Assessing the efficiency of water loss projects in Ekurhuleni Metropolitan Municipality

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DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the Degree of Masters of Business Administration at the Potchefstroom Campus of the North-West University. It has not been submitted before for any degree or examination in any other University.

Salome Chiloane
24th day of March 2018

ABSTRACT

This research set out to investigate the efficiency of 'as and when' water loss reduction projects in Ekurhuleni Metropolitan Municipality. The study thus focussed on a water loss eradication programme in Ekurhuleni Metropolitan Municipality. The study was motivated by the fact that Ekurhuleni Metropolitan Municipality is mostly implementing water loss reduction projects on an 'as and when' basis.

Thus, the aim of the study was to determine the efficiency of 'as and when' water loss projects. Semi-structured interviews were conducted on Project Managers and Senior Management to gather insights on the efficiencies of 'as and when' water loss projects. Moreover, information pertaining to the progress and performance of 27 'as and when' water loss projects from Ekurhuleni Metropolitan Municipality was collected. This information was in the form of projects reports, payment certificates as well as contractor appointment letters.

The term 'as and when' is an informal word which is used in Ekurhuleni Metropolitan Municipality. In literature, 'as and when' project management has similar characteristics with ad hoc project management. Ad hoc projects are indicated to be developed when an unprecedented challenge or problem arises that cannot be solved using standard or predefined business procedures. In assessing the efficiency of 'as and when' water loss projects, project time, cost and quality were determined. Moreover, semi-structured interviews were done with the aim of acquiring in-depth understanding on the practice of 'as and when' water loss projects.

The results of the study show that 19 projects (70%) were completed within the required timeframe and 14 projects (52%) were completed within budget whilst 16 projects (59%) were completed within the required scope. The reason for not completing projects within the required timeframe, budget and scope was attributed to a lack of adequate staff in the tendering department as well as a lack of adequate technical knowledge from contractors. Over and above this, the metro’s Project Managers were also identified as a cause for concern in managing the projects due to a lack of adequate technical skills and qualifications.

The study recommends that the metro should benchmark its project management strategy of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipalities to other metros as this

may assist the Metro to improve. This will further enable the Metro to form relations which are specifically aimed at assisting each other when it comes to project management issues. Over and above this, the metro should improve the technical skills of its Project Managers who are managing water loss projects. The development of a policy on the management of contractors and consultants is also recommended to better manage service providers. Lastly, the tendering department at the metro should be fully capacitated with adequate Human Resources in order to improve the metro's project management.

Keywords:
Efficiency, project management, programme, 'as and when' water loss projects, benchmark

DEDICATION

I dedicate this report to my husband, Emmanuel Nwabueze for granting me his continuous support and encouragement towards my studies. May the Almighty God continue to bless him abundantly. I further dedicate this report to my children, Koketso, Kgotso and Thatoyamodimo, for being such a wonderful inspiration to me. I hope that you will follow in my footsteps and do more.

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LIST OF ACRONYMS

Acronym	Abbreviation
CAPEX	Capital Expenditure
CIDB	Construction Industry Development Board
COO	Chief Operation Officer
DoD	Degrees of Delay
DWA	Department of Water Affairs
EMM	Ekurhuleni Metropolitan Municipality
EPA	Environmental Protection Agency
FY	Financial Year
GDS	Growth and Development Strategy
HOD	Head of Department
IDP	Integrated Development Plan
IMQS	Infrastructure Management Query Software
IWA	International Water Association
Kl	Kiloliter
M	Meter
M^3	Cubic Meter
MFMA	Municipal Finance Management Act (no 56 of 2003)
MM	Millimeter
MNF	Minimum Night Flow
NE	North East

NRW	Non-Revenue Water
OECD	Organisation for Economic Co-operation and Development
OPEX	Operational Expenditure
PM	Project Management
PMO	Project Management Office
PPM	Project Portfolio Management
R	South African Rands
SDBIP	Service Delivery Budget and Implementation Plan
SW	South West
UFW	Unaccounted for Water
US$	United States Dollars
WC	Water Conservation
WDM	Water Demand Management
WSA	Water Services Authorities
WSDP	Water Services Development Plan

CHAPTER 1: NATURE AND SCOPE OF THE STUDY

1.1 Introduction

Water is becoming an increasingly more valuable resource throughout the world. Though there is more water on earth, there are often shortages of fresh clean water in places where it is mostly needed. Water is often wasted or misused, resulting in expensive treatment solutions or even more costly outages. Drought conditions and water shortages in the past years showed how quickly lack of water can become an emergency. While the weather conditions cannot be controlled, water loss can be reduced in the broken system that delivers the drinking water (Global Water Technologies, 2017).

According to Hamilton and McKenzie (2014:1), water losses from municipal systems are becoming a serious problem throughout the world and particularly in developing countries. In developing countries, the problem is very serious due to lack of adequate funds which often results in poor maintenance of the water infrastructure. The United States Environmental Protection Agency (2013:1) indicated that the public water systems face a number of challenges. These challenges are aging infrastructure, increasing regulatory requirements, water quantity and quality concerns and inadequate resources and may be magnified by changes in population and local climate.

In some areas, water losses are estimated to be higher than the actual legitimate water use and the situation is gradually deteriorating to such an extent that intermittent supply is now the norm rather than the exception in some parts of the world. The International Water Association has identified water loss from municipal system as one of the most important issues facing a world where the ever-increasing population is placing additional strain on systems which are already failing to meet the current demands (Hamilton & McKenzie, 2014:1).

It has been estimated that the United States will need to spend approximately $200 billion dollars on water systems over the next 20 years to upgrade transmission and distribution systems. Of this amount, $97 billion (29%) is estimated to be needed for water loss control. (United States

Environmental Protection Agency, 2013:1). The American Water Works Association estimates that 18% of drinking water is lost each day through leaking pipes and broken water mains in the United States. In many old systems, even higher amounts are lost and water efficiency is desperately needed (Global Water Technologies, 2017).

A water loss control program can help water systems manage and eradicate these challenges. The management of water loss requires an investment in time and financial resources, management of water loss can be cost-effective if properly implemented. The time to recover the costs of water loss control is typically measured in days, weeks, and months rather than years. A water loss control program will also help to protect public health through reduction in potential entry points for disease-causing pathogens (United States Environmental Protection Agency, 2013:1).

South Africa's present level of nonrevenue water is estimated to be in the order of 37%, which is virtually at the world average of 36,6%. Of this, a quarter is considered to be losses through physical leakage. While South Africa compares well to the world average, the country does not compare well to other developed water scarce countries, such as Australia, whose nonrevenue water levels are often less than 10%. There is still much scope for improvement. As a water scarce country, 37% of non-revenue water cannot be afforded (The Water Wheel, 2013:15).

The Ekurhuleni Metropolitan Municipality is no exception to the rest of the world's municipal failing water system. At the end June 2016, the metro's current non-revenue water figure was sitting at 34.61% (Ekurhuleni Metropolitan Municipality, 2016: 975). In an attempt to reduce its non-revenue water, the metro has initiated a water loss eradication programme which aims to reduce the metro's water losses.

This research was carried out in order to determine whether the metro's implementation of water loss projects on an 'as and when' basis is efficient or not in Ekurhuleni Metropolitan Municipality. The study mainly focussed on water loss projects which are under the water loss eradication programme. In determining project efficiency, project time, budget and scope were assessed taking into consideration whether the projects were completed on time, within budget and scope.

It was expected that, in order for 'as and when' water loss projects to be successful, the manner in which such projects are managed will play a vital role. Thus, a semi-structured interview questionnaire was developed in order to understand the operation and management of 'as and when' water loss projects. Moreover, a decision on the criteria which are used to decide on whether or not a project or a programme will be implemented on an 'as and when' was also investigated.

1.2 Problem statement

Water scarcity is a South African reality. The country has an annual rainfall, which is below the world average (492 mm as opposed to the world average of 985 mm). Moreover, rainfall is seasonal and unevenly distributed throughout the country (Rand Water, 2017). The management of any form of water losses is important in South Africa. As indicated above, South Africa's present level of nonrevenue water is estimated to be in the order of 37%, which is virtually at the world average of 36,6% (The Water Wheel, 2013:15).

Of this, a quarter is considered to be losses through physical leakage. As indicated above that South Africa compares well to the world average, the country does not compare well to other developed water scarce countries, such as Australia, whose nonrevenue water levels are often less than 10%. There is still much scope for improvement. As a water scarce country, we cannot afford to waste so much water (The Water Wheel, 2013:15).

In Ekurhuleni Metropolitan Municipality, the non-revenue water figure at the end of June 2016 was 34.61% (Ekurhuleni Metropolitan Municipality, 2016: 975). The financial amount equivalent to this percentage value can be used to develop other areas since Ekurhuleni has a high level of service delivery backlogs. The Non-Revenue Water (NRW) figure is high and requires proper management in order to be minimised. Any form of water loss should be corrected and prevented. Failure to prevent water loss may result in high water shortages since South Africa is already a water stressed country.

In an attempt to reduce its water losses, Ekurhuleni Metropolitan Municipality has embarked on a water loss eradication programme aimed at reducing the metro's water loss and NRW. In 2012,

the metro's Non-Revenue Water figure was sitting at 39.3%. Any water services provider which encounters an unaccounted-for water above 20%, priority attention is required in order to minimise the losses. Thus, in attempt to reduce the water loss, Ekurhuleni Metro has embarked on a robust water loss eradication programme in 2011/12 financial year. The water loss eradication programme aims to reduce the metro's water losses. However, most of the water loss projects are conducted on an 'as and when' basis.

'As and when' projects at Ekurhuleni Metropolitan Municipality are projects which are rolled out based on the availability of funds. The municipality usually appoints a contractor and consultants based on the available funds to do work for which the municipality only has the budget. The problem with 'as and when' contracts, particularly in water loss projects, is that they are difficult to manage in terms of time and cost, for example, a contractor may be appointed to meter houses at the cost of R3 million. The contractor will then estimate the number of houses which the cost will cover as well as the timeframe.

During the implementation of the metering project, the municipality may have another R3 million which it will add to the already existing funds of R3 million. The contractor in this case will have to extend the scope of work and timeframe. This makes it difficult to make a thorough assessment in terms of the project time and budget. The municipality mostly implement their contracts on an 'as and when' basis. The efficiency and the sustainability of this 'as and when' basis need to be established from the project management point of view.

Thus, this research assessed the efficiency of the 'as and when' water loss projects which are aimed at reducing water loss in Ekurhuleni Metropolitan Municipality. An assessment of the water loss projects was based on project efficiency measures which would be identified in literature. The project efficiency measures were put to test in measuring water loss projects of Ekurhuleni Metropolitan Municipality. The assessment focussed on analysing the projects against the project efficiency measures. Based on the findings, recommendations which will assist in managing and implementing 'as and when' projects efficiently in Ekurhuleni Metropolitan Municipality were determined.

The South African National Water Act (No 36 of 1998) encourages water users to preserve, manage, conserve and protect water resources. The management of water loss is very important to Ekurhuleni Metropolitan Municipality as well as to South Africa. The study should assist Ekurhuleni Metropolitan Municipalities and other metros to assess the efficiency of their 'as and when' water loss projects. In the context of this study, water loss is water which has been lost in the water distribution system and Ekurhuleni Metropolitan Municipality cannot account for that water. The unaccounted-for water may be in the form of apparent losses or real losses (i.e. physical and commercial losses) as determined by the International Water Association water balance.

The study assessed the efficiency and management of the 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality. The projects which were assessed were from the 2011/12 financial year to the 2015/16 financial year (i.e. five years' data). Based on the findings, recommendations were also drawn in an attempt to better manage 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

1.3 Objectives of the study

The objectives of the study were to assess the efficiency of 'as and when' water loss reduction projects in Ekurhuleni Metropolitan Municipality. By successfully assessing 'as and when' water loss reduction projects, the metro will be able to determine whether the implementation of 'as and when' water loss projects is viable or not in terms of service delivery efficiency. Due to the large number of projects which are implemented on an 'as and when' basis, the metro will be able to determine whether such projects should be outsourced or implemented in-house.

1.3.1 Primary objective

The primary aim of this study is to assess the efficiency of 'as and when' water loss reduction projects in Ekurhuleni Metropolitan Municipality.

1.3.2 Secondary objectives

- To determine criteria for measuring project efficiency in literature in order to use empirical data to measure the 'as and when' water loss projects.
- To determine the efficiency and sustainability of 'as and when' water loss projects.
- To determine the criteria which is used to determine, manage and fund 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

1.3.3 Goals of the empirical research

In order to reach the goal of assessing the efficiency of 'as and when' water loss projects, the empirical study investigated the following issues:

- The operation and management of 'as and when' water loss reduction projects in EMM
- The implementation and execution of 'as and when' water loss reduction projects within the stipulated time frame, budget and scope
- To establish if a gap exists in the operation and management of 'as and when' water loss reduction projects.

1.4 Scope of the study

The Ekurhuleni Metropolitan Municipality is located in the East of Johannesburg and was established in the year 2000 (City of Ekurhuleni, 2011). The Municipality covers an extensive geographical area which includes areas from Alberton in the South to Germiston in the west to Nigel in the east. The municipality was established as one of the six metropolitan municipalities resulting from the restructuring of local government in the year 2000 (City of Ekurhuleni, 2011). Figure 1.1 depicts Ekurhuleni Metropolitan Municipality areas.

Figure 1.1: Ekurhuleni Metropolitan Municipality areas

(Source: The Local Government Handbook, 2016)

Ekurhuleni Metropolitan Municipality has a total surface area of about 2000km^2 with a population of about 2.8 million (City of Ekurhuleni, 2011). This is approximately 5.6% of the national population and makes up to 28% of Gauteng Province's population (City of Ekurhuleni, 2011). The study has thus assessed 27 water loss projects which have been implemented within Ekurhuleni Metropolitan areas. As indicated above, the projects which were assessed are from 2011/12 financial year to 2015/16 financial year (i.e. five years' data).

1.4.1 Limitations of the study

This research focussed on 'as and when' water loss projects which were implemented in Ekurhuleni Metropolitan Municipality. Only Ekurhuleni Metropolitan Municipality 'as and when' water loss projects were assessed. Thus, the research does not include 'as and when' water loss projects that are carried out by other Metropolitan Municipalities. The study has only investigated 'as and when' water loss projects which were implemented for five financial years (i.e. from 2011/12 to 2015/16 financial year).

1.5 Research methodology

The research tradition followed in this study is a case study using Ekurhuleni Metro as a model to assess the efficiency and management of 'as and when' projects. According to Anonymous (2017), case studies aim to analyse specific issues within the boundaries of a specific environment, situation or organisation. Ekurhuleni Metropolitan Municipality was used to assess the efficiency of 'as and when' water loss projects.

1.5.1 Literature study

In order to establish a sound theoretical background on the subject, a broad literature study on project efficiency, ad hoc project management, portfolio and programme management as well as water loss management was done. The internet and various text books, articles, journals and other relevant scientific sources have been studied in order to understand the concepts of the study and to retrieve possible scenarios (see: Chapter 2).

1.5.2 Empirical investigation

The empirical study was done through structured and non-structured means. In the empirical study, a semi-structured questionnaire had been used to collect primary data. The secondary data was project documentation which was analysed using the document analysis method. According to Doyle (2017), a semi-structured interview is a meeting in which the interviewer does not strictly follow a formalised list of questions. The interviewer usually asks more open-ended questions,

allowing for a discussion with the interviewee rather than a straightforward question and answer format. The interviewer may prepare a list of questions but does not necessarily ask them all, or touch on them in any particular order, using them instead to guide the conversation.

The semi-structured questionnaire is a data collection method which sets out the questions to be asked in a formal way in order to produce the desired results. The questions were open ended and close ended statement relating to the implementation of 'as and when' water loss projects, challenges and possible solutions on 'as and when' water loss projects. The questions and statements were formulated as simple and concise as possible to ensure that respondents understood the question. In a case were the respondent did not understand the question, a clarity was provided.

The purpose of the semi-structured questionnaire was:

- To identify the criteria which was used to determine whether a project or a programme should be implemented on an 'as and when' basis
- To identify if 'as and when' water loss projects are implemented efficiently
- To identify if management determine the efficiency of 'as and when' projects/programme in Ekurhuleni Metropolitan Municipality

After completion of the semi-structured interviews, a raw data set was available that needed to be processed to extract meaningful data. This was done using thematic analysis method.

The second part of the empirical study involved collecting project documents and analysing the documents. According to Bowen (as cited by Triad, 2016), document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic. The purpose of the document analysis was to determine whether 'as and when' water loss projects were completed within time, budget and scope. After collecting all the required project documentation, a raw data set was available that needed to be processed to extract meaningful data.

1.5.3 Selection of participants

The target population, which was selected to participate in this research, only includes Project Managers and Senior Management of Ekurhuleni Metropolitan Municipality. Both Project Managers and Senior Management were selected from Ekurhuleni Department of Water and Sanitation. The Project Managers were selected because they are responsible for the implementation of 'as and when' water loss projects. Whilst Senior Management are responsible for making decision in terms of prioritising project planning and implementation.

1.5.4 Data collection and analysis

The data was collected from Ekurhuleni Metropolitan Municipality from the Department of Water and Sanitation. A qualitative research method was followed for the research study. The method employed in analysing the data was document analysis taking into account the efficiency measures of project management (i.e. project time, cost and scope). Semi-structured interviews were conducted to the Divisional Head (DH) for Projects as well as five Project Managers in the Department of Water and Sanitation (i.e. EMM). The data collected from the six respondents was captured using the thematic analysis methodology

1.5.5 Measures of reliability, validity and trustworthiness

The research was based on empirical data that was collected from Ekurhuleni Metropolitan Municipality (i.e. Department of Water and Sanitation). The empirical data collected was kept by the Department of Water and Sanitation. Interviews with respondents were recorded to ensure that the information was captured correctly. The recordings of the interviews will be kept with the researcher for at least five years. Thus, it was assumed that, at the end of the study, the same conclusion would be reached if the study was conducted in a similar environment.

The research study only concentrated on one metropolitan municipality in Gauteng. Because this research is a case study, which only focusses on Ekurhuleni Metropolitan Municipality, it can thus be said that the results are not generalisable. In order to achieve generalisability for the South

African metropolitan municipalities, a bigger sample must be used over the country. However, the study could serve as a benchmark to other metropolitan municipalities.

1.5.6 Ethical aspects

For the sake of confidentiality purposes, the names of the contractors and consultants who were used for the study and the company names of the contractors and consultants as well as their contact details were not included in the report. This information was used solely for the analysis.

1.6 Significance of the research

The municipality mostly implement their projects on an 'as and when' basis. The efficiency or rather the sustainability of this 'as and when' basis needed to be established from the project management point of view and for the financial viability of the metro. Conducting the study should enable Ekurhuleni Metro to know whether implementing water loss projects on an 'as and when' basis will be sustainable or not. Furthermore, the study should enable management to know whether 'as and when' projects are managed efficiently or not. This should thus enable the metro to put relevant measures in place if applicable to better manage or possibly to do away with the implementation of 'as and when' projects.

Moreover, the study should contribute much within the context of the persistent water crisis of the South African economy as well as the challenging service delivery in metropolitan municipalities. According to Wegelin *et al.,* (2010), South Africa is a water scarce country and its annual runoff is less than 13% of the world average. The country is ranked the 30th driest in the world in terms of water resources (Government of South Africa, 2015). The world's average rainfall is 985mm per year, and South Africa receives an annual rainfall of 492mm. South Africa is thus classified as a water-stressed country as it receives nearly half of the earth's rainfall average (Rand Water, 2017).

Also, South Africa's rainfall is unevenly distributed. The eastern half of the country is much wetter than the western half due to the nature of the weather conditions. South Africa also experiences alternating periods of droughts and floods which affects the amount of water across South Africa.

In addition, hot dry conditions result in a high evaporation rate. Scientists predict that with global warming, South Africa will experience much wetter wet seasons and much drier dry seasons, resulting in an increase in floods and droughts (Rand Water, 2017).

The predictions of scientists are becoming a reality as the evidence of this is in the current state of the Cape Town drought. De Villiers (2017) has indicated that the provincial dam levels at the end of September 2017 were at 35.88% compared to 62.2% at the same time in 2016. The three years of below-average rainfall have exacerbated the situation and despite proactive measures like the implementation of water restrictions and programmes to clear the Berg River of alien vegetation, the reality is that Cape Town is faced with dire situation. It is thus very likely that Cape Town may enter summer which begin in December 2017 with only 25% of usable water in the dams.

According to De Villiers (2017), Cape Town Theewaterskloof Dam stood at 27% in September 2017, compared to 52% in 2016. Whilst the Voëlvlei Dam stood at 27% (2016, 69%), the Clanwilliam Dam at 41% (2016, 99%) and the Brandvlei Dam at 33% (2016: 57%). Because of this severe drought in Cape Town, the national Department of Water and Sanitation has requested the City of Cape Town to reduce its overall water consumption by 40%. A reduction of 40% would equate to roughly 520 million litres of collective water usage per day. By the end of September 2017, the citywide water consumption stood at 618 million litres per day, which was a decrease of 4 million litres compared to the previous weeks (De Villiers, 2017).

The Cape Town drought situation indicate the dire state of the South African water scarcity problem. Even though South Africa is a water scarce country, water losses in its water distribution systems remains one of its major problems. McKenzie (2014:33) has indicated that the average South African water loss is sitting at 31.8% and Non-Revenue Water is at 36.8%. The 36.8% is equivalent to 1 580million m3/annum which is approximately one third of the total water supplied. This represents an annual loss of over R7 billion based on an average bulk water tariff of approximately R5/m3. The 36.8% Non-Revenue Water (NRW) figure is considered to be in line with the international NRW figure of 36.6% (McKenzie *et al.*, 2012).

Though the South African NRW figure is in line with the international NRW figure, as a semi-arid country there is a greater need for improvement in terms of reducing NRW and water losses since

South Africa is a semi-arid country. Any form of water losses should be prevented, the study thus seeks to assess the efficiency of the planning, implementation and execution of 'as and when' water loss projects. The study is important to the country and Ekurhuleni Metropolitan Municipality as it attempts to assess the efficiencies of water loss projects.

1.7 Layout of the study

Chapter 1: Nature and scope of the study

This chapter introduces the topic and provides the scope of the study. Over and above that, the problem statement, delineation and significance of the study are outlined.

Chapter 2: Literature review

Inclusive in this chapter is the literature review. A comprehensive literature review was conducted to inform the empirical investigation. Thereafter, a literature review on measures of project efficiency, metropolitan municipalities, water loss crisis as well the management of 'as and when' projects was provided.

Chapter 3: Empirical Investigation

The methodology followed in conducting the research as well as the process which was followed in gathering the empirical data are outlined in this chapter. The results and analysis of the empirical data are also outlined in this chapter.

Chapter 4: Conclusion and recommendations

This chapter provides the main findings of the study. Contributions and an evaluation are provided. Thereafter, recommendations and a conclusion follow. At the end of this chapter, a reference list follows.

1.8 Summary

In order to determine whether a project or a programme is a success, project efficiency measures must first be considered. Project efficiency measures the internal factors (i.e. time, cost and scope/ functionality). This can be best done by understanding the internal processes which unfolds before a project is implemented (i.e. the planning process). A thorough planning will enable the project to be implemented and executed within budget and with the desired quality. For the purposes of this study, a semi-structured interview with the relevant management at the department enabled the researcher to acquire an in-depth understanding on the efficiency of the 'as and when' water loss project management at the metro.

An analysis of the project reports in terms of time, costs and quality was conducted in order to assess the project efficiency. In order to assess the timely completion of projects, the degree of delay was calculated. This provided a uniform measure for performance and allowed for comparison of the different projects within the different construction periods. The analysis was based on projects within the water loss eradication programme. The programme was chosen for the study to understand the roll out of 'as and when' water loss projects which is elaborated in detail in Chapter 2. In the next chapter, a comprehensive review of the literature that was studied during the research is provided.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature in the field of metropolitan municipalities, project management and water loss management. A preliminary literature survey was conducted with the aim of finding out what work has been done on 'as and when' project management and management of projects in the water industry. However, many studies have been conducted in project management, programme management and project portfolio management in the construction industry.

A broad literature review was conducted on the study area with special attention drawn to the South African context. The literature was reviewed to answer the research question, which is: What is 'as and when' project management? And what criteria is used to determine whether a project or a programme should be implemented on an 'as and when' basis? The secondary objective was to determine the criteria which is used to determine whether a project or a programme should be in implemented on an 'as and when' basis in Ekurhuleni Metropolitan Municipalities. The literature review was also used to form a basis for the research methodology and give an idea of the best suitable methods for this study area.

2.2 Metropolitan Municipalities in South Africa

2.2.1 Historic overview

South Africa underwent turbulent and dramatic socio-political and economic changes in the early 1990s after decades of totalitarian rule, followed by high economic growth levels in the next decade up to the 2007 economic downturn (Van Huyssteen *et al.*, 2010:23). Other countries also shared similar experiences in this respect, as several countries particularly those in Central Europe, of which Poland is the prime example, shared the same fate and has hence a lot to learn from each other experiences (Van Huyssteen *et al.*, 2010:24). Under apartheid, spatial planning in South African cities largely took the form of master planning and was fragmented and differentiated along racial lines (Todes *et al.*, 2010:416).

The Nationalist Government after its election victory in 1948, embarked on a programme of implementation of its master plan of separate development. This programme had as its premise that black South Africans would never be permanent residents of the country's urban areas and that peace between the racial groups was best secured by racial separation. This saw the passing of racist legislation such as the Group Areas Act (No. 41 of 1950), which assigned different residential and business sections in urban areas to each racial group.

This has resulted in the forced removal of Blacks from areas designated for white occupation. It was only in the middle-1990s that the transition from the apartheid government to post-apartheid democratic governance and planning approaches began. Based on the 1996-Constitution, which can be described as 'quasi-federal in form, but unitary in function, a new vision for reconstruction and development emerged. (Van Huyssteen *et al*., 2010:26).

The Constitution of South Africa provides for three categories of municipalities. The categories are classified into category A, B and C which are as follows:

Table 2.1: Categories of municipalities in South Africa

Categories	**Number of municipalities**
Category A	8 Metropolitan Municipalities
Category B	226 Local Municipalities
Category C	44 District Municipalities

(Source: Own compilation)

- **Category A: Metropolitan municipalities**

Category A municipalities are metropolitan municipalities which have the exclusive municipal executive and legislative authority in its area. Category A municipalities exist in the biggest cities in South Africa. They have more than 500 000 voters and the metropolitan municipality co-ordinates the delivery of services to the whole area. There are metropolitan municipalities in Johannesburg, Cape Town, Durban, Pretoria, Port Elizabeth, Bloemfontein and the East Rand. These municipalities are broken into wards.

Half the councillors are elected through a proportional representation ballot, where voters vote for a party. The other half are elected as ward councillors by the residents in each ward (Local Government, 2015).

- **Category B: Local municipalities**

Category B are municipalities which shares municipal executive and legislative authority in its area with a category C municipality within whose area it falls. These are areas that fall outside the eight metropolitan areas. Local municipalities also fall in a district and share powers and functions with District Municipalities. Currently there are 226 local (Category B) municipalities and each municipality is divided into wards. People in each ward are represented by a ward councillor (Local Government, 2015).

Category C: District municipalities

District municipalities are made up of several local municipalities that fall in one district. With the exception of the eight metros, the rest of the country is covered by the 44 district municipalities, which are divided into local municipalities and share responsibilities with them. In 2015, there were 44 District Councils in South Africa. Typically, there are between 4-6 local municipalities that fall under one district council (Local Government, 2015).

The purpose of district municipalities (Category C) and local municipalities (Category B) sharing the responsibility for local government in their areas, is to ensure that all communities, particularly disadvantaged communities, have equal access to resources and services. This arrangement is made in order to help local municipalities who do not have the capacity (finances, facilities, staff or knowledge) to provide services sustainably and adequately to their communities. It also helps to cut the costs of running a municipality by sharing resources with other councils (Local Government, 2015).

While metropolitan municipalities are responsible for all local services, development and delivery in the metropolitan area, local municipalities share that responsibility with district municipalities.

This is especially the case in very rural areas, where district municipalities will have more responsibility for development and service delivery.

Thus, all municipalities in the categories are responsible for the provision of basic services such as water, electricity, waste collection, municipal health services, municipal roads, libraries and other facilities. Since municipalities are responsible for provision of services such as water, this includes the provision of infrastructure which will ensure that water services reach its communities. The water infrastructure needs to be operated and maintained efficiently to ensure a sustainable water supply. Also, the water infrastructure needs to be expanded when population grow and replaced or repaired as it ages. All of this is done through the projects, and some of those projects are done on 'as and when' basis.

In South Africa there are currently 278 municipalities, comprising of eight metropolitan's municipalities, 44 district municipalities and 226 local municipalities (Corruption Watch, 2014). The municipalities are focussing on growing local economies and providing infrastructure and services. In Metropolitan municipalities two choices of two types of government exist. The first one is the mayoral executive system where the mayor has the authority, and the second one is the collective executive committee system where the executive committee has the authority.

As directed by the Constitution of South Africa, the Local Government Municipal Structures Act (No117 of 1998) contains criteria for determining when an area must have a category-A municipality (metropolitan municipalities). It also contains a criteria for determining when municipalities fall into categories B (local municipalities) or C (district municipalities). The Municipal Structures Act (No117 of 1998) further determines that category-A municipalities can only be established in metropolitan areas. According to the Act, Metropolitan councils have single metropolitan budgets, common property ratings and service-tariff systems, and single employer bodies. South Africa has eight metropolitan municipalities which are:

- Buffalo City (East London)
- City of Cape Town
- Ekurhuleni Metropolitan Municipality (East Rand)
- City of eThekwini (Durban)
- City of Johannesburg

- Mangaung Municipality (Bloemfontein)
- Nelson Mandela Metropolitan Municipality (Port Elizabeth)
- City of Tshwane (Pretoria).

According to the Act, Metropolitan councils may decentralise powers and functions. However, all original municipal, legislative and executive powers are vested in the metropolitan council. Non-metropolitan areas consist of district councils and local councils. District councils are primarily responsible for capacity-building and district-wide planning. The Local Government Municipal Structures Act (No 117 of 1998) further provides for ward committees whose tasks, among other things, are to:

- Prepare, implement and review integrated development programmes (IDPs)
- Establish, implement and review municipalities' performance-management systems
- Monitor and review municipalities' performances
- Prepare municipalities' budgets
- Participate in decisions about the provision of municipal services
- Communicate and disseminate information on governance matters.

A large part of the South African space economy is generated in the metropolitan regions particularly the Gauteng City Region. These metropolitan regions produced more than 64% of the South African economic output in 2004 and provided home to 38% of the South African population. The Gauteng Region is by far the biggest, housing almost a quarter of the country's population (the analysis suggests more than 22%) and contributing almost 39% to the national economy (CSIR, as cited by Van Huyssteen, 2010:30).

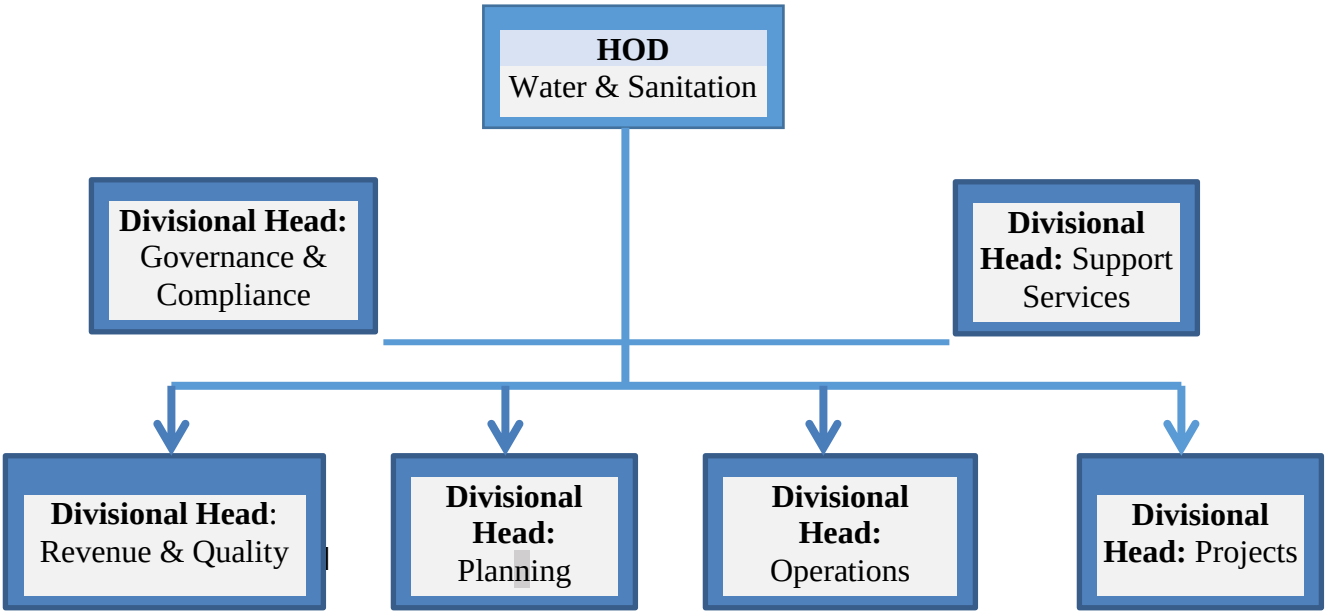
Metropolitan regions also play a critical role in driving innovation and regional competitiveness. An analysis of international trade figures for 2007, as measured through exports and imports highlights that more than 70% of all national exports and 90% of all national imports were recorded in the metropolitan municipalities (Van Huyssteen *et al*., 2009:178). The South African metropolitan regions alone produced 64% of the national GDP of the country in 2004 (Van

Huyssteen *et al*., 2010:24). The study was undertaken in Ekurhuleni Metropolitan Municipality which is amongst the eight metropolitans in South Africa.

2.2.2 Ekurhuleni Metropolitan Municipality

The Department of Water and Sanitation is one of the 27 departments within Ekurhuleni Metropolitan Municipality with a mandate to provide water and sanitation services. Figure 2.1 depicts the department's macro organisation structure with its various sections.

Figure 2.1: Departmental Macro Structure of Water and Sanitation



(Source: Department of Water and Sanitation, 2015: 5)

2.2.2.1 Functions of the Department of Water and Sanitation

The overall mandate for the department is to ensure adequate provision of water and sanitation services. This entails planning, developing, implementing, operating and maintaining water and sanitation services in alignment to the Integrated Development Plan. The department is comprised of six divisions as depicted Table 2.2. The services provided by each department are as follows:

Table 2.2: Department of Water and Sanitation divisions and functions

Operations Division	**Support Services Division**
▪ Repairs to water pipe bursts, leaks, valves, hydrants, ▪ Repair to sewer network excluding pump-stations (pumps, switchgears and electrical systems) ▪ Dislodging sewer blockages and cleaning of the affected areas ▪ Maintenance of reservoirs, main-holes and valves ▪ Meter connections; ▪ Monitor contractors working on water servitudes	▪ Customer Care & service; ▪ Education and Awareness; ▪ Administration duties; ▪ Financial Management ▪ Document Filing and Registry Functions; ▪ Budgeting and budget monitoring; ▪ Expenditure tracking; ▪ Quality Management ▪ Human Resources
Revenue and Water Quality Division	**Projects Division**
▪ Install new meters; ▪ Repair and maintenance to meters; ▪ Replace and calibration of meters; ▪ Water quality testing and records keeping; ▪ Issuing permits for waste water discharge into sewers; ▪ Tariff setting; ▪ Meter inspections	▪ Prepare tender documents & budgeting ▪ Design and implementation of projects; ▪ Approval of designs of consultants; ▪ Developing detailed feasibilities of projects; ▪ Supervise projects & Contracts management; ▪ Community involvement & participation
Planning Division	**Governance and Compliance Division**
▪ Master Planning of water and sewer infrastructure ▪ Plan projects ▪ Pre- and Feasibility Studies	▪ Risk Management; ▪ Performance Management Compliance; ▪ Ensuring compliance to the Legislation; ▪ Legal Advice;

▪ Develop and Review the WSDP; ▪ Township development approvals; ▪ Economic developments approval; ▪ Water Demand Management Strategy development, Implementation and monitoring;	▪ Regulatory Performance Management System (DWA); ▪ Audit Findings Tracking and action plans monitoring; ▪ Water Safety Plan monitoring; ▪ Contract documentation

(Source: Department of Water and Sanitation, 2015: 5)

The study has assessed 27 'as and when' projects which have been implemented by the Department of Water and Sanitation under the water loss eradication programme. As depicted on the Department of Water and Sanitation functions, the Planning Division is responsible for planning department projects whilst the Revenue and Water Quality Division is responsible for metering projects which also forms part and parcel of the 'as and when' projects. The operations division is also responsible for 'as and when' water loss projects which are mainly repairs to water pipe bursts, leaks, valves and hydrants. The project division is responsible for overseeing project implementation and for ensuring that all departmental projects including 'as and when' projects are executed accordingly.

The Ekurhuleni Metropolitan Municipality is an amalgamation (in the year 2000) of nine previously independently administered towns into one city, and is spatially highly fragmented both socially and economically (Todes *et al.*, 2010:416). As a legacy of apartheid some areas are well located in relation to current economic opportunities while others (mainly the former township areas previously reserved for African people and located on the periphery) have remained locational disadvantaged. A challenge in this metropolitan area is to integrate these areas into the historic nodes and to improve their economic opportunities that will benefit everyone equally.

The municipality is an important manufacturing center and is known as the industrial hub of Gauteng Province. It has experienced some level of industrial restructuring, as well as the decline of mining. Managing local economic change and promoting economic development for the benefit of all and enabling livelihoods are thus of some importance. Other significant challenges facing

Ekurhuleni Metropolitan Municipality includes: poor linkages across the area; decaying central business districts; service backlogs in previously disadvantaged areas; the legacy of mining, coupled with geotechnical problems across parts of the area; uncoordinated land use management approaches between various former towns and uneven distribution of social and institutional infrastructure (Todes *et al.,* 2010:416).

Though the metro is facing significant challenges in infrastructure. The water infrastructure is one of the most aged infrastructure in the metro which requires significant funding. The metro is sitting with almost R700 million worth of infrastructure replacement overdue for water (Ekurhuleni Metropolitan Municipality, 2015:10). High leakages in some areas can be attributed to the old infrastructure and at the rate of funding at the time of the study, it would take at least ten years to clear overdue replacements. Unless there is a paradigm shift, the infrastructure will at some point completely fail. A new model of infrastructure replacement and upgrading is a prerequisite as the current model will not eliminate these backlogs.

The aged infrastructure lead to high water losses at the metro. Because of the high water losses, the Ekurhuleni Metropolitan Municipality Department of Water and Sanitation has embarked on a wide range of Water Conservation / Water Demand Management (WC/WDM) Projects to ensure that the high percentage of Non-Revenue Water (NRW) / Water Losses are curtailed and brought to acceptable levels. The NRW at the end of the 2012/2013 financial year (June 2013) was 40.3% or 110 112 293 kl/yr. in water losses, a figure considered poor performance in terms of the International Water Association benchmarking practice (Ekurhuleni Metropolitan Municipality, 2015:2).

This figure translated to R561 million per annum of lost revenue and which is not sustainable. The Non-Revenue Water (NRW) at the end of the 2014/15 financial year (June 2015) was 36.1%, which was a welcome reduction from the peak of 40.3% in June 2013 but considered still very high NRW. Because of these high levels of NRW, a number of programmes and projects were identified with the intention of reducing NRW to 20% over the next ten years with an anticipated bulk water purchases savings of approximately R2.0 billion (Ekurhuleni Metropolitan Municipality, 2015:2). In order for those identified projects and programmes to yield positive

results, it is important for these water loss projects to be implemented efficiently. The implementation of the water loss projects efficiently may reduce the metros water loss to the targeted level of 20% in ten years.

2.3 Project efficiency

Within the field of project management, the concept of efficiency and effectiveness are commonly used but rarely defined (Sundqvist *et al*., 2014:279). Project efficiency and effectiveness measures are important to judge project performance and project success. Sundqvist *et al*., (2014) further indicates that researchers apply the concept of efficiency and effectiveness differently. Some researchers apply the concepts when describing how to improve some part of project management. Whilst other researchers apply the concepts when describing competencies for project execution (Lambel, as cited by Sundqvist *et al*., 2014:279).

Serrado and Turner (2015: 31) define project efficiency as meeting cost, time and goals. Turner and Zolin (2012: 87) suggest that project efficiency is important to success. Thus, the success of the project itself is measured by project efficiency, but the success of the investment is measured by wider measures as suggested by Turner and Zolin (2012). Project success is defined as meeting the wider business and enterprise goals as defined by key stakeholders. Shenhar *et al.*, (as cited by Serrado and Turner, 2015:31) noted that of the three traditional dimensions of project efficiency- time, budget and scope- scope has the largest role because it also has an impact on the customer and his or her satisfaction.

In quality management, efficiency means doing things right i.e. performance is done in a most suitable way given the available resources. Effectiveness means doing the right things i.e. selecting and focussing on producing an output that there is a demand for (Sundqvist *et al*., 2014:279). Effectiveness looks at external project factors (such as User satisfaction with product, level of effectiveness (i.e. achievement of outcomes), project functionality, free from defects, value for money, profitability, absence of any legal claims and proceedings, learning and exploitation and, generation of positive reputation) and its long term whilst efficiency looks at internal project factors (such as cost, time and scope) and its short term.

The three main dimensions of project management; time, cost and quality, are usually used to measure project efficiency (Serrado &Turner, 2015:30). Turner and Zolin (2012:87) indicate that project efficiency is important to project success. They have further reiterated that, the success process of the project itself is measured by project efficiency. Whilst the success of the project investment is measured by the wider measures. Project management success is the traditional measure of project success, measured at project completion, and is primarily based on whether the output is delivered on time, cost and functionality which is called project efficiency (Serrador & Turner, 2015:30).

As such, it is conceivable that each project would have measures appropriate to its goals. Fouché and Rolstadås, (2010:763) took into consideration all the performance indicators highlighted by these authors and concluded that project performance measurement criteria are dependent on the types of goals set for a particular project. In order for any project to perform efficiently, planning plays a vital role. The implementation of water loss projects needs a methodological approach if positive results are to be achieved.

2.4 Water loss project management

McKenzie (2014:2) emphasised that, reducing water loss in a municipal water distribution system is not a difficult task; it only requires a dedicated and methodical approach if real and sustainable savings are to be achieved. In many cases, water loss reduction interventions are introduced which are inappropriate to the problems experienced in the reticulation system. If a municipality intends to embark on a water loss project, it is important that an intervention is selected which will address the most serious problems experienced in a specific area in order to have a chance of success. In a municipal setting, the interventions may vary from one municipality to another municipality. The key issue is to decide which intervention would be more effective in reducing water loss.

McKenzie (2014:4) further indicated that the most common mistake, which is made by many municipalities in the globe, is to believe that water loss reduction is achieved through only by leak detection and repair. In such cases, more money is spent on purchasing expensive hi-tech

equipment's. If high levels of water loss are due to inaccurate metering or water theft, the intervention in leak detection and repair will yield negative results on water loss reduction. It is thus vital for municipalities to first conduct an analysis of water loss in the system in order to come up with interventions that could address the problem.

Identifying the root cause of water loss is a very critical phase if water loss reduction is to be achieved. Once the problems have been identified, the solutions are often obvious and the way forward become clear. McKenzie (2014:4) has identified the following key areas which a municipality needs to consider before embarking on a water loss reduction programme:

- **System schematics**

Understanding how the network system operates will assist in identifying key components such as master meters, reservoirs, purification plants etc. This will also assist in identifying were possible water loss problems may occur. The metro has an infrastructure management software which depicts its network system. Through this software, the metro is able to manage its water infrastructure.

- **Leak location and repair**

Repairing visible and reported leaks (preferably within 24 hours of being reported) is one of the most obvious and basic intervention that should be implemented as a top priority. However, this is not always possible due to lack of adequate leak fixing staff in many municipalities. In Ekurhuleni Metropolitan Municipality, the turnaround time for fixing water leakages is 48 hours.

- **Pressure management**

Pressure management is necessary to reduce the water pressure without compromising the level of service with regard to the consumers and fire-fighting. The metro has a number of pressure valves and towers which are managed to ensure that water services are not compromised.

- **Sectorising**

Sectorising is the process of cutting a big area into smaller manageable areas which will enable the person responsible for the areas to easily identify problem areas (McKenzie, 2014). It is however important for water utilities to have a smaller number of larger zones that can be properly

maintained rather than too many small zones that are not maintained. The process of sectorising is well known as a critical element of any water loss reduction programme. Sectorising in Ekurhuleni Metropolitan Municipality has been done per area (e.g. Katlehong, Tembisa and Alberton) for ease of water management.

- **Logging and analysis of minimum night flow**

After zones have been established, the flows and pressures can be monitored in order to identify specific problem areas. Logging and analysis of minimum night flow is also done at Ekurhuleni Metropolitan Municipality. This is done to understand the different areas of the metro.

- **Bulk management meters**

Bulk management meters assist water managers to monitor and understand the flows in the water supply network. McKenzie (2014) indicates that bulk meter management is essential for the proper operation and management of any reliable and well managed water supply network. The metro has not embarked on a bulk management meters projects yet. It relies on an infrastructure management software to monitor and understand the flow in the supply network.

- **Bulk consumer meters**

Industries pay for their water supply and do not expect to receive free water from municipalities, but they expect to receive a reliable water supply. Having bulk meters to big consumers like industries assists in monitoring the supply of water easily and this in turn enables water managers to know how much water is being utilised where and when. The metro has embarked on a replacement and installation of bulk metering projects to all industries which are situated in the vicinity. Ekurhuleni Metropolitan Municipality is known to be an industrial powerhouse of Gauteng Province. It is estimated that the metro has over 25 000 industries and between 2011 and 2016 the metro has metered approximately 1000 industries.

- **Domestic metering and billing**

Domestic metering and billing plays a vital role in water loss reduction. Responsible consumers who are paying for their water services will ensure that any visible leakage in their plumbing or street is urgently reported to the municipality to prevent high water bills. Ekurhuleni Metropolitan Municipality intends to have meters to all households and it has embarked on replacement and

installation of meters project to various households. A total cumulative of 31,957 meters were replaced by the end of June 2015 to ensure metering accuracy and reliability. Moreover, a total of 10 551 properties were metered for the first time and the majority of these in Tsakane under the flagship War on leaks Tsakane/Langaville/GeluksdalTsakane Metering and Retrofitting project (Ekurhuleni Metropolitan Municipality, 2015:7). It is estimated that the metro has 95 000 unmetered households.

- **Pipe replacement and repair**

Pipe replacement is one of the most expensive water loss intervention methods and it should be considered as the action of the last resort after other options including pressure management and leak repair have been exhausted. Ekurhuleni is sitting with almost R700 million worth of infrastructure replacement overdue for water. High leakages in some areas can be attributed to the old infrastructure and at the current rate of funding it will take at least ten years to clear overdue replacements (Ekurhuleni Metropolitan Municipality, 2015:10).

- **Water balance**

It is important to grasp the concept of water balance in order to be able to fully account for the systems input. Though the concept of water balance will assist in accounting for all the systems input, water experts around the world agree that there is no system that can ever be completely free from leakage, no matter how new or well managed (McKenzie, 2014). The metro is fully accounting for its system input. The metro has adopted the International Water Association method of accounting for its water.

- **Community awareness and education**

Community awareness and education plays an important role as a water loss reduction intervention (McKenzie, 2014). If communities can work with municipalities in conserving water and also assist by reporting leaks and paying for their water services, municipalities can encounter a greater reduction in water loss. It is thus important for municipalities to engage communities in all water projects and also provide education and awareness to enhance community member's knowledge and understanding in the importance of water conservation. Ekurhuleni Metropolitan Municipality

conducts community awareness and education to the community on an 'as and when' required basis.

Whether water loss reduction projects or programmes are implemented on an 'as and when' basis or not, the manner in which municipalities implement the projects/programme is important. Thus, a methodological approach needed to be followed if positive results were to be achieved. In order to thoroughly assess the efficiency of 'as and when' water loss projects, the concept of 'as and when' projects needed to be investigated.

2.5 'As and when' project management

The term 'as and when' projects is an informal terminology in Ekurhuleni Metropolitan Municipality which is always used. 'As and when' projects at Ekurhuleni Metropolitan Municipality are projects which are rolled out based on the availability of funds. The municipality usually appoints a contractor and consultant based on the available funds to do work which the municipality only has the budget. The problem with 'as and when' contracts particularly in water loss projects is that they are difficult to manage in terms of time and cost. For an example, a contractor may be appointed to meter houses at the cost of R3 million. The contractor will then estimate the number of houses which the cost will cover as well as the timeframe.

During the implementation of the metering project, the municipality may have another R3 million which it will add it up to the already existing funds of R3 million. The contractor in this case must extend the scope of work and timeframe. This thus makes it difficult to make a thorough assessment in terms of the project time and cost. The municipality mostly implement their contracts on an 'as and when' basis. The efficiency and the sustainability of this 'as and when' basis need to be established from the project management point of view and for the financial viability of the metro.

The manner into which this 'as and when' projects are planned, implemented and executed need to be identified in literature. Literature indicates that there are ad-hoc project management, programme management and portfolio programme management. Thus, literature in this field was

reviewed to acquire an understanding of were the term 'as and when' projects may have evolved from at Ekurhuleni Metropolitan Municipality.

2.6 Ad-Hoc project management

Ad hoc projects are usually developed when an unprecedented challenge or problem arises that cannot be solved using standard or predefined business procedures. Those problems are usually cross-departmental and involve several stakeholders from within and outside the organisation involving several departments such as marketing and sales, product development, customer service and support, maintenance and legal.

Collaboration in those instances becomes a necessity, often involving the formation of remote teams. The suddenness of said-projects, also means that they, by nature, have a short or temporary lifespan**.** Ad hoc projects unforeseen business problem. The problem can present itself as an unaccounted for drop in market share, a customer escalation, or even a last-minute board meeting (Ruum, 2017).

In the water industry, ad hoc water loss projects include pipe burst, leaking pipes, households and business broken water meters and other problems which needs to be attended to 'as and when' they occur.

2.7 Project and portfolio management

Managing multiple sets of projects simultaneously is a challenge that organisations must master today to implement their strategic objectives. Although the project management literature still focusses primarily on single projects, research in the last five years has increasingly acknowledged that multi-project issues have become critical for all organisations regardless of delivering projects to external or internal customers (Unger *et al.,* 2012:607).

Multi project PMOs have emerged within these multi-project management environments as a major device to develop competence in project management, manage single project performance and coordinate multiple projects and actors (Unger *et al.*, 2012:607). Good project portfolio

management (PPM) is becoming a key competence for companies handling numerous projects simultaneously. A project portfolio is a group of projects that compete for scarce resources and are conducted under the sponsorship or management of an organisation (Jonas, 2010:818).

According to Martinsuo (2013:794), project portfolio management (PPM) deals with the coordination and control of multiple projects pursuing the same strategic goals and competing for the same resources, whereby managers prioritise among projects to achieve strategic benefits. Project portfolio management can be considered a dynamic decision process, where a list of active projects is constantly updated and revised. Project portfolio management literature encourages evaluating, prioritising, and selecting projects based on strategy.

According to portfolio management principles, organisational resources should be allocated to projects in line with strategy. Development processes should consider the existence of different types of projects and their different requirements. Furthermore, portfolio (or multi-project) management requires sharing of resources, components or platforms across a multitude of projects during project implementation. Most of portfolio management studies are prospective in nature, i.e. they suggest good practices for project portfolio management.

Project portfolio management has received a stable and central position both in project management research, product development management research, and companies' management practices during the past decade. Companies have adopted project portfolio management frameworks, including the use of project evaluation and decision criteria, project evaluation and control routines, and other means to formalise their project portfolio management (Martinsuo, 2013:794). Despite the variety of instructions on how projects should be selected to the portfolio, how resources should be allocated across projects, how to align the entire portfolio with strategy, and how to assess the success of the portfolio, companies still struggle with the resource sharing problem across projects as well as constant changes in their portfolios (Elonen & Artto, as cited by Martinsuo, 2013:794).

Rouse (2015) explains project and portfolio management (PPM) as a formal approach that an organisation can use to orchestrate, prioritise and benefit from projects. Rouse (2015) has further

indicated that the project and portfolio management approach examines the risk-reward of each project, the available funds, the likelihood of a project's duration, and the expected outcomes.

There is an overlap between project management (PM) and project and portfolio management, but there is however very important distinction between these disciplines (System Evolution, Inc., 2011:2). Project and portfolio management looks at the projects from an enterprise point of view whilst project management looks at individual projects. In project management, projects are finite and each project has a well-defined scope, timelines and resources. In project and portfolio management, the project is infinite for the life of the enterprise and provides strategic methods for analysing and managing groups of concurrent projects (System Evolution, Inc., 2011:2). Table 2.3 indicates the difference between project management and project portfolio management in terms of the six characteristics which is scope, time, resources, tools, impact of change and industry evolution.

Table 2.3**:** Key differentiators of PM versus PPM

Characteristics	**Project management**	**Project portfolio management**
Scope	Control and manage scope against project specific requirements	Select projects with scope that supports organisational goals
Time	Manage task due dates and dependencies to ensure project delivery	Monitor all project timelines against short and long term goals
Resources	Utilise provided resources effectively and efficiently	Monitor and manage resource utilisation across the portfolio
Tools	Project plans, budget spreadsheets, project charters	Dashboards, resource leveling, PPM applications
Impact of change	Manage change within the purview of individual project to control scope	Measure change across the entire enterprise to foster user acceptance

Industry evolutions	N/A	Measure and evaluate future state against industry and portfolio

(Source: System Evolution Inc., 2011:2)

Strengths in project management can and will support strong project and portfolio management decisions; however, strong project management discipline does not necessarily correlate with sound PPM discipline. For example, a project may be very well managed, but it may not be appropriate for the organisation's long-term vision (System Evolution, Inc., 2011:2).

Organisations should have a project and portfolio management office which will deal with projects at a strategic level. According to the System Evolution, Inc. (2011:4), the benefits of executing a strong PPM strategy includes:

- Common criteria and consistent metrics for scoring and monitoring projects will make certain that projects are prioritised to maximise organisational benefits
- Rigorous evaluation of projects against company objectives and contributions to ROI helps ensure that projects are meeting short- and long-term business strategy and technological goals
- Sharing of 'lessons learned' from one project to the next benefits each new project with the collective wisdom of previous projects.

- Standardisation of processes, tools, and templates • across projects will increase efficiency and consistent communication
- Optimised resource utilisation will efficiently leverage all • available resources and proactively identify resource gaps

The organisation does not need to make new recruits in setting up the PPM office. Some of the senior employees from PM office should be moved to the PPM office, also senior management particularly the Chief Operations Officer (COO) should be part of the PPM office.

2.8 Programme management

When modern project management emerged between 1930s and 1950s, the terms project and program management were used interchangeably (Artto *et al.,* 2009:1). According to the Association of Project Management (2017), project management is the application of processes, methods, knowledge, skills and experience to achieve the project objectives. A project is a unique, transient endeavour, undertaken to achieve planned objectives, which could be defined in terms of outputs, outcomes or benefits. A project is usually deemed to be a success if it achieves the objectives according to their acceptance criteria, within an agreed timescale and budget.

Whilst programme management, on the other hand, is defined as a coordinated management of projects and change management activities to achieve beneficial change. A programme usually starts with a vision of a changed organisation and the benefits that will accrue from the change. Delivering the changed organisation will involve coordinating a number of projects and ensuring that their outputs are used to deliver benefits. A programme is comprised of multiple projects and is created to obtain broad organisational or technical objectives (Association of Project Management, 2017).

Akintonye and Shehu (2009b:1) indicate that programme management is not a synonym of project management, but it is an integrated approach that can streamline the effective delivery of projects. They indicated that the former has its roots in the latter and the two concepts are often confused. Therefore, it has been observed that organisations use the terms ‘project management’ and ‘programme management’ interchangeably, whereas the two are completely different but directly related to one another.

For programme management to succeed there is need to define and differentiate its practices from those of project management to avoid leaving them to serendipity. Programmes tend to be dynamic in nature with intense cross-discipline and cross-project integration (OGC, as cited by Akintonye & Shehu, 2009b:1), in which the actions of one functional project affects, supports and reinforces the other project teams involved in the programme. On the other hand, programme management involves management of a group of projects, while project management deals with the effective

management of activities to deliver the project within the approved cost quality and time (Burke, as cited by Akintonye & Shehu, 2009b:1).

Akintonye and Shehu (2009a:703) argued that programme management is not the same as project management, but rather an integrated approach that can streamline the effective delivery of projects. A fair amount of confusion exists among organisations regarding the definition of programme management. In addition to the lack of universal and consistent definition of programme management, Pellegrinelli *et al.* (as cited by Akintonye & Shehu, 2009a:703) have observed that when individuals involved in programmes meet one another they very often spend time trying to understand what the other's view of programme management is.

There is lack of clarity and understanding of what constitutes a programme. These ambiguities surrounding the nature and practice remain in the programme management environment, despite over a decade of academic and practitioner interests. On the other hand, it has been observed that it is not unusual to find that in the construction industry, organisations confuse programme management with 'schedule management' (construction programme – Gantt charts) or computer programming (Pellegrinelli, as cited by Akintonye & Shehu, 2009a:703).

The core essence of programme management includes activities such as the integrated planning of multiple projects, identification and understanding of dependencies, managing risks relating to complex interdependencies, maintaining focus on the overall business benefits, and coordinating large and often dispersed projects (Akintonye & Shehu, 2009b:3). OGC (as cited by Akintonye and Shehu, (2009b:3) explains that effective programmes require and involve substantial commitment in terms of resources, sufficient budget, prolonged timescales, potential disruption of extant projects or programmes, and major business or organisational change.

Project portfolio management, programme management and project management are identified as key for organisational growth, whilst ad hoc project management only involves those projects that are unplanned and organisations need to act speedily to execute such projects. Thus, the concept of 'as and when' projects may have been derived from the principles of ad-hoc project management.

Water management issues in South Africa and Ekurhuleni have been looked into in order to derive a further understanding on water project management as well as water losses.

2.9 Water management

As indicated above that South Africa is a water scarce country, water losses in its water distribution systems remains one of its major problems. McKenzie (2014:33) has indicated that the average South African water loss is sitting at 31.8% and Non-Revenue Water is at 36.8%. The Ekurhuleni Metropolitan Municipality NRW at the end of the 2012/2013 financial year (June 2013) was 40.3% or 110 112 293 kl/yr. in water losses, a figure considered poor performance in terms of the International Water Association benchmarking practice (EMM, 2015:4).

This figure translates to R561 million per annum of lost revenue and which is not sustainable. However, the NRW at the end of the 2014/2015 financial year (June 2015) was 36.1%, which was a welcome reduction from the peak of 40.3% in June 2013 but considered still very high NRW. Table 2.4 depicts the metro's NRW from 2009 to 2015.

Table 2.4: Ekurhuleni Historic NRW Figures

FINANCIAL YEAR	System Input Volume (kl/annum)	Billed Authorised Consumption (kl/annum)	NRW (kl/annum)	NRW %	Water Loss %	Historical Budget allocations
Jun 2009	329 424 656	201 338 050	128 086 606	38.9%	31.5%	R158m
Jun 2010	322 821 747	193 973 397	128 848 350	39.9%	32.3%	R135m
Jun 2011	332 555 664	204 396 405	128 159 259	38.5%	31.7%	R153m
Jun 2012	338 742 752	205 497 030	133 245 722	39.3%	31.3%	R161m
Jun 2013	344 435 300	203 796854	140 638 446	40.3%	31.8%	R100m
Jun 2014	356 640 839	221 965 939	134 674 900	37.8%	33.9%	R150m
Jun 2015	364 906 484	233 239 675	131 666 809	36.1%	32.1%	R190m

(Source: Ekurhuleni Metropolitan Municipality, 2015:4)

Industry norms require that a Water Utility should spend approximately 2% to 2.5% of the water asset replacement value on the refurbishment / rehabilitation of its water assets in order to maintain the water infrastructure in good working condition. The replacement value of the EMM 'Water Demand Related' infrastructure is R9.5 billion (source: IMQS, July 2013, as cited by EMM, 2015:4), which implies that an annual funding of R210m is required, whilst on average only R141m was allocated over the mentioned five-year period (this implies an annual budgetary shortfall of R69m/33% over a six-year period = R354m) (EMM, 2015:4). Table 2.5 indicates the operational and capital budget allocated to the Department of Water and Sanitation for the past five years.

Table 2.5: Department of Water and Sanitation operational and capital budget

FINANCIAL YEAR	**Operational Budget (OPEX)**	**Capital Budget (CAPEX)**	**Total**
2012/13	R3,587,217,000	R 410,000,000	R3,997,217,000
2013/14	R3, 889,156,000	R416,450,000	R4,305,606,000
2014/15	R5, 759,072,000	R472,126,000	R6,231,198,000
2015/16	R5,553,597,000	R474, 833,393	R6,028,430,393
2016/17	R6, 533,830,959	R334, 555,269	R6,868,386,228
Total	**R25,322,872,959**	**R2,107,964,662**	**R27,430,837,621**

(Source: own compilation)

The Department of Water and Sanitation operational budget is the budget which is used for operational activities of the department. The operational expenditure consists of employee related costs, contracted services, operational cost, inventory, bulk purchases, interest dividends and rent on land, contribution for bad debt as well as transfers and subsidies. Whilst a capital budget is a budget which is used for the departments projects (i.e. pipe replacements, meter installations and other projects).

These projects have been requested by community members and the department also determine the need for projects through the water infrastructure master plan. These projects are then included in the metro's Integrated Development Plan (IDP). The Integrated Development Plan (IDP) is a five-year plan which local government is required to compile to determine the development needs of the municipality (Knysna Municipality, 2012). The projects within the IDP are also linked to the municipality's budget. Thus, the IDP is reviewed annually to determine if community needs have not changed.

As depicted in Table 2.5, the budget for operational and capital project varies in the five years. This is so because departments are allocated funding based on the availability of the funds at the metro. The metro allocates these funds based on the IDP. Thus, those projects which have been requested by community members and those projects which have been determined by the department will determine the allocation of funding. The allocation of funding is also driven by the Growth and Development Strategy (GDS) of the metro. The Growth and Development Strategy is a roadmap which guides the metro's actions in order to realise the vision of becoming a smart, creative and developmental city. The targeted year of realising the metro's vision is 2055, thus the GDS outlines how the metro will have achieved the vision in 2055.

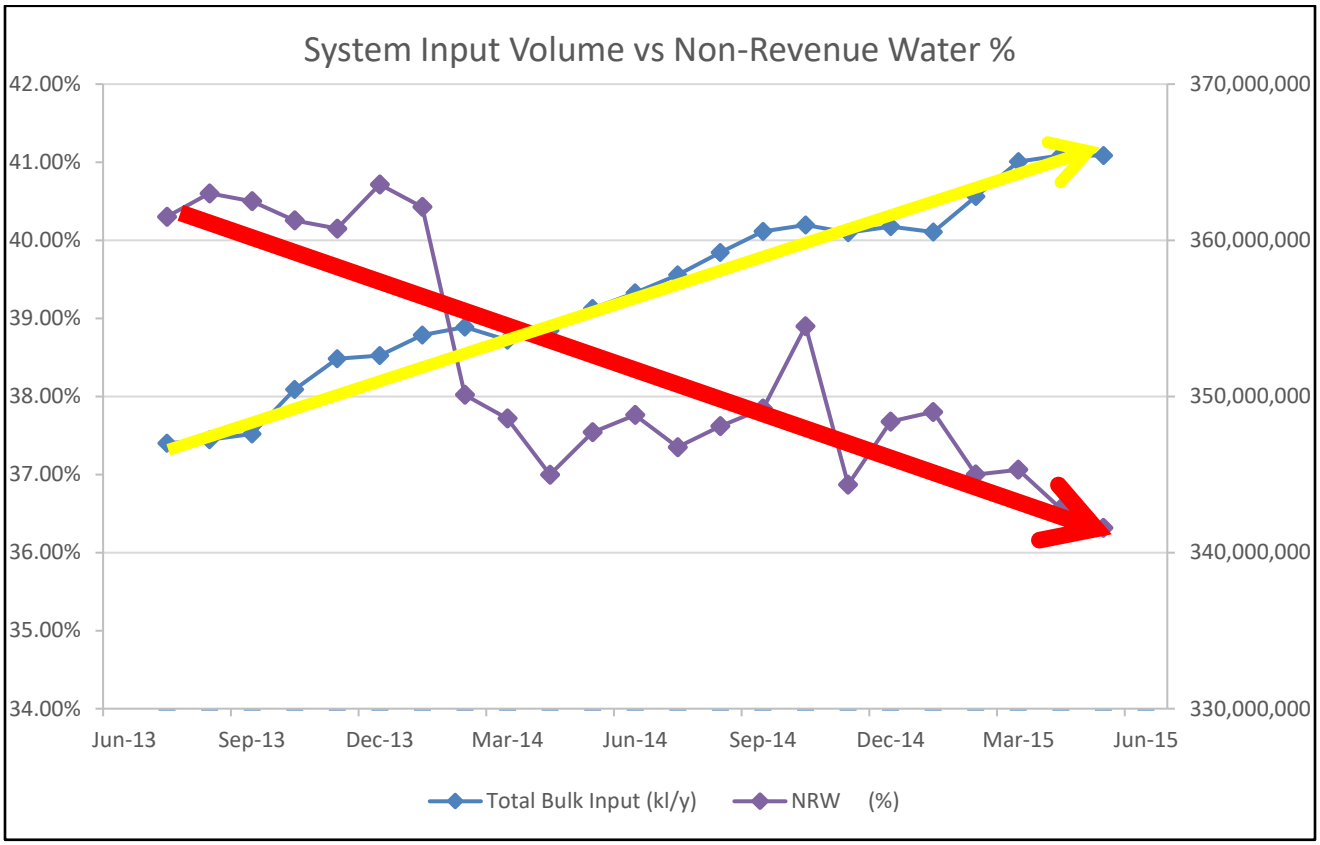
The 'as and when' water loss projects are thus funded by the operational and capital budget. The contracted services under operational budget for 2016/17 financial year was R 692,214,845, some of the work which contractors are been paid for are for 'as and when' water loss projects. Also, the capital budget consists of a budget for 'as and when' water loss projects. However, the capital budget for water loss projects is not adequate.

This under-funding as depicted above of the infrastructure rehabilitation programme has been the root cause of the NRW to remain consistently high over many years as reflected in Table 2.4. The 1% rise of NRW during 2012/2013 can directly be attributed to the R210m – R100m = R110m shortfall in budget allocation to fund the water loss eradication programme. In actual fact, the EMM WDM-related infrastructure has been neglected for at least the past ten years. The reduction of NRW is important to South Africa and to all South African Municipalities (EMM, 2015:4).

2.9.1 Reduction of Non-Revenue Water in EMM

Below summarised is the net progress in reducing non-revenue water from June 2013 to June 2015

Figure.2.2: Ekurhuleni Metropolitan Municipality NRW from June 2013 to June 2015



(Source: Ekurhuleni Metropolitan Municipality: 2015: 5)

As at the end of June 2015 the NRW figure was sitting at 36.1% which is 4.2% lower than the 40.3% recorded in June 2013. In real terms this translate to 7,858,280kl reduction in non-revenue water and an increase of 26,182,043kl billed authorised consumption against 18,323,763kl increase in bulk water purchases. The increase in bulk water purchases was not necessarily an increase in non-revenue as there was a concomitant increase in the estimated water sales revenue of 3%. The downward trajectory has been consistent since December 2013 with a clear trend and corroborated by a volumetric decrease in non-revenue water and an increase in water sales (EMM, 2015: 5). The NRW is an attribute of various water losses which municipalities cannot account for.

2.9.2 Types of water losses

Water losses are the sum of the physical losses and the commercial losses and are calculated from the difference between the total system input and the authorised consumption (McKenzie *et al.,* 2012), whilst Non-Revenue Water is the term which often represents different components to the various water suppliers. Non-Revenue Water incorporates the following items (McKenzie, 2014):

• Unbilled authorised consumption;
• Commercial Losses; and
• Physical Leakage.

- **Unbilled Authorised Consumption**

The unbilled authorised consumption is the volume of authorised consumption that is not billed or paid for. The level of unbilled authorised consumption will vary from water service provider (WSP) to WSP and in some areas virtually all water is metered and billed in some manner with the result that the unbilled authorised consumption is zero.

- **Commercial Losses**

Commercial losses or Apparent Losses are made up from the unauthorised consumption (theft or illegal use) plus all technical and administrative inaccuracies associated with customer Metering or billing.

- **Physical Leakage**

Physical Leakage or Real losses represent the physical leakage from the pressurised system, up to the point of measurement of customer use.

- **Authorised Consumption**

Authorised consumption is the volume of metered (authorised metered) and/or unmetered (authorised unmetered) water taken by registered customers, the water supplier and others who are authorised to do so by the water supplier, for residential, commercial and industrial purposes.

- **Billed Authorised Consumption**

Billed authorised consumption is the volume of authorised consumption which is billed by the Water Services Authority (WSA) and paid for by the customer. It is effectively the revenue water, which, in turn, comprises:

• Billed metered consumption;

• Billed unmetered consumption.

- **System Input**

The system input represents the volume input to the water supply system from the water services authorities (WSAs) own sources allowing for all known errors (i.e. errors on bulk water meters) as well as any water imported from other sources – also corrected for known bulk metering errors.

High levels of non-revenue water (NRW) reflect huge volumes of water being lost through leaks, not being invoiced to customers, or both. These high levels of non-revenue water seriously affect the financial viability of water utilities through lost revenues and increased operational costs.

2.9.2.1 Water balance

For municipalities to have control over their water supply systems, a concept of water balance will need to be adopted. A water balance is basically the amount of potable water which a municipality or a metro account for (depicted in Figure 2.2 below). The International Water Associated (IWA) has helped to establish a standardised water balance throughout the world. However, in certain countries, the standardised water balance must be modified to align it to the requirements of the country. McKenzie *et al.* (2012:19) has identified South African situation as one of the most difficult to address using a standard water balance format due to some factors. In South Africa, the most important issues that need to be incorporated in the water balance are the Free Basic Water as well as the Non-Recoverable Revenue Water as identified by Seago and McKenzie (2007).

- Free Basic Water is relatively simple to address and the recommended approach is to consider it Revenue Water that is billed at a zero rate (McKenzie *et al.,* 2012:19). McKenzie *et al.* (2012:21) have further indicated that the current allocation of Free Basic

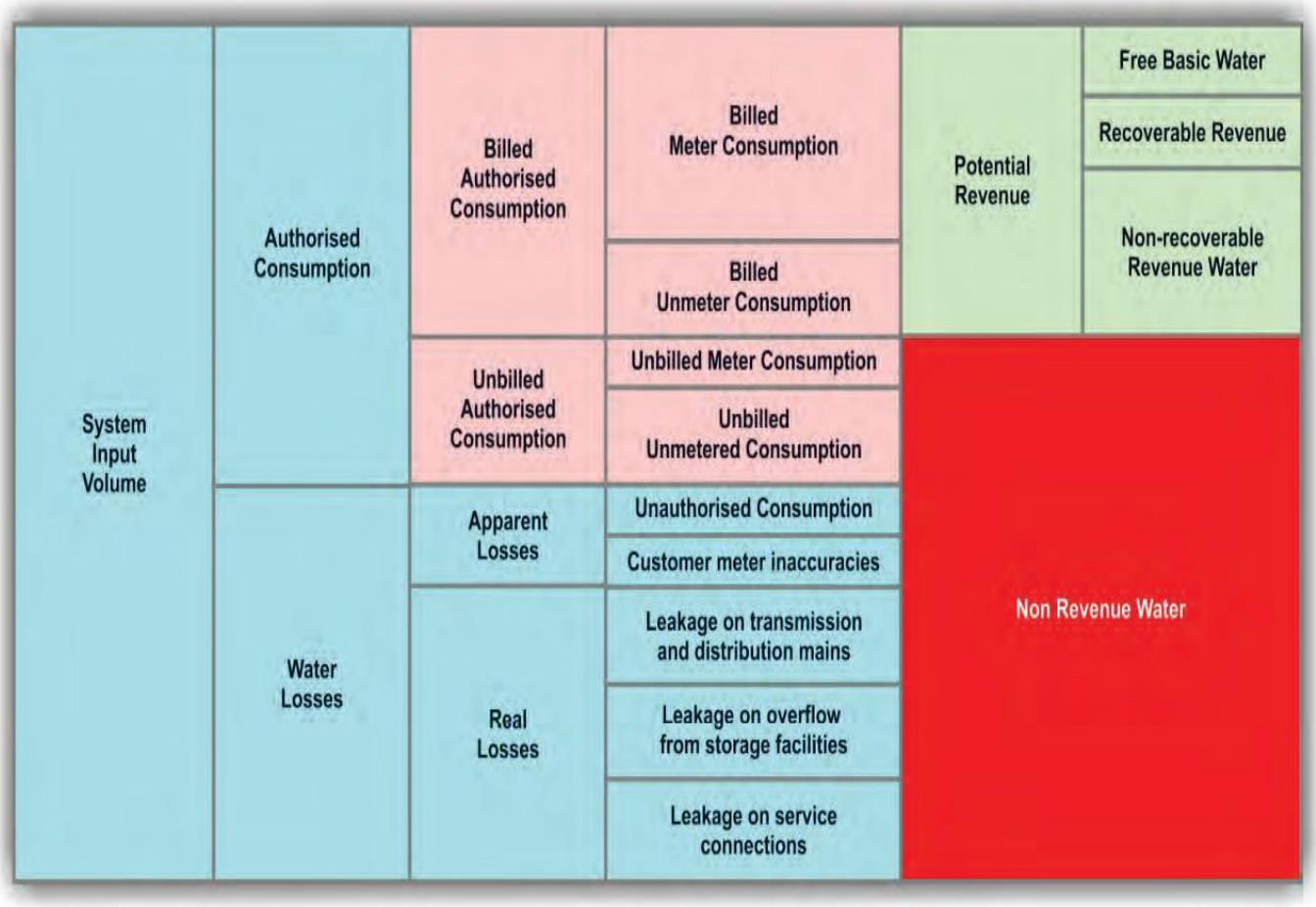
Water by municipalities is not standardized and many municipalities now provide a volume, which can vary from the original 6 kl per household per month as stipulated by National Government.

- The Non-Recoverable Revenue Water is water that has been metered and billed to consumers, but consumers cannot afford to pay for the water services. This mainly results since many households in South Africa experience high abnormal internal plumbing losses resulting in very high monthly water bills which the owner cannot afford pay. Technically, the water is considered to be Metered Billed Consumption and is therefore shown in a standard water balance as a Revenue Water (McKenzie *et al.*, 2012:20).

In reality, the situation is the opposite as the consumer may never pay for this water and at some point, the account may be written off. According to McKenzie *et al*. (2012), the Non-Recoverable Revenue Water is important to be included in the water balance since it represents either leakage or inefficient use. Figure 2.2 depicts the modified IWA water balance to incorporate these two components (i.e. Free Basic Water and Non-Recoverable Revenue Water).

McKenzie *et al.* (2012) have also noted that in most South African municipalities, the water balance can only be completed using information provided by the Technical Department and the Finance Department. This is the case at Ekurhuleni Metropolitan Municipality as the Water and Sanitation Department is responsible for the provision of the water services whilst the Finance Department is responsible for billing of water services. Figure 2.3 indicates the modified International Water Association (IWA) water balance.

Figure 2.3: Modified IWA Water Balance



(Source: Seago & McKenzie, as cited by McKenzie *et al.*, 2012:20)

As depicted in Figure 2.3, the IWA water balance is colour coded in blocks per areas of responsibility. As illustrated, the input volume, authorised consumption and water losses in the form of apparent and real losses are under the jurisdiction of the technical department which in Ekurhuleni Metropolitan Municipality is the Department of Water and Sanitation (McKenzie *et al.*, 2012:20). The Department of Water and Sanitation in Ekurhuleni Metropolitan Municipality is responsible for the physical operation, and maintenance of water reticulation systems. As such the Department of Water and Sanitation accounts for all aspects of water balance as depicted in Figure 2.2. This means that the department is also responsible for rolling out 'as and when' water loss reduction projects which are focus of the study.

The metering of consumers is usually the responsibility of the technical departments which is the case in Ekurhuleni Metropolitan Municipality. However, the billing of consumers is typically under the authority of the finance department which is also the case in Ekurhuleni Metropolitan Municipality. The overall Water Balance therefore bridges both the Technical and Financial Departments within a Municipality and such joint responsibility often results in some form of discrepancy (McKenzie *et al.*, 2012:20).

The billed and unbilled components of the water balance fall under the responsibility of the finance department and this is the case at Ekurhuleni Metropolitan Municipality. The study focussed on assessing the efficiency of 'as and when' water loss projects which the metro has implemented to reduce water loss (i.e. real and apparent losses) and ultimately decrease Non-Revenue Water. As indicated above that water loss is a component of the technical department, the study thus used 'as and when' water loss projects which are implemented by the Department of Water and Sanitation to assess their efficiency. Based on the findings, recommended strategic ways on implementing and managing 'as and when' projects are outlined.

2.10 Water loss management best practices

According to the European Union (2015), the annual volume of treated water leaking from a distribution system is an important indicator of the evolution of water distribution efficiency, in individual years and as a trend over a period of years. High and increasing annual volumes of leakage indicate ineffective planning and construction, and low operational maintenance activities. With the increasing international trend towards sustainability, economic efficiency and environmental protection, the topic of water supply system leakage is high-profile. This is especially so during times of water scarcity or drought, when consumers are asked to reduce their own consumption of water in order to maintain continuity of supply. Failure to quickly repair visible leaks is highly damaging to a Utility’s reputation.

In 1999/2000 the International Water Association, Water Loss Task Force has provided water supply managers with methods to assess the level of losses of water and has given guidance on

best practices for reducing these losses. Managing water distribution systems using these principles has developed a paradigm shift in how to control water distribution systems. Recent application of the International Water Association guidelines has been carried out in Leshan, Western China and in central Vietnamese cities. The experiences of these projects in the different countries demonstrate the importance of the International Water Association guidelines and their application in practice.

New Zealand and Germany are two countries which have good practices in terms of efficient water loss management. This is so because both countries have adopted the IWA method to assess their water losses. New Zealand was one of the first countries to adopt the IWA recommendations, when in 2002 Water New Zealand (previously known as the New Zealand Water and Waste Association (NZWWA)) commissioned and published the BenchlossNZ software and associated User Manual. These provided a standard annual water balance for bulk metering, consumption and water loss calculations, and recommended performance indicators for Non-Revenue Water and real (physical) losses, all based on international best practice (Lambert & Taylor, 2010:8).

Germany is one of the country with the lowest water losses which is below 10% (Pierderideapa, 2015). The adoption of the IWA method of assessing and managing water losses is yielding positive results to countries which have adopted the methodology. Ekurhuleni Metropolitan Municipality has also adopted the IWA method of assessing the level of water losses as well as the guidance on the best practices for reducing water loss. The adoption of the IWA methodology is slowly yielding positive results in terms of reducing the metro's NRW as depicted in Table 2.4.

2.11 Summary

It is evident from the literature review that project management, programme management and project portfolio management should be linked in order to attain success in organisation. Project portfolio management arranges organisational projects strategically aligning the projects with the organisational goals. The manner into which project portfolio management is rolled enables organisations to set up their projects on an individual basis or on a programme management basis. The manner in which these projects are arranged is largely dependent on the organisation's strategic needs.

Thus, in an ideal situation, organisations should have portfolio managers who are in top management, programme managers who manages organisation’s programmes as well as project managers who run with the daily operations of the projects. However, literature indicates that there is still confusion in organisations in terms of differentiating between project portfolio management, programme management as well as project management. However, all the three (i.e. project portfolio management, programme management as well as project management) needs to be managed efficiently to achieve the organisational success.

In the midst of all this, the key concepts (i.e. project management, programme management and project portfolio management) there is ad-hoc project management. Ad hoc project management involves those projects which are unplanned and requires to be executed urgently. The principles of ad-hoc project management are similar to 'as and when' project management. Just like project management, programme management and project portfolio management, ad-hoc projects also require to be managed efficiently in order to acquire organisational success.

Efficiency is associated with internal factors (i.e. time, cost and quality), effectiveness is very broad as it puts emphasis on external factors (i.e. client and user satisfaction, level of effectiveness, project functionality and fitness for purpose, free from defects, value for money, profitability, absence of any legal claims and proceedings, learning and exploitation and general positive reputation). Efficiency measures the organisational internal effectiveness and competency in project portfolio management, programme management as well as project management. It is thus crucial for organisation to be efficient when planning, implementing and executing their projects

as this can be a measure of organisation competency in project portfolio management, programme management, project management as well as ad-hoc project management.

Every municipality has its own water loss problems. Thus, water loss eradication programmes should be designed to meet the needs of each municipality. This study assessed the efficiency of projects from a water loss eradication programme in Ekurhuleni Metropolitan Municipality which is one of the eight Metropolitan Municipality in South Africa. However, the projects which were assessed were only those that were implemented on an 'as and when' basis as termed by the Ekurhuleni Metro. Thus, the practice of 'as and when' basis has been studied in order to grasp its evolution and it was linked, or rather its practice was found to be similar to the principles of ad hoc project management. Chapter 3 discusses the empirical investigation of the study.

CHAPTER 3: EMPIRICAL INVESTIGATION

3.1 Introduction

This study was done to assess the efficiency of 'as and when' projects in Ekurhuleni Metropolitan Municipality. In particular, a focus was based on projects which are on the water loss eradication programme of Ekurhuleni Metropolitan Municipality. In the context of the empirical investigation, the aim of this chapter is to identify and assess the project management efficiency of 'as and when' water loss reduction projects in Ekurhuleni Metropolitan Municipality. Different target populations have participated in the study. An overview has been given on the selected respondents who participated in the investigation. The analysis and interpretation of the data is also inclusive in this chapter.

3.2 Research methodology

The research tradition followed in this study was a case study using Ekurhuleni Metro as a model to assess the efficiency and management of 'as and when' projects.

3.2.1 Empirical research design

Only selected respondents were asked to be interviewed as there are hundreds of Project Managers in Ekurhuleni Metropolitan Municipality. It was not possible to reach each and every one of them. Therefore, the empirical investigation was performed on selected Project Managers and Senior Management from the metro's Department of Water and Sanitation who are responsible for the planning, implementation and execution of 'as and when' water loss reduction projects.

The method followed in any study is informed by a broad literature review and aspects such as the nature of the phenomenon under study, the research questions being asked and the problem that set off the enquiry. The research tradition followed in this study was a case study using Ekurhuleni Metro as a model to assess the efficiency and management of 'as and when' projects. Case studies aim to analyse specific issues within the boundaries of a specific environment, situation or

organisation (Anon., 2017). According to its design, case study research method can be divided into three categories: explanatory, descriptive and exploratory.

- Explanatory case studies aim to answer ‘how’ or ’why’ questions with little control on behalf of researcher over occurrence of events.
- Descriptive case studies aim to analyse the sequence of interpersonal events after a certain amount of time has passed.
- Exploratory case studies aim to find answers to the questions of 'what' or 'who'. Exploratory case study data collection method is often accompanied by additional data collection method(s) such as interviews, questionnaires and experiments.

In this study, Ekurhuleni Metro was used as a unit of analysis to assess the management efficiency of the metros 'as and when' projects. Thus, the study was exploratory (see above description) as it aimed at finding answers on the efficiency of 'as and when' water loss projects. Data collection consisted of the project documents, payment certificates and completion certificates. This was accompanied by additionally collecting data through semi-structured interviews with the metro’s Project Managers and Senior Management who are responsible for planning, implementing and managing water loss projects.

Ekurhuleni Metro is the second largest metro in Gauteng Province and it is South Africa’s most highly industrialised powerhouse and therefore attracts many people. The situation in Ekurhuleni Metro was therefore assumed to be adequate enough to assess the phenomenon under study. Thus, the study was based on facts from the body of knowledge and from the empirical data that was collected.

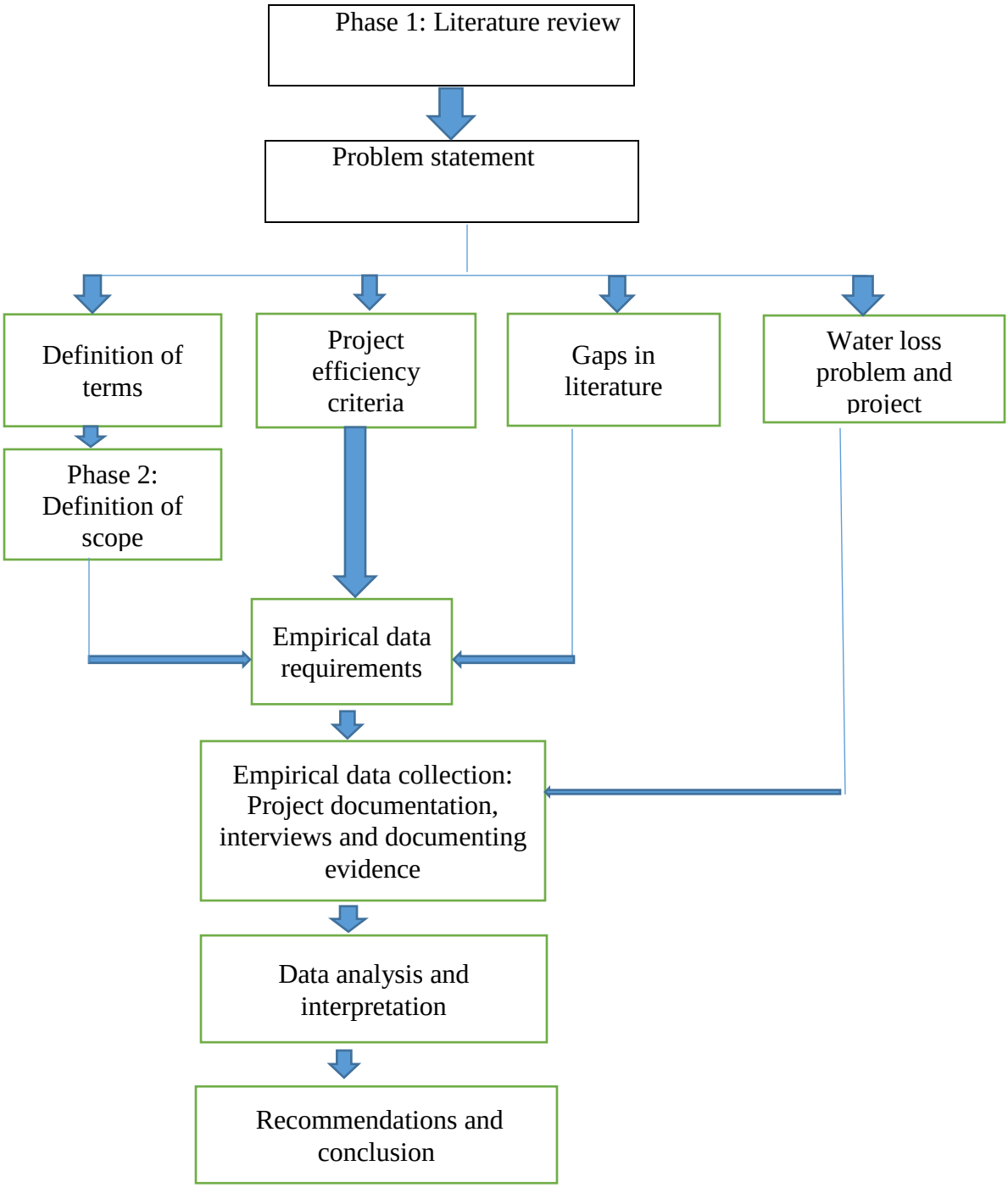
The research statements propose that, if 'as and when' water loss projects are implemented efficiently, this will improve service delivery and will greatly reduce the metro’s Non-Revenue Water. A qualitative approach was used for data collection, in particular semi-structured interview questions (see: Annexure A) were developed in order to understand a management decision on what criteria they use to decide on whether a project or a programme will be implemented on an 'as and when' basis. Over and above that, the criteria which it is used to fund and also manage 'as and when' projects was also questioned.

According to Wyse (2011), qualitative data collection methods vary using unstructured or semi-structured techniques. Some common methods which are used include focus groups (group discussions), individual interviews, documents and texts as well as participation and observations. The sample size is typically small, and respondents are selected to fulfil a given quota. Purposive sampling was used to select the sample for the study.

According to Bryman and Bell (2014:29), purposive sampling is a non-probability form of sampling which aims to sample participants in a strategic way, so that those sampled are relevant to the research questions. Participants from the Department of Water and Sanitation in EMM were chosen to be interviewed for the study because the department is responsible for implementing and managing projects under the water loss eradication programme.

Twenty-seven 'as and when' project reports pertaining to the water loss eradication programme were collected and analysed for the study. The study intended to collect and analyse 30 'as and when' water loss projects from 2011/12 to 2015/16 financial year, however the 'as and when' water loss projects which have been implemented and completed within the specified timeframe were 27. All the project documents of the 27 projects were relevant for the study. The empirical data was also used to confirm and support the literature study. Figure 1.2 shows the methodology which was followed for the research from literature survey until to the finalisation of the research report.

Figure 3.1: Research methodology and process diagram



(Source: own compilation)

The project reports were analysed based on project efficiency measures (i.e. time, budget and scope) which were determined from literature. The results were analysed in order to develop recommendations on whether 'as and when' projects are efficient and managed properly. The empirical data and results are represented both quantitatively and qualitatively for analysis. Thereafter, a formulation of recommendations and drawing of a conclusion follow.

3.2.2 Limitations of the empirical study

The second part of the data collection process involved collecting project documentation. These documents were received from the Department of Water and Sanitation and as such their authenticity could not be verified.

3.2.2.1 Reliability

According to Bryman and Bell (2014), reliability has to do with the question of whether the results of a study are repeatable. It refers to whether or not you get the same answer by using an instrument to measure something more than once (Bernard, as cited by Anonymous, 2017). In simple terms, research reliability is the degree to which research method produces stable and consistent results. A specific measure is considered to be reliable if its application on the same object of measurement number of times produces the same results (Bernard, as cited by Anonymous, 2017).

As indicated, the research was based on empirical data that was collected from Ekurhuleni Metropolitan Municipality (i.e. Department of Water and Sanitation). The empirical data collected was kept by the Department of Water and Sanitation. Interviews with respondents were recorded to ensure that the information was captured correctly. The recordings of the interviews will be kept with the researcher for at least five years. Thus, it was assumed that, at the end of the study, the same conclusion would be reached if the study was conducted in a similar environment.

3.2.2.2 Validity

Bryman and Bell (2014) indicated that validity is concerned with the integrity of the conclusion that are generated from a piece of research. When considering the definition of Bryman and Bell (2014), it can be said that the research instrument was internally valid as the empirical data that was collected was used to analyse whether the water loss projects in Ekurhuleni Metropolitan Municipality were efficient or not and also to determine the management of 'as and when' projects.

However, the result might not necessarily be externally valid as the size of the sample was small. Only 27 projects were evaluated, some of the projects may have been implemented by the same contractors. As indicated above, the study intended to collect and analyse 27 'as and when' water loss projects, however the 'as and when' water loss projects which have been implemented and completed were 27. All the project documents of the 27 projects were relevant for the study.

The 27 projects are 'as and when' water loss projects were implemented and completed from 2011/12 financial year to 2015/16 financial year by the department. The research study only concentrated on one metropolitan municipality in Gauteng. Because this research is a case study which only focusses on Ekurhuleni Metropolitan Municipality, it can thus be said that the results are not generalisable. In order to achieve generalisability for the South African metropolitan municipalities, a bigger sample must be used over the country. However, the study could serve as a benchmark to other metropolitan municipalities.

3.2.2.3 The target population

Only a sample of Project Managers and Senior Management who are responsible for the implementation and management of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality were approached for the interviews (i.e. purposive sampling).

3.2.3 Ethical considerations

As indicated above that for confidentiality purposes, the names of the contractors and consultants who were used for the study and the company names of the contractors and consultants as well as their contact details were not included in the report. This information was used solely for the analysis. The first page of the semi-structured questions was a consent letter (see: Annexure A) detailing the reasons for the interview and also assuring the respondents of the confidentiality of their responses.

3.3 Data gathering through semi-structured interviews and project documentation

The research execution plan was divided into two phases. The first phase incorporated a broad literature study on metropolitan municipalities, project efficiency criteria, water loss, project management as well as on projects which are implemented on an 'as and when' basis. The second phase incorporated a scope definition and collection of data. The primary data comprised of water loss project documentation which was implemented on an 'as and when' basis in Ekurhuleni Metropolitan Municipality. Semi-structured interview questions were also developed for Management. In particular, the interviews were conducted with the Divisional Head (DH) for Projects as well Project Managers in the Department of Water and Sanitation (i.e. EMM).

The reasons for conducting interviews with the Divisional Head and Project Managers was based on the fact that decisions on whether a project or a programme should be conducted on an 'as and when' basis are made on a managerial level. Thus, the Divisional Head together with his team made this decision. The Department of Water and Sanitation has approximately 20 Project Managers who oversee water loss projects. The study had initially intended to interview ten respondents, but only six respondents (i.e. 60%) agreed to be interviewed for the study.

The response rate on the interviews was sufficient to do a data analysis as the data reached saturation. According to O'Reilly and Parker (2012), thematic/data saturation means that data should be collected until there are fewer surprises in the data and no more patterns or themes are emerging from the data. The high response rate was a major benefit for the empirical study and consequently the empirical study may be a true reflection of the whole population.

In this study, Project Managers assisted in identifying key operational challenges of implementing 'as and when' projects. Thus, the study interviewed five Project Managers and one Divisional Head for Projects who are responsible for managing 'as and when' water loss projects. The study population interviewed held more information relevant to acquire all the required information. In conducting the study, the following resources were used for completion of the research.

3.3.1 Data collection

The data was collected from Ekurhuleni Metropolitan Municipality from the Department of Water and Sanitation. A qualitative research method was followed for the research study. A Qualitative research is primarily exploratory research. It is usually used to gain an understanding of underlying reasons, opinions, and motivations. It further provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research. Qualitative Research is also used to uncover trends in thought and opinions, and dive deeper into the problem (DeFranzo, 2011)

This research adopted a semi structured interview method to interview respondents and document analysis method to analyse the project documentations. A semi-structured interview is a meeting in which the interviewer does not strictly follow a formalised list of questions. The interviewer usually asks more open-ended questions, allowing for a discussion with the interviewee rather than a straightforward question and answer format. The interviewer may prepare a list of questions but does not necessarily ask them all, or touch on them in any particular order, using them instead to guide the conversation (Doyle, 2017)

Semi-structured interview questions were developed for Management and Project Managers. These interviews were particularly conducted on the Divisional Head (DH) for Projects as well as five Project Managers at the Department of Water and Sanitation (i.e. EMM). The primary data consisted of the responses from the structured interview questions, whilst the secondary data collection consisted of the following:

- Project reports
- Payments certificates
- Appointment letters

- Completion certificates (i.e. for completed projects)

When collecting the data for the study, the EMM Department of Water and Sanitation was informed of the study and what the project reports would be specifically used for. Thus, the Department of Water and Sanitation was requested to submit the project documentation on the water loss eradication programme.

Thus, the method employed in analysing the data was document analysis taking into account the efficiency measures of project management (i.e. project time, cost and scope). Semi-structured interviews were conducted to the Divisional Head (DH) for Projects as well as five Project Managers in the Department of Water and Sanitation (i.e. EMM).

- **Aspects regarding the semi- structured questions**

The quality of data is largely determined by the design of the questions and the manner into which interviews are done. The broad literature review formed the framework in which the questions were constructed. An email was sent to the target population with the questions (see: Annexure B). A well-constructed and well-administered questions of limited length, will generally yield a higher response rate as indicated above. The following concerns were identified while designing the questions:

- How to keep the questions simple, short and specific to the objectives;
- The time factor to complete the interview;
- How to improve the rate of response.

Since the interviews are the core component of the research, it was important for the questions to be critically examined before being finalised for dispatch.

3.3.1.1 Construction of the semi structured questions

To achieve the study objectives, careful considerations were made in preparing the semi-structured questions (see: Annexure A). Conducting a literature study (see: Chapter 2) provided the necessary knowledge to present questions to which respondents had to respond to according to their knowledge and experiences of planning, implementing and executing 'as and when' water loss projects. These questions were structured to determine the efficiency of 'as and when' water loss

projects. These questions were verified, and given validity, through interviews during the pilot testing phase with experts in the water industry.

3.3.1.2 Pilot testing

According to Venter (2010:50), pilot testing is important if the researcher want to be satisfied that the questionnaire will perform its function. The pilot -testing is the most inexpensive insurance the researcher can buy to assure the success of the semi-structured questions and the research project (Churchill *et al.,* as cited by Venter, 2010:50). The semi-structured questions were pre-tested amongst three members of the target population.

The semi-structured questions were subjected to a pilot test to identify weaknesses in the construction, formulation of the questions, the assessment of the validity and comprehension. Feedback on the content was carefully considered and suggestions were incorporated before the final questions were distributed.

3.3.2 Target population and type of sample

In assessing the efficiency of 'as and when' projects in Ekurhuleni Metropolitan Municipality, a water loss eradication programme was selected as a case study for this research. The Ekurhuleni water loss eradication programme is designed to obtain the broader organisational goal which is to minimise water losses. The water loss eradication programme consists of the following sub-programmes:

- Leak fixing and meter installation project in Tsakane
- Consolidation and replacement of all large water meters
- Metering of all informal settlement
- Metering of Council properties
- Metering school’s properties
- Domestic and bulk metering
- Pipeline and valve assessment and replacement
- Replacement of mid-block pipelines

Each sub-programme has projects which are implemented with an attempt to ultimately reduce water loss. Thus, 27 projects were analysed from the various sub-programmes. Data on a total of 27 projects were collected and analysed. The projects in the case study were implemented and executed from July 2011 until June 2016.

An email was sent to the Department of Water and Sanitation requesting completed project reports of the 'as and when' projects within the water loss eradication programme. Twenty-seven (27) project reports were then submitted for the study. The completed projects reports are from projects which have been implemented under the water loss eradication programme. Different projects have been implemented on the different sub-programmes. Table 3.1 indicates the number of projects which have been analysed per sub-programme from the Department of Water and Sanitation.

Table 3.1: Number of projects analysed per water loss programme from 2011 to 2016.

Water loss eradication programme	**Number of projects analysed**	**Allocated budget**
Leak fixing and meter installation project in Tsakane	1	R38,000,000
Consolidation and replacement of all large water consumer meters	1	R38,042,784
Metering of all informal settlement	1	R722,000
Metering of Council properties	3	R52,349,401.33
Metering of schools' properties	2	R16,110,938
Domestic and bulk metering	11	R180,426,887.60
Pipeline and valve assessment and replacement	2	R67,062,422.93
Replacement of mid-block pipelines	6	R94,948,904
Total	**27**	**R487,663,337.90**

(Source: own compilation)

3.3.2.1 Semi-structured interviews

According to Keller and Conradin (2010), semi-structured interviews are conducted with a fairly open framework, which allow for focussed, conversational, two-way communication. They can be used both to give and receive information. By using this type of data collection, the interviewer has worked out a set of questions beforehand, but intends the interview to be conversational.

Therefore, the interviewer can change the order of the questions or the way they are worded. The interviewer can give explanations or leave out questions that may appear redundant. Not all questions are designed and phrased ahead of time. The majority of the questions are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues.

Thus, the second part of the data collection involved interviewing respondents in the Department of Water and Sanitation who were working on water loss projects. The semi-structured interviews were conducted with the aim of acquiring an in-depth knowledge and understanding of the efficiency of 'as and when' water loss projects. Six employees who were managing water loss projects were interviewed telephonically. Several studies emphasise the methodological strengths of conducting qualitative interviews by telephone, such as perceived anonymity, increased privacy for respondents and reduced distraction (for interviewees) or self-consciousness (for interviewers) when interviewers take notes during interviews (Drabble *et al.*, 2016).

The study present findings on the semi-structured interview questions which were conducted with the Department of Water and Sanitation employees. Questions were asked on the departments efficiencies in rolling out water loss projects in particular 'as and when' water loss projects. Questions were answered on the practice of 'as and when' water loss projects, its implementation process as well as challenges which are experienced by the department when implementing and executing such projects. During the telephonic interview, the conversations were recorded in order to acquire an in-depth understanding of the interview when analysing what was said after the interview.

Eight semi-structured questions (see: Annexure A) were emailed (example of an email sent is attached as annexure B) to Project Managers, as well as a Divisional Head for Planning/Acting Divisional Head for Projects. The first page of the semi-structured questions was a consent letter detailing the reasons for the interview and also assuring the respondents about the confidentiality of their responses. The aim of the semi-structured interview questions to be sent to the interviewers

was to enable the respondents to familiarise themselves with the types of questions which would be asked. More questions arose from the already formulated questions.

The respondents were from various sections of the Department of Water and Sanitation. The department has six sections and the respondents were from three sections of the department (i.e. planning, projects and revenue and quality divisions). The reason for having respondents who are from various sections of the Department of Water and Sanitation was because water loss projects are rolled out by the various sections depending on the nature of the project which is implemented. Interviewing people from the various divisions was also done to acquire more diverse views on the theme.

The sample size consisted of six males. Table 3.2 depicts the demographics of the sample.

Table 3.2: Sample demographics

Educational Level		**Gender**		**Age group**			**Race**		
Matric or less	University degree	Male	Female	20 -30	30 - 40	>40	White	Black	Indians/coloureds
0	6	6	0		4	2	01	5	0
Total: 6		**Total:6**		**Total:6**			**Total: 6**		

(Source: own compilation)

As depicted in Table 3.2, all six employees had matriculated and they were all males. Four of the respondents were between the age of 30 and 40, whilst the remaining two employees were over 40. In terms of race, one employee was white and the remaining five employees were black. All respondents had a university degree and two of the respondents had Masters Degrees. Of the six interviewed employees, one respondent was in senior management, one respondent was in middle management and the other four respondents were Project Managers. Five respondents had more than eight years' project management experience whilst one respondent had six years' experience.

3.4 Data capturing

The next phase was to code the data manually in order to capture all the data.

3.4.1 Data capturing method used

The data collected from the six respondents was captured using the thematic analysis methodology. According to Javadi and Zarea (2016:33), thematic analysis is one of the types of qualitative research methods which has become applicable in different fields. Thematic analysis is an approach for extraction of meanings and concepts from data and includes pinpointing, examining, and recording patterns or themes. Data can be in any form including: transcription of an interview, notes in the field, political documents, pictures, and videos.

Thematic analysis is a method for detection, analysis and reporting the themes in data. It is the minimum organisation and description of a set of data that is widely used in qualitative data analysis. In analysing the data, the six steps approach of analysing data through thematic analysis was followed, as prescribed by Braun and Clarke (as cited by JVR Africa Group, 2017). The six steps approach is as follows:

- Familiarisation of the data
- Generation of the initial codes
- Searching for themes
- Reviewing themes
- Defining and naming themes
- Producing the report

According to Braun and Clarke (as cited by JVR Africa Group, 2017), familiarisation of the data is very important and requires the researcher to be fully immersed and actively engaged in the data by firstly transcribing the interactions and then reading (and re-reading) the transcripts and/or listening to the recordings. The generation of initial codes step requires the creation of a preliminary list of ideas related to the data. In this step the data should be organised into significance groups and should be coded manually or by using a computer software.

The data for this research was coded manually and the initial codes were generated in order to acquire more insight of the data. Sub-themes and themes which were discovered for the study were unplanned projects, ad-hoc projects, demand driven, financial availability, consultants, incompetent contractors, importance of developing project managers skills, staff shortages. The process of searching, reviewing, defining and naming themes has thus resulted in the production of this report.

The second part of the data capturing involved project document analysis. According to Bowen (as cited by Triad, 2016), document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning to an assessment topic. Analysing documents incorporates coding content into themes similar to how focus group or interview transcripts are analysed. In analysing the project documents, three project management efficiency factors (i.e. time, budget and scope) were taken into consideration:

Time: In order to assess the efficiency of the 'as and when' water loss projects, the timely completion of projects which is measured as the degree of delay was calculated. This provides a uniform measure on how 'as and when' different projects are managed with different construction periods. Thus, the degree of delay is calculated as a percentage over the specified construction period as follows (Mohlala, 2015:42):

$$\text{Degree of delay (DoD)} = \frac{\text{actual construction period} - \text{specified construction period}}{\text{Specified construction period}} \times 100$$

$$= \frac{\text{time overrun}}{\text{Specified construction period}} \times 100$$

For example, the DoD for a three-month projects that took six months to complete is:

$$= 6\text{-}3/3 \times 100$$

$$= 100\%$$

Budget: The planned project cost is a budgeted cost to implement and execute a project. Whilst actual project cost is the cost which was incurred for the project until project completion. The difference is the sum of the planned project cost less the actual project cost. Whilst the difference against planned cost in percent is the amount of planned project cost not utilised for the project (EMM Council Agenda, 2017).

Scope: Different projects have different quality criteria which the Department of Water and Sanitation assess. Thus, explanations for projects which have not met the required specifications would be provided. Projects which were not completed within the required specifications would be deemed as projects which were not completed within the agreed scope of work. Thus, the quality of the project would be deemed not good or poor. The Department of Water and Sanitation measures its performance quality mainly by defects and rework.

3.4.2 Analysis and interpretation of semi-structured interviews

The semi-structured questions focussed on the department's efficiencies in rolling out water loss projects in particular 'as and when' water loss projects. Questions were answered on the practice of 'as and when' water loss projects, its implementation process as well as challenges which are experienced by the department when implementing and executing such projects. There seemed to be a confusion on the usage of the term 'as and when' projects from respondents.

Out of the six respondents, four respondents (67%) indicated that 'as and when' water loss projects are those projects which are ad-hoc and as such cannot be planned. All the metro's departments have a repairs and maintenance budget which is meant for unplanned and unforeseen events. In the 2016/17 financial year the Department of Water and Sanitation's budget for repairs and maintenance was R599, 716,759 (EMM Council Agenda, 2017). Thus, this budget was used to cater for 'as and when' water loss projects such as repairing of pipe bursts, leaks, hydrants and any other unplanned and unforeseen projects.

Mostly, the metro uses contractors to execute unplanned and unforeseen projects as the department is apparently understaffed to attend to all the metro's water issues. On average, such unplanned and unforeseen water projects may amount to 2500 which are usually reported by residents through the metro's call center. Contractors are mostly liable for ensuring that when there are such unplanned water occurrences they are fixed within the required turnaround times. For water issues, the turnaround time is 48 hours whilst for sewage issues the turnaround time is 72 hours as stipulated by the metro's water supply by-laws (Ekurhuleni Metropolitan Municipality, 2001).

Two respondents (33%) indicated that there can never be 'as and when' water loss projects because 'as and when' projects are not necessarily planned. Thus, the difference between 'as and when' projects and normal projects (i.e. not 'as and when' projects) is that the normal project has a defined scope (i.e. beginning and end). As a result, the exact budget and cost is known. Whereas, the 'as and when' projects are those projects which are done 'as and when' needed. For example, a water loss project of metering unmetered households in Tsakane is referred to as an 'as and when' water loss project. The reason is because the exact number of unmetered households is unknown and as such, the project becomes 'as and when' because meters will be metered 'as and when' a household without a meter is found. Another type of an 'as and when' water loss project would be fixing of burst pipes or repairing leaking reservoirs. These types of projects are done 'as and when' the problems occur or when a need arises.

There is a second component of the 'as and when' projects, which is on the financial part. The financial part operates in a manner whereby if an allocated budget for an 'as and when' project is depleted before all the unmetered households in Tsakane are metered. The project will then continue 'as and when' the funds become available, usually in the next financial year or during the budget adjustment period which is in January of every year. Thus 'as and when' projects are operational/maintenance related, hence most of the water loss projects are done on an 'as and when' basis as they are demand and problem driven. The maintenance related projects are financed through the repairs and maintenance budget. Whilst the operational related projects are financed thorough the capital projects budget. As indicated above, the maintenance related projects are fixing of burst pipes or repairing leaking reservoirs. And the operational related projects are metering of unmetered households.

The Department of Water and Sanitation budgets per programme rather than per project. This is easier for the department to make use of their budget for capital projects as the money has been budgeted per programme. For water loss projects, the department budgets under a water loss eradication programme which consist of a number of projects. Table 3.3 and 3.4 depicts the 2013/14 financial year and the 2014/15 financial year water loss eradication programme budgeting as well as the estimated reduction on NRW.

Table 3.3: 2013/14 financial year water loss eradication programmes & associated NRW reductions

Programme No	DETAILS OF 2013 / 2014 WATER LOSS ERADICATION PROGRAMMES	2013/2014 Budget Allocation	NRW Reduction to meet 2013/2014 SDBIP Target (City Wide Impact)		
			(%)	Kiloliters	Rand Value
Capital Programmes Executed during 2013/2014:					
1	Pipeline and valve assessment and Replacement	R 62 149 921	0.36%	1 283 907	R 7 132 072
2	Replacement of mid-block pipelines	R 41 070 492	0.48%	1 711 876	R 9 509 429
8	Leak fixing & meter installation project in Tsakane ***	R 4 775 119	0.43%	1 533 556	R 8 518 863
9	Metering of all informal	R 2 436	0.12%	427 969	R 2 377 357
13	Consolidation & replacement of all large water consumer meters	R 40 732 108	0.31%	1 105 587	R 6 141 506
-	Improved accounting of the EMM water balance figures	-	0.80%	2 853 127	R 15 849 048
Grand Totals:		**R 148 730 075**	**2.50%**	**8 916 021**	**R 49 528 276**

(Source: EMM, 2015:6)

As depicted in Table 3.3, in 2013/2014 financial year (12 months period starting from July 2013 until June 2014) EMM managed to reduce NRW from 40.3% to 37.8% (i.e. 40.3%-2.5%=37.8%), which is a 2.5% reduction of the NRW. The various initiatives (Programmes / Projects) which have led to the reduction of the NRW by 2.5% are reflected in Table 3.3, together with the budgetary allocations per programme.

Table 3.4: 2014/15 financial year water loss eradication programmes & associated NRW reductions

Programme No	DETAILS OF 2014 / 2015 WATER LOSS ERADICATION PROGRAMMES	2014/2015 Budget Allocation	NRW Reduction to meet 2014/2015 SDBIP Target (City Wide Impact)		
			(%)	Kiloliters	Rand Value
Capital Programmes Executed during 2014/2015:					
1	Pipeline and valve assessment and replacement	R 57 968 040	0.21%	766 304	R 4 599 509
2	Replacement of mid-block pipelines	R 43 548 011	0.49%	1 788 042	R 10,732,188
8	Leak fixing & meter installation project in Tsakane ***	R 1 602 000	0.51%	1 861 023	R 11 170 237
9	Metering of all informal settlement	R 625 000	0.02%	72 981	R 438 049
11	Metering of all unmetered areas (10 000 stands)	R 10 980 429	0.07%	255 435	R 1 533 170
12	Replacement of all domestic water meters (backlog)	R17 768 000	0.16%	583 850	R 3 504 388
13	Consolidation & replacement of all large water consumer meters	R 25 578 482	0.14%	510 869	R 3 066 340
21	Install, replace and maintenance of water meters	R 31 930 038	0.10%	364 906	R 2 190 243
Grand Totals:		**R 190 000 000**	**1.70%**	**6 203 410**	**R 37 234 123**

(Source: EMM, 2015:7)

Table 3.4 indicates that during the 2014/2015 financial year (12 months period starting from July 2014 until June 2015) EMM managed to reduce NRW from 37.8% to 36.1% (i.e. 37.8%-1.7%=36.1%), which is a 1.7% reduction of the NRW. The various initiatives (Programmes / Projects) which have led to the reduction of the NRW by 1.7% are reflected in Table 3 below, together with the budgetary allocations per programme.

All respondents indicated that the 'as and when' projects are not centrally controlled as various departments manages their own projects. However, depending on the nature of the projects, some projects may share resources such as the same vote number. A vote number is used to allocate

funds to different departments and sections. It is used to control and manage the manner into which finances are used at the metro. For example, a vote number for travel will be different than a vote number for employee salaries/wages. Thus, in many instances projects share financial resources in a sense that a vote number for maintenance may be used for an operation project if the budget for maintenance is not used for certain reasons.

In terms of the efficiencies of 'as and when' water loss projects, five respondents (83%) indicated that water loss projects are efficient as they are done by various contractors. The practice of contracting the metro's projects saves the metro time and financial resources. Thus, the metro's Project Managers are employed to oversee the work of the contractors. The municipality does not have to employ many workers in this regard as contractors are doing almost all the project works at the metro.

As a result of this, contractors will be given a timeframe, scope and an estimated budget to conduct an as when project. In many instances contractors delivers accordingly leading to efficiency on 'as and when' projects. One respondent (17%) indicated that 'as and when' water loss projects are not entirely efficient. This is due to lack of adequate competency from some contractors who are doing the work. The respondent indicated that proper screening is needed before awarding contracts to contractors.

As indicated above, in terms of quality performance of the 27 'as and when' water loss projects, 16 projects (59%) were completed within the required specifications whilst only six projects (22%) were not completed within the required specifications and the remaining five projects (19%) were incomplete/abandoned. In terms of the efficiency of 'as and when' water loss projects, Table 3.5 and Table 3.6 indicates that in 2013/14 financial year, the water loss eradication programme has managed to decrease the metro's NRW by 2.5%. In 2014/15 financial year, a decrease of 1.7% of the metros NRW was encountered.

In terms of challenges which are associated with 'as and when' water loss projects. Five respondents (83%) indicated that the department could do much better in implementing water loss projects if adequate time was afforded when planning projects. However, other reason is that with

'as and when' water loss projects the intensity of the scope is not always known. For example, a water loss project of fixing households water leakages in Tsakane will be too complex. This is so as different households will have different water leakage problems. This thus makes it difficult to know the exact budget and also to estimate timeframe.

One respondent (17%) indicated that the management of the 'as and when' projects is more challenging. This thus makes it difficult to manage 'as and when' projects. The respondent further elaborated that departments are mostly working in silos and at times it becomes difficult to get a project done within a specified or estimated time frame and within budget.

Four respondents (66%) have elaborated that 'as and when' water loss projects are financially worthwhile for the metro as the NRW was reducing (depicted in Table 3.3 and 3.4). These respondents (66%) have further indicated that the 'as and when' water loss projects makes the metro system to be sustainable as they are maintenance and operational projects. It was further indicated that the 'as and when' water loss projects are financially viable due to the fact that the metro saves money in terms of hiring more people to do the 'as and when' jobs as the work is usually done by contractors. It further enables the metro not to have unnecessary storage facilities for inventory and building and maintaining workplaces for many employees.

All respondents felt that the metro could however still improve in the tendering department by hiring more staff. In most cases projects get delayed in the tendering processes and it is believed that this is so due to lack of adequate staff to execute the duties timeously. Also, the development of Project Managers' skills was lacking and noted as critical as most Project Managers do not have the relevant knowledge, experience and qualification to manage water loss projects. Also, an institutional support (i.e. the municipal Council) could assist the department to conduct 'as and when' projects very easily. It was indicated that the department does not have enough people to do most of the work. When a request to employ more people is made, the application is always declined or the number of people to be employed will be greatly reduced.

3.4.3 Analysis and interpretation of project documentation

According to the Construction Industry Development Board (CIDB), project performance can be measured against the following project parameters (CIDB, as cited by Mohlala, 2015:13):

- Time management
- Cost management
- Quality management
- Health and safety management
- Site management, and
- Sub-contractor management

It is important to understand the measurement of project performance in order to thoroughly assess the efficiency of the 'as and when' water loss projects.

3.4.3.1 Project performance

According to Mohlala (2015:13), project performance can thus be defined as the actions taken through the life cycle of a project to meet pre-determined goals. These goals may be one of the seven key performance indicators identified by the CIDB (2013).

As indicated above, the assessment of the efficiency of the 'as and when' water loss projects considered the timely completion of projects which is measured as the degree of delay was calculated. This provides a uniform measure on how 'as and when' different projects are managed with different construction periods.

Thus, the degree of delay is calculated as a percentage over the specified construction period as follows Mohlala (2015:42):

$$\text{Degree of delay (DoD)} = \frac{\text{actual construction period} - \text{specified construction period}}{\text{Specified construction period}} \times 100$$

$$= \frac{\text{time overrun}}{\text{Specified construction period}} \times 100$$

For example, the DoD for a three-month projects that took six months to complete is:

= 6-3/3 x 100

= 100%

For projects that were incomplete or had been abandoned at the time of data collection, the delay period and degree of delay are represented by the symbol '∞'. Abandoned projects are those projects which have been incomplete due to contractors failing to deliver. Also, projects which were meant to be implemented but the metro later decided not to implement the projects due to financial deficiencies or due to late appointment of contractors are considered abandoned.

Table 3.5 indicates the 27 projects with the respective construction periods and degrees of delay as calculated from the formula above. The table provides a general idea of project performance (in terms of timely completion) of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

Table 3.5: Project Performance of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

Project Name	**Specified construction period (months)**	**Actual construction period (months)**	**Time overrun (months)**	**DoD (%)**
1. Leak fixing and meter installation project in Tsakane	21	21	0	0
2. Project installation and repair of bulk water meters and related work to consolidate water connections to consumers in Wadeville and adjacent industrial areas on an-'as and when' required basis from August 2012 to June 2015.	35	35	0	0
3. Metering informal settlements project from 2012 to 2015 financial year.	36	36	0	0
4. Metering Council properties project 2015/16 financial year.	12	∞	∞	∞

Project Name	Specified construction period (months)	Actual construction period (months)	Time overrun (months)	DoD (%)
5. Water connections to Council properties Eastern Region 2014/15 financial year	12	12	0	0
6. Consolidation of water connections to Council properties South Region 2014/15 financial year	24	24	0	0
7. Metering schools' properties project from 25 March 2013 to end of June 2015 financial year.	27	27	0	0
8. Metering schools' properties for 2015/16 financial year	12	∞	∞	∞
9. Replacement of water meters North East (NE) Region in 2012/13 financial year (FY)	12	12	0	0
10. Replacement of water meters South West (SW) Region in 2012/13 FY	12	12	0	0
11. Replacement of water meters NE Region in 2013/14 FY	12	12	0	0
12. Replacement of water meters SW Region in 2013/14 FY	12	12	0	0
13. Refurbishment, new connections & replacement of bulk and domestic water meters for NE Region in 2014/15 FY	12	12	0	0
14. Refurbishment, new connections & replacement of bulk and domestic water meters for SW Region in 2014/15 FY	12	12	0	0
15. Installation of water meters on unmetered stands for NE Region in 2014/15 FY	12	12	0	0
16. Installation of water meters on unmetered stands for SW Region in 2014/15 FY	12	12	0	0

Project Name	Specified construction period (months)	Actual construction period (months)	Time overrun (months)	DoD (%)
17. Replacement of aged domestic water meters for NE Region in 2014/15 FY	12	12	0	0
18. Replacement of aged domestic water meters for SW Region in 2014/15 FY	12	12	0	0
19. Installation, replacement and repair of small meter installation on an 'as and when' required basis for a period with effect from date of award until 30 June 2015	36	24	12	33
20. Upgrading and construction of water network on an 'as and when' required basis from date of award until June 2016: Bulk water supply to Zincor Mine in Selcourt Springs	7	9	2	29
21. Replacement of water network in the Germiston Central Business District	24	25	1	4
22. Phomolong (Tembisa) midblock water replacement projects	25	∞	∞	∞
23. Tembisa 1 midblock water replacement projects	25	∞	∞	∞
24. Kwa-Thema midblock water replacement projects	25	25	0	0
25. Vosloorus midblock water replacement projects	25	25	0	0
26. Thokoza midblock water replacement projects	25	25	0	0
27. Daveyton midblock water replacement projects	25	∞	∞	∞

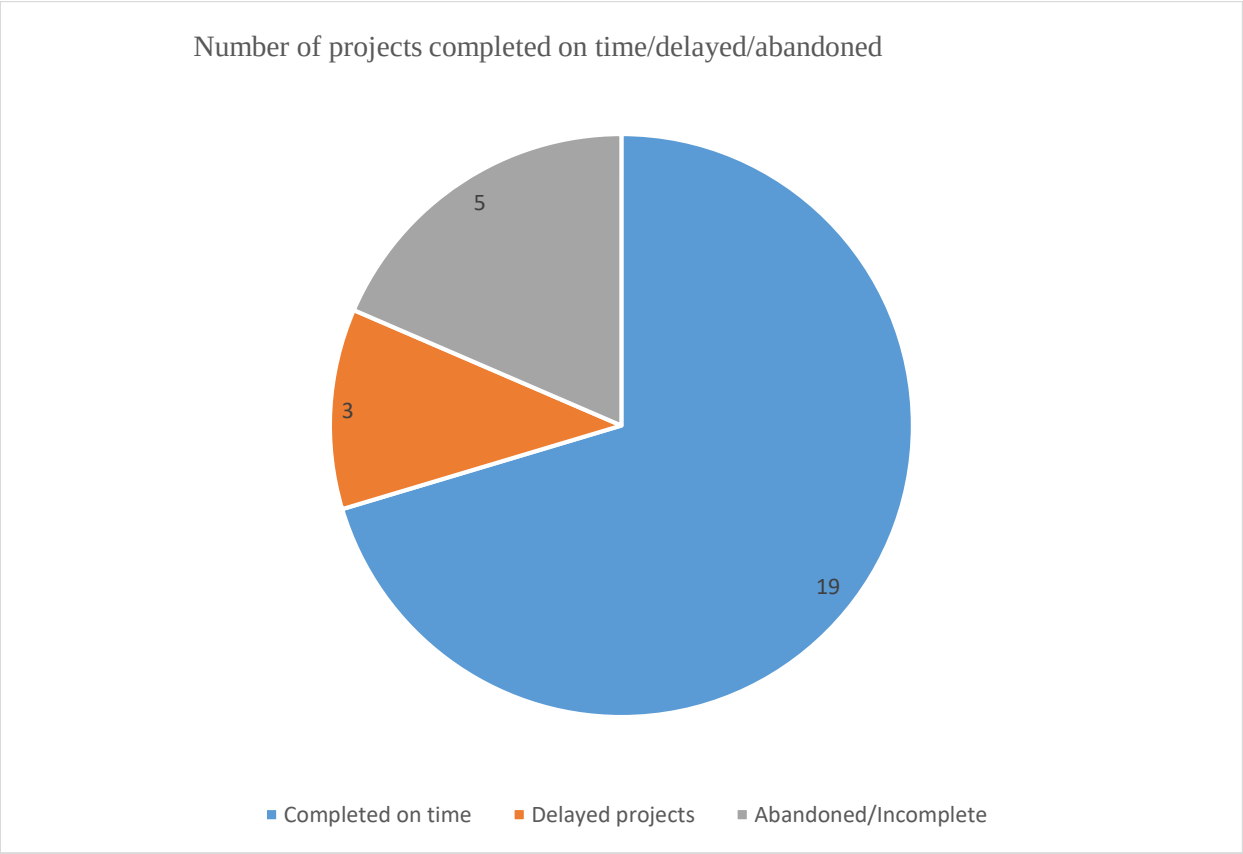
(Source: own compilation)

Table 3.5 depicts 27 water loss projects which were carried on an 'as and when' basis from 2011/12 financial year to 2015/16 financial year. Out of the 27 projects, 19 projects were completed within the stipulated time frame (i.e. financial year), five (05) projects were incomplete or abandoned whilst three (03) projects have been delayed. This means that 70% of the projects were completed timeously, 19% of the projects were incomplete or abandoned whilst 11% of the projects were delayed. Projects seems to be completed timeously when they are implemented on an 'as and when' basis as it gives the metro enough time to implement and manage any delays which may occur during the implementation phase.

'as and when' projects are planned on a financial year basis, the actual time frame of a project implementation is not taken into account as long as the project is completed within the specified or planned financial year. This affords department's time to implement and also accommodate any project delays which may occur. However, the implementation of projects in this manner enables unproductiveness and also renders poor services to the people.

Figure 3.2 shows the number of projects which were completed on time, delayed and abandoned/incomplete.

Figure 3.2: Number of projects completed on time, delayed and abandoned/incomplete.



(Source: own compilation)

The observation indicates that 19 projects (i.e. 70%) were completed within the planned financial year proves that the manner into which 'as and when' projects are planned, implemented and executed works for the metro. However, this render the metro to be unproductive due to lack of proper time planning. Only three (i.e. 11%) of the projects which have been implemented on an 'as and when' basis have not been completed on time. Out of the three projects which were not completed on time, the degree of delay are 33%, 29% and 4% respectively.

In a study conducted by Mohlala (2015:46) on emerging (i.e. new) contractors in government infrastructure projects, 27% of the projects had a degree of delay that is over 200% and 16% of the projects did not reach commissioning or close-out stage. This proved that project performance in government infrastructure project was a cause for a concern. This research aimed at assessing the efficiency of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

Therefore, the projects which were delayed and abandoned/ incomplete need to be studied at a greater length and compare to the projects which were completed on time.

3.4.3.2 Cost performance

The management of time, cost and quality is crucial. Thus, in assessing the management of costs in these projects, the planned cost will be compared to the actual project costs after implementation. Table 3.6 depicts the 27 'as and when' water loss projects as well as their planned and costs as well as the difference. The planned project cost is capital to implement and execute a project. Whilst actual project cost is the cost which was incurred for the project until project completion. The difference is the sum of the planned project cost less the actual project cost. Whilst the difference against planned cost in percent is the amount of planned project cost not utilised for the project (EMM Council Agenda, 2017).

For an example if a planned project cost is R200 and the actual project cost R150, the difference would be R200-R150= R50 and the difference against planned costs (%) would be R50/R200=25%. This would mean that 25% of the planned project cost was not utilised for the project. Thus, the project would have been over-budgeted, or savings were realised due to efficient production. The over-budgeting may be due to inaccurate costing practices or inefficiencies in the procurement process.

Table 3.6: Cost Performance of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

Project Name	**Planned project cost (Rands)**	**Actual project cost (Rands)**	**Difference (Rands)**	**Difference against planned costs (%)**
1. Leak fixing and meter installation project in Tsakane	38,000,000	38,000,000	0	0
2. Project installation and repair of bulk water meters and related work to consolidate water connections to consumers in Wadeville and adjacent industrial areas on an-'as and when' required basis from August 2012 to June 2015.	38, 042, 784. 15	38, 042, 784. 15	0	0
3. Metering informal settlements project from 2012 to 2015 financial year.	722,000	722,000	0	0
4. Metering Council properties project 2015/16 financial year.	3,330,264	879,867.05	2,450,396.95	74%
5. Water connections to Council properties Eastern Region 2014/15 financial year	9,138,637.93	9,138,637.93	0	0
6. Consolidation of water connections to Council properties South Region 2014/15 financial year	39,880,499.40	39,880,499.40	0	0
7. Metering schools' properties project from 25 March 2013 to end of June 2015 financial year.	11,610 938	16,042,949.90	4,432,560.90	-38%
8. Metering schools' properties for 2015/16 financial year	4,500,000	1,145,299.46	3,354,700.54	75%
9. Replacement of water meters North East (NE) Region in 2012/13 financial year (FY)	20,000,000	10,146,872	9,853,128	49%

Project Name	Planned project cost (Rands)	Actual project cost (Rands)	Difference (Rands)	Difference against planned costs (%)
10. Replacement of water meters South West (SW) Region in 2012/13 FY	5,579,101	5,579,101	0	0
11. Replacement of water meters NE Region in 2013/14 FY	52,918,790	24,973,889.54	27,944,900.46	53%
12. Replacement of water meters SW Region in 2013/14 FY	27,944,904.46	53,864,078	25,919,173.54	-93%
13. Refurbishment, new connections & replacement of bulk and domestic water meters for NE Region in 2014/15 FY	14,103,187.55	12,615,228	1,487,959	11%
14. Refurbishment, new connections & replacement of bulk and domestic water meters for SW Region in 2014/15 FY	26,459,395	19,012,733	7,446,662	28%
15. Installation of water meters on unmetered stands for NE Region in 2014/15 FY	3,594,659	3,194,842.31	399,816.69	11%
16. Installation of water meters on unmetered stands for SW Region in 2014/15 FY	6,000,000	5,671,054	328,946	5%
17. Replacement of aged domestic water meters for NE Region in 2014/15 FY	10,176,851.56	6,102,566.83	4,074,284.73	40%
18. Replacement of aged domestic water meters for SW Region in 2014/15 FY	9,649,999	R6,946,620	2,703,379	28%
19. Installation, replacement and repair of small meter installation on an 'as and when' required basis for a period with effect from date of award until 30 June 2015	4,000,000	4,000,000	0	0
20. Upgrading and construction of water network on an 'as and when' required basis from date of award until June	13,060,230	13,375,020	R314,790.00	-2%

2016: Bulk water supply to Zincor Mine in Selcourt Springs				
21. Replacement of water network in the Germiston Central Business District	54,002,192.93	54,002,192.93	0	0
22. Phomolong (Tembisa) midblock water replacement projects	8, 400, 000	8, 400, 000	0	0
23. Tembisa 1 midblock water replacement projects	8,100,000	8,100,000	0	0
24. Kwa-Thema midblock water replacement projects	11,050, 000	11,050, 000	0	0
25. Vosloorus midblock water replacement projects	24,052,946	24,052,946	0	0
26. Thokoza midblock water replacement projects	18,745,958	18,745,958	0	0
27. Daveyton midblock water replacement projects	24, 600, 000	24, 600, 000	0	0

(Source: own compilation)

Table 3.6 depicts 27 water loss projects which were carried on an 'as and when' basis from 2011/12 financial year to 2015/16 financial year. Out of the 27 projects, it is assumed that 14 projects were completed within the stipulated budget as the planned budget and actual budget were not included in the reports. This is due to the fact that the scope of 'as and when' water loss projects is usually unknown. Thus, the department usually budget capital for project implementation per programme. For example, budget for water loss eradication programme may be R100 million. 'As and when' water loss projects occur, the money will be deducted from the R100 million as the budget is for water loss projects.

Ten (10) projects did not manage to deplete the planned budget due to over-budgeting whilst three (03) projects over-spent. The three projects which over-spent are as follows:

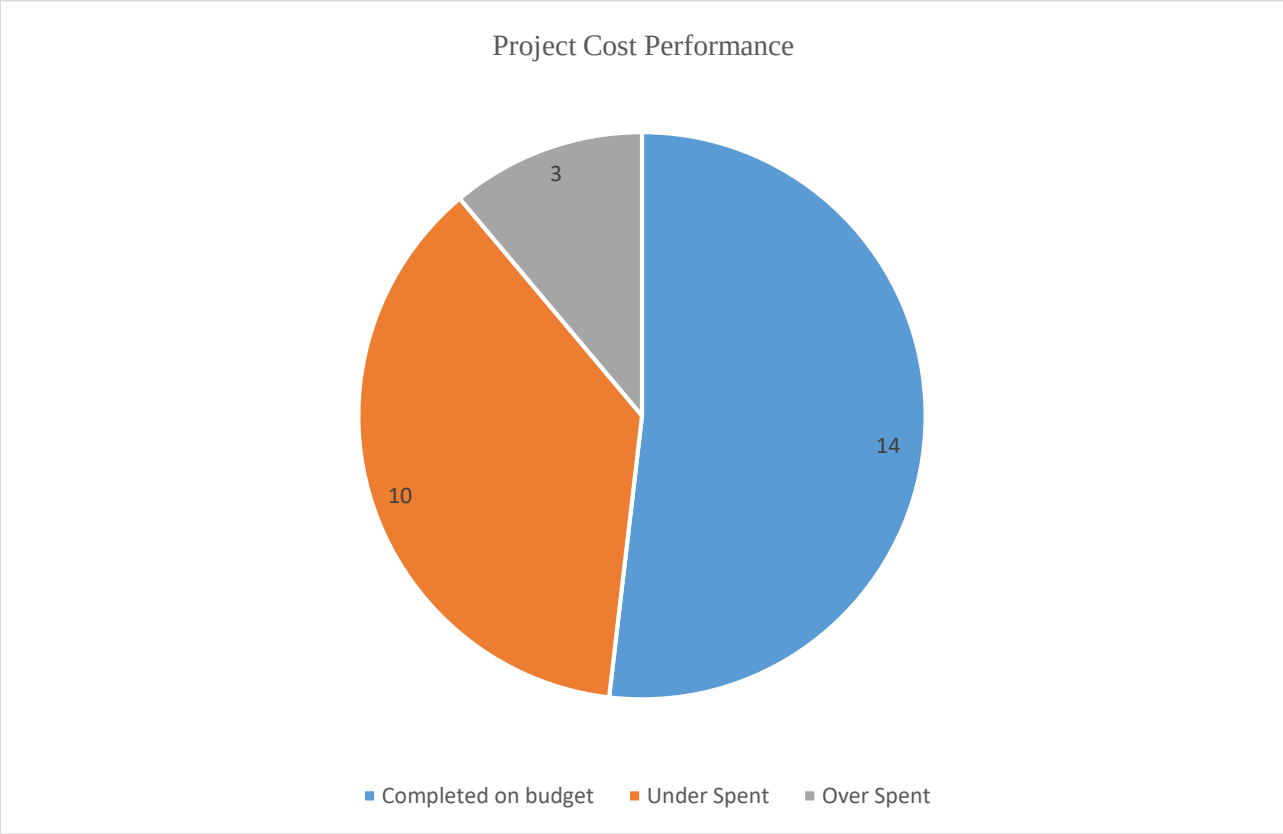
- The metering schools' properties project from 25 March 2013 to end of June 2015 financial year. This project has over spent by R4, 432,560.90 due to the fact that the scope of the project increased. The department decided to meter as many schools as possible so that the project can be concluded by June 2016. The metro has 550 schools and of the 550 identified

schools, a total of 382 were concluded with single meters installed and 168 was outstanding and it was planned to be metered during the 2015/2016 financial year.

- Replacement of water meters SW region in 2013/14 financial year. The department decided to meter as many household as possible as there were available funds from the department which were incurred after the metro's adjustment budget in January 2014.
- Upgrading and construction of water network on an 'as and when' required basis from date of award until June 2016: Bulk water supply to Zincor Mine Selcourt Springs. There was an over-expenditure of R314, 790 due to the project being completed two months after the anticipated time-frame. There was a claim for extension of time by the contractor due to the following reasons:
  - Manufacturing of changed special fittings delays,
  - Additional by-pass line to Zincor mine, (Existing AC Pipe),
  - EMM delays on securing a shutdown date as clients could not accept cutting of water,
  - Delays on way-leaves approvals.

The required extension of time was granted thus moving our completion date forward from 22 November 2014 to 30th January 2015. The extension was with cost on P&G's (i.e. Preliminary and general budget for the metro) at R314, 790.00. This means that 52% of the projects were completed within budget, 37% of the project under-spent whilst 11% of the projects were over-spent.

Figure 3.3: number of projects completed within budget as well as those projects which have under/over spent.



(Source: own compilation)

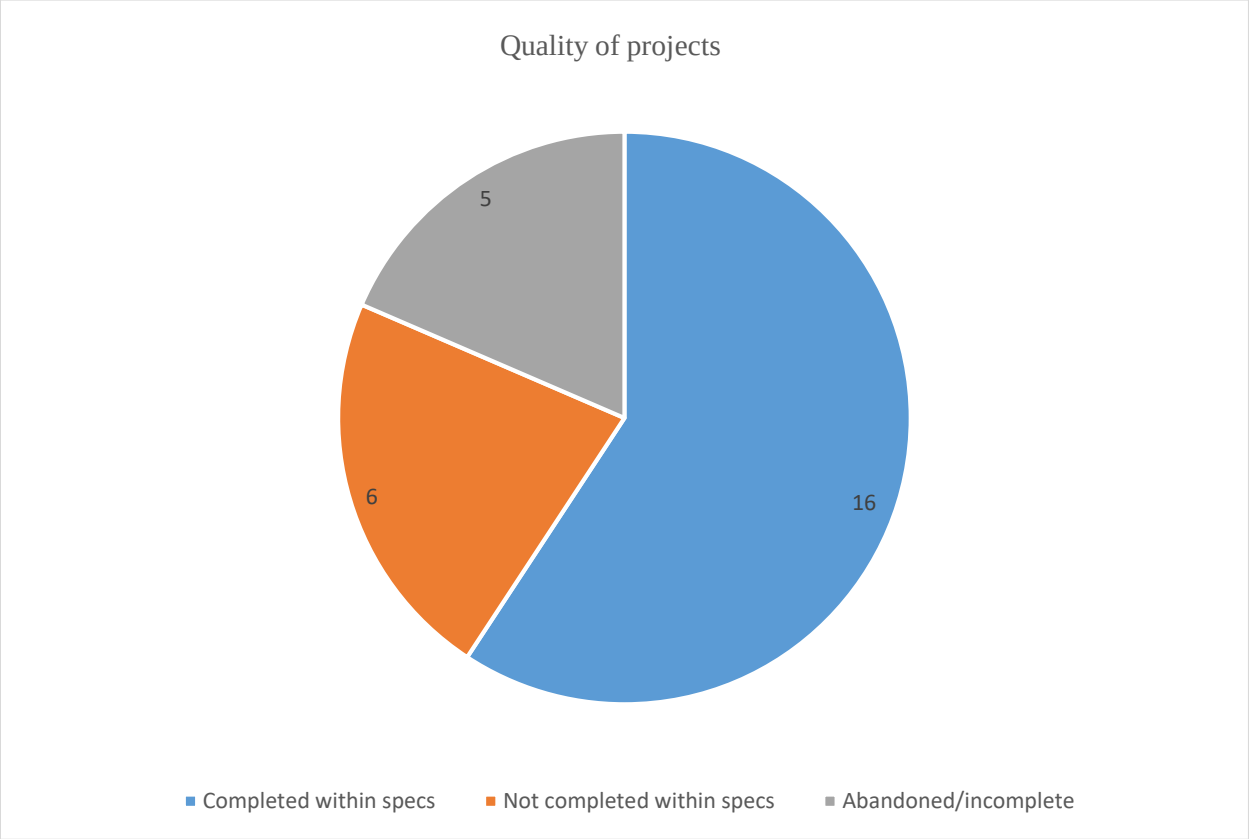
Of the ten projects which have underspent, two of those projects have been abandoned. Those projects are the metering of council properties and metering of school properties for 2015/16 financial year. The projects were abandoned due to late appointment of contractors and as thus they could not be implemented as planned in 2015/16 financial year. Even though these projects could not be implemented, costs have already been utilised for paying consultants. The department only managed to spend within budget on 14 projects out of the 27 projects. It can be said that the manner in which project costing was done was inaccurate as 48% of the projects were over/under expenditure. After assessing project time and cost, quality performance is now investigated to assess whether the projects were completed within the required specifications.

3.4.3.3 Quality performance

Quality performance is very important to measure the efficiency of 'as and when' water loss projects. In measuring the quality of the projects, the manner into which the project were executed is investigated. Different projects have different quality criteria which the Department of Water and Sanitation assess. Thus, explanations for projects which have not met the required specifications are provided. Projects which have not been completed within the required specifications are deemed as projects which have not been completed within the agreed scope of work. Thus, the quality of the project is deemed not good or poor. The department measures quality performance by defects and rework.

Out of the 27 'as and when' water loss projects, only six projects were not completed within the required specifications. Figure 3.4 depicts the number of projects which were completed within the required specifications as well as those that did not meet the required specifications.

Figure 3.4: Quality of projects



(Source: own compilation)

Even though the projects were 27, five projects were abandoned/incomplete (19%). The quality of those five projects cannot be assessed. This means that only 16 projects (59%) were completed with the required specifications, whilst six projects (22%) were not completed within the required specifications.

The projects were midblock water replacement projects as well as domestic and bulk metering. The details of the poor workmanship is explained below:

Midblock water replacement projects

Three of the six midblock projects that were implemented in Daveyton, Phomolong (Tembisa) and Tembisa one did not meet the required work specifications. The reasons are that the contractors did not conduct their work properly. That is, the contractor proceeded with the installation of pipes without pipe-jacking of road crossing. This practice has thus led to misaligned and leaking pipe joints rendering the project defective.

It was also noted that some households in Thokoza and Vosloorus were not being billed using the new meters installed. The reasons behind this was that the process of shutting the valves in order to allow the new line to be operational would affect many houses. Meaning that the houses which were to be affected would be without water for few days as some old lines did not have a shut-off valve and some shut-off valves were not operational anymore. This thus rendered the quality of work done poor as the new lines were not operational.

Domestic and bulk metering projects

On the domestic and bulk metering project, it was indicated that the metro had imposed penalties amounting to R214 990 due to quality of work and late completion of work. Some meters which were installed were not operational due to wrong installation technics which were applied. As such, a re-installation was required in order to have those meters to be operational. The re-installations of the meters were done by the same appointed contractor. The penalties were imposed whilst the contractor was working under the installation/replacement of water meters in South West Region in 2013/14 financial year.

3.5 Summary of the empirical investigation

Twenty-seven 'as and when' water loss projects were analysed. The first part of the analysis consisted of analysing the project efficiency. Looking on whether the 'as and when' projects are planned, implemented and executed within the stipulated time frame, budget and at the agreed work specifications. The analysis shows that most of the projects are completed within the agreed time frame. This is so because most 'as and when' water loss project do not have a clearly defined timeframe because they are operating on a financial year (12 months) to financial year basis.

In terms of budgeting, most of the projects are also not budgeted for as the projects arise based on the need and identified problems at the time. Thus, the department budgets per programme rather than per project. This makes it easier for the department to execute 'as and when' water loss projects. However, the project cost of 'as and when' projects is not always known as the scope of some projects is not well defined. Most projects (59%) were completed within the agreed project specs as the projects are done by contractors not the metro.

The second part of the analysis involved interviewing employees of the Department of Water and Sanitation who are responsible for water loss projects. The semi-structured interview questions revealed that 'as and when' water loss projects are very complex as in many instances the scope is not known and as such difficult to budget for and have a defined timeframe. It was further revealed that in many instances delayed projects are usually from metro’s site due to understaffing. Chapter 4 concludes the study and recommendations are also drawn.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

To conclude the study, a practical conclusion was made by revisiting the objectives of the study and discussing the main findings under each objective. Even though there were limitations to the study, the study assisted Ekurhuleni Metropolitan Municipality to re-assess the manner into which 'as and when' water loss projects been implemented and managed. Also, other metros can use the study to benchmark the implementation of as when water loss reduction projects. A brief evaluation of the study was made to confirm that the objectives were met. Finally, recommendations are provided and conclusions of the study have been drawn.

4.2 Main findings from the empirical investigation

In order to evaluate this research, the objectives of the study were revisited and the findings are indicated according to each objective. The factors used to measure project efficiency were determined through literature review. Different researchers and authors agree that the factors for measuring project efficiency are time, cost and quality. These factors were used to assess the efficiency of 'as and when' water loss projects under study during the analysis of the empirical data. Moreover, semi-structured interviews were conducted with the aim of acquiring an in-depth information on 'as and when' water loss projects at Ekurhuleni Metropolitan Municipality. The objectives of the study were as follows:

- To determine criteria for measuring project efficiency in literature in order to use empirical data to measure the 'as and when' water loss projects.
- To determine the efficiency and sustainability of 'as and when' water loss projects.
- To analyse the criteria which is used to determine, manage and fund 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

4.2.1 To determine criteria for measuring project efficiency in literature in order to use empirical data to measure the efficiency 'as and when' water loss projects

The factors used to measure project efficiency were investigated. Literature indicates that in measuring project efficiency, three key criteria's can be used. The criterions are time, cost and quality. All the factors for project efficiency were relevant in measuring Ekurhuleni Metropolitan Municipality 'as and when' water loss projects.

In measuring project efficiency using the empirical data, project time, cost and quality were looked into. Firstly, all the 27 projects were assessed in terms of time to see whether the 'as and when' water loss projects are completed within the specified time frame. The results indicated that out of the 27 projects, 19 projects (i.e. 70%) were completed within the planned financial year whilst five projects (19%) were abandoned/incomplete. Only three projects (i.e. 11%) which have been implemented on an 'as and when' basis have not been completed on time. Out of the three projects which were not completed on time, the degree of delay were 33, 29 and 4% respectively.

The five 'as and when' water loss projects which were abandoned/incomplete are:

- Metering Council properties project 2015/16 financial year.
- Metering schools' properties for 2015/16 financial year
- Phomolong (Tembisa) midblock water replacement projects
- Tembisa 1 midblock water replacement projects
- Daveyton midblock water replacement projects

Whilst the three 'as and when' water loss projects which were delayed are:

- Replacement of water network in the Germiston Central Business District
- Upgrading and construction of water network on an 'as and when' required basis from date of award until June 2016: Bulk water supply to Zincor Mine in Selcourt Springs
- Installation, replacement and repair of small meter installation on an 'as and when' required basis for a period with effect from date of award until 30 June 2015

Most of the projects were completed within the specified time frame. The reason for this was that 'as and when' water loss projects are implemented on a financial year to year basis. Meaning that, in many instances contractors have a full 12 months to conduct their project work. This is done so because 'as and when' water loss projects are conducted on a demand and problem basis as it was revealed in the semi-structured interview. Because of this, it becomes difficult to plan a timeframe on a project which its scope is not well defined and is not entirely known.

There are however those 'as and when' projects which have time frames. This are usually the ones were the project scope is not too complex. This is indicative of the three projects which were delayed, as the scope of these three projects in not too complex and thus contractors are able to determine the timeframe for completing the project. In terms of the abandoned/incomplete projects, out of the five projects which were abandoned/ incomplete, two of these projects did not commence due failure to secure contractors on time.

The two projects are metering council properties project 2015/16 financial year and metering schools' properties for 2015/16 financial year. The tendering department failed to secure contractors on time until time ran out. However, contractors started with work when the financial year end was coming to an end. This is also indicative by the semi-structured interview results as respondents indicated that the tendering department is under-staffed. The under-staffing of this department thus affect project implementation which have a detrimental impact on service delivery.

Whereas, with the other three projects which were abandoned, Phomolong (Tembisa) midblock water replacement projects, Tembisa 1 midblock water replacement projects and Daveyton midblock water replacement projects. The contractors in these three projects did not conduct their work properly as contractors proceeded with the installation of pipes without pipe-jacking of road crossing. This practice has thus led to misaligned and leaking pipe joints rendering the project defective. Phomolong and Tembisa 1 had the same contractor, whilst Daveyton had a different contractor. These projects were thus abandoned with payment made to the contractors by the metro. The metro has not retrieve its money back from the contractors who did not do proper work.

Cost performance

The second measure of project efficiency is cost and in terms of cost performance, the results indicated that majority (52%) of the projects were implemented and executed within budget. Out of the 27 projects, it was assumed that 14 projects were completed within the stipulated budget as the planned budget and actual budget were not included in the reports. This was due to the fact that the scope of 'as and when' water loss projects is usually unknown. This thus makes it difficult to know the exact project costs. Thus, the metro enables contractors to assess the scope of work as well as the estimated costs. This enables the metro to have an idea of the project cost.

Ten (10) projects did not manage to deplete the planned budget whilst three (03) projects over-spent. This means that 52% of the projects were completed within budget, 37% of the project under-spent budget whilst 11% of the projects incurred over-expenditure.

Quality performance

In terms of quality performance, only six projects were not completed within the required specifications. The projects were domestic and bulk metering as well as the midblock water replacement projects. The domestic and bulk metering project, the quality of work was poor and the metro charged penalties of R214, 990. The remaining five projects were midblock pipe replacement projects. The contractors in these five areas failed to deliver their work as per the required specifications.

The poor quality of work was due to the fact that contractors proceeded with the installation of pipes without pipe-jacking of road crossing. This practice had thus led to misaligned and leaking pipe joints rendering the project defective. Tembisa 1 area was the area with the highest failure rate, as meters were not installed at all. Also, road crossing and the interconnection of pipes were still outstanding. The contractor also skipped rocky areas. Over and above this, the contractor nor the consultants did not know the number of stands which have been piped.

It was also noted that some households in Thokoza and Vosloorus were not billed using the new meters installed. The reasons was that the process of shutting the valves in order to allow the new line to be operational would have affected many houses. Meaning that the houses which were to

be affected would be without water for few days as some old lines did not have a shut-off valve and some shut-off valves were not operational anymore. This thus rendered the quality of work done poor as the new lines were not operational and the metro was not getting any return on the investment made.

As indicated above, it should be noted that even though the projects were 27, five projects were abandoned/incomplete (19%). The quality of those five projects cannot be assessed. This means that only 16 projects (59%) were completed with the required specifications, whilst six projects (22%) were not completed within the required specifications.

4.2.2 To determine the efficiency and sustainability of 'as and when' water loss projects

The efficiency of 'as and when' water loss projects were determined by looking at whether projects have been implemented within the stipulated time, budget and scope. Also, semi-structured interviews were conducted to acquire an in-depth understanding of the operations and challenges of 'as and when' water loss projects. In terms of time, most of the projects have been completed within the stipulated timeframe. This is so, because 'as and when' projects do not have exact time frame but they are rather given a full financial year (i.e. 12 months from July to June every year) to be completed. This thus enables contractors and the metro sufficient time to plan, implement and execute the 'as and when' water loss projects.

In terms of cost performance of 'as and when' water loss projects, it was found that majority (14 projects) of the projects have been completed within budget. However, there were those projects who under-spent its budget (10 projects) and those which have over-spent its budget (03 projects). Again, the exact project budget of most 'as and when' water loss projects are unknown. This is so because of the complex nature of 'as and when' water loss projects. Some 'as and when' water loss projects may be required to be conducted in all the metros areas whereas others are area based. For the ones that are area based it becomes easier to determine project time, budget and scope. Whilst with the ones that are not areas based, it may become difficult to determine project time, cost and scope.

Quality performance was also found to be of minimal concern as most 'as and when' water loss projects have been executed as per the required specifications. Out of the 27 projects, only six projects were of poor quality. And three out of the six projects which were of poor quality were also not completed but contractors were paid. The metro needs a robust system which will ensure that contractors finish their work before they are paid full project amount. Overall, most projects have been delivered within specs.

4.2.3 To analyse the criteria which is used to determine, manage and fund 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

The semi-structured interviews revealed that 'as and when' water loss projects are unplanned projects and that they are also demand driven. Thus 'as and when' projects they are considered to be ad-hoc projects, or they rather share similar characteristics with ad hoc project management. As indicated above, Ad hoc projects are usually developed when an unprecedented challenge or problem arises that cannot be solved using standard or predefined business procedures. Those problems are usually cross-departmental and involve several stakeholders from within and outside the organisation involving several departments such as marketing and sales, product development, customer service and support, maintenance and legal.

The metro's 'as and when' water loss projects are not entirely ad-hoc, they however share some similar principles which are the involvement of several stakeholders within and outside the organisation. The concept of 'as and when' is mainly meant for the financial part at the metro. This is so because the 27 water loss projects which are considered as an as when projects are those projects which the metro done 'as and when' the finance becomes available to begin or complete a project. This practice of doing a project in a phased approach is indicated to be good as this is how organisations plans manage their portfolio projects.

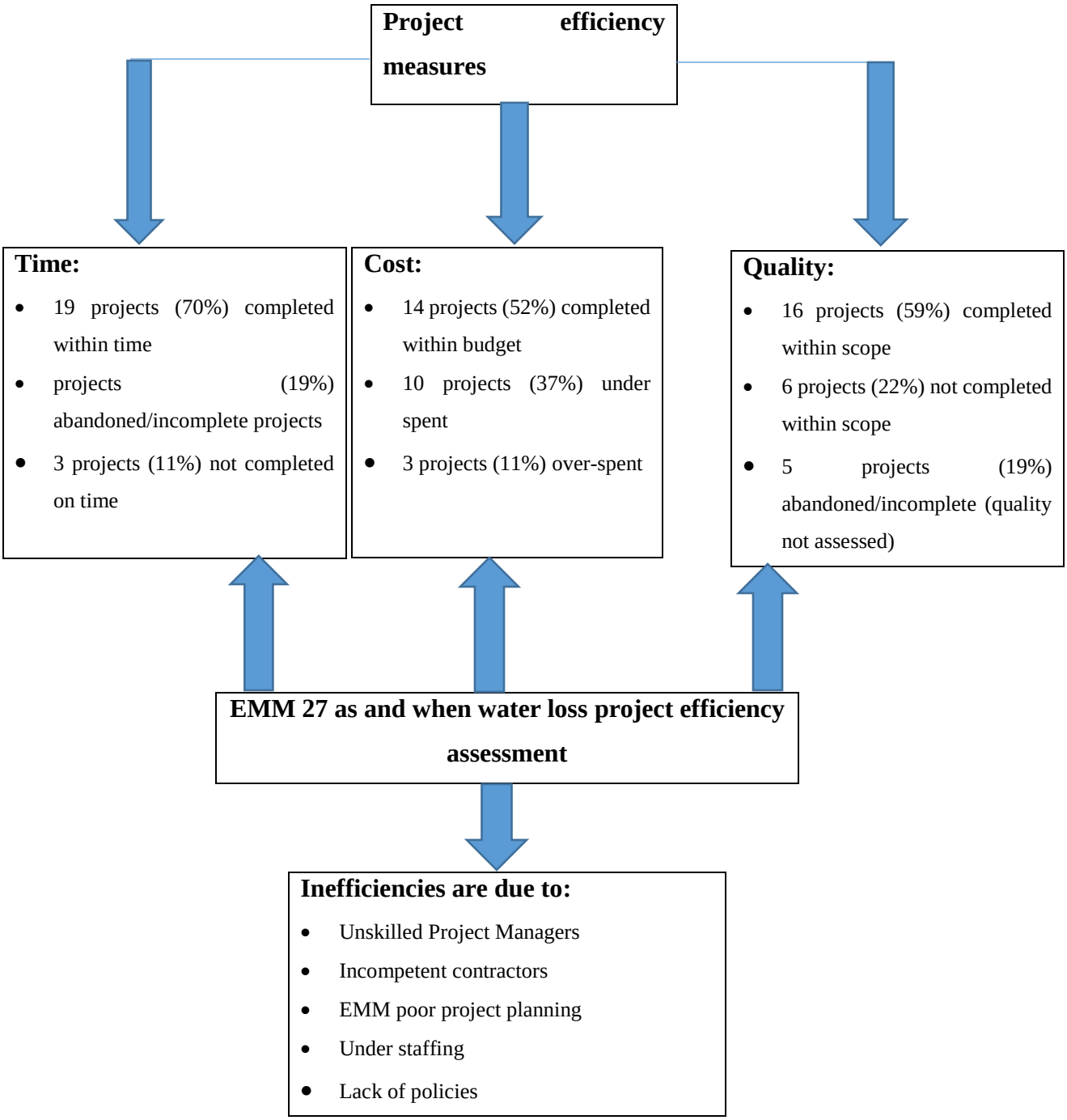
Thus, the manner into which the metro plan, implement and execute their 'as and when' water loss projects is in line with the Organisation for Economic Co-operation and Development (OECD) Water Governance Principles. The OECD Water Governance Principles provide the 12 must-do for governments to design and implement effective, efficient, and inclusive water policies in a

shared responsibility with the broader range of stakeholders (OECD, 2017). The 12 must do principles for governments are as follows:

1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.
2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.
3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.
4. Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.
5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.
6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.
7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.
8. Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders.
9. Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making.
10. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation.
11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.
12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.

In particular, principle seven and eight have been adhered to as Ekurhuleni Metropolitan Municipality has put in place appropriate measures in place by implementing the water loss eradication programme. The findings of the study are depicted in a comprehensive model below.

Figure 4.1: Findings of the study in a comprehensive model



(Source: own compilation)

4.3 Contribution of the study

The study has made a significant contribution in the area of water loss project management. Metropolitan Municipalities may use this research work to benchmark the efficiency of their 'as and when' water loss projects. The study has revealed that water loss projects are not implemented and managed efficiently as they should be. This is of great concern given the fact that South Africa is a water scarce country and as such efficient implementation and management of water loss projects should be given the outmost attention.

4.4 Evaluation of the study

As indicated on the main findings of the study, the objectives of the study were revisited and it is evident that the objectives of the study were met. The primary aim of this study was to assess the efficiency of 'as and when' water loss reduction projects in Ekurhuleni Metropolitan Municipality. In order to achieve the primary objective, the study investigated project efficiency measures in literature in order to measure the 'as and when' water loss projects. This was done and it was found that time, cost and scope/quality are the three key project efficiency measures. The study has thus collected project documentation to assess whether 'as and when' water loss projects are implemented and executed within the specified time frame, budget and scope.

Secondly, the study determined the efficiency of and sustainability of 'as and when' water loss projects. This was done through the semi-structured interviews by determining the operation and management of 'as and when' water loss reduction projects. Moreover, challenges on the implementation and management of 'as and when' water loss projects were determined to thoroughly assess the efficiency and sustainability of 'as and when' water loss projects.

Lastly, a criterion which is used to determine, manage and fund 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality was determined through the semi-structured interviews. This was done to understand the funding and management of 'as and when' water loss projects. The objectives of the study were thus met. In the next section, the recommendations for the study are discussed.

4.5 Recommendations

The efficiency of 'as and when' water loss projects were assessed through the use of the empirical data. From the empirical study it became evident that it is not easy to implement and manage 'as and when' water loss projects. The study recommends the following:

4.5.1 Up-skilling of water loss Project Managers

Water loss Project Managers at the metro need to be skilled in order to be able to do their work efficiently and effectively. A Project Manager who is project managing water loss projects, needs to have a background and experience on project management and water demand management issues. This will enable a more robust independent oversight on the contractors as the Project Managers will be able to apply project management principles like the use of the metric of earned value on the project life cycle. Thus, training and development programmes for Project Managers is needed. Relying on the consultants to train the Project Managers only is not adequate.

4.5.2 Increasing personnel in the tendering section

Hiring of more personnel who are responsible for ensuring that the tendering process is more efficient and effective was found to be key in improving project management at the metro. Most of the project which were not completed on time, was as a result of contractors starting their work late due to late appointment from the tender office. There is a thus a need to hire more people at the tender department to improve the efficiency of project implementation and execution.

4.5.3 Benchmarking of the implementation and execution projects

Benchmarking the implementation and execution of 'as and when' water loss projects in Ekurhuleni Metropolitan Municipalities to other metros may assist the metro to improve. This will further enable the metro to form relations which are specifically aimed at assisting each other when it comes to project management issues.

4.5.4 The development of a policy on the management of contractors and consultants

The metro needs to develop a policy that will be used as a guideline to manage contractors and consultants (i.e. service providers) who do not perform as per the contractual agreement. There were cases were work was not properly done but the metro paid the contractor and a consultant in full. The development of this policy will assist the metro in managing such cases and also to ensure that such service providers are not given work with the metro.

4.5.5 Measuring of performance metrics

The manner into which projects are planned, implemented and executed (i.e. within the specified timeframe, budget and cost) need to be performance assessed. Management need to account for project inefficiencies as they cost the metro time and money which results in poor service delivery. The measurement of the project performance may assist the metro to better manage projects and improve in service delivery.

4.5.6 Regular feedback and status upgrade

A system of having a regular feedback between staff and management need to be developed. This will improve the overall management of projects. This will further enable management to upgrade status of the overall project life cycle.

4.5.7 Recommendation for further research

The study did not establish whether there is a relationship between the contractors and consultants technical background, experience and project performance. Further studies on establishing the relationship would be recommended in order to cement the findings of the study. The municipality mostly implement their contracts on an 'as and when' basis. The long-term financial sustainability of the 'as and when' basis need to be established looking at financial gains/losses of contracting 'as and when' projects versus implementing the 'as and when' projects in-house.

4.6 Conclusion

In view of the high volume of water lost in the water distribution system of Ekurhuleni Metropolitan Municipality, the management of water loss projects still needs a greater development. In order for the metro to greatly reduce its water loss, the management of 'as and when' water loss projects will need to be given serious attention. The factors which were used to measure project efficiency were investigated and put to test in measuring 'as and when' water loss projects. The three key elements of project efficiency (i.e. time, cost and quality) which were used to measure project efficiency as prescribed by the body of knowledge were all relevant in assessing 'as and when' water loss projects in Ekurhuleni Metropolitan Municipality.

From the results, it was evident that the manner into which 'as and when' water loss projects are implemented and executed is efficient. As most of the projects were completed within the specified time frame, budget and scope. However, there is still a room for improvement with regards to the manner which the 'as and when' water loss projects are managed. Hiring of more personnel who are responsible for ensuring that the tendering process is more efficient and effective was found to be key in improving project management at the metro. Over and above that, 'as and when' water loss projects require project managers who have the relevant water demand management skills to enable a robust oversight on the contractors.

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ANNEXURE A: CONSENT LETTER AND QUESTIONS

Date: 28 June 2017

Dear Participant

RE: ASSESING THE EFFICIENCY OF WATER LOSS PROJECTS IN EKURHULENI METROPOLITAN MUNICIPALITY

My name is Salome Chiloane, a third year Masters of Business Administration (MBA) student at the North-West University: School of Business and Governance (old name: Potchefstroom Business School). I am conducting a study as part of my research work on the completion of my MBA degree. The study is titled assessing the efficiency of water loss projects in Ekurhuleni Metropolitan Municipality. Emphasis is based on the planning, implementation and execution of 'as and when' projects.

Your participation in this survey is voluntary and all information collected will be kept strictly confidential. Thank you in advance for your assistance in this research project. I thank you and truly appreciate your support and time.

Regards

Salome Chiloane

Contact details: 072 375 2126

Email Address: schiloane@webmail.co.za

SECTION A: Demographics

1. What is your gender?

- (•) Female
- ( ) Male

2. What is your age?

- ( ) 18 to 24
- ( ) 25 to 34
- ( ) 35 to 44
- ( ) 45 to 54
- ( ) 55 to 64
- ( ) 65 to 74
- ( ) 75 or older

3. What is the highest qualification you have completed?

- ( ) Less than high school degree
- ( ) High school degree or equivalent
- ( ) Diploma
- ( ) Bachelor degree
- ( ) Honours Degree
- ( ) Master's degree
- ( ) PhD

4. How many years have you been working in Ekurhuleni Metropolitan Municipality?

- ( ) 0 to 3
- ( ) 4 to 10
- ( ) 11 to 15
- ( ) 15 to 20
- ( ) 20 to 25

5. How many years have you been working as a Project Manager/Engineer?

- ( ) 0 to 3
- ( ) 4 to 10
- ( ) 11 to 15
- ( ) 15 to 20
- ( ) 20 to 25

6. Which section/department are you working from??

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SECTION B: Practice of 'as and when' water loss projects

7. What is your understanding of 'as and when' projects?

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8. What prompts a project to be implemented on an 'as and when' basis in the department?

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9. Who decides which projects should be implemented on an 'as and when' basis and why?

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10. Are the projects centrally controlled?

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11. Do the projects share common resources (e.g. personnel, infrastructure, and equipment's?

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12. Do you think the manner into which decisions on which projects should be implemented on an 'as and when' basis is correctly made?

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12. Do you think that the implementation of 'as and when' water loss projects is efficient (i.e. completed within time, budget and meets the specified quality)?

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Major challenges of implementing 'as and when' projects

13. What are the challenges which are been faced when implementing water loss projects on an 'as and when' basis?

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14. Are 'as and when' water loss projects financially viable/sustainable?

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15. What advice would you give to management in terms of the metro's/departments project planning, implementation and execution?

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ANNEXURE B: EXAMPLE OF EMAIL SENT TO PARTICIPANTS

From: Salome Chiloane
Sent: Wednesday, June 28, 2017 1:46 PM
To: Mandla Mthimkhulu
Subject: Research Questionnaire

Dear participant,

I am conducting a research on the metros 'as and when' water loss projects. I thus request your participation in the semi-structured interviews which I will conduct with you. As discussed, the semi-structured interview will take place on the 4th of July 2017 (at 12H00pm). I have thus attached a consent letter as well as questions which I will ask during the interview. Some questions will arise 'as and when' the interview proceeds.

Thanking you in advance.

Regards,

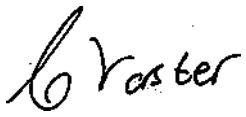
Salome Chiloane
Tel: +2711 999 1872
Fax: +2711 871 7457
Cell: +2772 375 2126

ANNEXURE C: LANGUAGE EDITOR CERTIFICATE

DECLARATION

I, C Vorster (ID: 710924 0034 084), Language editor and Translator and member of the South African Translators' Institute (SATI member number 1003172), herewith declare that I did the language and technical editing of a mini-dissertation written by Ms S Chiloane from the North-West University.

Title of the mini-dissertation: Assessing the efficiency of water loss projects in Ekurhuleni Metropolitan Municipality



15 November 2017

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C Vorster Date