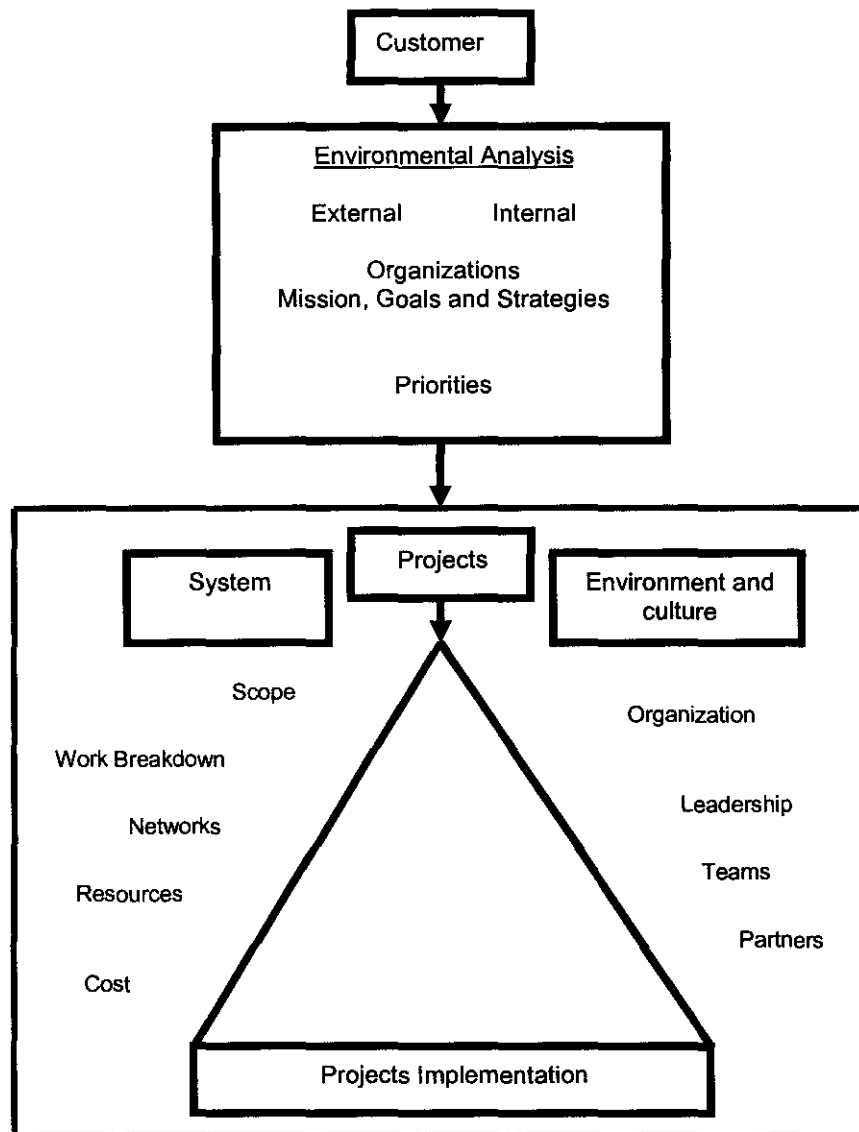


Figure 1: Integrated Management of Projects

What is also important to notice is that the subject project management has not arrived, and will never, at a point where everything is developed to a point of perfection. Therefore, this study will be conducted in one of the nine knowledge areas of project management, namely risk management, in an attempt to make a contribution to the body of knowledge of project management.

1.2 PROBLEM IDENTIFICATION AND DEFINITION

Successful project delivery is critical to the success of organizations that manage by projects or rely extensively upon projects to achieve corporate goals. There are several initiatives that organizations may pursue to develop a capability to deliver projects successfully. For example, organizations may implement enterprise-wide project management processes, highly integrated supporting processes and training programs to prepare project managers and team members to execute the processes effectively. Additionally, organizations may align project prioritization and selection decisions with corporate strategies. Management may commit to the success of the projects and establish explicit success criteria to guide project performance. As projects are under way, organizations may employ metrics to monitor and control project performance and target areas for improvement. By leveraging the results of prior projects, organizations can improve their processes, training and documentation. In these organizations, lessons are learnt, shared and applied. Ultimately, organizations developed the capability to deliver projects successfully – time and time again, Pennypacker & Grant (2003:4).

For organizations to develop in such a well functioning unit takes time and great effort from everyone involved and it must be driven from the top to change the culture of the organization into a culture of doing things in a certain way, which in itself is a different subject.

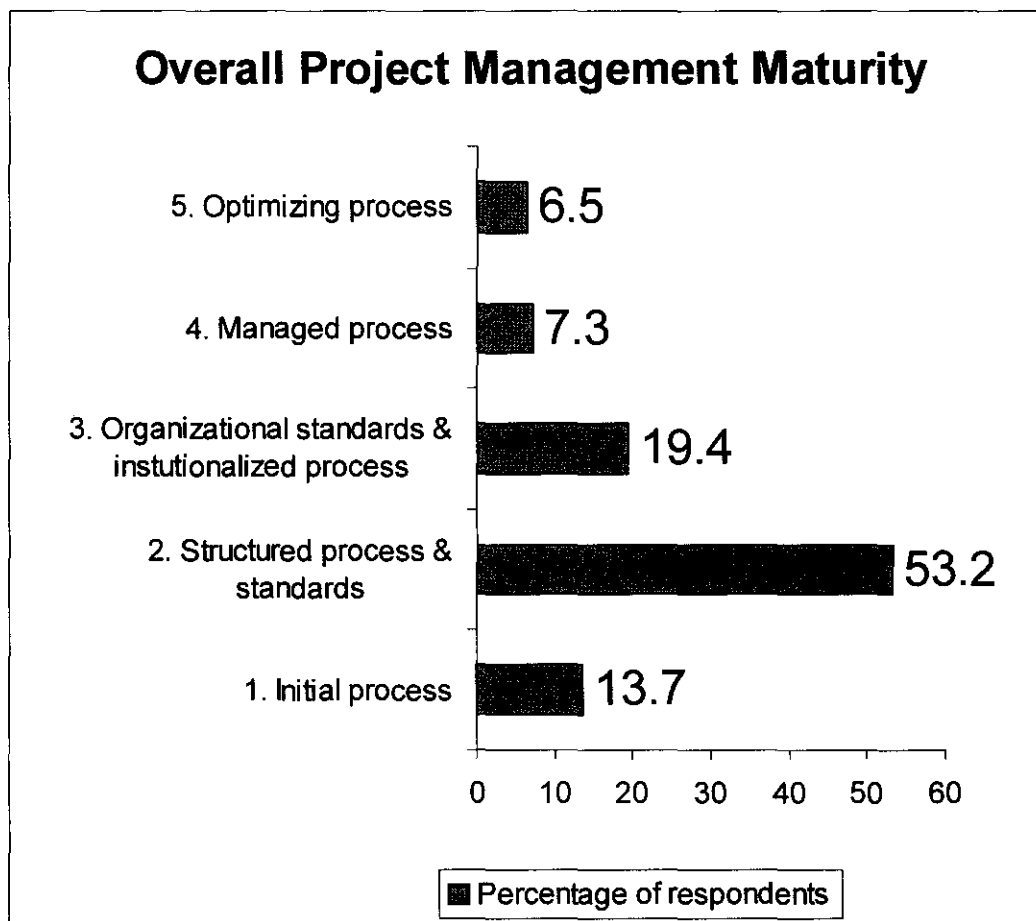
In the literature many books focus on the areas of project management but at the end they all come down to the following areas which the Project Management Institute (PMI) has

identified as comprising the Project Management Body of Knowledge, PMBOK (2000:6). The nine areas are:

- Scope management;
- Time management;
- Cost management;
- Quality management;
- Human Resources management;
- Risk management;
- Communication management;
- Procurement management; and
- Integration management.

Pennypacker & Grant (2003) conducted a benchmark exercise on the maturity level (this will be discussed extensively in chapter 4) of organizations as far as project management is concerned. Graph 1 gives the findings of the results. They found that a clear majority of respondents indicated their organizations are relatively immature in terms of the project management maturity model.

Source: Pennypacker & Grant (2003:8)



Graph 1: Overall Project Management Maturity

Nearly 67% of respondents indicated that their organizations were operating at level 1 – initial processes (13.7%) or at level 2 – structured process and standards (53.2%). While a notable portion of respondents indicated their organizations had reached level 3 – organizational standards and institutionalized process (19.4%), a mere 7.3% indicated their organizations were operating at level 4 – managed process and only 6.5% assessed their organizations to have achieved level 5 – optimizing process.

These results suggest that organizations still have a long way to go to be at an acceptable level to achieve success time and time again as was stated above.

If these results hold true for project management and as will be discussed in a literature review on project management in chapter 4, project management consists of nine knowledge areas, one can deduce that this is relevant for risk management in a project environment.

The purpose, then, of this dissertation is to conduct a literature review on strategic, project and risk management, an empirical research on the status of risk management maturity of organizations in the management of projects and practices of risk management. Strategy, because it is why organizations exist, project management due to it being the how of implementing the strategy and risk management, which is one of the best ways of ensuring success when organizations implement their strategies through capital projects. Research, because of it being a good way of finding out what is done on the subject under investigation. And then practices due to it being the ideal vehicle for learning and observing how it is done in real terms.

1.3 OBJECTIVE OF DISSERTATION

The objective of this study is to do a theoretical and an empirical investigation addressing the following aspects:

- To determine what the literature says about strategic, project and risk management;
- To establish if project managers use project risk management systems;

- To determine the maturity level of organizations in terms of risk management in capital projects;
- To give practical risk studies that can be used as examples by project teams in future; and
- To recommend a model for the improvement of the maturity level of an organization in terms of project management in general and risk management in particular when they implement their goals through projects.

1.4 DEFINING THE SCOPE OF THE STUDY

The target population of the empirical research will be business leaders and project managers implementing capital projects in South Africa. They represent a wide spectrum of industries and institutions; therefore, it can be said that the results should be applicable to all types of capital projects.

The theoretical research will cover strategic management and project management as a way of implementing organizations' strategic goals and objectives.

The risk and risk management theoretical research will cover most aspects of a project and will largely be applicable to any project.

The practices of risk management will be in the form of risk studies conducted in a large capital project.

1.5 RESEARCH METHODOLOGY

Research is based on the scientific method. The scientific method is a formal process of using systematically gathered data to test hypotheses or to explain natural phenomena. To

gain a better understanding of how to evaluate this process, a model of how research is done will be discussed, Kreitner and Kinicki (2001:26-27). A flowchart of the research process is presented in figure 2. The problem may be one of interest or may be derived from published research studies. In this case, properly identifying and attempting to solve the problem necessitates a familiarity with previous research on the topic. This familiarity contributes background knowledge and insights to solve the problem.

Next in line is the design of the study. There are two important, interrelated components to designing a study. The first consists of the measuring of variables. The second component of designing a study is to determine which research method to use.

After a study is designed and completed, data are analyzed to determine whether the objective of the study has been accomplished. Finally the results are reported and recommendations made.

Source: Adapted from Kreitner and Kinicki (2001:27) & Miller (1991: 117).

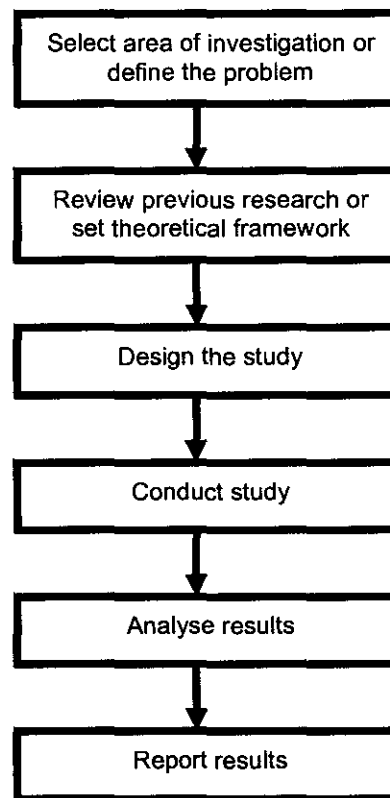


Figure 2: Model of Research Process

The dissertation will focus on selected available literature regarding strategic management, project management, risk and risk management. The available literature will be in the form of books, articles and the internet. The following research methods will be used in the study:

- Theoretical research will be conducted in order to first establish what normative project and risk management models are available and then secondly, by using this information to set the scene or environment for the research on project and risk management.
- Develop a questionnaire which will be sent to business and project managers in organization in South Africa that

are involved in the implementation of capital projects. The questionnaire is subdivided into three sections; the first section concerns background information, section two is about application of risk management and section three covers the awareness of risk by project teams.

The following is more detailed information on the layout of the questionnaire:

- **Section 1: Background Information**

In this section questions are asked to determine a demographic profile of the organization and the project manager. The evaluation of these dimensions is important because a positive result will validate the response in the next two sections.

- **Section 2: Operation of the Risk Management Process**

In this section the objective is to determine if risk management is applied in projects, if risk management systems are being used and to what extent risk management contributes to the success of projects. This section will determine the maturity level of the organization in terms of the application of risk management in projects.

- **Section 3: Risk Information**

The purpose of this section is to test if risk is at all addressed in the organization and if top management supports it, as well as the level of awareness.

1.6 LAYOUT OF THE STUDY

The layout of this dissertation per chapter is as follows:

- **CHAPTER 1: NATURE AND SCOPE OF THIS STUDY**

In this chapter the purpose and scope of the study is given.

- **CHAPTER 2: RESEARCH OBJECTIVE AND APPROACH**

The research objective and the approach that was employed in this study are discussed.

- **CHAPTER 3: STRATEGIC MANAGEMENT**

Strategic management is discussed to set the context on what strategy is and the process of strategy management and how businesses implement their strategy through projects.

- **CHAPTER 4: PROJECT MANAGEMENT**

This chapter covers a theoretical research of project management as a subject, which could be useful to understand the theoretical concept of risk in a project environment.

- **CHAPTER 5: RISK MANAGEMENT**

In this chapter the application of risk and risk management is explored throughout the project life-cycle.

- **CHAPTER 6: RESEARCH RESULTS**

The results of the empirical research are presented in this chapter.

- **CHAPTER 7: RESEARCH CONCLUSIONS AND FINDINGS**

This chapter summarizes all findings and knowledge gained with the investigation and concludes what was learnt.

- **CHAPTER 8: PRACTICES OF RISK MANAGEMENT**

Various risk studies that were conducted in a project are given as examples for future use by project teams.

- **CHAPTER 9: STUDY REVIEW AND OVERALL CONCLUSIONS**

Finally a review of each chapter is given to ease the reading work of this dissertation. Furthermore, the evaluation, contribution and the recommendations of the work are given. Finally, further study opportunities and overall conclusions are made.

Figure 3 depicts the layout of the study and gives an overview of how this dissertation could be read.

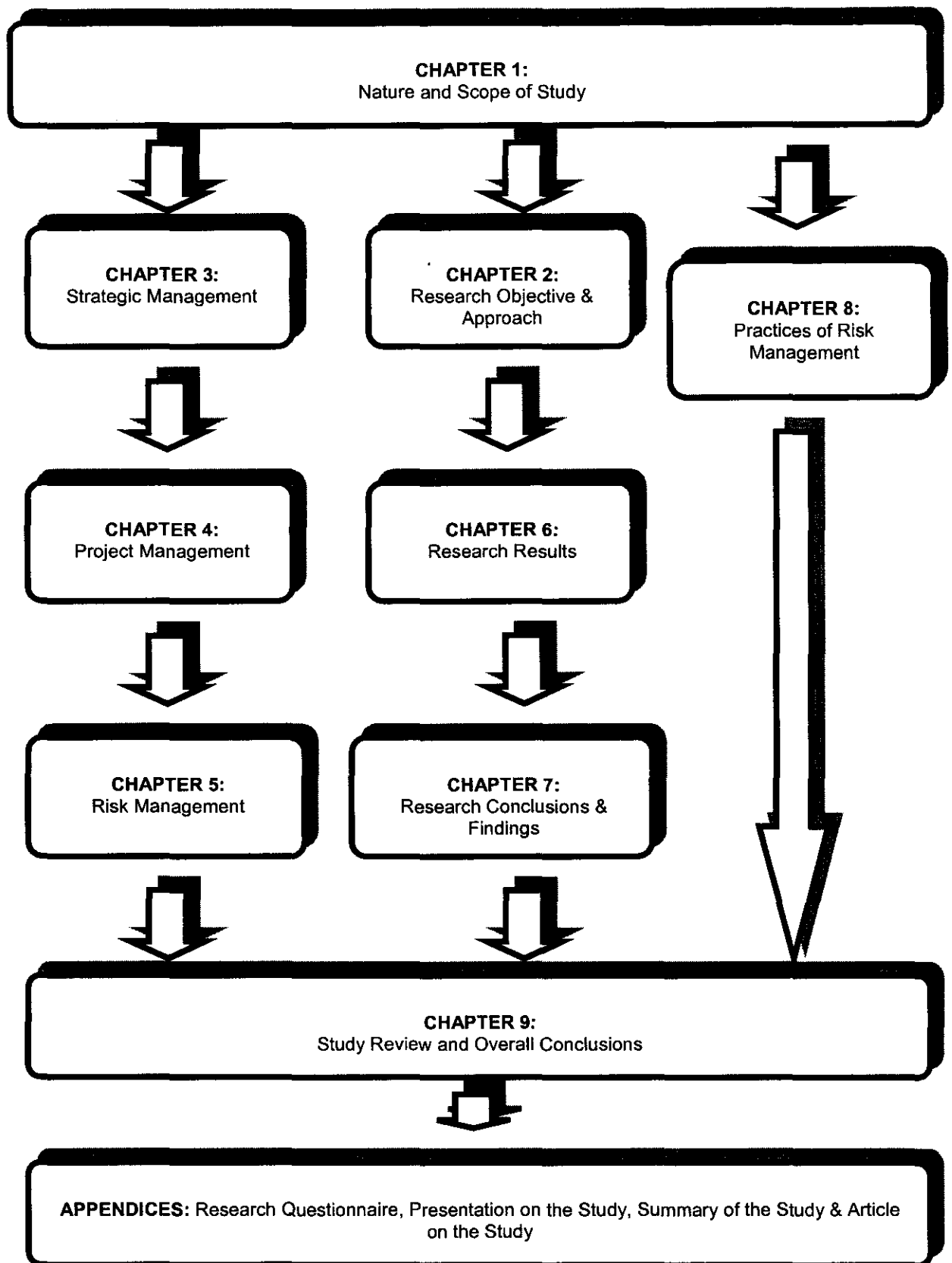


Figure 3: Layout of study

1.7 CONCLUSION

In chapter 1 a brief overview of how project management evolved over the years and the importance of project management for organizations to achieve their strategies was given.

Furthermore, a case was made for this study, as well as the objectives and methods of research which will be used were discussed. Finally the layout of this dissertation was given.

In the next chapter the research objectives and approach will be discussed in detail.

CHAPTER 2: RESEARCH OBJECTIVES AND APPROACH

2.1 INTRODUCTION

The purpose of research is to extend knowledge. Research may involve venturing into areas about which very little is known, or it may involve filling the gaps in existing knowledge. Research also has a self correction function, i.e. abandoning results that have been found to be incorrect, Behr (1983:4).

Kerlinger (1973:11) defines research as the systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relationship among natural phenomena.

It was decided that in this study a literature review will be done to get to know more about the subject under study and then secondly, to do an empirical research to find out how the actual implementation of the literature is conducted. The term 'empirical' means that which is verifiable by observation. The methods of empirical research have built-in mechanisms which ensure that the procedures and results of the researcher are open to scrutiny by his fellow professionals, Behr (1983:5).

Thirdly, examples of risk studies conducted in a large capital project will be given for the purpose of illustration and for possible future use by other project teams.

2.2 RESEARCH OBJECTIVES

The whole purpose of this study is to improve the risk management process in organization when they invest. These

investments will be implemented in the form of projects within the company. The following issues need to be addressed:

- Establish if project managers use project risk management systems;
- Determine the maturity level of organizations in terms of risk management in capital projects.

If the maturity level of an organization is high it means that they can, on a continuous basis, implement projects successfully.

Successful strategic implementation and execution is very important because it ensures that once the first two points are properly addressed that continuity in the process exists. This in turn means that companies can, on a continuous basis, implement their strategies, goals and objectives successfully.

2.3 DATA GATHERING AND ANALYSIS

The collection of data is the crucial operation in the execution of a good research design. The quality of the research rests upon the quality of the data.

The collection of data occurs in a designed inquiry only after a long series of steps including the following, Miller (1991:15):

- The definition of the problem;
- The construction of the theoretical framework;
- The stating of the hypotheses;
- The establishment of the design inquiry; and
- The determination of sampling procedures.

According to Kreitner and Kinicki (2001:28) there are four frequently used techniques for data collection:

- **Observation**

This technique consists of recording the number of times a pre-specified behaviour is exhibited;

- **Questionnaires**

Questionnaires ask respondents for their opinions or feelings about the related subject under study;

- **Interviews**

Interviews rely on either face-to-face or telephone interactions to ask questions of interest. In a structured interview, interviewees are asked the questions in the same order. Unstructured interviews do not require interviewers to use the same questions or format; and

- **Indirect methods**

These techniques obtain data without any direct contact with the respondents. This approach may entail observing someone without his or her knowledge. This method reduces responded error and is generally used in combination with one of the previously discussed techniques.

The data gathering and analysis phase of the study has the following three objectives:

- Gathering data on the demographics of the business leaders and project managers participating in this survey;

- Gathering data on the operation of the risk management process employed by the organization which will be surveyed; and
- The analysis will determine the maturity level of the organization in terms of risk management in their projects.

Business leaders and project managers from South African businesses were asked to participate by completing a questionnaire regarding data on their demographics, risk management process and the awareness and the use of risk in their project implementation. Interviews were also conducted with a selected group of project managers combined with project audits to determine the state of the work on risks and risk management.

A survey questionnaire (refer to Research Questionnaire, page 239) was developed and tested in a small pilot study in order to assess the clarity of the directions and questionnaire items. It was revised and submitted to a small group of project managers to test the study dimensions and variables as relating to the important factors in risk management in a project environment.

A questionnaire, with an introductory and explanatory letter, was sent to the selected group of business leaders and project managers and at the same time interviews with some project managers and audits on a few projects were conducted. At the end seventy three completed questionnaires were used in the study.

2.4 DATA REQUIREMENTS

Three types of data were gathered for the study:

- Background data;
- Risk management process data; and
- Risk data.

Chadwich et al (1989:137) give the following advantages and disadvantages of surveys by questionnaires:

- **Advantages:**

The major advantage is economical. A second is that the respondent may consult with others, review records, thinking about a question before answering.

There is also a view that it is a useful way to obtain information about sensitive topics.

- **Disadvantages:**

One limitation is that the questionnaire must be brief or most respondents will not take the time to complete it. Another is that the researcher cannot probe or follow up on interesting leads. Another problem is the risk that someone other than the selected respondent could complete the questionnaire. A final limitation is that a respondent can change his or her answers.

Secondary analysis is the use of research under trials for purposes different from the original research objectives, usually by persons other than those who collected the data, Bahr and Albert (1984:276).

They further state that secondary analysis offers substantial practical, social and scientific theoretical benefits.

Data can be classified under different aspects, referring to the way in which it has been collected or to some of its intrinsic values, Bless and Higgs-Smith (1995:99).

They go on to say that when researchers collect their own data for their research, it is called primary data. However, sometimes researchers use data that other investigators collected, in which case it is referred to as secondary data.

Chadwick et al (1984:440 – 442) define primary data as the collection of data from subjects or respondents as compared to using data already collected by someone else. They define secondary data as research collected by other persons.

To summarise the above views one can say that primary data for this study will constitute a questionnaire, interviews and audits that were sent out to and conducted with a selected group.

The secondary data gathering will be done in the form of a literature review from appropriate books, articles and internet information.

2.5 VALIDITY OF RESEARCH METHODOLOGY

All research methods can be evaluated from three perspectives, Kreitner and Kinicki (2001:29):

- **Generalizability**

Is also referred to as external validity, reflects the extent to which results from the study are generalizable to other individuals, groups or situations;

- **Precision of control and measurement**

This pertains to the level of accuracy in manipulating or measuring variables; and

- **Realism of the context**

A realistic context is one that naturally exists for the individuals participating in the research study. In other words, realism implies that the context is not an artificial situation contrived for the purpose of the study.

The validity of the research as a way of study is based upon certain characteristics of the method, Miller (1991:5):

- **It is thorough**

The researcher seeks to find out about all aspects and backgrounds of his subjects. He gets access to all available knowledge about it. If the task of learning so much proves too great, he limits the subject. But within the more restricted field, he still looks for all that has been contributed, using the resources of a good modern library and the internet, which help enormously by supplying indices, abstracts and huge compendiums of information. Thus the researcher, when he has done his task properly, is not ignorant – as most of us without special study are bound to be – of various little points which might invalidate the conclusions reached;

- **Research is responsible**

By the system of bibliography and footnotes, it checks up on each step of progress. Any unsupported statement is challenged by the writer himself. Exaggerations, prejudices and wishful thinking are likely to be detected and set right. This does not mean that imagination and individual opinion are ruled out.

They are, in fact, used extensively in all good research, but they are checked by facts and evidence. And if the evidence does not support them, they stand apart as especially disputable matters of which the author does not presume to require acceptance; and

- **Research is a system of world-wide collaboration**

The "learnt" periodical appears at their stated intervals, making research studies simultaneously available all over the world.

Belson (1986: 9) state," ...that for a measuring technique to be of any use in research, it must produce results that is sufficiently accurate and relevant for the operation in hand. In other words, the measure must be sufficiently valid for that purpose. A valid measure is one that accurately measures what it is supposed to measure."

A survey is valid to the degree that it measures what and only what it is supposed to measure. To be valid it must not be affected by extraneous factors that systematically "push" or "pull" the results in one particular direction. To the degree that things other than those being measured affect the results by introducing a systematic bias, the results are less valid. Unfortunately there are many factors that can bias the results of a survey, including the effects of sampling, Alreck & Settle (1985:64).

If the above criteria are applied to this study, then one can make a case that the research methodology is valid and will make a contribution to the literature due to the composition of the audience that make up the sample.

2.6 SAMPLE SIZE

The size of the sample is important and cannot be decided upon arbitrarily. A decision on the optimum size has to be taken with due regard to the kind of statistical analysis of the data. Although a sample size of 30 is regarded by many to be the minimum number in many cases, there are statistical techniques for the analysis of samples below 30. Of more importance to the researcher is the need to determine in advance of any data collection the types of relationship that he wishes to explore within subgroups of his eventual sample, Behr (1983:13).

The sample size depends on the budget and degree of confidence required. For any survey task and population, the researcher can "buy" higher reliability, lower sampling error and more confidence. Ordinarily, though, there is some minimum sample size below which the data is useless. Before determining the actual sample size to be used, the researcher should be aware of the maximum and minimum practical sizes that apply to virtually all surveys. Ordinarily, a sample of fewer than about 30 respondents will provide too little certainty to be practical and usually experienced researchers regard 100 or so respondents as the minimum sample size when the population is large. The exception would be the case where the survey contained only a few items and there is likely to be very little variance, Alreck & Settle (1985:87).

The central limit theorem states that for large samples, the sampling distribution of the mean can be approximated closely with a normal distribution. Therefore the theorem is of fundamental importance in statistics, because it justifies the use of normal-curve methods in a wide range of problems; it applies to infinite populations and also to finite populations

when the sample size (n), though large, constitutes but a small portion of the population. It is difficult to say precisely how large n must be so that the central limit theorem can be applied, but unless the population distribution has a very unusual shape, $n = 30$ is usually regarded as sufficiently large, Freund (1988:262).

After taking everything into consideration it was decided for this study not to have fewer than 30 responses. The actual figure was 73; therefore, it can be concluded that the sample will represent the population.

2.7 RESEARCH APPROACH

A working knowledge of current strategic, project and risk management theory, research and practice can help develop a understanding of why some organizations are successful in implementing their strategies through projects and others are not, refer to figure 4.

Theory is a story that explains why, Kreitner and Kinicki (2001:16-17). They go further and state that a good theoretical model defines key terms, constructs a conceptual frame work that explains how important factors are interrelated and provides a departure point for research and practical application.

Because of unfamiliar jargon and complicated statistical procedures, many people are put off by research. However, the following five sources of research insights can be useful in the process:

- **Meta-analyses**

This is a statistical pooling technique that permits researchers to draw general conclusions about certain variables from different studies. Meta-analyses are instructive because they focus on general patterns of research evidence, not fragmented bits and pieces or isolated studies;

- **Field studies**

Field studies probe individuals or group processes in an organizational setting. Because field studies involve real-life situations, their results often have immediate and practical relevance;

Source: Adapted from Kreitner and Kinicki (2001:17)

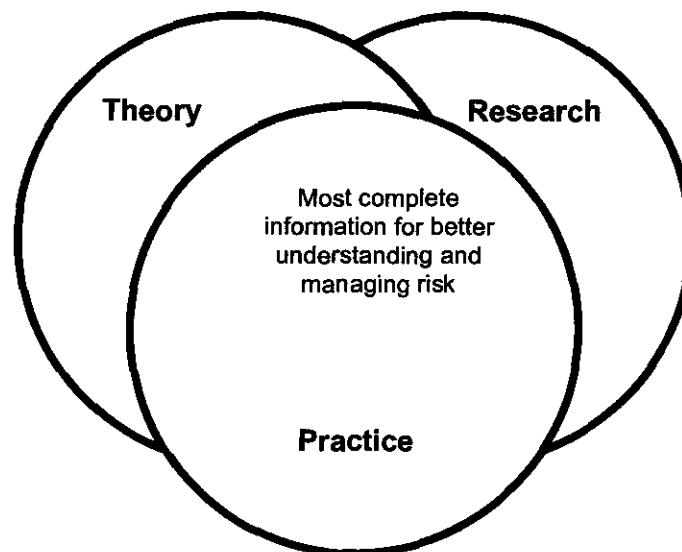


Figure 4: Learning about risk management through a combination of theory, research and practice

- **Laboratory studies**

In laboratory studies, variables are manipulated and measured in contrived situations;

- **Sample surveys**

In a sample survey, samples of people from specified populations respond to questionnaires. The researchers then draw conclusions about relevant populations. Generalization of the results depends on the quality of the sampling and questioning techniques; and

- **Case study**

A case-study is an in-depth analysis of a single individual, group or organization. Because of their limited scope, case studies yield realistic but not very generalized results.

Learning to manage is like learning to ride a bicycle. You watch others do it. Sooner or later, you get up the courage to try it yourself. You fall off and skin your knee. You climb back on the bike a bit smarter, and so on, until wobbly first attempts turn into a smooth ride. Your chances of becoming a successful project manager can be enhanced by studying the theory, research and practical examples. But there is more. In the world of competitive business, acquiring work-related knowledge is not enough today. According to the growing practice of knowledge management, key information and knowledge must be shared with co-workers who need to do a better job if the organization is to gain a competitive advantage.

The study consists of nine chapters as was discussed in chapter one. The following approach will be taken to address research objectives:

- A comprehensive literature study will be undertaken on strategic management, project management and risk management to learn more about the identified problem

areas as discussed in chapter one. Furthermore, this literature review will give a broad overview on how organizations start off with a strategy and how it is implemented by projects and at the same time, how, with the help of risk management the probability of success is increased. Risk management processes are also discussed in detail, maturity models are discussed, as well as what a company needs to do to implement and stimulate or create a culture of risk management use;

- An empirical study will also be conducted in the form of a questionnaire. The research will be based on the information obtained in the literature study to allow for direction and, will focus on addressing the real issues. The questionnaire consists of three sections: background information, operation of the risk management process and risk information. A brief description of these sections follows:

- **Background Information**

This section gives the context in which the research is conducted. This information will assist in evaluating the other sections of the questionnaire and at the same time validate the responses;

- **Operation of the Risk Management Process**

This part of the questionnaire looks at the application of the risk management processes and will assist in determining the maturity level of the organization in terms of risk management; and

- **Risk Information**

This last section gives information on how effective risk management is applied by a project team within a project.

- Finally, practices of risk studies conducted in a project by the author of this work will be described and these examples can be used in future by other project teams.

This questionnaire will be sent to a number of experienced project managers and leading business leaders involved in capital projects for their views on this topic, interviews will also be conducted with some of them and audits on some projects will be carried out. This selection of the survey participants will ensure that participants form a homogeneous professional group with a certain level of management and project management education and experience.

2.8 CONCLUSION

In this chapter it was stated that the ultimate goal of this study would be to improve the risk management process in the pre-feasibility phase of a project life-cycle.

A comprehensive literature study will be undertaken to learn more about the identified problem areas. This will be based on most recent articles and books on strategic management, financial management, project management and risk management.

Following this literature study an empirical study will be conducted amongst experienced project managers and leading business leaders for their views on project and risk management and on how it is applied in their businesses.

It will be followed by practices in risk management in the form of risk studies conducted in a large capital project.

CHAPTER 3: STRATEGY MANAGEMENT

3.1 INTRODUCTION

The importance of strategic management for organizational success is now well acknowledged in the literature. Strategic vision and action are necessary to enhance a company's competitive superiority, achieve superior performance and improve its value, Byars, Rue & Zahra (1996: iii).

The management of an organization, whether it is large or small or a sub-unit of a larger entity, has as one of its principal responsibilities to set the direction of the organization for the future, Cowley & Domb (1997:9). And this is where strategic management comes in as a management tool to develop a shared vision of what the organization will be in future.

Therefore, for any organization to survive in this complex and competitive global world a clear direction is needed on where the organization is heading and then the implementation thereof is critical for success. This chapter covers secondary data on strategic management.

The next three chapters will focus firstly on strategic management and then on project management as a process to implement the strategy, followed by risk and risk management in a project environment.

3.2 STRATEGY

In the literature many definitions of strategy exist. A few are given here:

Oxford Pocket Dictionary states that strategy is, "the art of war, especially of movements of troops and ships, etc. into favourable positions; plan of actions or policy in business or politics, etc."

Grant (1998:14) gives it as, "...strategy is the overall plan for deploying resources to establish a favourable position".

Thompson and Strichland (1995:6) give the following definition, "...strategy is best conceived as a combination of planned actions and on-the-spot adaptive reactions to fresh developing industry, and competitive events".

The concept "strategy", in the context of management, indicates a suitable plan or method for achieving the aims of the organization, irrespective of change, Knipe et al (2002:41).

It could then be stated that strategy is the development of various plans that will be implemented for the organization to be successful.

3.3 ELEMENTS OF SUCCESSFUL STRATEGIES

Grant (1998:9-10) gives four common factors that are conducive to success. These are illustrated in figure 5:

- Goals that are simple, consistent and long term;
- Profound understanding of competitive environment;
- Objective appraisal of resources; and
- Effective implementation. Without effective implementation the best laid strategies are of little use.

Source: Adapted from Grant (1998)

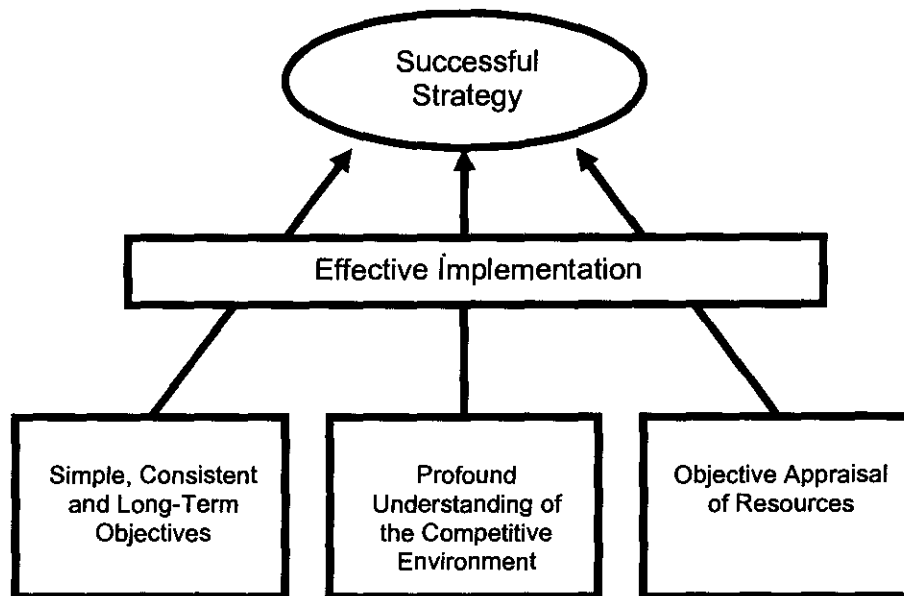


Figure 5: Elements of Successful Strategies

Kotze (1996:1-2) states that the elements of success are firstly, in the formulation of the strategy, i.e. deciding where the organization is today and where the organization should be tomorrow. Secondly, by implementation of strategy, i.e. deciding how to get the organization from where it is today to where it should be tomorrow. This should be combined with the basic elements that make up and drive the organization:

- Strategy formulation;
- Organizational structure;
- Human resources;
- Management processes and systems; and
- Corporate culture.

Both the above-mentioned authors are of the opinion that effective strategy implementation is important for any organization if it wants to be able to compete successfully in this competitive world today. Therefore, one can deduce that

more and more attention should be paid by top management on how they implement their strategies. This is where this work can be useful because project and risk management is ideally suited for this.

3.4 THE STRATEGIC MANAGEMENT PROCESS: AN OVERVIEW

Strategic management is the process of assessing "What we are" and deciding and implementing "What we intend to be and how we are going to get there". Strategy describes how an organization intends to compete with the resources available in the existing and perceived future environment, (Gray & Larson 2000:24).

Two major dimensions of strategic management are responding to changes in the external environment and allocating scarce resources of the firm to improve its competitive position. Constant scanning of the external environment for changes is a major requirement for survival in a dynamic competitive environment. The second dimension is the internal responses to new action programmes aimed at enhancing the competitive position of the firm. The nature of the responses depends on the type of business, environment volatility, competition and organizational culture.

Strategic management provides the theme and forms the future direction of the organization. It supports consistency of action at every level of the organization. It encourages integration of effort and strategies. It is a continuous iterative process aimed at developing an integral and coordinated long-term plan of action. Strategic management positions the organization to meet the needs and requirements of its customers for the long term. With the long-term position identified, objectives are set

and strategies are developed to achieve objectives and then they are translated into actions by implementing projects. Strategy can decide the survival of an organization. Most organizations are successful in formulating strategies for what course they should presume. However, the problem in many organizations is implementing strategies - that is, making them happen. Integration of strategy formulation and implementation often does not exist.

The implementation of strategy is a process and Byars, Rue & Zahra (1996:6) describe it as follows, "...the strategic management process involves the use of terms and expressions that have a variety of meanings and interpretations depending on the author and source. Basically, strategic management can be broken down into three phases, strategy formulation, strategy implementation and strategy evaluation".

Strategy formulation is concerned with making decisions with regard to:

- Defining the organization's guiding philosophy, purpose and mission;
- Establishing long-range objectives to achieve the mission; and
- Selecting the strategy to achieve the long-range objectives.

Strategy implementation is also about aligning the organizational structure, systems and processes with the chosen strategy. It involves making decisions with regards to:

- Developing an organizational structure, selecting leadership and providing motivational systems to achieve the strategy; and
- Establishing short-range objectives, developing budgets and functional strategies to achieve the strategy.

Strategy evaluation, sometimes referred to as strategic evaluation and control, involves the following activities:

- Establishing standards of performance for the overall organization and its different units or functional areas;
- Monitoring progress in the execution of the organization's strategy. This requires assessing and measuring the implementation of the strategies pursued by different units throughout the organization; and
- Initiating corrective actions to ensure continued commitment to the implementation of the strategy. Taking corrective actions requires the timely dissemination of feedback data to the managers of the organization's different units, its top management and members of its board of directors.

Knipe et al (2002:4) state that, strategic management consists of the following basic steps:

- Environmental analysis or scanning;
- Vision and mission statement;
- Strategy formulation;
- Strategy implementation; and
- Strategy evaluation and control.

All these processes give the organizational mission, long-range goals and objectives, strategy formulation and strategy implementation as the key steps in the strategic management process; therefore, these are the driving forces to move the organization towards a better tomorrow. These will now be discussed in more detail.

The typical sequence of activities of the strategic management process according to Gray & Larson (2000:25), figure 6 is:

- Review and Define Organizational Mission;
- Set Long-Range Goals and Objectives;
- Analyse and Formulate Strategies to reach Objectives;
and
- Implementing Strategies.

Source: Gray & Larson (2000:25)

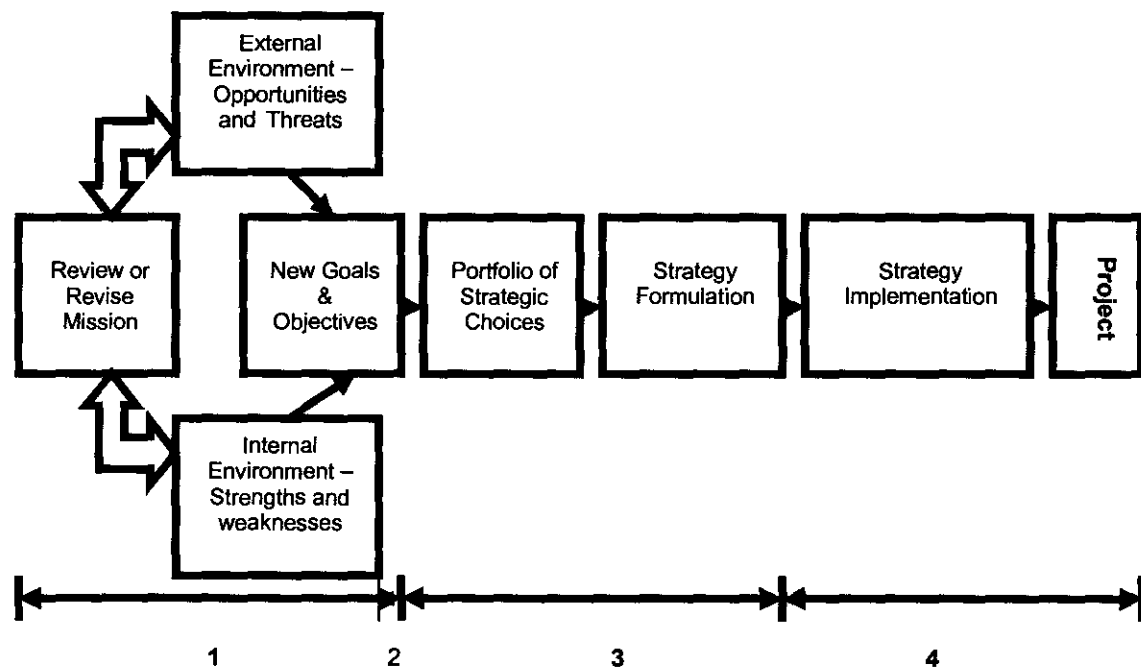


Figure 6: Strategic Management Process

A description of each of these activities will now follow:

- **Review and Define Organizational Mission**

The mission identifies “What we want to become” or the *raison d’être*. Mission statements identify the scope of the organization in terms of its products or service. Everyone in the organization should be keenly aware of the organization’s mission. A written mission statement provides focus for decision making when shared by organizational managers and employees. The mission statement communicates and identifies the purpose of the organization to all stakeholders. Mission statements can be used for evaluating organizational performance;

- **Long-Range Goals and Objectives**

Objectives translate the organization mission into specific, concrete, measurable terms. Organizational objectives set targets for all levels of the organization. Objectives pinpoint the direction managers believe the organization should move toward. Objectives answer in detail where a firm is headed and when it is going to get there;

- **Analyse and Formulate Strategies to Reach Objectives**

Formulating strategy answers the question of what needs to be done to reach the objectives. Strategy formulation includes determining and evaluating alternatives that support the organization’s objectives and selecting the best alternative. The first step is a realistic evaluation of the past and current position of the enterprise. This step typically includes an analysis of “who are the customers” and “what their needs are as they see them?”

The next step is an assessment of the internal and external environments. What are the internal strengths and weaknesses of the enterprise? Opportunities and

threats usually represent external forces for change such as technology, industry structure and competitions.

From this analysis critical issues and a portfolio of strategic alternatives are identified. These alternatives are compared with the current portfolio and available resources; strategies are then selected that should support the basic mission and objectives of the organization; and

- **Implementing Strategies**

The most critical activity of these four for success is to implement the strategies. This is normally achieved through projects. The systematic and structured approach of project management lends itself to the successful implementation of strategies.

One can therefore conclude that for any organization to be able to survive in today's competitive world it needs to make use of the strategic management process to assist it to develop a roadmap to remain in business and compete in the future. The vision states the purpose of the organization where as the mission statement can be used for evaluating organizational performance. Objectives answer in detail where a firm is headed and when it is going to get there, who the customers are and what their needs are.

3.5 IMPLEMENTATION OF STRATEGIES THROUGH PROJECTS

Organizations often use projects as the means by which they attempt to meet many of their objectives. The project is therefore a vehicle for the execution of organizational strategy.

This implies a high-level consideration of the role of projects in an organization, Mayor (1999:35).

To achieve service and product targets, public and private institutions usually do not rely on one project, but rather on several parallel programmes and projects that must be co-ordinated and combined to meet the strategic objectives of the organization. Projects must co-ordinate the efforts of multiple cross-functional teams operating in different functional areas and even geographic locations. Project information needs to be shared and presented to an increasing number of stakeholders, including top management, clients, and suppliers and governing bodies whose impact can threaten or strengthen the outcome of the project at any moment, Knipe et al (2002:40).

Normally, the project is generated in order to keep the organization economically alive, socially involved, technologically in step with evolution, culturally attuned to its environment or politically correct or in order to grow the organization by expanding its market. The link between the organization's vision and the project's expected outcome(s) is established during the initiation phase. The chief desire of the initiation phase is to take the desired outcome and plan the outputs. In order to achieve the desired outputs the project team defines the "what", "how", "who", "when", and "where". The "why" should align with the corporate vision and with objectives that drive the project as depicted in figure 7, Stewart (2000:41).

Source: Stewart (2001:41)

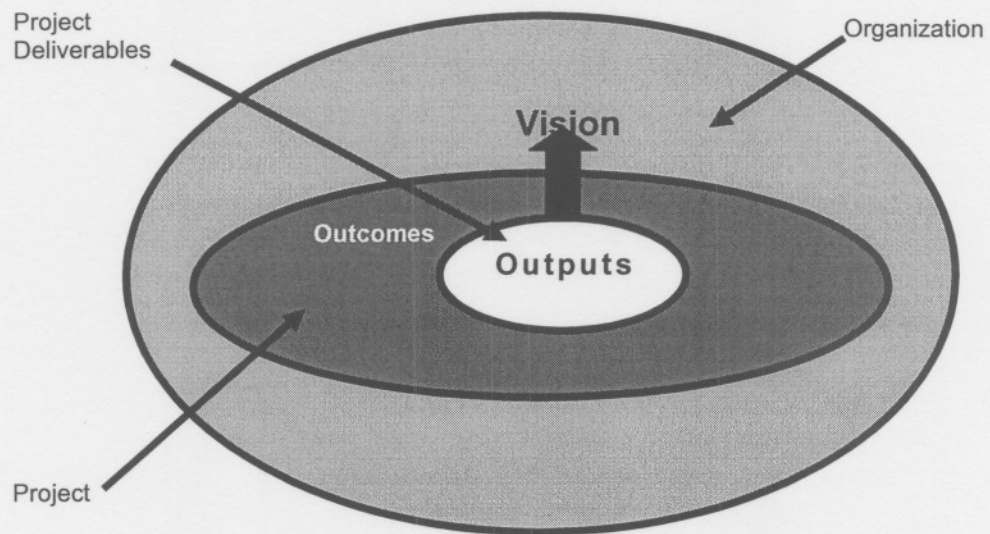


Figure 7: Vision Drives the Project

Implementation answers the question of how strategies will be realised, given available resources. The conceptual framework for strategy implementation lacks the structure and discipline found in strategy formulation. Implementation requires action and completing tasks; the latter frequently means mission – critical projects. Therefore, implementation must include attention to several key areas, see figure 8.

Source: Adapted from ICI (1992)

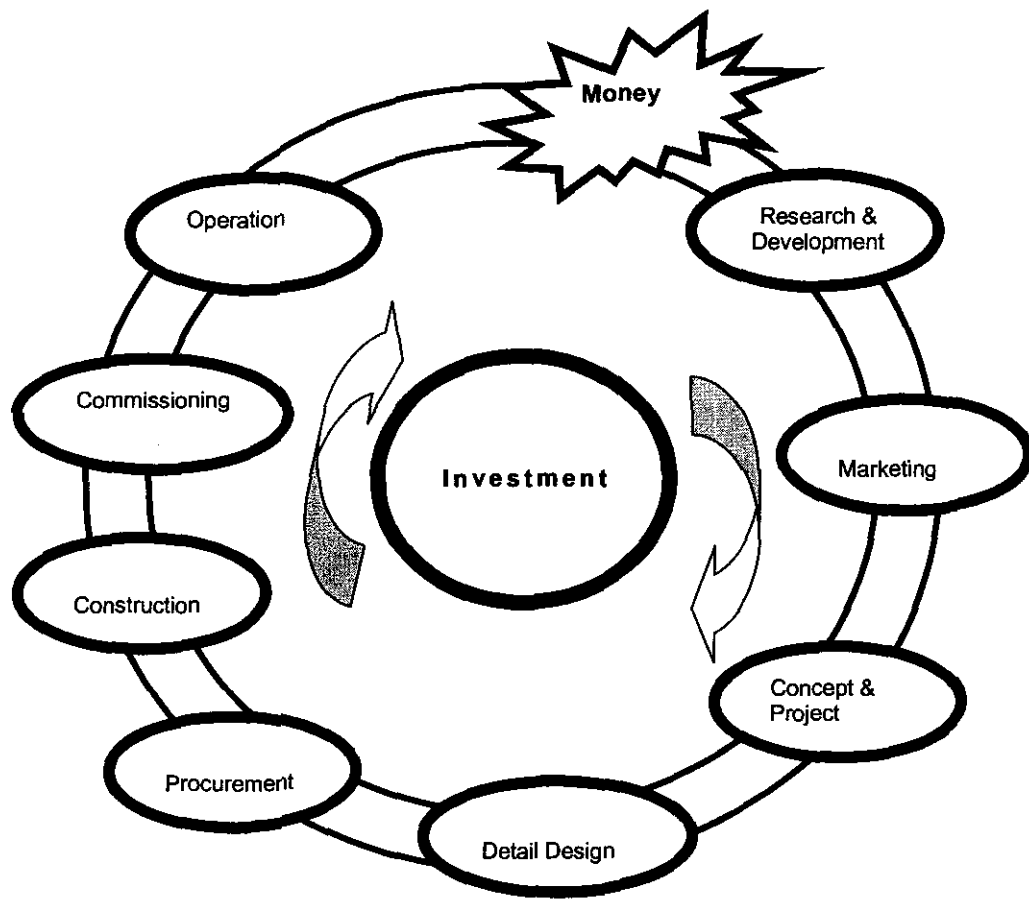


Figure 8: Project Life-Cycle

Why is Effective Project Management important? Think of Money. When several experienced Project Managers were asked "Why is Effective Project Management important", the majority answered, "Well it is obvious, just think of the money involved", (ICI:1992:1).

If one considers the amount of projects that are currently being undertaken in South-Africa alone and the money involved then it is clear that effective project management is important.

Project management is no longer a special need management. It is rapidly becoming a standard way of doing business. An increasing percentage of a typical firm's effort is being devoted

to projects, Gray & Larson (2000:7). They go further by stating that the future promises an increase in the importance and the role of projects in contributing to the strategic direction of organizations. They give several reasons for this:

- **Compression of the Product Cycle**

One of the most significant driving forces behind the project management is the shortening of the project life cycle. Instantaneous, worldwide flows of information reduce the competitive advantage of new products, which are more easily imitated. Time to market for new products with short life cycles has become increasingly important to all product organizations because of the velocity with which technology is changing. Speed is becoming a competitive advantage; more and more organizations are relying on cross functional project teams and project management methods to get new products and services to the market as quickly as possible;

- **Global Competition**

The transformation from national or regional economics to one global economy during the 1970s has not only led to dramatic technological innovations but has also created tremendous pressures on quality improvement and cost containment. Today's open market demands not only cheaper products and services but also better products and services. This has led to the emergence of the quality movement across the world with ISO 9000 certification, a requirement for doing business. ISO 9000 is a family of international standards for quality management and assurance. These standards cover design, procurement, quality assurance and delivery processes for everything from banking to manufacturing. Quality management and improvement invariably involve

project management. For many, their first exposure to project management techniques has been in quality workshops. Increased pressures to reduce costs have not only led to the migration of U.S. manufacturing operations to Mexico and the Far East, which by itself is a significant project, but also to transformation in how organizations try to achieve results. Project management with its triple focus on time, cost and performance is proving to be one efficient, flexible way to get things done;

- **Knowledge Explosion**

The growth in new knowledge has increased the complexity of projects because projects encompass the latest advances. For example, building a road 30 years ago was a somewhat simple process. Today, each area has increased in complexity, including materials, specifications, codes, aesthetics, equipment and required specialists. Not only has basic project work become more complex requiring greater degrees of coordination but existing products and services are also more technologically complex. In today's digital electronic age it is becoming hard to find a new product that does not contain at least one microchip. Product complexity has increased the need to integrate divergent technologies. Project management has emerged as an important discipline for achieving this task;

- **Corporate Downsizing**

After years of stressing growth and "big is better", organizations have begun to face the harsh reality that big is also more costly. The last decade has seen a dramatic restructuring of organizational life. Downsizing (or right sizing if you are still employed) and sticking to core competencies have become necessary for survival for many years. Middle management is a mere skeleton

of the past. In today's flatter and leaner organizations, where change is a constant, project management is replacing middle management as a way of ensuring that things get done. Corporate down sizing has led to a change in the way organizations approach projects. It is rare today to find any major project performed totally in-house. Companies outsource significant segments of project work and project managers have to manage not only their own people but also their counterparts in different organizations;

- **Increased Customer Focus**

Increased competition has placed a premium on customer satisfaction. Customers no longer simply settle for generic products and services. They want customised products and services that cater to their specific needs. This mandate requires a much closer working relationship between the provider and the receiver. Project management is critical both to development of customised products and services and to sustaining lucrative relationships with customers;

- **Rapid Development of Third World and Closed Economies**

The collapse of the Soviet Empire and the gradual opening of Asian communist countries have created an explosive in pent-up demand within these societies for all manner of consumer goods and infrastructure development. Western firms are scrambling to introduce their products and services to these new markets and many firms are using project management techniques to establish distribution channels and foreign base of operations. Likewise, these historical changes have created a tremendous market for core project work in the areas of heavy construction and telecommunications as

these countries strive to revitalise their inefficient industries and poor infrastructure. To reduce some of the risk and maximise individual talents more and more firms are entering into joint ventures with indigenous firms to complete large and small scale foreign projects. These foreign ventures have paid a premium on the adaptive capacity of project management personnel to work in foreign cultures with vastly different values, work habits and orientations; and

- **Small Projects Represent Big Problems**

The velocity of change required to remain competitive or simply keep up has created an organizational climate in which hundreds of projects are implemented concurrently. This climate has created a multi-project environment and a plethora of new problems. Sharing and prioritising resources across a portfolio of projects is a major challenge for senior management. Those who manage small projects often face a greater variety of problems than do managers of single mega projects. Frequently, the organizational culture does not support small projects and control systems are non-existent. Thousands of products and services companies are faced with multiple projects continuously in process. Many firms have no idea of the problems involved with inefficient management of small projects. Small projects typically carry the same or more risk as large projects. Small projects are perceived as having little impact on the bottom line because they do not demand large amounts of scarce resources and/or money. Because so many small projects are going on concurrently and because the perception of inefficiency impact is small, measuring inefficiency is usually non-existent. Unfortunately many small projects soon add up to large sums of money. Many customers

and millions of dollars are lost each year on small projects in products and service organizations.

In summary one can say that there is a variety of forces in today's business world that contribute to the increased demand for good project management across all industries and sectors.

3.6 CAPITAL BUDGETTING

Brigham and Gapenshi (1993:384) state that a number of factors combine to make capital budgeting extremely important. First, since the effects of capital budgeting decisions continue over many years, the decision maker loses some of this decision making or his flexibility. For example, the purchase of an asset with an economic life of 10 years often "locks in" the firm for a 10-year period.

An erroneous forecast of asset requirements can have serious consequences. If the company invest too much, it will incur unnecessarily heavy expenses. If it does not spend enough, two problems will arise. First the company's equipment will not be sufficiently modern to enable it to produce competitively. Second, if it has inadequate capacity, it will lose a portion of its market share to rival firms and regaining lost customers typically requires heavy selling expenses, price reductions or product improvements, all of which are costly.

Another aspect of capital budgeting is timing – capital assets must be available when they are needed. Otherwise market share could be lost and gained by a competitor whose capital budget process was done better. Therefore, effective capital budgeting will improve both the timing and the quality of asset acquired.

Finally, capital budgeting is also important because asset acquiring typically involves substantial expenditures and before a company spends a large amount of money, it must make the proper plans – large amounts of funds are not available automatically. A company contemplating a major capital expenditure program may need to arrange its financing several years in advance to ensure having the funds required for the expansion.

3.7 PROJECT CLASSIFICATION

Capital projects need to be investigated in detail because of the positive or negative impact that they could have on the company's bottom line. Different methods could be used in this exercise, but before this takes place projects are normally classified. Birgham and Gapenshi (1993: 386-387) categorise projects as follows:

- **Replacement: maintenance or business**

Category 1 is expenditure for the replacement or maintenance of the current asset base. The main issue or question is whether the company should either maintain or replace the current asset base;

- **Replacement: cost reduction**

This category, category 2, includes expenditure to replace serviceable but obsolete equipment. The reason to do this is to reduce the cost of labour, materials or other resources;

- **Expansion of existing products or markets**

These are expenditures necessary to expand existing products or to expand into existing geographic areas;

- **Expansion into new products or markets**

These are expenditures necessary to produce a new product or to expand into a geographic that are not currently being served; and

- **Safety and/or environmental projects**

Expenditure necessary to comply with government requirement, rules and regulations are often called "mandatory" investments or non-revenue producing projects.

3.8 CONCLUSION

Without a well-thought-out strategy an organization have no direction, but without proper implementation the best strategy is of no value. Therefore, one can see strategic management as a process that starts with developing a vision, mission, with clear objectives that are implemented through projects that never stops as depicted in figure 6.

The objective of this chapter is to provide a framework on what organizations need to do to be successful in implementing their strategic goals. The vehicle presented in this study is project management.

The next chapter will be a literature review on project management as a subject that will assist in understanding the whole process of implementing a strategy in any organization.

CHAPTER 4: PROJECT MANAGEMENT

4.1 INTRODUCTION

The past several decades have been marked by rapid growth in the use of project management as a means by which organizations achieve their objectives. Project management provides an organization with powerful tools that improve its ability to plan, implement and control its activities as well as the ways in which it utilises its people and resources, Meredith & Mantel (2000:1).

It is being said that the project manager will fill the void created by extinction of middle management. Stewart states the following, "...if the old middle managers are dinosaurs, a new class of manager mammal is involving to fill the niche they once ruled: project managers. Unlike his biological counterpart, the project manager is more agile and adaptable than the best he's displacing, more likely to live by his wits than throwing his weight around".

The project approach has long been the style of doing business in the construction industry, U.S. Department of Defence and Hollywood, as well as at big consulting firms. Now project management is spreading to all avenues of work. Today project teams carry out everything from post expansions to hospital restructuring to upgrading information systems, Gray & Larson (2000:3).

Projects make up around fifty percent of all work carried out. They can, therefore, be termed "an economical important" category of activities. That makes the subject of their management worth studying. However, it is not unusual to hear

the question from students at the start of a course, *"It's just common sense, isn't it?"* To some extent they are right. After all, there is nothing inherently different about the project management concepts. How is it that the majority of organizations are so poor at managing projects? The answer can be found in the definition of common sense as *"the obvious after it has been explained"*. It is observed that common sense is not so common sense and many of these apparently obvious aspects of the subject are neglected, Maylor (1999:5).

It can, therefore, be said that project management is not new, but the development of project management tools and techniques has enhanced project management as a profession so that it is being used all over industries for a wide variety of projects and even to manage the business by projects.

In this chapter, a theoretical review of project management will be undertaken from the most recent literature. Different project life-cycles with the different phases will be discussed in detail. The different knowledge areas of project management and the different tools and techniques will be reviewed. Project competencies and the role and responsibilities of the project manager will be highlighted.

4.2 DEFINITION OF A PROJECT

Lewis (1999:4) defines a project as, "...an one-time multi task job that has clearly defined starting and ending dates, a specific scope of work to be performed, a budget and a specified level of performance to be achieved".

Another project definition: "A project is a complex non-routine, one-time effort limited by time, budget, resources and

performance specifications designed to meet customer needs", Gray and Larson (2000:4).

The PMBOK (2000:4) states: "A project can be defined in terms of its distinctive characteristics – it is a temporary endeavour undertaken to create a unique product or service. Temporary means that every project has a definite beginning and a definite end. Unique means that the product or service is different in some distinguishing way from all other products or services".

A project can be defined as a non-repetitive activity. This needs to be augmented by other characteristics, Maylor (1999:5):

- It is goal oriented – it is being pursued with a particular end or goal in mind;
- It has a particular set of constraints – usually centred around time and resource;
- The output of the project is measurable; and
- Something has been changed through the project being carried out.

In context of the above three definitions one can define a project as a one-time, complex effort with limited time and budget that must meet design or performance specifications that will satisfy the customer's needs.

4.3 WHAT IS PROJECT MANAGEMENT?

The PMBOK (2000:6) defines project management: ...as the application of knowledge, skills, tools and techniques to project activities to meet project requirements. Project Management is accomplished through the use of the processes such as initiating, planning, executing, controlling and closing. The project team manages the work of the projects and the work typically involves:

- Competing demands for scope, time, cost, risk and quality;
- Stakeholders with different needs and expectations; and
- Identified requirements.

Project management involves three major categories of activities, i.e. planning, scheduling and controlling aimed at achieving project objectives, Lewis (1999:7).

Project management is the disciplined application of certain knowledge techniques, tools and skills to create a unique product or service. The project manager can choose from a range of processes to manage any particular project. The choice of which particular processes will be employed in any situation is left to the judgement of the individual project manager, Kenny (2003:43).

One can, therefore, state that project management is the application of project management knowledge, skills, tools and techniques to achieve project objectives, namely cost, time, budget and scope.

Figure 9 depicts these objectives and the environment in which they are manifested. The objectives of project management are to manage the project in such away that the objectives of the

project are met and that they fulfill the expectations of the client. The project objectives must also be aligned with the objectives of the organization. The success of any project is always measured in terms of these objectives.

The project manager must align himself totally with these objectives and, in order to achieve this, his principal duty must be to analyze with his client the objectives for the project. For any project to be successful an overall compromise situation with equal emphasis on all four factors must exist.

Source: Adapted from Burke (1999:20)

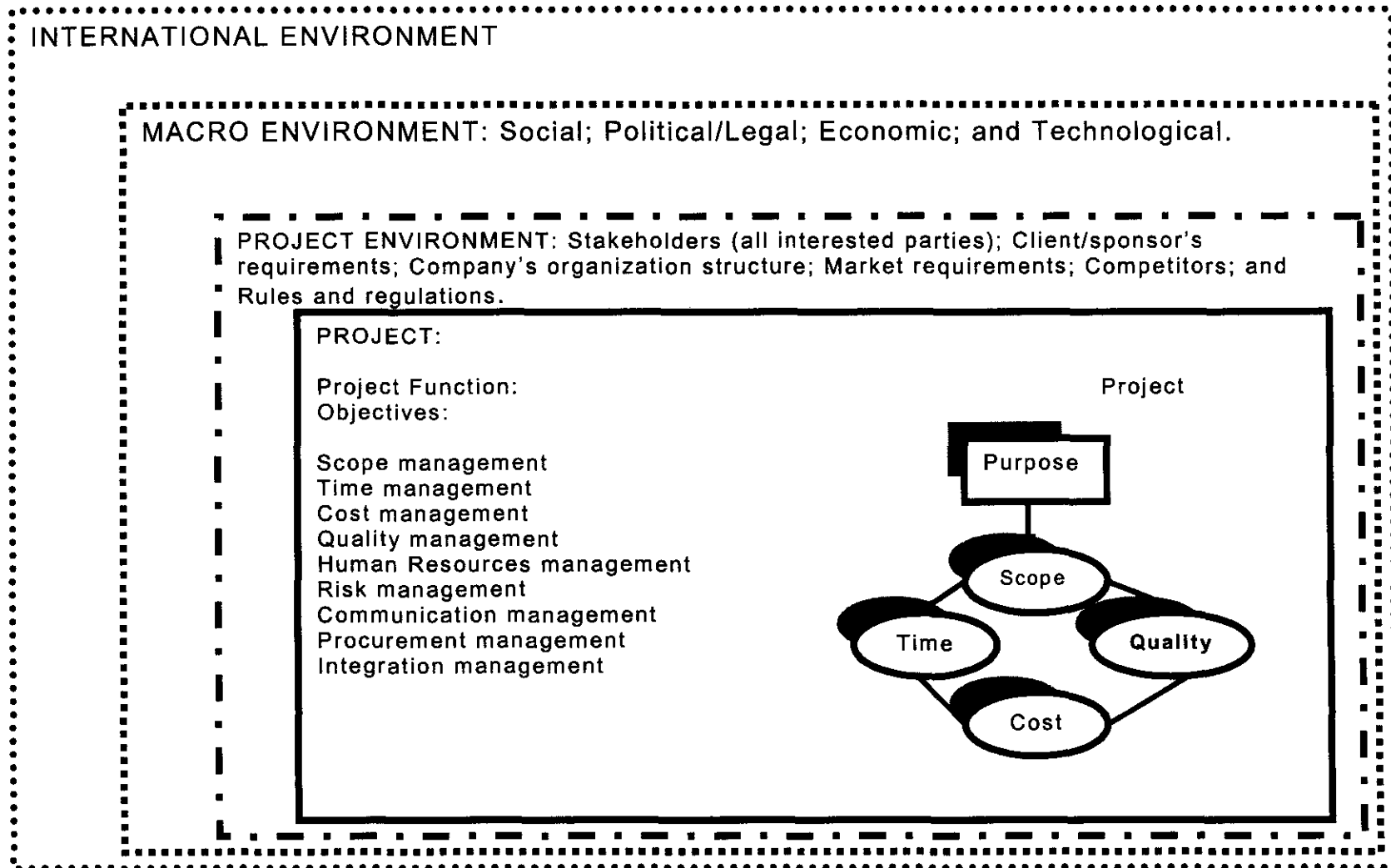


Figure 9: Project Environment

4.4 PROJECT LIFE-CYCLE

Bonnal et al (2002:1) state that, "...it is quite difficult to attribute the concept of project life cycle to one another in particular, since the concept has gradually derived over time".

They go further and give the following different life-cycle models for technical projects:

- Straightforward project life-cycle;
- Control-oriented project life-cycle;
- Quality-oriented life-cycle;
- Risk-oriented life-cycle; and
- Fractal project life-cycle.

Technical projects can be broken down into phases, also stages or steps. The phases can be divided into sub-phases, then sub-sub-phases and so on. The number and labels of these phases are deeply dependent on the field in which the model will be used. Obviously, the breakdown into phases of a small project is different from the ones used for large projects. The phasing of engineering and construction projects is also different from those used for the development and industrialisation of commercial goods. In spite of such differences, projects in a broad sense have two very basic phases in common: a pre-project phase and the project itself.

The pre-project phases aim to identify possible projects, called project concepts, and to appraise them in terms of benefits for the organization that intends to employ them. When such phases are completed, it is up to decision-makers to decide whether or

not to go ahead. Approved and funded projects are then implemented in the second phase, i.e. the project phase.

Several characteristics make these two phases different, i.e. Bonnai et al (2002:13) mention that a pre-project phase requires creativity, while a project phase must be managed with rigor.

A brief description of each of the above project life-cycles will now be given, Bonnai et al (2002: 1-19).

4.4.1 Straight-forward project life-cycle

The inputs of the initiation phase also called “concept phase” or “identification phase” are the keeping pace with technology innovations, economical trends, requests from customers, distributions or sales people, new products put on the market by competitors or brainstorming processes. The initial phase aims to sort all this information to identify some project concepts. This does not mean that all the concepts made out of this phase are to be carried out. A rational attitude towards each initiation phase is to identify as many project concepts as possible and to eliminate the discordant ones through a pre-selection procedure with respect to the objectives of the organization.

Selected project concepts – outputs of initiation phase – then are used as inputs for the second phase, the feasibility phase. This phase aims to analytically appraise project concepts in the context of the organization. This second phase can be understood as follows: on the one hand, there are the organization’s needs, which in some cases can be expressed with simple words of the strategic charter of the organization to which the feasibility is carried out. On the other hand, there are the

capabilities and the know-how of the organization. With this information, the decision-makers should be able to decide whether or not to go ahead with each project concept proposed.

The feasibility phase is known to be terminated when a decision-maker decides on a go/no-go of the project.

The way a project implementation is conducted depends on the organizational context within which the project is implemented. It is initiated when the project has been appraised to be feasible and profitable. Once launched, nothing is supposed to interrupt the realisation of the project, for projects presenting low complexity, the processes associated with this phase are quite straightforward. For speculative or complex projects, this phase can be split into a new sub-phases separated by intermediate decision points at the end of which the future owners and/or stakeholders of the final deliverable can decide whether or not to continue the implementation of the project. For instance, in the petroleum and chemical industries it is quite common to have this implementation phase be broken down into three sub-phases:

- A basic design phase carried out by an engineering company or an industrial architect, during which the documentation for tendering and contracting the physical construction or procuring equipment is prepared. This phase is considered completed when engineering, procurement and construction contracts are awarded and when the purchase order for long-lead equipment is placed.
- A detailed design phase, immediately followed by a construction phase, carried out by one or more contractors during which the final deliverable is made and commissioned; and

- A post-project phase, turnover phase or start-up phase during which the responsibility of the materialised deliverable is transferred from the engineers, the architects and/or the general contractors to the owners.

What makes the two design phases different is that, in a basic design phase, the final deliverable is seen as a set of functions to satisfy, while in the detail design and construction phase the final deliverable is handled as a breakdown of parts and pieces to procure or fabricate and to assemble.

The outputs of the basic design phase are similar to that of a feasibility study, except that they are more detail re-appraised based on an expanded description of the product and of the project. The milestones associated with completion of this basic design stage are important, because the project can be stopped at that point if the conclusions of the feasibility analysis are not confirmed.

4.4.2 Control-Oriented Model

This project life-cycle approach considers a project as a servomechanism see figure 10, with two levels of retroactivity: one using and acting on the product, i.e. the deliverable of the project, and another level using and acting on the project, i.e. the processes of making it deliverable. This model is interesting because it highlights one of the major duties of a project manager – checking that the product is being made, fulfils its specifications all along the implementation phase and that the project progresses satisfactorily to get the deliverable on time and on budget.

Source: Kelley (1982)

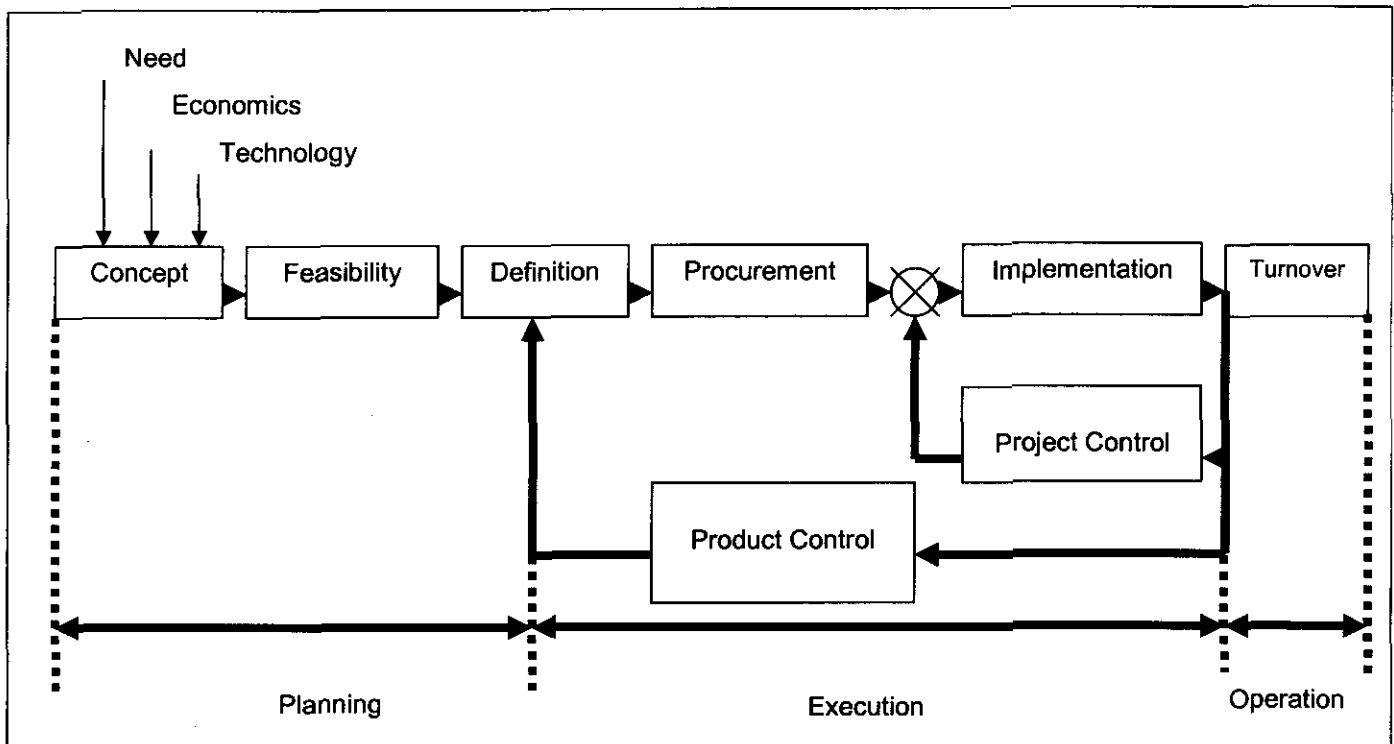


Figure 10: Control-Oriented Project Life Cycle Model

4.4.3 Quality-Oriented Model

This project life-cycle approach, figure 11, cannot be attributed to someone in particular. It is widely used in project management classes, especially those devoted to the management of IT projects. In it, the time runs from left to right – the level of conceptualisation of the project at a given time is featured on an orthogonal axis. At the early stage of the project, this level is high. This is because the purpose of a basic design phase is to specify a set of functions that the deliverable can satisfy. As the definition of the final product progresses, the level of conceptualisation gets lower. The lowest level is reached when parts and pieces are being manufactured or when individual equipment is installed. This level grows when manufactured parts

and pieces are assembled to form sub-assemblies, when assemblies or when installed equipment is networked. The highest level of conceptualisation is reached again when the project is terminated and the final deliverable is delivered.

This model is helpful to demonstrate that the documentation associated with a product/project shall not be issued erratically but shall follow rhythms of issuing to get and use at the right time documents describing the product/project at the right level of conceptualisation.

Source: Bonnai et al (2002)

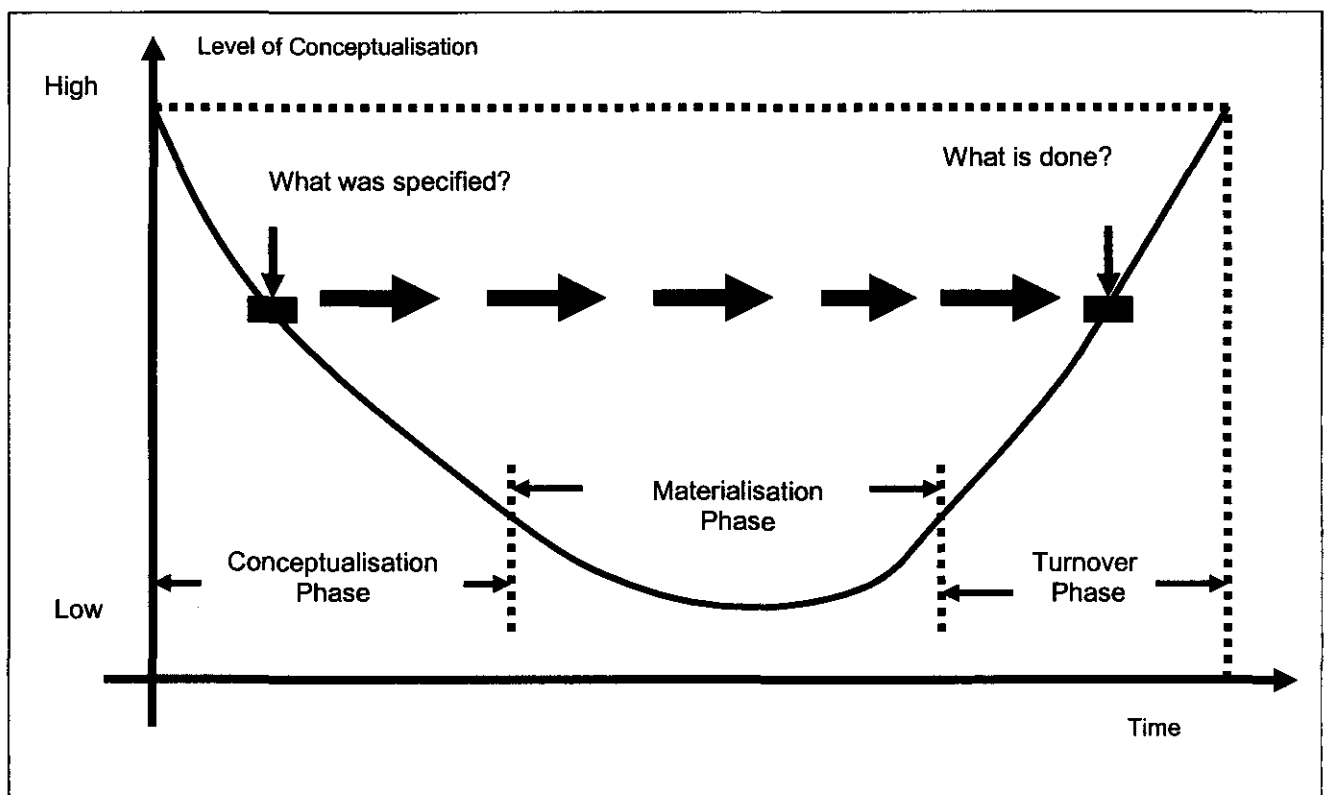


Figure 11: Project Life-Cycle Model Highlighting Project/Product Quality Matters

4.4.4 Risk-Oriented Model

Risk management is another important issue associated with the project management body of knowledge. This project life-cycle model is made of two very basic phases. The issues associated with the pre-project phase remain the same: on the one hand, the requirements (what one needs) and, on the other hand, the know-how and the capabilities of the organization (what one can). For instance, a project concept could consist in developing a new product to fill up a market niche. The feasibility phase consists in verifying that the market requirements are compactable or consistent with respect to the know-how of the organization.

Typically, the following studies are to be carried out:

- A market feasibility study – to confirm the opportunity of developing the new product;
- A technical study – to ensure the feasibility of the new product with respect to the means and the know-how of the organization;
- A financial study – to check if the organization can financially afford the development of the new product; and
- An environmental analysis – to verify that this product does not go against external legal requirements.

The project phase itself is divided into three sub-phases:

- A planning phase (Phase B in Figure 12). During which scenarios are elaborated.

- Execution phase (Phase C). During which the final deliverable is made; and
- A Closeout phase (Phase D). During which the experience acquired is recorded.

This model differs from other project life-cycle proposals because a scenario phase is inserted between the feasibility phase – more precisely the decision to go ahead – and the implementation of the project.

This intermediate phase is concerned with four out of the project risk management processes, viz. identification, conformance, evaluation and mitigation (as per the PMBOK Guide (2000)): The identification of the risks that are likely to affect the project's execution and the conformance to the specification of the final deliverable, its evaluation and its mitigation. The main aim of the scenario phase is to plan risk responses. During the execution phase, it is the duty of the project manager to make use of risk response planning elaborately in the scenario phase to steer the execution of the project within acceptable limits. All along the realisation of this phase, it also is up to the project team to record the uncertain events that occur and the responses implemented to restrain in the case of threats.

Source: Lacoste (1999)

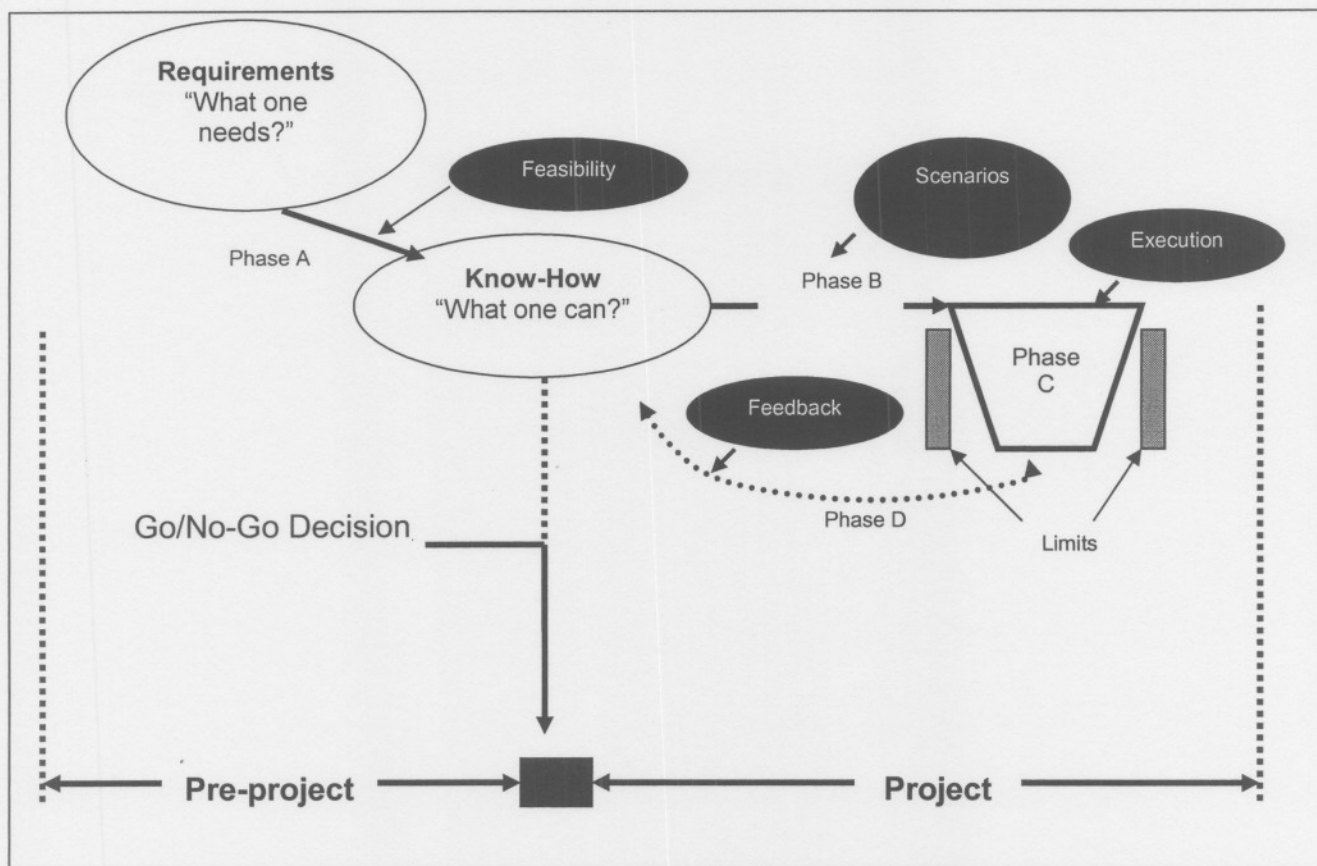


Figure 12: A Risk-Oriented Project Life-Cycle Model

4.4.5 Fractal Approach to Project Life-Cycles

This model takes the evolution of project management from a linear motion – the emergence and development of project planning and scheduling techniques in the '50s and '60s – via a reticular countenance, the introduction of the management by projects in organizations in the '70s and '80s – to reach a fractal dimension.

A fractal approach to project life cycles can explain situations that are difficult to model otherwise. Especially those concerned with the overlapping or fuzziness of interfaces between phases,

the spreading of responsibilities and decisions that are made complicated when dealing with the matrix organizations of projects and, more generally the uncertainty and imprecision associated with the execution of any project. One of the dualities that distinguishes pre-project and project phases can be heard from the mouths of many Research and Development project managers: "In a pre-project phase don't plan too much if you intend to remain creative. Plan your project correctly if you intend to deliver it in conformance with specification, on time and on budget." When looking to an endeavour with this in mind, it seems that some of it goes against universal management practices. However, once understood, it can be seen as a homogeneous mixture of creativity and of strictness, all along any project life cycle from an early feasibility stage to the completion of a project.

From the above one can state that most projects will go through the following phases in the life of a project and that it is not limited to this. Organization's can also use different combinations of these models to suit their specific needs.

- Concept development;
- Feasibility study;
- Basic design;
- Detail design;
- Construction, commissioning or/and start-up; and
- Operation.

These phases as depicted in figure 13 will now be discussed in detail:

- **Concept development**

Concept development is a phase in the project life cycle where one addresses all ideas that can be pursued as possible money making opportunities that need to be developed further until there is clear understanding that it will contribute to the bottom line of the organization. Once the idea or concept is of such a nature that it can be pursued further then it is taken to the next phase, viz. the feasibility phase.

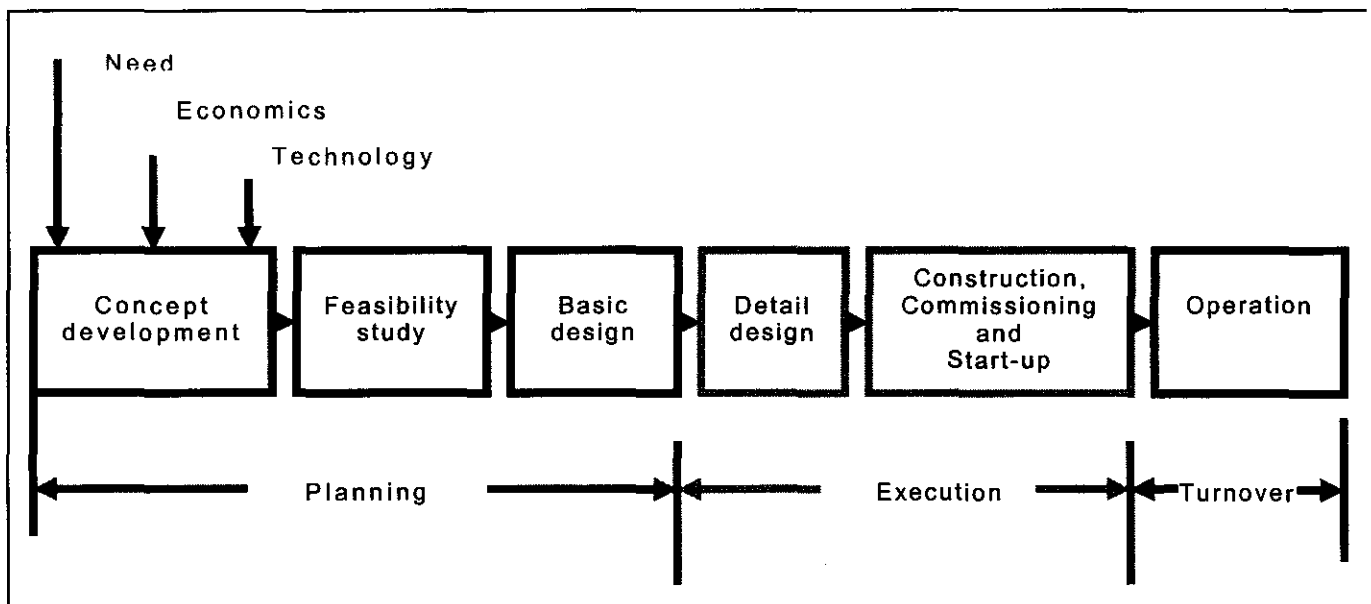


Figure 13: Generic Project Life-Cycle Model

- **Feasibility phase**

All ideas and concepts which were identified in the concept phase are now taken further to determine if they are feasible in terms of technology, return in investment, if they are in line with the organizations core business and if they are

aligned with the firm's strategic business objectives. The idea or concept that makes this hurdle is then taken to the next phase, namely basic design phase.

- **Basic design phase**

The idea or concept that makes it to the basic design phase is normally of such a nature that it will contribute to the growth of the organization. In this phase one will determine in more detail the type of technology that will be used and at the end of this phase an estimated cost will also be on the table to then determine a more firm return of investment and the go-no-go decision is also made here.

- **Detail design**

At this phase, as the name indicates, the detail of how the physical asset that will produce returns will look like.

- **Construction, commissioning or/and start-up**

In this phase the construction of the physical asset will be done, it will be commissioned and the start-up will also take place here.

- **Operation**

This phase normally runs over the life of the asset and this is where the organization gets its returns on the investment.

The first three phases are normally the planning phases or some will call then the front-end loading; this is where it is determined if the project will go ahead or not. And it is also here that, if done properly, in terms of risk assessments, selection of ideas, design alignment with the organization's objectives, it can make a major contribution to the continuous success of the organization.

The next two phases detailing design and construction, commissioning or/and start-up are formally called the execution phase; this is where the physical work takes place and must be managed with focus to ensure that the idea or concept that is implemented is performed successfully.

These five phases are normally done by the project team with the input of the business partners and discipline experts and makes out the project team. The last phase is normally managed by the business partner and runs over the life of the asset.

4.5 PROJECT MANAGEMENT KNOWLEDGE AREAS

The PMBOK (2000:189-191) describes the following nine project management knowledge areas, as illustrated in figure 14:

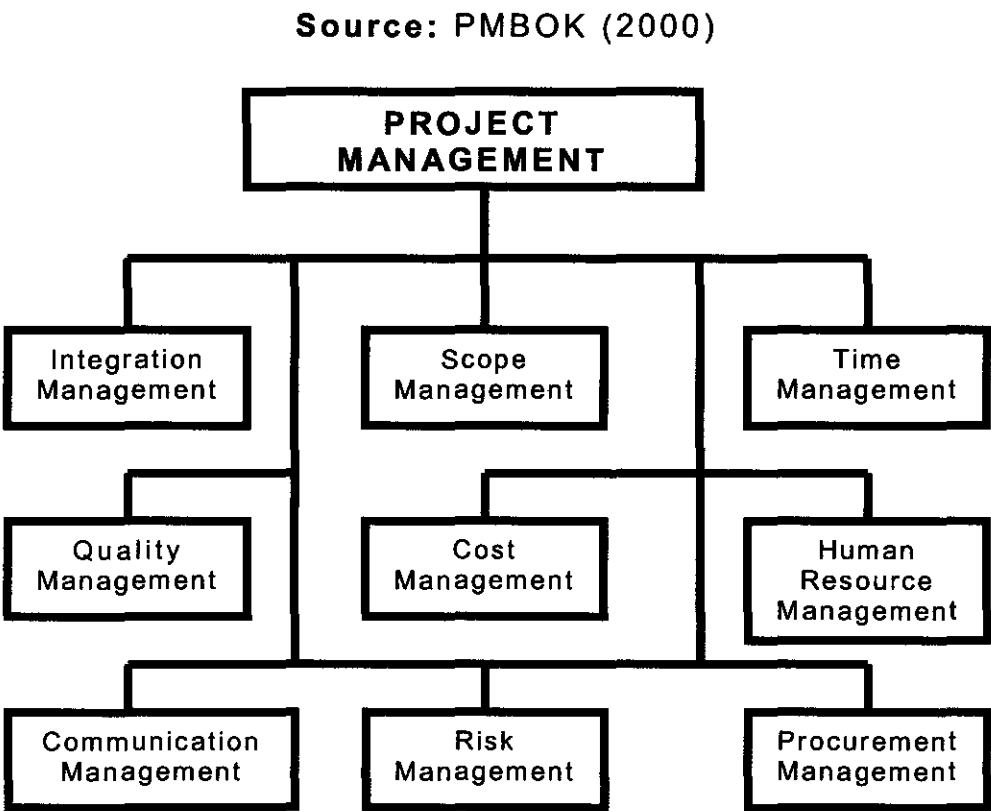


Figure 14: Project Management Knowledge Areas

- **Project Integration Management**

A subset of project management that includes the processes required to ensure that the various elements of the project are properly coordinated. It consists of:

- Project plan development – integrating and coordinating all project plans to create a consistent, coherent document;
- Project plan of execution – carrying out the project plan by performing the activity included herein; and
- Integrated change control – coordinating changes across the entire project.

- **Project Scope Management**

A subset of project management that includes the processes required to ensure that the project includes all the work required and only the work required to complete the project successfully. It consists of:

- Initiation – authorising the project or phase;
- Scope planning – developing a written scope statement as the basis for future project decisions;
- Scope definition – subdividing the major project deliverables into smaller, more manageable components;
- Scope verification – formalising acceptance of the project scope; and
- Scope change control – controlling changes to project scope.

- **Project Time Management**

A subset of project management that includes the processes required to ensure timely completion of the project. It consists of:

- Activity definition – identifying the specific activities that must be performed to produce the various project deliverables;
- Activity sequencing – identifying and documenting interactive dependencies;
- Activity duration estimating – estimating the number of work periods that will be needed to complete individual activities;
- Schedule development – analysing activity sequences, activity durations and resource requirements to create the project schedule; and
- Schedule control – controlling changes to the project schedule.

- **Project Quality Management**

A subset of project management that includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of:

- Quality planning – identifying which quality standards are relevant to the project and determining how to satisfy them;
- Quality assurance – evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards; and

- Quality control – monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

- **Project Cost Management**

A subset of project management that includes the processes required to ensure that the project is completed within the approved budget. It consists of:

- Resource planning – determining what resources (people, equipment, materials) and what quantities of each should be used to perform project activities;
- Cost estimating – developing an approximation (estimate) of the costs of the resources needed to complete project activities;
- Cost budgeting allocating the overall cost estimating to individual work activities; and
- Cost control – controlling changes to the project budget.

- **Project Human Resource Management**

A subset of project management that includes the processes required to make the most effective use of people involved with the project. It consists of:

- Organizational planning – identifying, documenting and assigning project roles, responsibilities and reporting relationships;
- Staff acquisition – getting the needed human resources assigned and working on the project; and

- Team development – developing individual and group skills to enhance project performance.

- **Project Communication Management**

A subset of project management that includes the processes required to ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information. It consists of:

- Communication planning – determining the information and communication needs of the stakeholders: who needs what information, when they will need it, and how it will be given to them;
- Information distribution – making needed information available to stakeholders in a timely manner;
- Performance reporting – collecting and disseminating performance information. This includes status reporting, progress measurement and forecasting; and
- Administrative closure – generating and disseminating information to formalise phase or project closure.

- **Project Risk Management**

Risk Management is the systematic process of identifying, analysing and responding to project risk. It includes maximising the probability of positive events and their consequences and minimising the probability of adverse events and their consequences to project objectives. It includes:

- Risk management planning – dealing with how to approach and plan the risk management for a project;

- Risk identification – determining which risks might effect the project and documenting their characteristics;
- Qualitative risk analysis – performing a qualitative analysis of risks and conditions to prioritise their effects on project objectives;
- Risk response planning – developing procedures and techniques to enhance opportunities and reduce threats from risk to the projects objectives; and
- Risk monitoring and control – monitoring residual risks, identifying new risks, executing risk reduction plans and evaluating their effectiveness throughout the project life-cycle.

- **Project Procurement Management**

A subset of project management that includes the processes required to acquire goods and services to attain project scope from outside the performing organization. It consists of:

- Procurement plans – determining what to procure and when;
- Solicitation planning – documenting product requirements and identifying potential sources;
- Solicitation obtaining quotations, bids, offers or proposals as appropriate;
- Source selection – choosing from among potential sellers; and
- Contract closeout – completion and settlement of the contract, including resolution of any open items.

4.6 RELATIONSHIP OF PROJECT MANAGEMENT TO OTHER MANAGEMENT DISCIPLINES

Project management is unique in enabling the modern manager to manage the status quo, change and technology. A project manager is a **generalist** and is able to manage all facets of an organization, Knipe et al (2002:20-22). Figure 15 gives a presentation of this.

They go further and state, "the overlap areas infer that project management staff must have sufficient understanding of the various disciplines to appreciate project requirements and issues. They must also be able to communicate appropriate direction and means of conflict resolution to these disciplines in order to reach a successful project conclusion".

Source: Knipe et al (2002:20)

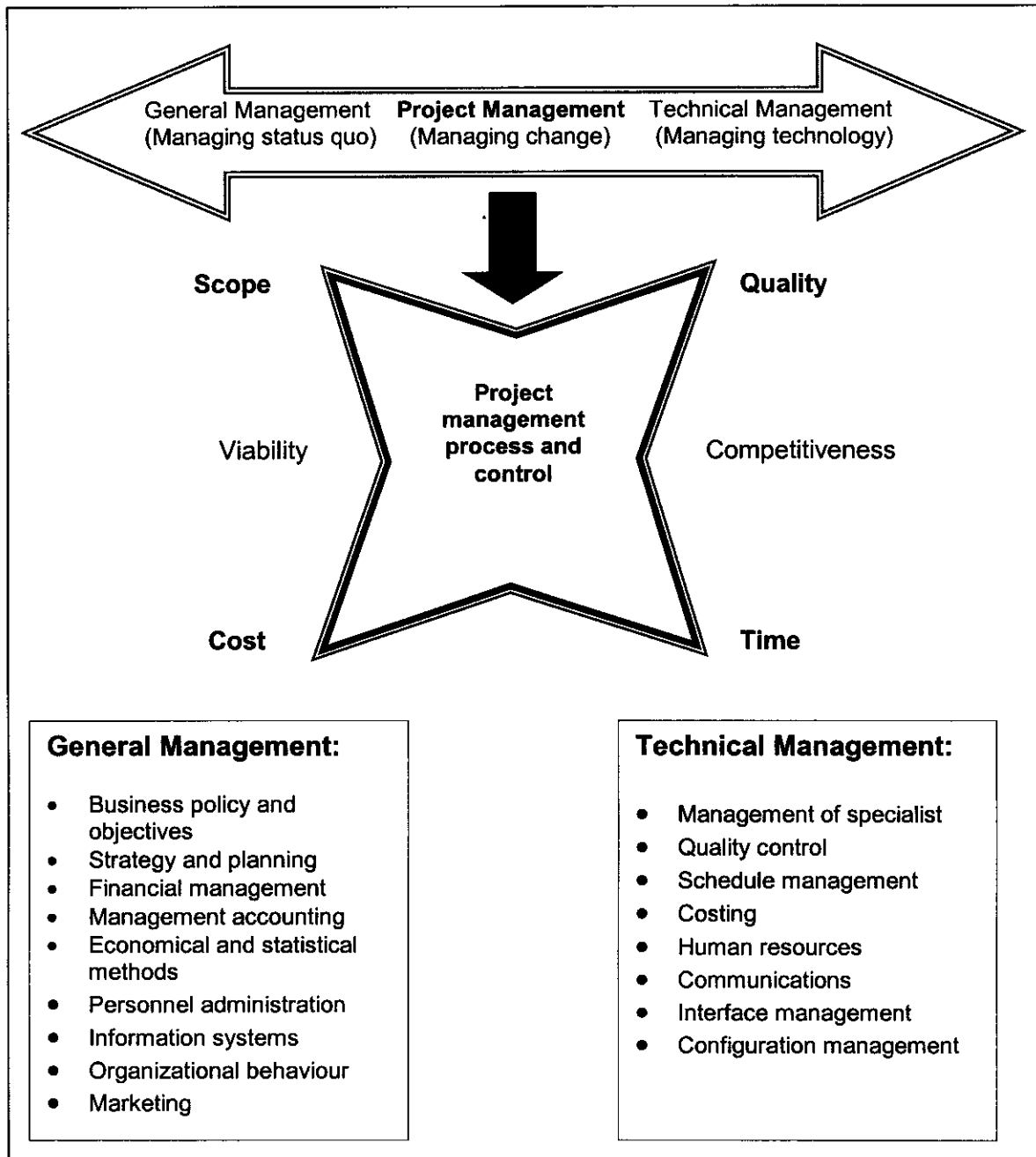


Figure 15: The general management-project interface

Effective managers must pay attention to what goes on both inside and outside their organizations. Regardless of where their attention might be focused at any particular time, managers are part and parcel of organizational settings. Profit-oriented

businesses are one type of organizational settings in which managers are found. Undoubtedly, one could write one's autobiography as a series of experiences with organizations such as hospitals, restaurants, schools, museums, sports teams and other. Some of these organizations were small and others were large. Some were for-profit companies and others were non-profit organizations. Some offered products, some offered both products and services and others offered only services. Some were well managed and others struggled merely to survive, Hellriegel et al. (2002:6).

It is referred to such a group of people as an organization because each has a structure and strives to achieve goals that individuals acting alone could not reach. All organizations strive to achieve specific goals, but they don't all have the same goals.

For organizations to be successful in whatever they want to achieve they need managers with certain competencies, i.e. communication, teamwork, planning and administration, strategic action, global awareness and self-management competencies and they need to do basic management functions, i.e. organizing, leading, controlling and planning.

The process consists of an iterative cycle of management tasks as depicted in figure 17.

For comparison the project management process is given in figure 18, and as can be seen project management has much in common with general management, there are, however, differences mainly due to the discontinuous nature of projects.

Much of the knowledge needed to manage projects is unique to project management, e.g. critical path analysis and work

breakdown structures. However, the PMBOK (2000:9) does overlap other management disciplines, as illustrated in figure 16.

Source: PMBOK (2000:9)

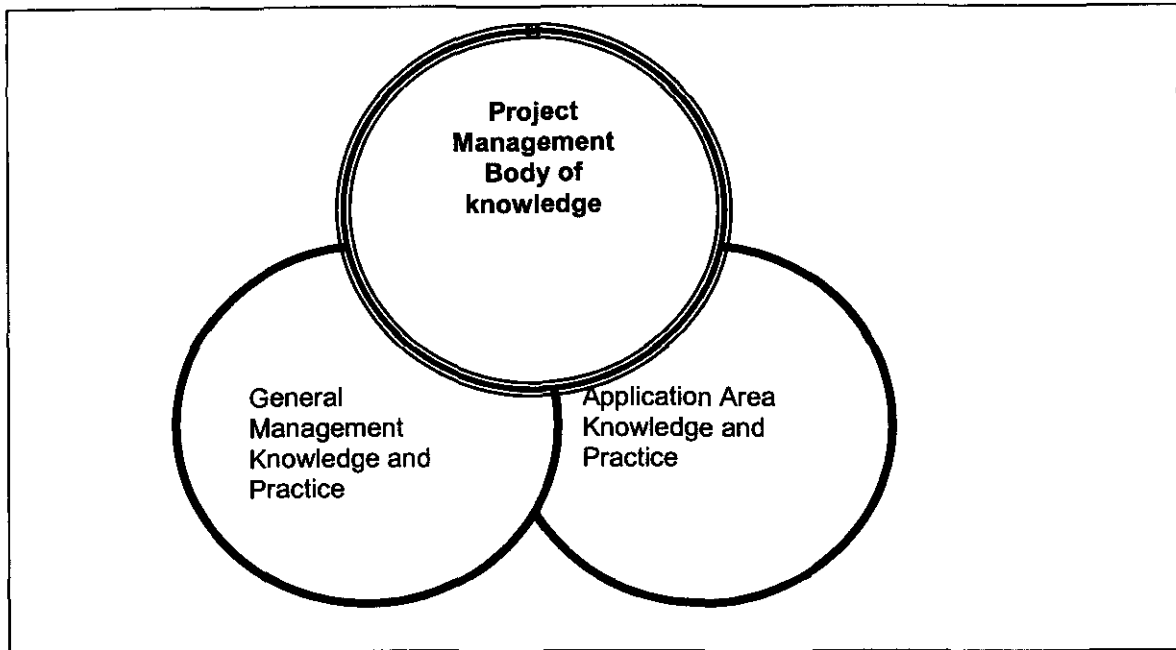


Figure 16: Relationship of Project Management to Other Management Disciplines

Source: Adapted from Hellriegel et al. (2002)

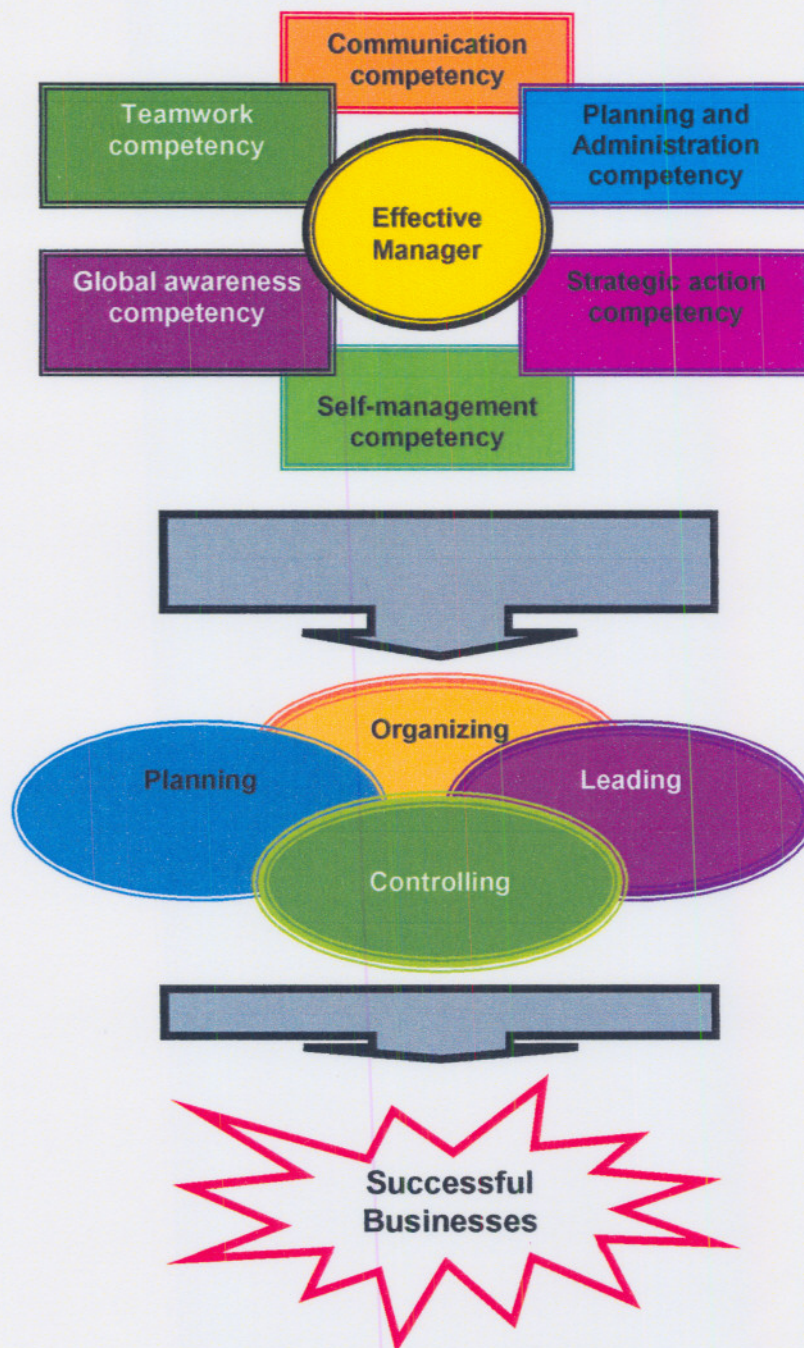


Figure 17: General Management Process

Where the general manager has six competencies and four management functions to achieve the organization's objectives, the project manager uses the nine project management knowledge areas to achieve the project objectives.

The project manager is, however, faced with unique and passing problems more often than the general manager is. The general manager normally has established working methods that he has refined over the years and is not always pressed for time. On the other hand, as was mentioned before, many tools and techniques were developed over the years to assist the project manager. But he is always, sometimes on a daily basis, faced with fresh problems and needs to establish new, temporary organizations and this is what distinguishes project from general management.

Source: Developed from the PMBOK



Figure 18: Project Management Process

4.7 PROJECT MANAGEMENT MATURITY LEVEL

As was mentioned in chapter 1 organizations find it difficult to repeat the success of projects on a continuous basis and the main reason for this is that they don't have systems in place to ensure repeatability.

One way of achieving this is by adopting a maturity level model which is implemented in the organization by a

focused effort by management that consumes time and resources, figure 19.

Pennypacker & Grant (2003) state that, "...the challenge facing contemporary project-performing organizations is that each of these ingredients to the capability to deliver projects successfully requires a substantial commitment of time and resources. Given the many initiatives required to achieve consistent project success, which initiatives should an organization undertake first? Or from a more strategic perspective, how should an organization pursue the development of project management capabilities purposefully over time? Project management maturity models are designed to provide the framework that an organization needs to purposefully and progressively develop its capabilities to deliver project after project".

Many project management maturity models have emerged since the mid 1990s, Pennypacker & Grant (2003).

The model that will now be discussed is one by Pennypacker (2001:25), the Project Management Solutions Project Management Maturity Model, viz.

- **Level 1: Initial Process**

Although there is recognition that there are project management processes, there are not established practices or standards and individual project managers are not held to specific accountability by any process standards. Management understands the definition of a project, that there are accepted

processes and is aware of the need for project management. Metrics are informally collected on an ad hoc basis;

- **Level 2: Structured Process and Standards**

Many project management processes exist in the organization, but they are not considered an organizational standard. Documentation exists on these basic processes. Management supports the implementation of project management, but there is neither consistent understanding, involvement, nor organizational mandate to comply with all projects. Functional management is involved in the project management of larger, more visible projects and these are typically executed in a systematic fashion. There are basic metrics to track project cost, schedule and technical performance, although data may be collected or correlated manually. Information available for managing the project is often a mix between summary level data and detailed level data;

- **Level 3: Organizational Standards and Institutionalised Process**

All project management processes are in place and established as organizational standards. These processes involve the clients as active and integral members of the project team. Nearly all projects use these processes with minimal exception – management has institutionalised the processes and standards with formal documentation existing on all processes and standards. Management is regularly

involved in input and approval of key decisions and documents and in key project issues. The project is evaluated and managed in light of other projects;

- **Level 4: Managed Process**

Projects are managed with consideration to how the project performed in the past and what is expected in the future. Management uses efficiency and effectiveness metrics to make decisions regarding the project and understands the impact on the other projects. All projects, changes and issues are evaluated based upon metrics from cost estimates, baseline estimates and earned value. Project information is integrated with other corporate systems to optimise business decisions. Processes and standards are documented and in place to support the practice of using such metrics to make project decisions. Management clearly understands its role in the project management process and executes it well, managing at the right level and clearly differentiating management styles and project management requirements for different sizes or complexities of projects. Project management processes and standards are integrated with other corporate processes and systems; and

- **Level 5: Optimising Process**

Processes are in place and actively used to improve project management activities. Lessons learnt are regularly examined and used to improve project management processes, standards and

documentation. Management and the organization are not only focused on effectively managing projects but also on continuous improvement. The metrics collected during execution are used to understand the performance of not only a project but also for making organizational management decisions for the future.

One can conclude that the maturity model is a holistic approach to improve an organization's effectiveness and efficiency that require commitment from top management. It is time consuming because it is a culture change that will affect the whole organization for the best if implemented correctly. Figure 19 depicts an integrated approach that is based on the nine knowledge areas as presented by the PMBOK (2000) and the maturity model that needs addressing in each of the five levels as organizations progress from one level to the next. By using this approach companies will ensure that they achieve successful projects time and time again.

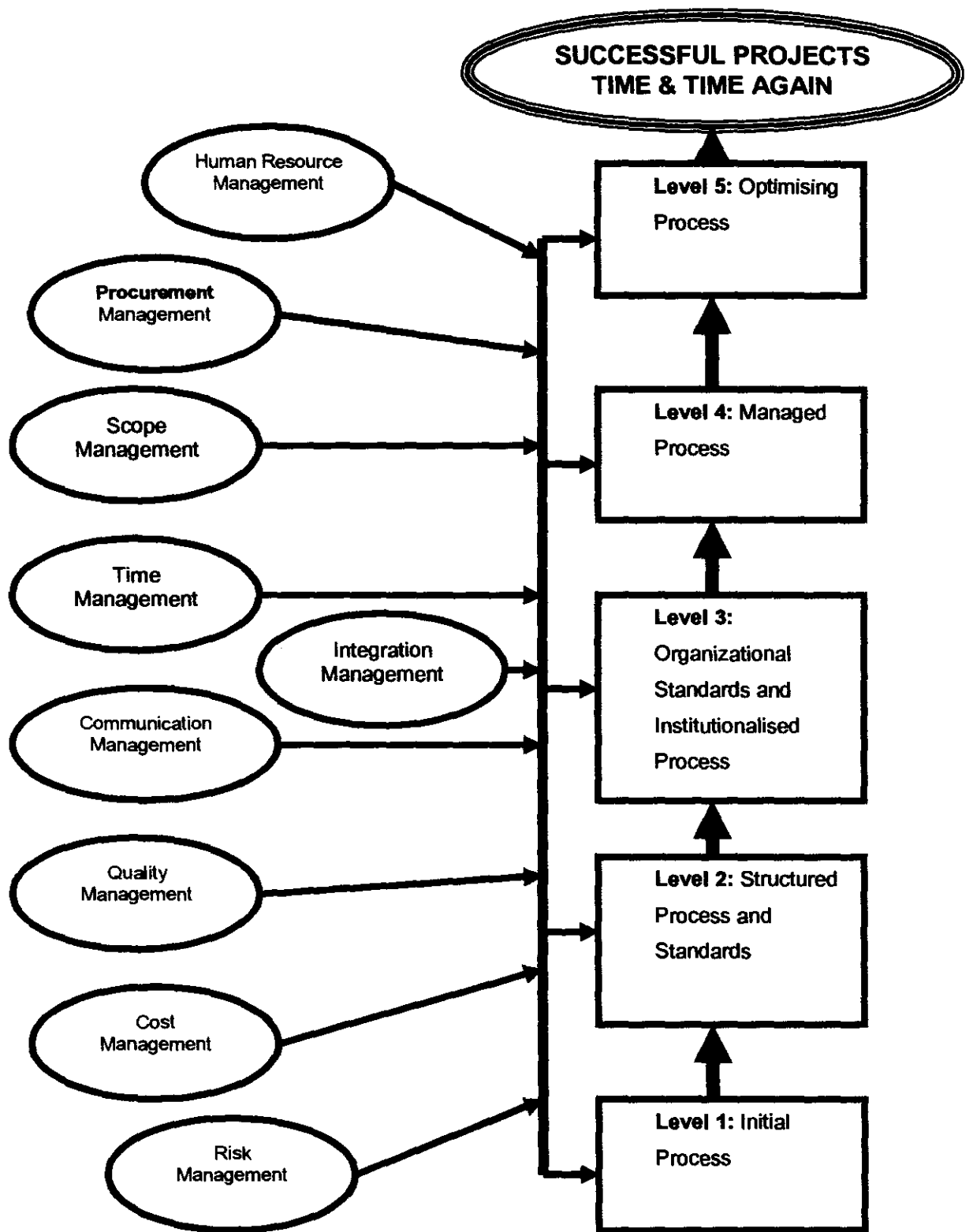


Figure 19: Integrated Model to Increase the Success Rate of a Project

4.8 PROJECT MANAGEMENT COMPETENCIES

A normal question for managers in the increasing number of firms that are highly dependent upon project work is how to staff them with effective project managers. We know that effective project managers are essential to project success and many organizations have spent large sums to improve the selection and development of managers for this role. Yet, there is still a widespread sense that we must do better, Hauschildt et al (2000:23).

Craford (1997) states that competence is a term which is widely used but which has come to mean different things to different people. It is, however, generally accepted as encompassing knowledge, skills, attitudes and behaviours that are causally related to superior job performance.

The PMI (2001:1) gives the following definition "... when applied to project management competence can be described as consisting of three separate areas", viz.

- What the individual project manager brings to a project or project-related task through his knowledge and understanding of project management. This dimension is called Project Management Knowledge;
- What the individual is able to demonstrate in his ability to successfully manage the project or complete project related tasks. This dimension is called Project Management Performance; and

- The core personality characteristics underlying a person's capability to do a project task. This dimension is called Personal Competency.

Thus, one can say that competence is a combination of dimensions, i.e. knowledge of the subject, skills or ability to perform and personal attitude, which is how he behaves when performing the project task.

The PMI (2001:2) states, "...a "competent" project manager alone does not guarantee project success. They believe that project success requires project manager competence as well as organizational project management maturity and capability – organizational performance cannot be ignored. In other words, having a project manager who possesses the "right" competencies cannot ensure project success. Focusing solely on the project manager's competence regardless of the organization's performance is too simplistic. There are too many organizational maturity factors and other contingencies that influence the outcome of the project as well. In fact, it is possible to have a "competent" project manager working within an "immature" organization, which could result in an unsuccessful project, or vice versa".

This concept is illustrated in figure 20, and shows how project manager competency and organizational maturity are required to consistently obtain project success and how both of these can be influenced by various contingencies or moderating variables.

The illustration shows that the competency of the project manager provides the basis for overall performance. Project performance is shown as having a major impact upon overall project success. After all, if the project does not follow the specified plans or processes, it will be difficult to obtain ultimate success with the project.

Source: PMI (2001:4)

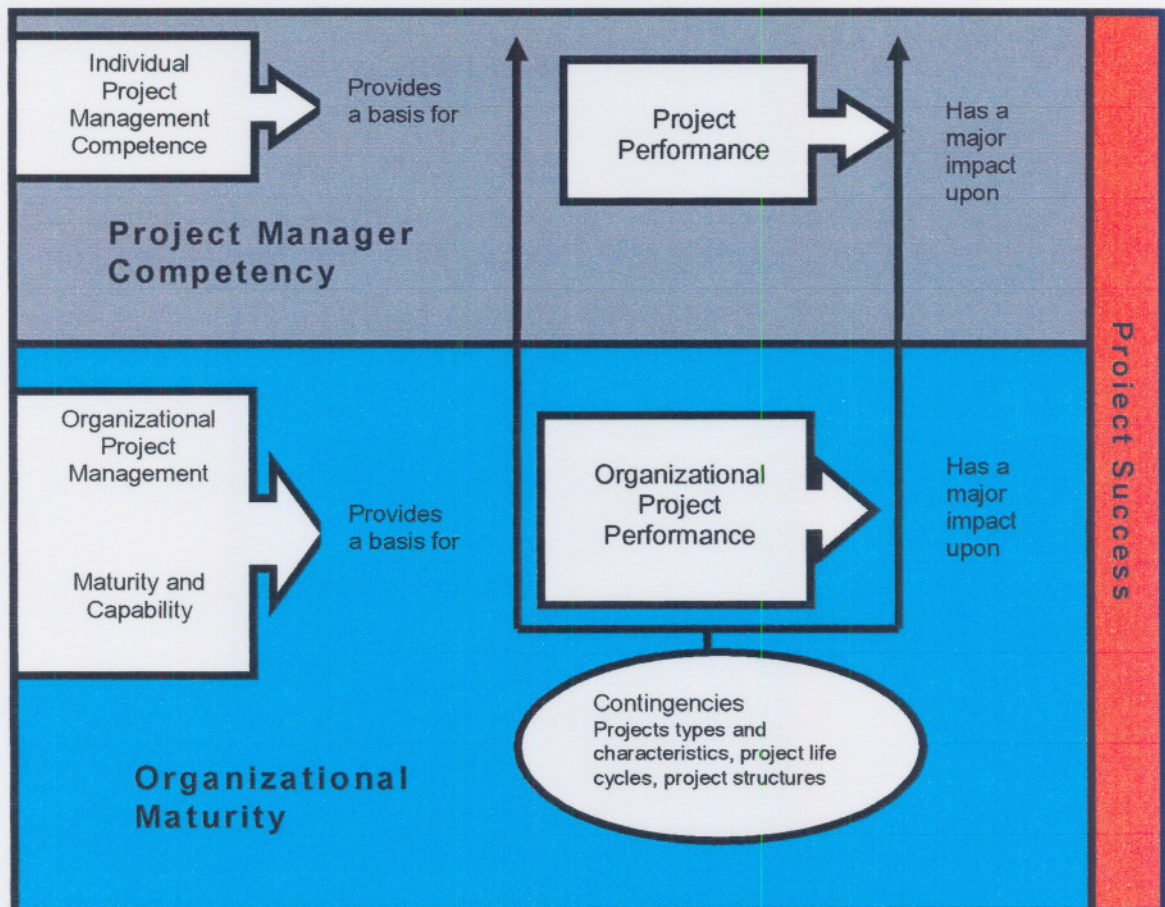


Figure 20: Project Manager Competency

It is, therefore, important for all organizations if they want to be successful in their project implementation to not only improve on their systems, standards and documentation, thus their maturity as far as project

management is concerned; but also to appoint the right persons as project managers and train them accordingly. Figure 21 provides an overview of the competency required by a project manager.

Source: PMI (2001:12)

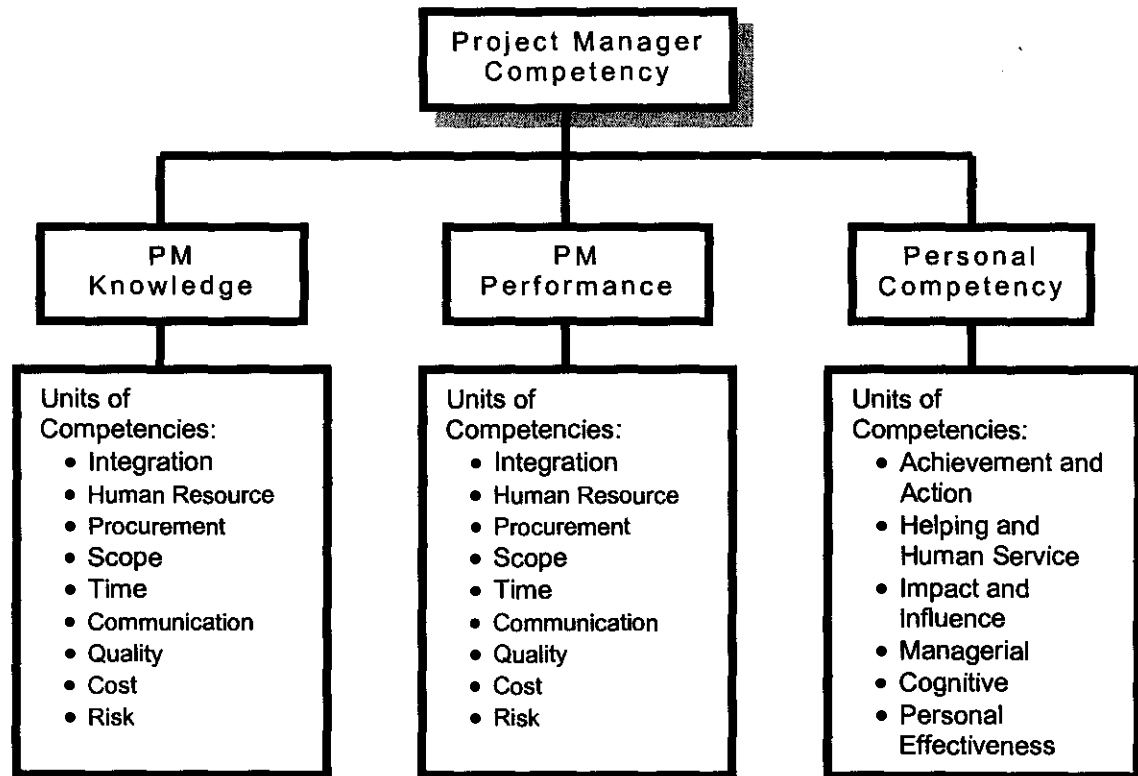


Figure 21: Competency Framework Structure

It illustrates that project management competencies consist of:

- **Project Management Knowledge Competencies**

The various units of knowledge competencies dimensions required to satisfy the competency level;

- **Project Management Performance Competencies**

The various units of performance competencies dimensions required to satisfy the competency level; and

- **Personal Competencies**

These competencies define the behavioural dimensions of project management competencies.

One can conclude that, when an organization wants to improve on its maturity level, a holistic approach is needed where all project personnel are properly selected and then trained in all the dimensions as in figure 21.

4.9 CONCLUSION

In this chapter a definition of a project and project management was given. Different project life-cycle models were discussed and a brief overview of project management knowledge areas was highlighted. The relationship of project management with general management was illustrated. The project management maturity level model was explained and then an overview

of the required project management competencies was given.

This, has hopefully, set the scene for the next chapters where a theoretical overview of risk management, one of the nine knowledge areas of project management, will be discussed in some detail.

CHAPTER 5: RISK MANAGEMENT

5.1 INTRODUCTION

Stability is no longer a word that can be applied to today's business. Markets move so frequently that companies have to embrace change as easily as they manage their normal business operations. For many companies change has been very much a random affair, without corporate structure and left to managers to justify and commission without reference to an overall strategy. As companies now count the cost of business change against a background of global uncertainty their projects have to become more strategic and cost effective. Executives are now much more interested in the risks of making change and are demanding better tools, methods and data to link the risks of projects to an overall strategy, Bartlett (2002:1).

During the past several years increasing attention has been paid to the subject of managing some of the risks inherent in most projects. For the most part risk has been interpreted as being unsure about project task durations and/or costs but uncertainty plagues all aspects of the work on projects and is present in all stages of project life- cycles, Meredith & Mantel (2000:62).

Risk management is a key component of project management and there has been a notable increase of

awareness and application over the past decade or so, Baccarini (2001:1).

Experience has shown that risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure. What we know, we plan for and are more often successful than not. However, without mitigation, risks will introduce chaos and failure into an otherwise well-planned and managed project, Royer (2000:6).

Many cost and time overruns in projects are mainly attributed to unforeseen events for which risk has not been appropriately accommodated in the project budget, Al-Tabtabai & Alex (2000:4).

Therefore, one can say that risk has and will always be an integral part of a project. Every project manager understands risks are inherent to projects; all risks can't be eliminated. No amount of planning can overcome risk, or the inability to control or change events. Plans are essentially lists of things to do. Most of the time what is missing from the plans is serious consideration of potential project risks.

Risk management, therefore, is a critical component of project management. The PMBOK (2000) lists risk as one of the nine knowledge areas of project management because of its importance as are the other ones to the successful implementation of projects.

The essential purpose of risk management is to improve project performance via a systematic process to identify, appraise and manage project related risk.

Figure 22 is a graphical view of the dilemma that project managers face. The chance of a risk event occurring is greatest in the initial phases. The cost impact of a risk event in the project is less if the event occurs earlier rather than later. The opportunity to minimise the impact of the risk exists early in the project life cycle. On the other side if the project has progressed through the life-cycle so the cost to fix the risk event increases.

Source: Adapted from Gray and Larson (2000)

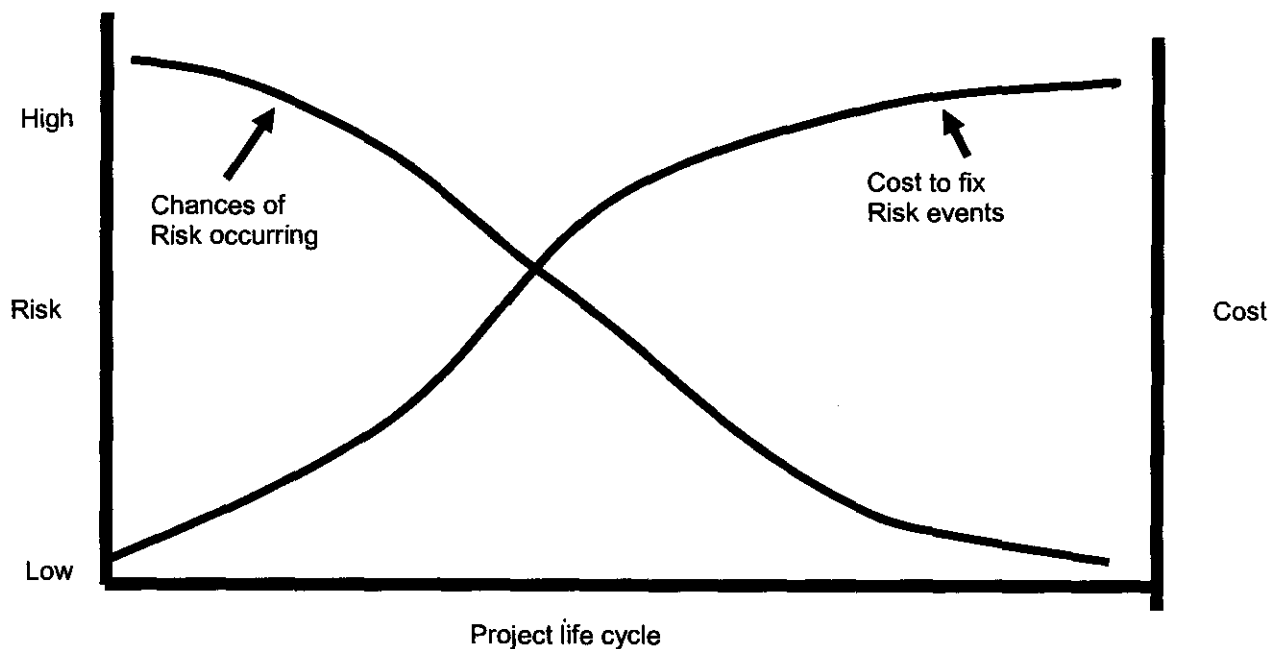


Figure 22: Risk Event Graph

In this chapter a literature review on risk and risk management is undertaken in a project environment in preparation for the research.

5.2 DEFINITION OF RISK

Before one can commence with the process of discussing risk it is important to know what risk is in the context of a project. There are many definitions in the literature, viz.

Gray & Larson (2000:139) give the following definition, "...risk is the chance that an undesirable event will occur and the consequences of all its possible outcomes".

Lewis (1999:298) states that "...anything that can go wrong in a project that will affect project targets".

The PMBOK (2000:207) definition: "An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives".

Burke (1999:230) defines project risk as "...any event that prevents the achievement or limits the achievement of the objectives as defined at the outset of the project, these objectives may be revised and changed as the project progresses through the project life cycle".

Therefore, one can conclude that risk is an undesirable event that if it occurs, will affect the objectives of a project negatively.

KPMG (2002) quantifies risk by the following simple equation:

- Risk = Potential loss/impact x likelihood or probability of occurrence.

Where:

- Potential loss/impact is given in terms of monetary loss; and
- Likelihood/probability of occurrence is self-explanatory and is based on the knowledge of the project team.

5.3 CATEGORIES OF PROJECT RISK

Throughout the life cycle of a project one is faced with different categories of risk. Gerosa & Nasini (2001:1-3) give the following types of risk:

- **Regulatory Risks**

Regulatory is the risk of not obtaining all approvals for executing and operating the facility, e.g. servitude approval, record of decision (ROD) approval. These approvals are obtained from the government and the bureaucracy normally hinders the process.

- **Completion Risks**

Completion risk is the risk that the project will not be completed within the established performance, schedule and cost objectives.

There are basically three ways of approaching completion risks:

- By adopting proven technologies;
- By introducing experienced contractors; and
- By defining an adequate contractual structure.

- **Market Risks**

Market risk is the risk that the target market will not materialise.

This risk must be carefully assessed and mitigated: the most common way of doing so is by signing agreements between the company owning the project and the customers. These risks vary over the life cycle of the project as indicated in figure 23.

Source: Adapted from Gerosa and Nasini (2001:3)

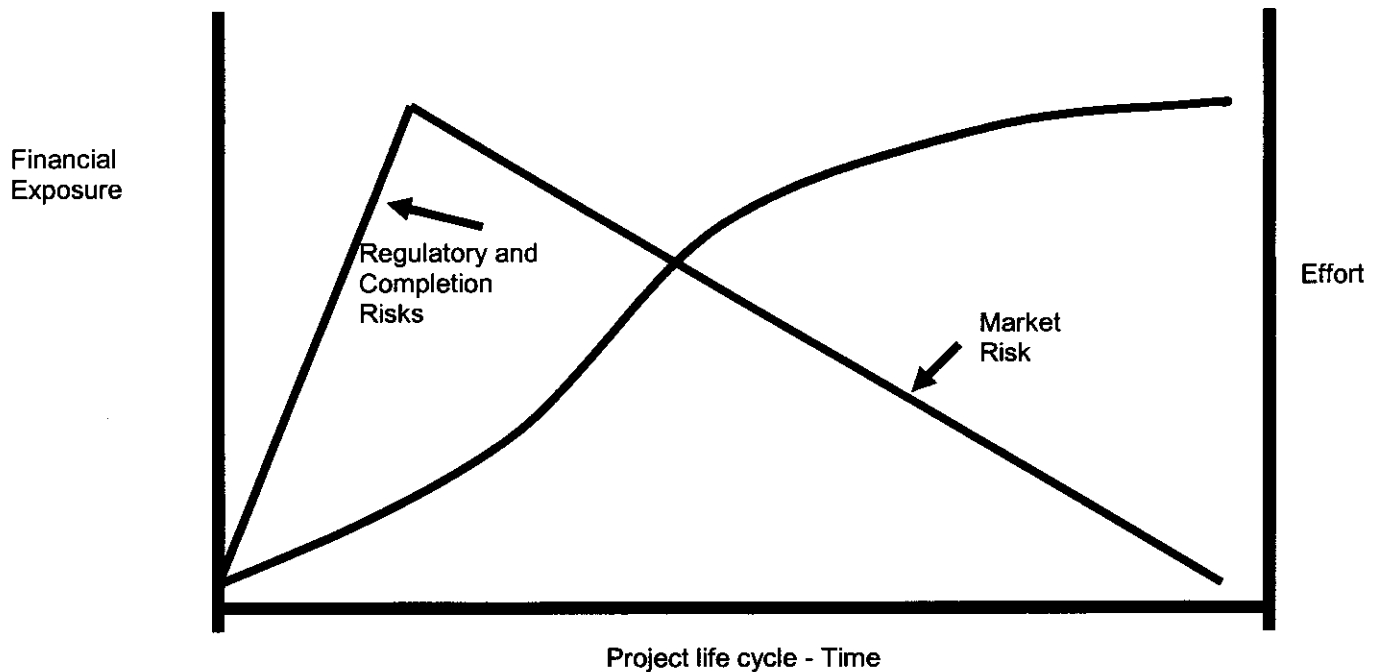


Figure 23: Financial Risk

Prinsloo (2003: 6-7) gives the following categories of risk:

- **Corporate risks**

Risks assumed by top management when they approve a project. This include corporate credit risk in respect of corporate obligations for provision of equity funding and contractual liabilities under completion guarantees and off take or marketing risks;

- **Socio-political (Country) risks**

Risks associated with undertaking the project in a specific country, state or area;

- **Business or commercial risks**

These risks are hazards in contractual or financial processes or systems that can negatively affect the project. These include fluctuations in exchange rates, increase in interest rates, inflation, trade and tariffs and insurance;

- **Legal risks**

Hazards in the legal system to provide protection, e.g. laws on taking and enforcement of security, protection of intellectual property rights, the regulation of fair trading and competition and dispute resolution;

- **Market risks**

Market risk is defined as the volatility in expected sales revenue from the project in relation to the volatility of the project cost base. Risks associated with product prices, freight costs and marketing and sales arrangements that can unduly affect the project.

- **Technology or design risks**

Technology or design risks are hazards in engineering processes or systems that can negatively affect the project. Risks that come with the complexity of the system to be built and the relative newness of the technology;

- **Project management risks**

These are hazards in executing the scope of the project that can negatively affect its outcome, e.g. contractor experience, sponsor experience. Risks that come with the available manpower and knowledge of those working on the project;

- **Construction or completion risks**

Hazards in completing the project to the budget cost, to schedule and performance such that the project does not achieve the objectives represented to the lenders;

- **Operational risks**

These risks are to protect profitability during start-up and sustainable operations. They include the danger of underestimating operating costs; and

- **Safety, Health and Environmental risks**

These are risks to the health and safety of workers especially when they perform work on construction sites. The impact of construction work on the environment has become more of an issue these days.

These two sets of categories of Gerosa and Nasini (2001) and Prinsloo (2003) come down to the same and are useful aids in analysing, selection of response strategies and tracking related risks. They can be depicted as in figure 24.

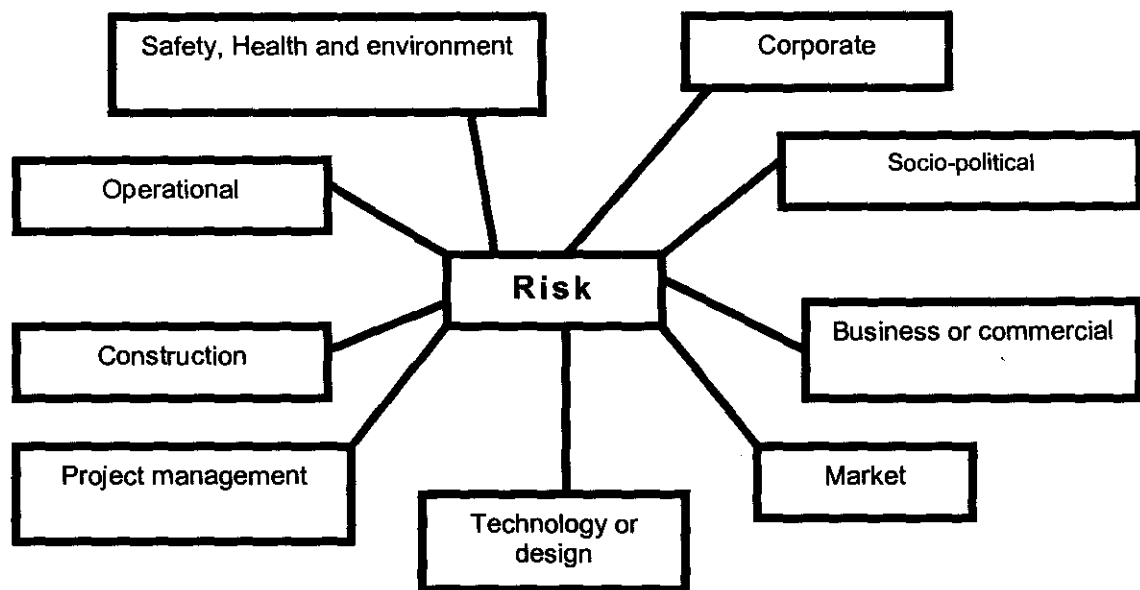


Figure 24: Categories of risk

5.4 WHAT IS RISK MANAGEMENT?

Risk management, as was discussed and illustrated in previous chapters, forms an integral part of project management. Formal definitions will now be given followed by a discussion.

The PMBOK (2000:191) defines risk management as: "...systematic process of identifying, analysing and responding to project risk. It includes maximising the probability of positive events and its consequences and minimising the probability of adverse events and consequences to project objectives".

Baccarini (2001:1) states that, "Project risk management is fundamentally a decision-making process. The

alternative to risk management is making reckless decisions or making decisions that are not based on careful consideration of facts and the risks involved. Managing risk demands a methodical approach and project risk management is a formalised and disciplined approach consisting of a set of processes for decision making".

De Villiers (1999:25) gives the following definition, "...Risk management is a formal process whereby risk factors are systematically identified, assessed, actioned, monitored and reviewed".

It can, therefore, be concluded that risk management is a formalised process consisting of various steps to ensure that all aspects of risk are managed. Furthermore, it forms an integral part of all knowledge areas of project management to ensure completeness, i.e. that no risk event is missed.

5.5 RISK MANAGEMENT PROCESS

In response of the growth uncertainty in modern projects, over the last decade the project management community has developed project specific risk management frameworks, Rodrigues (2001:1). The two that are most complete are the PMBOK 2000 edition and the Standards Australia publication AS/NZS 4360: Risk Management of 1995 and its revision of 1999: Standards Australia 1999.

Before one can describe the risk management process it will be prudent to state and discuss key concepts such as a process based on best practices.

Arthur Andersen (1999:10) states that whatever the area of risk, best practice risks management has three components:

- A whole system for identifying, capturing and measuring risks;
- A system for evaluating whether to accept risk, reject risk or take steps to reduce risks; and
- A system that can be maintained to ensure that the risk management is not a once off event but rather a systematic integrated iterative process.

KPMG (2002:15) advocates that a good system is designed to review the project management process and that the focus is on the following:

- Project strategic objectives;
- Identifying the risk that may impact on these objectives;
- Determine or establish the controls to manage these risks;
- Determine the perceived effectiveness of these controls; and
- Determine the areas where there might be a lack of control.

Then a systematic risk management process must be followed.

Both these practices let one focus on a systematic disciplined approach which will be discussed now.

Australia and New Zealand standards on risk management, AS/NZS 4360:1999[6] give the following components of the risk management process:

- Context setting;
- Risk Identification;
- Risk Analysis; and
- Risk Treatment Strategies.

The PMBOK (2000:191) gives the following components:

- Risk Management Planning;
- Risk Identification;
- Qualitative Risk Analysis;
- Risk Response Planning; and
- Risk Monitoring and Control.

These components are very similar but in some cases lack one or other component. A combination of the key features will now be discussed to give a better overview of the process, AS/NZS 4360:1999[6] and Baccarini (2001:1). Figure 25 illustrates the total risk management process.

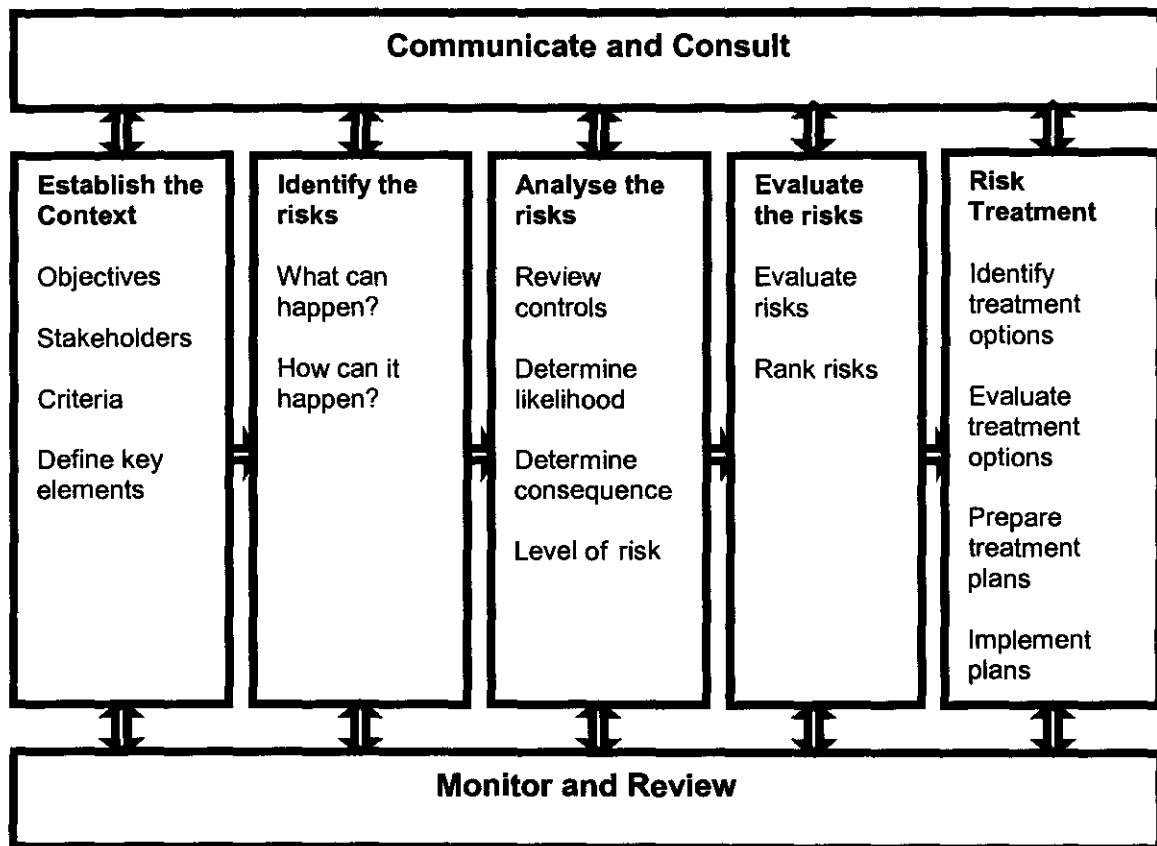


Figure 25: Risk Management Process

- **Context**

Risk identification is often seen as the heart of risk management but it is not, figure 25. To be able to identify the risk it is necessary to know what is at risk. A key context is the project scope and objectives and their relative importance must first be established; the link between the project and the organization's strategic goals and business plans must be understood;

- **Identification**

It is to determine which risks might affect the project and document their characteristics;

- **Risk Analysis**

The aim is to determine which risk events warrant response. Once the risk events have been identified, the next stage is to analyse and prioritise them to guide risk management action;

- **Risk Evaluation**

Evaluation takes the initial analysis and reviews it against the organization's known priorities and requirements. Any risks which have been accorded too high or too a low significance are adjusted, with a record of fact being retained for tracing purposes;

- **Risk Treatment**

Risk treatment insists on the selection and implementation of appropriate options for dealing with risk, i.e. what will be done in response to the identified risks?

- **Monitoring and Review**

The outputs must be kept under review as time moves on and the whole process needs to be monitored and sometimes redone; and

- **Communication and Consultation**

These are both key components of the risk management process and major beneficial side

effects. The operation of the process offers many opportunities for cost effective communication between people working on a project.

A risk register based on a risk workshop output and subsequent treatment planning provides a concise summary of the major uncertainties being addressed and once again ensures a focus on high priority issues.

For project risk management to be carried out effectively, all steps – from Context Setting, through to Planning, Identification and Analysis, to Response Planning, Monitoring and Control and Communication – need to be integrated consistently in line with the project objectives and the risk tolerances of the organization and stakeholders, Piney (2001:1).

Taken the above, it can be concluded that risk management is not an event but rather a process where it is very important to set the context in which the risk is manifested and then to apply the process as depicted in figure 25.

5.6 TIMING OF THE RISK MANAGEMENT PROCESS

The importance of applying risk management early in the project life-cycle was touched on in the introduction of this chapter and will now be explored further.

Projects don't fail at the end, they fail at the beginning. However, many project managers plunge in, hope for the

best, and later find themselves reacting to risk events and their consequences, Githens and Peterson (2001). They go further and state that, "a good front-end risk management project capability will help avoid common errors in development, which include the following:

- The tendency of project teams to plunge into projects without thinking things through. Many project teams approach the problem in a fragmented (rather than holistic) way, breaking the problem into smaller elements and then pay attention to those development elements that are in the individual's comfort zone;
- The tendency of project teams to focus on visible problems; and
- The tendency of project teams to assume that a review will catch any problems or mistakes".

De Villiers (1999:31) states, "...that it is very important for project managers to realise the implications of not addressing the risk issue early in the life-cycle of a project. If it is done in a thorough a systematic process, it will not only save money but will also add to the success of the project in general", refer to figure 26. Figure 26 depicts that if risk is addressed early in the life cycle of the project it costs less, e.g. if the same risk is addressed in the concept phase it will cost R1.00 to fix, R10.0 if addressed in the design phase and so on.

Githens and Peterson (2001:1) go further and say that if risk management is not applied early in projects then:

- Firstly, errors and omissions, i.e. a failure to perform basic project management practices can lead to project failure or significant rework;
- Secondly, it is observed that most product performance problems occur at interfaces (where two system interact with each other), not within sub-systems. Consequently, there is considerable rework and sub-optimisation of project performance; and
- Thirdly, as frustrations continue to mount in the project, the morale takes on a death-march-like tone; there is little satisfaction from work and the goal is just to survive the project.

Source: Adapted from Burke (1999)

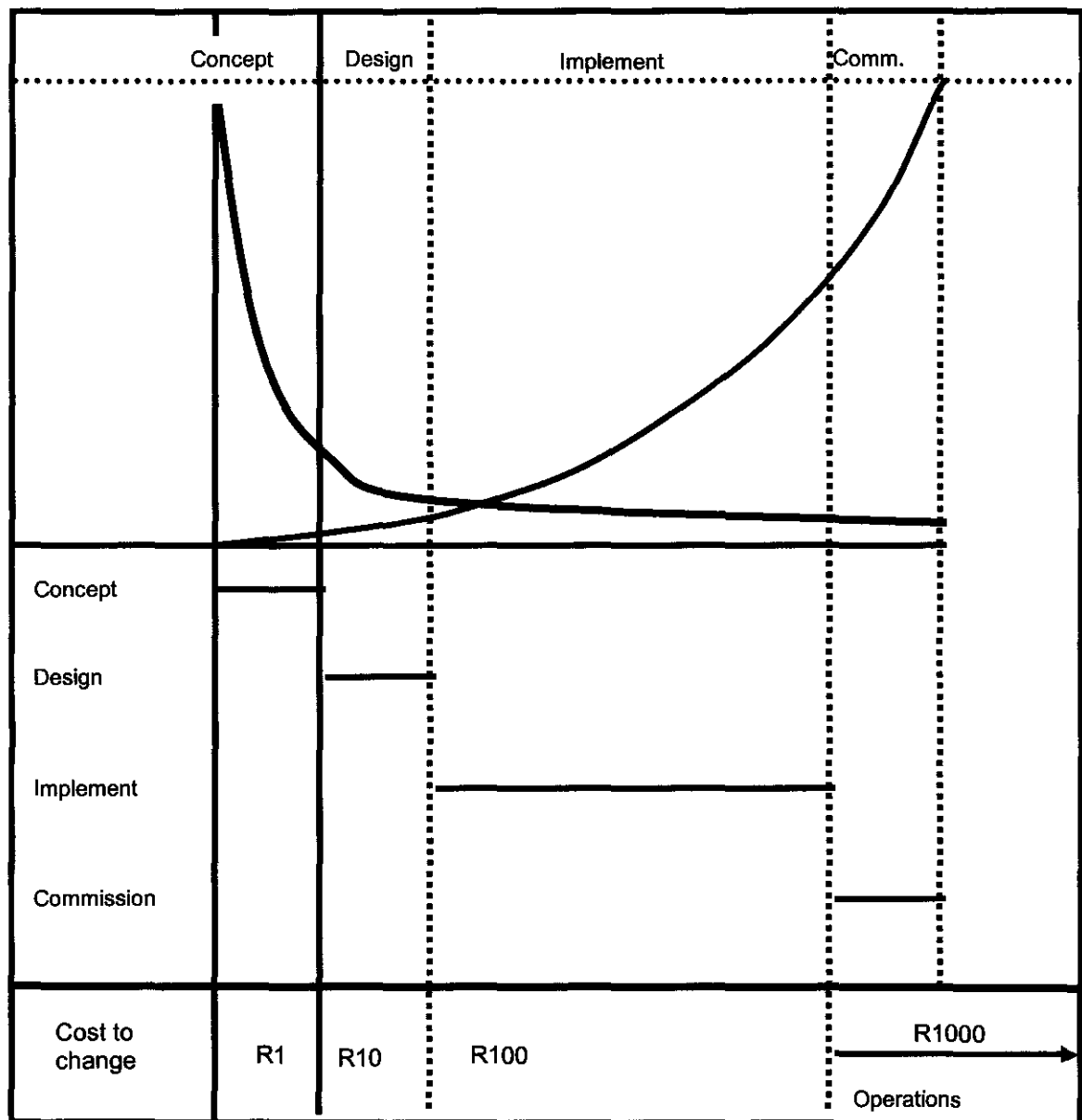


Figure 26: Cost of changes

It can, therefore, be concluded that the greatest benefit can be realised at the beginning of the project life-cycle, if the project team applies an integrated risk management

process in a holistic approach to all facets of the project making use of the project categories as discussed above.

5.7 RISK MANAGEMENT: TOOLS AND TECHNIQUES

If the risk management process described above is taken as a basis for discussing risk management tools and techniques, then it is prudent to describe the tools and techniques per step of the process, PMBOK (2000), Hillson (2001:1-7) and Hillson (2001:1-5).

The process method that will be used is as per Lewis (1999:187), figure 27.

Source: Adapted from Lewis (1999:187)

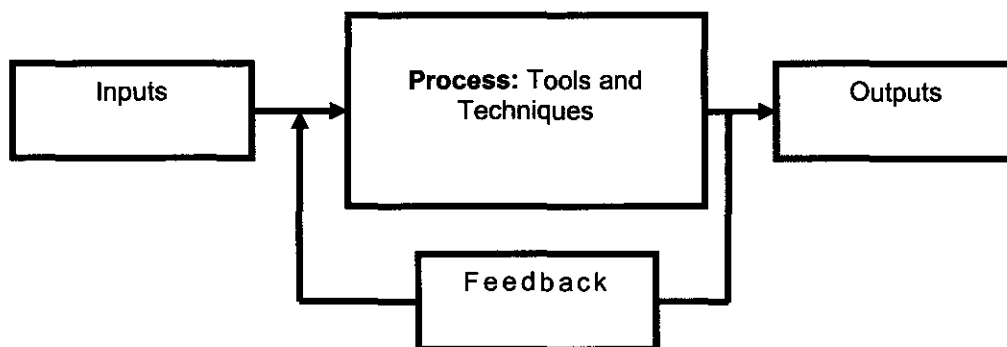


Figure 27: Process Model

The system has inputs, outputs and a process for transforming those inputs to outputs, together with a feedback loop to ensure that the system improves and doesn't stop after a few iterations.

The Tools and Techniques will now be described in terms of the following components of the risk management process:

- Risk Management Planning;
- Risk Identification;
- Risk Analysis;
- Risk Response Planning; and
- Risk Monitoring and Control.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR PLANNING

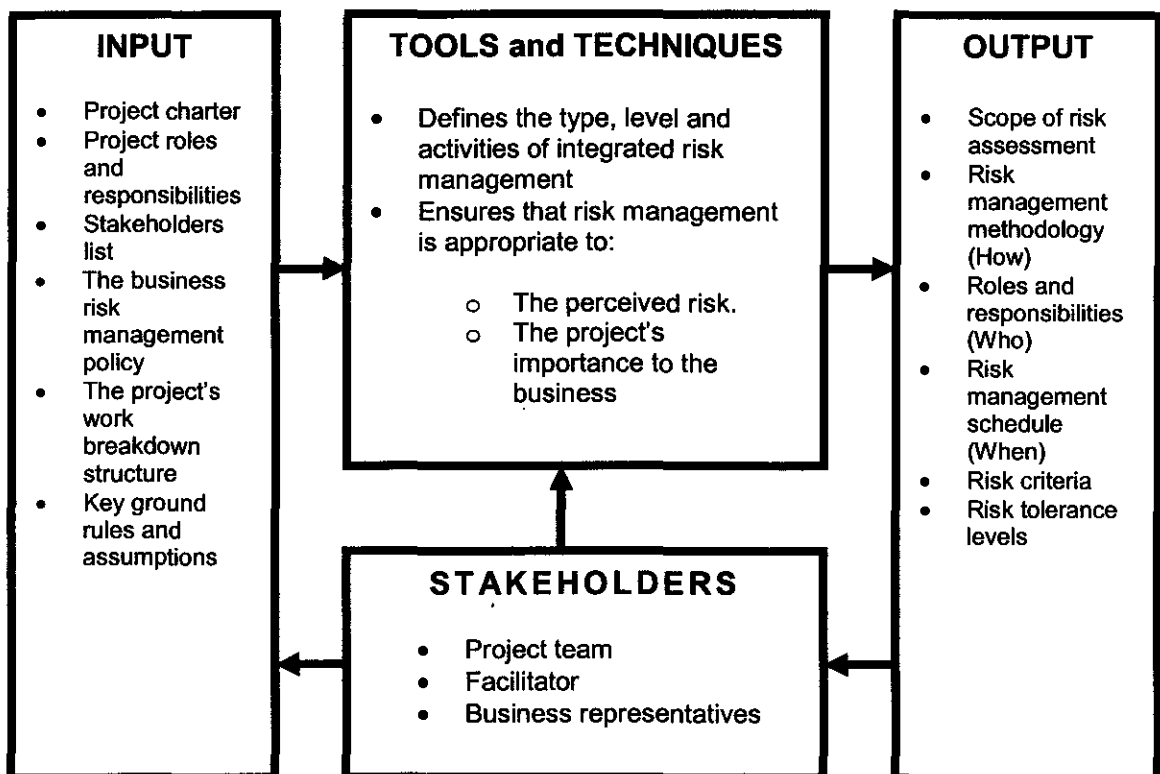


Figure 28: Tasks for Risk Management Planning

Each of the processes is now described:

- **Risk Management Planning;**

Figure 28 depicts the concept used in an attempt to facilitate the description of how to go about planning the risk management task. It shows the input requirements of the process that needs to be followed, the stakeholders and then the outputs that will be achieved. It is a holistic approach where the lack of one dimension could mean that the results to achieve could be useless and can lead to problems in the next step of the process.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR IDENTIFICATION

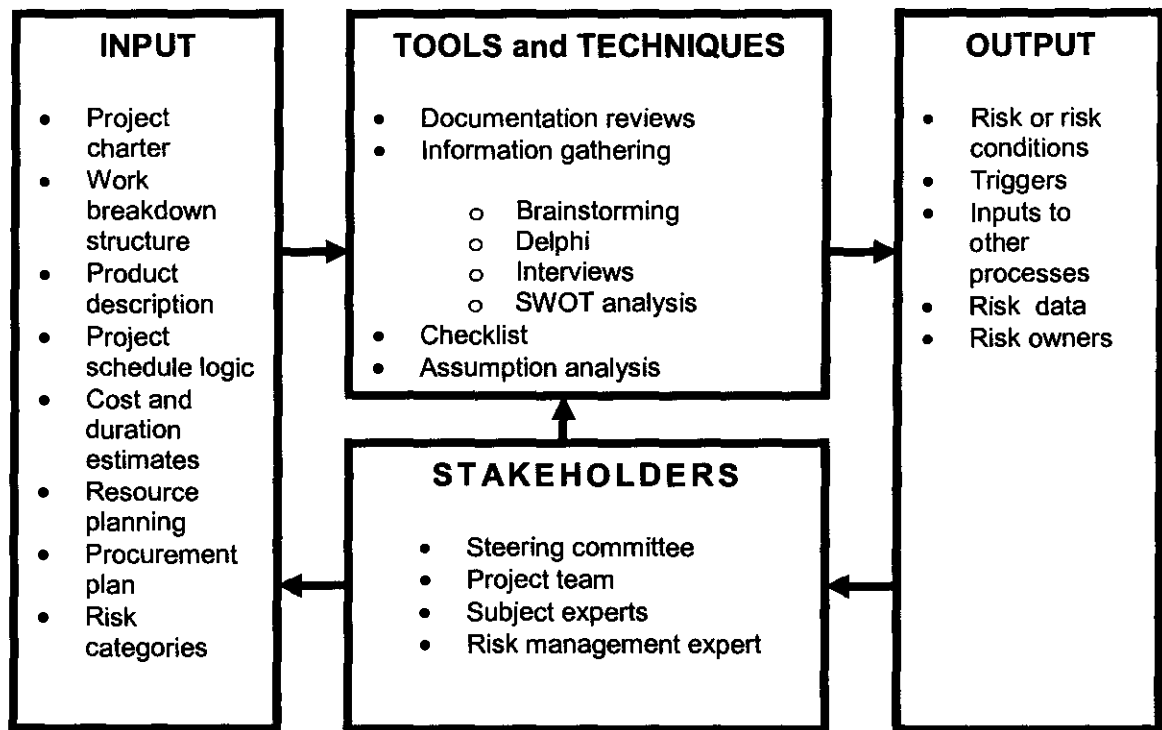


Figure 29: Tasks for Risk Identification

- **Risk Identification**

In figure 29 one can see that a number of known techniques can be employed to identify the risk, but this list is by no means the only one that exists, there are many more which can be used. It is also important to note that not only the steering committee and the project team need to give inputs and feedback, but in most cases subject experts, especially on technology and design issues, are addressed.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR QUALITATIVE ANALYSIS

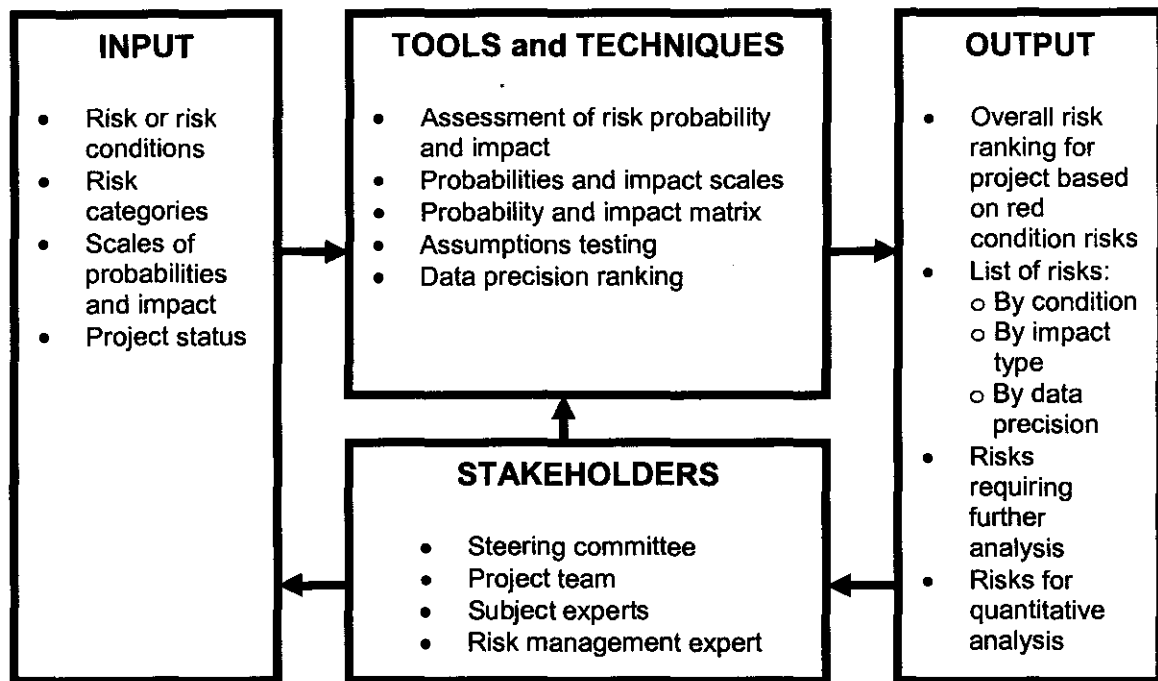


Figure 30: Tasks for Qualitative Risk Analysis

- **Risk Analysis**

Risk analysis involves evaluating risks for their possible effect on the outcome of the project, and can be either qualitative or quantitative. Qualitative risk analysis is the process to prioritise risks according to their potential effect on project objectives. It is one way of determining the importance of addressing specific risks and guides risk response measures.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR QUANTITATIVE ANALYSIS

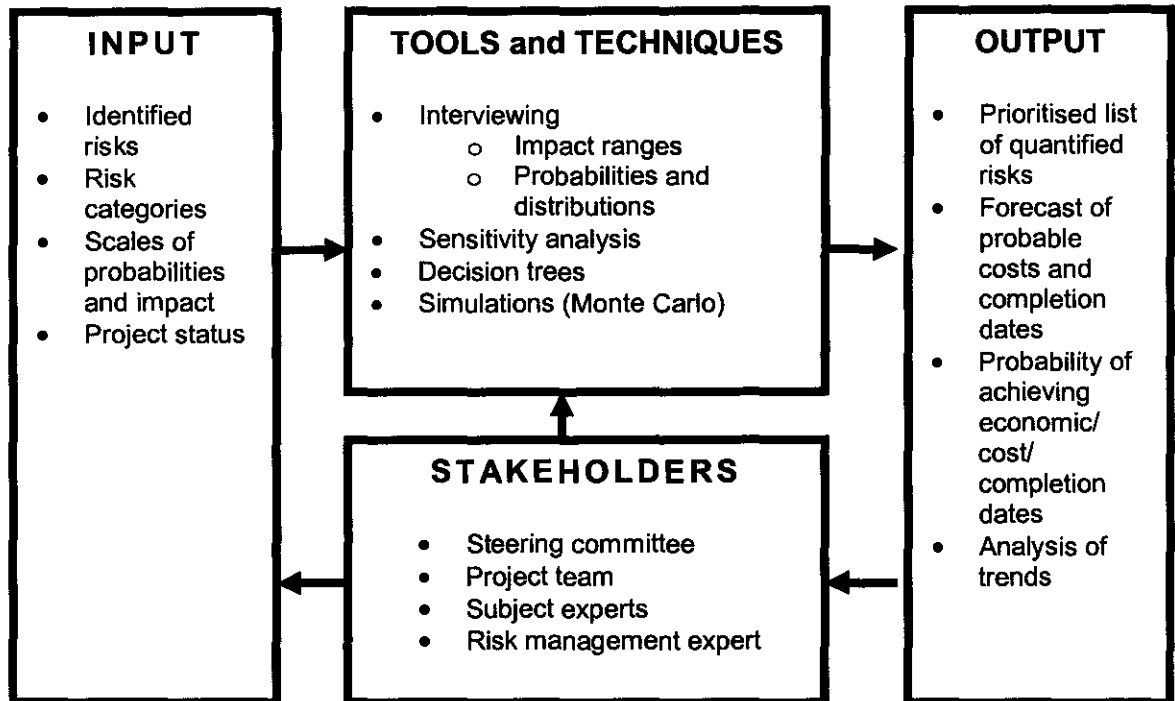


Figure 31: Tasks for Quantitative Risk Analysis

The quantitative risk analysis process aims to analyse numerically the probability of each risk and its impact on project objectives, as well as the extent of overall project risk.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR EVALUATION

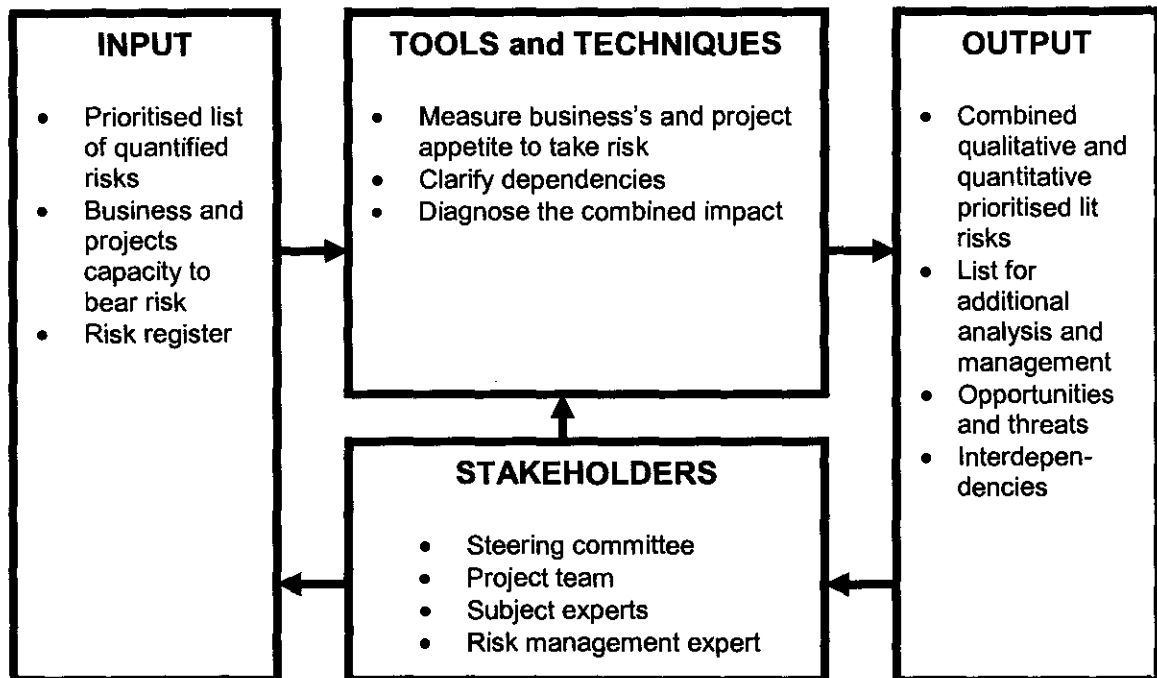


Figure 32: Tasks for Risk Evaluation

- **Risk Response Planning**

It is important to note that some businesses are more willing to take and accept risks where others are not willing to do so. Therefore, one must always bear the risk appetite in mind when evaluating risks.

Several risk response strategies are available. The strategy that is most likely to be effective should be selected for each risk, Prinsloo (2003). He goes on by specifically actions that should be developed to implement that strategy:

- **Avoidance**

Risk avoidance is changing the project plan to eliminate the risk or condition or to protect the project objectives from its impact. The project team can never eliminate all risks, but some specific risks may be avoided;

- **Transfer**

Risk transfer is seeking to transfer the impact of the risk to a third party together with ownership of the response. Transferring the risk does not eliminate it, but simply gives another party the responsibility for its management;

- **Mitigation**

Mitigation seeks to reduce the probability and/or impact of a risk to below an acceptable threshold. Taking early action to prevent a risk from occurring is more effective than trying to address the impacts after it has occurred; and

- **Acceptance**

This technique indicates that the project team has decided not to change the project plan to deal with a risk or are unable to identify any other suitable response strategy. Active acceptance may include developing a contingency plan to execute should a risk occur. Passive acceptance requires no action,

leaving the project team to deal with the risks as they occur.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR RESPONSE PLANNING

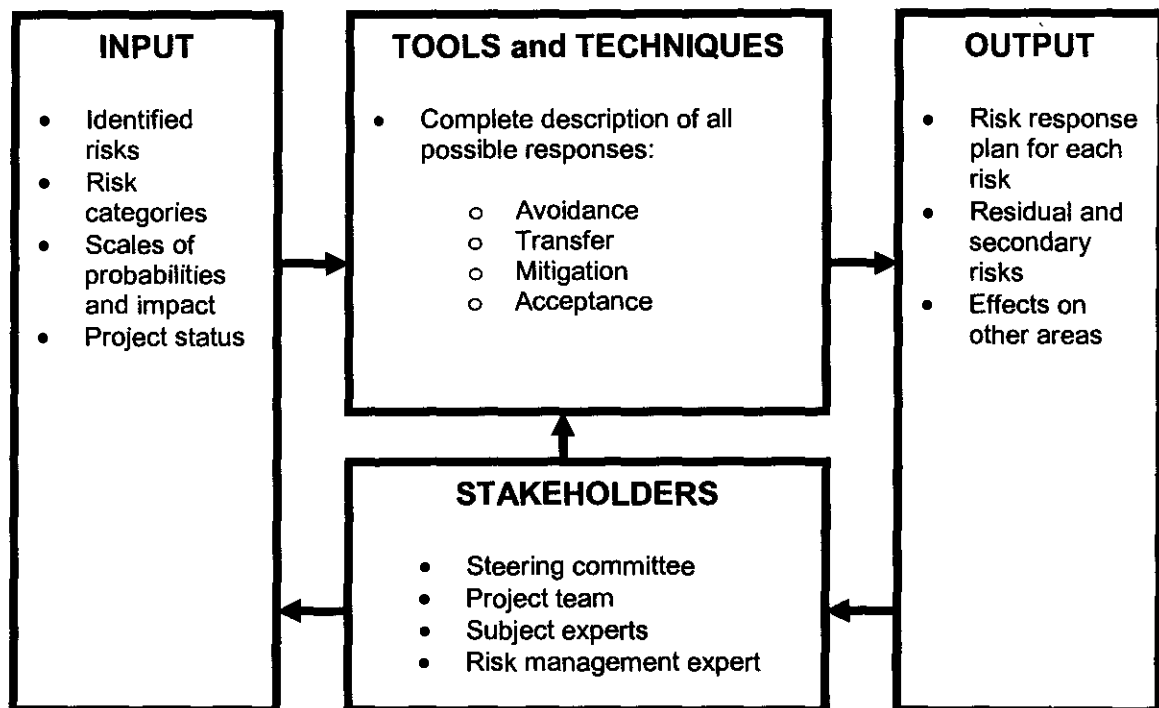


Figure 33: Tasks for Risk Response Planning

Risk response planning is the process of developing options and determining actions to enhance opportunities and to reduce threats to the project's objectives. It includes the identification and assignment of individuals or parties to take responsibility for each agreed risk response. This process ensures that identified risks are properly addressed. The effectiveness of response

planning will directly determine whether risk increases or decreases for the project.

Risk response planning must be appropriate to the severity of the risk, cost-effective in meeting the challenge, timely to be successful, realistic within the project context, agreed upon by all parties involved and owned by a responsible person. Selecting the best risk response from several options is often required.

Source: Adapted from Prinsloo (2003) and PMBOK (2000)

TASKS FOR COMMUNICATION

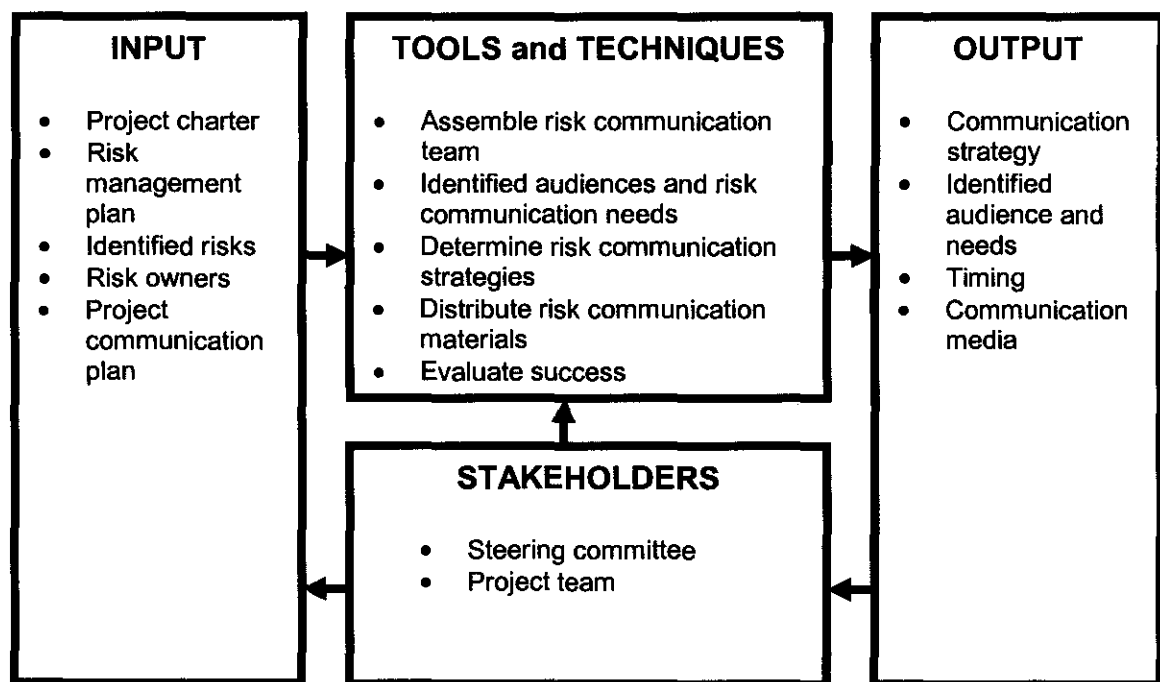


Figure 34: Tasks for Risk Communication

- **Risk Monitoring and Control**

The success of any process is how well it is communicated to its audience. Therefore, it is important to first know what you want to communicate, then to whom and then to do it as regularly as required or as possible. One of the nine knowledge areas of the PMBOK is project communication management; therefore project risk communication should be part of a well-developed communication plan.

5.8 RISK MANAGEMENT COMPETENCIES

Craford (1997) states that competence is a term which is widely used but which has come to mean different things to different people. It is, however, generally accepted as encompassing knowledge, skills, attitudes and behaviours that are causally related to superior job performance.

The Project Management Competency (PMC) Development Framework (2001:1) gives the following "...when applied to project management competence can be described as consisting of three separate areas", viz.

- What the individual project manager brings to a project or project-related task through his knowledge and understanding of project management. This dimension is called Project Management Knowledge;

- What the individual is able to demonstrate is his ability to successfully manage the project or complete project related task. This dimension is called Project Management Performance; and
- The core personality characteristics underlying a person's capability to do a project task. This dimension is called Personal Competency.

Thus, one can say that competence is a combination of dimensions, i.e. knowledge of the subject, skills or ability to perform and personal attitude, which is how he behaves when performing the project task.

In terms of risk management a project manager should have the following competencies to be able to perform his work, PMC Development Framework (2001:53 – 56).

- **Knowledge Competencies**

Demonstrate a knowledge and understanding of:

- **Input tools**
 - The inputs to risk planning and response development;
 - The tools and techniques utilised for evaluation of potential risk events and the planning and development of risk response development;

- **Risk response**
 - The inputs to execution of risk response plans;
 - The tools and techniques utilised for execution of risk responses;
 - The output of risk response execution;
- **Risk response control**
 - The inputs of risk response control;
 - The tools and techniques utilised for conducting risk response control;
 - The outputs of risk response control;
- **Project Closure**
 - The inputs to project closure with regards to risk;
 - The tools and techniques utilised for project closure; and
 - The outputs of project closure with regards to risk.
- **Performance Competencies**
 Demonstrate the ability to develop:
 - Preliminary Risk Assessment Matrix;
 - Contingency Plans;
 - Contractual Agreements;
 - Probability Impact Matrix;
 - Sensitivity Analysis;
 - Decision Tree Analysis;
 - Risk Response Plan;

- Project Risk Response Plans;
- Updates to Risk Response Plan;
- Corrective Actions; and
- Lessons Learnt.

It is of paramount importance for any successful project manager to have the right competency and experience in today's competitive world where an investment must start delivery as soon as possible to not lose the market opportunity or window of opportunity to the many competitors all over the world.

5.9 RISK MANAGEMENT MATURITY LEVELS

5.9.1 Introduction

This is a formal benchmarking process to assist organizations firstly to assess their current position on risk management and secondly to path the way to improve on this level.

The following table gives a comparison of the different maturity models that exist:

Source: RMRDPC (2002:4)

Level	Risk Management Maturity Model (RMMM)	Capability Maturity Model (CMMMI – SE/SW)	Systems Engineering Capability Model (EIA / IS-73.1.1)
0	Ad Hoc	Incomplete	Initial
1	Initial	Performed	Performed
2	Repeatable	Managed	Managed
3	Repeatable	Defined	Defined
4	Managed	Managed quanta	Measured
5	Managed	Optimising	Optimising

Table 1: Different Maturity Models

The Risk Management Research and Development Program Collaboration (RMRDPC) (2002:4) states that "...there is currently a broad consensus on the fundamentals and potential benefit of project risk management when it is conducted within a mature and effective process and supported by a comprehensive infrastructure. The organization must be able to benchmark its present maturity and capability in managing risk, using a generally acceptable framework to assess current levels objectively and assist in defining progress towards increased maturity".

There exist different models that can be used in this exercise:

- Risk Management Maturity Model (RMMM);

- Capability Maturity Model for systems Engineering Organizations (CMMI – SE/SW); and
- Systems Engineering Capability Model (EIA / IS 731).

The RMMM offers a framework to allow organizations to benchmark its approach to risk management against four standard levels of maturity and outlines the activities necessary to move to the next level. This model will be discussed in the next few paragraphs.

5.9.2 The Risk Management Maturity Model

According to Risk Management Research and Development Program Collaboration (2002:6) the maturity of one organization's risk management can be categorised into groups that range from those who have no formal process to organizations where risk management is fully integrated into all aspects of the organization. The models that will be described here, consist of four standard levels of risk management maturity as illustrated in figure 35.

Source: RMRDPC (2002:7-15)

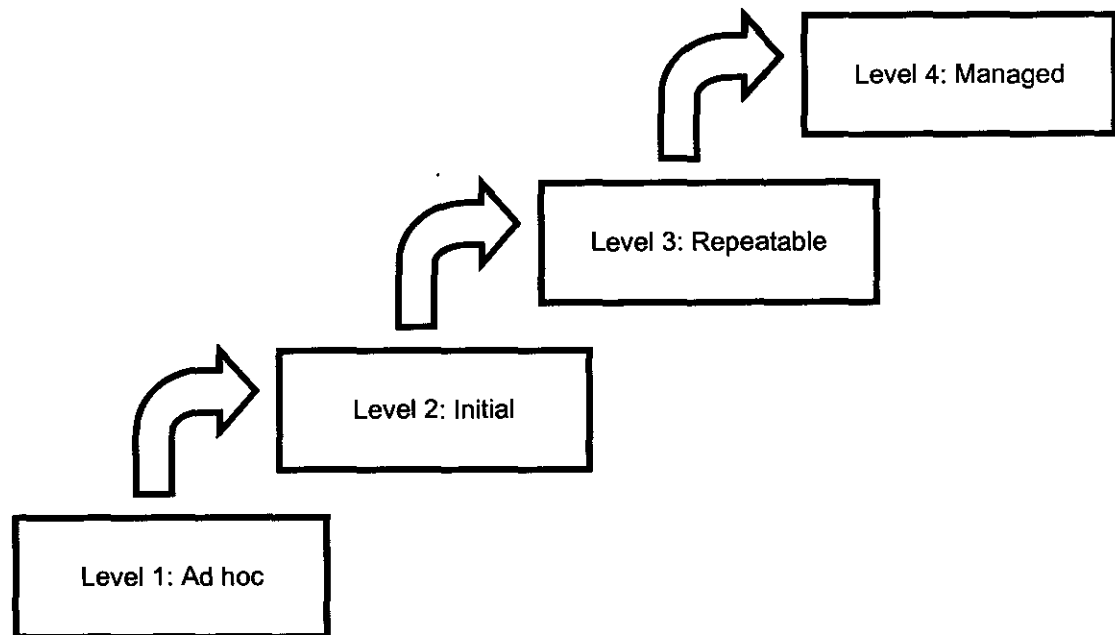


Figure 35: Risk Management Maturity Model

As per Risk Management Research and Development Program Collaboration (2002:7-15) the four levels are described as follows:

- **Level 1 – Ad Hoc**

At the Ad Hoc level, the organization is unaware of the need for risk management and has no structured approach to deal with uncertainty resulting in a series of crises for each project. Management and engineering processes, if they exist are repetitive and reactive, with little or no attempt to learn from past projects or to prepare for future uncertainties. No attempt is made to identify risks to the project or to develop

mitigation or contingency plans. The normal method for dealing with problems is to react after a problem occurs with no proactive thought. During a crisis, project teams typically abandon plans and hope for the best. Project success depends on having an exceptional manager and a seasoned and effective team. Occasionally, capable and forceful managers can identify and work to investigate risks during projects, but when they leave, their influence leaves with them. Even a strong engineering process cannot overcome the instability created by the absence of risk management practices.

In spite of this chaotic process of reactive crisis management, level 1 organizations frequently develop products that work even though they will normally exceed their original budget and schedule and will not contain all of the original required functionality. Success in level 1 organizations depends on the competence of heroics of the people in the organization and cannot be repeated unless the same competent individuals are assigned to the next project. Thus, at level 1, capability is a characteristic of the individuals of the organization.

- **Level 2 – Initial**

At the Initial Level, organizations are experimenting with the application of risk management, usually through a small number of

nominated individuals within specific projects. At this level the organization has no formal, or structured, risk management process in place. Although the organization is aware, at some level, of the potential benefits of managing their risks, there is no effectively implemented organization wide process implemented. Some projects, those containing the nominated individuals learn from past mistakes, however, there is no method implemented for providing these lessons learnt to all of the organization's projects. Risk management at this point may be described as the start of crystallisation of the organization's corporate experience. The organization is becoming aware that it can learn from past mistakes, but this knowledge is not yet formalised nor are there any structures in place to ensure its consistent application throughout the organization.

- **Level 3 – Repeatable**

At the Repeatable Level, the organization has implemented risk management into their routine business processes and has implemented risk management in most, if not all, projects. Generic risk policies and procedures are formalised and widespread, and the benefits are understood at all levels of the organization, although they may not be consistently achieved in all cases. Planning and managing new projects is based on experience with similar projects. Risk

management capability is enhanced by establishing basic risk management discipline on a project-by-project basis. Projects implement risk management through processes that are defined, documented, practiced, trained, measured, enforced and improvable. All projects have an assigned risk manager. On small projects the roles of the project manager and risk manager may be combined in the same person, but on larger projects the risk manager is distinct from the project manager.

Projects in level 3 make realistic project commitments based on results observed on previous projects and on risks identified for the current project. The risk manager for a project track costs, schedules, functionality and quality; problems in meetings and commitments are identified as they arise.

Risk management processes may differ between projects in a level 3 organization. The organizational requirement for achieving level 3 is that there are organizational level policies that guide the projects in establishing the appropriate management processes. The risk management capability of level 3 organizations can be summarised as disciplined because planning and tracking of the project is stable and earlier successes can be repeated. The project's risk management process is under effective control of

a project management system, following realistic plans based on the performance of previous projects.

- **Level 4 - Managed**

At the Managed Level, the organization has established a risk-aware culture that requires a proactive approach to the management of risks in all aspects of the organization. Risk information is continually developed and actively used to improve all organization processes and to increase the probability of success in projects and operations. A standard risk management process is documented and used across the organization. Processes established at level 3 are used and changed, as appropriate to help the organization's project and operations managers and technical staff perform more effectively. A group of personnel within the organization are assigned responsibility for risk management. This formal assignment provides for an informal communication channel to organization management outside of the project communications channels or operational management structure. An organizational-wide training program is implemented to ensure that the staff and managers have the knowledge and skills required to fulfil their assigned roles.

The risk management process capability of level 4 organizations can be summarised as standard and

consistent because activities are stable and respectable. Within established product lines, cost, schedule, functionality and quality risks are known, controlled and risk mitigation status is traced. This process capability is based on a common, organization-wide understanding of the activities, roles and responsibilities in a defined risk management process.

5.9.3 Determining Organizational Maturity Level

A brief description of each level can indicate where an organization stands in terms of the maturity of its risk process.

The following attributes can be used to determine the maturity level:

- Culture;
- Process;
- Experience; and
- Application.

Progress between Maturity Levels

Level 1 to 2 – Ad Hoc to Initial

As described above, an organization faces numerous problems as it starts implementing effective risk management. In order to develop from an Ad Hoc to the Initial Level, a number of actions must be accomplished,

- Clearly define the objectives of the risk management implementation to enable the risk process to be tailored and scoped accordingly;
- Get advice and guidance from recognised external experts who have a track record in assisting organizations in this type of implementation.
- Identify specific personnel to be the original implementers;
- Ensure adequate training and support for this team, including all the necessary risk skills and techniques, to ensure that they can act as “intelligent customers”;
- Undertake awareness briefings to sell the vision of risk management and its potential benefits to the entire project organization, from senior management to front-line employees;
- Ensure corporate backing, with nomination of a senior management sponsor to promote the implementation process;
- Nominate pilot applications for risk management, carefully selected to maximise the chances of early success;
- Publish and celebrate successes. Seek to develop momentum in the risk process and encourage other projects and individuals to apply risk management to their areas as they see clear benefits;
- Plan for long-term recognising that effective implementation of risk management will not be achieved overnight. One needs commitment from top management for the necessary resources before starting;

- Build effective controls into the process from the outset, with breakpoints to enable progress to be monitored and reviewed at key intervals. Collect and trend appropriate metrics;
- Consider producing draft risk procedures with templates for key inputs and outputs; and
- Identify and use appropriate project risk management tools such as risk information databases.

Level 2 to 3 – Internal to Repeatable

To move to the next level certain action steps need to be taken. The following can assist in this:

- Reinforce and strengthen corporate backing;
- Provide formal risk training to develop in-house expertise and process knowledge;
- Use external expertise as necessary to reinforce and support existing in-house skills;
- Allocate adequate resources to the risk management implementation process, with assignment or recruitment of sufficient staff and assigned budget for risk management training, risk assessment tools and other required risk management activities;
- Select key projects to demonstrate the benefits of risk management in all areas of the organization's business;
- Continue to publish and celebrate successes, encouraging wider application of risk management to other areas as benefits become clear;

- Provide opportunities for in-house staff to attend ongoing risk management training courses, conferences and seminars, workshops, etc;
- Formalise the chosen risk management process with clear definition of scope and objectives of risk management, together with agreed upon procedures and properly selected tools;
- Develop and promulgate an organizational policy on the use of risk management;
- Insist that all project managers use risk management as part of their routine management of projects. Include regular risk reporting as an important part of management reviews; and
- Start to assemble metrics from the risk process; identification of generic risks, effective responses, the cost of risk reduction, etc. Specific checklists can be generated to facilitate the risk identification and assessment processes, based on actual experience of risk management within the organization.

Level 3 to 4 – Repeatable to Managed

Level 3 is probably sufficient for most organizations, where risk processes are integral to the organization and are consistently and routinely applied to most or all projects. However, the consensus of the professional organizations that contributed to this model was that the Risk Management Maturity Model needed to identify a level beyond Level 3.

Actions to assist in progress towards Level 4 are:

- Ensure effective learning from experience. Undertake regular reviews of the risk management process, with value engineering of the process to ensure that it remains fully effective;
- Amend and strengthen the risk management process where necessary, including investment;
- Investigate novel applications of the risk management process beyond those already covered. Seek to modify and apply risk management to every activity within the organization;
- Use every means possible to develop a ***Risk Management Culture***, encouraging all personnel to ***think risk***, be aware of uncertainty and use risk techniques to assess and manage potential threats and opportunities. Build risk thinking into your organizational culture. Be aware of the possible range of attitudes about risk. Ensure that risk is included as a routine criterion in all decision-making.
- Identify and counter incidences of “risk fatigue”, where staff are losing interest in the process or there is a potential loss of momentum. Use regular re-launch promotions to renew the process, celebrating successes, publicizing improvement metrics, and rewarding effective risk management;
- Undertake regular risk management training to ensure that skills remain current; and
- Consider use of external risk expertise to widen the application of risk management into novel areas of

the organization, or to add the necessary momentum to maintain progress or introduce change.

As can be deduced from the above, it is an elaborate process to establish a risk culture in an organization. It takes time; a lot of resources and a commitment from top management to not only expose the company to risk management, but to move from one level to the next. As was stated for most companies it will be sufficient to be at level 3. Even that is a tall order, but if organizations make an effort to move to this level they will reap the benefit of being successful in implementing projects time and time again.

5.10 CONCLUSION

Everyone involved in projects understands that risks are inherent in projects. Risk management reduces the number of surprises and leads to better understanding of the outcomes of negative events, (Gray & Larson (2000:155).

By using risk management processes one enhances the success of the project, i.e. time, budget and quality objectives are met.

By using risk management early in the project life cycle cost can be reduced because it is cheaper to address risk events earlier on than to do this when the project has progressed a long way through the life cycle.

In this chapter risk and risk management was defined and the categories of risk were given with the effect it has on the project if not properly managed (as in figure 36). The risk management process and risk management maturity levels were described. Tools and techniques and risk management competencies were addressed to ensure that a holistic view on risk could be achieved and to assist in implementing a total risk management system in an organization.

No claim is made that this is complete; surely more can be learnt but this chapter can make a contribution towards improving the use of risk management in projects.

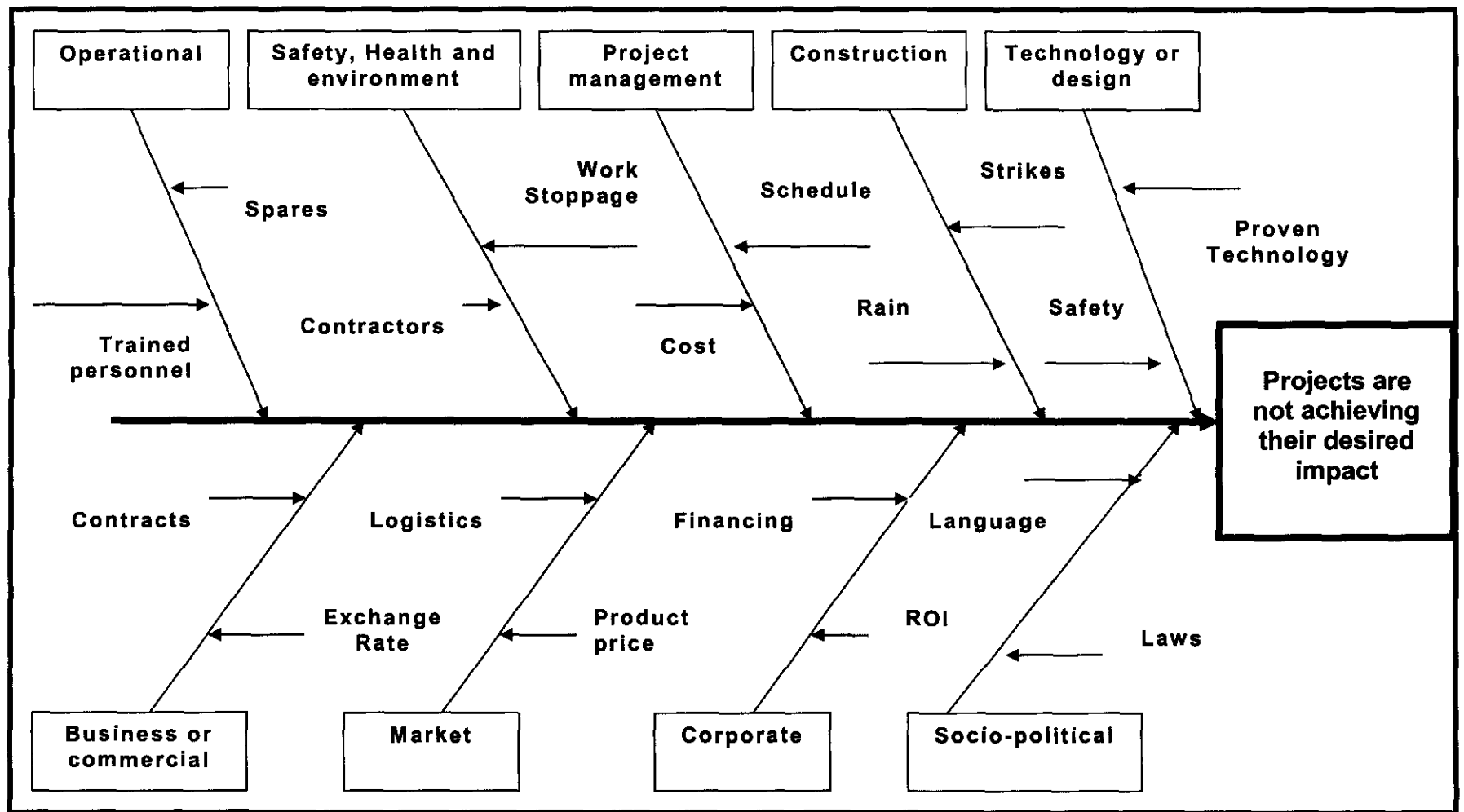


Figure 36: Cause-and-Effect of Not Managing Risks

CHAPTER 6: RESEARCH RESULTS

6.1 INTRODUCTION

The theory, which was described in chapters 3, 4 and 5, gave an overview of strategic, project and risk management. This information forms the basis of the development of the questionnaire, which is used in this study as a means of doing empirical research. The function of risk management and the use thereof in a project environment was designed in the form of a questionnaire and was tested and measured in practice.

In this chapter the findings obtained from the completed questionnaires will be analyzed and discussed.

The research is conducted to establish if the respondents are working in a project environment, to what extent they apply risk management processes in their projects and the level of risk awareness amongst them.

6.2 APPROACH USED IN COLLECTING THE DATA

A questionnaire was designed and sent to selected business leaders and project managers, in order to obtain information on the use of the risk management process and the project teams' awareness of risk in projects. Interviews were also conducted with a selected group of project managers combined with

projects audit to determine the state of the work on risks and risk management. The questionnaire was designed in such a way to meet the objectives set out in this dissertation.

The target group of this investigation is business leaders and project managers working in the engineering field within the petro-chemical industry in South Africa. The questionnaires were sent out to most respondents, via e-mail, with the exception where interviews and audits were conducted.

6.3 QUESTIONNAIRE DESIGN

The questionnaire is subdivided into three sections. The first section is about the demographic information of the respondent. The second section is about operation of the risk management process and section three covers risk information.

The questionnaire will be discussed further in the subsequent paragraphs.

Section 1: Background Information

In this section questions are asked to determine a demographic profile of the organization and the project manager. The evaluation of these dimensions is important because a positive result will validate the response in the next two sections;

Section 2: Operation of the risk management process

In this section the objective is to determine how effective and efficient risk management is applied within the projects managed by the respondents. This leads directly to the maturity level of the organizations as far as risk management is concerned; and

Section 3: Risk Information

The purpose of this section is to test if risk is addressed at all and to what level in the organization in the managing of projects, and if top management supports the process.

6.4 RESULTS OF SECTION 1: PROJECT MANAGEMENT INFORMATION

Introduction

The result of the questionnaire could be affected by factors such as experience, qualifications and perception of the respondent. The questions were in general well answered and all questionnaires received back were filled in correctly.

In the next sections the project management responses will be evaluated.

Type of organization and sector

i) Introduction

The purpose of these two questions is to determine the type of organization and sector in which the respondents' organization operates.

ii) Results

Tables 2 and 3 indicate the results of the empirical study.

Answer	Quantity	Frequency
Commercial private sector business	46	63%
Public sector organization operating commercial practices	27	37%
Traditional public sector	0	0%
Charity or Not-for-Profit	0	0%
Other	0	0%
Total	73	100%

Table 2: Type of organization

Answer	Quantity	Frequency
Government	0	0%
Services	51	70%
Manufacturing	22	30%
Mining and resources	0	0%
Utilities	0	0%
Communication	0	0%
Other	0	0%
Total	73	100%

Table 3: Sector

iii) Findings

From tables 2 and 3 it is clear in what type of business and in which sector the respondents are working. This is in line with the selected group to which the questionnaires were sent.

Main area of application of risk management

i) Introduction

The purpose of this question is to determine in which area of business risk management is applied.

ii) Results

The classification of the areas in which risk management is being used is given in the table below.

Answer	Quantity	Frequency
Projects	73	100%
Environmental assessments	8	11%
Safety assessments	5	7%
Technical assessments	12	16.4%
Investment or capital evaluation	1	1.4%
Cost and schedule estimation	14	19%
Business operations	0	0%
Portfolio management	0	0%
Trading	0	0%
Credit management	0	0%
Insurance	0	0%
Other	0	0%

Table 4: Main area of application of risk management

iii) Findings

Table 4 shows the main area of application of risk management in organizations is projects with 100% of the respondents giving the yes vote. The table further indicates that risk management is being used in other areas as well, however to a lesser degree. This could be because the sample is made up of project managers mainly. The good news, however, is that they all use risk management in the management of their projects.

Number of employees

i) Introduction

The purpose of this question is to establish the number of employees employed by the organization.

ii) Results

In table 5 the results are shown.

Answer	Quantity	Frequency
< 10	6	8%
10 - 100	17	23%
100 - 1000	15	21%
> 1000	35	48%
Total	73	100%

Table 5: Number of employees

iii) Findings

Table 5 shows that approximately 69% of organizations have more than 100 employees, which is a good indication of the size of the business taking part in this study. This will be further tested in the next two questions.

Monetary Value of the Projects

i) Introduction

The aim of this is to establish the size of the projects managed by the project managers.

ii) Results

The results are shown in table 6.

Answer	Quantity	Frequency
Less than R500 000	0	0%
R 500 000 – R 1 000 000	15	20.5%
R 1 000 000 – R 10 000 000	10	14%
R 10 000 000 – R 100 000 000	15	20.5%
Over R 100 000 000	33	45%
Total	73	100%

Table 6: Average monetary value of projects

iii) Findings

From table 6 one can see that more than 66% of the projects managed by the project managers in this study have a monetary value that exceeds R 10 million, which in any terms is a fair amount. This indicates then that the projects undertaken by the respondents are in line with the number of employees employed as was established in the previous question.

Experience of Project Managers

i) Introduction

With this question the purpose is to determine how experienced the respondents are in project management.

ii) Results

Table 7 gives the results of the research.

Answer	Quantity	Frequency
Less than 5 years	17	23%
6 – 10 years	11	15%
11 – 15 years	29	40%
16 – 20 years	16	22%
20 years and more	0	0%
Total	73	100%

Table 7: Years experience in project management

ii) Findings

Table 7 shows that more than 62% of the respondents have more than ten years experience in project management. One can, therefore, say that this further underlines the validity of the results of this demographic information as basis for the next two sections of questions.

6.5 RESULTS OF SECTION 2: OPERATION OF THE RISK MANAGEMENT PROCESS

How consistent is the risk management process?

i) Introduction

The purpose of this question is to determine how consistent the risk management process is when projects are managed.

ii) Results

Table 8 indicates the results of the empirical study.

Answer	Quantity	Frequency
All risk management follows the process definition identified earlier	32	44%
The process is not formally documented but it is understood and consistently applied	10	14%
There is no formal process but broadly the same outputs are generated by all our assessments	19	26%
Each risk assessment is set up independently according to the wishes of the initiator	12	16%
Total	73	100%

Table 8: The consistency in the risk management process

iii) Findings

From table 8 it can be seen that most respondents (44%) indicate that their risk management process is consistent. There is, however, still a long way to go before one can be satisfied with the results.

How much preparation is required for a risk assessment as it is currently operated?

i) Introduction

The purpose of this question is to establish whether the risk management is being used with diligence.

ii) Results

The results are shown in table 9.

Answer	Quantity	Frequency
So long as the participants are familiar with the work, very little at all	29	40%
A briefing on the work being assessed prior to considering the risks it faces	15	20%
Preparation of a brief detailing scope of work, stakeholders and risk evaluation criteria	29	40%
Total	73	100%

Table 9: Preparation is required for a risk assessment as it is currently operated

iii) Findings

From table 9 it is clear that the systems are being used with a fair bit of preparation work where 60% do just that, but 40% of the respondents are left to use the systems as they feel fit, as long as the participants are familiar with the work.

How are risks identified?

i) Introduction

With this question one wants to establish how risks are identified in a project.

ii) Results

Table 10 gives the responses of the respondents.

Answer	Quantity	Frequency
Against various standard categories e.g. Commercial, Technical, Programme	27	37%
Using checklists of known risks	28	38%
A meeting	27	37%
A call for contributions by mail, e-mail or similar means	4	5%
Free brainstorming – no structure	9	12%
Structured brainstorming – using prompts	23	32%
Other	0	0%

Table 10: How are risks identified?

iii) Findings

The majority of the respondents are using a method when they identify risk in their projects.

How do you describe the severity of a risk?

i) Introduction

The purpose of this question is to establish if proper methods exist to describe the severity of risk.

ii) Results

The results are given in table 11.

Answer	Quantity	Frequency
In words	11	15%
With a qualitative scale such as (High/Medium/Low), (0-10) or (A, B, C, D)	9	12%
With a quantitative likelihood and an impact or consequence measure for each risk	8	11%
With a probability and a monetary value that are multiplied to give a risk value	45	62%
Other	0	0%

Table 11: How do you describe the severity of a risk?

iii) Findings

A majority of the respondents use acceptable methods to describe the risk. What is good news is that a 62% of respondents use a probability together with a monetary value which is an indication that a well-thought-through system is being used.

What measures do you use to describe the severity of a risk?

i) Introduction

With this question, the measures used in describing the severity of a risk are the aim.

ii) Results

Table 12 gives the results.

Answer	Quantity	Frequency
Financial measures	54	74%
Timing or schedule measures	49	67%
Performance or throughput measures	15	21%
Quality measures	14	19%
Environmental impacts	11	15%
Safety criteria	34	47%
Others	0	0%

Table 12: What measures do you use to describe the severity of a risk?

iii) Findings

From table 12 it is clear that a range of measures are being used and that the respondents are using more than one measure and the financial measure enjoys the highest frequency of 74% followed by timing or

schedule measures with 67% and than safety criteria with 47%, which is in line with the objectives of a project as described in chapter 4.

What is the basis for evaluating the severity of risks?

i) Introduction

The purpose of these questions is to establish what the basis for evaluating the severity of risks is.

ii) Results

The results are given in table 13.

Answer	Quantity	Frequency
The judgment of those doing the assessment	20	27.4%
Scales drawn up for each case	20	27.4%
An internally defined set of scales used for all assessments	25	34%
An externally defined set of scales used for all assessments	6	8.2%
Others	2	3%
Total	73	100%

Table 13: What is the basis for evaluating the severity of risks?

iii) Findings

Table 13 indicates that only 27% of respondents feel they are left to follow their judgment, whereas the rest uses a proper basis for evaluating the severity of risks.

How are risks dealt with after being identified?

i) Introduction

The aim with this question is to determine how the respondents are dealing with risks after these risks have been identified.

ii) Results

Table 14 shows the responses to these questions.

iii) Findings

As can be seen from table 14, 88% of the respondents indicate that proper methods are being used to ensure that mitigation actions for the identified risks are implemented.

Answer	Quantity	Frequency
They are handed over to the person responsible for the work to use as they see fit	9	12%
Each risk is allocated to a department or function for treatment	5	7%
Each risk is allocated to a named individual for treatment	21	29%
They are prioritised and the most severe are allocated to a department or function for treatment	17	23%
They are prioritised and the most severe are allocated to a named individual for treatment	21	29%
Other	0	0%
Total	73	100%

Table 14: How are risks dealt with after being identified?

How often is the view of risks affecting an area of work reviewed and kept up to date?

i) Introduction

The objective with this question is to determine if a proper follow-up system exists that ensures that risks are reviewed and kept up to date.

ii) Results

The results are given in table 15.

Answer	Quantity	Frequency
It is not usually reviewed once it has been established	10	14%
Whenever there has been a major upheaval	9	12%
On a regular basis defined for each case	25	34%
On a regular basis set by an organizational practice	29	40%
Other	0	
Total	73	100%

Table 15: Work reviewed

iii) Findings

Most, 74% of the respondents, state that risks are reviewed at a regular basis and kept up to date.

How are those concerned with risk management in a particular area given opportunities to contribute and kept aware of developments?

i) Introduction

With these questions one wants to establish the continuous improvement of risk management within an organization. The results are given in table 16.

ii) Results

Answer	Quantity	Frequency
Everyone with a stake in a project or business activity is expected to take part in identifying, evaluating and dealing with risks and given the opportunity to do so	15	21%
Process documentation, such as the context definition and workshop output, is circulated to all who could be concerned	21	29%
We expect that anyone identifying a risk or who is able to contribute to dealing with one, will take the initiative and make this known	17	23%
Most communication about risks and risk management is informal	11	15%
It is not uncommon to find that people who should have been involved in the process are excluded or overlooked	9	12%
Total	73	100%

Table 16: Continuous improvement of risk management

iii) Findings

Table 16 shows that most of the respondents state that continuous improvement takes place in their organizations.

6.6 RESULTS OF SECTION 3: RISK INFORMATION

i) Introduction

This section was used in a previous study by the author and the results of this study will be compared. Furthermore, this section is based on an article by MacNamee (1999:1-4) and, which discusses risk and risk management in companies today. It includes a self-assessment questionnaire, adapted for a project environment, which was used in the research for this dissertation.

ii) Results

The results as mentioned are based on self assessment, where ten questions are asked and then the scores added up with the following meanings:

- **Scores less than 24:** Risk management is not part of project management now. The organizations should work on building an appreciation for risk management in projects;

- **Scores 24 – 36:** Risk management is part of project management, but it needs a bigger input from corporate governance culture; and
- **Scores more than 36:** Risk management plays an important part in project management, and this philosophy should be maintained.

Answer	Quantity	Frequency
Scores less than 24	4	5.5%
Scores 24 – 36	61	83.5%
Scores more than 36	8	11%
Total	73	100%

Table 17: Awareness of risk in a project environment

iii) Findings

From this table it is clear than only 5.5% of the respondents are not using risk management in their projects. The majority of 83.5% are using risk management in their projects but there is room for improvement. The rest, a mere 11%, accept that risk and risk management is important for the success of their projects and are making use of it.

The following are the results of a previous study, De Villiers (1999):

Answer	Quantity	Frequency
Scores less than 24	30	13%
Scores 24 – 36	150	65%
Scores more than 36	50	22%
Total	230	100%

Table 18: Awareness of risk in a project environment

iii) Findings

From this table it is clear than only 13% of the respondents are not using risk management in their projects. The majority, 65%, is using risk management in their projects but there is room for improvement. The rest, 22%, accept that risk and risk management is important for the success of their projects and are making use of it.

iv) Comparison

In the previous study 13% of the respondents are not using risk management in their projects against only 5.5% indicating now that they are not using risk management in their projects. The majority, 65% versus 83.5%, is using risk management in their projects but there is room for improvement. The respondents that indicated that risk management plays an important part in their projects, dropped from 22% to 11%.

6.7 CONCLUSION

In this chapter, the design of the questionnaire to collect the data for this study, the approach in collecting the data, the responses processed and results obtained were discussed.

In the next chapter concluding remarks on the results obtained will be discussed.

CHAPTER 7: RESEARCH CONCLUSIONS AND FINDINGS

7.1 INTRODUCTION

In chapter 6 the results obtained from the questionnaire, which was used in the empirical study, were processed, analysed and discussed.

In this chapter conclusions will be made on the results obtained in this study. Then guidelines on how to address the problems and shortcomings, which were identified in this research, will be recommended.

7.2 FINDINGS AND CONCLUSIONS

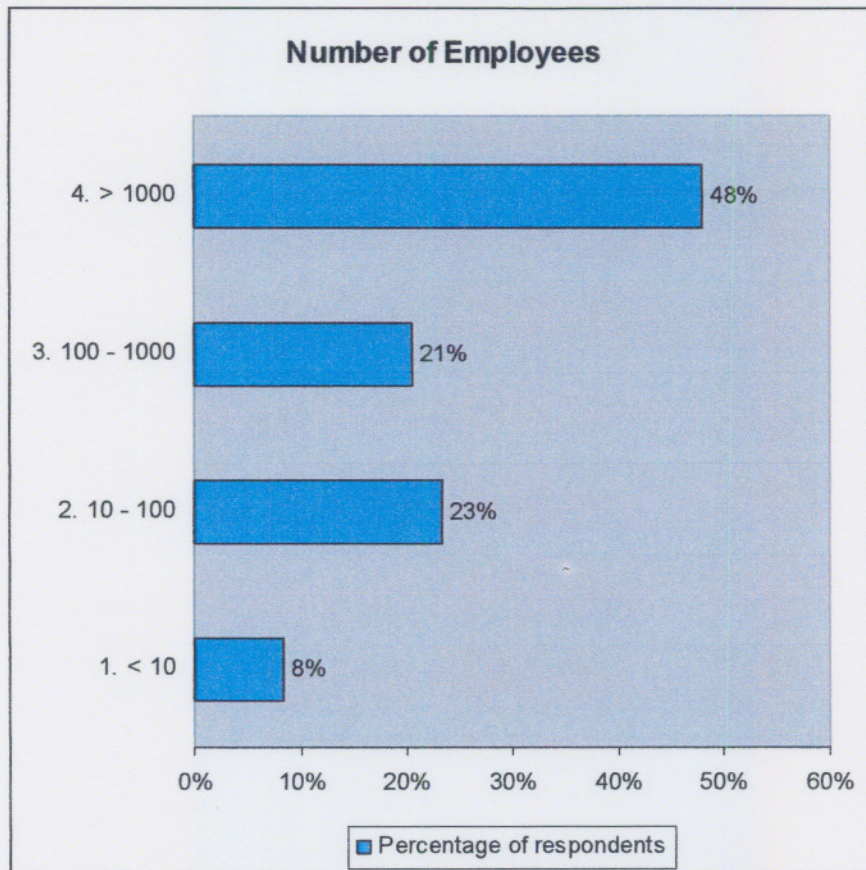
The findings and conclusions based on the results and remarks from the empirical study will be discussed in following paragraphs.

7.2.1 Findings from Section 1: Project Management

In this section the following findings came to the fore:

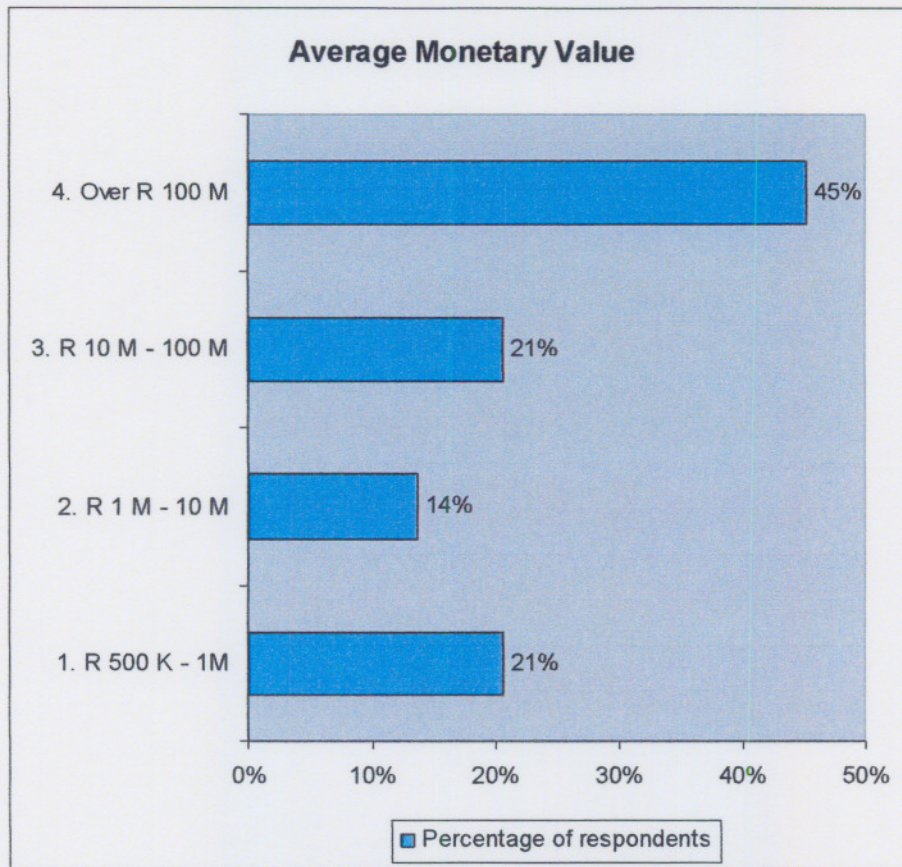
- 37% of the respondents work and manage projects in a commercial private business, where 63% work in the public business.
- 70% of the respondents indicated that their business operates in the services sector against 30% in the manufacturing sector.

- 100% of them stated that they use risk management in the management of their projects.



Graph 2: Number of Employees

This information is indicative that most of the respondents (48%) are working for big companies with more than 1000 employees.



Graph 3: Average Monetary Value

Graph 3 gives the average monetary value of the projects in Rand. None of the respondents indicated that they manage projects with a monetary value less than R500 000.

It is clear from graph 3 that most (45%) manage big projects with a monetary value of more than R100 million. This correlates well with the previous question where the same number of respondents indicated that they work for large companies.



Graph 4: Experience as Project Manager

Graph 4 gives the respondents' years experience as project managers. None indicated that they have more than 20 years experience as project manager.

It is clear from the information above that the respondents are experienced project managers, as 78% of them have more than five years experience in projects management, graph 4.

From the information gathered in this study the conclusion can be drawn that one is dealing with a group of experienced project managers working for large companies and on big projects, which, for the purpose

of this study, can be classified as being representative of project managers in general.

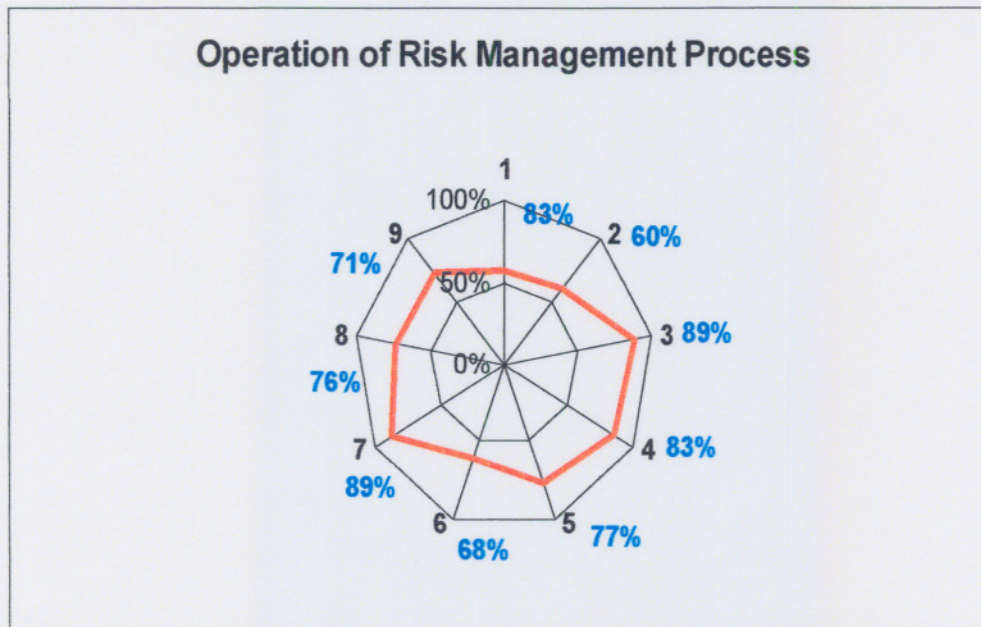
7.2.2 Findings from Section 2: Operation of Risk Management Process

In this section the following the following nine questions were asked:

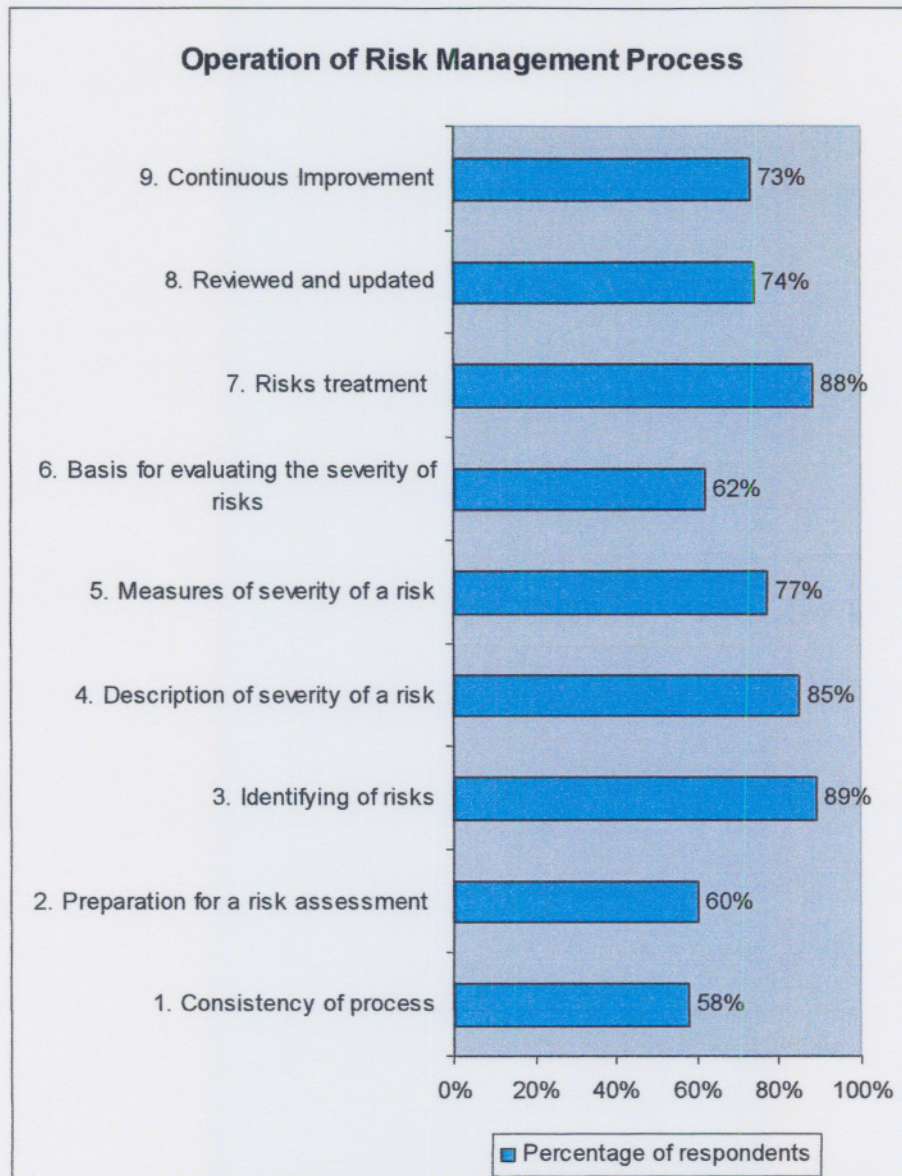
- 2.1 How consistent is the risk management process?
- 2.2 How much preparation is required for a risk assessment as it currently operates?
- 2.3 How are risks identified?
- 2.4 How do you describe the severity of a risk?
- 2.5 What measures do you use to describe the severity of a risk?
- 2.6 What is the basis for evaluating the severity of risks?
- 2.7 How are risks dealt with after being identified?
- 2.8 How often is the view of risks affecting an area of work reviewed and kept up to date?
- 2.9 How are those concerned with risk management in a particular area given opportunities to contribute and kept aware of developments?

The answer to these questions will not be given individually, but as a whole to illustrate how effective and efficient the process is being used. Graphs 5 and 6 give an overview of the responses. The average total positive rating is 74%, which is in itself

not bad, but there is definitive room for improvement, especially on question 1 where a rating of 58% was achieved, question 2 (60%) and finally question 6 with a figure of 68%.



Graph 5: Operation of Risk Management Process

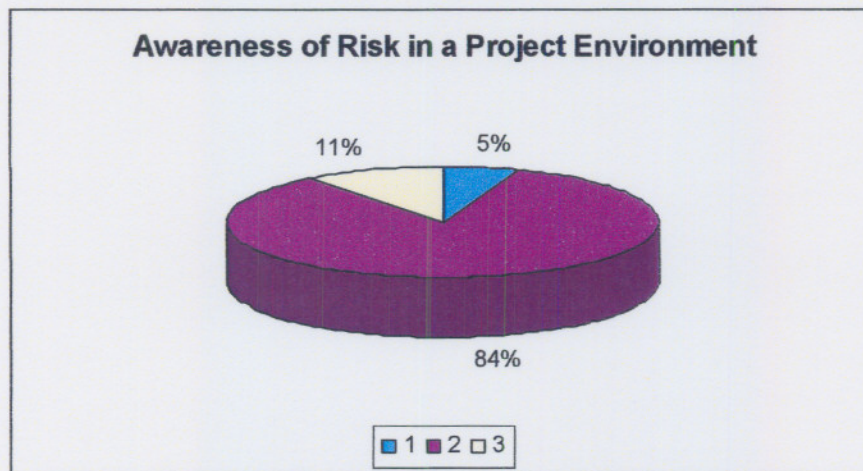


Graph 6: Operation of Risk Management Process

The conclusions that can be drawn from this information, is that there is room for improvement as far as the effective and efficient use of the risk management process is concerned. The recommendations will take this further in an effort to improve on this.

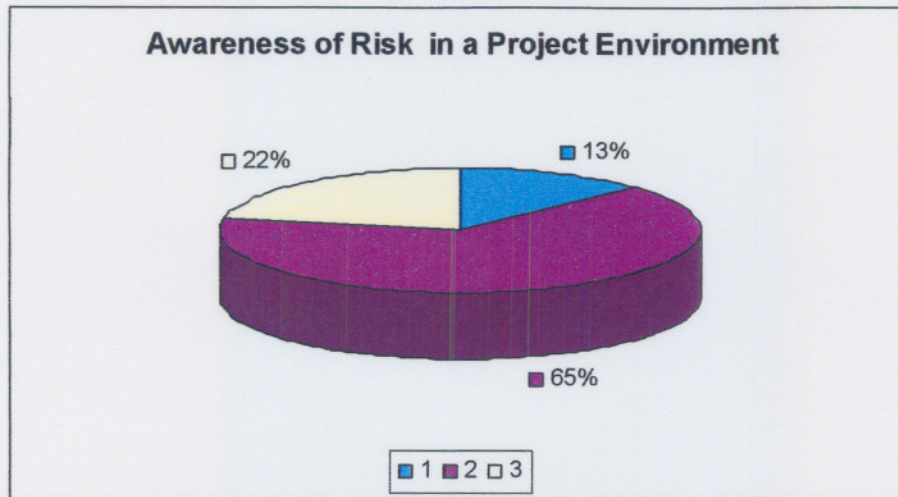
7.2.3 Findings from Section 3: Risk Information

In this section, see graph 7, it was found than only 5% of the respondents are not using risk management in their projects. The majority, 84%, is using risk management in their projects but there is room for improvement. The rest, 11%, accept that risk and risk management is important for the success of their projects and is making use of it.



Graph 7: Awareness of Risk in a Project Environment

In this section, which is a similar study conducted earlier by the author De Villiers (1999) (see graph 8), it was found than only 13% of the respondents are not using risk management in their projects. The majority, 65%, is using risk management in their projects but there is room for improvement. The rest, 22%, accept that risk and risk management is important for the success of their projects and are making use of it.



Graph 8: Previous Study: Awareness of Risk in a Project Environment

The conclusion from these results is in line with the findings in section two that the majority of the respondents are not making effective use of the risk management process when they manage their projects.

7.3 FINAL COMMENTS

Since it was concluded from this study that there is need for risk management systems in a project environment and that various risk categories exist, (refer to chapter 5), in this chapter the focus will be on the recommendations and also on how to implement these recommendations and that will be by way of different risk studies that were conducted in a well-managed project. A pilot project will be taken as the basis for explaining the possible studies that can be conducted in a project. It is important to notice that each project is unique, (refer to chapter 4), therefore it does not mean that all the risk assessment examples

that will be used in this chapter need to be carried out on other projects. The project team can decide to conduct more or fewer depending on the type or complexity or sensitivity of the project or the business.

Integrated Project Management Model

All organizations that are involved in project management should have an integrated approach toward managing their projects, see figure 49. This approach should address two key issues if managers and therefore businesses want to be successful, namely organization and people. This model starts with the organization's vision, mission and strategic objectives which form the basis for the existence of a project group or function. For the project group or function to achieve success, i.e. meet all project objectives time and time again the focus should be on the organization and people. On the organization side they should have proper systems in place that are at least based on the PMBOK (2000) nine knowledge areas. Furthermore, they should have governance in place to ensure that their project teams have support and guidance on the systems and that they are audited to ensure that the systems are functioning properly and that they are used correctly, and lastly that lessons learnt are captured and continuous improvement is achieved.

On the people side the focus should be on the selection of the correct project staff and to retain them, the compensation of the people is of paramount importance. And then lastly, the training of the staff

should enjoy high priority to ensure that a culture of success is established in the organization.

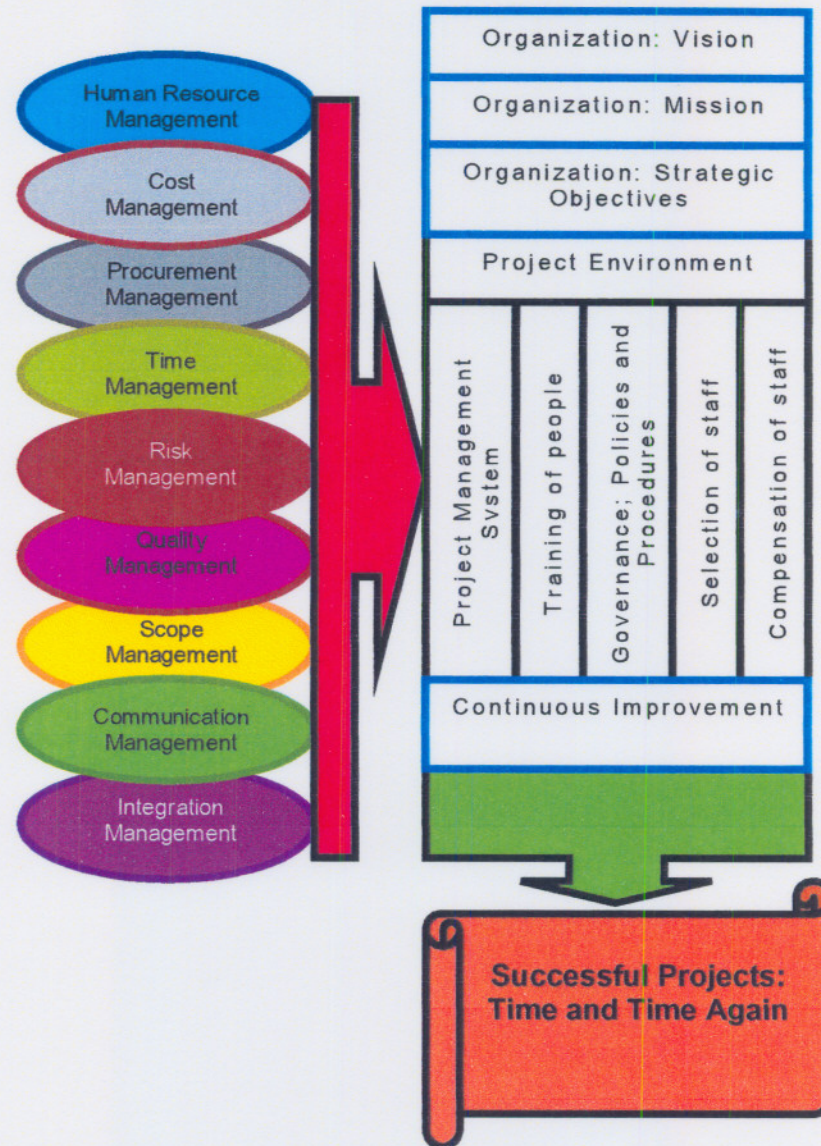


Figure 37: Integrated Project Management Model

7.4 CONCLUSION

In chapter three a theoretical overview of strategic management was given, in chapter four, project

management was explained, and in chapter five, risk management was discussed, with the emphasis on project management. In chapter six the results of the research were processed and discussed, and finally in chapter seven the findings and conclusions of these results were further discussed and recommendations are made in the next chapter.

What is clear from this study is that there is definitely a place for risk management in projects, and that there are opportunities for the development of risk management systems in a project environment.

CHAPTER 8: PRACTICES OF RISK MANAGEMENT

8.1 INTRODUCTION

Since it was concluded from this study that there is need for a risk management systems in a project environment and that various risk categories exist, (refer to chapter 5), in this chapter the focus will be on the different risk studies that were conducted in a well-managed project. A real project will be taken as the basis for explaining the possible studies that can be conducted in a project. It is important to notice that each project is unique, refer to chapter 4, therefore it does not mean that all the risk assessment examples that will be used in this chapter need to be carried out on other projects. The project team can decide to conduct more or less assessment depending on the type or complexity or sensitivity of the project or the business. Figure 38 gives an overview of the types of risk assessments that were carried out in the project.

All financial and confidential information used in the project was changed due the sensitivity that it has to the company where this project was conducted.

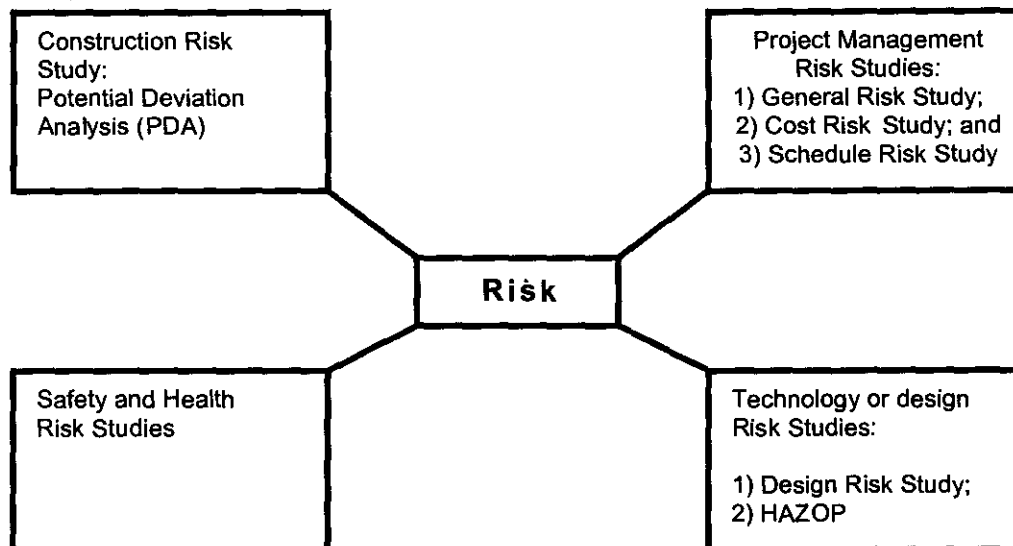


Figure 38: Types of Risk Assessments

8.2 PILOT PROJECT

8.2.1 Project Description

This chapter provides an overview of the proposed Gas Network Conversion Project. It firstly describes the existing distribution network, and then the process that Sasol Gas proposes to follow to convert the network from hydrogen-rich gas to natural gas.

8.2.2 Background and Context

Sasol Chemical Industries (SCI) and Sasol Synfuels Factory (SSF) use coal as a feedstock to produce hydrogen-rich gas. The hydrogen-rich gas which is currently used in the gas distribution network is

produced in Sasolburg. From Sasolburg, the gas is distributed by underground pipeline to users in Gauteng and from there to Secunda. The existing network was established during the 1960s.

Sasol distributes about 160 000 m_n³ of hydrogen-rich gas per hour to gas users. This is enough gas for 500 users such as other industries, hotels, restaurants and Egoli Gas. Egoli Gas operates its own network and supply some 13 000 domestic users in Johannesburg that use gas for cooking and heating. In order to supply these users with natural gas, instead of hydrogen-rich gas, the gas distribution network has to be changed over (converted).

8.2.3 Motivation for the Project

Sasol's motivation for the proposed Gas Network Conversion project is linked to the motivation for the overall project to bring natural gas to South Africa. The benefits that Sasol sees in the project are as follows:

- Natural gas has much lower amounts of sulphur than the coal which is used to make hydrogen-rich gas. This means that when the natural gas is used, there is less air pollution by substances such as sulphur dioxide and hydrogen sulphide.
- Natural gas will replace coal as the main energy source for the Sasol complex in Sasolburg.

- Natural gas has a higher heating value, meaning less volumes of natural gas are needed than hydrogen-rich gas to produce the same amount of heat. This will increase the storage capacity within the Sasol gas network pipelines, which will reduce supply disruptions to customers.
- It will allow more flexibility to Sasol since it is an additional raw material to support their current product range.
- Natural gas will enable Sasol Gas to claim an untapped market in the region, thus making Sasol the first company to explore this potential. Such a move is considered a strategic advantage for the company, with a positive impact on South Africa's economy. Sasol is one of the few industries in South Africa that adds significant value to raw materials by processing natural resources into end-use products.
- Mozambique will also benefit from this project since natural gas will become a significant export of the country, providing much-needed revenue to its weakened economy.
- This alternative energy will benefit the growth of the gas industry in Mozambique, which in turn will promote job opportunities for the region.
- Other benefits include various things, such as an alternative energy source for industrial and commercial developers.

- Municipalities and privatised gas distribution companies can utilise the Sasol Gas network to extend private use of gas in households.

8.2.4 Project Scope

The project scope comprises the following aspects:

- **Preparation work**

This work will be done by Sasol's engineers before converting the gas network from hydrogen-rich gas to natural gas. This covers an audit of the pipeline and customer's equipment and fitting of valves and meters.

- **Conversion process**

This process will be done over 12 weeks in 12 phases. Temporary vents will be installed. The temporary vents will be used to let out the hydrogen-rich gas from the underground pipe network, before filling them up with natural gas. Hydrogen-rich gas which is in the gas distribution network will be let out (vented) to the atmosphere, and the pipes will be filled up with natural gas. At the same time, Sasol's engineers will install new valves, meters and burner tips for its gas customers to ensure that equipment can handle natural gas. The 12 weeks programme excludes the conversion for Iscor and Egoli Gas.

- **Removing the temporary vents**

Once the network has been converted, there will no longer be a need for the temporary vents, and they will be removed.

- **Pipeline**

The design and construction of a hundred kilometre gas pipeline from Sasolburg to Johannesburg.

8.3 RISK ASSESSMENTS

As was stated above, the risk assessments that will be presented were carried out as per the risk categories as described in chapter 5 and the first in line will be the three project management risk studies. One will be a general risk assessment where all possible project risk are addressed and the other two will be a cost risk study and a schedule risk study; here a Monte Carlo simulation will be presented. Then a health and safety risk assessment will be discussed, after which two studies will be presented under the technology and design risk categories, followed by a potential deviation analysis that is categorized as a construction risk study.

8.3.1 Project Management Risk Studies

The first is a general risk study which was commissioned by the author on behalf of his employer for the project where he was the project manager and it was done by Meintjes (2003).

General Risk Study

Risk Assessment Methodology

The methodology used is based on the work of De Villiers (1999), not all steps were used and it was adapted to best fit this study.

The process will now be described in the appropriate steps:

- **Step 1: Identify Potential Risk Areas/Items**

Explore the entire project plans and look for areas of uncertainty and list them.

- **Step 2: Impact Analysis**

Take each area/item, which was identified in step 1, and assign the following to it:

- Probability of occurring
- Impact on the project
- The sensitivity to the project
- The category
- Calculate the risk ($\text{risk} = P \times I$)

- **Step 3: Response planning**

Once all the areas/items to address have been identified an action plan, responsible persons and a target completion date must be developed for each area/item, table 19 shows a typical action plan.

- **Step 4: Manage the resulting action plan**

After step 3 has been completed the project manager must ensure that all actions are completed or

reviewed to ensure that the intended risk profile for the project is achieved.

INTRODUCTION

With the introduction of natural gas to the Gauteng Network and Egoli Gas, the conversion of the latter customer is to be staged over an extended period. In the light of this it is necessary to supply Egoli Gas with hydrogen-rich gas for a period of time after the rest of the network has been converted to natural gas. During this time hydrogen-rich gas will initially be supplied, but will be substituted with an equivalent gas with a similar heating value and flame speed. The supply of hydrogen-rich gas will be from Sasolburg.

Timing of this project is critical and will be as follows:

- Construction contractor to be appointed at the end of November 2002.
- Construction commences mid January 2003.
- Completion of the pipeline and ready for commissioning by 15th December 2003.
- Sasol Egoli Pipeline ready for operation by 21st February 2004.

OBJECTIVE

Supply hydrogen-rich gas and then an equivalent gas with a similar heating value and flame speed to Egoli Gas for a period of 12 months at minimum cost.

RISK STUDY

A general risk study was undertaken with the above objective in mind. This began with a brainstorming exercise followed by an assessment of probability and impact for each item. A further analysis was done considering the sensitivity of issues as well. Thus, in some cases where the calculated risk was low, actions were still formulated because of the sensitivity of the issue. The outcome of the study is given in the table below.

ITEM No	RISK ITEM	C	P	I	R	S	POSSIBLE ACTION/SOLUTIONS	RESPONSIBLE PERSON
1	Servitudes : • Approval for construction • Conditions imposed by land owners • Shared servitude agreements	S.	0.15	80	12	H	1.1 Monitor SMRD on a regular basis.	J.V.
		S.C.	0.05	100	5	H	1.2 Monitor SMRD on a regular basis.	J.V.
		S.T.	0.2	80	16	M	1.3 Discuss conditions with servitude owners	P.V.
2	Completion date 15th December 2003	S.C.	0.2	60	12	M	2.1 When negotiating contract strive for optimum completion time.	
3	Dolomite Areas	T.C.S	1	60	60	H	3.1 Inform Sasol Gas about danger to existing pipe.	P.S.
							3.2 Investigate and design	J.V.
							3.3 Raise early warning	P.S.
4	Buoyancy of pipeline	T.	0.1	80	8	L		
5	Loss of key personnel	T.S.C	1	50	50	H	5.1 Key personnel should not travel together.	
							5.2 Submitting of deliverables at constant intervals.	
6	Water for the coolers	T.C.	0.1	80	8	L		
7	Availability of compressor (timing)	S.	0.5	60	30	M	7.1 Liaise with Adolf Wolmarans	P.F.
							7.2 Check buffer capacity at Cottesloe and Langlaagte	P.F.
8	Mechanical integrity of compressors	T	0.4	20	8	L		
9	EIA Approval	S.C	0.1	50	5	H	9.1 Constant monitoring of progress of DEAT by nature of business alliance	J.V.
10	River Crossing - License - DWAF	S.C.T	0.05	90	4.5	L	10.1 Submit detail report to DWAF and try and change requirement	P.V.
		T.C.	0.8	70	54	H		
11	Labour problems - internal/external	S.C.	0.5	70	35	M	11.1 Investigate incentives	D. d.V.

ITEM No	RISK ITEM	C	P	I	R	S	POSSIBLE ACTION/SOLUTIONS	RESPONSIBLE PERSON
							11.2	
12	Community problems	S.C.	1	40	40	H	12.1 Submit report with suggestions to minimise impact	I.G.
13	Cathodic Protection	T.	1	100	100	M	13.1 Appoint specialist design contractor	J.V.
14	Unknown Services	S.C.	1	20	20	M		
15	Tie-in around compressor	T.S.	0.1	40	4	L	15.1 Do tie-ins during December 2002	
16	Availability of free issue material	S	0.5	80	40	H	16.1 Procure in time 16.2 Include penalties in procurement contract	J.V./ R.P
17	Interface with SCI projects	T	0.2	20	4		17.1 Attend each other's meetings	
18	Public relations risk	S.C.	0.1	80	8		18.1 Keep public informed	D. d. V.
19	Partnering risk (local site contractor)	S.C.	0.9	40	36	M	19.1 Refer to 12	I.G.
20	Logistics	T.S.	0.1	60	6	L		
21	Informal settlements (new)	S.T.C	0.2	50	10	L		
22	Scope growth	C.S.	1	20	20	M	22.1 Finalise HAZOP studies 22.2 Freeze scope of work	P.F. P.F.
22	Scope growth	C.S.	1	20	20	M	22.3 Finalise HAZOP studies 22.4 Freeze scope of work	P.F. P.F.

ITEM No	RISK ITEM	C	P	I	R	S	POSSIBLE ACTION/SOLUTIONS	RESPONSIBLE PERSON
23	Risk study: MHI	T.C.	1	70	70	H	23.1 Include the requirements of Risk Study in final design	J.V.
24	Rock	T.C.	1	20	20	L		
25	Abnormal rainy season	S.C.	0.8	60	48	L		
26	Incorrect pipe sizing	T.C.S	0.8	100	80	H	26.1 Follow QA/QC procedures	J.V./ P.F.
27	3rd Party sabotage	C.S.	0.01	10	0.1	L		
28	Construction equipment sabotage	S	0.1	25	2.5	L		
29	Sizing of cooler	T.C.	0.1	80	8	L		
30	Pressure testing failure	S.C.	0.1	60	6	L	30.1 Follow QC procedures	

Table 19: General Risk Study

KEY: C = Category; P = Probability; I = Impact; R = Risk; S = Sensitivity

NOTES: Categories: S = Schedule; T= Technical; C = Cost

Sensitivity: L = Low; M = Medium; H = High

NEXT STEPS

The following two issues comprise the next steps:

- The project team is to continuously refer to the above risks and confirm that the issues are addressed.
- As new risks arise they are to be added to the list of risks.

Cost and Schedule Risk Studies

Now the other two project management risk studies will be presented; a cost risk study and a schedule risk study, for both these studies Monte Carlo simulations will be used, viz.

Risk Assessment Methodology

A project simulation model was used that translates the uncertainties specified at a detailed level into their potential impact on the costs and the schedule that are expressed at the level of the total project. The project simulation was performed using the Monte Carlo technique that is widely used by project managers and the like all over the world.

Continuous probability distributions are usually used in quantitative risk analysis. Distributions represent both probability and impact. Common distribution types include

the uniform, normal, triangular, beta and log normal. Two examples of these distributions are shown in Figure 39.

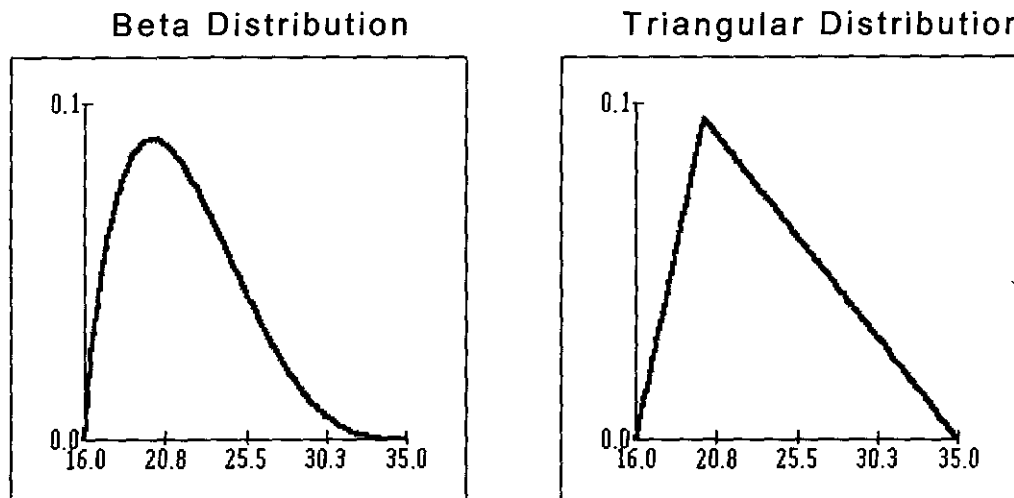


Figure 39: Examples of Commonly-used Probability Distributions

In both these simulations the triangular distribution was used where the low, the most likely and the high parameters for each cost item and milestone were defined.

The formulas used for calculating the mean and variance are:

- Mean = $(a + m + b)/3$ and
- Variance = $[(b - a)^2 + (m - a)(m - b)]/18$

The objective with both these simulations is to determine the probability of an overrun on firstly, the cost and secondly, the time. In both these cases fictitious figures

were used because of the sensitivity of the real information to the project owners.

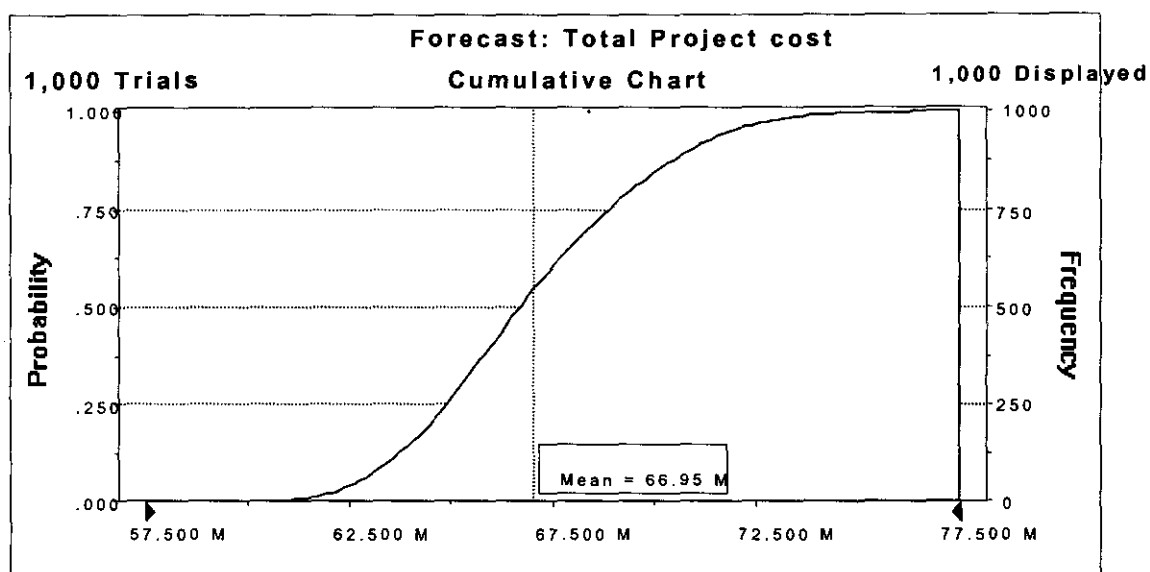
Natural Gas: Network Conversion Project					26-05-2003	
NB. Cost in millions of Rand						
Description	Low	Most likely	High	Mean	Sigma	Variance
	a	m	b	$\bar{x}$	σ	σ^2
MECHANICAL EQUIPMENT						
Info as per VGI estimate	23.40	26.0	29.90	26.4	1.3	1.8
In-house equipment	11.70	12.30	14.20	12.7	0.5	0.3
CONTRACTOR LABOUR						
Info as per VGI estimate	4.20	4.22	5.30	4.6	0.3	0.1
In-house equipment	0.46	0.49	0.63	0.5	0.0	0.0
Indirect field cost	0.16	0.17	0.20	0.2	0.0	0.0
ENGINEERING						
Outside engineering	6.60	7.30	8.70	7.5	0.4	0.2
Sastech	2.40	2.50	2.99	2.6	0.1	0.0
OTHER COST						
Pre-production	0.27	0.28	0.33	0.3	0.0	0.0
Spares	2.35	2.47	2.79	2.5	0.1	0.0
Insurance	0.82	0.87	0.90	0.9	0.0	0.0
Escalation	8.15	8.58	9.44	8.7	0.3	0.1
						↓
Totals for Project	60.51	65.18	75.38	67.0	3.1	2.4

Table 20: Project Budget

The cost simulation summary:

- Display Range is from 57 500 to 77 500 (R'000);
- Entire Range is from 59 899 559.5 to 76 896 568.3 (R'000); and

- After 1000 trials the Standard Error of the Mean is 101,904.6.



Graph 9: Cost Risk Simulation

The percentiles are as in table 21.

Percentile	R'000
0%	59 899 559.5
10%	62 919 820.8
20%	64 211 946.5
30%	65 138 936.1
40%	65 908 612.8
50%	66 949 352.2
60%	67 955 361.9
70%	68 903 244.0
80%	69 993 098.3
90%	71 319 590.1
100%	76 896 568.3

Table 21: Project Budget Percentiles

The information in table 20 forms the basis of this simulation and the total budget of the project is R 71 million; therefore, a possibility of 10% exists that the project will be overspent.

The simulation summary:

- Display Range is from 1600 to 2400 (days);
- Entire Range is from 1679.2 to 2400.2 (days); and
- After 1000 Trials, the Standard Error of the Mean is 4.0.

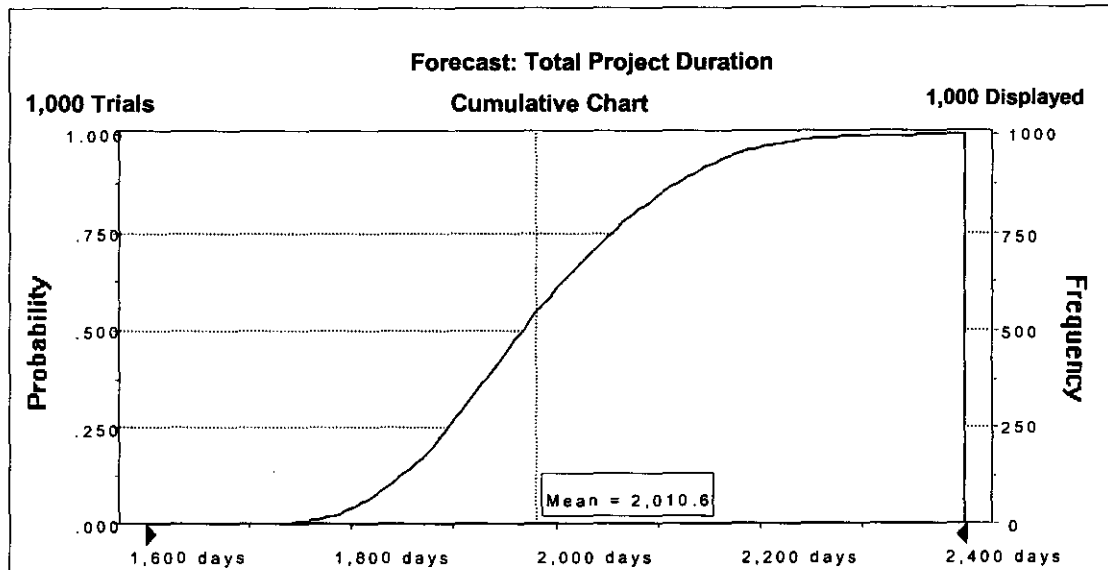
Natural Gas: Network Conversion Project

23-05-2003

NB. Milestones in days

Milestones	Low	Most likely	High	Mean	Sigma	Variance
	a	m	b	$\bar{x}$	σ	σ^2
Obtain final process package	25	30	40	31.7	3.1	9.7
Mechanical approval	6	10	13	9.7	1.4	2.1
Definition phase	170	200	220	196.7	10.3	105.6
Civil	90	100	120	103.3	6.2	38.9
Mechanical	90	100	120	103.3	6.2	38.9
Piping	100	120	130	116.7	6.2	38.9
Control Systems	90	100	120	103.3	6.2	38.9
Compile final quotation	7	10	12	9.7	1.0	1.1
Management Approval	6	10	12	9.3	1.2	1.6
Submit quotation to client	8	10	12	10.0	0.8	0.7
Client approval	48	50	60	52.7	2.6	6.9
Detail engineering	151	160	170	160.3	3.9	15.1
Procurement	280	312	350	314.0	14.3	204.7
Construction workshop	120	125	140	128.3	4.2	18.1
Pre-construction	53	60	70	61.0	3.5	12.2
Construction	95	100	110	101.7	3.1	9.7
Construction field	324	345	360	343.0	7.4	54.5
Pre-construction	35	40	50	41.7	3.1	9.7
Construction	234	250	260	248.0	5.4	28.7
Install long lead items	200	212	230	214.0	6.2	38.0
Ready for commissioning	3	5	8	5.3	1.0	1.1
Commissioning	6	10	12	9.3	1.2	1.6
Close out	3	5	7	5.0	0.8	0.7
Punch package distribution	3	5	7	5.0	0.8	0.7
As-built drawings in system	3	5	7	5.0	0.8	0.7
Post mortem	1	2	3	2.0	0.4	0.2
Final closure	1	2	3	2.0	0.4	0.2
Totals for Project		2378		2392.0	102.1	678.6

Table 22: Project Milestones



Graph 10: Schedule Risk Simulation

The percentiles are as in table 23.

Percentile	Days
0%	1 679.2
10%	1 845.9
20%	1 899.3
30%	1 940.8
40%	1 974.3
50%	2 010.6
60%	2 043.5
70%	2 076.5
80%	2 119.1
90%	2 180.1
100%	2 400.2

Table 23: Project Budget Percentiles

The information in table 22 forms the basis of this simulation and the total duration of the project is 2378

days; therefore, a possibility of 2% exists that the project will be late.

8.3.2 Health and Safety Risk Study

Now a health and safety risk study will be presented. This study was commissioned by the author on behalf of his employer for the project where he was the project manager and it was done by Stopforth (2003).

Risk assessment methodology

This risk assessment is done in accordance with the requirements of the Occupational Health and Safety Act of South Africa (Act No. 85 of 1993). The procedure is discussed below.

HEALTH AND SAFETY RISK ASSESSMENT

OBJECTIVE OF THIS DOCUMENT

Procedure for determining the approach for Safety and Health risks assessment. The following tasks are involved:

- Identification of issues that may have an impact on the people, project, legal and other requirements, construction or plants in the area.
- Proposals on methods to evaluate the risks on the construction site and surroundings, as well as possible mitigation methods.
- Develop a SHE plan, setting procedures and train personnel to prevent accidents and incidents.
- Determine the objective and targets.

PROJECT: **Natural Gas Network Conversion**

DATE: 4 April 2003

N o	HAZARDS	RISKS	ACTIONS/CONTROL MEASURES	RESPONSIBLE PERSON	DUE DATE	RECOMMENDATIONS
1.	LEGAL REQUIREMENTS	1. Job Stopped 2. Fines/Jail 3. Non-Conformances 4. Off Vendors List. 5. Criminal and civil liability.	1. Draw up a checklist for legal appointments. 2. Do legal appointment. 3. Need analysis on personnel & equipment to determine which legal requirements are applicable. 4. Notification to Department Labour. 5. Registered with COID Act. 6. Obtain copy of EIA & ROD from client. 7. Have copy of Act on site. 8. Training of employees. 9. Site establishment plan.	D Botes L Nel	Feed back by 11/04/2003	1. Site establishment plan to be approved by Managing contractor. 2. Check list for all equipment. 3. Keep copies of Department's notifications on site. 4. Keep copies of COID Act registration on site. 5. Lex Patria copy and contract. 6. Comply with all legislation. 7. Submit to VGI.
2.	CLIENT REQUIREMENTS	1. Non-Conformances 2. Job stopped 3. Off Vendors List	1. Obtained procedures / requirement from client. 2. Needs analysis to determine	D Botes L Nel	Feed back by 11/04/2003	1. Comply with requirements 2. Approve and co-ordinate

N o	HAZARDS	RISKS	ACTIONS/CONTROL MEASURES	RESPONSIBLE PERSON	DUE DATE	RECOMMENDATIONS
		4. Claims	requirements applicable. 3. Obtain transfer of responsibility. 4. Training of employees in client requirements. 5. Provide SHE plan and schedule.	H Fourie D Botes L Nel	11/04/2003 Feed back by 11/04/2003	SHE plan and schedule. 3. Submit to VGI.
3.	ADJACENT PLANTS / ENVIRONMENT/SERVICES (Water, Sewerage, Elect, Rand Water, Roads, Gas, Air products, Telkom, Petronet, Eskom)	1. Veld fire. 2. Heat Stroke. 3. Snakes/bees. 4. Drinking Water 5. Noise. 6. Unauthorised access to construction site. 7. Theft. 8. Public injuries / accidents.	1. Needs analysis with neighbours to determine risk. 2. Do risk assessment on existing risk. 3. Liasing with authorities. 4. Set up procedures and emergency plan. 5. Training of employees. 6. Security Procedure.	D Botes L Nel	Feed back by 11/04/2003	1. Implement procedures and emergency plans. 2. Submit to VGI.
4.	SITE ESTABLISHMENT AT WORK FRONT	1. Injuries 2. Damage 3. Time loss 4. Legal cost 5. Health problems 6. Strikes	1. Risk assessment to be done for site establishment (must include offices, workshops, equipment, personnel, tasks, eating/ablution facilities and transportation) - Alrode valve 35. - Power lines. - Taxi rank. - Klipriver valve 38. - Open veld. - Wadeville valve 33. - Slip way. - Barricading. - Wadeville valve 29/31. - Close road next to parking area. - Wadeville valve 26/27. - Access via veld. - Isando valve 22/23. - Fencing damaged.	D Botes L Nel	Feed back by 11/04/2003	1. Implement risk assessment. 2. Sign for right locations prior to hot-tap. 3. Keep strictly to method statement. 4. Submit to VGI.

N o	HAZARDS	RISKS	ACTIONS/CONTROL MEASURES	RESPONSIBLE PERSON	DUE DATE	RECOMMENDATIONS
			• Elandsfontein valve 24/25. 1. Almost in road. 2. Temporary fencing. 3. Pedestrians. 4. Traffic. • Benoni valve 43/44/45. 1. Heavy traffic. 2. Pedestrians. 3. Barricading. • Boksburg valve 20. 1. Robot and traces of vehicle accidents. 2. Visibility of traffic. • Vulcania valve 16/17. 1. Alpha Cement exit. • Springs valve 2/5/10/13. 1. Railway line. 2. Pedestrians. • Nigel pps tie-in. 1. High speed traffic. • Iscor tie-in 1. Railway line. 2. Method statement of work. 3. Determine the right location on pipelines / procedure. 4. Liasing with traffic department. 5. Warning / road signs. 6. Training of personnel.			
5.	CONTRACTOR/SUB- CONTRACTORS	1. Job stopped 2. Fines/Jail 3. Non-conformances 4. Off Vendors List 5. Claims	1. Kick off meeting held. 2. Agreement of requirements in contract. 3. Provide legal and client requirement. 4. Co-ordinate requirement compliance. 5. SHE-audits. 6. Approved SHE-plan and schedule.	D Botes L Nel	Feed back by 11/04/2003	1. SHE-Audit 2. Approve and co-ordinate SHE-schedule. 3. Submit to VGI.

N o	HAZARDS	RISKS	ACTIONS/CONTROL MEASURES	RESPONSIBLE PERSON	DUE DATE	RECOMMENDATIONS
			7. Provide SHE-plan and schedule. 8. Control all documentation.			
6	CHANGE, TOILET & EATING FACILITIES/MAIN CAMP	1. Fines. 2. Job stopped. 3. Non-conformance. 4. Off vendors list. 5. Strikes.	1. Comply with legal requirements and SABS standards.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
7	TRANSPORTATION	1. Fines 2. Accidents. 3. Off / Loading injuries. 4. Road Blockage 5. Damaged Roads	1. Roadworthy checks. 2. Planned routes. 3. Off / loading procedure. 4. Training. 5. Method Statement Transportation 6. Liasing with Traffic Department.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
8	ROAD / RAILWAY LINE CROSSINGS	1. Personnel run over. 2. Accidents	1. Procedure 2. Traffic and personnel control. 3. Signs. 4. Training. 5. Check way leave 6. Liasing with Authority.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
9	FIRE / ACCIDENTS / INCIDENTS / GAS LEAKS.	1. Injuries. 2. Traffic blockage. 3. Explosions.	1. Emergency plan. 2. Medical facilities. 3. First Aiders. 4. Certificates. 5. Training. 6. Communication. 7. Emergency equipment control. (Inspections) 8. Reporting System. 9. Appointed investigator. 10. Trained. 11. Investigation procedure.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
10	COMMUNICATION	1. Job stopped. 2. Damage. 3. Road accidents.	1. Communication structure. 2. Name list with contact details.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
11	ALCOHOL / DRUGS	1. Work injuries	1. Alcohol / drug policy.	D Botes	Feed back by	1. Submit to VGI.

N o	HAZARDS	RISKS	ACTIONS/CONTROL MEASURES	RESPONSIBLE PERSON	DUE DATE	RECOMMENDATIONS
		2. Unruly behaviour	2. Disciplinary procedure. 3. Awareness.	L Nel	11/04/2003	
12	RADIOGRAPHY WORK	1. Radiation 2. Theft	1. Procedure. 2. Control on site. 3. Standby. 4. Signs.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
13	PERSONNEL	1. Injuries 2. Unruly behaviour	1. Induction. 2. Personal protective equipment (PPE) 3. Training. 4. Disciplinary code	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
14	LIFTING EQUIPMENT & WORK.	1. Equipment failure. 2. Falling equipment.	1. Method statement. 2. Appointed person. 3. Trained. 4. Equipment checks and tests. 5. Documents available on site.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
15	TASKS	1. Injuries.	1. Risk assessments. 2. Written Safe work procedures. 3. Training. 4. Job observations. 5. PPE included. 6. PPE signs.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
16	STACKING AND STORAGE.	1. Collapsing. 2. Falling equipment.	1. Method Statement/ procedure.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
17	FLAMMABLE AND CONBUSTABLE LIQUIDES STORAGE	1. Pollution 2. Fire. 3. Explosions 4. Personnel exposure.	1. Bunded +10% 2. Emergency plan. 3. Fire protection. 4. Signs. 5. Pollution prevention / procedure. Hygiene surveys.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.
18	SMOKING	1. Fire 2. Explosions	1. Smoking policy / procedure. 2. Signs.	D Botes L Nel	Feed back by 11/04/2003	1. Submit to VGI.

Table 24: Health and Safety Risk Assessment

8.3.3 Technology and Design Risk Studies

The first will be a design risk study followed by a Hazard and Operability Study which is a design and safety study.

A Design Risk Study

Now only the executive summary of the design risk study will be given because of the sensitivity of the content of the business conducting the project. This study was commissioned by the author on behalf of his employer for the project where he was the project manager and it was done by McConnell (2003).

Risk Assessment Methodology

The methodology used in this assessment has replicated that applied by the UK Health & Safety Executive in their recent re-assessment of natural gas transmission pipelines for Land Use Planning zones in the UK. The method has a degree of conservatism included in it, while being able to realistically model major incidents which have occurred elsewhere, mainly in the USA.

Failure rate data has been derived from the 43 leak incidents which have occurred on the Gauteng high pressure (HP) network, 13 of which caused by external interference have an equivalent circular hole diameter greater than of 25 mm and are therefore classified as "punctures" with hole diameter 50 mm. No ruptures have been reported, so data from a much larger gas

pipeline population, the European Gas Pipeline Incident Data Group (EGIG) was used to obtain an estimate of puncture failure rate.

The total Gauteng pipeline "exposure" is 13 973 kilometre-years (i.e. a total of 567 kilometres in operation for an average of 24.6 years). For the EGIG rupture failure rate of 0.055 ruptures per 1000 kilometre-years for a 12" diameter pipeline, the number of punctures expected for the whole system over the past 25 years would be 1.3, whereas none have been recorded.

The assessment has examined 3 hole sizes, based on the actual experience of the Gauteng system, these being:-

- Puncture - equivalent to 50 mm hole size
- Rupture - equivalent to pipeline diameter
- Guillotine - equivalent to 2 open ends = $1.41 \times$ pipeline diameter

Frequencies of failure for each pipe diameter have been derived from Gauteng data for punctures and EGIG data for Ruptures and Guillotine failures. Sub-categories of failures for corrosion, mechanical defect, natural causes (ground movement) and others have been taken from EGIG data.

Release rates have been derived from conventional sharp-edge orifice calculations for HP gas using a discharge coefficient of 0.6. Die-off of the release rate

has been calculated using the reduction in inventory for the whole network for larger pipeline diameters. The volume of the whole network from the Nigel letdown station is calculated to be 50 495 m³ containing a total of 1424 tons of gas.

Consequence analysis following the release of gas has been applied using the approach derived for HSE's MISHAP 98 computer code. Three possible outcomes from a release of gas are assumed:-

- Immediate ignition causing a fireball - 25%
- Delayed ignition causing a jet fire - 25%
- No ignition - 50%

The fireball quantity has been calculated using the correlation derived by HSE based on experimental work carried out in the past. From this the size of the fireball is calculated, and the surface emission power of 270 Kilowatts per square metre assumed from the flame surface. From this the thermal radiation level at various distances is calculated using an atmospheric humidity of 50%. For fireball effects, the level of fatal injuries in the open air is assumed to occur to a level of 1000 tdu (thermal dose units = [thermal radiation level] to the power 4/3, multiplied by fireball duration in seconds). This is equivalent to the Dangerous dose concept used for HSE assessments.

The jet-fire effects have been calculated by calculating the size of the jet flame at the release rate after 30 seconds, and taking a surface emissive power of 270

KW/m², and then calculating the distance to the thermal radiation level of 12.5 KW/m² for fatal injury effects.

Both calculations have been calibrated against published results from the HSE methodology, and calculation methods and spreadsheets have been checked by Dr Alan King.

To obtain the Individual Risk Transects, the effect distances have been used to obtain the interaction distance from any given section of pipeline which could affect an individual at varying distances from the pipeline. Each of the risks for the six possible harmful outcomes of a release:

- puncture fireball
- puncture jet-fire
- rupture fireball
- rupture jet-fire
- guillotine fireball
- guillotine jet-fire

Have been computed and summed at various distances from the pipeline to give the total Individual Risk Transects. Risk Transects represent Individual Risk to persons next to the pipeline assuming they are in the open air for 100% of the time.

The F-N curves have been obtained by calculating the number of people who would be killed for any given section of pipeline. As presented in the DNV report, the standard length of pipeline used is 1 kilometre, but for

the risk "hot spots", the actual length of pipeline which presents a risk within a township has been used. In addition, a total F-N curve has been calculated for the whole Gauteng network.

The risk criteria adopted for assessing the F-N curves have been drawn from a UK study of hazardous transport operations carried out 15 years ago. These criteria take into account the unusual nature of distributed assets such as pipelines which present a low risk to any given individual (measured as Individual Risk), but do present a significant risk of an accident which could affect a large number of people.

Such an accident could have very damaging effects on Sasol's reputation and share price, by creating bad national and international headlines.

Executive Summary

Sasol Gas are planning to convert the Gauteng HP Gas network to natural gas, starting in late 2003, and continuing into 2004. An initial QRA Screening study was carried out by DNV and results presented in September 2002. It was apparent that a large number of people could be killed by a major rupture of the HP gas system, especially risk "hot spots" where high density population lives in sub-standard housing in unofficial townships on or near the pipeline.

This study has considered the risks in depth using methodology used by the UK Regulatory Authorities. It confirms that large numbers of people could be

affected, and analyses the detailed mechanisms for pipeline failures, along with the operating experience of the network since it started operating in 1966. The effects of a major incident killing 100+ people is likely to have national and international repercussions which could have a serious impact on Sasol's future operations.

This report provides an analysis of the safeguards which must be in place to prevent such an incident, and to minimise the risk to Sasol.

The change from hydrogen-rich gas (HRG) to natural gas (methane) is unlikely to change the risk (i.e. frequency) of a release incident, but it does increase the potential impact of an incident for two reasons – large natural gas releases are more likely to cause a high thermal radiation fireball than HRG, and the thermal radiation from a methane jet flame is approximately 3 times greater than from HRG. The fireball scenario can have widespread effects – for instance, the fireball from guillotine rupture of a 12" pipeline has a fireball diameter of 100 metres and lethal effects diameter 230 metres.

The Basis for Safe Operation depends on two main factors:-

- Ensuring that the integrity of the steel pipeline in the ground remains fit-for-purpose.
- Taking adequate measures to ensure that the risk of external interference is minimised.

Pipeline integrity is under the control of Sasol Gas whereas external interference is less controllable. Integrity control is covered in a separate report presented by Mr P Jones of Pipeline Integrity Engineers. It recommends measures to ensure that the pipeline does not corrode, does not have defects in the metal or in welds, and is not overstressed or overpressurised. Part of the requirement is the need to monitor for deterioration of the pipeline, rather than allowing leaks to occur before taking action.

A total of 19 corrosion leaks have occurred over the past 36 years, the largest of which was 15 mm equivalent circular hole diameter. Two mechanical defect leaks were recorded, the larger of which was greater than 50 mm diameter.

External interference poses the greatest threat because of the potential for a very large release. Twenty one leaks have been caused by external interference, the largest of which was 77 mm equivalent circular hole diameter. No pipeline ruptures (i.e. equivalent to pipeline diameter or larger) have occurred.

A number of measures are required to prevent external interference incidents:

Route HP pipelines away from populated areas wherever possible:

- Also where possible, develop future expansion of the system using "Distribution" gas systems (i.e. LP pressure below 7 bar) rather than "Transmission" systems (HP system above 7 bar).

- Bury the pipeline at depth greater than 1 metre.
- Minimise the stress levels in the pipeline by operating at lowest possible operating pressures, and having thicker pipe wall – pipe wall thickness has the greatest effect on resisting external interference impact effects.
- Avoid areas of unstable land, mine workings, sink holes – strengthen pipe where known hazards exist.
- Carry out regular surveillance of the pipeline routes using helicopter, road patrols and on foot, the frequency to be determined by the level of risk and potential impact of an incident. This is to try to detect digging operations before they reach the pipeline.
- Prevent new developments, especially housing estates, within the Land Use Planning Zones adjacent to the pipelines:

Pipe diameter	Inner zone based on risk	Outer Zone Based on risk
4 inch	10 metres	30 metres
6 inch	10	40
8 inch	10	55
12 inch	10	70
24 inch	10 (*35)	130
30 inch	10 (*45)	140

* Building Proximity Distance from UK Code IG/TD/1

Table 25: Recommended Land Use Planning Zones

Notes on table 23:

- Within servitude – allow no housing development;
- Within inner zone – allow no future development, stabilise and minimise existing development;
- Within outer zone – no more than 6 houses (30 people) within any circle of Outer Zone Radius from the pipeline, stabilise existing developments;
- Land Use Planning is an evolutionary process, which has only been applied within the last 10-15 years in the UK; and
- For existing risk “hot spots” consider special measures including mitigation methods such as more frequent surveillance, slabbing and marker tape to reduce the risk. The effects of these are calculated in the QRA in this report. Develop longer term plans for some “hot spots” where the pipeline integrity cannot be monitored.

Hazard and Operability Study (HAZOP)

This study was commissioned by the author on behalf of his employer for the project where he was the project manager and it was done by Scoltz (2003).

HAZOP Methodology

According to Kletz (1997) a hazard and operability (HAZOP) study is the method recommended for

identifying hazards and problems which prevent efficient operation of a plant.

HAZOP is a technique which provides opportunity for people to let their imagination go free and think of all possible ways in which hazards or operating problems might arise, but to reduce the chance that something is missed. It is done in a systematic way, each pipeline and each sort of hazard is considered in turn. The study is carried out by a team so that the members can stimulate each other and build upon each other's ideas.

HAZOP Study

- **Scope**

Natural Gas heaters to prevent condensation after pressure in pipeline has been reduced.

- **Documentation**

MFD supplied, as well as drawings of existing system.

- **Summary of risks**

Failure of heating is acceptable for 24 hours - filter sized to hold up this volume of condensate after low level alarm (LAH) is activated. Maintenance risk is high if tubes fail and work is done as previously on live equipment. Lastly, it is unacceptable and should be omitted.

- **Process**

Drawing 1 was used as the basis of the process that was under scrutiny and table 24 is the check list with all the questions that were asked during the study. Table 8.6 is the result or the risk register with the Item under investigation, the description of the Possible Cause(s), the potential consequences, the safeguards provided in the design, the recommendations and finally the responsible person who must ensure that the recommendations are implemented.

HAZOP NODES AND HAZARD CHECKLIST									
Project Title:				Date:19/05/2003					
Drawing Number		GC33VG664-1000-A3-0117							
NODE i.e. Number and/or Description of Equipment/Line/Path/Sub-system/Etc.		Nigel PRS heater							
Problem? Tick Yes / No. If yes – complete HAZOP Noting Form		Design Data *	No	Yes	Ref.No	Design Data *	No	Yes	Ref. No
POTENTIAL DEVIATIONS									
No flow	---	X			---				
* Less flow		X							
* More flow/velocity		X							
Reverse flow	---		X		---				
Two phase flow	---	X			---				
Flow other than design intent	---	X			---				
* More pressure		X							
* Less pressure		X							
* More vacuum		X							
* Less vacuum		X							
* More temperature			X						
* Less temperature		X							
* More warm up/cool down rate		X							
* More level		X							
* Less/No level		X							
* Change composition		X							
Contamination/impurities	---	X			---				
Runaway reaction	---	X			---				
Unwanted reaction	---	X			---				
POTENTIAL HAZARDS									
Freezing	---	X			---				
Explosive/Flammable mixtures	---	X			---				
Fire (internal/external)	---	X			---				
Pollution	---	X			---				
*Excess noise		X							
Erosion/corrosion	---	X			---				
Vibration	---	X			---				
Sudden stoppage	---	X			---				
Start-up/shutdown	---	X			---				
Static accumulation/lightning	---	X			---				
Failure mode valves	---	X			---				
Isolation/purging/inerting	---	X			---				
Cleaning/loading/unloading	---	X			---				
Other	---	X			---				

Table 26: HAZOP Nodes and Hazard Checklist

Ref. #	Item #/ Description	Deviation/ Hazard	Possible Cause(s)	Potential Consequences	Safeguards Provided	Recommendations	BY
1	Heater	Reverse Flow	Heating elements can short circuit causing a meltdown of heater exchanger tube	Gas leak to atmosphere	High ampere reading to heater	Install high pressure alarm on dome of heat exchanger. Maintenance should only be done when equipment is out of commission - operating and maintenance instructions should include this.	VGI
2	Filter	Less Flow	Filter element blocks up	Oil and dust	PDAH 001 & LAH 001	None	NA
3	Heater	High Temperature	Low gas flow, no gas flow	Overheating of equipment	TAHH-003	Trip should be locally reset by operations team.	VGI
4	Heater	Low temperature	TT-004 fails	Heating elements fail and no energy input into gas stream	None	TT-004 should fail to low in order to ensure continuous energy input.	VGI
5	Filter	High Level	LT-001 is not accurately set and auditing can't take place	Inaccurate calibration	None	Install local level glass and ensure maintenance instructions include frequent scheduled inspections.	VGI

Table 27: HAZOP Actions

8.3.4 Construction Risk Study

A construction study will now be presented, viz.

A Potential Deviation Analysis

This study was facilitated by the author on behalf of his employer for the project where he was the project manager, De Villiers (2003).

Risk Assessment Methodology

The method that will be used is the Potential Deviation Analysis developed by Productivity Development (PTY) LTD.

AGENDA

- Objective Statement;
- Approach and Planning;
- Assumptions and Decisions List;
- Identify Critical Areas;
- Potential Deviations;
- Preventative Actions; and
- Contingency Actions.

OBJECTIVE STATEMENT

Ensure smooth transition / Change over to new distributed control system (DCS) system without disturbance of plant production and interruptions to clients.

APPROACH AND PLANNING

Approach

- Indications will be changed over while plant on line with a duration of two (2) days; and
- Change unit E502 over first while unit E501 is on line with a duration of two (2) days; and
- Change unit E501 over first while unit E501 is still off line with duration of two (2) days.

Planning

- The target starting date will be determined after section 1100 has been changed over.
- A detail plant per loop will be developed, see point 3.3 below.

ASSUMPTIONS AND DECISIONS LIST

- No maintenance of field instruments during change over;
- Plant does not restart without signed ready for operations (RFO) documentation;
- All contractual, maintenance and operations change instructions through SASOL Technology;
- A Log Book to be available in the control room where possible changes are to be logged for review and possible implementation; and
- Daily plan/do/review meetings will be held in the plant conference room at 16:00.

CRITICAL AREAS

The following areas were identified as the most critical:

- Detail planning;
- The availability of the second bus on the DCS is highly critical for section 5000 and a decision to change over will be taken after section 1100 has been changed.

NB. The rest of the critical areas as in table below.

CRITICAL AREA	POTENTIAL DEVIATION	PREVENTATIVE ACTION	CONTINGENCY ACTION	RESP.	TCD
1. Resources					
1.1 Maintenance	1.1 Non-availability	1.1 Inform J Roets that he must be available.	1.1 If J Roets is not available G Boonzaier will stand in.	G Boonzaier	12/04/2003
1.2 Operations	1.2.1 Non-availability 1.2.2 Not trained	1.2.1 Inform K Snyman and Shift Process Controller that they must be available. 1.2.2 Make a set of MFDs available and familiarise Process Controllers with the changed system.	1.2.1 If K Snyman is not available M Arnolds or Y Balipersad will stand in. 1.2.2 Fall back on K Snyman and Shift Process Controller.	M Arnolds/ Y Balipersad	12/04/2003
1.3 SASOL Technology	1.3 Non-availability			M Arnolds/ Y Balipersad	
1.4 YOKOGAWA	1.4 Non-availability			D de Villiers	
1.5 PROCONICS	1.5 Non-availability		1.3 D de Villiers to get stand ins if T Pelser, K Budhai or R Humphries not available.		
1.6 VICOTEC	1.6 Non-availability	1.3 T Pelser, K Budhai and R Humphries to be available. 1.4 Get name of person that will be on standby. 1.5 Get name of person that will be on standby. 1.6 Three teams required	1.4 Get stand ins. 1.5 Get stand ins. 1.6 Stop change over.	D de Villiers D de Villiers D de Villiers	12/04/2003 12/04/2003 12/04/2003
2. Safety					
2.1 Permits for tie-ins	2.1.1 Leaks on plant and can't make safe. 2.1.2 Standby not available	2.1.1 None 2.1.2 Plan	2.1.1 Don't change over until repairs have been done. 2.1.2 None	G Boonzaier	
3. Pre-work					
3.1 Air supply to instruments	3.1 Not done	3.1 Plan and implement.	3.1 None	D de Villiers	12/04/2003
3.2 Modifications on level transmitters	3.2 Excessive time for modifications.	3.2.1 Ensure spare is available 3.2.2 Do one before change over.	3.2 Stop change over. 3.3 None	D de Villiers J van Niekerk	12/04/2003 12/04/2003
3.3 Detail planning	3.3 Not done	3.3 Develop detail plan with input from all relevant parties,			

CRITICAL AREA	POTENTIAL DEVIATION	PREVENTATIVE ACTION	CONTINGENCY ACTION	RESP.	TCD
		e.g. process, maintenance and contractors.			
4. Communication					
4.1 Radios	4.1.1 Not available	4.1.1-4 Make arrangements with Vicotec to supply radios.	4.1-4 Make arrangements with Infrachem (J Lombard) to supply radios.	G Boonzaier	12/04/2003
4.2 Changes	4.1.2 Overloaded	4.2 Don't make changes without formally approved.	4.2 Inform all parties involved and make a logbook available in the control room for logging of any changes requested.	D de Villiers/ T Manne	12/04/2003
	4.1.3 Flat batteries				
	4.1.4 Not enough spare batteries				
	4.2 Changes implemented without considering all venues.				
5. DCS System					
5.1 Hardware	5.1.1 Hardware failure	5.1.1 Yokogawa to provide start up spares.	5.1.1 Use sections 1200 and 3800s cards.	D de Villiers	12/04/2003
5.2 Software	5.1.2 Spares not available	5.1.2 Ditto.	5.1.2 None.	D de Villiers	12/04/2003
	5.1.3 Bus connector not repaired.	5.1.3 Card ordered.	5.1.3Yokogawa to expedite.	G Boonzaier	12/04/2003
	5. 2.1 Incorrect programming.	5.2.1 Yokogawa to be on standby.	5.2.2 Fix during change over.	J van Niekerk	12/04/2003
	5.2.2 No back-ups	5.2.2 Make back-ups.		G Boonzaier	12/04/2003
6. Field Equipment					
6.1 Control valves	6.1 Internal faults.	6.1 Pre-warn GP Controls.	6.1 Fix during change over.	G Boonzaier	12/04/2003
6.2 Transmitters	6.2.1 Problems with existing displacers.	6.2.1 Check level transmitters.	6.2.1 Do dry calibration during change over.	G Boonzaier	12/04/2003
6.3 Spares	6.2.2 Faulty thermocouples	6.2.2 Test all thermocouples.	6.2.2 Ensure that spares are available.	G Boonzaier	12/04/2003
6.4 Plant not available	6.2.3 Calibration errors	6.2.3 Check calibration during loops checks.	6.2.3 Re-calibrate during change over.	J van Niekerk	12/04/2003
	6.2.4 Faulty transmitters	6.2.4 Check during loops			

CRITICAL AREA	POTENTIAL DEVIATION	PREVENTATIVE ACTION	CONTINGENCY ACTION	RESP.	TCD
	6.2.5 Faulty Current-to-pressure converters (I/P). 6.3 Not available 6.4 Production pressures.	checks. 6.2.5 Check during loops checks. 6.3 Ensure that spares are available.	6.2.4 Replace during change over. 6.2.5 Replace during change over. 6.3 None.		

Table 28: Potential Deviation Analysis

8.4 CONCLUSIONS

As was mentioned above, it is extremely important that project managers take a holistic view on risk management in their projects if they want to be successful. In figure 40, which represents a cause and effect diagram it is shown how the effective and efficient management of the risks can have a positive effect on the project. On the other side, if risk is not properly managed by systematic iterative processes it can have negative effects on the project.

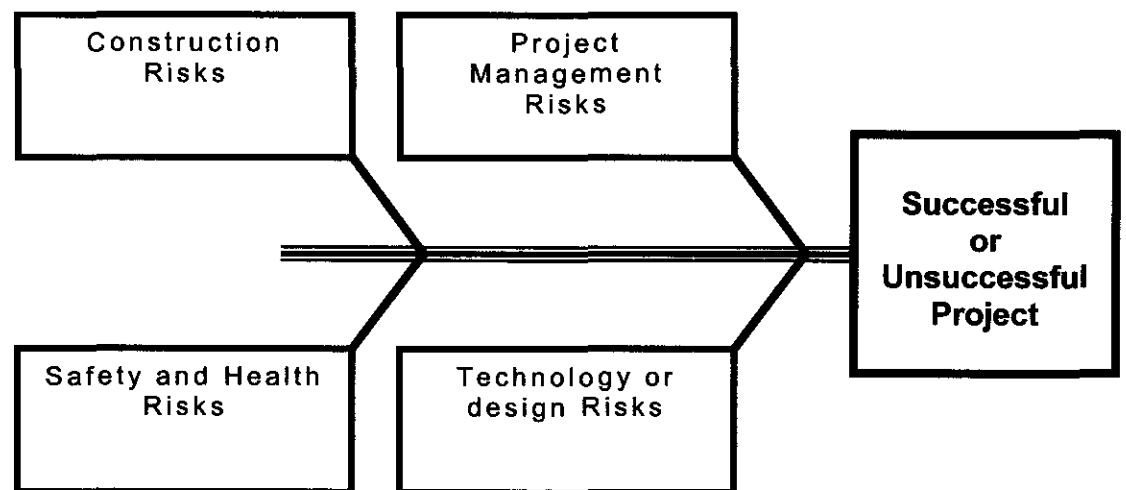


Figure 40: Causes and effect of Risk Management

It is also important to ensure that it does not matter how many risk studies are done; it must be ensured that at the end only one risk register exists which is managed to the end. This will ensure that all actions are addressed by the responsible person or persons

on a timely basis and that the process is repeated as and when required.

This then conclude this chapter and the next chapter will be the last, which will be a summary of each chapter. This will assist future reading and will also help the reader to find a subject of interest quickly.

CHAPTER 9: STUDY OVERVIEW AND FINAL CONCLUSIONS

9.1 INTRODUCTION

This work will be evaluated in terms of the objectives as were set out in chapter one. The contribution of this dissertation will be discussed and final recommendations will also be highlighted, followed by possible future study opportunities and overall conclusions.

9.2 OVERVIEW OF THE STUDY

The work done in this study is based on three dimensions as in figure 41, viz. theory, research and practices. The theory or literature is addressed in chapters 3, 4 and 5. Chapters 6 and 7 give the results and findings of the research. The whole of chapter 8 is dedicated to the practice dimension where four different risk studies were given.

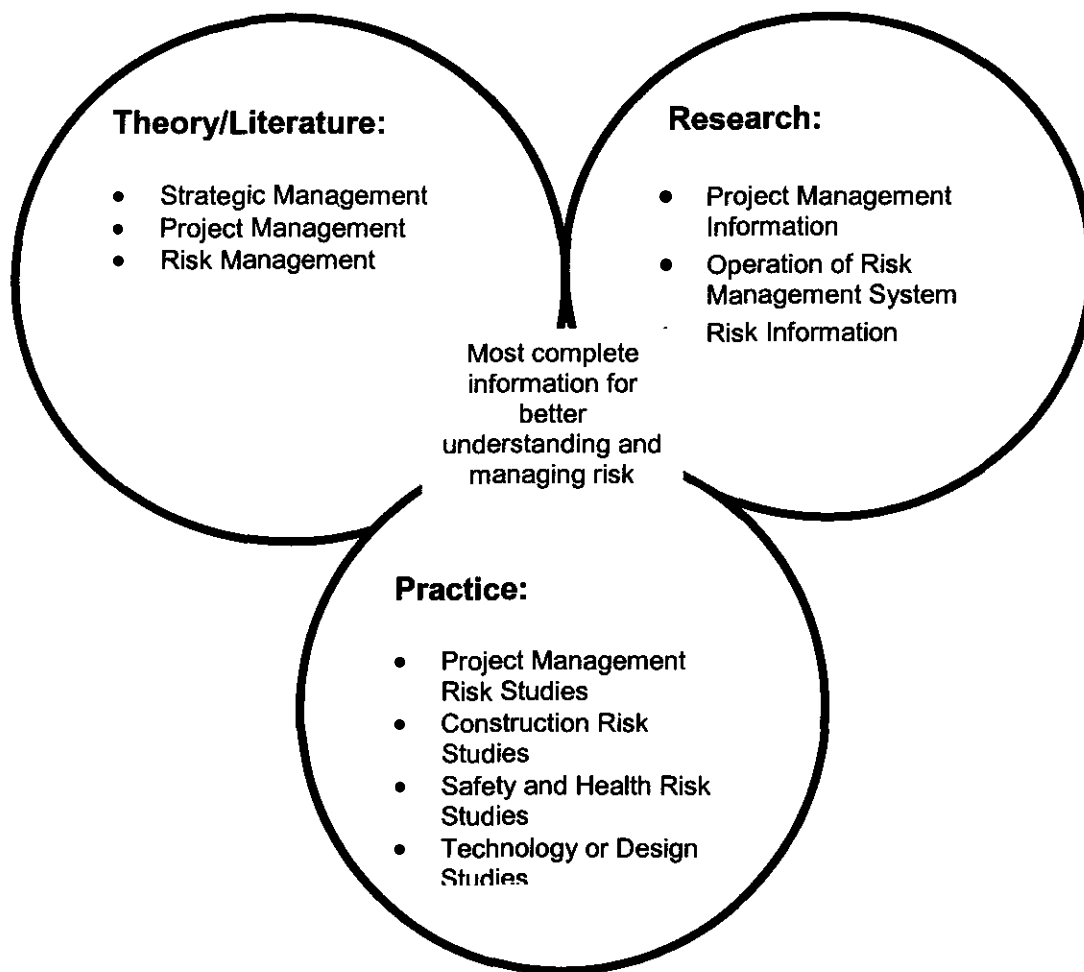


Figure 41: Combination of Theory, Research and Practices Model

9.3 EVALUATION OF THE STUDY

Introduction

The study will be evaluated in terms of the objective as was stated in chapter one and is given again for the purpose of evaluation:

- To determine what the literature says about strategic, project and risk management;
- To establish if project managers use project risk management systems;
- To determine the maturity level of organizations in terms of risk management in capital projects;
- To give practical risk studies that can be used as examples by project teams in future; and
- To recommend a model for the improvement of the maturity level of organizations in terms of project management in general and risk management in particular when they implement their goals through projects.

Evaluation

The first objective, namely literature review on strategic, project and risk management, was achieved because in the opinion of the writer a comprehensive review on these three subjects was undertaken as can be read in chapters three, four and five.

Objective two, project managers' use of project risk management systems, was determined and is given in chapters six and seven.

Determining the maturity level of organizations in terms of risk management in capital projects, which is the third objective, was addressed by chapters six and seven.

The fourth objective of practical risk studies is addressed where a whole chapter was dedicated to this, namely chapter eight.

Lastly, objective five is the research recommendation and was achieved and can be read in chapter seven.

Conclusions

It can be concluded that all objectives for this study that were set out in chapter one were achieved.

9.4 CONTRIBUTION OF THE STUDY

The contribution of this study will be given in terms of the model as adapted from Kreitner and Kinicki (2001:17) for this study where they state that a combination of theory, research and practice forms the basis for learning, improvement and contribution to the body of knowledge of the subject under study. This will then be done under the three headings, theory, research and practices.

Theory

Chapter 3, 4 and 5 form the basis of the theory where the literature on the subjects of strategic, project and risk management were explored in order to determine the current status and trends of these subjects. In the opinion of the author of this dissertation current models were adapted or improved upon. Furthermore, the importance of

aligning the organizational strategic objectives with the project's objectives and then making use of risk management to ensure success in the implementation of these objectives was put in context with this work.

Research

The research made a contribution in identifying the weaknesses and gaps that exist in the risk management processes and risk application in projects. And the recommendation stemming out of these weaknesses and gaps might help to ensure future success when organizations implement their objectives through projects.

Practices

By giving studies which were undertaken in a real project an attempt was made to illustrate how these studies are done in practice and how these can then be used as examples for other project teams.

Conclusion

In the opinion of the writer a contribution to the body of knowledge of project management in general and in particular towards risk management, was made through the theoretical, research and practical work of this study.

9.5 RECOMMENDATIONS

The following recommendations are made based on the literature work, the research conducted and the practical examples used in this study:

- That all companies or businesses that are involved in projects should adopt an integrated project management model to establish a sound project management culture, where not only risk is addressed, but also all nine knowledge areas of the project management body of knowledge, as depicted in figure 37;
- That in all projects managed by business should at an early stage of the project life-cycle use an overall risk management process to ensure that all possible risks are identified and managed; and
- That at the planning stage all possible risk studies that will be undertaken will be identified and become part of the overall risk strategy and be incorporated in the project execution plan.

9.6 FUTURE STUDY OPPORTUNITIES

In chapter 4 it is stated by Mantel (2000:1) that the past several decades have been marked by rapid growth in project management. Gray and Larson (2000:3) say that ...now project management is spreading to all avenues of

work. Today project teams carry out everything from post expansions to hospital restructuring to upgrading information systems.

Taken this as basis one can say that a contribution can be made towards the body of knowledge of project management if one takes any of the nine knowledge areas as per the PMBOK (2000) and apply literature, research and practical work to it.

9.7 OVERALL CONCLUSIONS

Chapter one gave the nature and scope of the study, where the problem was identified and defined, followed by the objective of this work and the research methodology that was used. This was followed by chapter two, where the research objectives and approach were described.

The next three chapters, three, four and five make up the theoretical work on the subjects of strategic, project and risk management.

The research work is given in chapters six and seven where a detailed analysis of the results, findings and conclusions was done.

Chapter eight was dedicated to the practical work that consists of various risk studies that were undertaken in a real project that can be used in future by other project teams.

Finally, a brief review of the study that facilitates the reading of the study and that gives the evaluation, contribution and recommendations of the study was given. Possible future study opportunities conclude this work.

The research questionnaire is given as appendix 1. Then a presentation on this study was given by the author at the Operations Research Society of South Africa National Conference 2003, on the 8th September 2003 and can be found as appendix 2. Thereafter a summary of this work in the chapters is presented as appendix 3 to highlight important findings.

Then an article on this dissertation was extracted and a few magazines were approached for possibly publishing the article that is found at the end of this work, appendix 4.

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APPENDIX 1

RESEARCH QUESTIONNAIRE

PO BOX 4959
VANDERBIJLPARK
1900

Tel: 016-982-2119 (H)
016-969-4393 (W)

1 August 2002

SUBJECT: RESEARCH WORK - RISK MANAGEMENT IN A PROJECT ENVIRONMENT

I, D de Villiers, am currently enrolled at the PU for CHE as a PhD student. For this course, a dissertation needs to be submitted, and research work will be undertaken.

I have decided to use Risk as a topic and have chosen project management organization for research purposes due to the nature of this dissertation. The title of my study is *Risk in a Project Environment*.

This questionnaire measures the maturity level of the organizations in terms of risk management in a project environment. You have been selected to complete the questionnaire because I believe you can help me with this research.

As only a limited number of questionnaires are being distributed, it is important that you respond to each question. If you do not know the precise answer to a question, please respond with your "best guess."

This questionnaire has been designed to be filled out quickly and easily. The results of this survey will **only** be used for the purpose as mentioned above.

Please return the questionnaire within fifteen days. If you require any further information please contact me on one of the above telephone numbers or on e-mail daan.devilliers@sasol.com.

I thank you for your participation in this research.

Thank you.

D de Villiers

Questionnaire

SECTION 1: BACKGROUND INFORMATION

1.1 Type of organization

Choose the most appropriate



Commercial private sector business



Public sector organization operating commercial practices



Traditional public sector



Charity or Not-for-Profit



Other

Please specify

1.2 Sector(s)

Choose the most appropriate



Government



Services



Manufacturing



Mining and resources



Utilities



Communication



Other

Please specify

1.3 Main area of application of risk management

Tick any that apply

☐ Projects

☐ Environmental assessments

☐ Safety assessments

☐ Technical assessments

☐ Investment or capital evaluation

☐ Cost and schedule estimation

☐ Business operations

☐ Portfolio management

☐ Trading

☐ Credit management

☐ Insurance

☐ Other

Please specify

1.4 Number of employees
Choose the most appropriate

☐ <10

☐ 10-100

☐ 100-1000

☐ >1000

1.5 What is the average monetary value of projects undertaken by you?
Choose the most appropriate

☐ Less than R500 000

☐ R 500 000-1 000 000

☐ R 1 000 000-10 000 000

☐ R 10 000 000-100 000 000

☐ Over R 100 000 000

1.6 How many years of experience do you have in Project Management?
Choose the most appropriate

☐ Less than 5 years

☐ 6 - 10 years

☐ 11 - 15 years

☐ 16 - 20 years

☐ 20 years and more

SECTION 2: OPERATION OF THE RISK MANAGEMENT PROCESS

2.1 How consistent is the risk management process?

Choose the most appropriate



All risk management follows the process definition identified earlier



The process is not formally documented but it is understood and consistently applied



There is no formal process but broadly the same outputs are generated by all our assessments



Each risk assessment is set up independently according to the wishes of the initiator

2.2 How much preparation is required for a risk assessment as it currently operates?

Choose the most appropriate



So long as the participants are familiar with the work, very little at all



A briefing on the work being assessed prior to considering the risks it faces



Preparation of a brief detailing scope of work, stakeholders and risk evaluation criteria

2.3 How are risks identified?

Tick any that apply



Against various standard categories e.g. Commercial, Technical, Programme ...



Using checklists of known risks



A meeting



A call for contributions by mail, e-mail or similar means



Free brainstorming – no structure



Structured brainstorming – using prompts

☐ Other Please specify

2.4 How do you describe the severity of a risk?

Choose the most appropriate

☐ In words
☐ With a qualitative scale such as (High/Medium/Low), (0-10) or (A, B, C, D)
☐ With a quantitative likelihood and an impact or consequence measure for each risk
☐ With a probability and a monetary value that are multiplied together to give a risk value
☐ Other Please specify

2.5 What measures do you use to describe the severity of a risk?

Tick any that apply

☐ Financial measures
☐ Timing or schedule measures
☐ Performance or throughput measures
☐ Quality measures
☐ Environmental impacts
☐ Safety criteria

☐ Others
Please specify

2.6 What is the basis for evaluating the severity of risks?

Choose the most appropriate

☐ The judgement of those doing the assessment

☐ Scales drawn up for each case

☐ An internally defined set of scales used for all assessments

☐ An externally defined set of scales used for all assessments

☐ Others
Please specify

2.7 How are risks dealt with after being identified?

Choose the most appropriate

☐ They are handed over to the persons responsible for the work to use as they see fit

☐ Each risk is allocated to a department or function for treatment

☐ Each risk is allocated to a named individual for treatment

☐ They are prioritised and the most severe are allocated to a department or function for treatment

☐ They are prioritised and the most severe are allocated to a named individual for treatment

☐ Other
Please specify



2.8 How often is the view of risks affecting an area of work reviewed and kept up to date?

Choose the most appropriate

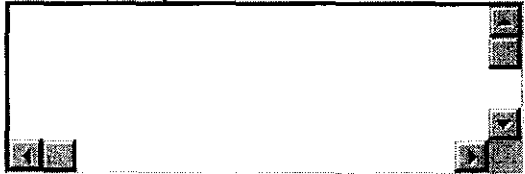
☐ It is not usually reviewed once it has been established

☐ Whenever there has been a major upheaval

☐ On a regular basis defined for each case

☐ On a regular basis set by an organizational practice

☐ Other
Please specify



2.9 How are those concerned with risk management in a particular area given opportunities to contribute and kept aware of developments?

Choose the most appropriate

☒ Everyone with a stake in a project or business activity is expected to take part in identifying, evaluating and dealing with risks and given the opportunity to do so

☐ Process documentation, such as the context definition and workshop output, is circulated to all who could be concerned

☐ We expect that anyone who identifies a risk or who is able to contribute to dealing with one will take the initiative and make this known

☐ Most communication about risks and risk management is informal

☐ It is not uncommon to find that people who should have been involved in the process are excluded or overlooked

SECTION 3: RISK INFORMATION

Please answer the following questions on the given scale.

	Never	Sometimes	Always		
3.1 Your project team discusses risk at your project meetings.	1 	2 	3 	4 	5
3.2 Your project team reports on major decisions referring to risks in those decisions.	1 	2 	3 	4 	5
3.3 You as the Project Manager consult with a risk manager on all your projects.	1 	2 	3 	4 	5
3.4 Risk management is a subject for discussion at you Steering Committee and Board.	1 	2 	3 	4 	5
3.5 Your project team attends workshops (either in-house or public conferences) on risk management practices.	1 	2 	3 	4 	5
3.6 Your project team is faced with many surprising difficulties.	1 	2 	3 	4 	5
3.7 When one decision turns out poorly, the project team learns from it.	1 	2 	3 	4 	5
3.8 Your project team is provided with tools needed to assess risk	1 	2 	3 	4 	5
3.9 Risk management is supported within your company.	1 	2 	3 	4 	5
3.10 Risk management results are part of your project team's performance rating.	1 	2 	3 	4 	5

RISK MANAGEMENT IN A PROJECT ENVIRONMENT

D de Villiers & P Pretorius
08/09/2003
ORSSA

Contents of Presentation

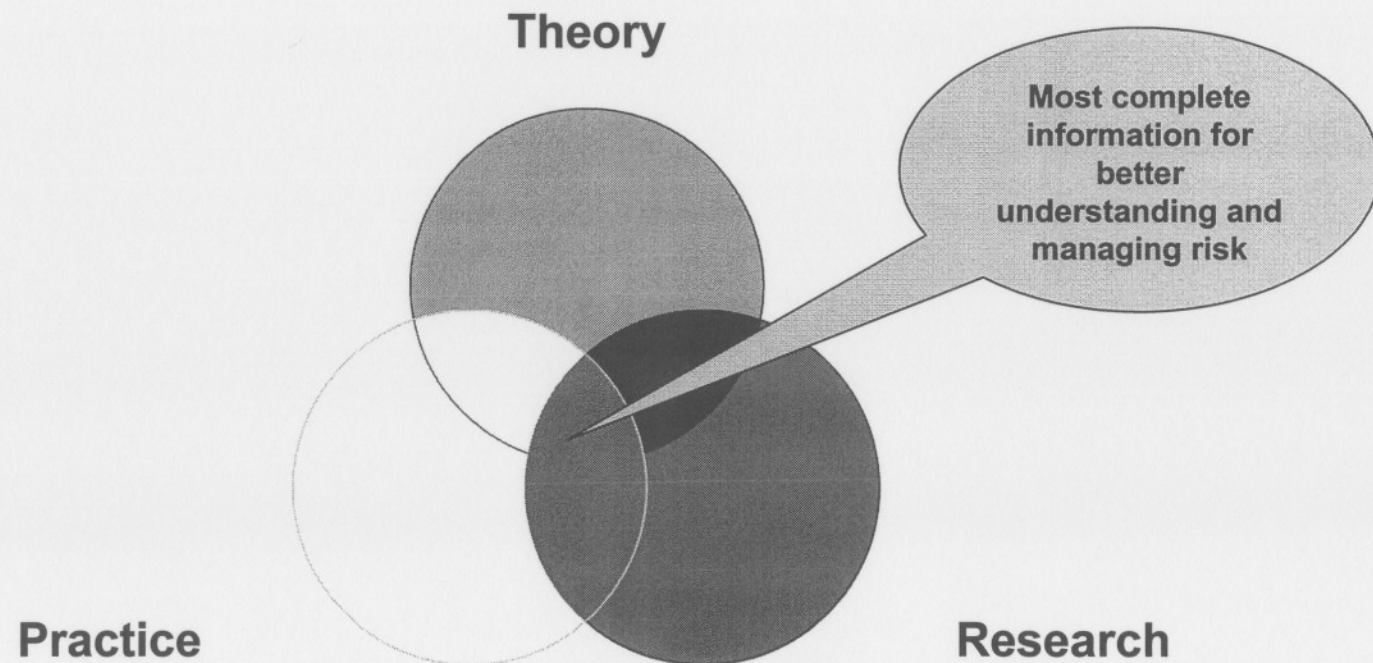
- Objectives of Study
- Study Approach
- References
- Theory/Literature
- Practice
- Research
- Conclusions
- Recommendation

Objectives of Study

- To determine what the literature says about strategic, project and risk management
- Determine the maturity level of organizations in terms of risk management in capital projects
- Establish if project managers use project risk management systems
- Give practical risk studies that can be used as examples by project teams in future

Study Approach

Contributing to the body of knowledge of risk management through a combination of theory, research and practice



Source: Adapted from Kreitner and Kinicki (2001:17)

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- **BYARS, L.L., RUE, L.W. & ZAHRA, S.A. 1996.** Strategic Management. Chicago:Irwin.
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Theory/Literature...

- Strategy

- Definition
- Process

- Project Management

- Definition
- Life-cycle
- Maturity Model
- Competencies

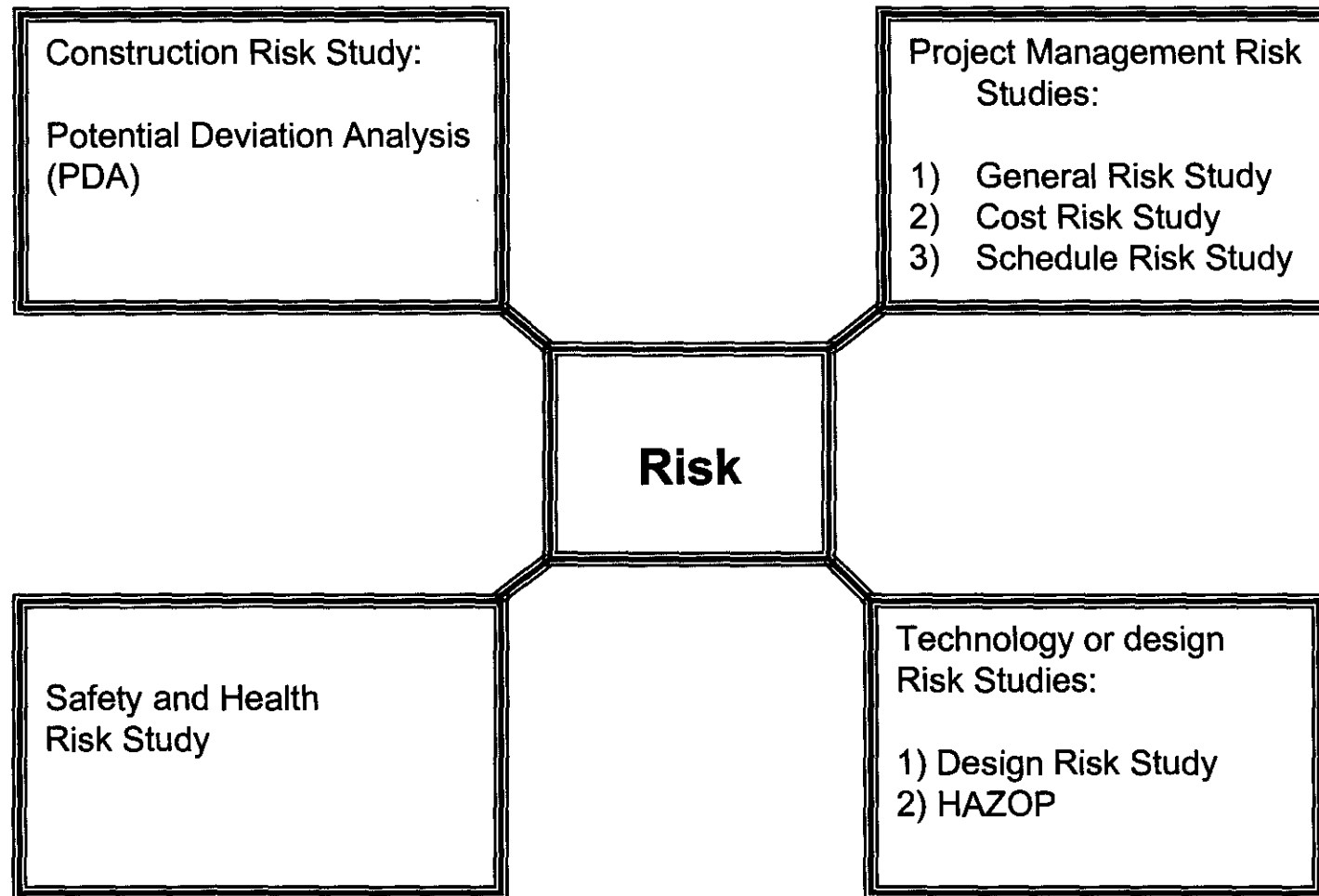
...Theory/Literature

- Risk Management

- Definition
- Process
- Tools and Techniques
- Maturity Model
- Competencies

Practice

Types of Risk Assessments:



Research - Methodology

- **Questionnaire: Send, Interviews and Audits**
 - Section 1: Background Information
 - Section 2: Operation of the Risk Management Process
 - Section 3: Risk Information

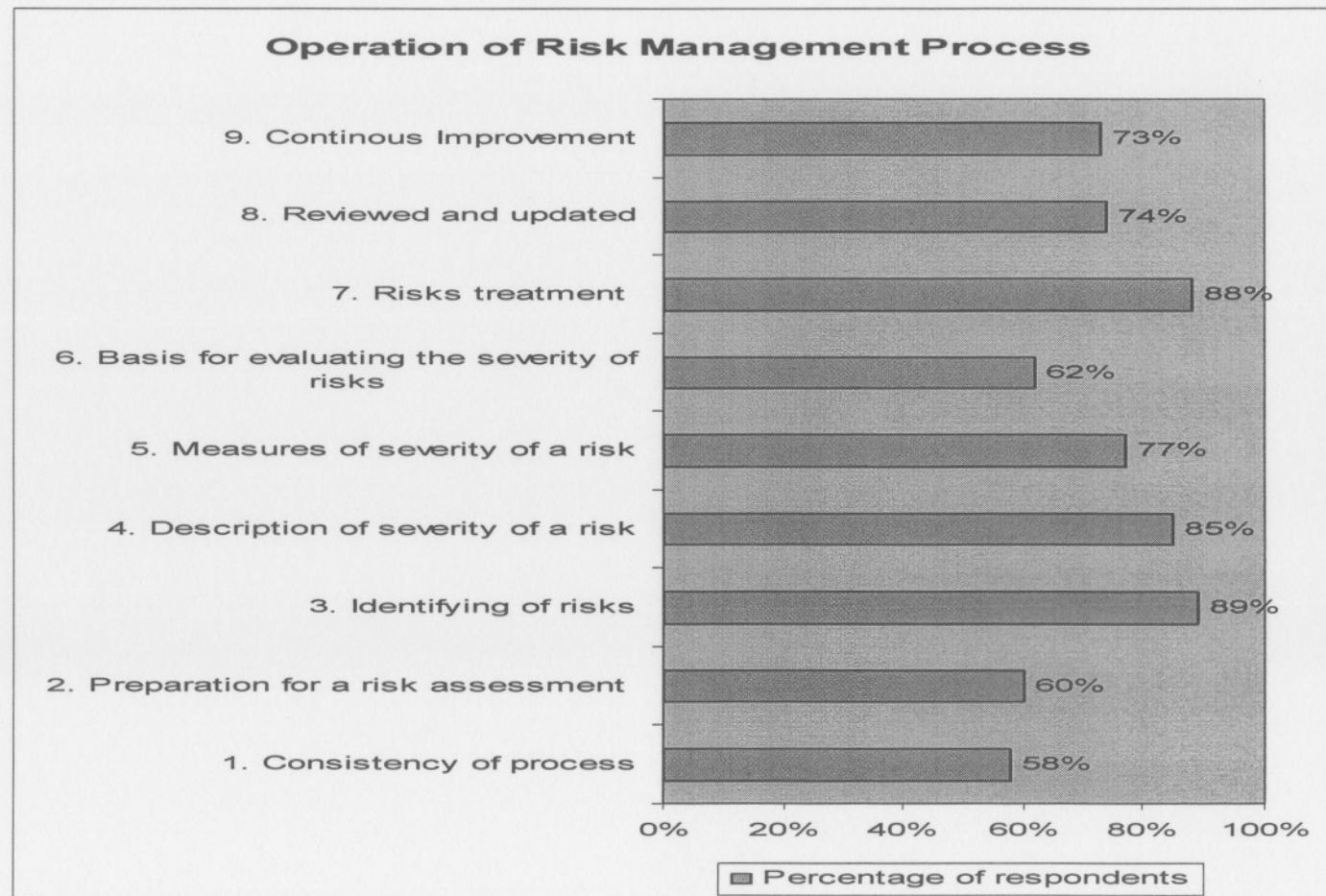
Research – Results...

- **Following findings came to the fore: -
Section 1:**

- **48%** of the respondents are working for **big companies** with more than **1000 employees**.
- **45%** manage big project with a monetary value of more than **R100 million**.
- **78%** of them have more then **five years experience** in project management.

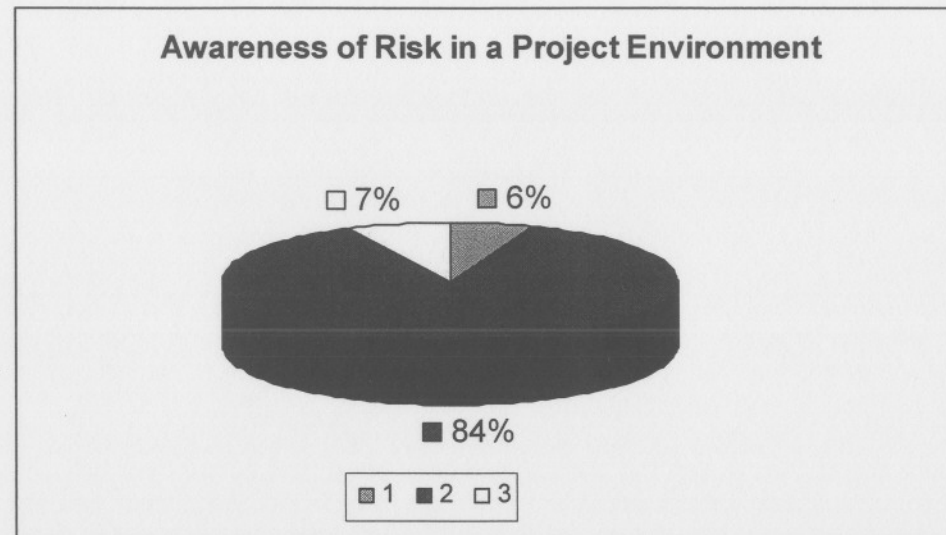
...Research – Results...

Section 2: Average 74%



...Research – Results

Section 3:



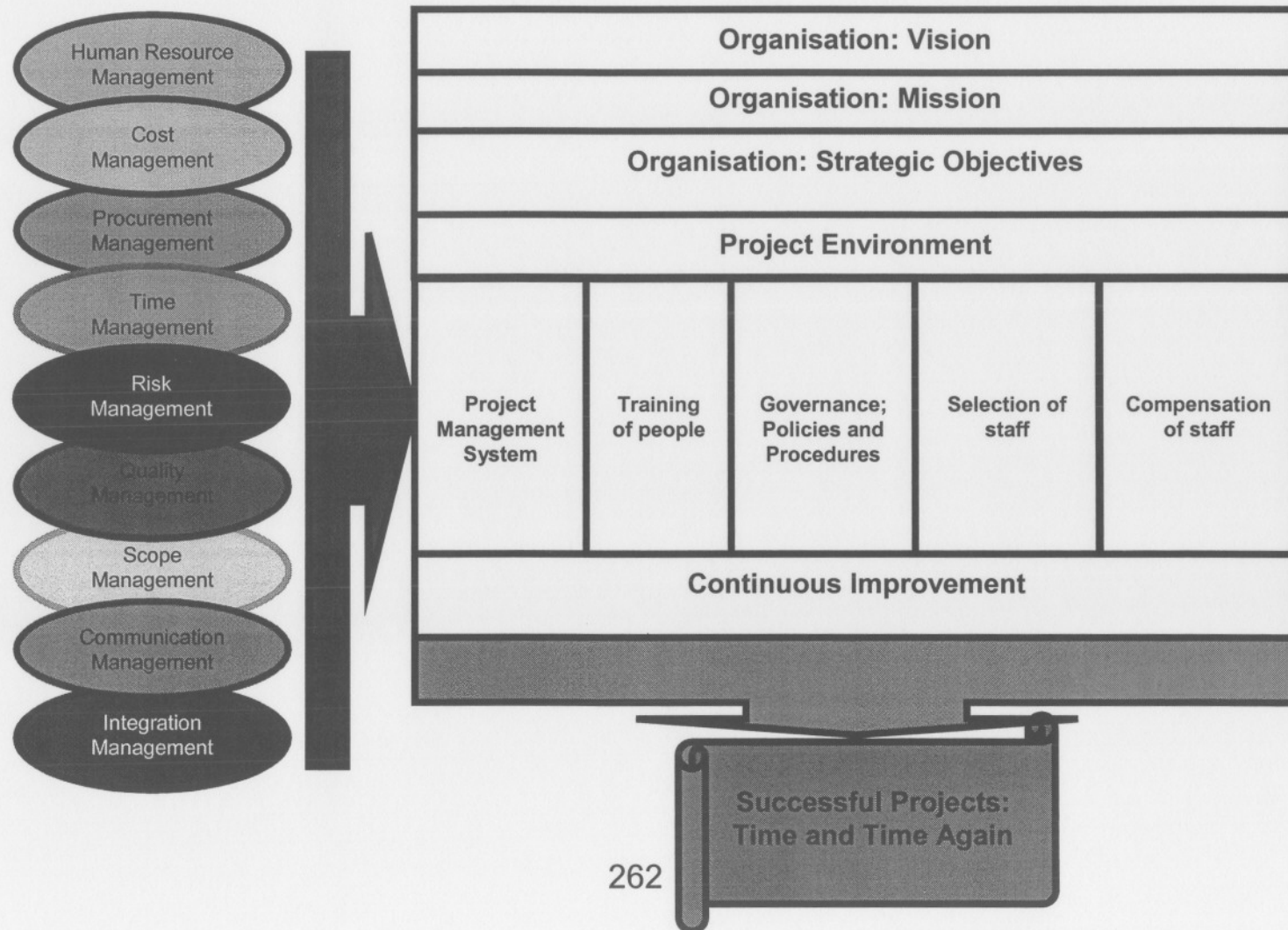
- 6% of the respondents are **not** using risk management in their projects.
- The majority, **84%**, is using risk management in their projects but there is **room for improvement**.
- 7%, accept that **risk and risk management is important for the success** of their projects and are **making use of it**.

Conclusions

- The **first objective** namely **literature review on strategic, project and risk management** was achieved because a comprehensive review on these three subjects was undertaken.
- Determining the **maturity level of organizations** in terms of risk management in capital projects, which is the second objective, was addressed by section 2 of the research work.
- **Objective three**, project managers use **project risk management systems**, was determined by section 3.
- The **fourth objective** of **practical risk studies** was addressed.

Recommendation

Integrated Project Management Model



Any questions?

APPENDIX 3

SUMMARY OF STUDY

Chapter 1: Nature and Scope of Study

Introduction

This study will be conducted in one of the nine knowledge areas of project management, namely risk management, in an attempt to make a contribution to the body of knowledge of project management.

Problem Identification and Definition

Pennypacker & Grant (2003) conducted a benchmark exercise on the maturity level (this is discussed extensively in chapter 4) of organizations as far as project management is concerned. Graph 1 gives the findings of the results. They find that a clear majority of respondents indicated their organizations are relatively immature in terms of the project management maturity model.

Nearly 67% of respondents indicated that their organizations were operating at level 1 – initial processes (13.7%) or at level 2 – structured process and standards (53.2%). While a notable portion of respondents indicated their organizations had reached level 3 – organizational standards and institutionalized process (19.4%), a mere 7.3% indicated their organizations were operating at level 4 – managed process and only 6.5% assessed their organizations as having achieved level 5 – optimizing process.

These results suggest that organizations still have a long way to go to be at an acceptable level to achieve success time and time again.

If these results hold true for project management as was discussed in a literature review on project management in chapter 4, one can deduce that this is relevant for risk management in a project environment.

The purpose of this dissertation is to conduct a literature review on strategic, project and risk management, an empirical research on the status of risk management maturity of organizations in the management of projects and practices of risk management. Strategy because it is why organizations exist, project management due to it being the how of implementing the strategy, and risk management because is one of the best ways of ensuring success when organizations implement their strategies through capital projects. Research was done due to it being a good way of finding out what is done on the subject under investigation in the field of use. And

then practices because this is the ideal vehicle for learning and observing how it is done in real terms.

Objective of Dissertation

The objective of this study is to do a theoretical and an empirical investigation answering the following questions:

- To determine what the literature says about strategies, project management and risk management;
- To establish if project managers use project risk management systems;
- To determine the maturity level of organizations in terms of risk management in capital projects;
- To give practical risk studies that can be used as examples by project teams in future; and
- To recommend a model for the improvement of the maturity level of rganizations in terms of project management in general and risk management in particular when they implement their goals through projects.

Defining the Scope of the Study

The target population of the empirical research is business leaders and project managers implementing capital projects in South Africa. They represent a wide spectrum of industries and institutions, therefore it can be said that the results should be applicable to all types of capital projects.

The theoretical research covered strategic management and project management as a way of implementing organization's strategic goals and objectives.

The risk and risk management theoretical research covered most aspects of a project and will largely be applicable to any project.

The practices of risk management are in the form of risk studies conducted in a large capital project.

Research Methodology

The dissertation focuses on selected available literature regarding strategic management, project management, risk and risk management. The available literature is in the form of books, articles and the internet. The following research methods are used in the study:

- Theoretical research is conducted in order to first establish what normative project and risk management models are available and then secondly, by using this information, to set the scene or environment for the research on project and risk management.
- A questionnaire which was developed was sent to business and project managers in organizations in South Africa that are involved in the implementation of capital projects. The questionnaire is subdivided into three sections, the first section concerning background information, section two is about application of risk

management and section three covers the awareness of risk by project teams.

Layout of the Study

The study consists of nine chapters; the first two give the nature of the study and research objectives. Chapters three, four and five are a literature review on strategic, project and risk management. The results, conclusion and findings of the study are given in chapters six and seven. In chapter eight consists of practice of risk management in projects and finally in this chapter an overview per chapter, evaluation and contribution of the study is given together with future study opportunities.

Chapter 2: Research Objective and Approach

Introduction

In this study a literature review is done to get to know more about the subject under study and then secondly an empirical research is done to find out how the actual implementation of the literature is conducted. The term empirical means: "that which is verifiable by observation". The methods of empirical research have built-in mechanisms which ensure that the procedures and results of the researcher are open to scrutiny by his fellow professionals, Behr (1983:5).

Research Objectives

The whole purpose of this study is to improve the risk management process in organizations when they invest. These investments will be implemented in the form of projects within the company. The following issues need to be addressed:

- Establish if project managers use project risk management systems; and
- Determine the maturity level of organizations in terms of risk management in capital projects.

Data Gathering and Analysis

The data gathering and analysis phase of the study has the following three objectives:

- Gathering data on the demographics of the business leaders and project managers participating in this survey;
- Gathering data on the operation of the risk management process employed by the organization which will be surveyed; and
- The analysis will determine the maturity level of the organization in terms of risk management in their projects.

Business leaders and project managers from South African businesses were asked to participate by completing a questionnaire regarding data on their demographics, risk management process and the awareness and the use of risk in their project implementation. Interviews were also conducted with a selected group of project managers combined with project audits to determine the state of the work on risks and risk management.

A survey questionnaire (refer to Research Questionnaire, page 239) was developed and tested in a small pilot study in order to assess the clarity of the directions and questionnaire items. It was revised and submitted to a small group of project managers to test the study dimensions and variables as relating to the important factors in risk management in a project environment.

A questionnaire with an introductory and explanatory letter was sent to the selected group of business leaders and project managers and at the same time interviews with some project managers and audits on a few projects were conducted. At the end seventy three completed questionnaires were used in the study.

Data Requirements

To summarise the above views one can say that primary data for this study will constitute a questionnaire, interviews and audits that were sent out to and conducted with a selected group.

The secondary data gathering was done in the form of a literature review from appropriate books, articles and internet information.

Validity of Research Methodology

Belson (1986: 9) state," ...that for a measuring technique to be of any use in research, it must produce results that are sufficiently accurate and relevant for the operation in hand. In other words, the measure must be sufficiently valid for that purpose. A valid measure is one that accurately measures what it is supposed to measure".

A survey is valid to the degree that it measures what and only what it is supposed to measure. To be valid it must not be affected by extraneous factors that systematically "push" or "pull" the results in one particular direction. To the degree that things other than those being measured affect the results by introducing a systematic bias, the results are less valid. Unfortunately there are many factors that can bias the results of a survey, including the effects of sampling, Alreck & Settle (1985:64).

If the above criteria are applied to this study, one can make a case that the research methodology is valid and will make a contribution to the literature due to the composition of the audience that make up the sample.

Research Approach

A working knowledge of current strategic, project and risk management theory, research and practice can help develop an understanding of why some organizations are successful in implementing their strategies through projects and other are not, refer to figure 4.

The study consists of nine chapters as was discussed in chapter one. The following approach will be taken to address the research objectives:

- A comprehensive literature study is undertaken on strategic management, project management and risk management to learn more about the identified problem areas as discussed in chapter one. Furthermore this literature review gives a broad overview on how organizations start off with a strategy and how it is implemented by projects and at the same time how, with the help of risk management the probability of success is increased. Risk management, processes are also discussed in detail, maturity models are discussed, as well as what a company needs to do to implement and stimulate or create a culture of risk management use;
- An empirical study is conducted in the form of a questionnaire. The research is based on the information obtained from the literature study to allow for direction and focus on addressing the real issues. The questionnaire consists of three sections: background information,

operation of the risk management process and risk information; and

- Practices of risk studies conducted in a project by the author of this work are described and these examples can be used in future by other project teams.

Chapter 3: Strategic Management

Introduction

Chapters 3, 4 and 5 focused firstly on strategic management and then on project management as a process to implement the strategy followed by risk and risk management in a project environment.

Strategy

In the literature many definitions exist for strategy. After analysing a few it could be stated that strategy is the development of various plans that will be implemented for the organization in order to be successful.

Elements of Successful Strategies

Both Grant (1998:9-10) and Kotze (1996:1-2) are of the opinion that effective strategy implementation is important for any organization if it wants to be able to compete successfully in this competitive world today. Therefore, one can deduce that more and more attention should be paid by top management to how they implement their strategies. This is where this work

can be useful because project and risk management is ideally suited for this.

The Strategic Management Process

The typical sequence of activities of the strategic management process according to Gray & Larson (2000:25), figure 6 is:

- Review and Define Organizational Mission;
- Set Long-Range Goals and Objectives;
- Analyse and Formulate Strategies to reach Objectives;
and
- Implement Strategies.

Implementation of Strategies through Projects

Normally, the project is generated in order to keep the organization economically alive, socially involved, technologically in step with evolution, culturally attuned to its environment or politically correct or in order to grow the organization by expanding its market. The link between the organization's vision and the project's expected outcome(s) is established during the initiation phase. The chief desire of the initiation phase is to take the desired outcome and plan the outputs. In order to achieve the desired outputs the project team defines the "what", "how", "who", "when", and "where". The "why" should align with the corporate vision and with objectives that drive the project as depicted in figure 7, Stewart (2000:41).

Project Classification

Capital projects need to be investigated in detail because of the positive or negative impact that they could have on the company's bottom line. Different methods could be used in this exercise, but before this takes place projects are normally classified. Birgham and Gapenshi (1993: 386-387) categorise projects as follows:

- Replacement: maintenance or business;
- Replacement: cost reduction;
- Expansion of existing products or markets;
- Expansion into new products or markets; and
- Safety and/or environmental projects.

Chapter 4: Project Management

Introduction

In this chapter, a theoretical review of project management is undertaken from the most recent literature. Different project-life-cycles with the different phases will be discussed in detail. The different knowledge areas of project management and the different tools and techniques are reviewed. Project competencies and the role and responsibilities of the project manager are highlighted.

Definition of a Project

In context of three definitions by Lewis (1999:4), Gray and Larson (2000:4) and PMBOK (2000:4) one can define a project

as a one-time, complex effort with limited time, budget that must meet design or performance specifications that will satisfy the customer's needs.

What is Project Management?

One can state that project management is the application of project management knowledge, skills, tools and techniques to achieve project objectives, namely cost, time, budget and scope.

Project Life-Cycle

From work done in chapter five one can state that most projects will go through the following phases in the life of a project and that it is not limited to this. Organizations can also use different combinations of these models to suite their specific needs, figure 13.

- Concept development;
- Feasibility study;
- Basic design;
- Detail design;
- Construction, commissioning and start-up; and
- Operation.

Project Management Knowledge Areas

The PMBOK (2000:189-191) describes the nine project management knowledge areas, as illustrated in figure 14.

Relationship of Project Management to other Management Disciplines

Project management is unique in enabling the modern manager to manage the status quo, change and technology. A project manager is a **generalist** and is able to manage all facets of an organization, Knipe et al (2002:20-22). Figure 15 gives a presentation of this.

They go further and state, "the overlap areas infer that project management staff must have sufficient understanding of the various disciplines to appreciate project requirements and issues. They must also be able to communicate appropriate direction and means of conflict resolution to these disciplines in order to reach a successful project conclusion".

Project Management Maturity Level

As was mentioned in chapter 1 organizations find it difficult to repeat the success on a continuous basis on projects and the main reason for this is that they don't have systems in place to ensure repeatability.

One way of achieving this is by adopting a maturity level model which is implemented in the organization by management through a focused effort that consumes time and resources.

The model that will now be discussed is one by Pennypacker (2001:25), the Project Management Solutions Project Management Maturity Model, viz.

- Level 1: Initial Process;
- Level 2: Structured Process and Standards;
- Level 3: Organizational Standards and Institutional Processes;
- Level 4: Managed Process; and
- Level 5: Optimising Process.

Project Management Competencies

The Project Management Competencies Development Framework (2001:1) gives the following definition "...project management competence can be described as consisting of three separate areas", viz.

- What the individual project manager brings to a project or project-related task through his knowledge and understanding of project management. This dimension is called Project Management Knowledge;
- What the individual is able to demonstrate in his ability to successfully manage the project or complete project related tasks. This dimension is called Project Management Performance; and
- The core personality characteristics underlying a person's capability to do a project task. This dimension is called Personal Competency.

Thus, one can say that competence is a combination of dimensions, i.e. knowledge of the subject, skills or ability to

perform, and personal attitude, which is how he behaves when performing the project task.

Chapter 5: Risk Management

Introduction

In this chapter a literature review on risk and risk management is undertaken in a project environment in preparation for the research.

Definition of Risk

If the definitions of Gray & Larson (2000:139), Lewis (1999:298), PMBOK (2000:207) and Burke (1999:230) form the basis of discussion one can conclude that risk is an undesirable event that if it occurs, will affect the objectives of a project negatively.

Categories of Risk

These two sets of categories of Gerosa and Nasini (2001) and Prinsloo (2003) come down to the same and are useful aids in analysing, selection of response strategies and tracking related risks. They can be depicted as in figure 24.

What is Risk Management?

In context of projects, if the description of PMBOK (2000:191), Baccarini (2001:1) and De Villiers (1999:25) is taken then it can be concluded that risk management is a formalised process

consisting of various steps to ensure that all aspects of risk are managed. Furthermore, it forms an integral part of all knowledge areas of project management to ensure completeness, i.e. that no risk event is missed.

Risk Management Process

In response to the growth uncertainty in modern projects, over the last decade the project management community has developed project specific risk management frameworks, Rodrigues (2001:1). The two that are most complete are the PMBOK 2000 edition and the Standards Australia publication AS/NZS 4360: Risk Management of 1995 and its revision of 1999: Standards Australia 1999.

Australia and New Zealand standards on risk management, AS/NZS 4360:1999[6] give the following components of the risk management process:

- Context setting;
- Risk Identification;
- Risk Analysis; and
- Risk Treatment Strategies.

The PMBOK (2000:191) gives the following components:

- Risk Management Planning;
- Risk Identification;
- Qualitative Risk Analysis;
- Risk Response Planning; and
- Risk Monitoring and Control.

These components are vary similar but in some cases lack one or other component. A combination of the key features will now be discussed to give a better overview of the process, AS/NZS 4360:1999[6]. Figure 25 illustrates the total risk management process.

Timing of the Risk Management Process

De Villiers (1999:31) states, "...that it is very important for project managers to realise the implications of not addressing the risk issue early in the life-cycle of a project. If it is done in a thorough a systematic process, it will not only save money but will also add to the success of the project in general".

Githens and Peterson (2001:1) go further and say that if risk management is not applied early in projects then:

- Firstly, errors and omissions, i.e. a failure to perform basic project management practices can lead to project failure or significant rework.
- Secondly, it is observed that most product performance problems occur at interfaces (where two systems interact with each other), not within sub-systems. Consequently, there is considerable rework and sub-optimisation of project performance.
- Thirdly, as frustrations continue to mount in the project, the morale takes on a death-march-like tone; there is little

satisfaction from work and the goal is just to survive the project.

It can therefore be concluded that the greatest benefit can be realised at the beginning of the project life-cycle, if the project team applies an integrated risk management process in a holistic approach to all facets of the project making use of the project categories as discussed above.

Risk Management: Tools and Techniques

If the risk management process described above is taken as a basis for discussing risk management tools and techniques, than it is prudent to describe the tools and techniques per step of the process, PMBOK (2000), Hillson (2001:1-7) and Hillson (2001:1-5).

The process method that will be used as a basis of presentation is as per Lewis (1999:187), refer to figure 27.

The system has inputs, outputs and a process for transforming those inputs to outputs, together with a feedback loop to ensure that the system improves and doesn't stop after a few iterations.

The Tools and Techniques will now be described in terms of the following components of the risk management process:

- Risk Management Planning;
- Risk Identification;
- Risk Analysis;

- Risk Response Planning; and
- Risk Monitoring and Control.

Risk Management Competencies

In terms of risk management a project manager should have the following competencies to be able to perform his work, Project Management Competency Development Framework (2001:53 – 56).

- **Knowledge Competencies**

Demonstrate a knowledge and understanding of:

- **Input tools**
 - The inputs to risk planning and response development;
 - The tools and techniques utilised for evaluation of potential risk events and the planning and development of risk response development;
- **Risk response**
 - The inputs to execution of risk response plans;
 - The tools and techniques utilised for execution of risk responses;
 - The output of risk response execution;
- **Risk response control**
 - The inputs of risk response control;
 - The tools and techniques utilised for conducting risk response control;
 - The outputs of risk response control;

- **Project Closure**

- The inputs to project closure with regards to risk;
- The tools and techniques utilised for project closure; and
- The outputs of project closure with regards to risk.

- **Performance Competencies**

Demonstrate the ability to develop:

- Preliminary Risk Assessment Matrix;
- Contingency Plans;
- Contractual Agreements;
- Probability Impact Matrix;
- Sensitivity Analysis;
- Decision Tree Analysis;
- Risk Response Plan;
- Project Risk Response Plans;
- Updates to Risk Response Plan;
- Corrective Actions; and
- Lessons Learnt.

It is of paramount importance for any successful project manager to have the right competency and experience in today's competitive world where an investment must start delivery as soon as possible to not lose the market opportunity or window of opportunity to the many competitors all over the world.

Risk Management Maturity Levels

This is a formal benchmarking process to assist organizations, firstly to assess their current position on risk management and secondly to path the way to improve on this level.

Table 1 gives a comparison of the different maturity models that exist.

Determining Organizational Maturity Level

A brief description of each level can indicate where an organization stands in terms of the maturity of its risk process.

The following attributes can be used to determine the maturity level:

- Culture;
- Process;
- Experience; and
- Application.

Chapter 6: Research Results

Introduction

In this chapter the findings obtained from the completed questionnaires will be analysed and discussed.

The research is conducted to establish if the respondents are working in a project environment, to what extent they apply risk

management processes in their projects and the level of risk awareness amongst them.

Approach used in Collecting the Data

A questionnaire was designed and sent to selected business leaders and project managers, in order to obtain information on the use of the risk management process and the project teams' awareness of risk in projects. Interviews were also conducted with a selected group of project managers combined with projects audit to determine the state of the work on risks and risk management. The questionnaire was designed in such a way as to meet the objectives set out in this dissertation.

Questionnaire Design

The questionnaire is subdivided into three sections. The first section is about the demographic information of the respondent. The second section is about operation of the risk management process and section three covers risk information.

Results of Section 1: Project Management Information

In this section the focus was on establishing the profile of the organization and that of the respondents because this will validate the research in that a specific group is targeted. Therefore, the questions were designed around factors like type of organization and sector in which it operates. Then on the main areas where risk management is applied, the monetary value of the projects, the number of employees and lastly the experience of the respondents.

Most of the respondents (63%) indicated that their businesses are commercial private sector businesses and the rest public sector organizations operating commercial practices. Seventy percent of them also responded that their businesses operate in the services sector and 30% in the manufacturing sector. Where it comes to the application of risk management 100% of the respondents indicated that the main area of application of risk management is projects; however, it is used in other areas as well. Nearly 70% of the respondents indicated that their organizations have more than 100 employees and 66% stated that the value of the projects they manage are R 10 million or more. On the question of experience as project managers 62% said that they have more than 11 years of experience.

Results of Section 2: Operation of the Risk Management Process

The focus of this section was on how effective the risk management process was operating. Nine questions were asked to the respondents and the following graph gives an overview of the results which are positive, but indicates clearly that there is room for improvement, refer to graph 5.

Results of Section 3: Risk Information

The results as mentioned are based on self assessment, where ten questions were asked and then the scores added up, with the following meanings:

- **Scores less than 24:** Risk management is not part of project management now. The organizations should work on building an appreciation for risk management in projects;
- **Scores 24 – 36:** Risk management is part of project management, but it needs a bigger input from corporate governance culture; and
- **Scores more than 36:** Risk management plays an important part of project management, and this philosophy should be maintained.

Chapter 7: Research Conclusions and Findings

Introduction

In this chapter conclusions will be made on the results obtained in this study. Then guidelines on how to address the problems and shortcomings, which were identified in this research, will be recommended.

Findings from Section 1: Project Management Information

In this section the following findings came to the fore:

- 37% of the respondents work and manage projects in a commercial private business, where 63% work in the public sector.

- 70% of the respondents indicated that their businesses operate in the services sector against 30% in the manufacturing sector.
- 100% of them stated that they use risk management in the management of their projects.

From the information gathered in this study the conclusion can be drawn that one is dealing with a group of experienced project managers working for large companies and on big projects, which, for the purpose of this study, can be classified as being representative of project managers in general.

Findings from Section 2: Operation of the Risk Management Process

In this section nine questions were asked. The answer to these questions will not be given individually, but as a whole to illustrate how effective and efficient the process is being used. Graphs 5 and 6 give an overview of the responses. The average total positive rating is 74%, which is in itself not bad, but there is definitive room for improvement especially on question 1 where a rating of 58% was achieved, question 2 60% and finally question 6 with a figure of 68%.

The conclusions that can be drawn from this information, is that there is room for improvement as far as the effective and efficient use of the risk management process.

Findings from Section 3: Risk Information

In this section it was found that only 5.5% of the respondents are not using risk management in their projects. The majority, 83.5%, is using risk management in their projects but there is room for improvement. The rest, 11%, accept that risk and risk management is important for the success of their projects and are making use of it.

The conclusion from these results is in line with the findings in section two that the majority of the respondents are not making effective use of the risk management process when they manage their projects.

Chapter 8: Practices of Risk Management

Introduction

Since it was concluded from this study that there is need for a risk management systems in a project environment and that various risk categories exist (refer to chapter 5) in this chapter the focus is on practices of risk management, that is by way of different risk studies that were conducted in a well-managed project. A pilot project is taken as the basis for explaining the possible studies that can be conducted in a project. It is important to notice that each project is unique (refer to chapter 4); therefore, it does not mean that all the risk assessment examples that are used in this chapter need to be carried out on other projects. The project team can decide to conduct more or fewer assessments depending on the type or complexity or sensitivity of the project or the business. Figure 38 gives an

overview of the types of risk assessments that were carried out in the pilot project.

All financial and confidential information used in the pilot project was changed due the sensitivity that it has to the company where this project was conducted.

RISK MANAGEMENT IN A PROJECT ENVIRONMENT

INTRODUCTION

Managing projects is one of the oldest and most respected accomplishments of mankind. We stand in awe of achievements of builders of pyramids, the architects of ancient cities, the masons and craftsmen of great cathedrals and mosques; of the might and labour behind the Great Wall of China and the wonders of the world, Morris (1994:1).

The project approach has long been the style of doing business in the construction industry, United States Department of Defense contracts and Hollywood, as well as at big consulting firms. Now project management is spreading to all avenues of work. Today, project teams carry out everything from port expansions to hospital restructuring to upgrading information systems. The "Big Three" automakers, Ford, Chevrolet and Mercedes credit their ability to recapture a significant share of the auto market to the use of project management teams, which quickly develop new cars that incorporate the latest automotive technology, Gray & Larson (1999:3).

Internationally, Project Management (PM) has become the fastest growing form of Management, Deacon (1998:6). One of the reasons is that the tools, techniques unique to PM have the capacity of dealing with rapid radical change resulting from fierce international competition and advances in technology.

The past ten years have seen project management continue to grow as a profession through a wide range of projects. The project management body of knowledge has been revised and expanded into nine knowledge areas and employers are increasingly encouraging their managers to gain professional management certification to comply with their quality management system. Project management techniques are now being used outside the traditional project industries and a management-by-projects approach has been adopted by many larger companies in an effort to keep their work small and manageable, Burke (1999:iii).

Project management has grown from the early initiative in the U.S. defense and aerospace sectors in late the 1950s and 1960s into a core competency that is recognized widely across most industry sectors, Morris (2001: 21).

He goes further, "... initial formulations of project management – largely be the U.S. Department of Defense and NASA – consisted of internally promulgated policies, procedures and practice. Later, books, articles, seminars and training programs explored and expanded project management practices. Much of this centered on the use of tools and techniques such as network scheduling and performance measurement and organizational issues – particularly middle management ones, such as conflict management and team work".

From the late 1960s to the early 1970s, project management societies began to provide professional forums for communication on the discipline, basically through journals, conferences and seminars. This continued until the

mid 1980s when PMI, the U.S.-based Project Management Institute and later APM, the U.K.-based Association for Project Management, embarked on programs to test whether people met their standards of project management professionalism.

One can, therefore conclude that project management is not a new subject, but one that has been with us for years and has evolved rapidly over the last few years. It is being used extensively in most sectors to implement the strategies of organizations, be it in public or private sector. The project's objectives must be aligned with the business's mission, goals and strategies to ensure that one achieve what was set out for the business when the strategies were formulated.

What is also important to notice is that the subject project management has not arrived, and will never, at a point where everything is developed to a point of perfection. Therefore this study will be conducted in one of the nine knowledge areas of project management, namely risk management, in an attempt to make a contribution to the body of knowledge of project management.

OBJECTIVES OF STUDY

The objectives of this work are as follows:

- To determine what the literature says about strategic, project and risk management
- To determine the maturity level of organizations in terms of risk management in capital projects

- To establish if project managers uses project risk management systems
- To give practical risk studies that can be used as examples by project teams in future.

STUDY APPROACH

The approach employed in this study is to make use of a combination of theory, research and practice as per Kreitner and Kinicki (2001:16-17) in order to contribute to the body of knowledge of risk management as depicted in figure 1.

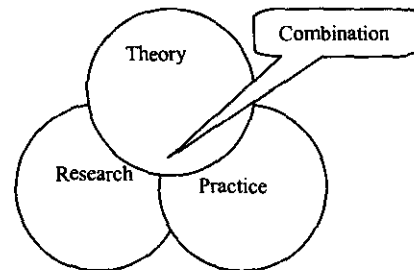


Figure 1: Combination of theory, research and practice

THEORY/LITERATURE

Introduction: Strategy

The importance of strategic management for organizational success is now well acknowledged in the literature. Strategic vision and action are necessary to enhance a company's competitive superiority, achieve superior performance and improve its value, Byars, Rue & Zahra (1996: iii).

The management of an organization, whether it is large or small or a sub-unit of a larger entity, has as one of its

principal responsibilities to set the direction of the organization for the future, Cowley & Domb (1997:9). And this is where strategic management comes in as a management tool to develop a shared vision of what the organization will be in future.

Therefore, for any organisation to survive in this complex and competitive global world a clear direction is needed on where the organisation is heading and then the implementation thereof is critical for success. This chapter covers secondary data on strategic management.

Definition of strategy

In the literature many definitions of strategy exist. A few are given here:

Oxford Pocket Dictionary states that strategy is, "the art of war, especially of movements of troops and ships, etc. into favourable positions; plan of actions or policy in business or politics, etc."

Grant (1998:14) gives it as, "...strategy is the overall place for deploying resources to establish a favourable position".

Thompson and Strichland (1995:6) give the following definition, "...strategy is best conceived as a combination of planned actions and on-the-spot adaptive reactions to fresh developing industry, and competitive events".

The concept "strategy", in the context of management, indicates a suitable plan or method for achieving the aims of the organization, irrespective of change, Knipe et al (2002:41).

It could then be stated that strategy is the development of various plans that will be implemented for the organization to be successful.

Strategic Management Process

Knipe et al (2002:4) state that, strategic management consists of the following basic steps:

- Environmental analysis or scanning;
- Vision and mission statement;
- Strategy formulation;
- Strategy implementation; and
- Strategy evaluation and control.

All these processes give the organizational mission, long-range goals and objectives, strategy formulation and strategy implementation as the key steps in the strategic management process; therefore, these are the driving forces to move the organization towards a better tomorrow. These will now be discussed in more detail.

The typical sequence of activities of the strategic management process according to Gray & Larson (2000:25), figure 6 is:

- Review and Define Organisational Mission;
- Set Long-Range Goals and Objectives;
- Analyse and Formulate Strategies to reach Objectives; and
- Implementing Strategies.

One can therefore, conclude that for any organization to be able to survive in today's competitive world it needs to make use of the strategic management process to assist it to develop a roadmap

to remain in business and to compete in the future. The vision states the purpose of the organization whereas the mission statement can be used for evaluating organizational performance. Objectives answer in detail where a firm is headed and when it is going to get there, who the customers are and what their needs are.

Introduction: Project Management

The past several decades have been marked by rapid growth in the use of project management as a means by which organisations achieve their objectives. Project management provides an organization with powerful tools that improve its ability to plan, implement and control its activities as well as the ways in which it utilises its people and resources, Meredith & Mantel (2000:1).

It is being said that the project manager will fill the void created by extinction of middle management. Stewart states the following, "...if the old middle managers are dinosaurs, a new class of manager mammal is involving to fill the niche they once ruled: project managers. Unlike his biological counterpart, the project manager is more agile and adaptable than the best he's displacing, more likely to live by his wits than throwing his weight around".

The project approach has long been the style of doing business in the construction industry, U.S. Department of Defence and Hollywood, as well as at big consulting firms. Now project management is spreading to all avenues of work. Today project teams carry out everything from post expansions to hospital restructuring to upgrading

information systems, Gray & Larson (2000:3).

Projects make up around fifty percent of all work carried out. They can, therefore, be termed "an economical important" category of activities. That makes the subject of their management worth studying. However, it is not unusual to hear the question from students at the start of a course, "*It's just common sense, isn't it?*" To some extent they are right. After all, there is nothing inherently different about the project management concepts. How is it that the majority of organisations are so poor at managing projects? The answer can be found in the definition of common sense as "*the obvious after it has been explained*". It is observed that common sense is not so common sense and many of these apparently obvious aspects of the subject are neglected, Maylor (1999:5).

It can, therefore, be said that project management is not new, but the development of project management tools and techniques has enhanced project management as a profession so that it is being used all over industries for a wide variety of projects and even to manage the business by projects.

Definition of a Project

Lewis (1999:4) defines a project as, "...a one-time multi task job that has clearly defined starting and ending dates, a specific scope of work to be performed, a budget and a specified level of performance to be achieved".

Another project definition: "A project is a complex non-routine, one-time effort limited by time, budget, resources and

performance specifications designed to meet customer need”, Gray and Larson (2000:4).

The PMBOK (2000:4) states: “A project can be defined in terms of its distinctive characteristics – it is a temporary endeavour undertaken to create a unique product or service. Temporary means that every project has a definite beginning and a definite end. Unique means that the product or service is different in some distinguishing way from all other products or services”.

A project can be defined as a non-repetitive activity. This needs to be augmented by other characteristics, Maylor (1999:5):

- It is goal oriented – it is being pursued with a particular end or goal in mind;
- It has a particular set of constraints – usually centred around time and resource;
- The output of the project is measurable; and
- Something has been changed through the project being carried out.

In context of the above three definitions one can define a project as a one-time, complex effort with limited time and budget that must meet design or performance specifications that will satisfy the customer’s needs.

Project Management

The PMBOK (2000:6) defines project management: ...as the application of

knowledge, skills, tools and techniques to project activities to meet project requirements. Project Management is accomplished through the use of the processes such as: initiating, planning, executing, controlling and closing. The project team manages the work of the projects and the work typically involves:

- Competing demands for scope, time, cost, risk and quality;
- Stakeholders with different needs and expectations; and
- Identified requirements.

Project management involves three major categories of activities, i.e. planning, scheduling and controlling aimed at achieving project objectives, Lewis (1999:7).

Project management is the disciplined application of certain knowledge techniques, tools and skills to create a unique product or service. The project manager can choose from a range of processes to manage any particular project. The choice of which particular processes will be employed in any situation is left to the judgement of the individual project manager, Kenny (2003:43).

One can, therefore, state that project management is the application of project management knowledge, skills, tools and techniques to achieve project objectives, namely cost, time, budget and scope.

Project Life-cycle

Bonnal et al (2002:1) state that, “...it is quite difficult to attribute the concept of project life cycle to one another in particular, since the concept has gradually derived over time”.

They go further and give the following different life-cycle models for technical projects:

- Straightforward project life-cycle;
- Control-oriented project life-cycle;
- Quality-oriented life-cycle;
- Risk-oriented life-cycle; and
- Fractal project life-cycle.

From the above one can state that most projects will go through the following phases in the life of a project and that it is not limited to this. Organizations can also use different combination of these models to suit their specific needs.

- Concept development;
- Feasibility study;
- Basic design;
- Detail design;
- Construction, commissioning or/and start-up; and
- Operation.

Maturity Model

Pennypacker & Grant (2003) state that, "...the challenge facing contemporary project-performing organizations is that each of these ingredients to the capability to deliver projects successfully requires a substantial commitment of time and resources. Given the many initiatives required to achieve consistent project success, which initiatives should an organization undertake first? Or from a more strategic perspective, how should an organization pursue the development of project management capabilities purposefully over time? Project management maturity models are designed to provide the

framework that an organization needs to purposefully and progressively develop its capabilities to deliver project after project.

Many project management maturity models have emerged since the mid 1990s, Pennypacker & Grant (2003).

The model that will now be discussed is one by Pennypacker (2001:25), the Project Management Solutions Project Management Maturity Model, viz.

- **Level 1: Initial Process**

Although there is recognition that there are project management processes, there are not established practices or standards and individual project managers are not held to specific accountability by any process standards. Management understands the definition of a project, that there are accepted processes and is aware of the need for project management. Metrics are informally collected on an ad hoc basis;

- **Level 2: Structured Process and Standards**

Many project management processes exist in the organisation, but they are not considered an organisational standard. Documentation exists on these basic processes. Management supports the implementation of project management, but there is neither consistent understanding, involvement, nor organizational mandate to comply with all projects. Functional management is involved in the project

management of larger, more visible projects and these are typically executed in a systematic fashion. There are basic metrics to track project cost, schedule and technical performance, although data may be collected or correlated manually. Information available for managing the project is often a mix between summary level data and detailed level data;

- **Level 3: Organisational Standards and Institutionalised Process**

All project management processes are in place and established as organisational standards. These processes involve the clients as active and integral members of the project team. Nearly all projects use these processes with minimal exception – management has institutionalised the processes and standards with formal documentation existing on all processes and standards. Management is regularly involved in input and approval of key decisions and documents and in key project issues. The project is evaluated and managed in light of other projects;

- **Level 4: Managed Process**

Projects are managed with consideration to how the project performed in the past and what is expected in the future. Management uses efficiency and effectiveness metrics to make decisions regarding the project and understands the impact on the other projects. All projects,

changes and issues are evaluated based upon metrics from cost estimates, baseline estimates and earned value. Project information is integrated with other corporate systems to optimise business decisions. Processes and standards are documented and in place to support the practice of using such metrics to make project decisions. Management clearly understands its role in the project management process and executes it well, managing at the right level and clearly differentiating management styles and project management requirements for different sizes or complexities of projects. Project management processes and standards are integrated with other corporate processes and systems; and

- **Level 5: Optimising Process**

Processes are in place and actively used to improve project management activities. Lessons learned are regularly examined and used to improve project management processes, standards and documentation. Management and the organization are not only focused on effectively managing projects but also on continuous improvement. The metrics collected during execution are used to understand the performance of not only a project but also for making organizational management decisions for the future.

One can conclude that the maturity model is a holistic approach to improve an organisation's effectiveness and

efficiency that require commitment from top management. It is time consuming because it is a culture change that will affect the whole organisation for the best if implemented correctly. An integrated approach that is based on the nine knowledge areas as presented by the PMBOK (2000) and the maturity model that needs addressing in each of the five levels as organizations progress from one level to the next. By using this approach companies will ensure that they achieve successful projects time and time again.

Competencies of project managers

A normal question for managers in the increasing number of firms that are highly dependent upon project work is how to staff them with effective project managers. We know that effective project managers are essential to project success and many organizations have spent large sums to improve the selection and development of managers for this role. Yet, there is still a widespread sense that we must do better, Hauschildt et al (2000:23).

Craford (1997) states that competence is a term which is widely used but which has come to mean different things to different people. It is, however, generally accepted as encompassing knowledge, skills, attitudes and behaviours that are causally related to superior job performance.

The Project Management Competencies Development Framework (2001:1) gives the following definition "... when applied to project management competence can be described as consisting of three separate areas", viz.

- What the individual project manager brings to a project or project-related task through his knowledge and understanding of project management. This dimension is called Project Management Knowledge;
- What the individual is able to demonstrate in his ability to successfully manage the project or complete project related tasks. This dimension is called Project Management Performance; and
- The core personality characteristics underlying a person's capability to do a project task. This dimension is called Personal Competency.

Thus, one can say that competence is a combination of dimensions, i.e. knowledge of the subject, skills or ability to perform and personal attitude, which is how he behaves when performing the project task.

The PMI (2001:2) states, "...a 'competent' project manager alone does not guarantee project success. They believe that project success requires project manager competence as well as organizational project management maturity and capability – organisational performance cannot be ignored. In other words, having a project manager who possesses the 'right' competencies cannot ensure project success. Focusing solely on the project manager competence regardless of the organisation's performance is too simplistic. There are too many organizational maturity factors and other contingencies that influence the outcome of the project as well. In fact, it is

possible to have a “competent” project manager working within an “immature” organization, which could result in an unsuccessful project, or vice versa”.

Introduction: Risk Management

Stability is no longer a word that can be applied to today’s business. Markets move so frequently that companies have to embrace change as easily as they manage their normal business operations. For many companies change has been very much a random affair, without corporate structure and left to managers to justify and commission without reference to an overall strategy. As companies now count the cost of business change against a background of global uncertainty their projects have to become more strategic and cost effective. Executives are now much more interested in the risks of making change and are demanding better tools, methods and data to link the risks of projects to an overall strategy, Bartlett (2002:1).

During the past several years increasing attention has been paid to the subject of managing some of the risks inherent in most projects. For the most part risk has been interpreted as being unsure about project task durations and/or costs but uncertainty plagues all aspects of the work on projects and is present in all stages of project life cycles, Meredith & Mantel (2000:62).

Risk management is a key component of project management and there has been a notable increase of awareness and application over the past decade or so, Baccarini (2001:1).

Experience has shown that risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure. What we know, we plan for and are more often successful than not. However, without mitigation, risks will introduce chaos and failure into an otherwise well-planned and managed project, Royer (2000:6).

Many cost and time overruns in projects are mainly attributed to unforeseen events for which risk has not been appropriately accommodated in the project budget, Al-Tabtabai & Alex (2000:4).

Therefore, one can say that risk has and will always be an integral part of a project. Every project manager understands risks are inherent to projects; all risks can’t be eliminated. No amount of planning can overcome risk, or the inability to control or change events. Plans are essentially lists of things to do. Most of the time what is missing from the plans is serious consideration of potential project risks.

Definition of risk

Before one can commence with the process of discussing risk it is important to know what risk is in the context of a project. There are many definitions in the literature, viz.

Gray & Larson (2000:139) give the following definition, “...risk is the chance that an undesirable event will occur and the consequences of all its possible outcomes”.

Lewis (1999:298) states that "...anything that can go wrong in a project that will affect project targets".

The PMBOK (2000:207) definition: "An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives".

Burke (1999:230) defines project risk as "...any event that prevents the achievement or limits the achievement of the objectives as defined at the outset of the project, these objectives may be revised and changed as the project progresses through the project life cycle".

Therefore, one can conclude that risk is an undesirable event that, if it occurs, will affect the objectives of a project negatively.

Risk Management

Risk management, as was discussed and illustrated in previous chapters, forms an integral part of project management. Formal definitions will now be given followed by a discussion.

The PMBOK (2000:191) defines risk management as: "...systematic process of identifying, analysing and responding to project risk. It includes maximising the probability of positive events and its consequences and minimising the probability of adverse events and consequences to project objectives".

Baccarini (2001:1) states that, "Project risk management is fundamentally a decision making-process. The alternative to risk management is making reckless decisions or making decisions that are not based on careful

consideration of facts and the risks involved. Managing risk demands a methodical approach and project risk management is a formalised and disciplined approach consisting of a set of processes for decision making".

De Villiers (1999:25) gives the following definition, "...Risk management is a formal process whereby risk factors are systematically identified, assessed, actioned, monitored and reviewed".

It can, therefore, be concluded that risk management is a formalised process consisting of various steps to ensure that all aspects of risk are managed. Furthermore, it forms an integral part of all knowledge areas of project management to ensure completeness, i.e. that no risk event is missed.

Risk Management Process

In response of the growth uncertainty in modern projects, over the last decade the project management community has developed project specific risk management frameworks, Rodrigues (2001:1). The two that are most complete are the PMBOK 2000 edition and the Standards Australia publication AS/NZS 4360: Risk Management of 1995 and its revision of 1999: Standards Australia 1999.

Before one can describe the risk management process it will be prudent to state and discuss key concepts such as a process based on best practices.

Arthur Andersen (1999:10) states that whatever the area of risk, best practice risks management has three components:

- A whole system for identifying, capturing and measuring risks;
- A system for evaluating whether to accept risk, reject risk or take steps to reduce risks; and
- A system that can be maintained to ensure that the risk management is not a once off event but rather a systematic integrated iterative process.

KPMG (2002:15) advocate that a good system is designed to review the project management process and that the focus is on the following:

- Project strategic objectives;
- Identifying the risk that may impact on these objectives;
- Determine or establish the controls to manage these risks;
- Determine the perceived effectiveness of these controls; and
- Determine the areas where there might be a lack of control.

Then a systematic risk management process must be followed.

Both these practices let one focus on a systematic disciplined approach which will be discussed now.

Australia and New Zealand standards on risk management, AS/NZS 4360:1999[6] give the following components of the risk management process:

- Context setting;
- Risk Identification;
- Risk Analysis; and
- Risk Treatment Strategies.

The PMBOK (2000:191) gives the following components:

- Risk Management Planning;
- Risk Identification;
- Qualitative Risk Analysis;
- Risk Response Planning; and
- Risk Monitoring and Control.

For project risk management to be carried out effectively, all steps – from Context Setting, through to Planning, Identification and Analysis, to Response Planning, Monitoring and Control and Communication – need to be integrated consistently in line with the project objectives and the risk tolerances of the organization and stakeholders, Piney (2001:1).

Taken the above, it can be concluded that risk management is not an event but rather a process where it is very important to set the context in which the risk is manifested and then to apply the process.

Maturity Model

This is a formal benchmarking process to assist organizations firstly to assess their current position on risk management and secondly to path the way to improve on this level.

The Risk Management Research and Development Program Collaboration (RMRDPC) (2002:4) states that "...there is currently a broad consensus on the fundamentals and potential benefit of project risk management when it is conducted within a mature and effective process and supported by a comprehensive infrastructure. The organisation must be able to benchmark its present maturity and capability in managing risk, using a generally acceptable framework to assess current

levels objectively and assist in defining progress towards increased maturity”.

There exist different models that can be used in this exercise:

- Risk Management Maturity Model (RMMM);
- Capability Maturity Model for systems Engineering Organizations (CMMI – SE/SW); and
- Systems Engineering Capability Model (EIA / IS 731).

The RMMM offers a framework to allow organizations to benchmark its approach to risk management against four standard levels of maturity and outlines the activities necessary to move to the next level. This model will be discussed in the next few paragraphs.

PRACTICES

Since it was concluded from this study that there is need for a risk management systems in a project environment and that various risk categories exist, the focus will be on the different risk studies that were conducted in a well-managed project. A pilot project will be taken as the basis for explaining the possible studies that can be conducted in a project. It is important to notice that each project is unique; therefore, it does not mean that all the risk assessment examples that will be used in this chapter need to be carried out on other projects. The project team can decide to conduct more or less assessment depending on the type or complexity or sensitivity of the project or the business. Figure 2 gives an overview of the types

of risk assessments that were carried out in the pilot project.

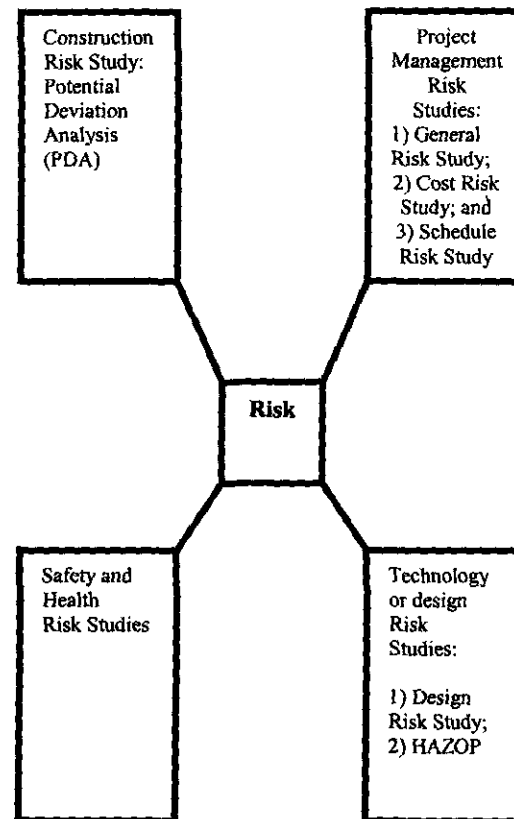


Figure 2: Types of Risk Assessments

EMPIRICAL RESEARCH

A survey questionnaire was developed and tested in a small pilot study in order to assess the clarity of the directions and questionnaire items. It was revised and submitted to a small group of project managers to test the study dimensions and variables as relating to the important factors in risk management in a project environment.

The data gathering and analysis phase of the study has the following three objectives and will be addressed in three separate sections:

- Gathering data on the demographics of the business leaders and project managers participating in this survey.
- Gathering data on the operation of the risk management process employed by the organization which will be surveyed.
- The analysis will determine the maturity level of the organisation in terms of risk management in their projects.

Business leaders and project managers from South African businesses were asked to participate by completing an electronic questionnaire regarding data on their demographics, risk management process and the awareness and the use of risk in their project implementation.

A questionnaire with an introductory and explanatory letter was e-mailed to the selected group of business leaders and project managers. Some interviews and projects were also conducted using this questionnaire. Seventy three questionnaires, interviews and audits that were received back and conducted were used in the study.

If the maturity level of an organization is high it means that they can on a continuous basis implement projects successfully.

Successful strategic implementation and execution is very important because it ensures that once the first two points are properly addressed that continuity in the process exists.

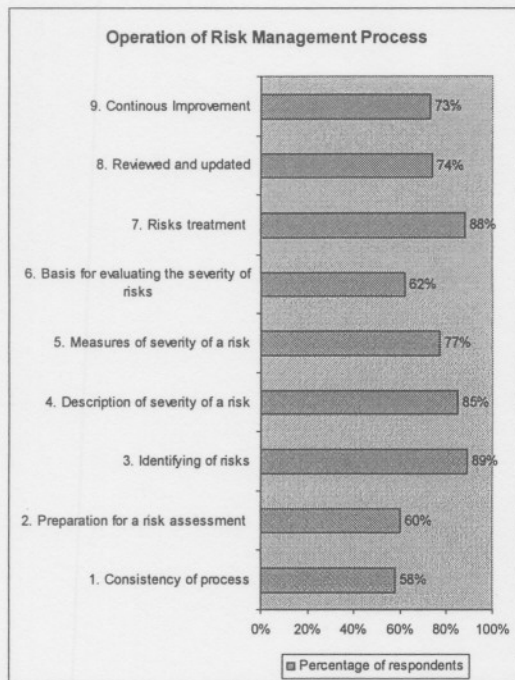
Results

Findings from Section 1: Project Management:

- Forty eight percent (48%) of the respondents are working for big companies with more than 1000 employees.
- Forty five percent (45%) indicated that manage big project with a monetary value of more than R100 million; this correlates well with the previous question where the same number of respondents indicated that they work for large companies.
- the respondents are experienced project managers as 78% of them have more then five years experience in projects management

Findings from Section 2: Operation of Risk Management Process

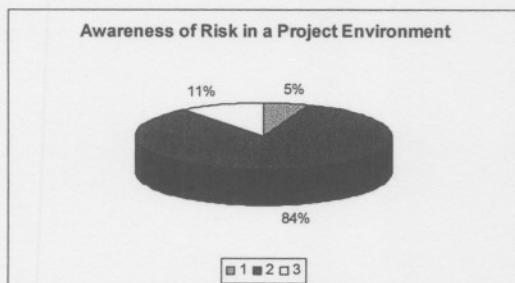
As a whole to illustrate how effective and efficient the process is being used; Graph 1 give an overview of the responses. The average total positive rating is 74% which is in itself not bad, but there is definitive room for improvement especially on questions 1, 2 and 6 where a rating of 58%, 60% and 62% was received respectively.



Graph 1: Operation of Risk Management Process

Findings from Section 3: Risk Information

Graph 2 illustrates what was found; only 5% of the respondents are not using risk management in their projects. The majority, 84%, is using risk management in their projects but there is room for improvement. The rest, 11%, accept that risk and risk management is important for the success of their projects and is making use of it.



Graph 2: Awareness of Risk in a Project Environment

CONCLUSION

The following conclusions can be drawn from this study:

- The first objective namely literature review on strategic, project and risk management was achieved because a comprehensive review on these three subjects was undertaken.
- Determining the maturity level of organizations in terms of risk management in capital projects, which is the second objective, was addressed by section 2 of the research work.
- Objective three, project managers using project risk management systems, was determined by section 3.
- The forth objectives of practical risk studies is addressed.

RECOMMENDATION

What is clear from this study is that there is definitely a place for risk management in projects, and that there are opportunities for the development of risk management systems in a project environment.

The following recommendations are made based on the literature work and the research conducted in this study:

- That all companies or businesses that are involved in projects should adopt the maturity model methodology to create a risk management culture.

- That all project managed by businesses should at an early stage of the project life-cycle use an overall risk management process to ensure that all possible risk are identified and managed.
- That at the planning stage all possible risk studies that will be undertaken be identified and become part of the overall risk strategy and be incorporated in the project execution plan.

It is extremely important that project managers take a holistic view on risk management in their projects if they want to be successful.

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