

EVALUATION OF LABOUR-INTENSIVE CONSTRUCTION PROJECTS IN MADIBENG MUNICIPALITY, NORTH WEST PROVINCE, SOUTH AFRICA

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A project report submitted to the Faculty of Engineering and the Built Environment, University of Witwatersrand, Johannesburg, in partial fulfillment of the requirements for the degree of Masters of Science in Engineering.

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DECLARATION

I hereby declare that this project report is my own, unaided work. It is being submitted for the Degree of Masters of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

M. R. Ngebulana

_____ day of _____ 2006

ABSTRACT

The launch of the Expanded Public Works Programme has led to preferential use of labour-intensive construction methods over conventional methods in construction and maintenance of public infrastructure assets. This report evaluated five bulk water infrastructure projects in Madibeng Municipality where labour-intensive construction methods were used.

The research found that factors which adversely affected construction progress included: inability to transfer experience and lessons learnt from one project to the next, skills and experience shortcomings, administrative and management realities, negative interventions from stakeholders and failure of the Municipality to set specific objectives and monitor project achievements with respect to intended objectives. Appropriate training and support from local communities were found to enhance success during construction.

It was concluded that labour-intensive construction methods are feasible for bulk water provision projects and can generate productive significant employment provided certain basic requirements were in place. Ultimately the findings led to the compilation of lessons learnt from the projects.

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1. INTRODUCTION

Like most developing countries, South Africa has a pressing need to provide infrastructure and housing as well as generate employment; both in context of low levels of individual skills and institutional capacity. Since 1994, the South African government has embarked on programmes aimed at addressing these problems, the most recent being the Expanded Public Works Programme which was launched in 2004.

This investigation project will evaluate five potable water reticulation infrastructure projects conducted labour-intensively in Madibeng Municipality in the North West Province, South Africa.

1.1 Background

South Africa is one of the world's leaders in the production and export of precious metals and minerals such as gold, coal, diamonds and platinum. However, despite its natural wealth, a large percentage of the population is unemployed and most people live below the poverty line and are without basic services. Moreover, data from Statistics South Africa and the Labour Force Survey indicates that unemployment rates have grown significantly in the country over the past decade.

Unemployment is not a recent problem nor is it unique to South Africa. Many reasons¹ have been offered to explain the country's high unemployment rate, some of which include: the consequences of previous political and economic policies and laws, the country's debt servicing, population growth, lack of attention to human capital development and prolonged deterioration in the real growth rate and rising capital intensity of production.

South Africa is characterised as a middle income developing country and has one of the highest unemployment rates in the world as illustrated in Table 1.1.

Table 1.1: Unemployment rates by region

Region	Total unemployment (%)
World	6.3
Industrialised economies	6.8
Transition economies	9.4
South Asia	4.8
Latin America and Caribbean	9.0
Middle East and North Africa	11.9
Sub Sahara Africa	10.8
South Africa	26.5*

(Source: Extracts from ILO, 2004 and * Labour force survey, 2005)

¹ Reasons for poverty and unemployment in South Africa were taken from a report "Creating Jobs, Fighting poverty: An Employment Strategy Framework" Author is unknown, report from government website: www.polity.org.za/html/govdocs/misc/jobsframework1.html sighted in October 2004.

More than one decade after the first democratic election in the country, the central economic problem confronting the South African government is an unemployment rate of crisis proportions and the concomitant deepening of poverty and inequality (Mayer and Altman, 2005). The poverty and unemployment problem did not begin post 1994, but an analysis of South Africa's first nationally representative household income and living standard survey indicated that half of all black South Africans lived in poverty in 1993 (Michael and Julian, 2001).

One of the means of mitigating unemployment problems in developing countries has been the use of labour-intensive construction methods. Programmes implemented in other countries like Kenya, Honduras and India have resulted in the construction of good quality infrastructure to serve the basic needs, while creating significant jobs for communities in need (McCutcheon, 1995; McCutcheon 2003:15-56; McCutcheon and Taylor Parkins, 2003).

In the past South Africa has also undertaken large scale labour-intensive programmes such as the National Public Works Programme, however, the programme did not meet most of its principal objectives (McCutcheon, 2001). After previous unsuccessful attempts at other similar programmes, the South African government recently launched the Expanded Public Works Programme in 2004 which aims to create 1 million work opportunities in a five year time frame in order to

alleviate the increasing unemployment problem (Phillips, 2004).

Assuming that the programme will take three years for the programme to reach full-scale implementation, the funding of the Expanded Public Works Programme will result in approximately one million work opportunities of varying duration, or approximately 500 000 person-years of employment. The programme aims to create employment opportunities for at least 40% women, 30% youth and 2% disabled.

1.2 Current situation in South Africa

According to Lighthelm et al (1990) and Reiley (1992), the level of unemployment in South Africa increased from 7% in 1980 to 18% in 1991. Since then, the unemployment rates have increased drastically reaching levels of 30.5% in 2002 (Labour Force Survey, 2005). Unemployment trends from 1995 to 2005 are presented in Table 1.2. below.

In South Africa, two different concepts of unemployment are used routinely, i.e. the strict (narrow) definition and the expanded (broad) definitions. The narrow definition applies to a job-search test while the broad definition accepts as unemployed those who did not search for work in a 4-week reference period, but who report being available for work and say they would

accept if a suitable job were offered. In 1998, the narrow concept was declared the 'official' definition of unemployment.

Table 1.2: Unemployment trends in South Africa (1995-2005)

Year	Strict definition* (%)	Broad definition** (%)
1995	16.9	26.5
1996	19.3	34.9
1997	21.0	38.9
1998	25.2	37.5
1999	23.3	36.2
2000	25.8	35.9
2001	29.5	41.5
2002	30.5	41.8
2003	28.0*	41.8*
2004	26.2*	41.0*
2005	26.5**	40.5**

(Source: extracts from South Africa's economic development trajectory (Mayer and Altman, 2004) - * September data from Labour Force Survey, 2005 and ** March 2005 data from Labour Force Survey 2005)

Columns 2 and 3 in Table 1.2 present the strict and broad definitions, respectively. According to column 2, unemployment rates had decreased temporarily by 2.1% in 1999 and then continued on the rising trend until 2003 during which they dropped by 2.5%. A further decline of 1.8% was recorded in 2004 and subsequently unemployment increased by 0.3% to 26.5% in 2005.

According to the Labour Force Survey (2005), South Africa had an official (narrow definition) total

unemployment rate of 26.5% and an expanded (broad) definition of 40.5% in 2005.

Literature suggests that the high unemployment rate is exacerbated by the low levels of skills in the country (McCord, 2004). According to McCord (2004), skills development is important for alleviating unemployment as general observations indicate that unemployment rates are the lowest among educated persons in South Africa.

Unemployment has also been linked to the prevalent and increasing crime rates in South Africa. According to the South African Police Services (SAPS) Crime Statistics (2004), there is empirical evidence that crime increased at the same time as unemployment rose. The report suggested that the rise in unemployment may be forcing more people into illegal ways of gaining income for survival.

One of the traditional ways for one to begin to earn money and enter into the formal economy has been via the construction industry (McCutcheon, 2003). The industry constitutes a substantial percentage of the country's expenditure and with current backlogs in infrastructure provision for poor communities, there is a large scope for this industry to contribute to employment creation initiatives. In an attempt to alleviate unemployment and poverty, the Department of Public Works has embarked on a number of labour-

intensive programmes, the most recent being the Expanded Public Works Programme.

Phillips et al (2005a) observed that unemployment is so acute in South Africa that no single intervention will solve it. In addition, in order for government to reach its aim of halving unemployment by 2014, some 546 000 full-time jobs will have to be created annually. Although labour-intensive construction projects generally result in the generation of short term employment², it is thought that the correct implementation of initiatives such as the Expanded Public Works Programme could contribute meaningfully towards the targeted jobs which need to be generated.

1.3 Defining labour-intensive construction

In the construction industry construction methods can be classified as equipment intensive or labour-intensive, depending on the content of labour and equipment. Equipment intensive construction is the conventional construction method which refers to the combination of labour and equipment in such a way that most of the work is conducted by equipment and only supported by a small labour force (McCutcheon, 1995).

²Jobs generated by construction projects generally last as long as the construction period which is generally limited. The types of jobs to be generated by initiatives such as the Expanded Public Works Programme are expected to last for between four to six months.

According to McCutcheon (2006a), labour-intensive may be defined as the economically efficient employment of as great a proportion of labour as is technically feasible, ideally throughout the construction process including production of materials, to produce as high a standard of construction demanded by the specification and allowed by the funding available; labour-intensive construction results in the generation of a significant increase in employment opportunities per unit of expenditure by comparison with conventional capital intensive methods. According to the definition emphasis is not only on the use of more labour than conventional methods, but also places importance on other important elements of a project such as quality and cost.

It is also important to accentuate the difference between optimal and maximum use of labour. According to Tajgman and de Veen (1998), the latter may occur in projects where income generation and job creation are the principal objectives, and would include disaster relief or food for work projects which are temporary and where quality and productivity are usually low. Relief programmes are conducted to react to natural or man made catastrophes such as droughts, floods and wars and their prime objective is to provide food and income to affected individuals while providing infrastructure. On the other hand, optimal use involves an appropriate mix of labour and equipment required to provide products of adequate quality in a cost effective manner (Tajgman and de Veen, 1998).

It is imperative to distinguish between relief programmes and labour-intensive construction methods. Although they have very different aims and objectives, the two are often confused. Due to the undesirable outcomes of relief programmes, labour-intensive programmes could be perceived negatively which often leads to resistance towards adopting this construction technology.

1.4 Problem statement

The 2004 Division of Revenue Act³ mandates provinces and municipalities to adopt and use labour-intensive methods on appropriate infrastructure projects. In 2004 informal interviews conducted with representatives from Tshwane, Madibeng and Buffalo City municipalities revealed that Municipality representatives were struggling to incorporate the use of labour-intensive construction methods into the day to day running of infrastructure projects. Another sentiment shared was that labour-intensive projects were reserved for 'special' projects as they always presented problems relating to management of large labour forces on site. It was easier dealing with conventional equipment intensive projects.

³ Division of Revenue Act: Local Government Allocations 2004/2005, <http://www.info.gov.za/notices/2004/26220/index.html> sighted October 2005.

The negative perception and reluctance to conduct projects labour-intensively was found to be very disturbing given that it is at municipality level that the projects within programmes are actually implemented. A closer look at some of the municipality's projects where labour-intensive construction methods were attempted revealed inadequate planning, organising and management of the construction process as a result many problems were encountered during implementation. At termination of the construction phase, there was no evidence that the projects had been evaluated to determine whether the project objectives had been met. Although the use of labour-intensive construction methods is one of the requirements for municipalities applying for funding for infrastructure projects, there does not seem to be a system in place to enforce or monitor this requirement.

1.5 Aim and Objectives of the report

To date Madibeng Municipality has, to some extent, attempted to incorporate the objectives of the Expanded Public Works Programme into some of their infrastructure projects. The aim of this research is to evaluate data from potable water reticulation infrastructure construction projects conducted in Madibeng Municipality where labour-intensive construction methods were conducted.

The objectives of the research are to:

1. Establish the aims and objectives for the water supply projects;
2. Document the experiences and findings of the projects;
3. Analyse project findings and evaluate the project achievements in comparison to the intended objectives; and
4. Document lessons learnt from the projects.

It is the intention of this research to derive best practice from the findings of the evaluation of the projects which could assist decision makers and municipality representatives attempting labour-intensive projects with no or limited experience.

1.6 Scope and methodology

Initially, discussions were conducted with representatives from Madibeng Municipality to determine the extent of the Municipality's incorporation of the Expanded Public Works Programme into their day to day delivery. The discussions were also to assess the problems encountered with labour-intensive projects conducted over the past four years. This was done to justify the need for this research, and it was followed by a literature review of international and local experiences with respect to programmes and labour-intensive projects. The literature review was followed by collection of data on five potable water supply

projects conducted in Madibeng Municipality, namely: Brits Industrial Area, Maboloka and Environs Water Supply Scheme, Oskraal and Environs Water Supply Scheme which consists of the Madidi and Oskraal Plots phases, and Letlhakaneng. The sample group was selected on the basis of data availability; this is a major limiting factor as most labour-intensive projects are not well documented.

The following procedure was followed for assessment of the four completed projects:

- Accumulation of data from available project documentation such as project close out reports, project plan reports, project communications like faxes, e-mails and letters and project contracts;
- Personal interviews with two Madibeng Municipality representatives, three consultants and one contractor; and
- Compilation of available data highlighting driving and restraining forces identified from the project.

Field work was conducted on one project which was under construction during the time of research as follows:

- Assembling of available information such as contract documentation, project plan reports from the Municipality and existing communication as found in consultant's project files; and

- Personal interviews with one representative from Madibeng Municipality, two consultants, one Resident Engineer, one site agent, four labourers, one sub-contractor and three residents from the affected community (one man and two women) who were directly involved in the projects. The participants were identified as key personnel from available project documentation.

Compilation of data was then followed by evaluation of the project outcomes which was in-turn followed by documentation of lessons learnt.

This research is based on only five projects where reasonable information could be found. However, at times data was found to be incomplete and incompatible. In such cases information had to be calculated or deduced from other available sources such as close out reports, consultants or contractors where available.

It was also disturbing that often the aims and objectives of the projects were not properly documented, but instead the author had to be extracted these from communication documents between the client, consultants and contractors and from the interviews conducted. However, the construction costs stated in this report can be regarded as reliable as these were obtained from actual payment certificates, monthly progress reports and close out reports.

1.7 Structure of the report

Against this background section, Chapter 2 will set the scene by presenting experiences from labour-intensive construction programmes conducted in other countries upon which the objectives and principles of labour-intensive construction technology were founded. This will form the basis for evaluating the labour-intensive projects in Madibeng Municipality.

Chapter 3 will focus on literature on South Africa's labour-intensive construction programmes. Formal evaluations of the programmes will also be documented where available. This chapter will focus on the Expanded Public Works Programme, the recent large scale programme under which two of the evaluated projects in Madibeng Municipality were conducted.

Chapter 4 will discuss the five water reticulation infrastructure projects conducted in Madibeng Municipality. The procedure followed to evaluate the projects includes documentation of available project information, followed by detailing of the project framework which includes contractual matters, training, health and safety and productivity. The projects are then evaluated according to the primary objectives to determine whether they were successful or not.

Chapter 5 provides an overall analysis of findings from the evaluated projects. It then identifies the driving

and restraining forces which led to the outcome of the projects.

Lastly, Chapter 6 draws conclusions based on the achievement of objectives of the five Madibeng Municipality projects. It then documents lessons learnt and provides recommendations for the planning, organising and implementation of future projects, based on the experiences gained from the projects.

2 INTERNATIONAL LITERATURE REVIEW

2.1 Introduction

Labour-intensive construction is a topic of interest for many developing countries undertaking strategies to alleviate poverty and unemployment. As a result, the topic has been extensively researched and a great deal of literature material is available on the subject. In order to evaluate the labour-intensive projects conducted in Madibeng Municipality, it is important to understand what makes such progress successful and what fundamentals are necessary to enhance successful implementation.

This chapter will discuss the use of labour-intensive construction methods in international programmes and the majority of the chapter will be dedicated to best practice and summary of reasons for successful implementation of such programmes.

2.2 Best practices from international programmes

The use of labour forces in the construction of infrastructure is not a new concept and can be traced as far back as the construction of major structures

namely: the Egyptian Pyramids⁴ and the Great Wall of China⁵, which are two of the seven construction wonders in the world.

Later in the 1930's, one of the solutions embarked on in America to alleviate the high unemployment problem brought about by the Great Depression, was to undertake large public works projects (Garraty, 1998). Labourers employed to participate in these projects had little prior experience and learnt on the job, but managers and equipment operators usually had related prior experience and the workers with limited experience at the outset moved up to higher paying jobs that they learnt during the project.⁶

⁴ In the book, *Science, the Universe and God: The Search for Truth*, Keith Mayes highlights that today the construction industry is so used to employing machinery to conduct virtually all major construction work that it is sometimes forgotten that machinery is a relatively new development. In the past, people relied on hand tools and innovation to achieve success in construction of structures. For example, the Great Pyramid of Egypt was constructed hundreds of skilled workers who had limited construction machinery at their disposal. Information was obtained from the website: http://en.wikipedia.org/wiki/Egyptian_pyramids_construction_techniques sighted August 2006.

⁵ Another example of the use of labour to construct magnificent structures is the Great Wall of China which built by millions of workers who toiled under arduous work and poor living and construction conditions. The successful construction of the wall was again achieved by the use of proper management of the labour force and appropriate design and construction methods. Information was obtained from the website http://www.travelchinaguide.com/china_great_wall/construction/labour_force.htm sighted August 2006.

⁶ Information from an article by Andrew J. Dunar who teaches history at the University of Alabama in Huntsville. He is the co-author of *Building Hoover Dam: An Oral History of the Great Depression* obtained from http://www.pbs.org/wgbh/amex/goldengate/sfeature/sf_30s.html sighted July 2005. No date of publication of article found.

In South Africa example of the use of large labour forces in infrastructure is the so called 'Poor White Problem'⁷ in South Africa where many roads on the Witwatersrand were built by hand to relieve poverty after the great depression and drought in the 1930's (Abedian and Standish, 1985).

For more than three decades developing countries such as Kenya, Botswana and Lesotho have embarked on large scale labour-intensive construction programmes which have resulted in thousands of kilometres of roads and years of productive employment. Evaluation of these programmes has led to delineation of a set of principles governing the successful implementation of labour-intensive construction methods. During this work other issues were identified as having a bearing upon labour-intensive work, including the nature of work and the level of technology within the society involved in technology transfer, the type and extent of training required, the need for targeting the poor and the distinction between labour-intensive work and emergency, drought and/or relief efforts (McCutcheon, 2003:15-56).

The construction industry has been known to generate employment for under/un-skilled local communities in

⁷ Extracts from the Preamble of "Labour-intensive strategy and framework manual for implementation of infrastructure projects in Gauteng", 2003, prepared for the Department of Public Transport, Roads and Works.

the past. However, over the past century or so, conventional construction methods have become increasingly capital intensive, resulting in lesser employment opportunities per unit of expenditure. Thus throughout the industry an increase in expenditure has generally resulted in the generation of less employment per unit of expenditure than formally (McCutcheon et al, 2003).

Extensive literature is available on the substitution of labour⁸ for equipment in which the feasibility of the reverse substitution of labour for equipment was analysed. Some of the key findings from the early phase of the study included the fact that substitution was technically feasible for road construction. The economic feasibility depended on relative factor prices and factor productivities under different conditions. However, the data normally available was found to be inappropriately structured or too poorly defined with respect to environmental conditions to permit a quantitative analysis of the substitution possibilities.

Subsequent phases established that labour-intensive construction methods were in fact technical feasible for a wide range of construction activities and could

⁸ 1971 the World Bank launched the Study of the Substitution of Labour and Equipment in Civil Construction in order to investigate the value of using appropriate construction methods for socio-economic benefit of countries with abundant labour and scarce financial resources. The findings of the study is documented in the report: The Study of the Substitution of labour and equipment in civil construction (SOL) (April 1986) - A research and implementation project, Project completion report.

generally produce the same quality of products as equipment intensive methods. Other findings included the fact that labour productivity could be increased through better organisation and management, better tools and light equipment and through the upgrading of the health and nutritional status of the workers.

Further research into labour-intensive construction methods was conducted by McCleary et al (1976). During the study a cost-benefit analysis was conducted using shadow prices⁹ for alternative technologies of gravel road construction in Thailand. The study concluded that labour-intensive construction methods could be competitive with machine based ones at shadow prices and that the former could be cheaper at shadow prices if higher labour productivity could be achieved.

Deepak et al (1978) conducted a study in the Philippines which compared various machine-labour combinations for road construction. Productivities and costs were obtained from field studies on pilot studies of labour-intensive gravel construction. Analyses were made of alternative labour-intensive methods for excavation and haulage, and shadow prices were derived for various inputs. Labour-intensive construction methods were found to be more economically viable than

⁹ Shadow price is defined as the change in the objective value of the optimal solution on an optimisation problem obtained by relaxing the constraint by one unit. For example, a shadow price is the maximum price that management is willing to pay for an extra unit of a given limited resource. The value of shadow price can provide a decision maker with powerful insight into problems.

machine-intensive construction at both market and shadow prices.

The findings and experiences from the abovementioned studies, and others not included in this report, were documented and compiled into lessons learnt and reasons for success. According to McCutcheon (2003), the following factors were considered to be the main reasons for their success:

- Major policy and decision makers understood the concepts and principles of labour-intensive work and the principles of long-term programmes.
- Programmes were long-term and national and were not ad hoc projects.
- There was a sound intellectual assessment of the technical feasibility and economic efficiency of labour-intensive method: cognisance was taken of technological and institutional capacities. The principles of labour-intensive work were incorporated into daily work.
- Technical, institutional, organisational, managerial and socio-economic aspects received concentrated attention during preliminary work, continued through pilot projects, embryonic training programmes and subsequent large scale, national programmes.
- Strong organisations were established with good management systems: a balance was achieved between decentralisation and centralisation.
- Training was extensive and good at what it set out to do, that is the training of hands-on site

supervisors/road builders, multi-site supervisors, clerks, vehicle/tractor drivers and artisans.

- There was long-term political support.
- Long-term financial commitment was provided by government and donors.
- On balance there was good co-ordination between government, government departments, those administering the programme, local authorities, those providing technical assistance and donors. Independent evaluation assisted as did the continuity and commitment provided by particular individuals.

Furthermore, programmes have to be conducted in a logical and methodological manner to ensure good organisation, planning, management, monitoring and control. According to McCutcheon (2003), the establishment of a programme for large scale replication of innovatory work would be possible through the following phases:

Phase 1: Orientation which includes reaching consensus with all parties concerning policy objectives, types of different projects in one programme, method of construction, conditions of employment and many other factors. During this stage, it is critical that all stakeholders have an understanding of the concepts and principles of labour-intensive work.

Phase 2: Preparatory work during which analysis of the institutional structure, organisation, levels of

funding, specific technical analyses, criteria for staff recruitment, identification of initial communities and training sites are investigated. Preparatory work includes the design, specification, documentation, administrative, technical and training manuals, selection of trainees, briefing of communities and prioritising.

Phase 3: Pilot/Initial training which involves pilot and/or demonstration projects incorporating an embryonic training programme.

Phase 4: Expanded training which is the expansion of the pilot and demonstration projects and training programmes into a large scale local, provincial and/or national programme. It is crucial that expansion only occur at a rate at which the programmes is able to produce the skilled human resources required, local communities and institutions have the capacity to absorb the trained personnel and the national/provincial institution is able to absorb the trained management personnel and maintain its overall role in relation to budget, planning, coordination, monitoring and control.

These phases are necessary because of the absence of an existing labour-intensive industry, the low level of existing skills and the lack of institutional capacity at local, provincial and national levels.

2.3 Conclusion

An overview of sub Saharan experiences indicates that programmes of labour-intensive construction and maintenance of physical infrastructure have achieved the following complementary development objectives (McCutcheon, 1999):

- A significant increase in employment generation per unit of expenditure;
- The construction and maintenance of technically sound and economically efficient assets;
- The development of individual skills: technical, supervisory, managerial and entrepreneurial; and
- The building of institutional capacity at local, regional and national levels.

International evidence has shown that large scale, well managed labour-intensive public works programmes can create significant employment and at the same time generate infrastructure of required quality. On the contrary, inadequate planning and hasty implementation leads to failure of programmes and the following are some of the lessons learnt from international programmes (McCutcheon, 2003).

- The use of labour-intensive construction methods in carrying out programmes for construction of infrastructure combined with labour-intensive maintenance generates significant full-time jobs.

- Good flow of communication between workers, supervisors, clients, consultants and affected communities is crucial for the successful implementation of labour-intensive construction methods.
- Monitoring and feedback systems should be developed to ensure that all stakeholders understand their responsibility, roles and expectations.
- It is very important to train contractors prior to commencement of works.
- Findings of studies in which the impact of labour-intensive construction methods were compared with conventional construction methods indicate that labour-intensive projects create more than twice the number of jobs, can be at least 30% less expensive, and reduce the use of foreign exchange.
- The success of labour-intensive programmes depends on the minimum wage rate applied. If too high, the programme will be too expensive and if too low, the programme will struggle to attract and retain the required labour force.
- The programmes have to adhere to the country's legal requirements and any special exemptions or requirements required should be communicated and arranged in advance with the relevant policy makers.
- Labourers have to be paid in cash and on time.
- It is imperative that, as far as possible, payment should be linked to work completed.
- Independence from expatriate skills eliminates cost associated with recruiting expatriates.

Experiences and lessons learnt have provided pertinent foundation for sound decision making for some subsequent labour-intensive programmes and projects which are discussed in Chapter 3. Lessons learnt from these past experiences have been adopted where best practice assists with the scope definition, setting of objectives, and creating the necessary environment and support for new programmes, with the aim of increasing the chances of successful implementation.

The findings from this chapter will form the basis for assessing whether the water reticulation projects from Madibeng Municipality, to be evaluated in later chapters, were conducted in a manner which supports the choice of construction method. With this background, it will be possible to determine and isolate factors which contribute to the success or failure of the projects. The list of reasons for success from international programmes will therefore be used as a checklist against which the projects are assessed taking into consideration the unique circumstances governing every project.

3 SOUTH AFRICAN LITERATURE REVIEW ON LABOUR-INTENSIVE CONSTRUCTION

3.1 Introduction

Creation of jobs for the large unskilled labour force in South Africa has become one of the priorities of the country's government. The unemployment problem is often identified with the rural areas and because these areas often have no or inadequate public infrastructure, the scope of creation of employment through investing in construction of infrastructure assets by using labour-intensive construction methods is appealing.

Over the years, the high unemployment rates in South Africa have facilitated the expanded use of labour-intensive construction methods in the construction industry. Unlike the international programmes discussed in previous chapters, the use of labour-intensive construction methods in the country was not limited to low volume roads, but also extended to a wider range of other infrastructure projects.

This chapter discusses former and current programmes undertaken by the South African government in its endeavours to use large labour forces in the construction industry in an attempt to alleviate the unemployment problem. The chapter then documents the

reasons for success and failure of the programmes and focuses on the current national programme, the Expanded Public Works Programme. In addition, the chapter will also discuss estimations for the cost to labour for labour-intensive programmes as compared to conventional construction methods. This will set a benchmark to evaluate whether the cost to labour in the Madibeng Municipality projects to be evaluated was significantly increased as compared to conventional construction methods.

3.2 South African labour-intensive programmes

Over the past three decades, billions of rands have been spent on projects and so called programmes with stated objectives of creating employment and providing infrastructure (Thwala, 2001). The sub-sections below will briefly discuss programmes such as Zibambele, Gundo Lashu, Zivuseni, the National Public Works Programme and its Community Based Public Works Programme and the Expanded Public Works Programme.

3.2.1 National Public Works Programme

Early in 1992, a senior member of the South African Federation of Civil Engineering Contractors (SAFCEC) realised that greater use of labour-intensive methods of construction could alleviate unemployment and bring more work into an industry that had been crippled with recession, cutback in government spending and civil war

(McCutcheon,2001). Subsequent meetings conducted between representatives of several civil engineering industries, and later the Congress of South African Trade Unions (COSATU), led to the drafting of a Framework Agreement in which the industry committed itself to maximise the use of labour-intensive systems of construction within public works programmes and the trade unions agreed to the linking of payment to production in public works.

During this time, the South African government was embarking on the Reconstruction and Development Programme and one of the main thrust of this programme was to link reconstruction and development through an infrastructural programme. The key area where special measures to create jobs could link to building the economy and meeting basic needs would be in redressing apartheid-created infrastructural disparities (McCutcheon, 2001).

A Technical Focus Group was appointed and its primary task was to identify those sectors of public works infrastructure in which labour-intensive production methods may be successfully developed and also to make estimates of the potential employment creation resulting from the National Public Works Programme. The results were accepted by the government as the basis for the National Public Works Programme¹⁰.

¹⁰ Information on the National Public Works Programme was obtained mostly from McCutcheon R.T. (2001), Employment generation in public works: recent South African experience.

In August 1994, the South African Government of National Unity launched a National Public Works Programme¹¹ which was based on proposals generated through a widely participatory detailed study by the National Economic Forum during the first half of 1994¹², which in turn had grown out of deliberations carried out by the Employment Task Force of the National Consultative Forum on Drought and incorporated into the Reconstruction and Development Programme. The pre-investment work for this programme was taken forward by the National Economic Forum. The responsibility of the National Public Works Programme was allocated to the National Department of Public Works.

The main objectives of the National Public Works Programme (McCutcheon, 2001) were to:

- Reduce unemployment through the creation of productive labour absorbing jobs and opportunities

¹¹ J. Radebe, Minister of Public Works, Press Release "National Public Works Programme", (Pretoria: Department of Public Works, 4 August 1994).

¹² -National Economic Forum: Technical Committee on a Public Works Programme (NEFTC),, February 1994.

-National Economic Forum: Technical Committee on a Public Works Programme (NEFTC), National Employment Creation Programme for the Provision of Public Infrastructure Using Labour Intensive Methods (National Public Works Programme) Pre-Investment Investigation: Proceedings of Workshop, February 10 and 11 1994 (Johannesburg: NEF, February 1994).

-National Economic Forum: Technical Committee on a Public Works Programme (NEFTC), Pre-investment Investigation: Report of the Technical Focus Group (Co-convenors: R.T. M^cCutcheon and S. Phillips) (Johannesburg: NEF, April 1994).

-National Economic Forum: Technical Committee on a Public Works Programme (NEFTC), Final Report (Johannesburg: NEF, June 1994).

for local contractors, through labour-intensive approaches;

- Educate and train those on the programme as a means of economic empowerment;
- Create, rehabilitate and maintain physical assets, clinics, schools, crèches and roads, which serve to meet the basic needs of poor communities and promote broader economic activity; and
- Build capacity of communities to manage their own affairs, strengthen the local government and other institutions and generate sustainable economic development.

Thirteen key principles were defined to guide the implementation of the National Public Works Programme of which five were singled out for more detailed delineation: labour-intensity, community empowerment, education and training, sustainability and planning and monitoring and evaluation.

The infrastructure provision of the state was carried out in a way that also maximised productive employment, training and capacity building, and community employment.

There were two strategic thrusts:

- 1) A programme to re-orient public expenditure on infrastructure and transform the institutional capacity of the function of national, provincial and local

government to ensure larger scale job creation, skills development and capacity building in forthcoming years.

2) A Community-Based Public Works Programme (henceforth referred to as the CBPWP) to ensure short term funding to a variety of government and non-government organisations provided they meet the criteria consistent with the objectives of the National Public Works Programme. This fund would focus on creating employment and alleviating poverty in the short-term, while the capacity is built to deliver jobs in a cost effective manner through normal expenditure on infrastructure projects.

The objectives of the CBPWP were:

- Short-term delivery of employment opportunities and infrastructure particularly in rural areas;
- Target the most needy, especially rural women and youth;
- Kick start the National Public Works Programme by building capacity (at provincial and local levels); and
- Demonstrate to government departments and the private sector how sustainable infrastructure could be delivered without large scale use of machinery and without sacrificing standards.

The programmes were rolled out and after implementation several evaluations were conducted to determine whether the objectives of the National Public Works Programme had been achieved through the employ of the millions of

rands expended during implementation. One of the positive outcomes of the National Public Works Programme was that the work conducted by the Department of Public Works had led to policy development and the establishment of a framework for future progress.

According to McCutcheon (2001), employment generation for conventional construction of infrastructure had been estimated at 14 000 per billion rand of investment and over a five-year period the labour-intensive methods were expected to result in an increase in employment opportunities of between 300% and 500%. However, in 1995 the civil engineering industry had employed 64 424 people at R6 billion turnover and in 1998 employed 75 387 people at R9 million turnover at current prices (McCutcheon, 2001). In other words, the employ of labour-intensive methods had only generated 10 737 jobs per billion rands expenditure in 1995 and this figure declined to only 8 376 per billion rand expenditure in 1998.

Also, according to McCutcheon (2001) another problem which contributed to the unsatisfactory performance of the National Public Works Programme was the fact that the Department of Public Works, which had traditionally been the state's landlord, did not have the skills and experience of handling projects related to construction and maintenance of major physical infrastructure. This responsibility generally lay with the departments of Transport and Water affairs.

In addition, it was hoped that focus on the development of small contractors would increase overall empowerment, however, this yielded no noticeable effect on the overall empowerment and no published data was available on the number of small contractors who operated in the National Public Works Programme. According to McCutcheon (2001), the National Public Works Programme made no allowance for a development programme for these contractors despite international experience which indicated that 75% of small businesses fail.

Assessment of the funds allocated to the CPWP (Mthombeni, 1995) revealed the following:

- The bulk of the funding was spent on "shelf" projects, i.e. previously identified projects that had already been designed and specified. These projects had not been conceived from an employment generation perspective.
- Little coherent training, technical development and capacity building were carried out.
- There were wide disparities in wage rates and conditions of employment.
- Monitoring and evaluation systems were not established.
- There were institutional difficulties within the Department of Public Works and its provincial department.
- There was a lack of understanding of the role of the CPWP in relation to the National Public Works

Programme, in particular its role as a pilot programme for the National Public Works Programme. The National Public Works Programme was envisaged to last over ten years; however, the lifespan of the CPWP was not clearly spelt out. As a result, the CPWP was expected to develop capacity of the provinces in its first year of operation which, by reference to relevant experience was not a realistic time frame.

In order to evaluate the quality of physical assets resulting from the National Public Works Programme, in 1995 a Quality of Assets investigation was initiated by National Public Works Programme Task Team (Phillips et al, 1995b). The study aimed to evaluate a selection of Community Employment Programme (CEP) in order to verify the reports of quality problems, try to define minimum technical problems, identify causes of quality problems and identify reasons for success, and make recommendations for actions to limit quality problems in future CPWP projects. The study found that only 26% of the projects evaluated had no quality problems with the rest having quality problems varying from minor to serious. The study also revealed that some engineers (and facilitators) had insufficient knowledge of appropriate technology and labour-intensive construction, which in some cases led to extremely low task productivities, adversely affected the cost effectiveness of projects.

During 1992, the National Consultative Forum of Drought set up an Employment Task Force which explored short term (Phillips et al, 1995a) and long-term options to achieve these goals. In relation to the long term, it made recommendations as to the pre-investment work that needed to be carried out for a National Employment Creation programme using labour-intensive methods for the construction and maintenance of public infrastructure.

In addition, and of particular interest and direct significance to projects from Madibeng Municipality which are to be evaluated later in this report, the Technical Focus Group found that there were a number of sectors of infrastructure in which labour-intensive construction methods may be introduced and developed under the National Public Works Programme. Phillips et al (1995a) found that there is a great potential for using highly labour-intensive methods in construction of many infrastructure projects including dams, railways, supply and sanitation systems. However, owing to the high material costs involved, the percentage of construction costs to labour in this sector would not be as high as in some other sectors such as roads.

A model of the National Public Works Programme was developed in order to examine optimum employment creation in projects and the resulting maximum spending which can be achieved when compared to conventional spending on labour is presented in Table 3.1.

Table 3.1 Spending on targeted labour as percentage of spending on labour, plant and material

Sector	Current spending	Maximum spending
Projects with low capacity building requirements	60%-80%	60%-80%
Low-cost housing	25%-35%	30%-40%
Social buildings	20%-30%	25%-35%
Water reticulation	5%-15%	25%-35%
Stormwater	5%-15%	40%-50%
Sanitation	5%-15%	25%-35%
Roads	5%-15%	30%-80%
Dams	10%-20%	50%-80%
Railways	5%-15%	20%-30%
Forestry	25%-35%	35%-45%
Electrification	10%-15%	12%-17%
Small scale agriculture-related infrastructure	40%-80%	40%-80%

Source: Table 3 Technical analysis of employment creation potential of a National Public Works Programme (Phillips et al, 1995)

Examples of projects with low capacity building requirements are painting public buildings and one-off refuse collection exercises. Such projects are conventionally highly labour-intensive and hence there is little room for increasing labour intensity. Similarly, the construction of small scale agriculture-related infrastructure is conventionally highly labour-intensive, and hence there is little potential for increasing labour intensity.

According to Table 3.1 above, conventionally the cost to labour (as compared to the total project cost) of water reticulation projects was only 5% to 15%, but if labour-intensive construction methods were used the cost to labour could be significantly increased to 25%

to 35%. These figures will be used as a benchmark to determine whether optimum employment was created in the five water reticulation projects in Madibeng Municipality to be evaluated in later chapters.

3.2.2 Gundo Lashu

Gundo Lashu¹³ was launched in 2001 by the Roads Agency Limpopo (RAL) to improve transport infrastructure in poor and previously disadvantaged rural areas in Limpopo. It was the aim of the programme to increase accessibility of communities to services such as health and education. The primary objective of Gundo Lashu was to provide good quality, cost-effective rural roads using labour-intensive construction methods.

The objectives of the programme were to:

- Develop and train at least 24 local contractors using labour-intensive methods and thereby bring 300km of rural roads up to RAL standards;
- Engage rural communities and generate 1 million workdays of employment (40% male, 60% female), hence improving livelihoods for communities participating in the programme; and
- Strengthen the capacity of the RAL to manage, monitor and evaluate the implementation of Gundo

¹³ All facts and data presented under the Gundo Lashu sub-section was obtained from an article titled Gundo Lashu - Labour-intensive Rural Roads Programme obtained from the Government Innovators Network website www.innovations.harvard.edu/awards.html?id=6014

Lashu in accordance with corporate governance best practice.

Gundo Lashu was the first long-term labour-intensive public works road sector programme in South Africa, where emerging contractors were given extensive formal training and a series of practical on-site training projects in labour-intensive road works over a period of 21 months. Poor households without any income were targeted first to ensure that a wider net of families gained the positive effects of this programme. Twenty-four contractors were trained under the programme and 2 400 people who had no income received a monthly remuneration¹⁴ through the creation of 320 000 workdays that were created through the programme.

For each project, the contractors employed between 60 and 100 local workers on a task-based payment system where workers were paid R30/task. Due to the occasional nature of road upgrading projects, the duration of employment of the workers was approximately four months. On average 51% of workers were women, 58% youth and 1% disabled. All the workers were provided with both on-the-job training and formal training funded by the Department of Labour. The formal training covered topics ranging from life skills to basic agriculture.

¹⁴ Payment was task based. In other words, the contracting households were paid based on the amount of work completed in their assigned section of the road.

By 2004, the budget for the programme was R50 million and it was achieving a 600% increase in employment compared to similar conventional machine-intensive road works without increasing the overall cost per kilometre (Phillips, 2004).

Taylor et al (2005) conducted a study in which a preliminary comparison was conducted between the cost of using labour-intensive and conventional construction methods for rural road improvement in the programme. The study found that the cost of machine-based and labour-based methods was broadly similar according to a financial analysis, but labour-intensive methods were found to be cheaper than machine-based methods when using shadow wage rates. The study also found that labour-based methods contributed 28% more than machine-based methods directly and indirectly in terms of GDP, increased employment six times and had a greater impact on the income of poor households.

The labour-intensive methods were also found to encourage setting up of small businesses, generation of self employment, increased social stability and lower levels of crime, and improvement in nutrition and education; however these benefits depended critically on sustained employment opportunities and complementary output, as well as effective targeting of employment to the poor.

No information could be found in the reviewed literature on the resulting level of service and quality of roads achieved through the programme.

3.2.3 Zivuseni Programme

The Zivuseni programme¹⁵ was launched in 2002 in Gauteng with the aim of alleviating poverty by providing short-term employment and training to the unemployed by creating jobs in the maintenance and refurbishment of government buildings such as schools and hospitals.

The workers were appointed on contract at R40/day for three months and were provided with personal protective equipment. The projected budget for the programme was R50 million in 2003, which would double to R100 million in 2004 and then would increase by R50 million in the subsequent year.

Based on the limited literature reviewed, it was established that no evaluation was conducted on the programme. This can be said to be typical of relief programme mentality. As a result the impact of the programme on the targeted communities could not be

¹⁵ Facts on the Zivuseni Programme was obtained from the following sources:

An article by Thomas Thale "Thousands line up for government jobs", 10 June 2002 from the City of Johannesburg website www.joburg.org.za sighted in November 2005.

Transformation of provincial routine road maintenance unit in South Africa, 2004, Proceedings of the 8th conference Asphalt pavements for South Africa, Sun City, South Africa

assessed as far as the number of people trained, the extent and quality of infrastructure produced, the number of jobs created or social impact.

Although this programme was not strictly a construction programme, it was included in the literature review to illustrate the challenge of finding information even in major provincial labour-intensive programmes. Although jobs were created during implementation of this programme, the quality of work or value added by the millions of rands expended on this programme does not appear to have been evaluated and it is not clear as to whether the aims and objectives of the programme were met.

3.2.4 Zibambele Road Maintenance

The Zibambele Roads Maintenance System¹⁶ was introduced in rural KwaZulu-Natal in 1999. The KwaZulu-Natal Department of Transport in its Road to Wealth and Creation determined that more than 14 000km of rural roads required maintenance; and this coupled with the national objective of alleviating poverty saw the development and launch of the Zibambele Programme in January 2000 (Taylor Parkins, 2006).

¹⁶ Information in this sub-section was obtained from the following sources:

1. Taylor Parkins, F. Strategic Consideration for large scale labour-intensive maintenance programme version 1.0.0 May 2006; and
2. An article "Zibambele Road Maintenance - 2000 Winner: KwaZulu-Natal Province, South Africa" from the Government Innovators Network website www.innovations.harvard.edu/awards.html?id sighted November 2005. Author is unknown.

The programme involved contracting the maintenance of rural access roads to households, who were responsible for a certain length of road for a period of one year. The programme used labour-intensive road maintenance methods to provide an income to poor families.

The programme aimed to employ 40 000 contractors (households) and cover some 17 000km of road by 2009, which was intended to contribute to stabilising the poverty of the estimated 500 000 destitute households in rural KwaZulu-Natal.

The length of road allocated to each household depended on the difficulty of the terrain, but in general contractors tended between 600m and 1 500m of road. The limiting factor used to determine the length of road allocated to a household was that maintenance activities should not exceed 60 hours¹⁷ a month to allow income to be spread more widely, and to allow contracting households time for other activities.

The Zibambele programme was a gender affirming programme, with more than 98% of contracts in 2000 being given to women headed households. The contracted households were chosen by the community themselves, who identified families who were most in need of

¹⁷In other words, the length of section of road allocated to a household was determined in such a way that the tasks required to maintain that section of road would necessitate a maximum of 60 hours a month to accomplish. It is important to recall that payment was based on productivity and not on time spent.

assistance. The contracted household then supplied a person to work on the road for 2 days/week, and was supplied with a set of tools and basic training. In addition to maintaining the road surface, drainage system and verges, contractors were responsible for the removal of litter and noxious weeds from the roads. Tasks were set and monitored by an overseer who typically looked after 130 contracts and reported monthly on progress. The overseers were in turn managed by a social consultant and a technical consultant who reported to the department.

During 1999/2000, a total of 2 700 contracts were awarded with the ultimate target of 40 000 contracts at the end of the programme. By December 2004, the contractors were receiving a total monthly income of R370.00 for the successful implementation of the maintenance of the allocated section of road. The present rate of remuneration is R390.00 per month (Taylor Parkins, 2006). A total of 14 800 contracts had been awarded in the 2003/2004 financial year as compared to the original target of 14 000. By August 2005, 25 267 Zibambele contracts had been awarded (24 004 of whom were women and 1 253 male) and these contractors maintain 15 423km of KwaZulu-Natal's rural road network (Taylor Parkins, 2006). According to Taylor Parkins, at present payments to the contractors has amounted to R278.3 million since the launch of the programme.

The programme not only provided income for poor households, it also provided other secondary, yet important benefits, such as, assistance to obtain identity documents (ID), opening banking accounts, setting up savings clubs and accessing credit, with a view to allowing a member of the household to start a small business.

The cost effectiveness of the programme was evaluated by McCord (2002) and it was concluded that the programme was cost-effective in terms of transferring resources from the state to recipients, the proportion of programme costs spent on labour and the cost of the creation of a day's work.

According to Strebels (2004), a social impact study conducted on the programme indicated considerable satisfaction with the programme among affected communities. According to the study the programme had allowed many household heads to meet basic needs, such as nutrition, health care and schooling. The findings indicated that 99% of participants considered the selection process for contractors fair or very fair, 96% felt that life had changed because of the programme, 94% were proud to work for Zibambele and 81% thought that the project had improved their quality of life. Many also expressed increased optimism for the future as a result of working for Zibambele, and saw it as restoring the human dignity of households.

Once more, no information was available on technical evaluation of the quality of products resulting from the programme. One of the aims of the programme was to maintain the road at a specified level of service; however the literature reviewed could not establish whether the required level of service was achieved. In spite of this, because payment was linked to productivity, it could be safe to assume, by implication, that the resulting services were considered to be of acceptable quality.

3.2.5 Expanded Public Works Programme

The Expanded Public Works Programme¹⁸ was formally announced by President Mbeki in his State of the Nation Address in February 2003 and was later launched in May 2004 in Giyani, Limpopo. The programme is a short to medium term intervention by the government, through the Department of Public Works, aimed at alleviating unemployment in South Africa. The programme is a nationwide programme which will draw significant numbers of the unemployed into productive work so that workers gain skills while working, hence increasing their capacity to earn an income.

¹⁸ Background information on the EPWP was sourced from Philips (2004), McCutcheon et al (2006), A Glendinning's 2005 presentation on the "The Expanded Public Works Programme" prepared on behalf of the Department of Public Works and the First 2005/06 quarterly report, Financial Year 2005/06 1 April 2005 - 30 June 2005 as per 01 November 2005.

The Expanded Public Works Programme's goal is to create work opportunities (coupled with training) for a minimum of one million people in South Africa in the first five years of the programme, i.e. by 2009 (Department of Public Works, 2005).

The programme takes advantage of the abundant labour resources in the country and the limited financial resources, targeting people with no or low level of skills who currently do not have any employment opportunities. This is achieved by realigning government expenditure in such a way that a considerable portion of resources contribute towards employment creation and not only to the provision of infrastructure.

The objectives of the programmes are:

- To increase the contribution of public sector expenditure on goods and services to the alleviation of unemployment;
- To provide (unskilled) unemployed people with a combination of work experience and training; and
- To deliver quality, cost effective services using labour-intensive techniques.

The programme is a cross-cutting initiative covering all spheres of government and affects the following sectors:

- Environmental & culture sector (e.g. environmental improvement programmes);
- Infrastructure sector (labour-intensive construction and maintenance);
- Social sector (home-based care and early childhood development); and
- Economic sector (small business development, income generating projects).

In the infrastructure and environment & culture sectors, the focus is on the substitution of labour for machines. The social sector is by its nature labour-intensive, while the economic sector focuses on the creation of emerging entrepreneurs.

There is no special funding for the programme from government, but the emphasis is on changing the way in which normal expenditure occurs to simultaneously provide services and physical infrastructure while creating employment opportunities for the unemployed; at the same time linking employment to training and skills development. The Municipal Infrastructure Grant (MIG) (which succeeded the Consolidated Municipal Infrastructure Programme (CMIP)) is one of the mechanisms for the delivery of infrastructure and these funds are to be utilised for the implementation of the Expanded Public Works Programme objectives. In other words, an Expanded Public Works Programme project would

be one where deliberate attempt is made by the public sector body to use its expenditure on goods and services to create additional work opportunities for the unemployed.

In the infrastructure sector, R15 billion of the conditional infrastructure grants allocated to provinces and municipalities over five years has been earmarked for the Expanded Public Works Programme. In addition, R4 billion has been earmarked on the environmental sector departments budgets for environmental Expanded Public Works Programme programmes and at least R600 million allocated to social sector Expanded Public Works Programme programmes over the next five years (i.e. 2009).

Initially, it was envisaged that the focus infrastructure to be constructed from the Expanded Public Works Programme's R15 billion would include low cost, low volume urban and rural roads, stormwater drainage, pedestrian sidewalks and cycle paths and trenches. However, McCutcheon et al (2006a) argue that in no way does this initial focus limit the type of projects to those mentioned above, but it is hoped that some authorities will engage on higher standard work, expanding the use of labour-intensive construction methods and hence creating more jobs.

Central to the structure of the Expanded Public Works Programme is the provision of training to previously

unemployed beneficiaries, and Vuk'uphile, the Expanded Public Works Programme Contractor Learnership Programme, is one of its flagship programmes. This learnership programme has been developed to build capacity amongst emerging contractors to equip them with the skills to execute the increasing amount of labour-intensive work that forms part of the Expanded Public Works Programme and is managed by the National Department of Public Works, Construction Education and Training Authority (CETA), Independent Development Trust, and ABSA.

Training involves formal institutional training as well as work place training over a two year period. The on-the-job training is provided in the form of ring fenced contracts issued by an implementing municipality. The learners are supported by financial institutions such as ABSA to assist with access to finance and to develop a financial track record. This package of support together with access to a qualified experience mentor during implementation of the projects ensures that when the learner contractors exit the programme they have the necessary skills and expertise to tender for and execute labour-intensive projects under the Expanded Public Works Programme.

The Expanded Public Works Programme also requires that beneficiaries undergo at least 2 days of training for every 22 days worked. The Guidelines for the Implementation of Labour-Intensive Infrastructure Projects also require that managers of labour-intensive

projects be trained in order to build capacity to manage Expanded Public Works Programme projects at the required scale.

According to McCutcheon et al 2006a, there are two broad categories of training namely: labour and management. With the 2 days of training for every 22 days worked, and taking into consideration that infrastructure projects last on average for 4 to six months, little if any technical training can be provided for labourers. The second type of training is that required at all other levels including hands-on site supervisors, managers, contractors, consultants and clients (McCutcheon et al, 2006a). Training of hands-on site supervisors is also imperative to ensure successful implementation of projects as it was found by the South African National Productivity Institute that management was responsible for 85% of the improvement in labour productivity.

In summary, aforementioned information suggests that the Expanded Public Works Programme has in place most of the fundamental requirements to promote successful implementation. Based on lessons learnt and reasons for success of large scale programmes from international experiences, the Expanded Public Works Programme ought to be successful because:

- the programme is supported and guided by policy and has been incorporated into municipal and provincial grants;

- there is sound intellectual assessment on the technical feasibility and economic efficiency of labour-intensive methods;
- concentrated attention was paid to technical, institutional, financial, managerial and socio-economic aspects;
- extensive and relevant training was and is still being conducted;
- it has medium-term political and financial support; and
- there is good coordination between government, government department, those administering the programme, local authorities, those providing technical assistance and donors.

The reviewed literature does not cite the existence of a good management and monitoring system which could be a threat to the overall achievement of the Expanded Public Works Programme. With no system in place it will be difficult to accumulate and capture data on, for example, the number of jobs created during implementation resulting in under- or overestimation of actual employment created. As a result the results of the programme may be open to criticism and questioning, which might bring disrepute to this initiative.

3.3 Discussion

To summarise, according to McCutcheon (1999), evaluations of South African labour-intensive programmes have demonstrated that:

- Projects were rarely found to be labour-intensive;
- No permanent opportunities were created;
- No physical and social infrastructural assets were created;
- Projects were not integrated into development programmes;
- Projects were inadequately planned, designed, coordinated and implemented;
- Institutional capacities were inadequate to deal with short-term programmes in addition to normal activities; and
- In some instances, permanent workers were replaced by temporary workers.

This, in addition to poor targeting of beneficiary communities led to an insignificant impact on the employment creation effort and most of the programmes were considered to be labour-extensive instead. In most cases, the products resulting from the programmes were found to be of unacceptable quality and were rarely maintained.

In order to determine progress on implementation of the Expanded Public Works Programme, a workshop¹⁹ was conducted in September 2004 between representatives of the National Department of Public Works (NDPW), members of the Portfolio Committee on Public Works and other stakeholders where different provinces presented progress on the implementation of the programme since launch.

Major challenges as identified by provinces included:

- Expanded Public Works Programme conceptual framework was not widely understood by decision makers;
- Lack of co-ordination of projects among provinces;
- Insufficient reporting and inefficient data collection, resulting in difficulty in obtaining progress reports from provinces;
- Acceptance of CETA-accredited standards, the low numbers of training providers applying for accreditation, shortage of accredited training providers and lack of understanding of training requirements;
- Lack of personnel, especially in the social sector departments allocated to the Expanded Public Works Programme, as well as a lack of high-level drive to expand the Expanded Public Works Programme programmes in this sector;

¹⁹ Unknown author (2004) Report of the portfolio committee on public works on the workshop held with the Department of Public Works, Information sharing with MEC's, SCOPA public hearing on the annual report of the department, the budget committee public hearing with the department; Department annual report as adopted on 24 November 2004.

- Slow consolidation of existing programmes into the Expanded Public Works Programme;
- Corruption, with specific regard to councillors who are also building contractors and the possible use of public funds for other purposes;
- Lack of commitment to Expanded Public Works Programme targets;
- Inefficient monitoring systems and the vastness of other provinces causing difficulties with regard to the supervision and monitoring of projects;
- Financial constraints for emerging contractors;
- Lack of sustainable opportunities after qualifying as contractors and learners;
- Inherent conflicts with ongoing conventional projects; and
- Unfair labour practices.

The challenges brought up by the municipalities are in no way unique, but are reiterative of those encountered by previous programmes both in South Africa and other sub-Saharan countries. However, it should be noted that these challenges were raised only four months after the official launch of the Expanded Public Works Programme in May 2004. The first quarter monitoring report in November for the 2004/5 financial year indicated that the programme was slowly gathering momentum, but that more work was required to obtain accurate and comprehensive monitoring reports from all the sectors. The report did not include the number of jobs created from infrastructure projects implemented by municipalities through Municipal Infrastructure

Grant (MIG) because the MIG reporting system was not finalised and the Expanded Public Works Programme indicators from municipalities could only be reported once the system was fully operational.

The perceived high cost associated with labour-intensive construction methods is another serious threat to the roll out of the Expanded Public Works Programme. According to McCutcheon et al (2006b), some of the amounts already tendered for under the Expanded Public Works Programme have been much higher than those normally expected from conventional methods. It was found that estimates given by trainees, when asked to estimate the cost of a simple labour-intensive contract, varied extensively and were two orders of magnitude out! McCutcheon et al (2006b) found that many of the tendered prices submitted are of the order of 30% more expensive than contracts for similar work done by conventional methods. This suggested that the contractors simply price in a 30% increase because they are not in a position to evaluate their estimates accurately.

In order to mitigate this problem, a procedure called "team balancing" is recommended. According to Crowell and McCutcheon (2000), the suggested definition of team balancing is the optimisation of resources applied to any operation, or set of operations comprising a project, taking cognisance of parallel and subsequent tasks and the need to keep the entire work force optimally employed. A team balancing methodology has

been develop and refined.²⁰ Given that the cost of labour is a major component of the project cost, lack of knowledge of estimating for labour-intensive work is a major constraint to sound planning, estimating, tendering and implementation (McCutcheon et al, 2006a).

3.4 Conclusion

The relative failure of the South African government's previous attempts at labour-intensive programmes post 1994 can be attributed to many reasons as discussed above, but none of the reasons are unique nor are they significantly different from those already identified in other sub-Saharan countries. Disturbingly some of these experiences date as far back as two decades ago, and yet current programmes are still experiencing similar challenges.

Another disturbing factor encountered in almost all the programmes discussed in sub-sections above is the limited availability on technical evaluation of the programme outcomes. Evaluations, where conducted, focused more on social impacts, the number of jobs created, cost, and types of assets produced with very little reference made to their quality or maintenance. Quality of products resulting from labour-intensive initiatives seems to not receive as much attention as the other elements of programmes which are typical of relief programmes.

²⁰ Croswell and McCutcheon (2003: 387-413)

The repetitive and common challenges which are typical of labour-intensive programmes may lead to stakeholders resorting to business as usual, i.e. equipment intensive construction methods, which would deprive the country of this potential to significantly increase employment generation opportunities. According to McCutcheon et al (2006a), although policy is in place and legislation has been enacted, without the teeth of enforcement, the opportunity will be avoided by the inertia of the status quo.

However, despite all these challenges, based on the current unemployment and poverty statistics in the country, a significant increase in the number of persons employed per unit of expenditure has to be achieved through the Expanded Public Works Programme and the industry as a whole (McCutcheon et al, 2006b). One way of achieving this is through the re-engineering of the construction industry which is currently equipment intensive orientated. Such re-engineering requires regarding significant increase in the productive use of labour as a "design driver" in the construction process (McCutcheon et al, 2006b). Consultants need to be able to estimate works and generate appropriate designs and documentation to create an environment conducive to the use of labour-intensive construction methods. Also, in order for work to be executed efficiently, adequately trained "hands-on" site supervisors capable of organising and managing the use of labour-intensive methods are required.

Lastly, based on the facts above, it may appear that the success of Expanded Public Works Programme is already threatened by many serious challenges, the most crucial being the suggestion that municipality representatives who are supposed to drive the process do not understand the concept, requirements and implementation plans of the Expanded Public Works Programme. Lack of training provided by the State has adversely affected trainers who in turn are not equipped with the skills to train municipality representatives. This will severely limit the chances of success of the programme as it is at this grass root level that projects are to be implemented.

This chapter has examined some of the literature available on labour-intensive projects and programmes conducted in South Africa. The following two chapters will describe and evaluate five water reticulation projects conducted labour-intensively in Madibeng Municipality.

4 MADIBENG MUNICIPALITY WATER PROJECTS

4.1 Introduction

South Africa is demarcated into nine provinces with 53 district municipalities which in turn have 262 local municipalities. Madibeng Municipality is located in the North West Province and is one of the 5 local municipalities under Bojanala District Municipality. The locality and extent of the Municipality is illustrated in Figure 4.1.

In 2005, the North West Province was the fourth poorest province in South Africa with an official unemployment rate of 28.8% (Labour Force Survey, 2005). The North West Province comprises mostly of rural areas. An interpretation of the 2001 and 2005 Statistics South Africa data indicates that although the population of working age has increased by some 109 000, the number of people working has decreased from 918 000 in 2001 to 875 000 in 2005.

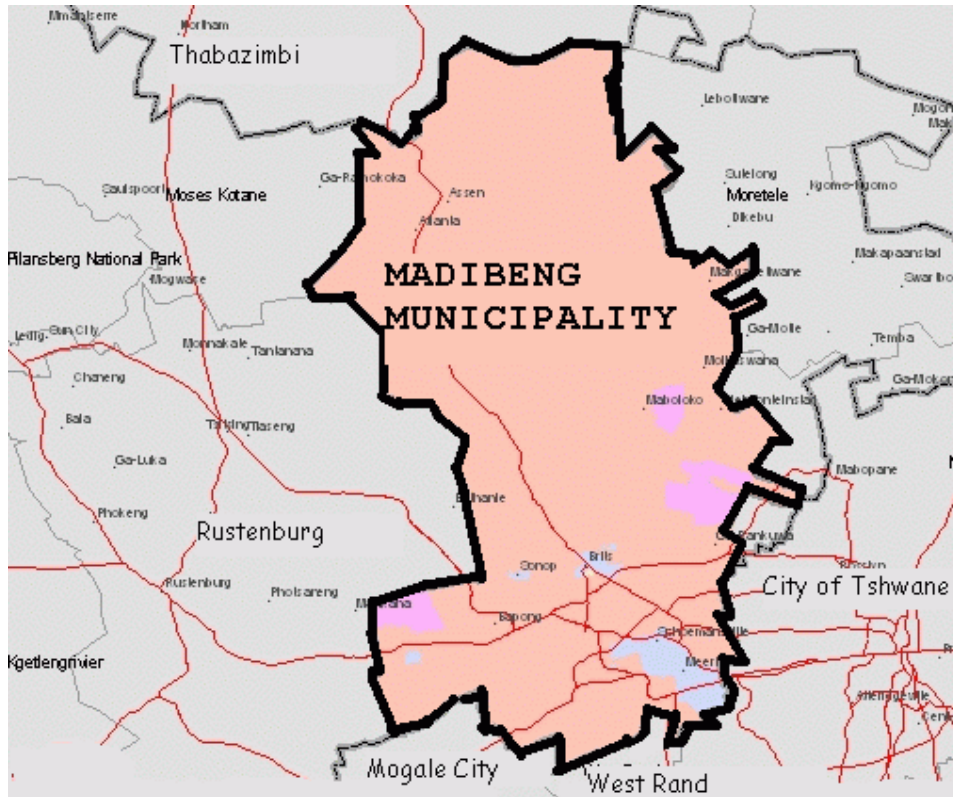


Figure 4.1: Madibeng Municipality Locality Map

(Source: Municipal demarcation Board, 2003)

In 2001, Madibeng Municipality had a population of 338 261 and comprised 92 072 households. The level of skills within the jurisdiction of Madibeng Municipality was found to be low with the 2001 statistical data indicating that only 20% of the population had successfully matriculated and only 5% thereof had attained tertiary qualifications. The rest of the population had either not completed matric or had no or limited primary schooling. The number of households without an income increased from 13% in 1996 to 23% in 2001, implying that unemployment levels are rising in Madibeng.

Data from Statistics South Africa (2001) identified at least eleven industries which include retail, agriculture, manufacturing, mining and construction, among other. These are illustrated in Figure 4.2 below.

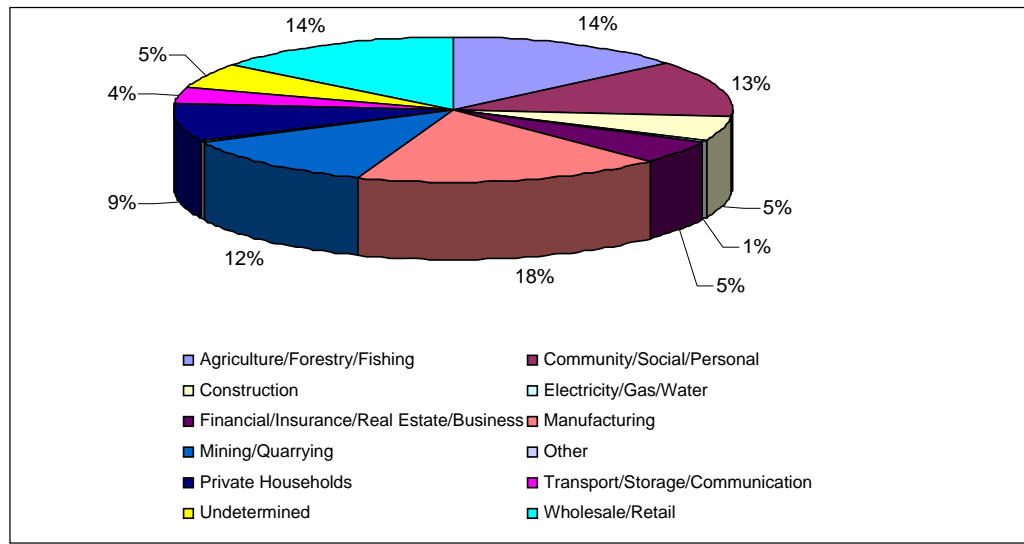


Figure 4.2: Madibeng Municipality industries
 (Source: Statistics South Africa 2001)

Provincial and Municipality budgets are a controlling factor for allocation of funds into different industrial sectors. The largest employing industry was manufacturing which employed 18% of the employed workforce followed by retail and agriculture which employ 14% each. The mining of platinum and other natural resources has resulted in the mining industry providing employment for 12% of the employed labour force.

As discussed in earlier chapters, historically the construction industry has proven to be one of the

industries which can employ large forces of low skilled labour. However, in Madibeng Municipality the construction industry only employed 5% of the total employed labour force.

Since this research focuses on water supply projects, it was important to establish the need for potable water infrastructure in the Municipality. It was found that, according to Statistics South Africa (2001), the Municipality had 14%, 42.5% and 27.2% of the population accessing drinking water from indoors taps system, taps inside yard and community stands, respectively. See Figure 4.3 below.

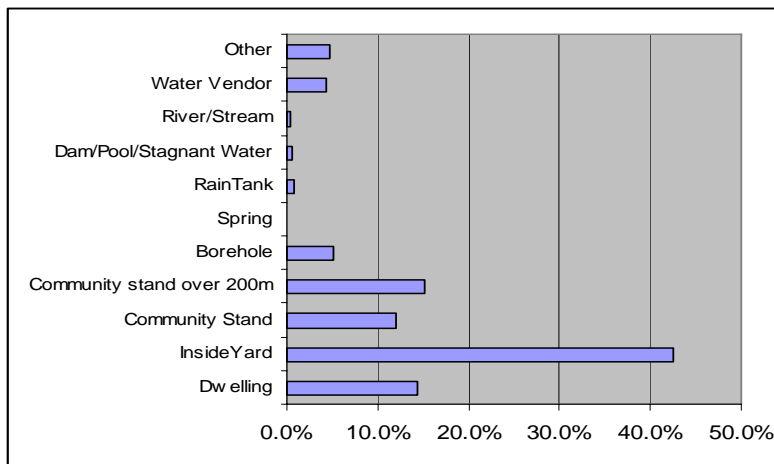


Figure 4.3: Types of water sources in Madibeng Municipality
 (Source: Statistics South Africa, 2001)

The population which still relies on stagnant water and other unsafe sources of water would form part of the justification for the demand which caused the

Municipality to embark of the many water project conducted over the past five years.

This chapter will discuss findings from the evaluation of completed projects (namely: Brits Industrial Area, Maboloka and Madidi) and one project in Letlhakaneng which was underway during the time of research. In general, the projects aimed at providing bulk water infrastructure for rural in Madibeng Municipality and the works conducted by labour generally included activities such as clearing of site, excavation, bedding, laying of pipes, backfilling and provision of house connection and other supporting structures. International and local experience has indicated that labour-intensive techniques were possible and suitable for the above mentioned tasks, provided the design and site conditions allowed for such.

4.2 Process for implementation of water projects

No formal procedure was documented to guide the process of implementation for the water projects. However, a trend was observed in all projects where they generally commenced with the Municipality conducting a needs analysis to identify and prioritise the needs of local communities. In other words, a demand driven approach was used to ensure that the limited available funds were utilised appropriately to address community needs.

The needs analysis was followed by an application to CMIP or MIG²¹ for funding. Once funding was approved a consultant was appointed who was tasked with the design of the infrastructure, preparation of contract documentation, tendering, appointment of contractor and construction supervision. Often the approved funding from CMIP and MIG were insufficient and had to be augmented by funds from other sources such as DWAF, the

²¹ The Consolidated Municipal Infrastructure Programme (CMIP) was the finance vehicle used to provide funds for the infrastructure projects applied for and conducted prior to 2004. The Municipal Infrastructure Grant (MIG) provided funding for projects conducted subsequent to 2004. MIG is a conditional grant to support municipal capital budgets to fund municipal infrastructure and to upgrade existing infrastructure, primarily benefiting poor households. The MIG was set up to merge other funding programmes such as CMIP, Water fund Service Capital fund, EPWP, Local Economic Development Fund, etc. The MIG is a new infrastructure transfer mechanism and is geared to making the system of transfers to municipalities simpler, more certain and direct. Information obtained from "The Municipal Infrastructure Grant 2004-2007: From programme to projects to sustainable services" by Department of Provincial and Local Government.

Municipality itself and the People's Republic of China's Material Grant.

A contractor was then appointed following normal bidding procedures. The contractors only provided core staff with the rest of the labour to be sourced from the local community. Prior to commencement of construction, local Councillors appointed a Project Steering Committee (PSC), Community Liaison Officer (CLO) and Labour Desk Officer (LDO).

After completion of the project, the infrastructure was transferred to the Municipality who would then be responsible for the running and maintenance thereof, ensuring that the infrastructure functions efficiently and hence delivers the required services to the targeted communities. Against this background, Figure 4.4 illustrates a schematic representation of the process followed for the implementation of the water projects in the Municipality.

One of the major merits of the structure presented in Figure 4.4 is the fact that selection of projects to be undertaken is guided by thorough needs analysis implying that communities are provided with services which meet their most pressing needs. As a result, the probability of rejection of the project by the community is reduced because they can appreciate the impact the project will have on their standards of living.

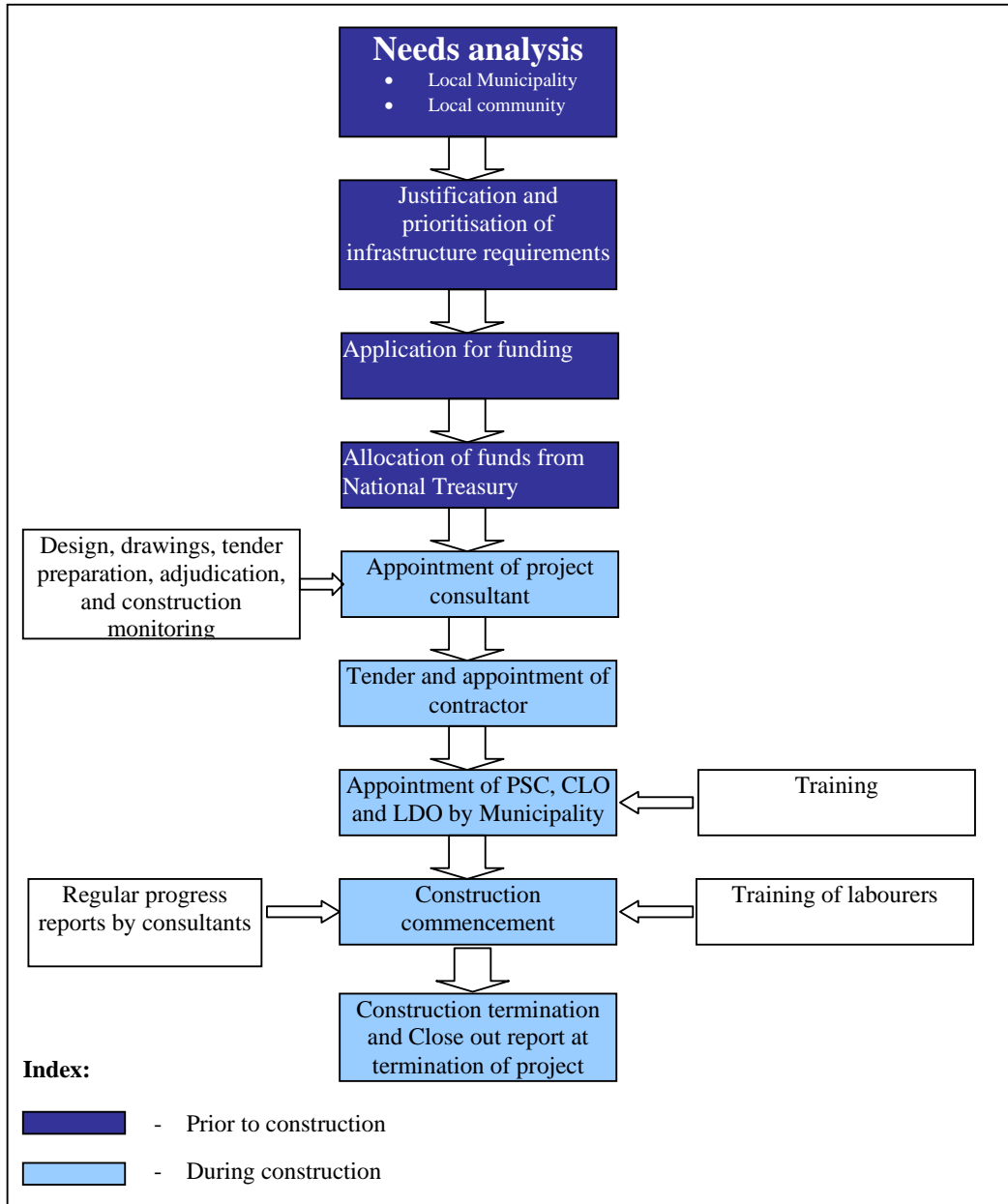


Figure 4.4: Madibeng Municipality project flow chart
 (Source: Research fieldwork, 2005)

One major disadvantage with the structure is the fact that the Project Steering Committee (PSC) is only

selected during construction phase and is not involved at all during the design phase. The late involvement of the PSC could lead to misunderstanding of the importance of project objectives, such as the use of labour-intensive methods and payment being linked to task completed.

The structure also does not show early involvement of local councillor who have a significant influence on communities. Exclusion of such important stakeholders leads to power struggles which may result in problems during construction.

4.3 Brits Industrial Area

4.3.1 Introduction

The project is located in Brits and the aim of the project was to reduce the frequency of pipe bursts and leaks in the industrial area network, increasing the reliability of the water supply to the industries and increasing pressure in some areas. The existing asbestos pipes could not accommodate the large movements resulting from the active clays on which the pipes were laid. As a result, the pipes frequently broke and burst leaving the industrial area and surrounding communities without water.

Labour-intensive construction method was the preferred method of construction for the following reasons:

- The project was funded by the Consolidated Municipal Infrastructure Programme (CMIP) which provided funds to municipalities for provision of infrastructure through the use of emerging contractors, the use of labour-intensive construction methods and the maximising of job-creation opportunities.
- The site conditions were already known because the works involved the excavation of existing backfilled trenches, hence no hard excavations were likely to be encountered.

- The site was located in a built up area and labour-intensive methods were more suitable because of the limited working space required.
- The risk of damaging other existing services traversing the site would be reduced by using labour for excavations.

4.3.2 Project objectives

The objectives of the project as deduced from various project documents obtained from the consultants were:

1. Use of local sub-contractors where feasible;
2. Identification of local skills that can be used to execute the Works;
3. Use of labour-intensive construction methods, as far as possible;
4. Business knowledge transfer - a joint venture participation between an established contractor and Small Micro Medium Enterprises (SMME) with Historically Disadvantaged Individual (HDI) status; and
5. Creation of as much employment as possible for the local community.

4.3.3 Project description

The project was split into different phases because of budget constraints and the first phase involved the replacement of the prioritised portions of the

infrastructure experiencing the most frequent pipe bursts as illustrated in Tables 4.1 below.

Table 4.1: Brits Industrial area project description - Phase I

Pipe no	Length (m)
1	884
2	1 650
3	700

(Source: Bigen Africa Project File, 2003)

This phase involved the construction of a total length of 3 234m of 250mm diameter pipe.

Phase 2 included replacement of the remaining portions of the network. These pipes were as follows:

Table 4.2: Brits Industrial area project description - Phase II

Pipe no	Length (m)	Diameter (mm)
4	1 919	160
5	624	160
6	1 076	200
7	490	250
8	791	160
9	1 017	160

(Source: Bigen Africa Project File, 2003)

The second phase included the replacement of a total pipe length of 5 917m. Overall, the project involved the replacement of a total of 9 151m of existing pipes

with uPVC pipes of diameters varying from 160mm to 250mm.

4.3.4 Project information

At the completion of the project, R2.4 million had been spent on the project over a period of 9 months. Information on youth and disabled persons employed during construction was not available. Table 4.3 presents a summary of the project information.

Table 4.3: Brits Industrial Area project information

Project Value	R2 400 000	
Project duration	May 2003 - February 2004 9 months	
Total mandays from local labour	Women	Men
	1 210	3 476

(Source: Bigen Africa Project File, 2003)

In total, the project created 4 686 mandays of employment for the local community.

Labour was used for activities such as the excavation, bedding, pipe laying, backfilling of trenches and reinstatement of fences and driveways.

4.3.5 Project framework analysis

Contract documentation

The contract documentation was amended in a manner which accommodated the use of labour-intensive construction methods by, for example, classifying excavations as follows:

PSDB1.2.1 Classes of excavation²²

a) Soft excavation

i) Class 1

Soft excavation Class 1 shall be excavation, including the excavation of boulders not exceeding 0.04m³, in material that can be excavated and removed from the excavation by an average able bodied labourer or group of such labourers, at a rate of production of not less than 2.0m³ per 9.25 hour working day, using only picks, 'gwalas', shovels and similar tools.

ii) Class 2

Soft excavation Class 2 shall be excavation, including the excavation of boulders not exceeding 0.04m³ (excluding soft excavation Class 1) in material that can be excavated and removed from the excavation by an average able bodied labourer or group of such labourers, at a rate of production of not less than

²² Clause extract from Bigen Africa, 2003, Brits Industrial area - water supply infrastructure rehabilitation/augmentation project; Contract S4/2003: Contract Documentation - Project Specifications.

1.0m³ and not more than 2.0m³ per 9.25 hour working day per labourer, using only picks, 'gwalas', shovels and similar hand tools.

b) Intermediate excavation

Intermediate excavation shall be excavation (excluding soft excavation) in material which requires ripping or loosening by mechanical means prior to removal of the loosened material utilising methods as described in PSDB1.2.2 (a).

c) Hard rock excavation

Hard rock excavations shall be excavation of undecomposed boulders exceeding 0,04m³ and excavation in solid rock occurring in bulk or in banks or ledges, which require loosening or breaking up by drilling, wedging, splitting, blasting or by other quarrying methods prior to being excavated and removed from the excavation using only picks, 'gwalas', shovels and similar hand tools.

Training

No information could be found on the training of the on site supervisor; neither was formal training conducted for the labourers, but according to the contractor interviewed²³, labourers learnt technical skills from the contractor's core team.

²³ Mr. Chris Jordan from FM Enterprises was interviewed via telephone and email on the 21 June 2005.

Only the CLO and LDO attended formal training and the total cost was R6 720.

Contractor development

The contractor appointed for the project comprised a joint venture (JV) between an established firm and an emerging black firm. During the interview it was established that this project was the first labour-intensive project to be conducted by the JV partners and hence they had limited experience with planning, organisation and management of the construction process. According to the contractor, no assistance or guidance was provided by the consultants in terms of costing or managing the construction process. It was therefore difficult for them to program and cost the works.

Task determination

The excavation task was determined by employing two labourers to conduct trial excavations on the pipe route over a day and the average of the productivity achieved was taken as the task. An excavation of 2m^3 was hence established for the specific site conditions. The assigned excavation task rate of production of 2m^3 per day is too low when compared to the industry average of 3m^3 to 6m^3 for soft excavation conditions. However, the site conditions had guided the decision because when dry the clay was very stiff and resisted

penetration by picks and shovels and when wet the clay attached itself to the tools increasing the difficulty of excavating. Excavations had to be conducted at optimum moisture content in order to ensure that the clay was workable. Based on these facts, it was concluded that the task of 2m³ was reasonable and appropriate for the site conditions. According to progress reports, labourers could not achieve more than 2.2m³/day of excavation.

A rate of R55/task, which was equivalent to the industry daily average in the province, was paid.

Labour issues

The ratio of men to women participating in the project was 1:3. Recruitment was conducted by the LDO and there seemed to be no criteria for selection. No targets were set by the Client prior to project commencement as to the percentage of women, youth and disabled to be employed. Women and men were paid the same rate for tasks and there was no discrimination on tasks to be performed based on gender.

Payment of progress certificates

The Client was able to process payments on time and labourers were hence paid on time and as a result there were no delays due to a slow down or strike because of late payments.

Tools and equipment

Limited equipment plant was used during construction. The contractor was required to provide a Troxler nuclear system for testing compaction of the backfill. For labour-intensive projects, and where local contractors are used, the use of basic, readily available equipment is encouraged. For example, a Dynamic Cone Penetrometre (DCP) test could be used to assess the density of the surrounding natural ground in comparison to the trench compactions. The equipment is easy to use, inexpensive, does not require professional skills to operate and record readings, and the resulting data is easy to analyse and interpret.

Taking into account the clayey conditions on soil, the Troxler was an appropriate tool to use on this site because the consistency or hardness of the clay²⁴ would have had an effect on the penetration of the DCP rod into the soil. Under identical conditions throughout the site, the DCP could have been used; however, as the moisture content of the soil to be tested could not be controlled then the DCP tests had a potential of providing inaccurate readings.

²⁴ When dry, the consistency of clay is very hard and it would be difficult to penetrate with the DCP rod and the readings would indicate very low penetration rates which would imply very hard consistency and hence very good compaction. On the other hand, when moist, the consistency of clay would be soft and hence it would be easier for the rod to penetrate. In other words, even if compacted to the same density, clay at different moisture contents would present different resistance to the penetration of the rod.

The survey equipment utilised included an automatic surveyor's level and a tachometer. Most small contractors do not have these instruments or the skills to operate them. As a result, these services would have to be outsourced. An alternative could have been the use of aerial photos and fish line and pegging system which not only increases the involvement of labour, but also has an opportunity to empower local sub-contractors with the skills to conduct surveying.

Health and Safety

Safety requirements, in accordance with the Occupational Health and Safety Act, were not fulfilled during construction; however a safety officer was appointed to ensure general safety of the site. There were, however, no incidents or accidents recorded during construction.

Time and productivity

Only 15 days were provided for the contractor to plan and organise the site prior to construction commencement. This limited time did not allow for the LDO and contractor to determine available local skills which could have enhance the skills of the work force.

The majority of activities on site were task-based and hence only paid for when the work was completed.

There was a lack of prior induction of the community; as a result there was lack of willingness to work especially from people who had not been employed for a long time. A week after construction commencement, the labourers complained about the hard work and became dissatisfied with wages.

According to the contractor, women labourers tended to be more committed to the project which was indicated by their consistent attendance as presented in the project's attendance sheets. Supervisors found that men tend to be absent for more days than women, especially on days subsequent to pay days.

4.3.6 Analysis

In order to assess whether labour was used optimally in the project, a team balancing exercise was conducted as part of the research to determine the number of tasks, and hence the cost to labour, which was then compared to the actual cost of labour. This is presented in Table 4.4 below.

The quantities were calculated from the available information such as length of pipeline constructed, assumed trench dimensions (based on experience, pipe sizes and working space), number of driveways reinstated and the Bill of Quantities where available.

A total of 9 605 tasks were calculated and at a rate of R55/day, the cost to labour would have been R 528 259.11. In reality, 5 475 labour days were achieved and with an average of 1.1 tasks achieved per day, the actual cost to labour was R331 237.50 which is 42% of what it could have been had all activities designated for labour-intensive construction been conducted by labour.

Table 4.4: Team Balancing exercise Brits Industrial Area project

Activity	Unit	a	b	c	d	e	f	g
Site clearance	m ²	13,727	100	137	5	27	30	5
Excavate	m ³	15,374	3	5125	100	51	80	64
Remove pipes	m	9,151	90	102	5	20	20	5
Compaction	m ²	64,057	600	107	4	27	30	4
Re-bedding*	m ³	6,406	5	1281	30	43	60	21
Pipe laying	m	9,151	42	218	4	54	40	5
Blanketing*	m ³	1,922	6	320	10	32	50	6
Backfilling*	m ³	7,687	8	961	20	48	70	14
Reinstatement of driveways	m ²	3,000	4	750	20	38	40	19
Reinstatement of fences	m	730	7	104	5	21	30	3
Site cleaning	m ²	15,000	30	500	12	42	40	13
Total				9605	215	403	490	159

(Source: Research fieldwork, 2005)

Key: a- quantity, b- task, c- no of tasks, d- estimated no of workers, e- no of days, f- balance days, g- actual no of workers.

* Including wetting to optimum moisture content

The project progress reports indicated that in total 219 labourers were employed for the total duration of

the project. In other words, more labourers were appointed although fewer tasks were performed in comparison to the 9 605 tasks which were to be conducted by 159 labourers according to the team balancing exercise.

4.3.7 Evaluation of project objectives

The success of a project depends not only on the successful length of pipe laid and number of erven connected, but also on whether the other non-technical objectives were achieved. The project objectives are evaluated below.

1. Use of local sub-contractors

No involvement of local sub-contractors could be deduced from the available information and the contractor confirmed that none were utilised during the project. Therefore, the objective was not met.

2. Identification of local skills that can be used to execute the Works

Only unskilled labour from the local communities was employed during the project and no analysis of local skills was conducted prior to construction because of the limited time allocated from appointment of contractor to site hand over. This objective was therefore not met.

3. Use of labour-intensive construction methods

The project documentation explicitly indicated activities to be conducted by labour and the payment of these were dependent on use of labour. The project was designed to accommodate the use of labour. The cost to labour constituted 14% of the total cost of the project which is not significant (as stated under the definition of labour-intensive construction projects).

4. Business knowledge transfer

A 70/30 percentage joint venture (JV) was formed between a major contractor and an emerging black contractor for the implementation of this project.

5. Creation of as much employment as possible for local community.

Some employment was created during construction, however, based on the team balancing exercise more employment could have been generated if labour was used optimally to conduct all activities which could be conducted by labour. The labour used also appears to have not been productive. Therefore this objective was not met.

It is therefore concluded that one out of five of the objectives were met.

4.4 Maboloka and Environs Water Supply Scheme

4.4.1 Introduction

The project entailed the planning, design, construction and materials management and implementation of a bulk water supply scheme to augment the existing infrastructure which supplied Maboloka and surrounding rural villages. The existing bulk water supply infrastructure was more than 20 years old and had reached the end of its design life. Rapid growth in the villages had resulted in a demand of potable water exceeding the capacity of the existing infrastructure.

4.4.2 Project objectives

The primary objectives of the project were to:

1. Utilise labour-intensive construction methods;
2. Include youth and women in an active role during construction;
3. Conduct pro-active training methods of labourers;
4. Implement innovative construction and material management approach; and
5. Training of emerging contractors.

4.4.3 Project description

The entire project consisted of the upgrading of the booster pumping station at the Brits, a 20km 600mm

diameter pipeline to Maboloka and a 12 Mℓ storage capacity at Letlhabile.

According to the project implementation plan, 8km of the pipeline had to be constructed using labour-intensive construction methods.

The implementation of this project was justifiable because it addressed other problems in addition to the lack of potable water. The existing pipe network was abused by certain groups in communities who had illegally connected to the water supply, drawing water without paying for it and then selling it to people downstream who could not get water because of insufficient capacity. This theft of water resulted in the Municipality being unable to recover its costs and also could not meet the demand of all communities.

Prior to commencement of the design, an analysis was conducted to determine the potential for the communities to pay for the water services. It was found that although most of the households did not have formal employment, the majority of the houses earned R1 100/month. On this basis, it was concluded that the communities would be able to pay for the services rendered by the upgraded pipeline.

4.4.4 Project information

The project cost was R23.7 million of which R11.7 million was for material from the Materials Grant from the People's Republic of China, with the rest of the funds obtained from MIG. The project duration was 10 months. Table 4.5 summarises the project information.

Table 4.5: Maboloka and Environs - Project Information

Project Value	R23 700 000		
Project duration	October 2004 to August 2005 10 months		
Total mandays from local labour	Women	Men	Youth
*	15 318	30 636	30 636

(Source: Bigen Africa project file, 2004)

Note: * Figures indicated are not the confirmed actual figures, but the target as stipulated during the planning phase of the project. The actual mandays created and the participation of men, women and youth could not be confirmed because of lack of data.

It was the intention of the project to create a total of 76 590 mandays. The total labour force had to comprise 33% of women. This percentage included all women, i.e. both youth and non youth.

4.4.5 Project framework analysis

Contractual matters

Limited contract documentation was available on this project. The available information made reference to the use of labour-intensive construction methods,

although these were only limited to site clearance and backfilling of trenches.

Training

According to available communication documentation, training formed an important part of the Works execution and a total of 820 people underwent training, with 800 training on practical labour-intensive construction, 10 on administration and the rest on life skills. The programme also included the training of the LDO and CLO. Training costs amounted to R300 000 and was conducted by Construction Education and Training Authority (CETA) accredited service providers.

The content and modules of the training could not be established from the available documentation. It is therefore not possible to determine whether the content was relevant and of value to the construction process and project as a whole.

Contractor development programme

During the project Madibeng Municipality identified, appointed and trained ten emerging contractors who participated in the delivery of the 8km sections of the pipeline. The Municipality provided constant monitoring and assistance for the contractors throughout the project and these measures were

successful as this panel of pipe laying contractors were able to complete their project satisfactorily.

At the end of the project, the Municipality provided the contractors with further opportunities in pipe laying projects which they had to bid for through a normal procurement process. This was an effort to ensure that the skills learnt during the Maboloka project could be used to further develop and sustain these new business entities. However, these attempts failed because of a general lack of entrepreneurship or business skills from the contractors. According to a Municipality representative, who wished to remain anonymous, most of the contractors were not interested in the development and sustainability of their business, but they saw this opportunity as a quick money making scheme.

As a result, subsequent projects awarded to most of the contractors were sold to other established contractors for a profit²⁵. As a result, none of the contractors succeeded beyond a year of operation.

From interviews with representatives from the Municipality (who also wished to remain anonymous) failure of the contractor initiative programme could be

²⁵ It would appear that the prices on which the contracts were awarded were, from the onset, high. This would partly explain why the contracts were sold for a profit and yet the "new" contractors were nonetheless able to pay a profit to the emerging contractors over and above being able to cover their own costs and still make acceptable margins.

attributed to the biased selection process of appointing participants. The process was contaminated by political fraud and corruption. The selection was not based on the potential or ability of the prospective contractor, but decision makers selected family members and acquaintances as beneficiaries of the programme.

Other problems encountered during the Maboloka project included power struggles between three active municipal councillors representing different wards. They all claimed to be the leaders of the community. In order to resolve the problem, a Project Steering Committee (PSC) was elected which fairly represented the different groups in the community. The authority of the LDO and CLO were overruled and the PSC assumed the responsibility of liaising with the community, recruitment and determination of training requirements.

The involvement of the main contractor's permanent staff was limited to key personnel with unskilled labour sourced from the local community.

Task determination

No information on the conditions on site, which would direct the decision making for choice of construction techniques, was available. Also no information was available on the actual tasks conducted by labour or the determination of the task sizes. The available

information also did not distinguish between the expenses of the 8km pipe conducted by labour from the rest of the pipeline constructed by employing conventional construction methods.

A rate of R55 was paid per task.

Labour issues

A total of 800 labourers were employed on a rotational basis²⁶ from the local communities.

In order to ensure project buy-in, the consultants participated in some of the community's social events and even sponsored a couple of the community's annual events which was a major boost to local participation and support for the project.

Health and Safety

Health and safety requirement were complied with and the services to ensure compliance with the Occupational Health and Safety Act (Act 85 of 1993) were outsourced. No record of accidents and incidents was found in the available information.

²⁶The number of labourers working in a team at any one time could not be established from the available documentation.

Time and productivity

According to the consultants, during construction absenteeism was experienced mainly amongst the youth and male labourers after pay day which negatively affected productivity. This behaviour was rarely observed amongst female labourers whose absenteeism was generally due to family responsibilities.

4.4.6 Analysis

According to the consultant's close out report, the total project expenditure was as presented in Table 4.6.

Table 4.6: Maboloka and Environs Total Project Cost

Material	R11 700 000
Labour	R7 800 000
Tools/Plant	R3 900 000
Training	R300 000
Total	R23 700 000

(Source: Bigen Africa project file, 2004)

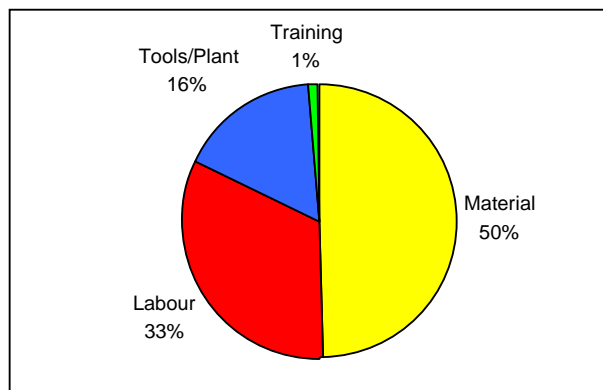


Figure 4.5: Maboloka and Environs total project cost including material

(Source: research fieldwork, 2005)

The material, which was obtained from the materials grant, constituted 50% of the total cost while labour costs accounted for 33% of the total project cost. This amount constituted all monies paid to contractors and subcontractors.

Problems of theft and wastage of material experienced during construction were eliminated by the contractor signing for delivery of materials and taking responsibility for the storage thereof.

According to progress reports and the close out report, a total of 76 590 mandays were created during this project which is suspiciously the same amount as the targeted jobs stated in the project planning documentation²⁷.

A team balancing exercise was attempted as part of this research. Due to the unavailability of relevant project information the activities which, from experience, can be conducted labour-intensively were used in the team balancing exercise. The productivity norms for determining the size of tasks were obtained from Steidl (1998).

²⁷ It is not often that the actual employment created during construction is exactly the same as the targeted employment which is conceived prior to the construction process commencing. No labour register was established in the available documentation and hence could not confirm the actual number of jobs created.

The quantities of tasks were based on a 20km pipeline with trenches 1.5m deep and 1.4m wide. The exercise was conducted on the assumption that the entire pipe length was constructed using labour-intensive methods (in the absence of any guidance as to construction methods used on different sections of the pipeline).

If all the tasks were conducted using labour, then 22 677 tasks would have been achieved and at a rate of R55/task this would have accounted for only 10% of the stated project cost which are considerably low when compared to the stated 76 590 mandays and 33% cost to labour.

Table 4.7: Team balancing exercise for Maboloka & Environs

Activity	unit	a	b	c	d	e	f	g
Site clearance	m ²	30,000	100	300	5	60	30	10
Excavate	m ³	44,800	3	14933	100	149	80	187
Construction of manholes								
excavation	m ³	173	3	58	3	19	20	3
concrete floor casting	m ²	115	2	58	5	12	10	6
masonry wall ²⁸	m ²	288	12	24	2	12	10	2
Compaction	m ²	140,000	700	200	4	50	30	7
Bedding²⁹	m ²	14,000	8	1750	30	58	60	29
Pipe laying	m	20,000	42	476	4	119	40	12
Blanketing²⁹	m ³	4,200	4	1050	10	105	50	21
Backfilling²⁹	m ³	16,800	6	2800	20	140	70	40
Reinstatement of driveways	m ²	1,300	4	325	20	16	40	8
Reinstatement of fences	m	1,424	7	203	5	41	30	7
Site cleaning	m ²	15,000	30	500	12	42	40	13
Total				22677	220	823	510	344

(Source: Research fieldwork, 2005)

Key: a- quantity, b- task, c- no of tasks, d- estimated no of workers, e- no of days, f- balance days, g- actual no of workers

²⁸ There are 50 bricks in 1m² of wall. On average a good brick layer can lay 1000 bricks in a day. Therefore a total of 20m² can be laid in a straight wall in one day. However, taking into consideration the fact that the construction of a manhole requires formation of corners and working conditions are constricted, only 60% of this productivity can reasonably be in one day. Hence the task for construction of masonry walls was assumed to be 12m².

²⁹ The size of task was derived from using the productivity norm for spreading of 13.5m². Assuming that haulage, compaction and the constricted working conditions will take 40% of the total time, a task of 8m² for bedding and backfilling was calculated. The lower task of 6m² for blanketing was due to the precautionary measures required to construct this layer, ensuring that the pipes are not damaged.

4.4.7 Evaluation of project objectives

1. *Utilising labour-intensive construction methods*

The cost to labour constituted about 33% of the total cost of the project. At first glance, the objective to use more labour than conventional construction methods appears to have been achieved, but it appears as though the labour force was not productive. Labour-intensive construction involves the efficient use of more labour than conventional construction methods to produce assets of specified quality within the time and cost frame, therefore this objective can not be said to have been achieved because of the high cost achieved during construction.

2. *Inclusion of youth and women in an active role during construction*

The planned ratio of men to women was 2:1 and the project was also supposed to employ a large number of youth. Information on the actual number of women, men, youth and disabled employed was not available, hence it is impossible to evaluate whether this object was actually met.³⁰

³⁰ The figures provided in this report for the total mandays generated were obtained from the project close out report by Bigen Africa. The report only indicated the total cost for training, labour, material and tools and plant without specifically indicating the number of women, men, youth employed and trained. As a result, the analysis of the project performance can not be said to be very accurate because of the limited information available.

3. Conduct pro-active training methods of labourers

Labourers were trained by a service provider who is accredited by CETA and some R300 000 was spent on training. The training modules seem to comprise the elements necessary to provide the skills for supervisors, labourers and other personnel involved in the implementation of a labour construction project.

4. Implement innovative construction and material management approach

The consultant's design had taken into account the method of construction, and designs were appropriate. Labour was not only to be used for the normal site clearance, bedding, backfilling, removal and reinstatement of fences, but also for construction of manholes which were built using masonry walls with a concrete base. These activities increased the involvement of labour. Conventional methods would have involved the installation of pre-cast manhole rings which would have been too heavy for labourers to handle. The objective of implementing alternative construction methods can therefore be said to have been met.

5. Emerging contractor development

The training of labour and the implementation of a programme for emerging contractors was successfully completed. Bricklaying skills were added to the community's skill pools which can be used for a wider spectrum of projects in the built industry. In other words, the skills learnt were not only confined to pipe

laying projects. These skills may increase the opportunity of the labourers to obtain more jobs in other sectors such as environmental and social.

The ten emerging contractors trained were able to achieve the aim of the project which was to construct an 8km section of the pipeline. Due to limited project information, an evaluation of the efficiency of these contracts could not be conducted. All ten contractors were, however, said to have not been successful beyond the project although the Municipality had provided an exit strategy by earmarking and reserving certain future labour-intensive projects within the Municipality for the contractors. Despite these efforts, all the contracting firms failed and any subsequent contracts awarded were sold to established contractors.

The "silent" objective of any contractor development is to help start a sustainable business which should survive beyond the embryonic phase; otherwise the exercise of contractor development is futile. The fact that the emerging contractors failed implies that they were left without an income and were drawn back into the pool of the unemployed. It can therefore be said that this objective was not met.

In conclusion, the project has achieved only two out of the five set objectives.

4.5 Oskraal and Environs Water Supply Scheme

The Oskraal and Environs water supply project composed of two phases namely the Oskraal Plots and Madidi. Madidi was the first project which commenced in February 2002. The overall project was terminated with the completion of the Oskraal Plots phase in September 2003. The funding of this project was granted by the minister of Department of Water Affairs and Forestry (DWAF) under the Consolidated Municipal Infrastructure Programme (CMIP).

The overall aim of the project was to provide water for rural communities in and around Madidi. The designated areas were previously served by boreholes with very low yields and local people often had to resort to walking long distances to get water from polluted water sources. This put the health of the communities at risk. The first phase of the project was evaluated separately from the second phases because more information was available for the former as it was felt that if the two were treated as one, the value of the information would be lost.

The overall objectives of the Oskraal Environs project were to:

- use local suppliers and sub-contractors;
- use labour-intensive construction methods where possible; and

- create as much employment as possible for local communities.

Information from the two construction phases is analysed in the sub-sections below.

4.5.1 Madidi Water Reticulation Project

Project description

The Madidi phase included the construction of a 10.6km pipeline which would connect to the bulk and internal infrastructure components of future phases of the Oskraal Environs Project.

General Project Information

As indicated in Table 4.8 below, the total project cost was R4 773 078 and the projects was conducted over a period of nine months.

Table 4.8: Madidi water reticulation project information

Project Value	R4 773 078		
Project duration	February 2002 to November 2002 9 months		
Total mandays from local labour	Women	Men	Youth
	14 214*	17 250*	-

(Source: Bigen Africa project file, 2002)

Notes: * Only recorded from February to May 2002 which represents only 1/3 of the project duration. No subsequent information on labour was available.

No information was available in the available project information on the target mandays for women, men and youth and the actual mandays, as provided by the site diary, are presented in Table 4.8 above. The documenting of labour days was abruptly terminated in May 2002 when the project was no longer being conducted labour-intensively because of problems encountered during construction. The contractor had experienced serious problems with the use of labour and had resorted to using conventional construction methods to complete the project³¹.

Information from construction phase

Prior to commencement of the actual scope of work, a vast section of existing pipeline network was discovered and the contractor's permanent staff had to locate the services under a variation order. The possibility of existing services had not been envisaged during tendering and the scope of work was increased which required an extension of time to complete the actual works tendered for.

Training - No evidence of formal training was found in the project information and the contractor³² confirmed

³¹ Although an option to change construction methodology was not provided for in the contract, the pressure to deliver the project on time irrespective of the challenges encountered led to a decision by the responsible parties to allow for the use of conventional construction methods in order to meet delivery dates.

³² Telephonic interviews were conducted with a representative from the contractor's firm, Mr. Chris Pelser on 26 October 2005.

that the only training offered was by key staff who guided and the unskilled local labour force.

Tasks - Due to hard excavation conditions, excavations were conducted by equipment and labour was used for the backfilling and laying of pipes.

According to the contractor, the labourers refused to be paid per task because of alleged negative influence from one of the councillor and some trade union representatives. When approached to intervene, the Client and consultants did not offer any support to resolve the problem.

The contractor therefore paid labourers a daily rate, irrespective of productivity. This resulted in labourers only backfilling up to 2m³/day which equated to a cost of R25/m³ prior to additional cost of watering and compaction. The contractor had tendered a rate of R8/m³ for the 5m³ task.

The payment of labourers per hour regardless of productivity resulted in a significant increase in the project cost. Claims regarding loss of time and income by contractor were rejected by the consultants stating that it was the responsibility of the contractor to manage, monitor and control productivity of the labourers. As a result, the contractor incurred a loss

on the project, but was not willing to disclose the financial aspects of the project.

Tools and equipment - Excavations were conducted by two excavators and three TLB backactors. Compaction was conducted with two VIPAC rollers.

Time and productivity - The design had stipulated the use of cast iron saddles, but there was a local shortage of supply which led to further delays in progress on site. Permission was later granted by the consultant to utilise other saddles which were readily available in close vicinity of the site.

Theft of material and equipment disrupted progress and contributed to further delays as it took long to replace the stolen equipment. The site agent was also hijacked at gun point.

Multiple projects were underway in the same area and at the same time as the Madidi project. During his proceedings, another contractor cut off water supply to the site. As a result, the contractor did not have water for testing pipes after installation. A local sub-contractor had to be contracted to supply the site with some 30 000l/km for the 90mm diameter pipes.

Another contractor was conducting blading on roads in the vicinity of the site which resulted in most of the Madidi contractor's trenches being backfilled prior to installation of the pipes. As a result more labour, time and money was required to re-excavate the trenches.

All in all, there was a general lack of support from the community. On many occasions, the community from certain sections of Madidi prevented the contractor from working.

An attempt to rotate the labour force in order to increase the number of individuals participating in the project was not welcomed by the communities.

Analysis

No team balancing exercise was established in the available project documentation. A team balancing exercise was therefore conducted as part of the research and is presented in Table 4.9 below.

According to the team balancing exercise presented in Table 4.9, the 10 726 tasks would cost R536 309.00 at a rate of R50/task. This would have constituted 11% of the total project cost. On the contrary, the contractor confirmed that the actual cost to labour was 30% of the contract cost which is equivalent to

R1 431 923. When compared to the calculated cost from the team balancing exercise, the actual cost was 2.7 times the calculated cost. As a result of the contractor's inability to manage the labour force, exorbitant cost increases were experienced during the project which were incurred by the contractor.

In reality, only 2m³ of backfilling was achieved per labourer per day which is less than half of the estimated task. The site conditions were conducive for more productivity and it can therefore be concluded that lack of motivation to produce underpinned the low productivity.

Table 4.9: Team balancing exercise for Madidi Water Reticulation

Activity	Unit	a	b	c	d	e	f	g
Site clearance	m ²	15,900	100	159	5	32	30	5
Location of existing pipes	m ³	11,130	3	3710	40	93	70	53
Wetting of soil for compaction	m ²	15,900	90	177	10	18	20	9
Compaction	m ²	79,500	700	114	4	28	30	4
Bedding	m ³	7,950	8	994	30	33	60	17
200 diam. pipe laying	m	10,600	48	221	4	55	40	6
Blanketing	m ³	2,385	6	398	10	40	50	8
Backfilling	m ³	12,720	8	1590	20	80	70	23
Reinstatement of driveways	m ²	3,000	4	750	20	38	40	19
House connections								
Excavations	m ³	2,646	3	882	5	176	80	11
90 mm diam pipe laying	m	3,780	90	42	3	14	20	2
Bedding and backfilling	m ³	1,701	5	340	6	57	20	17
Meter installation	no	3,500	13	269	7	38	60	4
Reinstatement of fences	m	3,860	7	551	5	110	30	18
Site reinstatement	m ²	15,900	30	530	12	44	40	13
Total				10726	181	856	660	209

(Source: Research fieldwork, 2005)

Key: a- quantity, b- task, c- no of tasks, d- estimated no of workers, e- no of days, f- balance days, g- actual no of workers

The tendered price for backfilling was R8/m³ for 5m³ task and yet actual volumes achieved were only for 2m³ at R25/m³ (with a rate of R50/day for an average of 2 tasks per day). Figure 4.6 below presents an illustration of the comparison of the actual and estimated rates.

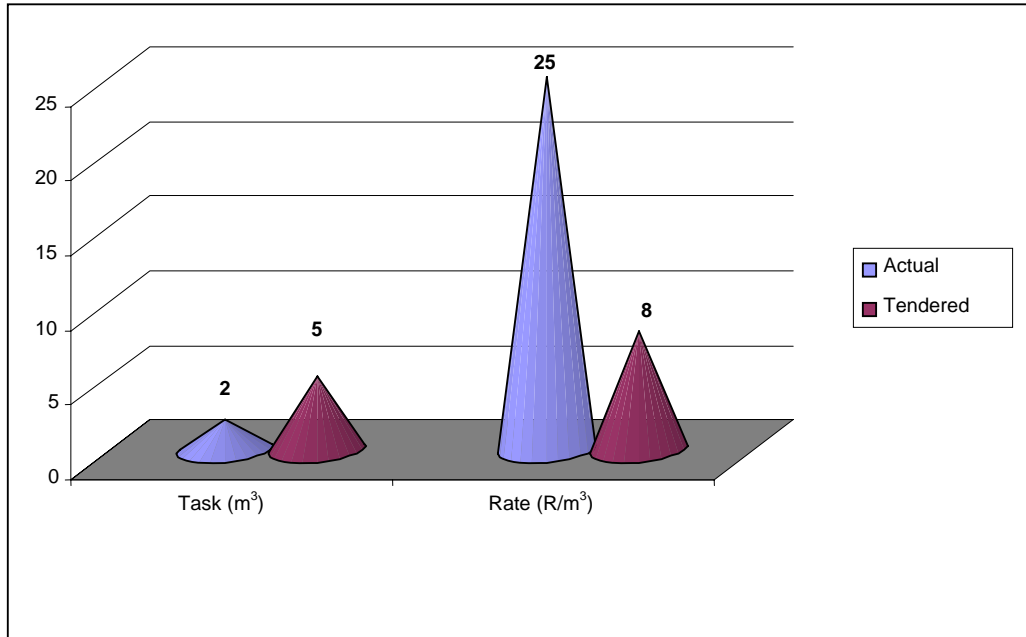


Figure 4.6: Comparison of actual vs. tendered tasks and rates for Madidi water reticulation project
 (Source: Research fieldwork, 2005)

In other words, less than half of the estimated backfilling task was achieved at a price which is more than three times the tendered price. Needless to say, the contractor was severely affected by the very low productivity achieved on site.

In conclusion, the project did not have community support, which was demonstrated by negative activities such as theft of material and equipment, prevention of project progress by locals and refusal to be paid per task, which is one of the vital fundamentals for the successful implementation of labour-intensive construction.

4.5.2 Oskraal Plots

Project Description

This was the second phase of the Oskraal Environs Project and included the upgrading and construction of bulk and internal infrastructure components for a number of rural villages with some 3 573 families. These villages include Oskraal Agricultural Holdings, Ramabokala, Rampa, Ramogoadi, Madidi, Lekgema, Rankotia and Ntsopilong.

The project involved the construction of some 9.4km 250mm diameter pipe network from Bapong through Modderspruit to Majakaneng and a 10 Ml reservoir and pump station at Majakaneng. The new pipeline extended from the existing Mothutlong reservoir situated in the Swartkoppies Mountains, directly north of Mothutlong extending to the reservoir between Oskraal and Kgabalatsane.

DWAF, through the People's Republic of China Materials programme, donated uPVC pipes for the project to an estimated value of R9.5 million.

General project information

According to the project close out report, the project created infrastructure assets worth R11.9 million for Madibeng Municipality over a duration of 7 months. The targeted mandays for men, women and youth achieved through the project was a total of 31 452 days although more mandays were actually achieved as presented in Table 4.10 below.

Table 4.10: Oskraal plots project information

Project Value	R11,9 million		
Project duration	February 2003 to August 2003 7 months		
Actual total mandays from local labour	Women	Men	Youth
	12 602	20 327	6 813
Target mandays as per project plan	10 484	10 484	10 484

(Source: Bigen Africa project file, 2002)

Limited information was available with respect to the project scope and specifications; hence it was impossible to conduct a team balancing exercise for this phase of the project.

Project Framework

Contractual matters - Madibeng Municipality appointed a Community Liaison Officer (CLO) and a Labour Desk Officer (LDO) who underwent appropriate training

including labour relations, basic leadership and management and labour desk organisation.

Activities such as removal of vegetation, backfilling, excavation and removal of existing pipes were some of the activities to be conducted labour-intensively. One contractor was appointed for the installation of the gravity feeder main and the works had to commence at the same time as another contractor who was appointed for construction of the reservoirs.

The two contracts were being implemented simultaneously and it was recommended that the conditions of employment for the labourers in the two contracts be the same to avoid complaints and dissatisfaction amongst workers. The consultants therefore requested that labourers be paid on a fortnightly basis instead of a monthly basis in order to be consistent. However, the request was rejected by the contractor on the basis that the requests had not been part of the contract during bidding and that it was its firm's policy to pay on a monthly basis which still complied with the basic conditions of employment.

The consultants also requested partial rotation of the labour team on a six weekly basis where the core of any one team would work for at least one month. This would have ensured a fair distribution of available work to individuals in the target communities without jeopardising continuity and productivity. The contractor considered partial rotation not to be a good practice as it was felt that there would not be

sufficient progress and staff would feel insecure, which could adversely affect productivity.

Training - Training provided included management training (institutional training), life skills training, technical training, project steering committee and community member training. All training providers were accredited by CETA. The Labour Desk Officer (LDO) and CLO (Community Liaison Officer) were trained in conflict resolution over a period of 3 days, while Project Steering Committee (PSC) members were trained over a period of 2 months.

However, details for the duration and content of the training for the labourers or site supervisors could not be found in available documentation.

Tasks determination - Excavations were conducted by machinery because of the shallow rock outcrop conditions encountered on site. Prior to project commencement, a TLB backactor was used to excavate trial pits to a depth of 1.2m at 250m intervals along the pipeline route to determine the excavation conditions. The majority of the site was found to be underlain by shallow bedrock therefore excavation by labour was deemed to be not feasible³³.

Due to the shallow rock outcrop soil conditions, explosives were used for rip the hard material and then

³³ However, they could have used a compressor and jackhammers and then proceeded to excavate by hand.

equipment was used to remove the ripped material³⁴. As a result, labour was only used for bedding and backfilling.

Labour - Local unskilled labour was employed during project implementation. According to the project plan the same number of mandays for men, women and youth were planned.

Health and Safety - The services of a safety officer were outsourced to ensure that all safety requirements were complied with. The requirements of the Occupational Health and Safety Act: No 85 of 1993 were complied with.

Time and productivity - Progress was adversely affected by delays in material delivery. The client was responsible for the delivery of pipes and delay in material resulted in labourers not working, hence not being paid. The labourers felt it was unfair to be penalised for the late delivery of materials which was not within their control.

Absenteeism was experienced especially on days subsequent to paying labourers which adversely affected the construction programme.

³⁴After "exploding", the resultant material would be regarded as soft and the subsequent excavations could have been conducted labour intensively.

Social and environmental aspects - Some local residents filed complaints that the explosives used during trenching had caused severe cracking on their houses. No crack survey was conducted prior to the use of explosives and an investigation had to be conducted to determine whether the cracks had developed as a result of blasting. The investigation, however, concluded that the cracks were typical of heave movement in clayey areas.

Other major problems encountered included the equipment traversing and damaging an archaeological site. According to archaeologist, the Swartkoppies mountain range has hundreds of Iron Age sites associated with Early Tswana settlement. Part of the pipeline installation was already underway (some 700m) when it was discovered that the excavating activities had resulted in the destruction of the archaeological site ten meters broad and some seven hundred meters long. Cultural resources like archaeological sites are a non-renewable resource, and the scientific data lost during excavation can never be recovered. Destruction of such sites is in contravention of the National Heritage Resources Act 1999 (No. 25 of 1999).

Nine graves were also traversed during trenching and the project was temporarily discontinued. A rescue archaeological survey and excavations were conducted to assess damage and determine a way forward at a great

expense to the project. An Environmental Impact Assessment had to be conducted to assess the impact on the environment and this delayed the project even further.

Analysis

According to the project close out report, the actual total labour days of 39 742 mandays were achieved during the project. Discussions with the consultant indicated that on average a person could complete 1.5 tasks a day³⁵. This indicates that the set task was too low as the labourers could achieve more than one task in a day. No information was found on the actual cost to labour; instead the cost was calculated based on the task productivities and the number of labour days achieved. At a rate of R50/task, the total cost to labour was calculated to be R2 980 650, which is 25% of the total cost.

The planned number of labour days were compared to the actual days achieved this is presented in Figure 4.7. It can be deduced from the graph that 17% and 94% more women and men, respectively, were employed during the project, 35% less than planned youth participation was achieved. An investigation into the low employment of youth was not conclusive, but it was the feeling of representatives from Madibeng Municipality that there was a general lack of interest to participate in the

³⁵ A labourer achieving 1.5 tasks a day implies that they earning R75 a day which is well above the minimum wage.

project by the youth. The LDO could not be reached for comments or confirmation.

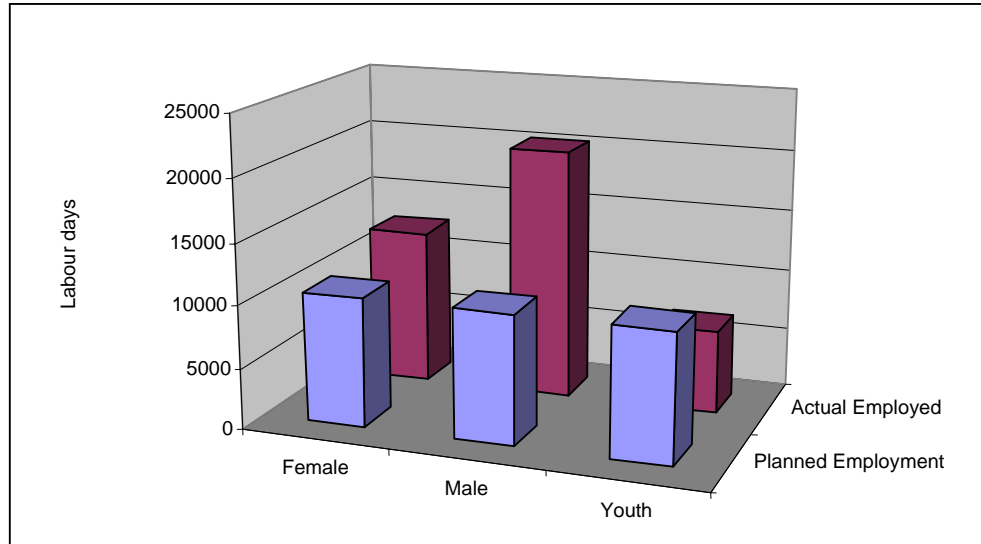


Figure 4.7: Oskraal plots actual vs. planned labour days (Source: research fieldwork, 2005)

It is also considered that in order to extend the participation of labour, thereby creating more employment for local community, labour could have been used to excavate the soil after the hard material was ripped and blasted.

4.5.3 Evaluation of project objectives

1. Use of local suppliers and sub-contractors

Records indicated that in the Madidi project, a sub-contractor was appointed to provide water for the testing of pipes. However, for the Oskraal Plots phase the available information does not mention the use of

local suppliers and sub-contractors. Suppliers from outside the local communities were used to procure materials such as concrete, manhole covers and water meters. There was also no mention of the use of local sub-contractors. This objective was therefore not achieved.

2. Use of labour-intensive construction methods where feasible

During construction at the Oskraal plots, labour was used for activities such as pipe laying and backfilling. I consider that there was more scope to increase the use of labour, such as removal of ripped material after blasting. In other words, labour was not used as far as possible to increase the expenditure per capita on labour.

Similarly for the Madidi phase, if the definition of labour-intensive construction is adopted as the economically efficient employment of as great a proportion of labour as is technically feasible to produce as high a standard of construction as demanded by the specification and allowed by the funding available, then this project can not be said to have been conducted labour-intensively. Employment was indeed created through the project for many locals, but the cost of the project was higher than the budget. The project lacked one of the vital principles for successful implementation of labour-intensive construction methods which is to link payment to productivity; hence it resulted in excessive costs.

The project was therefore conducted labour extensively which means that labour was used regardless of productivity.

3. Creation of employment for local communities

The close out report for Oskraal Plots indicates that more employment than anticipated was achieved for the number of men and women, although it fell short of youth participation. It can therefore be concluded that the employment opportunities were created for local communities.

At Madidi, employment was only created for a third of the construction period after which conventional construction methods were resorted to because of the poor management of the labour which led to the construction cost being too high.

4.5.4 Conclusion

In conclusion, the Oskraal and Environs Water Supply project resulted in infrastructure to the value of R27.2 million³⁶ which was handed over to the Madibeng Municipality to operate and maintain. The projects analysed, i.e. Madidi and Oskraal plots created a total of 71 206 mandays with 26 816 mandays to women and 6813 to youth. However, the use of labour was not well

³⁶ This cost includes other supporting infrastructure conducted under the same programme.

planned, organised or managed and as a result was not cost effective.

A critical evaluation of the overall project objectives alludes to the fact that although attempts were made to achieve the objectives, the project has fallen short of meeting all three objectives.

4.6 Letlhakaneng Water Reticulations

4.6.1 Introduction

Fieldwork was conducted on the Letlhakaneng Water Reticulations project which was underway at the time this research was conducted, but has since been completed. Letlhakaneng water reticulation project is the second phase to the Maboloka Environs project. The project entailed planning, design, construction, materials management and construction of a bulk water supply scheme to augment the existing infrastructure which supplies Maboloka and surrounding rural villages.

The funds for the project were provided by the Municipal Infrastructure Grant (MIG).

4.6.2 Project objectives

The objectives of the project were:

- utilisation of labour-intensive construction methods;
- inclusion of women and youth during construction,
- training of labourers; and
- utilisation of local sub-contractors.

4.6.3 Project description

The project involved an installation of some 12km uPVC pipelines, valves, fittings, as well as the installation of some 900 domestic water meters.

The works included:

- Site clearance and earthworks required for the pipe trenches,
- Earthworks for, delivery of materials and fittings, and laying of approximately 12km of uPVC pipeline, varying between 75mm to 200mm in diameter,
- Construction and installation of approximately 900 erf connections, including water meters outside the stand and standpipe inside the stand.
- Construction of thrust blocks and/or other supports to the pipe work.

4.6.4 Project Information

The total project cost was R2 231 474.50 and the project was conducted over a duration of 4 months.

Table 4.11: Letlhakaneng water reticulation project information

Project Value	R2 231 474.50		
Project duration	July 2005 to November 2005 4 months		
Total mandays from local labour	Women	Men	Youth
	1594	1990	897

(Source: Bigen Africa project file, 2005)

In total 4481 mandays were created during the project. The workforce was rotated every two weeks and the participation of men, women and youth was as presented in Table 4.11 above.

4.6.5 Project Framework

Contract Documentation

According to the contract documentation, certain portion of the Works had to be executed using labour-intensive construction methods. These excluded excavation but included:

- Clearing and grubbing;
- Bedding, selected fill, backfilling and compaction of all pipe trenches irrespective of depth but assisted by mechanical compaction equipment in order to achieve the specified densities;
- Reinstatement of all fill, shoulder and pavement layers at road crossings, but using mechanical compaction equipment in order to achieve the specified densities;
- Transportation and spoiling of all trench materials, where the disposal site is located within 20m of source;
- Removal of oversized materials on the edge of the roadway during the construction of roads³⁷;

³⁷ Another contract was awarded to a different contractor to construct roads and sewer services in the village. The scope of work for Letlhakaneng water reticulation project appears to have been inclusive of some of the activities from the roads and sewer contracts.

- Laying, testing and disinfection of all pipelines, including all fittings, valves, and house/erf connections, but excluding all storm water pipe- and rectangular culverts;
- Construction of all manholes, cleaning eyes, kerb inlets, junction boxes, culvert floors, end structures and balustrades, valve chambers, thrust blocks, pipeline markers and the like (earth-, concrete-, brick- and metal works), but excluding the mixing of concrete and transportation of same to the point of pouring;
- Dismantling and re-erecting of fences; and
- Cleaning and tidying up of the site.

These items were obtained from the Bill of Quantity and would only be paid for provided labour-intensive construction methods were used.

Local sub-contractors were employed to transport materials from the stores to the sites, and to provide water for compaction of the bedding and backfilling.



Photographs 1&2: Local contractors supplying water and delivering pipes to the site

There were no written contracts between contractor and sub-contractors. The client was not even aware that sub-contractors had been appointed until disputes arose because of late payment of sub-contractors. After payment of progress certificates by the Client, the main contractor ignored to pay sub-contractors for services rendered and a dispute arose when the contractor could not pay the sub-contractors. This caused delays on site. As an intervening measure, a memorandum of cession agreement was then entered into between the Client and all suppliers and sub-contractors. Similarly there were no contracts of employment for the labourers. This practice which is not allowed in terms of the Expanded Public Works Programme guidelines.

Training

No LDO or CLO were trained for this project because the community wanted the PSC to be responsible for the

running of the project. Local labourers were not trained formally because of their short participating duration of only 2 weeks in the project. Instead the contractor's key staff conducted on-site training for new labourers with every rotation.

Health and Safety

With the assistance of a health and safety consultant, the project was able to meet most of the Health and Safety Act requirements. A health and Safety Manual was available on site which detailed hazards and risks and also detailed measures to mitigate these risks. As an example, random illegal dumping sites were identified as a hazard because it could lead to collapse of trenches if encountered during trenching and backfilled.

Task determination

Although the contract had indicated that excavations were to be conducted labour intensively, excavations on site were carried out by 3 TLB backactors because of the soil conditions on site³⁸. According to the geotechnical report, the site is underlain by strongly cemented ferruginised material which classified as a medium excavation when using equipment. The soil

³⁸ Although this project formed part of the Expanded Public Works Programme, no contracts were in place as per EPWP guidelines. Had the contracts been in place and the conditions thereof been enforced, the contractors would not have been paid because an incorrect construction method, which contradicts the terms of the contract, would have been used.

conditions were therefore not conducive for excavation by labour. However, the deep layer of collapsible soil observed on site had a consistency which could be classified, in general, as medium dense. The bottom of the trenches were seldom found to be on the hard pan ferricrete which would have been hard to excavate, but could still be excavated by labour.

An average productivity of only 42m of pipe laid per day was achieved by a team at any one time, which was very low. This implied that only 7 pipes were laid and backfilled per day by the teams.

Time and productivity

One of the causes for low productivity was the delay in delivery of soil onto site. This was due to poor planning. Soil for backfilling was obtained from borrow pits which were located some 1km from site and there was no system in place to ensure timely delivery of sufficient soil to site.

Time was also lost due to idle time due to heat stresses. The average temperature on site was well into the thirties on average and the labourers found it intolerable to work efficiently under such conditions³⁹.

³⁹ The teams could have rather opted to work before 9:00 and then after 15:00.

Social impact

During recruitment a rate of pay was negotiated and accepted, but after a week of commencement of Works, the community allegedly received negative influence from local trade union representatives who encouraged them to demand higher wages. The labourers attempted to renegotiate the rates, but the contractor insisted that the rate had been agreed upon and was final. This resulted in a strike which delayed the project by some three days.

The client then negotiated with the labourers an extra payment of R5/day for the labourers to utilise their own tools, which had to be of acceptable working condition. As a result the labourers were receiving R65/task which was higher than the industry average. This generated an entrepreneurial flare in the community as some individuals bought tools and rented them out to the labourers for a rate of R2/day.

Generally it was found that women labourers displayed more interest in the work than the men⁴⁰. They expressed a lot of excitement over the opportunity to work and moreover, they were intrigued by performing work which is traditionally reserved for men.

⁴⁰ Information was obtained from informal interviews (20 September 2005) conducted on site during which the following people were interviewed: Labourers- Mrs. Ramaboa, Mrs. Montsho, Mr. Dikaneng, and the site agent - Mr. Mpho Ntswane.

A woman in her 60's who was part of the workforce revealed that she was the sole breadwinner in her household and she took care of her deceased daughter's children. They were barely surviving on her pension money and the project had brought some relief hence she was committed for the two weeks she had on site. The only downside was that she would have to return home after only two weeks, however, the opportunity was "better than nothing".

On the other hand, the site agent remarked that the men were more easily influenced by negative forces and tended to be more dissatisfied than the women. Absenteeism was also experienced on workdays succeeding paydays.

4.6.6 Analysis

By September 2005, 50% of the project time had lapsed and only 23% of the works had been completed. I conducted an exercise to identify the cause of the slow progress and to find remedial measures to ensure timely completion of the project.

At the average rate of production of 42m/day of pipe, only 3.8km of pipe length would have been laid by the end of the 4 months construction period. The required 12km would have only been completed by July 2006 (i.e.

project duration would have been increased by seven months).

The 3 TLB backactors were achieving a combined 100m pipe length/day, which is lower than expected productivity, because of the very dense soil conditions and the defective working condition of the equipment. However, the slow rate of pipe laying and backfilling conducted by labour was identified as the critical activity in the project programme. In order to meet the completion deadline, an increase in productivity or number of labourers would be required.

The resulting strategy to drastically increase productivity included the following recommendations:

- Appointing local donkey cart owners as subcontractors to deliver the required backfill material from the borrow pit located some 1km away from the site. This would reduce standing time due to late delivery of backfilling material.
- The labourers could be allowed to work from as early as possible, when there is sufficient day light, so that by the time the summer heat became unbearable they would have achieved some acceptable productivity for the day. Drinking water could also be provided at accessible locations for the workers who currently had to walk long distances to get access to potable water.
- The frequent partial rotation of labour reduced the rate of production because as the team was

achieving its best productive rate, the team was replaced by another team which still had to be trained. The benefits of the training were, therefore, short-lived and the cycle was then repeated with a new team. Consideration could be given to employing a larger force, for example, twice the size of the current one (there is currently adequate working space to fit more than two teams of the current size), and the teams could be rotated on a monthly basis instead of 2 weeks.

A team balancing exercise was conducted to determine the number of tasks and labour (and hence cost) which would be required to complete the work on time. The exercise included the excavation using labour as the soil conditions were considered to be conducive for such construction methods. The team balancing exercise is presented in Table 4.12 overleaf.

Table 4.12: Team balancing exercise for Letlhakaneng

Activity	Unit	a	b	c	d	e	f	g
Site clearance	m ²	18,000	100	180	5	36	40	5
Excavation	m ³	12,000	4	3000	60	50	50	60
Bedding*	m ³	7,800	8	975	15	65	60	16
Pipe laying	m	12,000	60	200	6	33	30	7
Blanketing*	m ³	2,340	6	390	10	39	40	10
Backfilling*	m ³	9,360	8	1170	30	39	40	29
Reinstatement of road crossings	m	1,800	5	360	10	36	35	10
Removal of oversized material ⁴¹	m ³	80	0.5	160	8	25	15	13
Construction of manholes	No	30	0.5	60	6	10	10	6
Dismantling and reinstating fence	m	3,000	15	200	10	20	20	10
House connections	No	900	4	225	10	23	25	9
Donkey cart Haul ⁴²	m ³	7,000	4	1750	20	88	60	29
Site cleaning	m ²	18,000	30	600	15	40	40	15
Total				9310	200	467	425	219

(Source: Research fieldwork, 2005)

Key: a- quantity, b- task, c- no of tasks, d- estimated no of workers, e- no of days, f- balance days, g- actual no of workers

Notes:* Including wetting to optimum moisture content

The team balancing exercise indicates that 208 workers would be required to undertake the 9 310 tasks. At a rate of R65/task, the cost to labour would have been R605 150 which is 27% of total project cost. Moreover, an additional 4 829 mandays could have been created if excavations had been conducted using labour and had other available local resources, such as the donkey carts, being used.

⁴¹ Average Haulage distance to dumping area = 1km. Therefore, if a wheelbarrow has a capacity of 0.065m³ and an average person can reasonably make 6 trips in a day (i.e. 12km); therefore the total volume which can be removed and hauled per day is 0.39 m³ which is rounded off to 0.4 m³.

⁴² The capacity of a donkey cart is about 0.5m³ (McCutcheon, 1985) and assuming that one cart can manage 8 trips a day, then the total volume which can be hauled in a day is 4m³.

The resident engineer, however, opted for a different strategy to increase productivity by assigning more labour to the site. This resulted in the size of the team being tripled and more stringent supervision measures being implemented. In order to save on the cost for transportation of the backfilling soil, the pedogenic material from the excavations was sieved and used for bedding and mixed with the fine grained silty sand within the vicinity of the trenches and this was used for backfilling. These interventions improved productivity which resulted in an improvement in the overall progress of the project.

In order to increase the use of labour in the project, manholes were constructed in-situ which comprised a concrete floor and masonry walls.

4.6.7 Evaluation of project objectives

1. Utilisation of local labour-intensive construction methods

Labour-intensive construction methods were used for bedding, pipe laying, blanketing and backfilling. In addition, the manholes were constructed in-situ which increased the labour content. A proposal had also been made to use potable custom made concrete manhole covers in a form of rectangular concrete panels with hooks, which could easily be handled and assembled to form the manhole cover.

The light, easy-to-handle covers would have been appropriate for the labourers to handle and hence increase the number of activities performed by local labour. Local contractors could also have been used to produce the panels creating employment for even more locals. However, the limited duration of the project did not allow for setting up of such local producers.

The objective of utilising labour-intensive construction methods can, however, be said to have been achieved.

2. Inclusion of women and youth during construction

The workforce was almost balanced from a gender perspective, and youth constituting 20% of the total labour force. Therefore this objective was met.

3. Training

The contractor, labourers or other project staff did not undergo any formal training by a CETA accredited trainer. Instead, the contractor's core team trained the rotating teams in pipe laying and bricklaying skills. Bricklaying skills were invaluable for the community as these skills are not only confined to the construction industry, but are also beneficial in the building industry.

Since no formal training was conducted, the labourers were not trained on other important aspects such as life skills. The objective to train is therefore considered to have not been achieved.

4. Utilisation of local sub-contractors

Local sub-contractors were used to transport material and to provide the site with water. With proper planning, it is considered that local sub-contractors could have been used to produce manhole covers as described above. In addition, meaningful participation of local sub-contractors could have been achieved by using donkey carts to transport backfilling soil. This objective was therefore not satisfactorily met because local sub-contractors were not optimally used.

It is therefore concluded that two out of the four project objectives were achieved.

4.7 Conclusion

A summary of the evaluation of the projects is presented in Table 4.13 below.

Table 4.13: Summary of objectives achieved by projects

Project Name	Objectives achieved
Brits Industrial	1 out of 5
Maboloka	2 out of 5
Oskraal and Madidi	0 out of 3
Letlhakaneng	2 out of 4

(Source: Research fieldwork, 2005)

From a technical perspective, all the projects were successful as they achieved their aim of providing infrastructure assets, but none of the projects were able to meet all other principal project objectives. The Oskraal Environs project failed to achieve any of its objectives.

In all projects, some employment opportunities were created for unskilled labour forced who were sourced from local communities. The projects provided short-term income for the locals. Where training was conducted the community was provided with skills which will, hopefully, increase their likelihood of finding further employment subsequent to project termination.

The low rate of achievement of objectives could be indicative of the considerable emphasis that is still

placed on producing physical infrastructure assets (as is the focus for conventional construction methods) and sufficient attention is not paid to community and social aspects of the project, which are also of great importance.

In the evaluated projects, unavailability of and poor quality of project data was a major limiting factor to the research. It was apparent that there was no standardised or formalised reporting system. The Municipality does not appear to have standardised requirements for reporting on projects. As a result information available on one project was not necessarily available on the next, rendering the analysis of the findings very difficult. Despite these challenges, the available information suggests that none of the projects achieved all the objectives.

Furthermore, no information was available on the quality of the produced infrastructure. The fact that the close out reports and media publications confirmed that the targeted areas previously without water had water at the end of the projects could be taken as an unofficial confirmation that the quality of the infrastructure was able to deliver adequate water at the required pressure to the targeted communities.

The following chapter will evaluate the findings and analyse observations from the five projects. Thereafter, driving and restraining forces will be

determined in order to highlight factors which supported or prevented successful implementation during implementation of projects.

5 EVALUATION OF FINDINGS FROM PROJECTS

5.1 Introduction

The previous chapter documented five potable water infrastructure projects which were undertaken in Madibeng Municipality in the past five years. Each project's objectives were evaluated to determine the overall success of the project taking into account not only the technical achievement, but also the social aspects which are just as important.

Some of the objectives common to all projects included training, use of local labour and sub-contractors and the creation of employment opportunities for the local community. The projects were funded by Consolidated Municipal Infrastructure Programme (CMIP) prior to 2004/2005 financial year and subsequently by the Municipal Infrastructure Grant (MIG). Only two of the projects, namely: Letlhakaneng and Maboloka were funded by MIG which implies that the employment created will contribute towards the Expanded Public Works Programme's employment creation targets.

Although all the projects resulted in the creation of much needed infrastructure assets for Madibeng Municipality, the projects were found to fall short of achieving some of their principal objectives. At the worst, the Oskraal Environs Project was unable to satisfactorily meet any of its principal objectives.

To some extent, the consultant's designs and project documentation were prepared with the method of construction in mind, which was reflected in the contract documentation and innovative designs, such as the construction of manholes by labour instead of using manhole rings.

This chapter will analyse the findings from the projects evaluated in the previous chapter and the driving and restraining forces, as observed in the five projects, will be discerned.

5.2 Analysis of project information

This sub-section will first analyse the average mandays created per kilometre pipe as determined from the findings of the five evaluated bulk water infrastructure projects. Secondly, the duration of training provided during construction will also be evaluated to determine whether sufficient time was spent on training on-site supervisors, labourers and others involved in the construction process.

5.2.1 Percentage of cost to labour

Table 5.1 presents a summary of the actual cost of labour compared to the total project cost (including the value of material for projects where the materials

were obtained from the People's Republic of China Materials programme).

Table 5.1: Summary of cost to labour

Project name	Total project Cost	Actual cost to labour	% to Labour
Brits Industrial	R2.4mil	R331 237.50	14
Maboloka	R23.7mil	R7 800 000.00	33
Oskraal Environs	R16.7mil	R4 412 573	28
Lethakaneng	R2.231mil	R646 318.40	27

(Source: Research fieldwork, 2005)

The maximum cost to labour was achieved at the Maboloka project at 33% and the lowest was at 14% as achieved at the Brits Industrial project. An average cost to labour of 26% was achieved by all projects. The percentage cost to labour should not be viewed in isolation, but should be coupled with productivity in order to assess whether labour was used efficiently. For example, the high cost to labour at Maboloka does not necessarily indicate that the high cost to labour was expended on productive employment.

As mentioned in Chapter 3, the Technical Focus Group had found that there were a number of sectors of infrastructure in which labour-intensive construction methods could be introduced and developed under the National Public Works Programme (Phillips et al, 1995a). The study found that there was a great potential for using labour-intensive methods. Table 3.1 presented the spending on targeted labour as a

percentage of spending on the total project cost. The Technical Focus Group indicated that labour costs in conventional water reticulation construction projects constituted between 5% and 15% of the project cost, but if the use of labour was optimised the figure could increase to between 25% and 35%.

As indicated in Table 5.1, and taking into account the maximised cost to labour as suggested by the Technical Focus Group, only two of the projects in Madibeng Municipality managed to achieved labour costs in the 25% to 35% range, namely Maboloka and Letlhakaneng. The Brits and Oskraal projects yielded labour cost percentages which were similar to conventional construction projects despite them being "labour-intensive". In the case of the Brits Industrial project, it could be said that probably labour was not used optimally during construction hence the low cost to labour.

High cost to labour is not necessarily a commendable achievement for labour-intensive construction projects. If looked at in isolation, high costs could mean nothing more than the fact that a great proportion of the project funds were spent unproductively on labour. This was demonstrated in the Madidi project by labourers being paid high rates for very low productivities.

5.2.2 Resulting employment mandays

The number of mandays created per kilometre pipe is presented in Table 5.2.

Table 5.2: Mandays per km pipe length

Project name	Labour Cost (R)	Pipe length(km)	Actual Mandays	Mandays per km	Calc mandays*	Calc mandays*/km
Brits Industrial	491,687.50	9.2	4 686	509	9 605	1 044
Maboloka	7,800,000.00	20	76 590	3 829.5	22 677	1 133
Oskraal Plots	2,980,650.00	9.4	39 742	4 228		
Madidi	1,431,923.00	10.6	31 464	2 968	10 726	1 012
Letlhakaneng	605,150.00	12	4 481	373	8 770	731
				Average	2 381.5	Average ⁴³ 980

*The product of actual no workers and balance days from team balancing exercise

(Source: Research fieldwork, 2005)

According to Table 5.2, the mandays per kilometre pipe length generated by the projects differ with a significant variance from as low as 373 to as high as 4 228 mandays/km. The large variance could have resulted from the fact that some of the projects included the construction of additional supporting infrastructure, such as reservoirs and pump stations, and the available information was such that the cost of and employment created by the actual pipe laying could not be isolated from the total infrastructure cost. The calculation for mandays created per kilometre pipe length could have been also been distorted by the incomplete information on actual mandays created in some of the project.

⁴³ Average calculations based on Brits, Maboloka, Madidi and Letlhakaneng projects only.

Data derived from the team balancing exercises was then used to estimate the optimum number of employment days created per kilometre. This was done in order to have a figure to compare the actual mandays per kilometre to. The resulting mandays per kilometre varied from only 731 to 1 133 mandays/km with an average of 980 mandays/km length. The variance in the values was found to be low and the calculated mandays per kilometre pipe was just less than half of the actual mandays per kilometre.

5.2.3 Training

Information on training of hands-on site supervisors and labourers was often not available, but training for the Community Liaison Officer (CLO) and the Labour Desk Officer (LDO), where provided, is summarised as follows:

Brits Industrial Area	: 3 days
Maboloka	: 4 days
Oskraal plots	: 3 days

On average, the CLO and LDO were trained over a 3 day period by accredited service providers. No training of the CLO and LDO was conducted for the Madidi and Letlhakaneng projects.

Information on the training of unskilled labour was only available for the Brits Industrial Area and the Maboloka project. Training was conducted over a period of 3 days for a 9 month construction period and a period of 4 days for a 10 month construction period for Brits Industrial Area and Maboloka projects, respectively. Although based on very limited data, it can be concluded that in all cases less than half a day of training was provided per 22 days which is insufficient when compared to the required two days per 22 days in terms of Expanded Public Works Programmes guidelines.

5.3 Driving forces in project implementation

In order to realise the value out of previous experiences, it is important to identify factors which promoted and encouraged successful implementation during construction. Below are aspects which were identified from the evaluated projects as having enhanced or acted as driving forces during construction.

5.3.1 Training

Although not evaluated during this research, literature research has proven that training (especially of the on-site supervisor) is vital for the successful implementation of labour-intensive construction

programmes. The training has to be relevant and comprehensible for the local labourers.

5.3.2 Health and Safety Compliance

The health and safety aspects of the projects were addressed with diligence in all projects, except the Brits Industrial Area. Compliance with the Health and Safety Act was ensured by experienced outsourced consultants. Health and Safety issues form an integral part of any project and failure to comply with the act requirements results in high risk exposure not only for the labourers, consultant and contractor, but mostly for the client. Large labour forces are used to implement labour-intensive projects which increases risk from a health and safety perspective, requiring stringent controls to ensure safety for all on site.

5.3.3 Prompt payment of progress certificates

The promotion of emerging contractors has been one of government's major focuses for a while. The correct implementation of programmes to assist the development of emerging contractors could result in the establishment of successful and sustainable construction firms. However, in most cases these initiatives fail because of the inability of clients to pay progress certificates on time. Late payment introduces cash flow problems and as a result the contractor can not pay their creditors, staff and

labour force. This is especially critical in labour-intensive projects as the late payment of labourers may lead to dissatisfaction and unrest which might result in strike actions.

In the evaluated projects, payment of progress certificates was honoured promptly and as a result there were no delays in this regard which would have adversely affected the construction programme.

5.3.4 Proper identification and design of labour-intensive activities

The implementation of labour-intensive methods begins with appropriate designs and is carried through to contract documentation which is prepared by consultants. To some extent, the bulk water projects evaluated were supported by appropriate designs and documentation. The willingness and capability of a consultant to find new avenues of creating productive employment within the projects ultimately determines the number of jobs to be created. In the case of the evaluated Madibeng Municipality projects, the consultants were innovative in finding unconventional ways of creating productive employment which significantly increased the number of jobs created.

5.3.5 Team balancing

Team balancing optimises resources applied to any task taking cognizance of parallel and subsequent tasks and the need to keep the entire workforce optimally employed (Crowell and McCutcheon, 2000). Team balancing also provides other important information such as the total number of tasks and the number of labourers required which allows a contractor to accurately cost and programme the works.

It is therefore necessary that consultants learn and transfer team balancing skills to the contractors participating in labour-intensive projects. It was proven in earlier chapters that the inability to estimate cost of projects leads to automatic increase in cost tendered for in an attempt to mitigate the risk presented by not being able to cost projects.

5.3.6 Appropriate planning

Proper planning is the most crucial step towards successful implementation of any project. In order to mitigate the problems which were encountered during the implementation of the projects evaluated, it was important to pay due attention to the following planning aspects:

- Properly investigating availability of labour and determining their willingness to participate in labour-intensive projects;
- Educating and ensuring that labourers comprehend the concepts of the method of construction and also the objectives of the project; and
- Establishing proper and reproducible methods of determining task sizes which should be negotiated and agreed upon prior to commencement of the project.

5.4 Restraining forces in project implementation

Identification of reasons for failure and shortcomings in projects could aid the Municipality to avoid repeating similar mistakes in projects. Analysing these negative forces can provide invaluable experience for future projects and form the basis of best practices which, if taken into consideration during the planning of future projects may enhance the chances of success of projects.

5.4.1 Absenteeism

The projects evaluated indicated that problems of absenteeism were encountered generally on the workday subsequent to payday. It is common knowledge amongst site agents and resident engineers (even those on conventional construction sites) that a high rate of

absenteeism occurs subsequent to payday. During the Letlhakaneng project, it was observed that this behaviour was more prevalent among male labourers than females.

It is crucial that decision makers be aware of such absenteeism patterns so that the effect thereof on project programmes is minimised. An investigation could also be conducted to establish measures which can discourage such behaviour or reward continuous attendance on sites.

In addition, research⁴⁴ indicates that the South African construction industry has the third highest incidence of HIV/AIDS in the country. Although not researched in this project report, high absenteeism should be expected on sites because of the effects of HIV and AIDS. A study needs to be conducted to assess the impact of this epidemic on the construction industry. HIV policies have to be developed and implemented because the impact of this disease will be felt by this industry which is currently repositioning itself to be more labour-intensive.

⁴⁴ Information obtained from "Specification for HIV/AIDS awareness" (2003) by the Construction Industry Development Board, Generic Specification issued for public comment, June 2003.

5.4.2 Disregarding the involvement of important stakeholders

It has been alleged on three of the projects analysed that local trade union representatives and local councillors visited the site after commencement of Works and influenced the labourers to demand more money. This led to go-slows and strikes, hindering progress. The allegations could not be confirmed because the people making the allegations did not want to be on record expressing negative views about trade unions. Trade unions form a critical part of the success of a project especially when dealing with labour-intensive construction methods.

It is therefore recommended that councillors and local trade unions be involved at an early stage of the project to negotiate rates, task and conditions of employment.

5.4.3 Low rates of production

The linking of performance to payment is one of the pivotal principles of implementing labour-intensive construction projects. Literature has shown that failure to pay per task results in extremely low rates of production with an exorbitant increase in cost. This fact was confirmed by the low productivity achieved in the Madidi project where the local community refused to be paid per task which resulted in

exorbitant increases in the cost to unproductive labour.

Otherwise, in other projects where payment was linked to tasks, the projects achieved acceptable rates of production and on average 1.5 tasks⁴⁵ were achieved per day.

The late delivery of material to some of the projects also contributed to slow productivity. Late delivery implies that the labour force, through no fault of theirs, have to be unproductive and idle as they await material delivery.

5.4.4 Insufficient lead-in times

In all the projects evaluated the contractors were given only 15 days from award of tender to site handover and commencement of construction. Prior to commencement of the Works a contractor needs to familiarise him/herself with the contract documentation to ensure that he/she understands the scope of work and complies with all contractual requirements, arrange for guarantees and insurance.

⁴⁵ Although it demonstrates that labourers are motivated to increase productivity when payment is linked to tasks completed, achieving more than 1 task a day is not necessarily good as it indicates that the size of the task might have been set too low.

At the same time the contractor also needs to ensure that he/she becomes familiar with the site, community processes and customs, and engage in some community participation activities to achieve project buy-in. Fifteen days may have been adequate for conventional projects, but with the added responsibilities which come with labour-intensive construction methods, the time allocation from award of tender to commencement of construction needs to be reviewed.

5.4.5 Prioritisation of service delivery over employment creation

Due to the pressure on municipalities to deliver services as soon as possible, it was observed that the delivery of services is prioritised over other initiatives such as the creation of employment. This is not surprising considering continued violent demonstrations against many municipalities, for their slow service delivery. Discussions were conducted with representatives⁴⁶ from Madibeng and Tshwane municipalities which revealed that they were not aware of any mandatory correlation between the Expanded Public Works Programme and the normal delivery process of infrastructure assets.

When asked whether the Expanded Public Works Programme objectives were prioritised during the implementation

⁴⁶ All municipality representatives requested that their identities be kept confidential due to the sensitivity of information offered. Telephone interviews were conducted with representatives in November 2005.

of infrastructure projects, the most common response was that performance was measured only according to successful delivery of infrastructure and services and not the number of jobs created. Priority was on a faster delivery of infrastructure and little thought was given to job creation during projects.

As indicated in earlier chapters, the Expanded Public Works Programme does not have any special funds allocated to it, but relies on the already existing grants, such as the Municipal Infrastructure Grant, to create jobs while at the same time providing infrastructure assets.

5.4.6 Absence of contracts for local labourers and sub-contractors

During training, Labour Desk Officers (LDO) learnt skills to prepare, interpret and issue employment contracts. According to law, every labourer should receive an employment contract prior to commencement of employment, but in reality this was not always found to be the case.

Labourers have to sign a contract of employment so that they understand the conditions under which they are employed. The contract has to be written in a language that is understood by the labourers so that the employment conditions are clear. This would limit the number of disputes which may arise from

misinterpretation or misunderstanding. Efforts should be made to assist illiterate labourers with their contracts so that they can also understand what they are signing for. At Letlhakaneng, some of the labourers did not even know what a contract was.

The fact that the sub-contractors at Letlhakaneng only had a gentleman's agreement with the main contractor is also disturbing. Proper contract documentation should be made compulsory in order to avoid any disputes which are likely to arise. The absence of sub-contracts could lead to exploitation of local sub-contractors during construction.

5.4.7 Poorly defined project objectives

In order to ensure optimum use of local labourers and sub-contractors, the Municipality needs to set, monitor and enforce specific targets to be achieved by the projects and programmes. It is not adequate to say that local labour should be used "as far as practical", for example. Instead the construction activities to be constructed by labour should be explicitly stated and compliance thereto should be monitored. Severe penalties, such as no payment for work completed, should be implemented if the incorrect method of construction is used. The Guidelines provide the contractual basis for achieving these objectives and the penalties for non-compliance.

In order for the Expanded Public Works Programme to reach its target of 1 million work opportunities in the set time frame, all municipal projects which are funded by MIG and other grants related to the Expanded Public Works Programme have to set achievable targets which will in turn contribute to the 1 million employment opportunities target by 2009.

5.4.8 Improper management of emerging contractor programmes

Any programmes involving emerging contractor attempted by the municipality should be offered to those individuals who demonstrate capability and enthusiasm to becoming a contractor. In addition, they should have attempted to run their own business prior to the programme because candidates' previous business experience could provide an indication of the individual's commitment to running a successful business. Such programmes should not just be seen as a quick money making scheme as observed from the experience with the 10 contractors trained under the Maboloka project, but rather as long-term initiatives to assist and support true entrepreneurial ambitions.

It is recommended that the selection criteria be stringent to limit the entry of individuals who do not intend running a sustainable firm, but are looking for instant money to upgrade their life styles. The team selecting entrants into the programme should not be

biased and should have no relationship with candidates to eliminate the problem of nepotism. This would limit the corruption currently plaguing most well meant government initiatives and increase the chances of success of such business entities beyond the learnership programme.

6 CONCLUSION

6.1 Introduction

The first chapters in this project report have provided a basis for evaluating the five bulk water infrastructure projects conducted in Madibeng Municipality. This basis was supported by best practices derived from experiences and lessons learnt from labour-intensive programmes conducted both internationally and in South Africa. The previous two chapters documented, evaluated and analysed the findings from the five water projects in Madibeng Municipality and one of the major outcomes included identifying restraining and driving forces which affected the implementation of the project.

This chapter draws conclusions on the outcome of the research and provides crucial findings from the study. It then documents lessons learnt and provides recommendations for the planning, organising and implementation of future projects and programmes, based on the experiences from the projects.

6.2 Critical findings from the study

Critical findings from the study can be summarised as follows:

- In all projects evaluated, lack of appropriate and consistent data was found to be a stumbling block to achieving an accurate evaluation of the project. Understandably, at the time of writing the Municipal Infrastructure Grants reporting system was still not finalised hence the Expanded Public Works Programme indicators could only be reported once the system was fully operational. However, the delay in formalising a reporting system will result in information being lost or misplaced which will lead to inaccuracies in the ultimate reporting of the Expanded Public Works Programme on objectives achieved. This will result in a lack of confidence in the overall achievement of the programme hence undermining this initiative.
- The projects within the Municipality appear to be run on a project-to-project basis instead of the recommended phased approach as recommended by McCutcheon et al (2003). For example, even during the implementation of one, the Oskraal project which had more than one construction phases, there appeared to have been no transfer of information or experience from the one phase to the next. The

research has found no continuity between the projects despite them being managed under the same department in the same Municipality and by the same consultants.

- During construction disruptions in production resulted mainly from:
 - Negative influence on labour by the union representatives;
 - Late delivery of material from the client;
 - Too frequent rotation of labour teams; and
 - Absenteeism which was generally experienced amongst male labourers.

- The analysis of data based on actual and hypothetical information indicates that at least 980 mandays/km can be created if labour-intensive construction methods are used productively in bulk water infrastructure projects.

- In one of the projects evaluated, an emerging contractor programme⁴⁷ was found to be unsuccessful because all the trained contracting firms were not able to sustain their firms beyond the learnership phase. The reasons for failure were suspected to be the flawed and corrupt

⁴⁷ This emerging contractor programme was an initiative by Madibeng Municipality where emerging local contractors were offered an opportunity to participate in the Maboloka project and other future labour-intensive programmes. It should not be confused with the Expanded Public Works Programme's learnership programme.

selection process where friends and family members were selected as participants for the programme. This deprived enthusiastic entrepreneurs of an opportunity to be trained and gain experience.

- The project objectives were found to be too vague and there appeared to be no system to monitor or enforce achievement. At times, the objectives used such phrases as "as far a possible" instead of being specific about the number of jobs expected out of a project, which ultimately have to contribute towards the greater Expanded Public Works Programme targets and objectives. Most of the objectives had to randomly be deduced from different project documents and were seldom incorporated in the municipal project plans which determine what the projects should accomplish.
- The importance of the principle of linking payment to tasks, which is one of the major reasons for success for international and other local labour-intensive programmes, was demonstrated in the Madidi project where the local community refused to be paid for tasks completed, but insisted on being paid per day. As a result, production was extremely low and the cost to labour increased drastically. The contractor resorted to completing the Works with conventional methods and made a loss on the project because his estimates during tendering did not materialise during construction.

- Most of the case histories have revealed a lack of attention to important detail such as no effort to properly determine tasks or acceptable task rates which would have enhanced and made the labour intensive construction more efficient. It was noted from the case studies that the professional team (i.e. Client, consultants and contractors) were not thoroughly committed to achieving the broader socioeconomic objectives which were defined in the preliminary programme documentation.
- Lastly, it can be concluded that it is possible to create significant number of jobs in bulk water infrastructure projects without compromising the project budget or quality. This is so, provided the projects are planned; organised and managed in such a way as to create an environment conducive to the implementation of labour-intensive construction methods.

6.3 Lessons learnt and recommendations

Employment creation and poverty alleviation is one of the South African government's major priorities, and the Expanded Public Works Programme is one of the strategies to achieve the government's ambition to significantly reduce unemployment and provide skills for people. In view of the fact that they can offer skills and create more employment than conventional

construction methods while producing infrastructure of the specified quality, labour-intensive construction methods should be a technology of choice for projects and programmes relying on funding from government. However, this in no way excludes the invaluable contributions that could result from private sector projects.

In order for this to be achieved, a change of mindset and a shift away from traditional perceptions of labour-intensive construction is required. Instead of labour-intensive construction methods being limited to "special" projects, they should be seen as the primary method of implementation with conventional equipment based methods being used only as an alternative where the environment does not allow for the use of labour-intensive construction methods.

In order to facilitate this transition and encourage the use of labour-intensive methods, lessons learnt from previous projects and programmes could be used to forecast challenges in future projects and assist in finding mitigating measures prior to implementation. This would facilitate successful execution of projects. Based on the findings of the research, a list of lessons learnt from the evaluation of water projects in Madibeng was compiled and the lessons learnt include:

1. A memorandum of cessions agreement facilitates the payment of sub-contractors and suppliers

which leads to services and products being delivered on time, reducing delays on site.

2. A contract of employment should be signed with every worker to ensure that the employment conditions are understood and agreed upon prior to commencement of work. Similarly, sub-contractors should also have a contract.
3. Local councillors and trade unions should be involved in negotiations from early stages of projects. They could also be involved in the determination of tasks and rates and negotiations for condition of employment.
4. Capacity building and buy-in from all stakeholders will assist with the success of the implementation phase of the project. Community participation is vital at all stages of a project.
5. The duration of rotation of teams should be such as to allow for skills to be transferred and for the use of the acquired skills to benefit the project. If the rotation is too frequent, skills are lost with the arrival of a new team and the benefits of training do not contribute to the project.
6. Payment has to be linked to tasks in order to ensure acceptable productivity.
7. Sufficient time should be allocated prior to construction commencement in order to allow time for a thorough analysis of local resources which can be utilised during the project and hence improve on the participation of local communities.

8. High rates of absenteeism should be expected after payday, especially amongst male labourers. A penalty and reward initiative could be implemented to encourage consistency in attendance.
9. Timely delivery of material reduces idling time and discouragement of labourers.
10. The contractor should be paid on time in order for the labourers to in turn be paid on time to eliminate dissatisfaction, strikes and loss of support for the project by the community.
11. The Municipality should coordinate programmes/projects within the same area to ensure synergy between project processes.
12. The Municipality should set specific targets to be achieved by a project which are to be in line with the Expanded Public Works Programme objectives.
13. Fast delivery of services and infrastructure should not be prioritised over other vital objectives such as employment creation.
14. Appropriate and meaningful training is required to ensure that skills transfer occurs for the benefit of the programme/project, and also for the personal development of the labourers.

It is recommended that the above lessons learnt, together with reasons for success/failure from other international and local labour-intensive construction experiences, be referred to for guidance in execution

of future projects in order to avoid repetition of the same mistakes.

Beyond the achievement of the short-term objectives set by a project, the Municipality may have to also investigate long-term means of creating employment through activities such as maintenance, leak detection, efficient meter reading processes and data capturing for the installed pipelines. Such long-term programmes will not only create sustainable employment for some people in the local communities, but will also improve the efficient operation of the Municipality's water network system, hence good quality of services delivered.

In conclusion, the problems encountered during the five projects are not new or unique, but are resonant of those encountered in other projects both internationally and locally. At a national level the Expanded Public Works Programmes seems to have fulfilled most of the basic fundamentals and principles of large scale labour-intensive programmes, however, serious challenges are being experienced during implementation at Municipality level. At the inception of the programme implementation phase it was established that some Municipality representatives still did not understand the requirements of the Expanded Public Works Programme nor the principles and objectives of labour-intensive construction methods. It is therefore recommended that municipalities conduct an audit of the capacity and level of skills within the

relevant departments and then invest in establishing the required institutional capacity.

Similarly, it is also recommended that a proactive approach be adopted by training contractors and on-site supervisors who are appointed to implement labour-intensive projects. It should not be assumed that contractors will be able to handle such projects without appropriate training and support.

Also, it is the design and contract document that ultimately determines the method of construction and the actual number of jobs to be created during programme execution. It is therefore recommended that the selection criteria for appointing consultants should include demonstration of capability, innovation and commitment to support labour-intensive construction initiatives. This should be in addition to providing proof that the consultant has successfully completed a course on labour-intensive construction concept and principles. This selection criterion should have a substantial weighting in relation to other criteria such as cost.

Although this research has achieved its objectives, it has not dealt with other vital issues such as evaluation of quality, operation and maintenance of the created infrastructure and the social impact of the projects on local communities. Further research could be conducted to determine how the projects affected the

communities and how the skills and experience acquired during the labour-intensive construction projects have affected those who partook in the projects.

Lastly, the seemingly higher cost and endless problems encountered during labour-intensive projects could lead to stakeholders opting to revert to conventional construction methods. However, unemployment, lack of skills and poverty remain an undisputable reality in South Africa. Labour-intensive construction methods remain one of the avenues in the construction industry which has a potential to create employment for the large unemployed labour forces with low levels of skills. As a result, reverting to conventional construction methods would not only retard substantial progress already made towards the use of labour-intensive construction methods in the country, but would also deprive the nation of a practical opportunity to alleviate the chronic unemployment problem. Therefore practical solutions need to be found within Municipality to mitigate the problems which arise from implementation of labour-intensive programmes and projects. Furthermore, these should be made "conventional" and become the construction method of choice for every project, where feasible.

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