

**“THE USE AND IMPORTANCE OF PROJECT MANAGEMENT TOOLS AND
TECHNIQUES FOR EFFECTIVE HIGHWAY PROJECTS IN KIGALI AND
THEIR IMPACT ON PROJECT SUCCESS”**

A THESIS

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CERTIFICATE

This is to certify that the Thesis Work entitled «**THE USE AND IMPORTANCE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES FOR EFFECTIVE HIGHWAY PROJECTS IN KIGALI AND THEIR IMPACT ON PROJECT SUCCESS**» is a record of the original bonafide work done by **NGOBOKA Jules Cesar (Reg.No: PG 20134044)** in partial fulfilment of the requirement for the award of Master of Science Degree in Highway Engineering and Management of College of Science and Technology during the academic year 2012-2013.

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DECLARATION

I hereby declare that the thesis entitled “**THE USE AND IMPORTANCE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES FOR EFFECTIVE HIGHWAY PROJECTS IN KIGALI AND THEIR IMPACT ON PROJECT SUCCESS** ” submitted for the Degree of Master of Science is my original work and the thesis has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any Degree or Diploma.

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BONAFIDE CERTIFICATE

Certified that this thesis titled **“THE USE AND IMPORTANCE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES FOR EFFECTIVE HIGHWAY PROJECTS IN KIGALI AND THEIR IMPACT ON PROJECT SUCCESS ”** is the bonafide work of **NGOBOKA Jules Cesar (Reg. N°: 20134044)** who carried out the research under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

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ABSTRACT

The effectiveness of roads infrastructures in City of Kigali has effects on the goals, objectives and expectations of both road projects stakeholders and contractor's.

Hence, the use and importance of project management tools and techniques is among other ways which can be underlined for effectiveness of road projects. Thus, the overall objective of the research was to investigate the use and importance of project management tools and techniques for improved projects success in Highway Projects and their impact on project success over the life cycle of highway projects in Kigali to enhance achievement of project goals and objectives.

To attain the above objective, a methodology to be followed for the research was divided into four main parts, such as the establishment of research basic which aims to define theoretical framework of the research and questionnaire design, the next step was to undertake questionnaire to the field with roads contractors (National and International Companies) working with the Ministry of Infrastructure through Rwanda Transport Development Agency, City of Kigali, Gasabo District, Kicukiro District and Nyarugenge District to assess the most frequency use, importance as well as the effectiveness of project management tools and techniques from road contractor's. The above was followed by data entry into excel spread sheet and data coding for analysis. Then data was interpreted depending on findings.

From findings, it has been observed that most important and effective project management tools and techniques in highway projects are not used by roads contractors in City of Kigali, where this may leads to projects delay as well as projects failure.

Therefore, road contractors have to provide to their employees regular training on the use of project management tools and techniques especially in engineering field as well as related project management software's.

TABLE OF CONTENTS

CERTIFICATE	ii
DECLARATION	iii
BONAFIDE CERTIFICATE.....	iv
ACKNOWLEDGEMENT	v
ABSTRACT.....	vi
TABLE OF CONTENTS.....	vii
LIST OF TABLES.....	x
LIST OF FIGURES	xi
LIST OF SYMBOLS AND ABBREVIATIONS	xii
CHAPTER 1: GENERAL INTRODUCTION	1
1.1. Introduction	1
1.2. Background	2
1.3. Description of the study area.....	4
1.4. Problem Statement	4
1.5. Research Objectives	5
1.5.1. Main Objective.....	5
1.5.2. Specific Objectives	5
1.6. Research Proposition.....	6
1.7. Research Contribution.....	6
1.8. Structure of the Research	6
CHAPTER 2: LITERATURE REVIEW	8
2.1. Introduction.....	8
2.2. Project Management Tools and Techniques	9
2.3. Definitions.....	11
2.3.1. Project Charter	11
2.3.2. Work Breakdown Structure (WBS).....	12
2.3.3. Earned Value Management.....	17
2.3.4. Critical Path Method (CPM).....	20
2.3.5. Gantt chart.....	26
2.3.6. Program Evaluation & Review Technique (PERT).....	28
2.3.7. Cost Breakdown Structure (CBS).....	31
2.4. Project success and Failure	32
2.4.1. Project Success.....	32
2.4.2. Project Failure.....	34

2.5. Project Critical Success Factors (CSFs)	34
2.6. Project life cycle	36
2.6.1. Introduction.....	36
2.6.2. Project Management Life Cycle	37
CHAPTER 3: RESEARCH METHODOLOGY AND METHODS	41
3.1. Research Methodology	41
3.1.1. Qualitative and quantitative approaches	41
3.1.2. Sample population	43
3.2. Research Methods.....	44
3.3. Data Analysis Approach Employed in this Research	45
3.4. Summary of Chapter	46
CHAPTER 4: FREQUENCY OF USE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES AT DIFFERENT STAGES OF THE PROJECT LIFECYCLE, AND ASSOCIATED CHALLENGES	47
4.1. Introduction.....	47
4.1.1. Summary of data analysis	47
4.1.2. Type of Company and Area of Specialization.....	49
4.2. Data Analysis and Discussions	50
4.3. Summary of Chapter	54
CHAPTER 5: PRACTITIONERS' VIEWS ON THE EFFECTIVENESS OF THE MOST FREQUENTLY USED PROJECT MANAGEMENT TOOLS AND TECHNIQUES, AND NEED FOR TRAINING.....	55
5.1. Introduction.....	55
5.2. Data Analysis and Discussions	55
5.3. Summary of Chapter	58
CHAPTER 6: IMPACT OF THE USE AND EXPLOITATION OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS.	59
6.1. Introduction.....	59
6.2. Data Analysis and Discussions	59
6.3. Summary of Chapter	60
CHAPTER 7: CRITICAL SUCCESS FACTORS (CSF) ASSOCIATED WITH THE EFFECTIVE USE AND EXPLOITATION OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS IN KIGALI.....	61
7.1. Introduction.....	61
7.2. Data Analysis and Discussions	62
7.3. Summary of Chapter	64

CHAPTER 8: APPROPRIATE SETS OF GUIDANCE ON FREQUENCY OF USE, EFFECTIVENESS, AND TRAINING NEEDS OF PLANNING TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS.....	65
8.1. Introduction.....	65
8.2. Guidance on Use of project management tools and techniques	65
8.3. Guidance on Effectiveness of tools and techniques across project lifecycles	71
8.4. Guidance on the need for training in the use of appropriate project management tools and techniques.	72
8.5. Summary of Chapter	74
CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS.....	75
9.1. Introduction.....	75
9.2. Conclusions.....	75
9.3. Recommendations.....	75
REFERENCES	77
APPENDICES	85
Appendix A: Questionnaire for data collection	85
Appendix B: Correspondents addressed to different institutions in Kigali requiring roads contractors for data collection.....	91
Appendix B 1: Letter addressed to RTDA.....	91
Appendix B 2: Letter addressed to City of Kigali	92
Appendix B 3: Letter addressed to Gasabo District.....	93
Appendix B 4: Letter addressed to Nyarugenge District	94
Appendix B 5: Letter addressed to Kicukiro District	95
Appendix B 6: Whom so ever it may concern.....	96
Appendix C: Correspondents from different institutions in Kigali	97
Appendix C 1: Letter from RTDA.....	97
Appendix C 2: Letter from City of Kigali	99
Appendix C 3: Letter from Kicukiro District	100
Appendix C 4: Letter from Gasabo District.....	101
Appendix C 5: Letter from Nyarugenge District	102

LIST OF TABLES

Table 1: PMTT and project management knowledge areas [2]	11
Table 2: Project Life Cycle Phases [30]	38
Table 3: Project Management tools and Techniques degree of importance	50
Table 4: Project Management Tools and Techniques frequency of use	52
Table 5: Project Management Tools and Techniques Challenging	53
Table 6: Effectiveness of project Management tools and techniques	56
Table 7: Project Management tools and techniques level of training	57
Table 8: Main Challenges that impact on the use of PMTT	59
Table 9: Critical Success Factors	62
Table 10: Critical Success Factors of roads contractors in City of Kigali	63
Table 11: Project Management Tools and Techniques (PMTT)	72
Table 12: PMTT degree of importance rank	73
Table 13: Most PMTT frequently used	73
Table 14: Effectiveness of Project management tools and techniques	74

LIST OF FIGURES

Figure 1. City of Kigali map [69]	4
Figure 2: Own designed Work Breakdown Structure	13
Figure 3: EVM Components (PMI, 2004)	18
Figure 4: Keys EVMS Performance Measurement Metrics [55].....	19
Figure 5: Own designed Critical path method diagram	22
Figure 6: Critical Path for a project (Class notes by Prof. Charles EGBU: 2013)	22
Figure 7: Gantt chart diagram (Class notes by Prof. Charles EGBU: 2013)	27
Figure 8: Four phases of the project life cycle.....	38
Figure 9: Activities undertaken during the initiation phase. [30]	38
Figure 10: Project Planning Activities [30]	39
Figure 11: <i>Types of Data</i>	41
Figure 12: Methodology to be used in this research.....	45
Figure 13: Respondents Sex.....	47
Figure 14: Respondents Education Level	48
Figure 15: Respondents Area of Specialization.....	48
Figure 16: Respondents Position in the Organization.....	48
Figure 17: Type of Company.....	49
Figure 18: Company area of specialization	49
Figure 19: Project Management tools and techniques degree of importance Chart	51
Figure 20: Project Management Tools and Techniques frequency of use Chart.....	52
Figure 21: <i>Project Management Tools and Techniques Challenging Chart</i>	53
Figure 22: Effectiveness of Project management tools and techniques chart.....	56
Figure 23: Project Management Tools and Techniques level of training graph.....	57
Figure 24: Main Challenges that impact on the use of PMTT.....	60
Figure 25: Critical Success Factors Chart.....	63

LIST OF SYMBOLS AND ABBREVIATIONS

AC: Actual Cost
BAC: Budget at Completion
BCWP: Budgeted Cost of Work Performed
BCWS: Budgeted Cost of Work Schedule
CBS: Cost Breakdown Structure
CP: Critical Path
CPM: Critical Path Method
CSF: Critical Success Factors
ES: Earned Schedule
EV: Earned Value
EVM: Earned Value Management
FF: Free Float
GDP: Gross Domestic Product
GERT: Graphical Evaluation and Review Technique
KCC: City of Kigali Council
KIST: Kigali Institute of Science and Technology
MININFRA: Ministry of Infrastructures
NGO's: Non Government Organization
OBS: Organizational Breakdown Structure
P.M: Project Management
PDM: Precedence Diagramming Method
PERT: Programme Evaluation and Review Technique
PM: Project Manager
PMBOK: Project Management Body of Knowledge
PMI: Project Management Institute
PMM: Project Management Methodology
PMTT: Project Management Tools and Techniques
PV: Planned Value
RMF: Road Maintenance Fund

RTDA: Rwanda Transport Development Agency

SPI: Schedule Performance Index

SPSS: Statistical Packages for Social Sciences Software

SV: Schedule Variance

SWOT: Strength Weakness Opportunities Threats Analysis

TF: Total Float

WBS: Work Breakdown Structure

CHAPTER 1: GENERAL INTRODUCTION

1.1. Introduction

Project management in Rwanda is currently considered as managerial tool that helps private companies to attain business objectives. According to Cleland [1] , an organization with the help of project management may, manage its limited resources, reduce product development time, deal with technological complexity, take care of stakeholder satisfaction and compete in global market. Much work has been done relating to PM over the past two decades and researchers and practitioners strived to investigate reasons of project failures and factors responsible for success [49]. There are five main processes take place in projects management comprising: initiation; planning; execution; monitoring and control process and closing process. A range of project management tools and techniques are used in projects to plan and control scope of work involved delivering a product up to satisfactory level. Just like other professions, project managers use certain PMTT for making their PM activities easier [49]. Every project has different objectives but same tools and techniques of PM are applied to these projects for their management, scheduling and control irrespective of its type may it be a construction, manufacturing [49]. Thus, the effective implementation and execution of projects substantiates the importance of project management methodology (PMM).

Broadly, PMM incorporates a range of knowledge areas and a set of tools and techniques which help and manage all components of the project [2]. Hence, Chin and Spowage (2010) states that methodology should be adaptable to scale of the project. PMM is employed in all project phases such as planning, coordination, conceptualization and closing in order to meet the stakeholder's requirements to complete the project within budget and on time. However, to seek effectiveness of the existing methodologies in the market, understanding of their requirement and characteristics is must. The effective methodology is the one that can be adaptable to the specific project environment, works well in the vibrant nature of projects and responsive to stakeholders demands [49]

There are numerous institutions around the world called bodies of knowledge involved in development and promotion of project management and produced project management recognized published standards.

The Project Management Body of Knowledge (PMBOK) comprising project management skills, tools and techniques, has been developed by Project Management Institute (PMI) over past 50 years. Project managers apply these generally accepted published standards to manage their projects. However the question regarding the extent of their usage and impact of project performance is still needed to be answered [30]. However, many researchers commented that benefits retrieved from the use of PMTT may include better resource control (financial and human), increased customer service, minimized costs, improved quality, better profitability and productivity, better internal control and better job satisfaction [30]. The implementation of PMTT brings cost reduction stated by Sdrolias [30]. This paper observes project management practices in context of the use and importance of project management tools and techniques for improved projects success in Highway Projects in Kigali.

1.2. Background

Rwanda is a country under development, construction industry especially roads infrastructure plays a significant role in the socio-economic development of the nation. It provides the physical infrastructure that is central to the country's economic development. Its activities create business for suppliers and manufacturers and it provides employment to professionals, semi-skilled and unskilled labour. However, the nation's construction industry is underdeveloped and plagued with a host of problems, which includes a lack of management, technical capacity, and access to credit facilities as well as opportunities. [57]

Transport infrastructure provides easy access to markets and inputs, stimulating agricultural production and leading to improved welfare of the population. Through employment provided by new infrastructure projects, rehabilitation and maintenance, the industry contributes significantly towards the country's GDP (Gross Domestic Product). Not only does the construction sector provide employment to the country's work force, but more than 50% of the employment so created is in the unskilled labour market, resulting in capacity building. [57]

Rwanda Government's Transport Sector Policy aims at promoting efficient and effective transport services as a means of providing support to increase agricultural production, trade, tourism and social administrative services.

The Government is to develop and maintain economic, efficient and effective transport infrastructure to facilitate the provision of safe and efficient transport services. This shall include increased participation of the local construction industry in the development of transport infrastructure and the provision of transport services. [57]

Apparently the quality of road infrastructure has a direct impact on the level of people's and a well functioning of construction industry (company) has an important role towards this end. It is from these regards that Highway projects in City of Kigali are amongst major infrastructures which are being implemented as long as the city is growing day to day.

After 1994 Genocide, Rwanda faced a severe shortage of professional personnel which marked clear and tremendous obstacles to development of all aspects. City of Kigali too experienced lack of Engineers as well as good technicians where road projects were run by chance without proper project management processes. Few years after, some International and few national Companies were in place to run highway projects in City of Kigali.

Today City of Kigali has set a Master plan for the whole City including roads infrastructure and is having a reasonable number of National Companies but till today they are challenged during roads projects implementation with poor project management process. Rwanda through its Ministry of Infrastructure has set up running program of Highway Engineering and Management under RTDA (Rwanda Transport development Agency) where both national and international companies on road projects are monitored through. It has been observed that most of national companies when offered tenders to implement roads projects let's say in Kigali, they fail to work within the contracted period and end up by delaying and increasing penalties during their over execution period. As a result the project does not achieve its goals and stakeholders' expectations as specified.

1.3. Description of the study area

The research was limited in City of Kigali with National and International currently roads Contractor's working with City of Kigali, Kicukiro District, Gasabo District, Nyarugenge District and MININFRA through RTDA due to following reasons:

- Most of road contractors are based in City of Kigali;
- About 25% of Rwanda budget each year is budgeted for roads infrastructures and City of Kigali is among cities which is under development;



Figure 1. City of Kigali map [69]

1.4. Problem Statement

Generally many countries under development fail to accomplish successfully contracted highway projects within due period due to lack of or poor planning, whereby projects run by chance or luck including those in City of Kigali (Rwanda). It has been observed that there is a delay of completion for Road Contractor's during the execution of roads projects in City of Kigali, that delay result from several reasons and among a series of reasons for project failing, Mr. Hughes (1986) identified three main reasons for projects failing such as:

- Lack of understanding of project management tools and an over reliance on project management software,
- Communication problems, and
- Failures to adequately adjust to changes that occur during the course of the project.

The research problem was expressed in the following statement: *“There is a delay of roads projects completion contractual dates in Kigali, due to lack of understanding and usage of project management tools and techniques and their project management software over the entire life cycle of project”*.

The research overcame the started problem then determine appropriate sets of guidance on the use of project management tools and techniques in such away roads projects success in City of Kigali, therefore; project management skills is very important and needful to smoothly run projects as per the goals.

1.5. Research Objectives

1.5.1. Main Objective

To investigate the use and importance of project management tools and techniques for improved projects success in Highway Projects in Kigali

1.5.2. Specific Objectives

- i. To thoroughly review the literature in the general areas of project management tools techniques, and in the particular context of Highway Projects
- ii. To ascertain and document the most frequently used project management tools and techniques, at different stages of the project lifecycle, in highway projects in Kigali and offer reasons for their use
- iii. To investigate the perceptions of practitioners as to the effectiveness of the most frequently used project management tools and techniques in so far as it pertains to project success
- iv. To document the main challenges that impact on the use and exploitation of project management tools and techniques in highway projects.
- v. To establish the need for training, if at all, for the use and exploitation of project management tools and techniques for highway projects in Kigali.
- vi. To identify and document the Critical Success Factors (CSF) associated with the effective use and exploitation of project management tools and techniques in Highway Projects in Kigali.

- vii. To provide appropriate sets of guidance around (i) the most frequently used project management tools and techniques (ii) effectiveness of tools and techniques across project lifecycles and (iii) the need for training on the use of appropriate tools and techniques. The purpose being to improve awareness and understanding of good practices and with a view of benefiting highway projects and clients/customers.

1.6. Research Proposition

City of Kigali like other Rwandan Institutions receives annual budget from its government to run various projects including highway projects. Among those projects some are funded by RMF as well as NGO's and other National and International donor's volunteers. This action is followed by projects implementation process that needs proper and adequate project management process. Thus the lack of understanding of project management tools and techniques and their impact on project success leads to the failure of highway projects completion on due date.

Therefore, the use and importance of project management tools and techniques for the above process is indirectly estimating the efficiency of highway projects in Kigali.

1.7. Research Contribution

The research provided deeply to the researcher a general understanding of project management tools and techniques for highway projects in Kigali. It will also provide for both Clients and Contractors to review the use and importance of project management tools and techniques during the entire project life cycle.

The better the use of project management tools and techniques, the better the quality of the project and improved control of cost and time overruns, which may improve performance of project resources and save cost and time for other interventions.

1.8. Structure of the Research

The thesis consists of nine chapters such as:

Chapter 1: General Introduction to the research that present the background, problem statement, research objectives, research contribution and research structure.

Chapter 2: discusses the Literature Review.

Chapter 3: presents the Research Methodology and Methods.

Chapter 4: focuses on Frequency of use of project management tools and techniques at different stages of the project lifecycle, and associated challenges

Chapter 5: Practitioners' views on the effectiveness of the most frequently used project management tools and techniques, and need for training

Chapter 6: Impact of the use and exploitation of project management tools and techniques in highway projects.

Chapter 7: Critical Success Factors (CSF) associated with the effective use and exploitation of project management tools and techniques in Highway Projects in Kigali.

Chapter 8: Appropriate sets of guidance, frequency of use, effectiveness of, and training needs of planning tools and techniques in highway projects

Chapter 9: Conclusions and Recommendations

References

Appendices

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Project management has been around for decades and has gained its reputation in recent years as a management practice that helps an organization to achieve its business results. Project management helps an organization reduce product development time to market, utilize limited resources, handle technological complexity, respond to stakeholder satisfaction and increase global market competition [1]. Even with its significance in business practices, research on project management is still relatively young and lacks theoretical bases and concepts [2]. To lead a project successfully, a project manager has to become practiced at initiating, planning, executing, monitoring and controlling and closing [3]. To do so, project managers typically use several tools and techniques to help them coordinate activities along a project life cycle. This seems to be the correct approach since several studies have suggested that the proper use of project management tools and techniques impacts the success of a project [4-10]. On the contrary, the inappropriate use of tools and techniques can also be counterproductive to project management outcomes [6-12].

In practice, there are many project management tools and techniques (PMTT) available to project managers and project team members. The questions are: ‘what are the appropriate PMTT to use that will lead to better project performance and when should a project manager or a team member use such tools and techniques?’. While PMTT literature suggests the use of some tools and techniques, propositions were based on experience or the conceptual beliefs of the authors rather than on solid empirical research. In addition, while the literature focuses mostly on the use of certain tools and techniques, it fails to empirically confirm the impact of the use of PMTT on project success. [2] The research question is: ‘In a specific phase of a project life cycle, which project management tools and techniques are used and whether or not such uses impact the success of a project?’ The answer to this question is to investigate the use and importance of project management tools and techniques for improved projects success in Highway Projects in Kigali.

Nowadays, project management is supported by various tools and techniques. By using appropriate tools and techniques in the right way will have direct impact on the delivery of a successful project [13]. Despite the fact that with all the support and help which can be provided by using some well known project management software and structured approaches, projects may still fail to meet their target deadlines within their budget. Many things can go wrong during the course of any project and these may lead the project to not satisfy its objectives [13]. Additionally, it is argued that there is no doubt that any estimation for the project's costs is likely to have a margin [13].

Generally, it is accepted that a good process of project evaluation and control, supported by appropriate project management tools and techniques, can reduce the incident of projects being over time and over budget. In a useful survey findings indicate that all project managers should be trained on the use of project management software in order to deliver effective management for their projects [13].

2.2. Project Management Tools and Techniques

In the literature, PMTT have been discussed mostly in project management books, both for academic and practical purposes. In terms of the definition, some authors perceived PMTT as software for project management [14] while others view them as systematic procedures or practices that project managers use for producing specific project management deliverables [15]. Since it is mostly in book form, generally, the literature on PMTT discusses the processes of how to use PMTT and to a certain extent, the benefits of using PMTT to produce the project management deliverables for each project management activity. The same discussion is also found in some journal articles. For example, [16] discuss the use of Monte Carlo analysis for project risk analysis while [17] discusses the use of Work Breakdown Structure. Earned Value Management is a topic of discussion for many authors [18-20]

Project Management Institute (PMI) has suggested nine knowledge areas in project management [21]. In project integration management, the literature suggests the use of PMTT such as project selection methods and project charter [22-24]. Work Breakdown Structure (WBS), scope statement and quality function deployment, etc. should be used for scope management [22-25].

For project cost management, several authors suggest the use of cost estimating techniques and Earned Value Management [18-26]. In quality management, a project manager has the options of benefit/cost analysis, flowcharting, cause-and-effect diagrams, cost of quality, Pareto diagrams, and control charts [22-24]. CPM, PERT, GERT, Gantt charts, simulation, Monte Carlo analysis, buffer management, schedule crashing, milestone charts, etc. are the PMTT suggested for time management [16-27]. Risk matrix, Monte Carlo analysis, decision tree analysis, check list, SWOT analysis and Delphi are some examples of PMTT available for project risk management [16-24]. PMTT such as stakeholder analysis and responsibility matrix can be used for human resource management and communications management [22-24]. Make-or-buy analysis and contract type selection are the options of PMTT for procurement management [23].

Table here below illustrates some examples of PMTT present in the literature, organized using project management knowledge areas [3]. Note that some PMTT, e.g. ROI, Payback period, cost/benefit analysis, SWOT analysis, flow charting, cause-and-effect diagram and risk management, are common to both project and general management. Others PMTT such as WBS, Earned Value Management, CPM, PERT and GERT are unique to project management.

Since there are many PMTT available for project managers, the question arises ‘How are PMTT actually used in practice?’ Thamhain’s study on project managers’ familiarity with the use of PMTT indicates that only 28% of PMTT in the study are actually used by project managers and project managers have only 50% basic familiarity with those tools and techniques [76].

Table 1: PMTT and project management knowledge areas [2]

Knowledge areas	PMTT
Integration management	Project selection, return on investment, payback period, project charter
Scope management	WBS, scope statement, quality function deployment, change request, scope change control, product review, performance measurement, lesson learned
Cost management	Cost estimating techniques, earned value management, cost change control system, performance measurement
Quality management	Benefit/cost analysis, flowcharting, cause-and-effect diagram, cost of quality, Pareto diagram, control charts, trend analysis, quality audits, benchmarking, statistical sampling
Time management	CPM, PERT, GERT, Gantt charts, simulation, Monte Carlo analysis, buffer management, schedule crashing, milestone charts, variance analysis
Risk management	Risk matrix, Monte Carlo analysis, decision tree analysis, check list, SWOT analysis, and Delphi, project risk audit, earned value management
Human resource management	Stakeholder analysis, responsibility matrix, team building activities, reward and recognition systems, organisation charts, project team directory
Communications management	Stakeholder analysis, earned value management, information retrieval systems
Procurement management	Make-or-buy analysis, contract type selection, statement of work, contract change control system, source selection, bidder conferences

2.3. Definitions

Even though, there are many tools and techniques from the above knowledge areas, the author has selected some of them to be discussed.

2.3.1. Project Charter

Project Charter is a statement of the scope, objectives and participants in a project and is a critical document to ensure that everyone involved in the project is aware of its purpose and objectives. It outlines the project objectives, identifies the main stakeholders, and defines the authority of the project manager [28].

It serves as a reference of authority for the future of the project and its management. The detail within the charter should be proportionate with the size of the project.

Its purpose is to document the reasons for undertaking the project, Objectives and constraints of the project, Assumptions that influence the project environment, directions concerning the solution, scope, identities of the main stakeholders and empowers the Project Manager with the authority to carry out the project [28].

A **project charter** is a document that formally recognizes the existence of a project and provides direction on the project's objectives and management [29].

2.3.2. Work Breakdown Structure (WBS)

A project team armed with a well-defined project scope document can proceed to the next most important phase in project planning: development of the work breakdown structure (WBS). The WBS is a hierarchical structure in which all of the major phases of project work are organized in a logical manner. Simply stated, it is a layout of how the work of the project has to be performed and managed. [59]

The WBS links together the project scope, the schedule, and the cost elements, and forms the basis for the entire project information structure.

It provides the framework that captures the project's work information flows, as well as the mechanism for tracking the project's schedule and progress. It also provides the basis for summarizing and reporting the project's cost data.

In essence, the WBS creates a common framework that

- ✓ Presents the entire project as a series of logically interrelated elements
- ✓ Facilitates project planning
- ✓ Provides the basis for estimating and determining project costs and budgets
- ✓ Provides the mechanism for tracking project performance, cost, and schedule
- ✓ Provides the basis for determining the resources needed to accomplish project objectives
- ✓ Provides the mechanism for generating project schedule and status reports
- ✓ Triggers the development of the project network and control systems
- ✓ Facilitates the assignment of responsibilities for each work element of the project

There are some important features to note here. First, the breakdown of project activities is hierarchical, moving from the overall project level, down through specific project deliverables (and sometimes sub deliverables), and finishing with work packages. According to the Project Management Institute's PMBoK, work packages are the elemental tasks at the lowest level in the WBS and represent basic project activities for which duration and budget figures can be assigned. Along with a well-defined project scope document, a WBS with sufficient levels of detail is an invaluable tool for managing scope change. Project scope can easily be expanded or diminished by including or eliminating the appropriate work packages, and by making the necessary adjustments in terms of resources and schedules. [67]

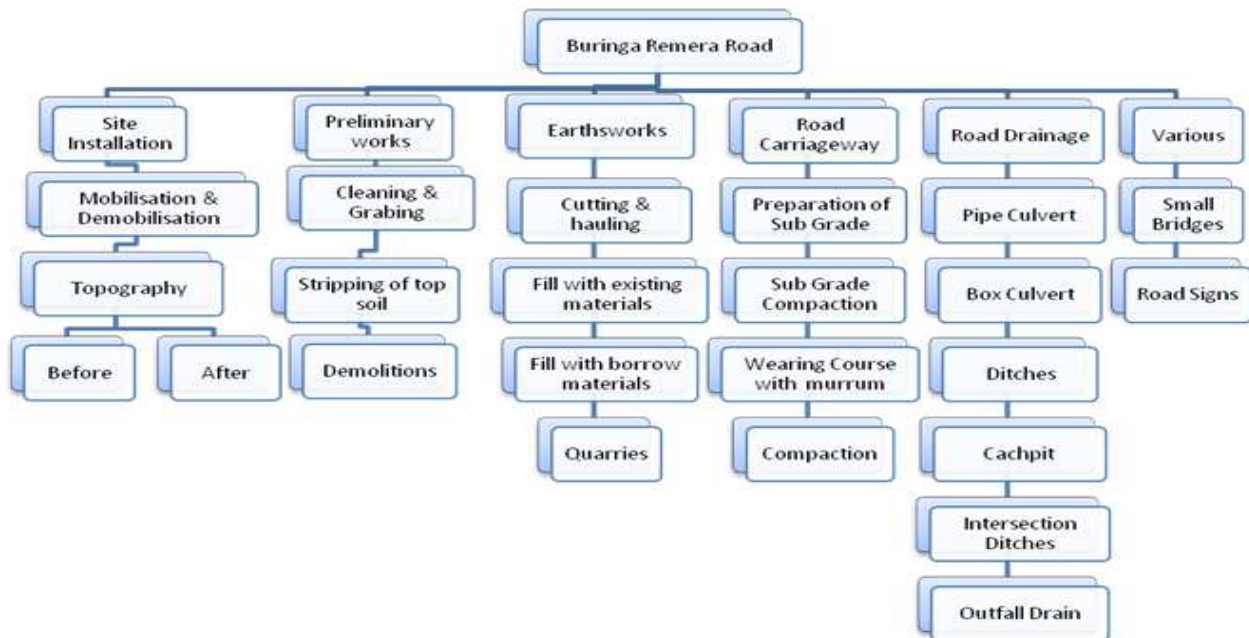


Figure 2: Own designed Work Breakdown Structure

WBS is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project says **PMBOK Guide (ed.) (2008)**.

The provided WBS above divides the work and responsibility into individual work packages which makes it easy for the project manager to manage and monitor the implementation for the project by:

- ✓ Making it possible to plan, schedule and budget;
- ✓ Providing a framework for tracking and monitoring cost and work performance;
- ✓ Defining communication channels;
- ✓ Assisting in understanding and coordinating many parts of the project;
- ✓ Pointing to problems and ensuring they are quickly addressed.

AEW Services, Vancouver, BC © 1990, 2001 argue that the process of project control described earlier requires the establishment of a firm base line defined in terms of scope, quality, time and cost on a compatible basis, and in units that can be more readily handled. One of the more important and powerful techniques for managing a large complex project, therefore, is the Work Breakdown Structure (WBS), which greatly facilitates control.

Types of Work Breakdown Structures

There are many different types of work breakdown structures. The **product-based WBS** is most suitable for projects that have a tangible outcome, such as the design and construction of a tunnel, or a new fighter jet prototype. In these kinds of product-based work breakdown structures, it is relatively easy to break the project into deliverables, sub deliverables, and ultimately into manageable work packages. A product-based WBS also facilitates cost estimation of the various product components, which in turn provides a basis for comparison with the project's actual cost performance.

Organizational breakdown structure, known as OBS, the organizational units responsible for completing the work requirements of the project are integrated into the structure. The clear advantage of an OBS is that it establishes, in a hierarchical format, accountability, responsibility, and reporting relationships for the various organizational units that are involved in completing the work.

When a project involves a series of phases or tasks, such as in an information systems project, a **process oriented WBS** is more appropriate.

Unlike a product based WBS, a process-oriented WBS involves completion of major tasks in sequence as the project evolves over time. In general, a process-oriented WBS can be better integrated with the overall project, because the tasks can be delineated to the lowest level, while the product-based WBS is most useful for accumulating product cost information.

In addition, hybrid structures that involve a combination of features from both product- and process-based structures can be used.

In the present-day project environment, with its proliferation of computerized project management systems, both types (product and process) of WBS can be used. However, the choice really depends on the particular project, its purpose, the organization's information system and how it interfaces with the other organizational units, and, ultimately, how useful it is as a planning aid. [67]

Work Breakdown Structure Development

The construction of the WBS is worthy of special consideration, because it is critical to the information structure that will be set up to cover most of the project's managerial data set. In this section, we review the procedure for constructing a WBS, as well as some of the practical aspects that should be considered in developing one.

Constructing a WBS is a group effort. The responsibility for the top three levels usually lies with the project manager, who typically works with other managers to develop the major deliverables found there. At the lower levels, however, input into the details should come from those responsible for the day-to-day work. In addition to the project team, each person responsible for a specific work package must be consulted.

There are no universal standards as to the number of levels to use in a WBS. This is typically dictated by the complexity of the project, and the number and nature of the activities. Most have three or four levels at a minimum, although more may be needed if there are significantly more sub deliverables and work packages.

As a rule, the greater the number of work packages, the greater the amount of time, effort, and cost incurred in developing the WBS. However, the increased number of packages also significantly enhances the accuracy of project status monitoring and reporting. On the other hand, larger but fewer work packages reduce the cost of WBS development, but the accuracy of project status monitoring and reporting suffers. In most practical situations, a compromise on the number and size of work packages is struck.

The most important levels in the WBS development process are the top few levels, which represent the project and associated major deliverables, and the lowest levels, which represent the work activities that are to be scheduled and resourced. Typically, the intermediate levels are an aggregation of the lower-level activities, and serve as the mechanism for reporting. The intermediate levels can also be used to set up cost accounts through which cost and budgetary information can be gathered and monitored.

A WBS should be constructed by separating the total work, in a hierarchical framework, into discrete and logical sub elements that reflect completeness, compatibility, and linkage to the project's end item. This hierarchical structure facilitates the aggregation of budget and actual costs incurred into larger cost accounts. In this way, the total value of the work at one level is an aggregation of all the work completed one level below, which enables project work and cost performance to be monitored. The WBS should also reflect all of the project requisites, as well as functional requirements, and should incorporate both recurring and nonrecurring costs.

In a WBS, the lowest level consists of tasks of short duration that have a discrete start and end point. Because they consume resources, costs are often reported at this work package level. Work packages serve as control point mechanisms for monitoring and reporting performance, in terms of whether associated tasks were completed according to specifications, on time, and within budget. The responsibility for completing work packages should be assigned to the appropriate organizational units and individuals, and the resulting WBS should reflect the reporting requirements of the organization.

Therefore WBS can develop by one of two methods: top-down or bottom-up.

-  The **top down approach** begins with the total work required to produce the project's end product. This is successively broken down, first into major work blocks and then into more detailed work package levels until a required level of detail has been achieved.
-  The **bottom up approach** begins with a comprehensive list of all the activities or tasks required to complete the project. Then it moves up, in a hierarchical format, first to work packages, then to cost accounts, and so on, until the top level represents the total work to be performed.

It is highly unlikely that the first version of the WBS will be the last. More often than not, it will undergo frequent revisions in response to feedback that work must be broken into more detailed tasks.

Clearly, only individuals who have a thorough knowledge of the work to be performed can conduct the appropriate level of detailed breakdown. In addition, it is impossible to establish estimates of task duration, resource requirements, and the network of precedence relationships among activities without complete agreement on details at the lowest level. One final caveat: while the WBS is very much a part of the overall project planning process, the two data sets for project planning and the work breakdown structure are distinct entities and should be kept separate. [67]

2.3.3. Earned Value Management

Refer to Project Management body of knowledge; Earned Value Management (EVM) in its various forms is a commonly used method of performance measurement. It integrates project scope, cost and schedule measures to help the project management team assess and measure project performance and progress. It is a project management technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project (PMI, 2004).

Components of EVM:

- **Planned value (PV):** Means, the approved budget for the work scheduled to be completed by a specified date; also referred to as the budgeted cost of work scheduled (BCWS). The total PV of a task is equal to the task's budget at completion (BAC) the total amount budgeted for the task.
- **Earned value (EV):** Means, the approved budget for the work actually completed by the specified date; also referred to as the budgeted cost of work performed (BCWP).
- **Actual cost (AC):** Means, the costs what you have actually spent at a given time; also referred to as the actual cost of work performed (ACWP).

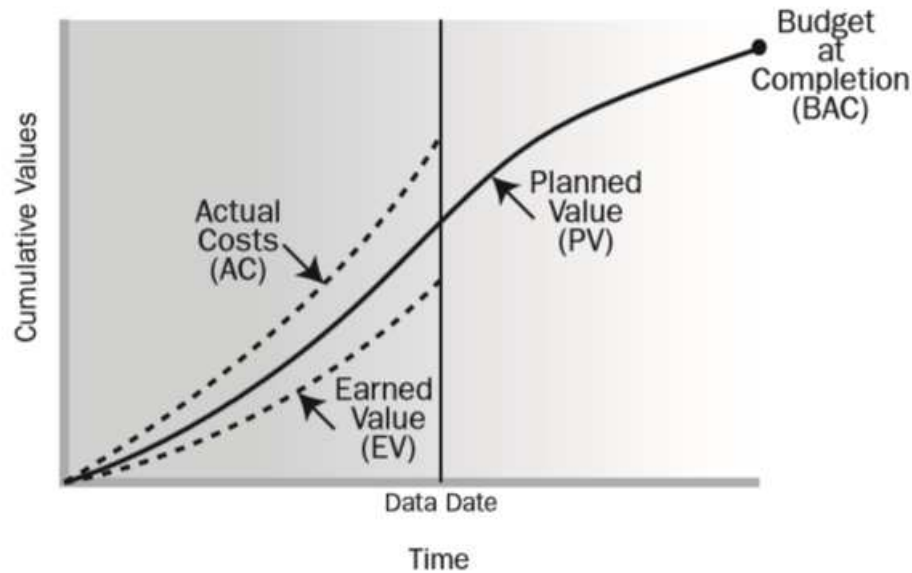


Figure 3: EVM Components (PMI, 2004)

After the approval of project baseline below variances should be monitored in such way project meets its expectations:

- ✓ **Schedule variance.** Refer to project management body of knowledge; Schedule variance (SV) is a measure of schedule performance on a project. It is equal to the earned value (EV) minus the planned value (PV). The EVM schedule variance is a useful metric in that it can indicate a project falling behind its baseline schedule. The EVM schedule variance will ultimately equal zero when the project is completed because all of the planned values will have been earned. EVM SVs are best used in conjunction with critical path methodology (CPM) scheduling and risk management. (PMI, 2004).

$$\text{Equation, } SV = EV - PV.$$

- ✓ **Cost variance:** The project management body of knowledge says that; Cost variance (CV) is a measure of cost performance on a project. It is equal to the earned value (EV) minus the actual costs (AC). The cost variance at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent. The EVM CV is particularly critical because it indicates the relationship of physical performance to the costs spent. Any negative EVM CV is often non-recoverable to the project. (PMI, 2004).

Equation, $CV = EV - AC$.

- ✓ **Schedule performance index.** The project management body of knowledge says that, the schedule performance index (SPI) is a measure of progress achieved compared to progress planned on a project. It is sometimes used in conjunction with the cost performance index (CPI) to forecast the final project completion estimates. The SPI is equal to the ratio of the EV to the PV. (PMI, 2004).

Equation, $SPI = EV/PV$.

- ✓ **Cost performance index.** The project management body of knowledge states that, the cost performance index (CPI) is a measure of the value of work completed compared to the actual cost or progress made on the project. The CPI is equal to the ratio of the EV to the AC. (PMI, 2004).

Equation, $CPI = EV/AC$.

Histogram below illustrate the keys EVMS performance measurements metrics

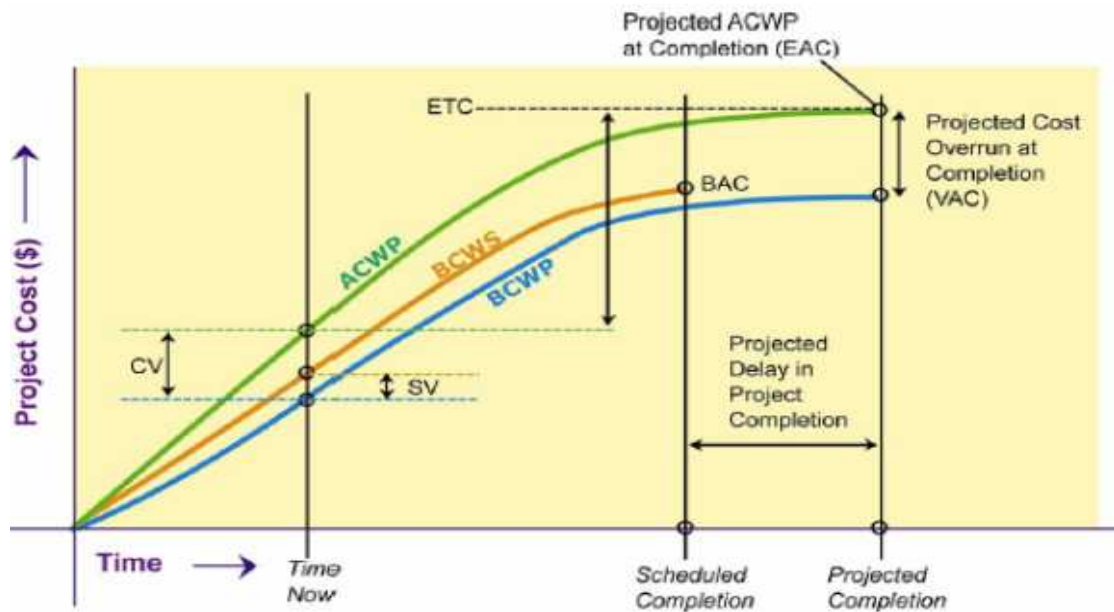


Figure 4: Keys EVMS Performance Measurement Metrics [55]

2.3.4. Critical Path Method (CPM)

CPM is a schedule network analysis technique used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. Early start and finish dates are calculated by means of a forward pass, using a specified start date. Late start and finish dates are calculated by means of a backward pass, starting from a specified completion date, which sometimes is the project early finish date determined during the forward pass calculation says **PMBOK Guide (ed.) (2008)**.

Critical path method (CPM) is a schedule network analysis technique. It determines the amount of float, or schedule flexibility, for each of the network paths by calculating the earliest start date, earliest finish date, latest start date, and latest finish date for each activity.

This is a schedule network analysis technique that relies on sequential networks (one activity occurs before the next, a series of activities occurring concurrently is completed before the next series of activities begins, and so on) and on a single duration estimate for each activity. The precedence diagramming method (PDM) can be used to perform CPM.

Keep in mind that CPM is a method to determine schedule durations without regard to resource availability.

The *critical path (CP)* is generally the longest full path on the project. Any project activity with a float time that equals zero is considered a critical path task. The critical path can change under a few conditions. When activities with float time use up all their float, they can become critical path tasks. Or you might have a milestone midway through the project with a *finish no later than* constraint that can change the critical path if it isn't met.

Float time is also called *slack time*, and you'll see these terms used interchangeably. There are two types of float: total float and free float. *Total float (TF)* is the amount of time you can delay the earliest start of a task without delaying the ending of the project. *Free float (FF)* is the amount of time you can delay the start of a task without delaying the earliest start of a successor task.

In the following section, you'll calculate the CP for a sample project, and I'll illustrate how you derive all the dates, the CP, and the float times. **PMP Guide (5th edition) (2009)**

CPM as a management methodology has been used from the mid 50s. The main objective of the CPM implementation was to determine how best to reduce the time required to perform routine and repetitive tasks that are needed to support an organization. Initially this methodology was identified to conduct routine tasks such as plant overhaul, maintenance and construction. (Moder and Phillips, 1964) Critical path analysis is an extension of the bar chart.

The CPM uses a work breakdown structure where all projects are divided into individual tasks or activities. For any project there is a sequence of events that have to be undertaken. Some tasks might be dependent on the completion of the previous tasks while other might be independent of the tasks ahead and can be undertaken at any given time.

(Lowe, 1966) Job durations and completion times also differ significantly. CP analysis helps decision makers and project execution members to identify the best estimates (based on accurate information) of the time that is needed to complete the project.

There exist two methods by which the Critical Path can be identified such as:

- a. **The forward pass:** Here, CPM calculates the earliest time within which a project can be completed. “The date each activity is scheduled to begin is known as the “early start,” and the date that each activity is scheduled to end is called “early finish.” (Winter, 2003) In this method of critical path determination, the earliest possible date for starting of the project is identified and then the activities are lined up to identify the completion date.
- b. **The backward pass:** Here, selecting the date 2. When the organization wishes to complete the project or the last activity identifies CP. Time requirements are based on working backward from the final date desired for the last activity to the initial first activity. The dates identified in this method of CPM are called late start dates (for the starting of the first activity) and the late finish dates (for the last activity in the project).

Important for the CPM using either the forward pass or the backward pass is that the total time needed for completion of the project does not change but the dates when the project can be started might differ based on the approach used in the two methods. The selection of either the forward or the backward pass depends on the final desired results and the available documents and accurate data needed to determine the time for every activity on the network diagram.

(Baram, 1994) Slack or float is defined as the time between the earliest starting time (using the forward pass method) and the latest starting time (using the backward pass method) used for identifying the critical path. Total float (float) is the amount of time an activity can be delayed without delaying the overall project completion time. (Winter, 2003)

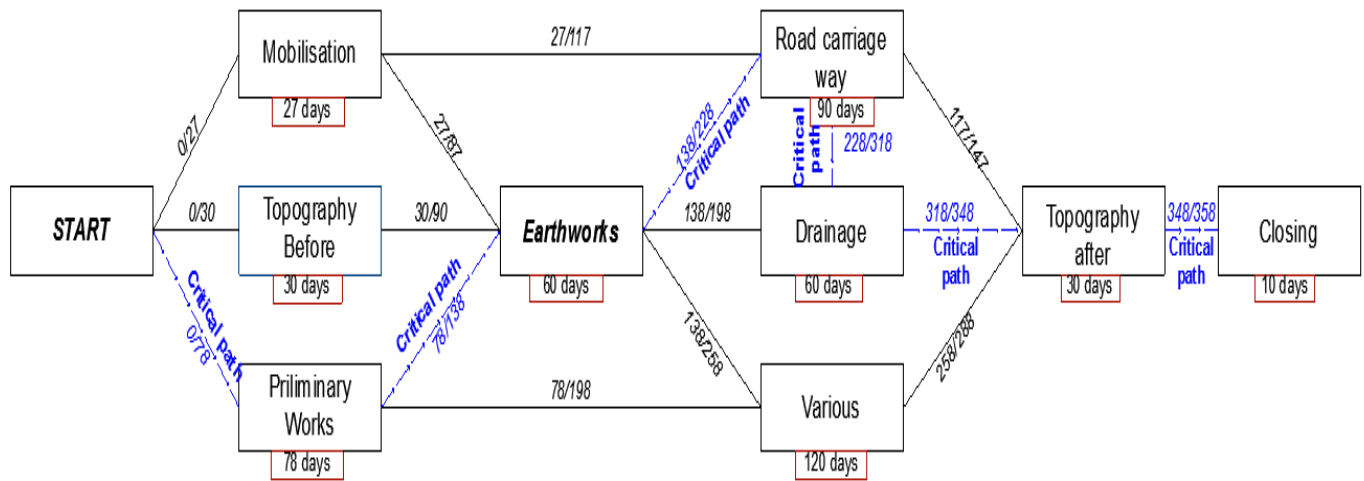
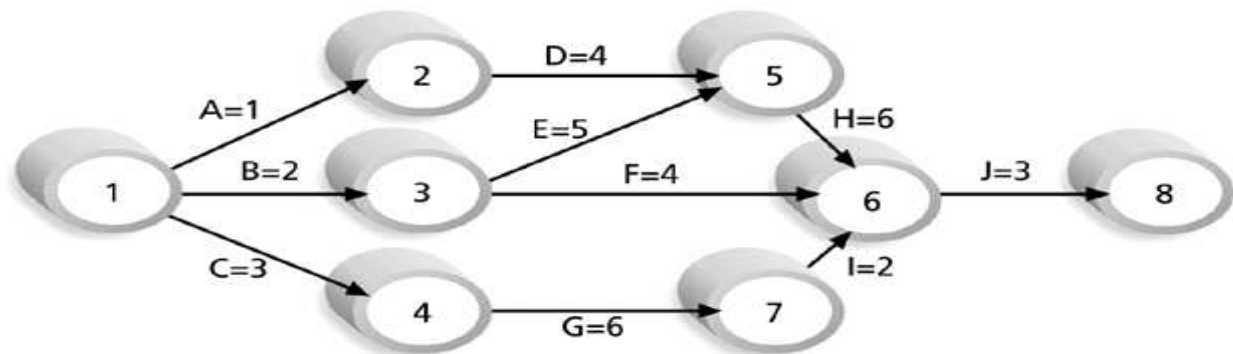


Figure 5: Own designed Critical path method diagram

Example: Determining the Critical Path for X Project



Note: Assume all durations are in days.

Path 1: A-D-H-J Length = 1+4+6+3 = 14 days

Path 2: B-E-H-J Length = 2+5+6+3 = 16 days

Path 3: B-F-J Length = 2+4+3 = 9 days

Path 4: C-G-I-J Length = 3+6+2+3 = 14 days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

Figure 6: Critical Path for a project (Class notes by Prof. Charles EGBU: 2013)

Advantages of using the Critical Path Method

In the age where tools available to management are constantly changing and improving the ability of CPM to still command respect among the project teams and managers is testimony to the fact that this tool has proved very valuable and beneficial. Listed below are some of the major reasons why CPM is still used in organizations today:

- ✓ CPM encourages managers and project members to graphically draw and identify various activities that need to be accomplished for project completion. This step encourages all members in the project team to evaluate and identify the requirements of the project in a critical and logical fashion.

Activities that precede and follow other activities also require their own evaluation and analysis. This factor becomes very important if the activities are conducted at different physical locations and the time and cost element is also subjected to external variables that have the potential to seriously impact the project time.

- ✓ The network diagram also offers a prediction of the completion time of the project and can help in the planning and scheduling of the activities needed for the completion of the project.
- ✓ Identifying the critical path for the project is the next stage of the analysis of the network diagram. In doing this, the management of the project has a reasonable estimate of the potential problems that might occur and the activities at which these problems might occur. In many cases the critical path also determines the allocation of resources. The interpretation of the network diagram also ensures that the same resource is not allocated for the same period of time.
- ✓ CPM also encourages a disciplined and logical approach to planning, scheduling and managing a project over a long period of time. Often, the root cause of many project overruns is the failure to identify the factors that have the potential to seriously impact the project. By forcing individuals in the project team to identify activities, attention to details can be achieved.

In turn, this helps a true and much more accurate picture of the processes that need to be set up for the project and the time and cost that is needed for every stage.

- ✓ A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the organization is also an important task to be undertaken at this point.

In an organization, SWOT analysis should be undertaken at the corporate level and at the department level. Carrying out an analysis using the SWOT framework will reveal changes that can be accomplished; as opposed to those changes that appear to be optimal solutions initially but would not be as effective in the long run. Being realistic when evaluating variables affecting the organization's function and its future is very important in order to make the SWOT analysis exercise effective. Areas of improvements, problems faced, badly executed decisions and avoidable choices made have to be evaluated. The opportunities and the areas where the company can grow and improve should also be evaluated along with real and perceived threats that face the company. Identifying methods for creating an effective team performance across job-function strata in the organization; and analyzing the methods for assigning responsibilities and duties is important.

- ✓ Optimization of the time-cost relationship in project management is also possible using the CPM as managers can visually identify the activities that can pose a problem if not managed and monitored effectively over a period of time

In many situations the cost structures in organizations are still based on functional structures, although project structured organization might have different form of costing used for different projects. The task of identifying the accurate cost of the project is not easy and is not universal to all projects or all companies. Developing time-cost relationships for projects requires that project managers are able to identify root cause of the problems that are impacting the time and the cost variable.

- ✓ Based on the time-cost variables, the project can be tweaked to best satisfy the goals and aims of the organization. For example, if a project team is able to identify that they need more time if the project has to be within a certain budget or vice versa this fact is clear right from the start of the project.

While it is presumptuous to aver that every factor affecting activities can be identified at the initial stages, a large portion of the factors and variables can be understood and the risks and uncertainties associated with each are known prior to starting of the project.

- ✓ Tracking the CPM is also helpful. Managers can identify areas where attention needs to be focused.

Critical paths do not remain static for the life of the project; rather there is a very high chance that the CP might change due to internal and external factors affecting the organization.

The 9/11 attacks, for example, shutdown every major port. CP that estimated for example seven days for delivery of raw material from out of the U.S. had to change their critical paths. In some cases, the internal factors such as union issues and sudden equipment failure might also impact the critical path.

- ✓ Scheduling of activities is possible. The CPM identifies the entire chain of activities. Often, during the initial stages of the project the number of activities and the cost requirements might be high; but as the project progresses the activities might sort themselves out into routine or critical. Project managers, instead of tackling the entire issue, can focus their attention to groups of activities that are immediate and have the ability to impact the next downstream activity.
- ✓ The CPM also identifies slack and float time in the project. Thus, project managers can identify when resources can be reallocated to different activities and the shifting and moving of activities to best optimize the utilization of the resources.
- ✓ Critical paths are also periodically updated for any project and offer the project manager and members visual representations of the completion of various stages of the project and easily identify problem areas where further attention might be required.
- ✓ In many large projects, there can be more than one critical path in the network diagram mapped out. When such a situation arises, CPM can help managers identify suitable plan of actions to handle these multiple critical paths.
- ✓ CPM has been widely used by a variety of organizations in almost all industries with great success. CPM can also help estimate the project duration and this information can be used to minimize the sum of direct and indirect costs involved in the project planning and scheduling.
- ✓ CPM offers organizations a form of documentation that they can reuse for similar projects that they might undertake in the future. Documenting various activities and the root causes of the problems can help future-project manager avoid similar pitfalls.

In addition, documentation can provide valuable data for estimation of time requirements and cost factors, as opposed to managers using estimations and guesses of the cost.

- ✓ Critical Path Analysis formally identifies tasks which must be completed on time for the whole project to be completed on time, and also identifies which tasks can be delayed for a while if resource needs to be reallocated to catch up on missed tasks. (Mind Tools, 2004) The CPM can identify the paths that can be taken to accelerate a project to be completed prior to its due date or identify the shortest possible time or the least possible cost that is needed to complete a task.
- ✓ CPM methods are based on deterministic models and the estimation of time activities are based on historical data maintained within the organization or data obtained from external sources (like request for proposals return information) [60]

2.3.5. Gantt chart

A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. On the left of the chart is a list of the activities and along the top is a suitable time scale. Each activity is represented by a bar; the position and length of the bar reflects the start date, duration and end date of the activity. [70] This allows you to see at a glance:

- What the various activities are
- When each activity begins and ends
- How long each activity is scheduled to last
- Where activities overlap with other activities, and by how much
- The start and end date of the whole project

To summarize, a Gantt chart shows you what has to be done (the activities) and when (the schedule). [72]

Gantt chart is a graphic display of schedule-related information. In the typical bar chart, schedule activities or work breakdown structure components are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars says **PMBOK Guide (ed.) (2008)**.

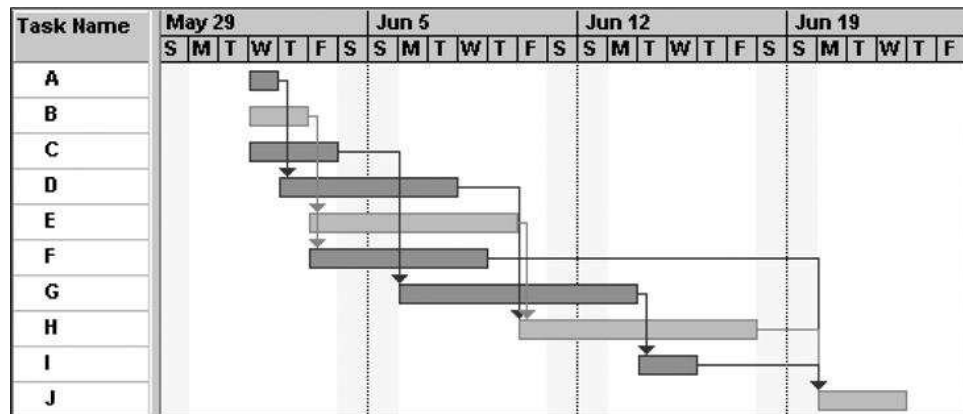


Figure 7: Gantt chart diagram (Class notes by Prof. Charles EGBU: 2013)

Advantages of Gantt chart

While there are a number of reasons to use Gantt charts below are five key reasons they are often advantageous:

- ✓ **Avoid Completion Confusion:** Gantt charts were created to keep users on track, providing a visual timeline for starting and finishing specific tasks. By providing a visual overview of milestones and other key dates, these charts are thought to offer a more understandable and memorable method of maintaining timescale-based tasks and deliverables whether tracked on a daily, weekly, monthly or yearly basis. Below diagram shows the power of visualization found in Gantt charts.
- ✓ **Keep Everyone on the Same Page:** Where there is a visual framework for the work to be done, there are fewer chances for misunderstanding, especially when it comes to highly complex tasks. Using Gantt charts allow all types of stakeholders to have the same information, set mutually understood expectations, and conduct their efforts according to the desired protocol.

- ✓ **Understand Task Relationships:** These charts can make clear how various tasks are interrelated and perhaps rely on the completion of another to meet specific objectives. These task relationships revolve around understanding the timing of each task, which then impacts other tasks listed. This can better assure the optimum work flow, maximized productivity and overall project success.
- ✓ **Effectively Allocate Resources:** By being able to look ahead on the Gantt chart, users can clearly discern where resources need to be anticipated, allocated or shared to maximize the use of those resources. The more closely the chart is followed, the better chance there is of keeping project costs within budget while also better assuring on-time completion.
- ✓ **Get a Handle on the Future:** While it is often easy to get caught up in day-to-day tasks as detailed on a chart, Gantt chart advantages include helping decision-makers look farther ahead to ensure each given project is working toward the achievement the organization's long-term strategic objectives. [70]

2.3.6. Program Evaluation & Review Technique (PERT)

PERT was developed during the 1950s through the efforts of the U.S. Navy and some of its contractors working on the Polaris missile project. Concerned about the growing nuclear arsenal of the Soviet Union, the U.S. government wanted to complete the Polaris project as quickly as possible. The Navy used PERT to coordinate the efforts of some 3,000 contractors involved with the project. Experts credited PERT with shortening the project duration by two years. Since then, all government contractors have been required to use PERT or a similar project analysis technique for all major government contracts. [60]

The Program Evaluation and Review Technique (PERT) is a widely used method for planning and coordinating large-scale projects. As Harold Kerzner explained in his book *Project Management*, "PERT is basically a management planning and control tool. It can be considered as a road map for a particular program or project in which all of the major elements (events) have been completely identified, together with their corresponding interrelations'. PERT charts are often constructed from back to front because, for many projects, the end date is fixed and the contractor has front-end flexibility.

"A basic element of PERT-style planning is to identify critical activities on which others depend. The technique is often referred to as PERT/CPM, the CPM standing for "critical path method." [71]

NETWORK DIAGRAMS

The chief feature of PERT analysis is a network diagram that provides a visual depiction of the major project activities and the sequence in which they must be completed. Activities are defined as distinct steps toward completion of the project that consume either time or resources. The network diagram consists of arrows and nodes and can be organized using one of two different conventions. The arrows represent activities in the activity-on-arrow convention, while the nodes represent activities in the activity-on-node convention. For each activity, managers provide an estimate of the time required to complete it. [60]

The sequence of activities leading from the starting point of the diagram to the finishing point of the diagram is called a path. The amount of time required to complete the work involved in any path can be figured by adding up the estimated times of all activities along that path. The path with the longest total time is then called the "critical path," hence the term CPM. The critical path is the most important part of the diagram for managers: it determines the completion date of the project. Delays in completing activities along the critical path necessitate an extension of the final deadline for the project. If a manager hopes to shorten the time required to complete the project, he or she must focus on finding ways to reduce the time involved in activities along the critical path. [60]

The time estimates managers provide for the various activities comprising a project involve different degrees of certainty. When time estimates can be made with a high degree of certainty, they are called deterministic estimates. When they are subject to variation, they are called probabilistic estimates. In using the probabilistic approach, managers provide three estimates for each activity: an optimistic or best case estimate; a pessimistic or worst case estimate; and the most likely estimate. Statistical methods can be used to describe the extent of variability in these estimates, and thus the degree of uncertainty in the time provided for each activity. Computing the standard deviation of each path provides a probabilistic estimate of the time required to complete the overall project [60]

PERT ANALYSIS

Managers can obtain a great deal of information by analyzing network diagrams of projects. For example, network diagrams show the sequence of activities involved in a project. From this sequence, managers can determine which activities must take place before others can begin, and which can occur independently of one another. Managers can also gain valuable insight by examining paths other than the critical path. Since these paths require less time to complete, they can often accommodate slippage without affecting the project completion time. The difference between the length of a given path and the length of the critical path is known as slack. Knowing where slack is located helps managers to allocate scarce resources and direct their efforts to control activities. [60]

For complex problems involving hundreds of activities, computers are used to create and analyze the project networks. The project information input into the computer includes the earliest start time for each activity, earliest finish time for each activity, latest start time for each activity, and latest finish time for each activity without delaying the project completion. From these values, a computer algorithm can determine the expected project duration and the activities located on the critical path. Managers can use this information to determine where project time can be shortened by injecting additional resources, like workers or equipment. Needless to say, the solution of the algorithm is easy for the computer, but the resulting information will only be as good as the estimates originally made. Thus PERT depends on good estimates and sometimes inspired guesses. [71]

PERT offers a number of advantages to managers. For example, it forces them to organize and quantify project information and provides them with a graphic display of the project. It also helps them to identify which activities are critical to the project completion time and should be watched closely, and which activities involve slack time and can be delayed without affecting the project completion time. The chief disadvantages of PERT lie in the nature of reality. Complex systems and plans, with many suppliers and channels of supply involved, sometimes make it difficult to predict precisely what will happen. The technique works best in well-understood engineering projects where sufficient experience exists to predict tasks accurately in advance. [71]

PERT is a technique for estimating that applies a weighted average of optimistic, pessimistic, and most likely estimates when there is uncertainty with the individual activity estimates says **PMBOK Guide (ed.) (2008)**.

PERT is a technique that uses Optimistic time (O), Pessimistic time (P) and Realistic Time (R) estimates to calculate the EXPECTED TIME (ET) or a particular task.

The Optimistic time (o) and Pessimistic time (p) reflects the minimum and maximum possible periods of time for an activity to be completed.

The Realistic time (r) or the most likely time, reflects the Project manager's "Best Guess" of the amount of time required for a task completion. [60]

Calculating expected completion time (ET)

$$E T = \frac{o + 4 r + p}{6}$$

Because the expected Completion time should be closer to the realistic time (r), it is typically weighed Four times more than the Optimistic time (o) and the Pessimistic time (p). Once you add these values together, it must be divided by 6 to determine the Expected Time for a task. [60]

2.3.7. Cost Breakdown Structure (CBS)

Costs are allocated to the lowest level of the WBS. The tasks at this level can often be subdivided into discrete activities to be completed by different departments therefore one task may have several costs elements. Once costs have been assigned to tasks, it is possible to monitor the project in terms of actual, forecast and earned cost on a task. [73]

In order to be able to summarize costs within projects across projects a CBS needs to be developed. The majority of organizations have a standard CBS that is applied across all projects and is nearly always determined by the finance department. Finance often refers to the structure as the code of accounts which includes other elements over and above pure costs. With some computerized tools, a separate CBS is set up which is normally a simplified version of the code of accounts so that it can be understood more easily by non-financial managers. [73]

The overall purpose of the CBS is to breakdown all the associated costs for purposes of identification and control. [73]

2.4. Project success and Failure

2.4.1. Project Success

Without any specific discussion about the PMTT, the literature on project success suggests that the proper use of PMTT impacts the success of a project [4-10]. To determine the success or failure of a project, many authors proposed different project success dimensions. Recently, the literature on project success focuses on a multi-dimension and multi-criteria approach, referred to as the stakeholder approach. The logical framework method defining project success as the combination of project management success and product success [31]. He suggested that time-cost-performance can be used as criteria for project management success while the goal and purpose of the projects (e.g. customer satisfaction and profit) should be used to measure product success. Similar findings are found in the studies of [32-36]. The study of Shenhar *et al.*, (2001) suggested project success dimensions as project efficiency, benefits to customers, benefits to the performing organization and preparation for the future.

In sum, the stakeholder approach includes internal and external criteria as the dimensions of project success. Although there is no mutual agreement on what should be used as the dimensions of project success, the pattern of success dimensions from the literature can be categorized into three major groups: internal factors (time, cost and performance), customer-related factors (satisfaction, actual utilization and benefits) and organizational related factors (financial, market, benefits). These groups are aligned with the new research agenda on a value-creation aspect of projects [49]

According to Cleland *et al* (1975), a project is termed successful if it passes four success test criteria i.e. the time criterion completed on time; the cost or money criterion completed within budget; the effectiveness criterion completed in accordance with the original set performance and quality standards; and client's satisfaction criterion accepted by the intended users or clients whether the client is internal or from outside the organization. [49]

The above success criteria call for successful project implementation by the utilization of proven management techniques of planning, organizing, directing and control. The issues on life cycle management, time management, conflict resolution and management, networking, contracts management, project choice and project quality are the key factors that contribute to project success. Effective project choice, for example, which results in a good project selection, greatly improves the probability of project success especially when the project is executed in accordance with project management implementation guidelines. [49]

The Critical Path Method (CPM) and Programme Evaluation and Review Techniques (PERT), for example, contribute a lot to project success as they promote a great discipline through definition of project scope, time scale/schedule and cost. [49]

The definition of project success is ambiguous, Salleh (2009). PMBOK 4th edition (2008) stated that a project is successful if it achieves the triple objective outcome of within time, scope, and quality. This is the traditional view of project management as used by Munns and Bjeirmi (1996). It implies the successful achievement of time, cost and quality objectives, as well as the quality of the project process, Erling et al (2006). Turner (2004) identifies on time, within budget and to specification especially for information technology projects as the standard for judging success. Erling et al (2006) stated that overall project success deals with the wider and longer term impact of the project, which means both project management success and project product success. They noted that project management can be determined at the end of the project, which means in many cases, success criteria will be determine months or years after finishing the project, especially public projects. Hence, determining if a project is successful is difficult if viewed from the above two success criteria. [63]

Baccarini (1999) use the concept project success in a different approach, viewing it as product success, which implies the quality and impact of the end product to the end user (in terms of satisfaction of user(s) needs, meeting strategic organizational objectives, satisfaction of stakeholders' need) when a project execution is finished. [63]

Ashley et al (1987, p 71) defined project success as the results much better than expected or normally observed in terms of cost, schedule, quality, safety and participant satisfaction.

In their work, Baker et al (1988) defined project success to include technical performance and satisfaction among various key people on the project to clients, project team and users.

Power and Dickson (1973) mentioned in their work on managing information systems projects that time, cost, user satisfaction and the impact on computer operations. [63]

However, Lim and Mohamed (1999) cautioned that project managers should not only look at project success as the achievement of some predetermined project goals, like time, cost, performance, quality and safety, but also consider the users who do not have similar predetermined goals regarding the project at all. Hence, the expectation on the outcome of the project and the perception of project success or failure will be different for everyone, [33]. The above literatures points to Steinfort (2011, p.3) conclusion that success needs to be investigated from the perspective of active project team stakeholders as well as from that of their client/benefit recipients and in the theoretical and empirical/practical review of critical success criteria and factors on any project. [63]

2.4.2. Project Failure

Project failure is illustrated by a failure to achieve the four success criteria and is manifested by the lack of application of proven project management techniques. It does not mean that the project may not have been physically completed but the question is when is the completion? Is there any time or cost overrun? Is the quality specified standard achieved? Can it stand the test of time? Can its potential be maximally realized? Is the client and end-user satisfied? If the client is proposing another project, can he insist on working with the same team? If the answers to the above questions are in the affirmative, the project is termed successful but if otherwise it means a failure. [27]

2.5. Project Critical Success Factors (CSFs)

Many studies have been conducted over the years to determine which project management success factors influences success.

Fortune and White (2006) stated that there is a clear lack of consensus between researchers and authors regarding what factors affect project success. Baccarini (1999) Liu and walker (1998) agree that defining critical success factors for a project is contentious and intricate.

Critical success factors concept was developed by Daniel (1961) about how to manage information systems crises, and was further developed by Rockart (1979) on his work by identifying the use of critical success factors to create competitive advantage, Barbara (2010). Remus (2007) noted that the strength of critical success factors is through their identification and confirmation through working with senior management teams other teams close to the work on how to involve and concentrate on key design features for success. Zwikaël and Globerson (2006) describe critical success factors the main reasons responsible for project failure or success. They identified that project failure is still very high because critical success factors are rarely specific enough for project managers to act on. Erling et al (2006) defined critical success factors as “those features which have been identified as necessary to be achieved in order to create excellent results: if the critical success factors are not present or taken into consideration, one can largely expect that problems will be experienced which act as barriers to overall successful outcome”. [42]

Anderson and Jessen (2000) stressed the need to separate the actual task and people oriented issues while evaluating project results. They identified critical success factors based on a step wise structure, reflecting progression through a project. They covered: Scope (Project mission and goals, terms of references), Planning (Planning at global level, planning at detail level), and execution (activities, decisions), and control (financial and technical control, internal and external communication). Belassi and Turkel (1996) grouped the critical success factors into four areas: the project (e.g. size, uniqueness, urgency etc), the organization (structure, management support), the external environment (technological, financial, political) and the project manager and his team (background, skills). Cooper and Klienschmidt (1996) focused on the identification of critical success factors for new product development, including a defined strategy and adequate research and development spending. [42]

Pinto and Slevin (1987) demonstrated how to use critical success factors to diagnose a projects status. Westerveld (2003) uses foundation for quality management model to categorize critical success factors; leadership and team, policy and strategy, stakeholder management, contracting, resources, and product management. Barbara (2010) used a multi method to identify critical success factors for projects and classified them as:

People (right mix of people, in terms of skill-based, role, and the type of people), Process (short time span, tight dateline, time for celebration, use of practice run), Task (meaningful and real, well, client accessible, well defined), and Location (appropriate venues with range of facilities). Lester (1998) found a different set of critical success factors, senior management commitment, organization structure and risk management. [35]

According to Fortune and White (2006), there is a clear lack of consensus between researchers regarding what factors affects project success. The disagreement is further hardened by the dynamic nature of the business environment as it tries to adapt to fast changes in technology.

Ronald Daniel was among the first experts who offered the critical success factors as the business guidance for the first time in 1961. In his opinion there are three to six critical factors which determine the success in all industries. [35]

Among the next experts, Rockart contributed in the field of introducing the Critical success factors more than other researchers.

In 1986 Ashley identified these seven factors as the success factors:

1. Construction activities programming
2. Design planning
3. Project manager commitment to the goals
4. Project team motivation
5. Project manager technical capabilities
6. Control systems
7. Definition of work and its field

2.6. Project life cycle

2.6.1. Introduction

The project life cycle provides the basic framework for managing the projects [30-38].

Understanding project life cycles benefits research in project management; as noted by Slevin and Pinto (1987), the concept of a project life cycle provides a useful framework for looking at project dynamic overtime. Within its life cycle, a project is typically divided into phases where extra control is needed to effectively manage the completion of a major deliverable.

Depending on the management and control needs of an organization, the individuality of the industry, the nature of projects, and its areas of applications; the names and numbers of phases in project life cycles vary [30-39].

The phases can be sequential, overlapping, or spiral. While the sequential and overlapping models are common to most projects, the spiral model is widely used in software development and information system projects [39]. Even though there are many project life cycle models with various phase names and numbers of phases, the most common life cycle is the one with four distinct phases: conceptual, planning, execution and termination [30]. Since it is widely used and listed in PMBOK the authors utilized this life cycle model in this research.

2.6.2. Project Management Life Cycle

Project Management Methodology Guidebook states that the process each manager follows during the life of a project is called the Project Management Life Cycle. A proven methodical life cycle is necessary to repeatedly implement and manage projects successfully.

During the life cycle of **any project**, proven and tested project management processes or best practices should be initiated. The types and extent of processes initiated depend on the nature of the project, i.e. size, probability of failure and consequences of failure. Strong and effective leaders apply process to protect all projects.

The Project Management Institute (PMI) provides guidance for project management in the Project Management Body of Knowledge (PMBOK). Every project has a life cycle, with a beginning, a life and an end (defined by accomplishing the objective). The following defines a typical project life cycle and shows the relationship between PMBOK Life Cycle Phases and our Life Cycle Phases:

Table 2: Project Life Cycle Phases [30]

PMBOK Phases	Our Methodology Phases
Initiation (Definition)	Initiation
Planning	Planning
Executing Controlling	Execution and Control
Closing	Close-out

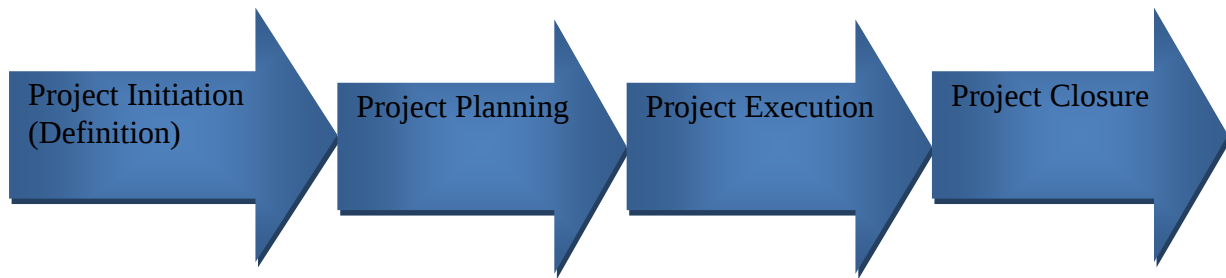


Figure 8: Four phases of the project life cycle.

Phase 1: Project Initiation (Definition).

The initiation phase essentially involves the project start-up. It is the phase within which the business problem or opportunity is identified, the solution is agreed, a project formed to produce the solution and a project team appointed. [23]

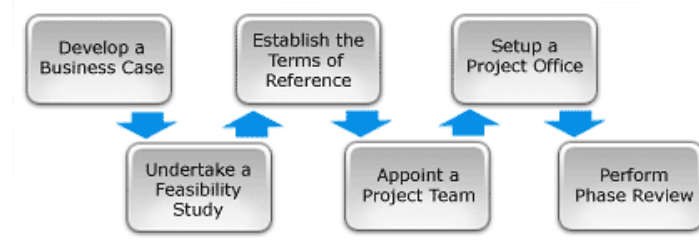


Figure 9: Activities undertaken during the initiation phase. [30]

Phase 2: Planning Phase

The next stage of the project life cycle is project planning. At this stage, we assume that a contractor or project organization has been chosen to develop and implement the project.

Two of the most important aspects of project planning are project scope definition, which sets the stage for developing a comprehensive project plan, and the development of the work breakdown structure (WBS). Scope definition establishes the criteria that will be used to evaluate whether the major phases of the project have been completed. The outcome of this process is to develop a document called the **work scope document**, which describes project objectives and requirements. [30]

The terms “project scope” and “statement of work” are often used synonymously, and there are many similarities between the two. However, there is an important difference. While the SOW document is developed by the project client, the scope document is developed by the contractor or project organization responsible for developing and implementing the project. Once the client chooses the contractor for the project, the SOW document can be used as the basis for further refinement, typically as a result of negotiations between the contractor and the client. The outcome of this process is the project scope document, which serves as the foundation for all downstream project development activities.

A full and complete definition of the project scope leads to the next most important step in project planning: the development of the work breakdown structure (WBS). In this phase, the overall project is broken into manageable and well-defined work packages. The creation of a WBS ensures that no element of work is overlooked or duplicated, and that the relationships among work packages are clearly identified and understood.

The WBS is the basis on which project schedules and cost estimates are developed, and also provides the framework for assigning management and task responsibilities. While we will discuss WBS in more detail later in this chapter, it is important to note that a well-defined project scope and an accurate WBS are the twin pillars for ensuring project success.

The two, in tandem, constitute the basis for effective project cost and value management. [67]



Figure 10: Project Planning Activities [30]

Phase 3: Project Execution

The Execution phase is typically the longest phase of the project (in terms of duration). It is the phase within which the deliverables are physically constructed and presented to the customer for acceptance. To ensure that the customer's requirements are met, the Project Manager monitors and controls the activities, resources and expenditure required to build each deliverable throughout the execution phase. A number of management processes are also undertaken to ensure that the project proceeds as planned.

Phase 4: Project Closure

Following the completion of all project deliverables and acceptance by the customer, a successful project will have met its objectives and be ready for formal closure. Project Closure is the last phase in the project and must be conducted formally so that the business benefits delivered by the project are fully realized by the customer.

CHAPTER 3: RESEARCH METHODOLOGY AND METHODS

3.1. Research Methodology

3.1.1. Qualitative and quantitative approaches

The research topic was dealing with data (*numbers in context*) that is of a specific type. It is called **quantitative data**, or **numerical data**. There is another type of data, however, and that is **qualitative data**, often called **categorical data**. The first type, numerical data is defined as data that consist of numerical measures or counts. Categorical data, on the other hand, consists of attributes, labels or non numerical categories. [74]

Figure below illustrate the types of data

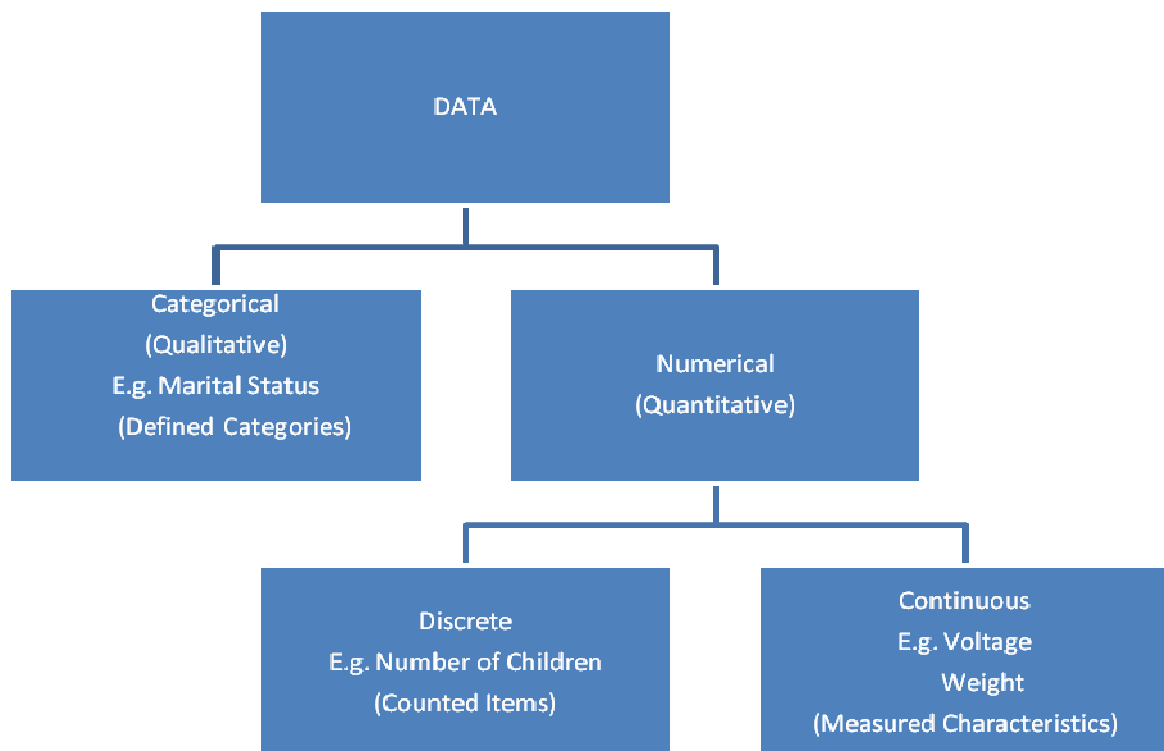


Figure 11: Types of Data

Much of engineering research seeks to identify how outcomes are determined by reducing reasonable causes to a discrete set of indicators or variables.

Quantitative methods are a good fit for deductive approaches, in which a theory or hypothesis justifies the variables, the purpose statement, and the direction of the narrowly defined research questions.

The hypothesis being tested and the phrasing of the research questions govern how data will be collected (i.e. a locally developed survey, commercial instrument, or final course grades) as well as the method of statistical analysis used to examine the data (Creswell, 2002).

The purpose of quantitative studies is for the researcher to project his or her findings into the larger population through an objective process.

Data collected, often through surveys administered to a sample or subset of the entire population, allow the researcher to generalize or make inferences.

Results are interpreted to determine the probability that the conclusions found among the sample can be replicated within the larger population.

Conclusions are derived from data collected and measures of statistical analysis. [75]

Quantitative research is also based on the quantitative measurements of some characteristics. It is applicable to phenomena that can be expressed in terms of quantities. Qualitative research, on the other hand, is concerned with qualitative phenomena, i.e., phenomena relating to or involving quality or kind. For example, when we are interested in investigating the reasons for human behavior (i.e., why people think or do certain things) we quite often talk of Motivation Research, an important type of qualitative research. This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose. Therefore the research is both quantitative and qualitative oriented and methodology adopted is a questionnaire.

The quantitative and qualitative approaches will be used to investigate broadly the use and importance of project management tools and techniques in highway projects and their impact on success of projects in Kigali, Road projects contractors' knowledge of using project management tools and techniques and their perceptions relative to project management tools and techniques.

3.1.2. Sample population

Refers to Charles Teddlie and Fen Yu (2007), the purpose of sampling is to obtain a group of subjects who will be representative of the larger population or will provide specific information needed. The degree of representativeness is based on the sampling technique employed.

A convenience sample population was taken from RTDA, City of Kigali, Gasabo District, Kicukiro District and Nyarugenge District of road contractors who are currently operational at a population size of 16 road contractors with a view to get field data.

The sampling method for collecting data for this research was by the formula stated by (Taro Yamane, 1973) method for calculating the sample size with a 95% confidence level 5% error margin as shown below:

$$n = \frac{N}{\left[1 + N e^2 \right]} \quad (\text{Eqn 3.1})$$

Where:

n is the sample size

N = Population size and

e = Error margin

Road contractors currently operational in RTDA, City of Kigali, Gasabo District, Kicukiro District and Nyarugenge District as population size and from the Eqn 3.1 calculate the sample size under study.

Applying Eqn 3.1 population size (N) was 16 roads contractors

The sample size (n) to was, $n = \frac{16}{\left[1 + 16 * 0.05^2 \right]} = 15.38 = 16$ the research used 16 copies of questionnaires for 16 road contractors as a sample size working in highway projects in Kigali. The sample size was the same as sample population of 16 for road contractors in City of Kigali.

The total number of respondents in this research was estimated to 16 roads contractors and it was easy to approach them in order to elicit useful information. The sample size was equal to 16 roads contractors from the total number of the population.

3.2. Research Methods

Questionnaire was designed in such a way for gathering information from respondents to meet research objectives.

Colin Neville (2007) states that survey is a method of gathering information from a sample of population under study. He adds that survey involves selecting a representative and unbiased sample of subjects drawn from the group that the researcher wishes to study.

In this research, a questionnaire survey was conducted for data collection. Same questions with same wording were asked to roads contractors. The purpose of using a questionnaire was to avoid any kind of bias in gathering information on the use and importance of project management tools and techniques in highway projects in Kigali.

Questionnaires contained direct questions (close-ended questions in multiple choice format and some open questions in quantitative nature). Based on the aim and objectives of the study to be conducted all variables to be investigated using the questionnaire have equal strength in terms of importance because they are complementary in ensuring the use and importance of project management tools and techniques practices. Questionnaires were distributed to respondents by the researcher in person and were self-administered. Respondents were given at most one week to complete the questionnaires and then returned to the researcher for analysis.

The targeted group was road contractors working with RTDA, City of Kigali, Gasabo District, Kicukiro District and Nyarugenge District implementing their projects in City of Kigali or connecting Kigali to other provinces.

Figure below shows the summary of stages through which research methodology was implemented to meet research objectives.

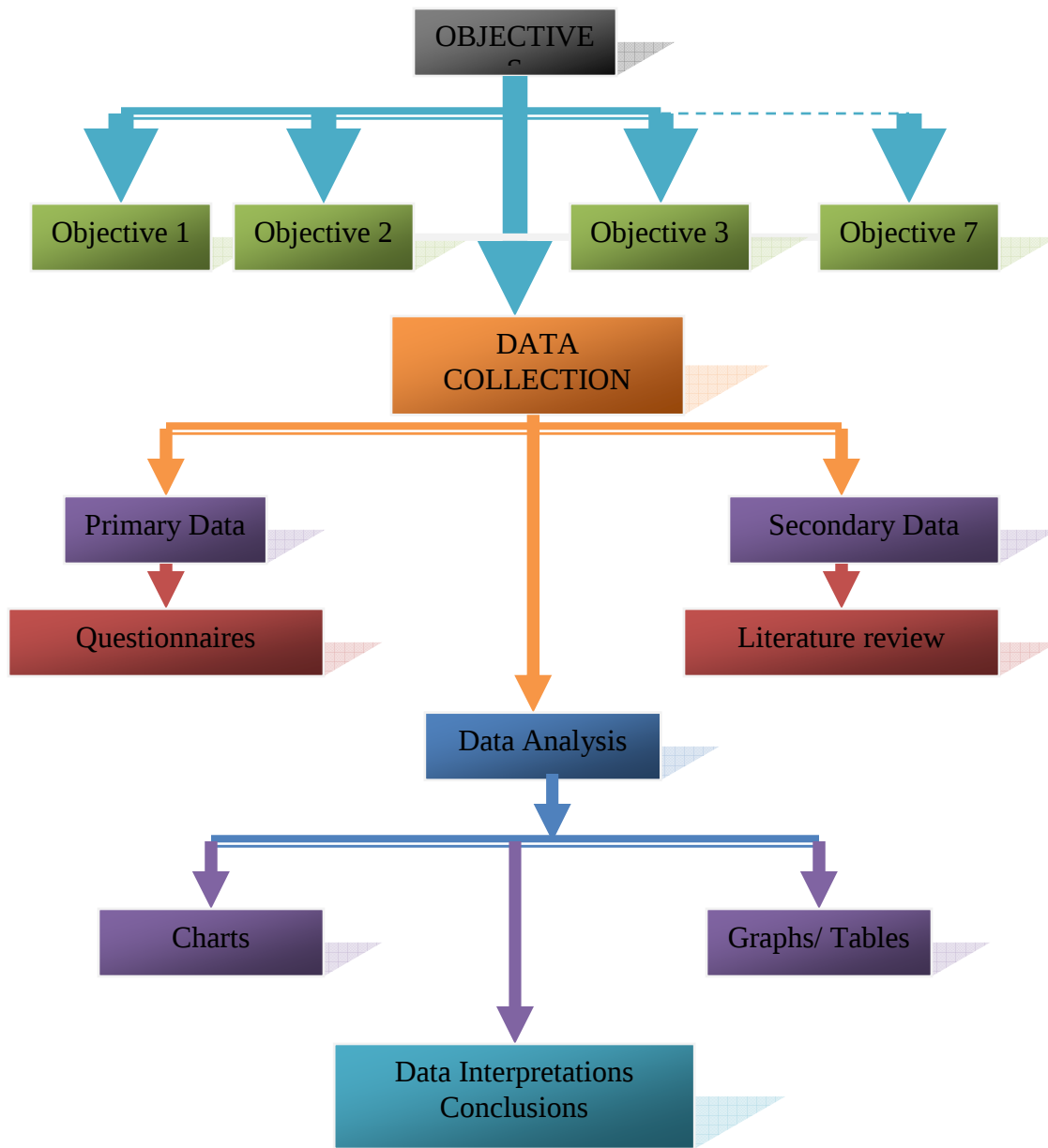


Figure 12: Methodology to be used in this research

3.3. Data Analysis Approach Employed in this Research

This part of the research was summarized, in the form of tables and graphs data gathered from questionnaires and was analyzed in relation to responses by using excel spread sheet (percentages) for quantitative data. Qualitative data was analyzed by analytical method. Then information collected using questionnaire was entered in excel spread sheet for data analysis.

3.4. Summary of Chapter

This part of the research aims to critically interpret findings by comparing results obtained with the concepts of the use and importance of project management tools and techniques in compliance with standards, noting any change, cause of that change and assessing the results in light of research question and objectives.

Conclusion was drawn from the results of findings. The recommendations were made based on the conclusion for the purpose of improvement of professional practices in the use and importance of project management tools and techniques in highway projects in Kigali.

CHAPTER 4: FREQUENCY OF USE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES AT DIFFERENT STAGES OF THE PROJECT LIFECYCLE, AND ASSOCIATED CHALLENGES

4.1. Introduction

The aim of this Chapter was to investigate the frequency of use of project management tools and techniques by roads contractors in City of Kigali and faced challenges Vis a Vis their usage. Basing on answers from respondents i.e. roads contractors in Kigali, data findings ranked the most frequently used project management tools and techniques as well as associated challenges, where results respond to the third and fourth objectives of the research.

4.1.1. Summary of data analysis

The research was limited to roads contractors in City of Kigali, where a total number of 16 copies of questionnaires were distributed to respondents; all copies were responded and return back to the researcher for data analysis. A maximum of 81% of respondents were male and 19% were female, their education background with a maximum of 44% of total respondents are with Bachelor's degree, 37% Masters Degree and 19% with a Diploma Level. Their area of specialization with a maximum of 63% was Civil Engineers, 19% of respondents were Surveyors, 12% of them were Architecture and 6% of respondents were Mechanical Engineer. Their position in their organization with a maximum of 37% of respondent were Project Manager's, 19% of respondents were Site Manager's and Technical Director's respectively. Summary is illustrated in figures here below:

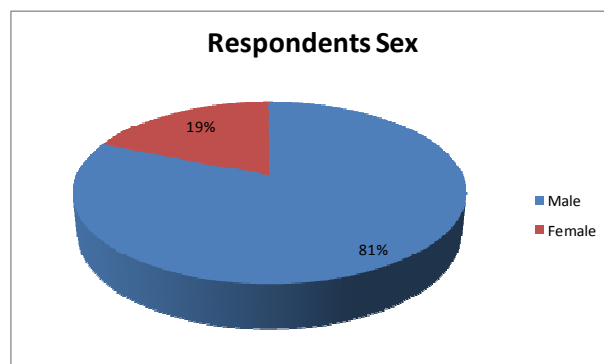


Figure 13: Respondents Sex

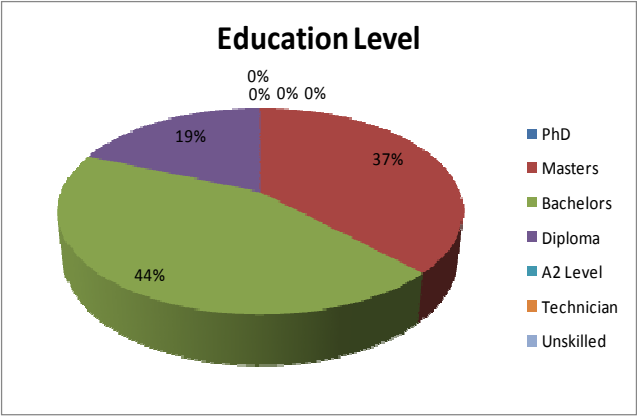


Figure 14: Respondents Education Level

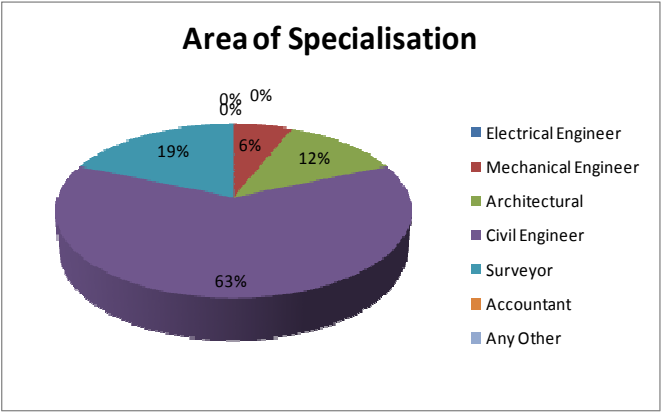


Figure 15: Respondents Area of Specialization

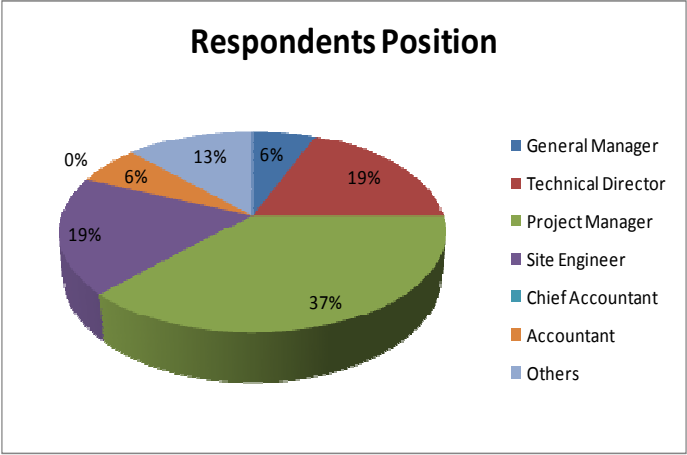


Figure 16: Respondents Position in the Organization

4.1.2. Type of Company and Area of Specialization

A maximum of 57% were local Company, 25% were Local Government Company and remaining 18% of respondent were International, Joint venture and Local Endowment Companies with 6% each. Their area of specialization was General Contractor with a maximum of 50% of respondent and Road Contractor with a maximum of 50% of respondent respectively. See figures below:

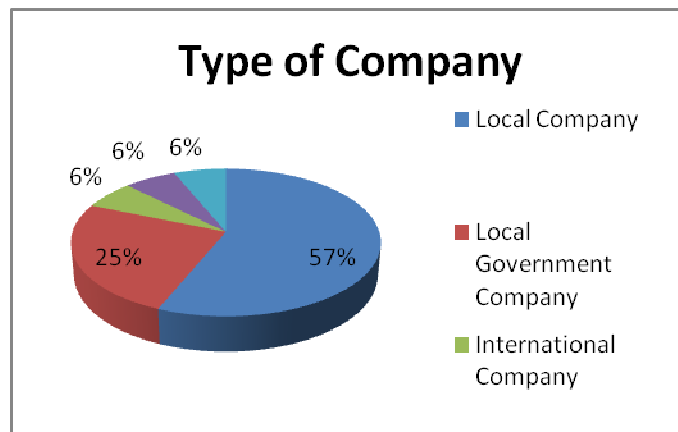


Figure 17: Type of Company

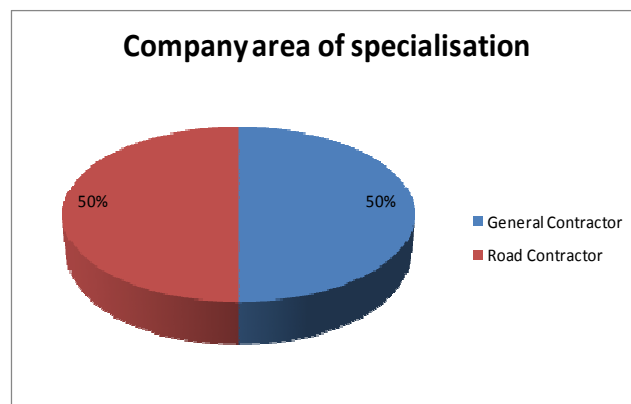


Figure 18: Company area of specialization

4.2. Data Analysis and Discussions

One of the research objectives was to investigate the frequency of use of project management tools and techniques with roads contractors in City of Kigali.

Data collected and analyzed from roads contractors in City of Kigali regarding the degree of importance of project management tools and techniques, their frequency in use and associated challenges are as follows:

i. Project management tools and techniques degree of importance

The research ranked the degree of importance while collecting and analyzing data as follows:

1. Very Important
2. Important
3. Neutral
4. Fairly Important
5. Not Important

Table 3: Project Management tools and Techniques degree of importance

i. Degree of Importance

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX
	1	2	3	4	5		1	2	3	4	5	
Project Charter	2	5	3	4	2	16	13%	31%	19%	25%	13%	31%
WBS	11	4	0	1	0	16	69%	25%	0%	6%	0%	69%
EVM	12	1	2	0	1	16	75%	6%	13%	0%	6%	75%
Cost Analysis	8	5	0	3	0	16	50%	31%	0%	19%	0%	50%
CPM	11	3	2	0	0	16	69%	19%	13%	0%	0%	69%
PERT	10	3	2	0	1	16	63%	19%	13%	0%	6%	63%
Gant Chart	10	4	1	1	0	16	63%	25%	6%	6%	0%	63%
SWOT	4	6	5	0	1	16	25%	38%	31%	0%	6%	38%
OrganizationChart	7	6	1	2	0	16	44%	38%	6%	13%	0%	44%
Stakeholders Analysis	3	8	2	3	0	16	19%	50%	13%	19%	0%	50%
Contract Type Selectio	8	6	0	2	0	16	50%	38%	0%	13%	0%	50%

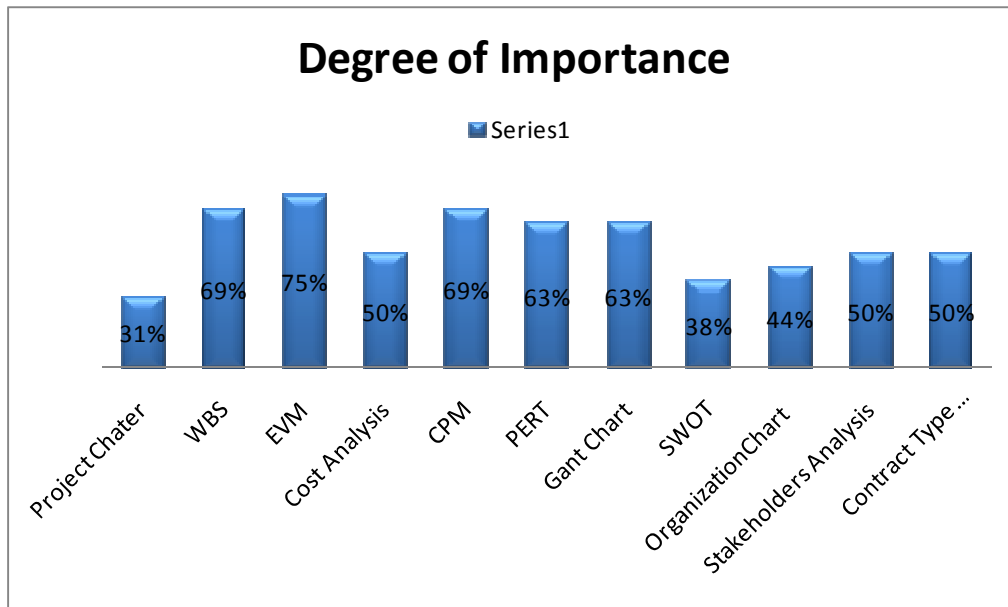


Figure 19: Project Management tools and techniques degree of importance Chart

Refer to data findings above, the most important tools and techniques are ranked in percentage index where the most important tools and techniques are EVM with 75% of respondents, WBS and CPM with 69%, PERT and Gantt Chart 63% respectively. This reveals that these tools and techniques are very important in managing projects. Here road contractors in City of Kigali from their answers mentioned that EVM, WBS, CPM, PERT are most important project management tools and techniques since their percentage is ranging between 60% to 75 %

ii. Project Management tools and techniques frequency of use

The research ranked project management tools and techniques frequency of use while collecting and analyzing data as follows:

1. Very Frequently used
2. Frequently used
3. Neutral
4. Fairly frequently used
5. Not Used

Table 4: Project Management Tools and Techniques frequency of use

ii. Frequency of Use of Tools and Techniques

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX	
	1	2	3	4	5		1	2	3	4	5	%	
Project Charter	0	1	2	5	8	16	0%	6%	13%	31%	50%	50%	5 Not Used
WBS	3	9	0	4	0	16	19%	56%	0%	25%	0%	56%	2 Frequently used
EVM	1	4	1	3	7	16	6%	25%	6%	19%	44%	44%	5 Not Used
Cost Analysis	1	3	3	5	4	16	6%	19%	19%	31%	25%	31%	3 Neutral
CPM	1	3	2	5	5	16	6%	19%	13%	31%	31%	31%	4 Fairly frequently used
PERT	0	1	1	6	8	16	0%	6%	6%	38%	50%	50%	5 Not Used
Gant Chart	3	10	0	3	0	16	19%	63%	0%	19%	0%	63%	2 Frequently used
SWOT	0	0	1	4	11	16	0%	0%	6%	25%	69%	69%	5 Not Used
OrganizationChart	3	9	0	2	2	16	19%	56%	0%	13%	13%	56%	2 Frequently used
Stakeholders Analysis	0	0	1	6	9	16	0%	0%	6%	38%	56%	56%	5 Not Used
Contract Type Selection	2	6	0	6	2	16	13%	38%	0%	38%	13%	38%	4 Fairly frequently used

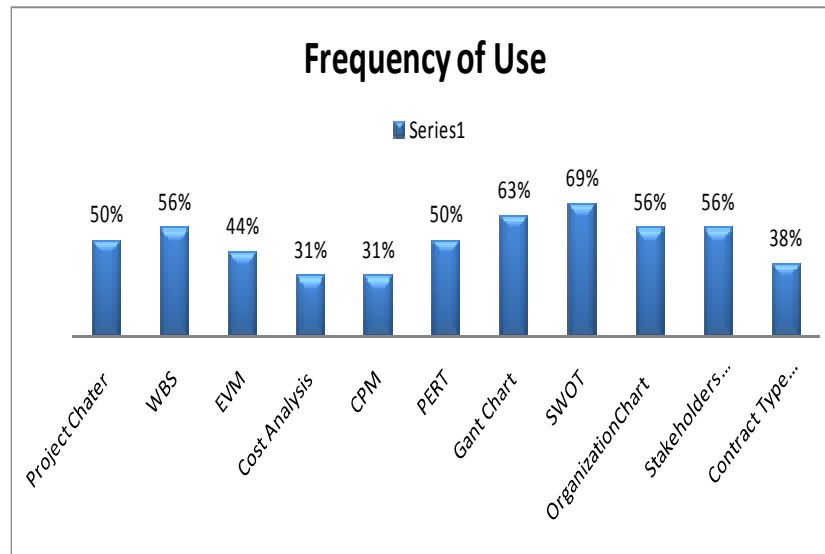


Figure 20: Project Management Tools and Techniques frequency of use Chart

The graph above shows that project management tools and techniques, five of them such as Project Charter, EVM, PERT SWOT and Stakeholders are totally not used while on the hand there were mentioned to be the most important in project management, CPM and Contract Selection are fairly frequently used while three of them such as WBS, Gant Chart and Organization Chart are frequently used. This reveal that road contractors in City of Kigali do not using the most important project management tools and techniques.

iii. How Challenging is it to use and employ of Project Management Tools and Techniques in highway projects in Kigali.

The research ranked project management tools and techniques how challenging is it to use and employ them while collecting and analyzing data as follows:

1. Very Challenging
2. Challenging
3. Neutral
4. Fairly Challenging
5. Not Challenging

Table 5: Project Management Tools and Techniques Challenging

How Challenging is it to use and employ below tools and techniques in transport projects.

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX	
	1	2	3	4	5		1	2	3	4	5	%	
Project Charter	1	7	3	5	0	16	6%	44%	19%	31%	0%	44%	2:Challenging
WBS	1	7	1	6	1	16	6%	44%	6%	38%	6%	44%	2:Challenging
EVM	8	3	1	1	3	16	50%	19%	6%	6%	19%	50%	1:Very Challenging
Cost Analysis	4	5	2	3	2	16	25%	31%	13%	19%	13%	31%	2:Challenging
CPM	8	4	2	0	2	16	50%	25%	13%	0%	13%	50%	1:Very Challenging
PERT	6	6	1	1	2	16	38%	38%	6%	6%	13%	38%	1:Very Challenging
Gant Chart	1	2	0	8	5	16	6%	13%	0%	50%	31%	50%	5:Not Challenging
SWOT	7	5	2	2	0	16	44%	31%	13%	13%	0%	44%	1:Very Challenging
OrganizationChart	0	2	1	5	8	16	0%	13%	6%	31%	50%	50%	5:Not Challenging
Stakeholders Analysis	2	4	2	4	4	16	13%	25%	13%	25%	25%	25%	3:Neutral
Contract Type Selection	2	3	0	5	6	16	13%	19%	0%	31%	38%	38%	5:Not Challenging

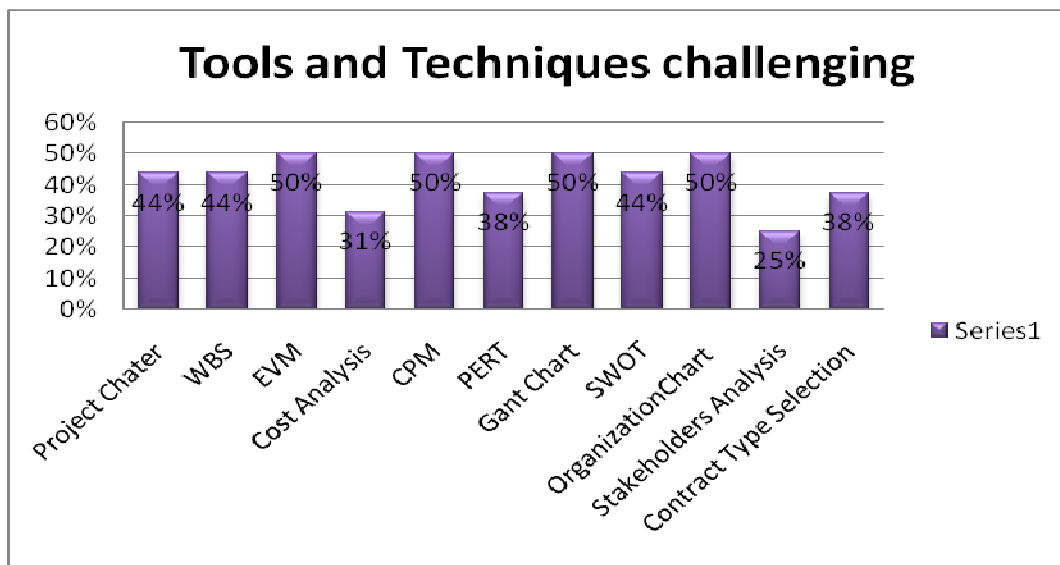


Figure 21: Project Management Tools and Techniques Challenging Chart

Research findings reveal that EVM, CPM, PERT and SWOT are the most challenging tools and techniques as indicated in Figure above, Project Charter, WBS and Cost Analysis are the ones challenging while Gant Chart, Organization Chart and Contract Selection are not Challenging. This reveals that the most important project management tools and techniques are the ones very challenging means that there are not used.

4.3. Summary of Chapter

As these project management tools and techniques are more important to roads projects in all project phases such as Initiation phase, Planning Phase, Execution phase and Closing Phase each with it plays a big role in its respective phases, referring to research findings above, where the most important project management tools and techniques are the ones not frequently used and mostly Challenging by road contractors in City of Kigali, it reveal that roads contractors in City of Kigali do not use them, thus it leads to highway projects delay.

CHAPTER 5: PRACTITIONERS' VIEWS ON THE EFFECTIVENESS OF THE MOST FREQUENTLY USED PROJECT MANAGEMENT TOOLS AND TECHNIQUES, AND NEED FOR TRAINING

5.1. Introduction

In this Chapter, basing on respondents views, the researcher deeply analyzed in section 5.2 the effectiveness of the most frequently used project management tools and techniques and their need of training by roads contractors in City of Kigali. Findings helped to identify the effectiveness of the most frequently used project management tools and techniques and identify tools and techniques which have to be reinforced by doing more or regular training based on their degree of importance.

5.2. Data Analysis and Discussions

Regarding the effectiveness of the most frequently used project management tools and techniques and need of training, data findings were analyzed and summarized as follows:

i. Effectiveness of project Management tools and techniques results

The research ranked the most effective project management tools and techniques while collecting and analyzing data as follows:

1. Very Effective
2. Effective
3. Neutral
4. Fairly effective
5. Not Effective

Table 6: Effectiveness of project Management tools and techniques
Effectiveness of Project management tools and techniques

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX
	1	2	3	4	5		1	2	3	4	5	
Project Chater	3	6	5	2	0	16	19%	38%	31%	13%	0%	38%
WBS	13	1	0	1	1	16	81%	6%	0%	6%	6%	81%
EVM	12	2	1	1	0	16	75%	13%	6%	6%	0%	75%
Cost Analysis	10	3	1	1	1	16	63%	19%	6%	6%	6%	63%
CPM	11	3	2	0	0	16	69%	19%	13%	0%	0%	69%
PERT	6	7	2	0	1	16	38%	44%	13%	0%	6%	44%
Gant Chart	9	5	0	1	1	16	56%	31%	0%	6%	6%	56%
SWOT	3	8	4	0	1	16	19%	50%	25%	0%	6%	50%
OrganizationChart	3	10	1	2	0	16	19%	63%	6%	13%	0%	63%
Stakeholders Analysis	2	8	2	4	0	16	13%	50%	13%	25%	0%	50%
Contract Type Selection	9	5	2	0	0	16	56%	31%	13%	0%	0%	56%

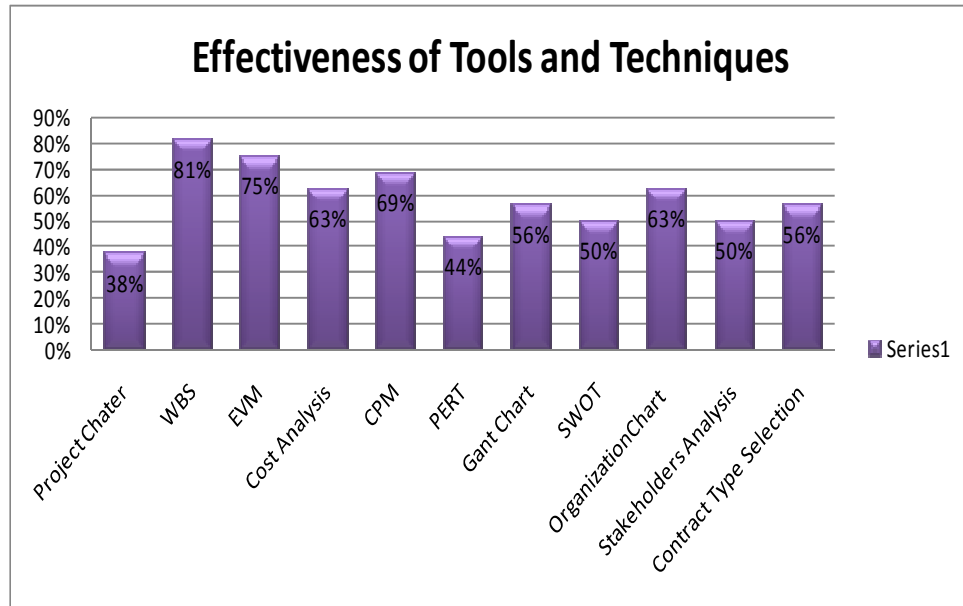


Figure 22: Effectiveness of Project management tools and techniques chart.

Table 6 above, reveals that WBS with 81%; CPM with 69% as well as Gant Chart with 56% respectively of total respondents are most effective at project planning phase, for cost control EVM with 75% of respondents as well as cost analysis with 63% during project execution phase. The results above reveal that the most important project management tools and techniques are the most effective in project management.

ii. Project Management tools and techniques need of training

The research ranked project management tools and techniques need of training while collecting and analyzing data as follows:

1. Very High Level of need
2. High Level of need
3. Neutral
4. Fairly High Level of need
5. No Need

Table 7: Project Management tools and techniques level of training
Tools and Techniques need of training

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX
	1	2	3	4	5		1	2	3	4	5	
Project Chater	1	5	4	4	2	16	6%	31%	25%	25%	13%	31%
WBS	7	4	1	3	1	16	44%	25%	6%	19%	6%	44%
EVM	12	2	2	0	0	16	75%	13%	13%	0%	0%	75%
Cost Analysis	7	6	2	1	0	16	44%	38%	13%	6%	0%	44%
CPM	10	1	3	2	0	16	63%	6%	19%	13%	0%	63%
PERT	8	4	2	2	0	16	50%	25%	13%	13%	0%	50%
Gant Chart	5	5	1	5	0	16	31%	31%	6%	31%	0%	31%
SWOT	9	1	5	1	0	16	56%	6%	31%	6%	0%	56%
OrganizationChart	1	5	2	7	1	16	6%	31%	13%	44%	6%	44%
Stakeholders Analysis	2	8	4	2	0	16	13%	50%	25%	13%	0%	50%
Contract Type Selection	5	6	2	3	0	16	31%	38%	13%	19%	0%	38%

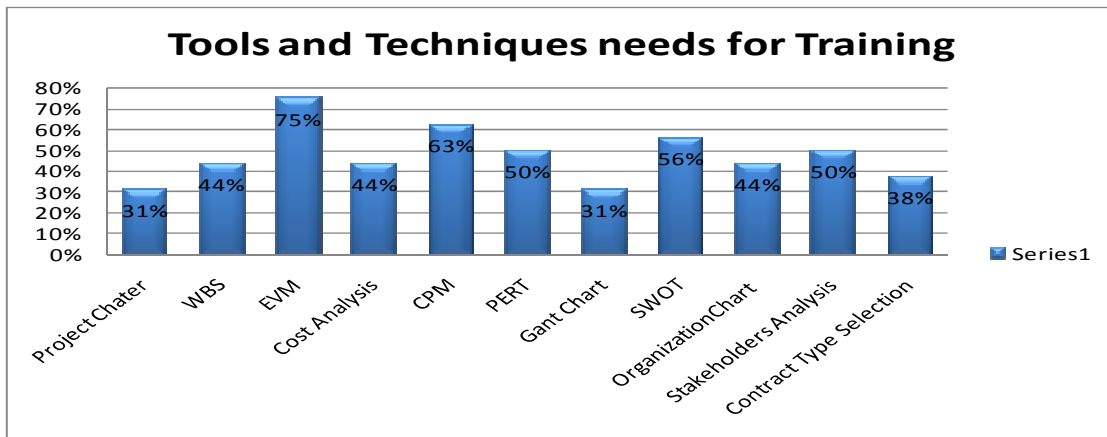


Figure 23: Project Management Tools and Techniques level of training graph

Data findings here above reveal that the most important project management tools and techniques need to be trained by roads contractors in City of Kigali are as follows: For project cost control EVM with 75% as a level of training of total respondents, Tools for project planning such as: CPM with 63%, SWOT with 56% and PERT with 50% respectively of total number of respondent.

5.3. Summary of Chapter

Data findings reveal that the most important and most effective tools and techniques need training, this means that roads contractors in City of Kigali run roads projects by chance and this leads to project delay as well as project failure.

CHAPTER 6: IMPACT OF THE USE AND EXPLOITATION OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS.

6.1. Introduction

This Chapter was discussing on the main challenges that impact on the use and exploitation of project management tools and techniques in highway projects in City of Kigali. The impact on the use and exploitation of project management tools and techniques can be either positive or negative depending on respondent's answers to questionnaires where this chapter can respond to.

6.2. Data Analysis and Discussions

One of the research objectives was to document the main challenges that impact on the use and exploitation of project management tools and techniques in highway projects in City of Kigali. Table below after analysis reveal that lack of training is the one that impact on the use of project management tools and techniques in highway projects in City of Kigali.

Table 8: Main Challenges that impact on the use of PMTT

S/N	Answer Option	Main Challenges	Frequency	%
1	APMS	Access to project management software's	13	16%
2	ATM	Awareness of Top management	10	13%
3	LE	Lack of experience	7	9%
4	LK	Lack of Knowledge	5	6%
5	LT	Lack of Training	15	19%
6	NI	Not Important	4	5%
7	TL	Time Limit	7	9%
8	WPT	Willingness of project team	8	10%
9	WTM	Willingness of Top management	11	14%
		Sum	80	

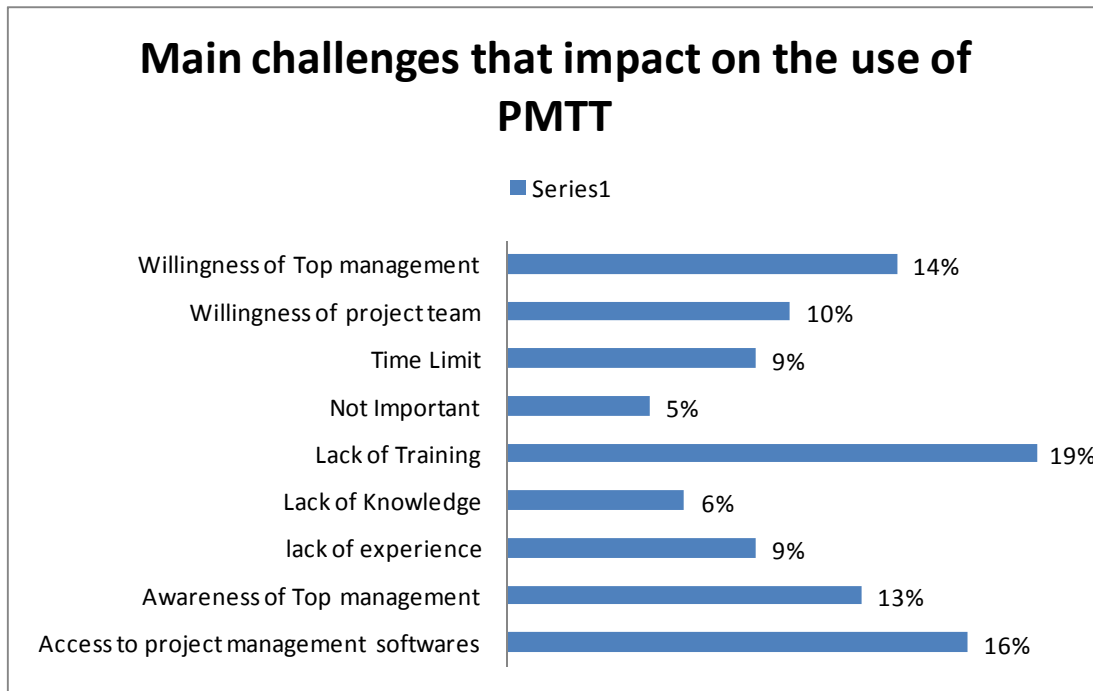


Figure 24: Main Challenges that impact on the use of PMTT

Data findings reveal that 19% of respondents need training on project management tools and techniques, 16% of respondents do not access project management software's, 14% of respondents reveal that there was willingness of top management and 13% of respondents reveal that awareness of top management was also among the main challenges that impact on the use of PMTT.

6.3. Summary of Chapter

Reference was made to data findings here above, roads contractors in City of Kigali need training and do not access to project management software's, this means that the use and exploitation of project management tools and techniques was very low and that impact on projects delay and failure.

CHAPTER 7: CRITICAL SUCCESS FACTORS (CSF) ASSOCIATED WITH THE EFFECTIVE USE AND EXPLOITATION OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS IN KIGALI.

7.1. Introduction

The successes of a project as well as the factors that affect this success are considered in a various ways by different project management scholars. There is no unified treatment and definitions of these concepts although there is a consensus about the importance of this aspect for the project management practice. In this respect, Prabhakar (2008) generalizes that the only agreement is the disagreement on the issue “what is project success”. Baker, Murphy and Fisher (1983) note that what is really important is whether project stakeholders are fully satisfied by its results. Good schedules and correctly utilized budgets will not matter if the final project outcomes do not meet the expectations and goals.

H. Kerzner (1987) defined the critical success factors as those components that are required to establish an environment where projects are “managed consistently with excellence”. Typically, the satisfaction of clients is identified as the main factor of project success. Stakeholders’ satisfaction became increasingly important due to the competitive character of the marketplace and uncertainty of the environment.

As a first systematical classification of critical success factors in the area of project management is provided by Schultz, Slevin and Pinto (1987). These authors identify two groups of factors such as strategic and tactical, which influence project performance at various stages of project life cycle. For example, the “strategic” group consists of factors as project mission, top management support, and project scheduling. The “tactical” group includes factors as client consulting, human resource selection and personnel training. Additionally, Pinto and Slevin (1988) augmented the range of success factors by considering the specifics of the various stages of project life-cycle. Research has shown that success factors impact can vary at different phases of the project life-cycle and in relation to the measures of success chosen by analysts.

This approach is further developed by Kerzner (2001) who states that in the past (at least 20 years ago) project success was related to the completion of project activities in the due term, budget, and expected quality.

Later the understanding of project success has been altered by including the limitation of minimum changes in the scope of activities without interruptions in the workflow, without shifts in the corporate culture, and with full acceptance of results by the project client.

From another point of view, a stream of scholars (e.g. Belassi and Tukel, 1996; Lim and Mohamed, 1999) prefer not to distinguish between the project success and the success of project management as a whole. Rather, they consider the project success as a part of or even a consequence from the overall managerial success. By further research (e.g. Baccarini, 1999; Shenhar, Levy and Dvir, 1997) the project success concept has been expanded to a six dimension construct where, additionally to the original dimensions (time, cost and quality), other important issues have been incorporated. These facets are: meeting the strategic goals of the client organization, achieving satisfaction of the end users, and attaining satisfaction of all other stakeholders. Finally, in case that the criteria for project success are defined in a particular setting, there are still some conditions that should be provided in order to consider a project as successful.

7.2. Data Analysis and Discussions

Critical Success Factors are factors that impact on project success. Here roads contractors from their response illustrates that project management skills comes in front as CSF's as illustrated in figures here below:

Table 9: Critical Success Factors

S/N	Answer Option	CSFs Meaning	Frequency	%
1	CFS	Consultant firm skills	1	1%
2	PMS	Project Management Skills	33	41%
3	PMT	Project Management Tools	1	1%
4	PM&TC	Project Management &Team Competences	19	23%
5	PP	Project Planning	12	15%
6	PSD	Project Scope Definition	3	4%
7	RP	Regular Payment	2	2%
8	TMS	Top Management Support	10	12%
		Sum	81	

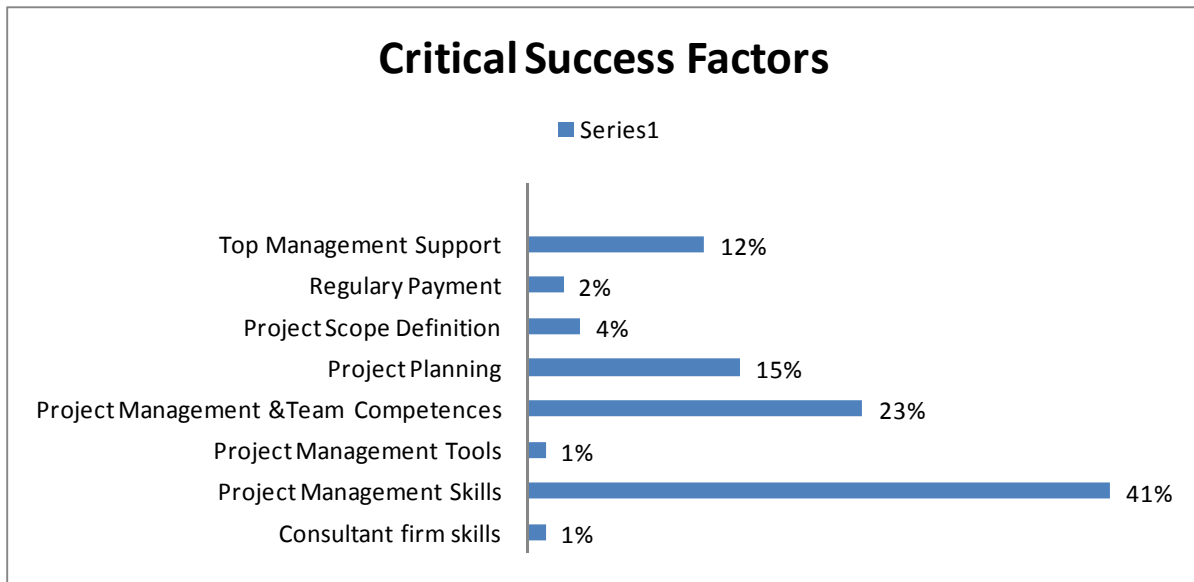


Figure 25: Critical Success Factors Chart

Basing on findings here above, a maximum of 41% of total respondents reveal that Project management skills is ranking as the first CSF's, maximum of 23% of respondents ranked Project Manager and Team Competences for the 2nd position, Project Planning with 15% 3rd Position, Top Management Support at 4th. See Table 10 here below.

Table 10: Critical Success Factors of roads contractors in City of Kigali

S/N	Critical Success Factors	% Weight
1	Project Management Skills	41
2	Project Manager & Team Competences	23
3	Project Planning	15
4	Top Management Support	12
5	Project scope definition	4
6	Regular Payment	2
7	Consultant firm skills	1
8	Project Management tools	1

7.3. Summary of Chapter

Regarding the results above of this chapter, the critical success factors in City of Kigali, the summary are as below:

- ✓ By more concentration on these factors, their effectiveness could be maximized.
- ✓ These factors assist the managers in utilizing the resources and facilities and consequently reforming their use pattern.
- ✓ They accelerate organization's success achievement by faster removing the existing barriers, especially in competitive conditions
- ✓ They prevent probable perceptual errors and imaginations of the managers based on the importance of some factors to other factors and realize the factors prioritization and impede the realization of various errors.
- ✓ They help the organization to implement the strategic plans successfully.

CHAPTER 8: APPROPRIATE SETS OF GUIDANCE ON FREQUENCY OF USE, EFFECTIVENESS, AND TRAINING NEEDS OF PLANNING TOOLS AND TECHNIQUES IN HIGHWAY PROJECTS

8.1. Introduction

In this chapter, the researcher provided a set guidance based on the most frequently used project management tools and techniques and most effective across project life cycle as well as need of training of planning tools and techniques in highway projects in City of Kigali.

8.2. Guidance on Use of project management tools and techniques

The use of project management tools and techniques during the lifecycle of a project varies depending on project phases:

- i. In project initiation phase, the most used project management tools and techniques is project charter, it helps the integration of management and selection of project team to whom responsibility is attributed, the above tools is mostly used by the client in project brain storming.
- ii. In project planning phase, here the project is under responsibility of contractors where tools and techniques are needed at deferent's planning components:

- **Project Plan**

A project plan is a formal, approved document used to guide both project execution and project control. The primary uses of the project plan are to document the planning assumptions and decisions, facilitate communication among stakeholders and document approved scope, Work Breakdown Structure (WBS), cost, and schedule baselines. The objective of a project plan is to define the approach to be used by the Project team to deliver the intended project management scope of the project. At the minimum, a project plan answers basic questions about the project:

- ✓ (Why?) Why is it being sponsored?
- ✓ (What?) What are the major product/deliverables?
- ✓ (Who?) Who will be involved and what will be their responsibilities within the project?
- ✓ (When?) What is the project timeline and when will particularly meaningful points, referred to as milestones, be completed?

Tools: Project Schedule helps the Project Manager to assess the progress of the project by using Ms Project 2007, PRIMAVERA.

Techniques: CPM and PERT.

- **Resources Plan**

After the Project plan is formed, it is necessary to allocate the resources required to undertake each of the activities and tasks within the project plan. Although general groups of resources may have already been allocated to the project plan, a detailed resource assessment is required to identify:

- ✓ The types of resources (labor, equipment and materials) needed to deliver your project.
- ✓ The total quantities of each resource type required,
- ✓ Roles, responsibilities and skill-sets of all human resources,
- ✓ Items, purposes and specifications of all equipment resource,
- ✓ Items and quantities of material resource.

A schedule is assembled for each type of resource so that the Project Manager can assess the resource allocation at each stage in the project.

Tools: Schedule for each type of resources so that the Project Manager can assess the resource allocation at each stage in the project by using Ms Project 2007, **PRIMAVERA**.

Techniques: CPM and PERT.

- **Financial Plan**

Similar to the resource Plan, a Financial Plan is prepared to identify the quantity of money required for each stage in the project. The total cost of labor, equipment and materials is quantified and an expense schedule is defined which provides the Project Manager with an understanding of the forecast spending vs. the actual spending throughout the project.

Preparing a detailed project's success will depend on whether or not it is delivered within the time, cost and quantity estimates for this project.

To create a financial plan, the following steps are undertaken:

- ✓ List the types of costs to be incurred on the project.
- ✓ Identify the unit cost for each cost type.
- ✓ Identify when the costs will be incurred by completing an expense schedule.
- ✓ Identify the cost per activity by completing an activity expense schedule.

Tools: Excel spread sheet

- **Quality Plan**

Meeting the quality expectations of the customer is critical to the success of the project. To ensure that the quality expectations are clearly defined and can reasonably be achieved, a Quality plan is documented.

The quality plan consists of:

- ✓ Defines what quality means in terms of this project,
- ✓ Lists clear and unambiguous quality targets for each deliverable. Each quality target provides a set of criteria and standards which must be achieved to meet the expectations of the customer,
- ✓ Outlines a plan of activities which will assure the customer that the quality targets will be met (i.e. a Quality Assurance Plan),
- ✓ Identifies the techniques used to control the actual level of quality of each deliverables as it is built (i.e. a Quality Control Plan).

Finally, it is important to review the quality not only of the deliverables produced by the project but also of the management processes which produce them. A summary of each of the management processes undertaken during the execution phase is identified, including time, cost, quality, change, risk, issue, procurement, acceptance and communications management.

- **Risk Plan**

A document that a project manager prepares to foresee risks, estimate impacts and define responses to issues. There are four potential strategies that projects may choose to:

- ✓ Avoid risk: Change plan to circumvent the problem
- ✓ Control/mitigate risk : Reduces impact through intermediate steps
- ✓ Accept risk: Take the chance of negative impact
- ✓ Transfer risk: Outsource risk to third party that can manage the outcome, e.g. financially through insurance contracts.

- **Acceptance Plan**

The key to a successful project is gaining acceptance from the customer that each deliverable produced meets or exceeds his/her requirements. To clarify the criteria used to judge each deliverable for customer acceptance, an Acceptance Plan is produced.

The Acceptance Plan provides the criteria for obtaining customer acceptance, a schedule of acceptance reviews within which customer acceptance will be sought and a summary of the process used to gain acceptance of each deliverable from the customer.

- **Communication Plan**

The process of identifying the type and regularity of information to be provided to all project stakeholders to keep them informed of the progress of the project.

A Communication Plan includes:

- ✓ Who the target audiences,
- ✓ What the key messages that are trying to be articulated,
- ✓ When timing, it will specify the appropriate time of delivery for each message,
- ✓ Why the desired outcomes,
- ✓ How the message will be delivered,
- ✓ By who will deliver the information and how he or she is chosen.

- **Procurement Plan**

The last planning activity within the Planning phase is to identify the elements of the Project which will be acquired from external suppliers to the project. The Procurement Plan provides a detailed description of the products (i.e. goods and services) to be procured from suppliers, the justification for procuring each product externally, as opposed to from within the project, and the schedule for procurement. It also references the process for the selection of a preferred supplier (“Tender Process”) and the process for the actual order and delivery of the procured products (“Procurement Process”)

iii. In Project Execution Phase:

The Execution phase is typically the longest phase of the project (in terms of duration). It is the phase within which the deliverables are physically constructed and presented to the customer for acceptance. To ensure that the customer’s requirements are met, the Project Manager monitors and controls the activities, resources and expenditure required to build each deliverable throughout the execution phase.

A number of management processes are also undertaken to ensure that the project proceeds as planned.

✓ **Build the deliverables**

This phase involves physically constructing each deliverable accepted by the client. Regardless of the method used to construct each deliverable, careful monitoring and control processes should be employed to ensure that the quality of the final deliverable meets the accepted criteria set by the client.

✓ **Monitor and control:**

Whilst the project team is physically producing each deliverable, the Project Manager implements a series of management processes to monitor and control the activities being undertaken by the project team.

✓ **Time management:**

It is the process of recording and controlling the time spent by staff on the project. Each team member should record the time spent on particular activity on a timesheet form in order to allow the Project Manager to control the amount of time spent to each activity within the project so as to keep the project plan fully up to date.

✓ **Cost management:**

It is a process by which all expenses incurred on the project are identified, approved and paid. Expenses forms for labor, materials and equipment are completed and approved by the project manager and recorded for auditing purposes.

✓ **Quality management:**

It is defined as the extent to which the final products confirm to the client requirements. Quality management is a process by which quality is assured and controlled for the project using quality assurance and quality control techniques.

✓ **Change management:**

It is a process by which changes to the project scope, deliverables, scheduling or resources are formally requested, evaluated and approved for implementation. All changes must be recorded

✓ **Risk management:**

It is a process by which risks to the project are formally identified, quantified and managed. At each stage of the project all risks identified must be recorded.

✓ **Procurement management:**

It is the process of sourcing products from an external supplier. In order to track completed purchase request a procurement register has to be maintained.

✓ **Acceptance management:**

It is a process of gaining client acceptance for product produced on the project. Acceptance forms are used by project staff to request an acceptance of a completed product.

✓ **Communication management:**

It is the process by which formal communication messages are identified, created, reviewed and communicated within a project. The most communication method of communicating the status of the project is via a project status report. All communication should be recorded in a communication register.

iv. In project closure phase

Following the completion of all project deliverables and acceptance by the customer, a successful project will have met its objectives and be ready for formal closure. Project Closure is the last phase in the project and must be conducted formally so that the business benefits delivered by the project are fully realized by the customer.

• **Perform project closure**

Project closure involves undertaking a series of activities to wind up the project, including:

- ✓ Assessing whether the project completion criteria have been met;
- ✓ Identifying any outstanding items (activities, risks or issues);
- ✓ Producing a hand-over plan to transfer the deliverables to the customer environment;
- ✓ Listing the activities required to hand over documentation, cancel supplier contracts and release project resources to the business;
- ✓ Communicating the closure of the project to all stakeholders and interested parties.

From Project Management Guidebook, A project closure report is documented and submitted to the client and project sponsor for approval. The project manager is then responsible for undertaking each of the activities identified within the project closure report on time and according to budget. The project is closed only when all the activities listed in the project closure report have been completed.

To determine conformance, a review is undertaken of the level of conformity of the project activities to the management processes outlined in the Quality Plan. Results, key achievements and lessons learnt are documented within a Post Implementation Review report and presented to the Project Sponsor for approval.

8.3. Guidance on Effectiveness of tools and techniques across project lifecycles

The effectiveness of project management tools and techniques plays a big role across project lifecycles. It is this regards that, basing on findings in Chapter Five, guidance on effectiveness of tools and techniques across project lifecycles depends on their degree of importance and their effectiveness.

Project Charter is the most important and most effective tool in project initiation phase, where project must have a good start by allocating project personnel for project brainstorming and a well prepared study, etc.

For Project Planning phase, project planning components as illustrated in section 8.2 is most useful, the most important and effectiveness tools and techniques are, WBS, CPM and Gant Chart used to control schedule of activities and project deliverables.

Project Execution Phase: Is the longest phase in project lifecycle, where more attention has to be taken. All project planning have to be successful well managed using proper project management tools and techniques such as: SWOT for risk management, EVM and cost analysis for cost management, CPM for planning management, etc.

Project Closure Phase: This phase is the one when the project is ending has to be closed and handed it over to the client. Here the organization must prepare a report on the implementation of the project in general and lessons learned during its implementation where these lessons may be used as references to the next project.

Table below illustrates a guidance of most effective used project management tools and techniques and their respective knowledge areas

Table 11: Project Management Tools and Techniques (PMTT)

S/N	Project Management Tools and Techniques (PMTT)	Knowledge Areas
1	Project Charter	Integration Management
2	Work Breakdown Structure (WBS)	Scope Management
3	Earned Value Management (EVM)	Cost Management
4	Benefits/Cost Analysis	Quality Management
5	CPM, PERT, Gant Chart	Time Management
6	SWOT Analysis	Risk Management
7	Organization Chart	Human Resource Management
8	Stakeholders Analysis	Communication Management
9	Contract Type Selection	Procurement Management

8.4. Guidance on the need for training in the use of appropriate project management tools and techniques.

The need for training in the use of project management tools and techniques depends on their degree of importance, most frequently used and their effectiveness across project lifecycle. As mentioned the need of training depend up on the degree of importance, frequency and effectiveness, refer to tables here below, roads contractors in City of Kigali, ranked PMTT depending on their degree of importance, PMTT used and not used and the most effective hence from here training can be done according to the above parameters.

Table 12: PMTT degree of importance rank

S/N	Degree of importance of (PMTT)	% Weight	Rank
1	Project Chatter	31	7
2	Work Breakdown Structure (WBS)	69	2
5	CPM	69	
3	Earned Value Management (EVM)	75	1
6	PERT	63	3
7	Gant Chart	63	
8	SWOT Analysis	38	6
9	Organization Chart	44	5
10	Stakeholders Analysis	50	4
11	Contract Type Selection	50	
4	Benefits/Cost Analysis	50	

Table 13: Most PMTT frequently used

ii. Frequency of Use of Tools and Techniques

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX	
	1	2	3	4	5		1	2	3	4	5	%	
Project Chater	0	1	2	5	8	16	0%	6%	13%	31%	50%	50%	5 Not Used
WBS	3	9	0	4	0	16	19%	56%	0%	25%	0%	56%	2 Frequently used
EVM	1	4	1	3	7	16	6%	25%	6%	19%	44%	44%	5 Not Used
Cost Analysis	1	3	3	5	4	16	6%	19%	19%	31%	25%	31%	3 Neutral
CPM	1	3	2	5	5	16	6%	19%	13%	31%	31%	31%	4 Fairly frequently used
PERT	0	1	1	6	8	16	0%	6%	6%	38%	50%	50%	5 Not Used
Gant Chart	3	10	0	3	0	16	19%	63%	0%	19%	0%	63%	2 Frequently used
SWOT	0	0	1	4	11	16	0%	0%	6%	25%	69%	69%	5 Not Used
OrganizationChart	3	9	0	2	2	16	19%	56%	0%	13%	13%	56%	2 Frequently used
Stakeholders Analysis	0	0	1	6	9	16	0%	0%	6%	38%	56%	56%	5 Not Used
Contract Type Selectio	2	6	0	6	2	16	13%	38%	0%	38%	13%	38%	4 Fairly frequently used

From table13, it is clear that they are a big number of PMTT which are not used (about 5) while in table 12 it is mentioned that they are important, automatically there is a need of training of that set of PMTT such as: Project Chatter, EVM, CPM, PERT, SWOT, Stake Holders analysis and Contract Type Selection.

Table 14: Effectiveness of Project management tools and techniques

Effectiveness of Project management tools and techniques

Tools and Techniques	NUMBER OF RESPONDENTS					SUM	RATING SCALE					MAX
	1	2	3	4	5		1	2	3	4	5	
Project Charter	3	6	5	2	0	16	19%	38%	31%	13%	0%	38%
WBS	13	1	0	1	1	16	81%	6%	0%	6%	6%	81%
EVM	12	2	1	1	0	16	75%	13%	6%	6%	0%	75%
Cost Analysis	10	3	1	1	1	16	63%	19%	6%	6%	6%	63%
CPM	11	3	2	0	0	16	69%	19%	13%	0%	0%	69%
PERT	6	7	2	0	1	16	38%	44%	13%	0%	6%	44%
Gant Chart	9	5	0	1	1	16	56%	31%	0%	6%	6%	56%
SWOT	3	8	4	0	1	16	19%	50%	25%	0%	6%	50%
OrganizationChart	3	10	1	2	0	16	19%	63%	6%	13%	0%	63%
Stakeholders Analysis	2	8	2	4	0	16	13%	50%	13%	25%	0%	50%
Contract Type Selection	9	5	2	0	0	16	56%	31%	13%	0%	0%	56%

From table 14 here above it reveal that the same tools and techniques such as: WBS, EVM, CPM, PERT, SWOT, Stake Holders analysis and Contract Type Selection seems to be the most effective in project management, therefore training is highly needed so that roads projects can run smoothly and meet stakeholders expectations.

8.5. Summary of Chapter

One of the specific objectives of the research was to provide appropriate sets of guidance around (i) the most frequently used project management tools and techniques (ii) effectiveness of tools and techniques across project lifecycles and (iii) the need for training on the use of appropriate tools and techniques. The purpose being to improve awareness and understanding of good practices and with a view of benefiting highway projects and clients/customers

Refer to data findings; it has been observed that PMTT across project lifecycle are very important, not frequently used and most effective during the project implementation and need training so that roads contractors in City of Kigali can meet client expectations.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.1. Introduction

The Chapter provided a summary of research findings and some recommendations for future researchers and academia, for practice, policy makers as well as highway industry in general.

9.2. Conclusions

The main objective of the research was to investigate the use and importance of project management tools and techniques for improved projects success in Highway Projects in Kigali. After research investigation, findings reveal that roads contractors in City of Kigali are not using PMTT in their respective projects where 15 respondents out of 16 of respondents which cover 19% need training as main challenge, 13 respondents out of 16 respondents which cover 16% do not access project management software's 11 respondents out of 16 respondents which covers 14% and 10 respondents out of 16 respondents which covers 13% respectively there is willingness and awareness of top management. For the use of PMTT, the research reveals that tools and techniques are not used by roads contractors as indicated in Chapter 4 to 7. Due to the above outcome, the expressed problem statement in Chapter 1 section 4.3 which started that there is a delay of roads projects completion due dates in Kigali, due to lack of understanding of project management tools and techniques and their project management software over the entire life cycle of project is justified since roads contractors in City of Kigali are not familiar with the use of project management tools and techniques, need regular trainings on PMTT and their do not access to project management software's which are the keys factors to projects success.

9.3. Recommendations

Project Management tools and techniques are practically most important around project lifecycle, it is in this regards that, participant in roads projects in City of Kigali such as project team and some members of project stakeholders have to be aware with a maximum level of understanding of project management tools and techniques in such a way that roads projects meet clients expectations and avoid delays due to such misunderstanding.

A part from that, the use of Project management tools and techniques plays a big role in highway industry, after a deep investigation findings reveals that roads contractors in City of Kigali runs their projects by chance and this leads to roads projects delay where at the end contractors experience projects loss and failure. From the above, I do recommend to highway industry in Rwanda especially roads contractors in Kigali, to set preliminary requirements in terms of both human and equipments resources, provide regular training on the use of project management tools and techniques, project management software's and other training related to project management.

In additional to this, research findings reveal that the use of project management tools and techniques around the project lifecycle is still limited due to untrained personnel, accessibility on project management software's, willingness and awareness of top management in highway industry (roads contractors) in City of Kigali. Therefore, the top management of any organization has to set a policy such as: regular project management tools and techniques training in highway aspects, mobilize staffs to access and be familiar with the use of project management software's in order to meet client's expectations and government goals thereafter highway industries in Kigali can be competitive in the region and be more professional during roads projects implementation.

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APPENDICES

Appendix A: Questionnaire for data collection

Research Topic: The Use and Importance of Project Management Tools and Techniques for Effective Highway Projects in Kigali and their Impact on Project Success

Dear Respondent, this questionnaire is for academic purposes only. It is designed as one of the tools for collecting data pertaining, the subject matter. It is on this note that the researcher is kindly requesting you to respond to the questions laid down to the best of your Knowledge.

1. What is your age?

- a. 20-30 ☐ b. 31 – 40 ☐ c. 41 – 50 ☐ d. 51 – 60 ☐ e. More than 60 ☐

2. What is your Sex?

- a. Male ☐ b. Female ☐

3. What languages can you read, speak and write?

- a. Kinyarwanda - English ☐ b. Kinyarwanda – French ☐ c. English - French ☐
d. Kinyarwanda – English and French ☐ e. Kinyarwanda ☐ f. French ☐ English ☐

4. Your Education level

- a. PhD ☐ b. Masters ☐ c. Bachelor's ☐ d. Diploma ☐ e. A₂ level ☐ f. Technician ☐
g. Unskilled ☐

5. Your area of specialisation

- a. Electrical Engineer ☐ b. Mechanical Engineer ☐ c. Architecture ☐ d. Civil Engineer ☐
e. Surveyor ☐ f. Accountant ☐ g. Any other related field ☐

6. Your working experience(years)

- a. Below 5 ☐ b. 5- 10 ☐ c. 11- 15 ☐ d. 16 – 20 ☐ e. 21- 25 ☐ f. 26-30 ☐
g. 31-35 ☐ h. 36-40 ☐ i. More than 40 ☐

7. Your position in your Organization?

- a. General Manager ☐ b. Technical Director ☐ c. Project Manager ☐
d. Site Engineer/Manager ☐ e. Chief Accountant ☐ f. Accountant ☐ g. Others ☐

8. Type of your Company

- a. Local Company ☐ b. Local public/government Company ☐ c. International Company ☐
d. Joint venture of local and foreign company ☐ e. Local Endowment ☐

9. Area of specialization of your Company

- a. General Contractor ☐ b. Road Contractor ☐

10. Company experience

- a. 1- 5 Years ☐ b. 6-10 Years ☐ c. 11-15 Years ☐ d. 16-20 Years ☐ e. Over 20 Years ☐

11. How may road projects so far have you run?

- a. 1 – 3 ☐ b. 4 – 6 ☐ c. 7 – 9 ☐ d. More than 9 ☐

12. Indicate your level of understanding of project management tools and techniques

- a. Very high ☐ b. High ☐ c. Low ☐ d. Very Low ☐

13. Please indicate the

- (i) degree of importance, and the
- (ii) frequency of use of the following planning tools and techniques used in managing highway (roads) projects

Importance:

- 1. Very Important;
- 2. Important;
- 3. Neutral
- 4. Fairly Important;
- 5. Not Important

Frequency of Use:

- 1. Very Frequently used
- 2. Frequently used
- 3. Neutral
- 4. Fairly frequently used
- 5. Not Used

Tools and Techniques	Very Important	Important	Neutral	Fairly Important	Not Important		Very Frequently	Frequently	Neutral	Fairly Frequently	Not Used
Project Charter											
Work Breakdown Structure											
Earned Value Management											
Cost Analysis/Benefit											
Critical Path Method											
(PERT) Program Evaluation & Review Technique											
Gant Chart											
(SWOT) Strength Weakness Opportunities Threats Analysis											
Organization Chart											
Stakeholders Analysis											
Contract type Selection											

14. By drawing on your experiences of highway (roads) project,

- (1) How **effective**, in terms of how they impact on project success, are the following frequently used project management tools and techniques; and
- (2) How **Challenging** is it to use and employ these tools and techniques in transport project

Effectiveness:

1. Very Effective;
2. Effective;
3. Neutral
4. Fairly Effective;
5. Not Effective

Challenging:

1. Very Challenging
2. Challenging
3. Neutral
4. Fairly Challenging
5. Not Challenging

Tools and Techniques	Very Effective	Effective	Neutral	Fairly Effective	Not Effective		Very Challenging	Challenging	Neutral	Fairly Challenging	Not Challenging
Project Charter											
Work Breakdown Structure											
Earned Value Management											
Cost Analysis/Benefit											
Critical Path Method											
(PERT) Program Evaluation & Review Technique											
Gant Chart											
(SWOT) Strength Weakness Opportunities Threats Analysis											
Organization Chart											
Stakeholders Analysis											
Contract type Selection											

15. By drawing on your experiences of highway projects, please kindly document main challenges that impact on the use and exploitation of project management tools and techniques in highway projects.

16. By drawing on your experiences of road project, please indicate the need for training of the following tools and techniques used in transport projects

Need for training:

1. Very High Level of need;
2. High Level of need;
3. Neutral;
4. Fairly High level of need;
5. No Need.

Tools and Techniques	Very High level of need	High Level of need	Neutral	Fairly High level of need	No Need
Project Charter					
Work Breakdown Structure					
Earned Value Management					
Cost Analysis/Benefit					
Critical Path Method					
(PERT) Program Evaluation & Review Technique					
Gant Chart					
(SWOT) Strength Weakness Opportunities Threats Analysis					
Organization Chart					
Stakeholders Analysis					
Contract type Selection					

17. Please kindly list Critical Success Factors (CSF) associated with the Effective use and exploitation of project management tools and techniques in Highway Projects. These are factors if absent seriously affects the effective use and exploitation of project management tools and techniques in Highway Projects

For any query do not hesitate to contact me on e-mail ngoboka74@gmail.com and phone number + 250 788301654
Thank you.

Appendix B: Correspondents addressed to different institutions in Kigali requiring roads contractors for data collection

Appendix B 1: Letter addressed to RTDA

NGOBOKA Jules César
HEM Student
PG 20134044
University of Rwanda
College of Science and Technology
Phone Number: 0788301654

Kigali, 22/07/14

The Director General of RTDA
KIGALI.

Dear Sir,

Re: Request for List of Roads Contractor's Company

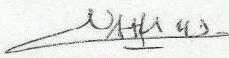
I am here by requesting to your office a list of Roads Contractor's Company working with your institution especially in roads projects to be questioned in the Master's research titled *"The use and Importance of Project Management Tools and Techniques for Effective highway projects in Kigali and their impact on project success"*.

In fact Sir/Madam, I am a student pursuing Master's Degree in High way Engineering and Management (HEM), batch 2 (2012/2013) at University of Rwanda College of Science and Technology with a registration number of PG 20134044 as indicated to the attached copy of to Whom so ever it may concern.

Sir/Madam, if possible avail the list within one week and will be used for academic purpose only;

I look to your prompt reply.

Sincerely,


NGOBOKA Jules Cesar



Appendix B 2: Letter addressed to City of Kigali

NGOBOKA Jules César
HEM Student
PG 20134044
University of Rwanda
College of Science and Technology
Phone Number: 0788301654

Kigali, 29/07/14

The Mayor of Kigali City
KIGALI.



Dear Sir/Madam,

Re: Request for List of Roads Contractor's Company

I am here by requesting to your office a list of Roads Contractor's Company working with your institution especially in roads projects to be questioned in the Master's research titled *"The use and Importance of Project Management Tools and Techniques for Effective highway projects in Kigali and their impact on project success"*.

In fact Sir/Madam, I am a student pursuing Master's Degree in High way Engineering and Management (HEM), batch 2 (2012/2013) at University of Rwanda College of Science and Technology with a registration number of PG 20134044 as indicated to the attached copy of to Whom so ever it may concern.

Sir/Madam, if possible avail the list within one week and will be used for academic purpose only;

I look to your prompt reply.

Sincerely,


NGOBOKA Jules Cesar

Appendix B 3: Letter addressed to Gasabo District

NGOBOKA Jules César
HEM Student
PG 20134044
University of Rwanda
College of Science and Technology
Phone Number: 0788301654

Kigali, 29/07/14



The Mayor of Gasabo District
KIGALI.

Dear Sir,

Re: Request for List of Roads Contractor's Company

I' am here by requesting to your office a list of Roads Contractor's Company working with your institution especially in roads projects to be questioned in the Master's research titled *"The use and Importance of Project Management Tools and Techniques for Effective highway projects in Kigali and their impact on project success"*.

In fact Sir/Madam, I am a student pursuing Master's Degree in High way Engineering and Management (HEM), batch 2 (2012/2013) at University of Rwanda College of Science and Technology with a registration number of PG 20134044 as indicated to the attached copy of to Whom so ever it may concern.

Sir/Madam, if possible avail the list within one week and will be used for academic purpose only;

I look to your prompt reply.

Sincerely,


NGOBOKA Jules Cesar

Appendix B 4: Letter addressed to Nyarugenge District

NGOBOKA Jules César
HEM Student
PG 20134044
University of Rwanda
College of Science and Technology
Phone Number: 0788301654

Kigali, 29/07/14

The Mayor of Nyarugenge District
KIGALI.

Dear Sir,



Re: Request for List of Roads Contractor's Company

I' am here by requesting to your office a list of Roads Contractor's Company working with your institution especially in roads projects to be questioned in the Master's research titled *"The use and Importance of Project Management Tools and Techniques for Effective highway projects in Kigali and their impact on project success"*.

In fact Sir/Madam, I am a student pursuing Master's Degree in High way Engineering and Management (HEM), batch 2 (2012/2013) at University of Rwanda College of Science and Technology with a registration number of PG 20134044 as indicated to the attached copy of to Whom so ever it may concern.

Sir/Madam, if possible avail the list within one week and will be used for academic purpose only;

I look to your prompt reply.

Sincerely,


NGOBOKA Jules Cesar

Appendix B 5: Letter addressed to Kicukiro District

NGOBOKA Jules César
HEM Student
PG 20134044
University of Rwanda
College of Science and Technology
Phone Number: 0788301654



Kigali, 29/07/14

The Mayor of Kicukiro District
KIGALI.

Dear Sir,

Re: Request for List of Roads Contractor's Company

I am here by requesting to your office a list of Roads Contractor's Company working with your institution especially in roads projects to be questioned in the Master's research titled *"The use and Importance of Project Management Tools and Techniques for Effective highway projects in Kigali and their impact on project success"*.

In fact Sir/Madam, I am a student pursuing Master's Degree in High way Engineering and Management (HEM), batch 2 (2012/2013) at University of Rwanda College of Science and Technology with a registration number of PG 20134044 as indicated to the attached copy of to Whom so ever it may concern.

Sir/Madam, if possible avail the list within one week and will be used for academic purpose only;

I look to your prompt reply.

Sincerely,

NGOBOKA Jules Cesar

Appendix B 6: Whom so ever it may concern



COLLEGE OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING
(NYARUGENGE CAMPUS)

DEPARTMENT OF CIVIL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY

Ref: CEET/RL/2013-14/174

Date: 30th June 2014

To

Whom so ever it may concern

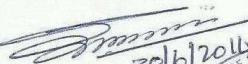


Dear Sir/Madam,

This is to certify that **Mr. NGOBOKA Jules Cesar (PG 2013 4044)** is a bonafide student, studying in MSc in Highway Engineering & Management, in the Department of Civil Engineering and Environmental Technology during the Academic Year 2012-2013. Currently he is working on her Thesis **"THE USE AND IMPORTANCE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES FOR EFFECTIVE HIGHWAY PROJECTS IN KIGALI AND THEIR IMPACT ON PROJECT SUCCESS"**. He may need some relevant information or data from your office and accessing to your labs and sites to complete his research work. I am requesting your good office to assist him in what so ever manner

In case, any other additional information will be required, please do not hesitate to contact me any time

Sincerely Yours,


Dr. G. SENTHIL KUMARAN
B.E (Civil), M.E (Structures), D. Arch., Ph.D.,
Head of Department



P.O.Box 3900, Kigali, Rwanda

www.ur.ac.rw

Tel: +250 252 574 696
+250 252 574 698

Fax: +250 252 571 924
+250 252 571 925

Email: info@kist.ac.rw
hceet.est@ur.ac.rw

Appendix C: Correspondents from different institutions in Kigali

Appendix C 1: Letter from RTDA

LIST OF COMPANIES WITH CONTRACT AMOUNTS							
REF	COMPANY NAME	PHONE CONTACT	EMAIL ADDRESS	CONTRACT AMOUNT	YEAR OF CONTRACT SIGNATURE	TYPE OF TENDER	COMMENT
1	ITEC Engineering	(250)788414045	itec05@gmail.com	75,581,242	2012	CONSULTANCY	Traffic count on unpaved road
2	TECHNIPLAN	(39)0685350880	techniplan.spa.@agora.it	USD 226,200	2013	CONSULTANCY	EIA study for feeder roads in Rwanda
3	IT Transport Ltd		itt@ittransport.co.uk	GBP 145,820	2014	CONSULTANCY	Consultancy for updating the road maintenance fund allocation formulae
4	CIMA International	5143372462	www.international.cima.ca	USD 2,218,872	2013	CONSULTANCY	Supervision of works for Mwityazo-Kivumu Kibuye road (66Km)
5	ROUGHTON INTERNATIONAL	(44)(0)2380278600	matumueni.bukaka@roughtron.com	USD 314,839	2013	CONSULTANCY	Supervision of works for Tumba College Road
6	SWEROAD	46-10-123-3300	sweroad@sweroad.se	USD 523,282.35		CONSULTANCY	Contract for Consultants' Services for Road Safety Audit of the National Road Network and Development of Road Safety Action Plan
7	ITECO Engineering Ltd	(255)132614685	info@itecoconsult.com	99,426,334	2013	CONSULTANCY	Technical audit of WB projects Ruhengeri-Kigali road
8	SCET TUNISIE	21671800033	direction@scet-tunisie.com.tn	319,072,000.00	2013	CONSULTANCY	Detailed technical study Urban Roads Huye-Muhanga-Ngoma
9	HORIZON	(250)252570374/5/6	info.construction@horizongroup.com	755637589	2013	CONTRACTOR	Maintenance of Multi year Nyakinama-Musanze-Cyanika and Musanze-Rubavu asphalt Road

10	NPD COTRACO	(250)583987/514585	contraco@rwandatel1.rwanda1.com	1,141,927,135	2013	CONTRACTOR	Works for improvement of Nyabugogo Ponds Lourds road section
11	FAIR CONSTRUCTION	(256)772700400	fair@fairconstruction.rw.com	2,949,726,240	2013	CONTRACTOR	Works of access to Tumba College
12	CHINA HENAN INTERNATIONAL COOPERATION GROUP CO. LIMITED (CHICO)	(250)784951129	chicorwanda@gmail.com	2,333,428,569	2013	CONTRACTOR	works for Gasaka-Musange feeder roads
13	ECOAT	(250)788301770	ecoat2020@yahoo.fr	532,980,120	2013	CONTRACTOR	Maintenance Nyankora-Murindi Nasho unpaved road
14	CHINA ROAD AND BRIDGE CORPORATION	25472458		111,574,916	2013	CONTRACTORS	Supply and installation of new traffic lights
15	STRABAG	49 221 824-2099	strabag@rwanda1.com		2012	CONTRACTORS	Rehabilitation of Kigali-Gatuna Asphalt road
16	HYCOGEC	(250)788301068	hycogec@ymail.com	71,095,000	2013	SERVICES	Study of urban roads Rwamagana-Nyagatare
17	ITT	(44)1235833753	itt@itttransport.co.uk	148,409,964	2014	SERVICES	Consultancy for updating RMF Allocation formulae and HR Audit
18	WAPCOS	(91-124)2397391	mail@wapcos.gov.in	662,704,951	2013	SERVICES	Implementation of a passenger ferry and inland waterway cargo system on lake Kivu
19	TAEP KOWEIT	(965)22413270	taepdg@taepeurope.com	535,272,135	2013	SERVICES	Supervision of Rubengera-Gisiza road
20	INFRAMAD	(250)788301068	inframad@moov.mg	214,507,952	2013	SERVICES	Study for the construction of new Nyabarongo Bridge and access road

Provided by
Nyirase Shatun
Director of Procurement/RDA
AP. 04/09/2014

Appendix C 2: Letter from City of Kigali

Current list of companies working with the City of Kigali in road construction projects

A) Road Construction

Major requirements for these companies are Equipment, Companies experience, experience for key personnel and bank guarantees.

List of companies

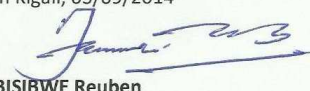
1. China Road and Bridge Corporation
2. NPD COTRACO
3. Horizon Construction
4. Engineering Regiment
5. EMP (currently no on-going contract)
6. STRABAG (working with RTDA on Kigali-Gatuna road).

B) Road design and supervision services

Major requirements include personnel experience, companies experience and possession of some equipment/tools.

1. CCC
2. HYCOGEC
3. Cavicon
4. GECO Africa
5. PRISMA
6. INFRAMAD
7. MITIANA
8. Atlantis

Done in Kigali, 03/09/2014



AHIMBISIBWE Reuben

Director of Infrastructure Department
City of Kigali

Appendix C 3: Letter from Kicukiro District

REPUBLIC OF RWANDA



KIGALI CITY
KICUKIRO DISTRICT
P.O.BOX 657 KIGALI

LIST ELIGIBLE CONSTRUCTION COMPANIES AND CONSULTING FIRMS IN ROAD CONSTRUCTION

CONSTRUCTION COMPANIES

- EMP
- HORIZON CONSTRUCTION
- NPD COTRACO
- ECOTIBAT

CONSULTING FIRMS

- CCC
- ATLANTIS
- HECOGEC
- GE&SS

Patrick KABONGO Tumbar
[Signature]

Appendix C 4: Letter from Gasabo District

REPUBLIC OF RWANDA



KIGALI CITY COUNCIL
GASABO DISTRICT
P.O Box: 7066 KIGALI
Website: www.gasabo.gov.rw
E-mail: gasabo_district@yahoo.com

Kigali, 18/8/2014
Ref: 2139/070102.2014

Mr. Aime HABIMANA
Tel: 0788595772

Dear Sir,

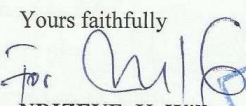
Re: Road Construction & Consulting Companies working with Gasabo District

With reference to your letter dated 18/08/2014 requesting Gasabo District to provide you with the list of Road Construction & Consulting Companies working with Gasabo District.

I am glad to give you the list of the eligible Companies Gasabo District has been working with to date;

- NPD- COTRACO
- HORIZON
- CHINE ROAD AND BRIDGE CORPORATION
- ECOSTRAP Ltd
- E.R.E
- ERCOBAC LTD
- ALBRIDGE & HEAVY EQUIPMENT LTD

Yours faithfully

for 
NDIZEYE. K. Willy
Mayor of Gasabo District



Appendix C 5: Letter from Nyarugenge District

REPUBLIC OF RWANDA



Kigali City
NYARUGENGE DISTRICT
P.O. BOX. 1092
Email: nyarugenge@minaloc.gov.rw
Tel: 572800-575052; Fax: 575052
Mr .Habimana Aime
Tel .0788595772

Dear Sir,

Re: Road construction and consulting Companies working with Nyarugenge District.

With reference to your letter dated **18/08/2014** requesting Nyarugenge District to provide you with the list of Road Construction and Consulting Companies working with Nyarugenge District .

I am glad to give you the list of the eligible Companies in Nyarugenge District that have been working with us to date.

- ❖ 3N CONSTRUCTION LTD
- ❖ REGECO LTD
- ❖ ERICOF LTD
- ❖ LUXIN INVESTMENT LTD
- ❖ GM CIVIL ENGINEERING CONTRACTORS LTD

Yours faith fully

A handwritten signature in blue ink, appearing to read 'Ezra Mutwara Kayiga', is written over the typed name and partially over the official stamp.

MUTWARA KAYIGA Ezra
Executive Secretary Nyarugenge District



CC: - Mayor of Nyarugenge District

Vice Mayors of Nyarugenge District (ALL)

