Monitoring Labour Creation

Monitoring Labour content of items in labour intensive construction projects

Authors:
Jesse Brandsma
Jan Willem Groefsema

Supervisors:
Prof. R. McCutcheon
Mrs. A. Fitchett
Ir. A. Hartmann
Dr. Ir. S.J. de Boer

Studies:
Industrial Engineering & Management
Civil Engineering & Management

University of Twente
Drienerlolaan 5
Postbus 217 Enschede
The Netherlands

Internship report for:
WORK Research Centre for Employment
Creation in Construction
School of Civil and Environmental Engineering

University of the Witwatersrand
Private Bag X3
WITS 2050, Johannesburg,
South Africa

Date:
14-3-2007

Version:
Version 9

Preface

This report is the outcome of an internship research assignment done on behalf of the WORK Research Centre for Employment Creation in Construction at the University of the Witwatersrand, Johannesburg, South Africa and the Expanded Public Works Programme. This internship is part of our Masters Civil Engineering & Management and Industrial Engineering & Management at the University of Twente, Enschede, the Netherlands.

The research assignment concentrated on the development of a method to calculate and capture the labour content of labour intensive marked items in the general Bill of Quantities. The Gundo Lashu ("Gundo Lashu" is a Venda word meaning "Our Victory" or "Victory is ours") project in the Limpopo province was used as input from practice to develop this method. The Gundo Lashu project provided us with great insight into labour intensive construction projects. During our field studies we visited several sites and interviewed different actors within the project. These visits provided us with useful information for the development of the method.

We would like to thank Professor R.T. McCutcheon for this opportunity and for his ability to motivate us when we lost track of what we were doing. We would like to thank Mrs A. Fitchett who supplied us with very useful comments and suggestions, who made us think about what we were doing and who was able to make us smile with her stories about her students, cars and all the other subjects she spoke about. We would like to thank Mr. M.R. Lieuw Kie Song, who unfortunately was not able to attend our final presentation, for his criticism and support. We also thank Mr. Niel Swartz from the Road Agency Limpopo for his extreme hospitality, help and information he provided during our field study in Polokwane, Limpopo.

We thank ir. A. Hartmann, dr. ir. S.J. de Boer, ir. F.L.M. Taylor Parkins, Mr. H. Quainoo, Mr. M. Laubscher of Misha Consulting cc, Mr J. Hongve from ILO ASSIST, Ms. Mapula and Mr. I. Mulaudzi from Road Agency Limpopo, Mr. D. Rosslee from Mosomo consultancy, Mr. J. Grobler from M&G consultancy, Mr. S. Matjiu from BKS consultancy and Mr. Ned from Maraka Pula construction for their support and hospitality. We would like to thank everybody else who we forgot to mention but who supported us during our internship.

We noticed a great commitment to labour intensive construction methods from every person we spoke to. We sincerely hope that this commitment stays and brings people together. We would like to wish everybody the best for the future and we hope that the term ‘labour intensive’ will be become common practice in South Africa.

Johannesburg, December 2006

Jesse Brandsma

Jan Willem Groefsema

Management summary

This research developed an easy to implement and to use method, which will enable the Expanded Public Works Program to capture the correct labour content figure of labour intensive marked items in the Bill of Quantities of a labour intensive construction project. The method was designed with the use of practical information from the Gundo Lashu project, Limpopo province and with the help of design conditions derived from international literature about monitoring & evaluation systems and labour intensive construction practices.

The goal of this research is dual.
"To design a system by which LC of random LI projects can be planned, steered and evaluated in different phases of the construction."

And,

"To give recommendations on how to implement this M&E system in an effective, efficient, reliable and consistent way."

Firstly, a literature study was conducted to find design criteria in order to correctly measure and adjust the labour content for individual items. Secondly, international literature on productivity measurements and calculation methods for labour content were analysed. Thirdly, a fieldtrip was conducted to find the productivities and labour content for items in the Gundo Lashu projects. At the same time the organisation around and the relationships within the Gundo Lashu projects were analysed with the use of a stakeholders' analysis. Fourthly, the information about productivities, design conditions and organisation of the Gundo Lashu project was used to create a method that is able to measure the labour content of a labour intensive marked item.

Conclusions
The calculation of general labour content for a labour intensive marked item proved undoable due to variations in project conditions, available resources, restrictions in time & costs and the project organisation. The Gundo Lashu projects did not provide any productivity rates other than the ILO standards. No database was kept to improve productivities or to document agreed productivities. This shows the need for an incentive to keep track of these numbers.

Therefore it can be concluded that each project needs to be able to design its own labour content goals. It is clear that the use of tenders has to be integrated in this method as it is an official planning document for the labour intensive project and because it includes all agreements between the contractor and the client. Several methods were developed but the method to have the contractor fill in a minimum labour content proved superior to the other designed methods. This method gives incentives to the contractor to improve his labour content, which is important to the goals of the Expanded Public Works Program. It has the advantages that it is integrated in the construction processes, it can be implemented easily, it can initiate an industry of labour content techniques and acts as planning and steering mechanism for clients. Its disadvantages are that it needs a competitive market and competent contractors.

Recommendations
The method has to be implemented together with preliminary targets. These targets will provide shadow labour figures that can help clients to evaluate their tenders. This has to be developed further in order to create feedback loops between practice and the calculation outcome of the consultant. More research has to be done on the reward system used and on the best tender system for labour content. Also a system should be researched that can measure labour content quickly and correctly with the minimum possibility of fraud. A first step in this direction has already been taken, but needs to be developed further.

When the recommendations are taken into account this method can work in practice. It provides EPWP with correct information about the labour creation in labour intensive construction projects.

List of Abbreviations

ACI	Agile Construction Initiative
BoQ	Bill of Quantities
CETA	Constructions Education and Training Authority
CIDB	Construction Industry Development Board
CLO	Community Liaisons Officer
DOL	Department of Labour
DPW	Department of Public Works
ELHUS	Excavation, Load, Haul, Unload, Spread
EPWP	Expanded Public Works Programme
Framework	Net Job Calculation Framework
GDS	Growth and Development Summit
GL	Gundo Lashu
ILO	International Labor Organization
LBT	Labour Based Technology
LC	Labour Content
LI	Labour Intensive
M&E	Monitoring and Evaluation
MB	Machine Based
MIG	Municipal Infrastructure Grant
PIG	Provincial Infrastructure Grant
RAL	Road Agency Limpopo
RARP	Rural Access Roads Programme
TA	Technical Assistant
LBT	Labour Based Technology
PPPD	Per Person per Day
PPD	Person per Day

Table of Contents

1 Introduction

This research is conducted on behalf of the WORK research centre. The WORK research centre explores ways and means to generate employment in the provision of infrastructure. This research is a contribution to this objective. The research presented here will try to develop a way to establish the labour content of labour intensive marked items in the Bill of Quantities. It also aims to develop a way to use the method in practise and to act as a monitoring and evaluation method.

In this report the following steps will be taken. First the context of the problem, the problem and the approach to solve the problem will be outlined and explained. In the third chapter theories and the approach to collect the necessary data will be explained. The fourth chapter will present the result of the field study and the confrontation of this with the theory. The confrontation between the field study (the practical data) and the theory (conditions) will lead to a way to measure the labour content and to the design of the method.

2 Context

In this chapter the background of the country of South Africa will be outlined. The political situation in earlier days has been of great influence on the current construction industry. The Expanded Public Works Program is a result of the legacy of the past.

Economical & social background
South Africa is a country with large differences between regions, people and cultures. It is often described as a combination of a first world country with a third world country. It upholds western standards in the big cities while just outside these big centres some third world practices takes place. One of the biggest problems is the high unemployment rate and subsequently high crime rate. Taking in account both the formal and informal sectors, unemployment amongst the economically capable has grown from 7% in 1980, through 18% in 1991 to between 27% and 37% in 2001(McCutcheon & Taylor Parkins, 2003).
Reasons for the problems and the large differences can be traced back to the legacy of the past and to the inadequate economic growth with a lack of investment. Because of this legacy most of the South African population lacks skills and education. This prevents people from participating in the economy effectively. It is general knowledge that over 50% of the South African population lives below the poverty line.

The construction industry of South Africa
In general the current South African construction industry has two main streams. One stream considers a small group of very large construction companies whom control the biggest percentage of the money flow. This group of large sized contractors adopts western Machine Based (MB) constructing methods. Although they are the largest contractors in South Africa, they earn 70 percent of their revenues in foreign countries and are therefore a powerful force within the South African construction industry. In the South African construction industry there is an uneven balance between these two streams resulting in less competition. Because of the legacy there is a high backlog of Public Works projects. An estimate is that about 400 billion Rand is needed to tackle this backlog. Of course, it is in the interest of South Africa to do this with as much labour as possible in order to boost the economy.

Labour intensive construction methods
Labour intensive (LI) construction methods are a different kind of construction techniques and methods than normally used. They are designed to incorporate as much labour as possible without compromising efficiency and economics. This is done by using locally available resources (e.g. materials, tools and labour) as much as possible by using specific design methods and construction techniques. LI methods were designed and improved during the seventies and eighties. Several projects in Honduras, Kenya, etc showed the successfulness of these methods.

In South Africa it remains difficult to implement these methods in the current construction industry, because the industry has invested in machinery and are forced to earn a return on these investments. Therefore the use of machinery in the construction is of great importance to these companies. Because Labour Intensive (LI) methods have no visible financial advantages to in their companies' strategy, these are not considered or even opposed. The other stream consists of a very large group of small contractors who take the rest of the money flow for their account. These small companies are able to use LI construction methods as a part of their strategy. One of the main goals for the EPWP programme is to convince the large construction companies that LI items can be profitable for their construction projects. It will then be possible to implement LI projects on a larger scale.

International efforts for LI methods
The International Labor Organization (ILO) is the worldwide organisation who promotes decent work for all. It is an agency of the United Nations formed trough the negations of the Versailles Treaty. Initially it was an agency of the League of Nations, but after the Second World War it became the ILO. The main target of the ILO is to: create employment, improve working and living conditions, provide information and training opportunities, on a global basis. Since the Second World War a lot of programs started in less developed countries to bring down the unemployment number, and a lot of these programs claimed success in achieving this goal.

In the early seventies the ILO and the World Bank conducted a research which provided the intellectual basis for further investigation in South Africa. The first research they did was mainly carried out in Asia and later on in Sub-Saharan Africa. Since the first research, large scale infrastructure construction and maintenance projects have been done in countries like Kenya, Lesotho, Botswana, Malawi and Ghana.

The South African government asked the ILO to help setup LI projects for low volume roads in South Africa as part of the EPWP programme. Now, ILO consultants give road agencies and other clients' technical advice and financial help. They give technical assistance and help to communicate the methodology to municipalities.

EPWP programme
To counteract the unemployment problems, the government of South Africa initiated a nation wide programme called Expanded Public Works Programme (EPWP).The EPWP is one of the initiatives from the Growth and Development Summit (GDS) in June 2003 and is now a GDS programme. This programme is designed to contribute to the governments' intension to alleviate poverty and to reduce unemployment. The programme covers four sectors: infrastructure, environment, social and economic sectors. Its goal is to create jobs on short/medium term and to provide people with better chances for a job on the long term through the use training and education. The long term goal of the government is to have enough economic growth to support these trained and educated work seekers.

In the coming five years the department of public works needs about 150 Billion Rand for infrastructure projects. Roughly 10 percent of this amount, 15 billion Rand, is set aside for EPWP infrastructure projects. This makes the infrastructure sector the biggest sector (in allocated resources) within the EPWP programme. EPWP infrastructure projects utilize labour intensive construction methods to create employment and to train people. Labour intensive construction methods have been optimized and used since the seventies and are actively supported by the World Bank and other international organisations as one of the means to counteract unemployment in third world countries. The method uses designs and technologies that incorporate locally available resources such as gravel and labour. E.g. the use of hand compressed tiles for houses or the compaction of earth using hand tools. Because of the low costs of these resources the method can compete with other conventional methods while creating more employment. The government of South Africa chose this method because of these advantages. Labour intensive construction methods will be explained in more detail further in this report.

The funds are in most cases used to improve and expand the infrastructure (labour intensive suitable infrastructure) in mostly rural areas. The EPWP programme targeted to create 900.000 job opportunities before June 2008 in the infrastructure sector. One job opportunity is defined as:

"Paid work created for an individual on an EPWP project for any period of time. The same person can be employed on different projects and each period of employment will be counted as a job."(DPW, 2004)

The Department of Public Works (DPW) is coordinator of the EPWP programme. They work together with important departments in the other sectors. Because EPWP is such a broad and big program, numerous departments are involved in the execution and planning of the project. While the department of public works is the overall coordinator, the responsibility for the infrastructure sector funds is delegated to the provinces and the municipalities. They are responsible for setting priorities, for the allocation of funds and for meeting the conditions set by EPWP. Because the programme has a two goals: provide employment and training people the Department of Labour (DOL) and the Constructions Education Training Authority (CETA) are responsible for setting up training and learnerships for the employees. The figure below gives an overview of the structure of EPWP.

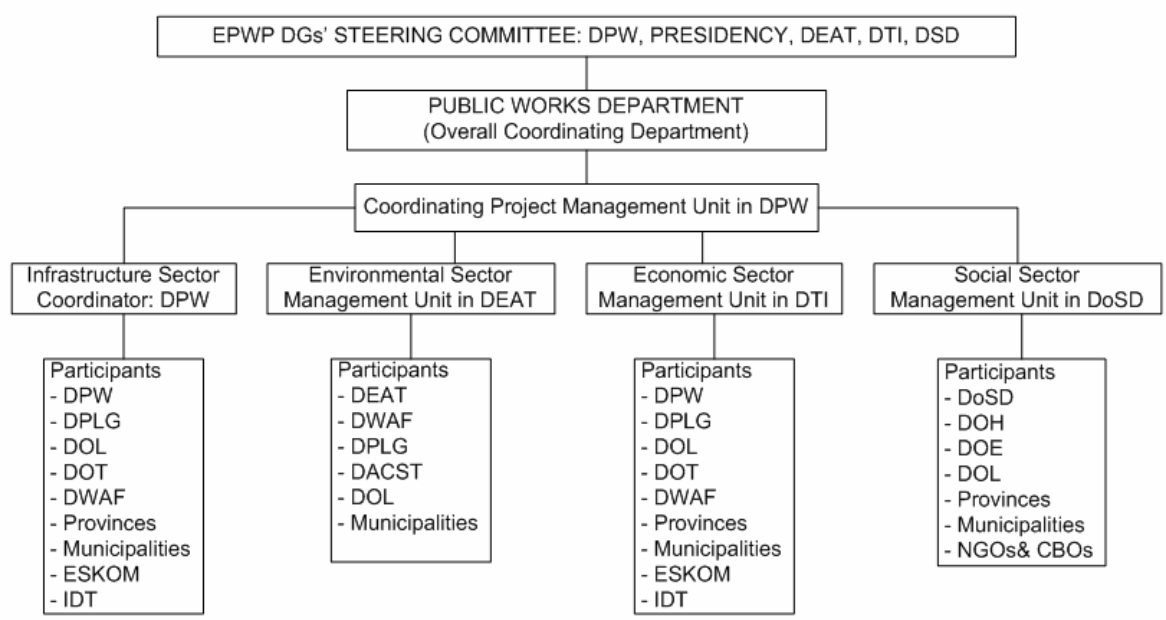


Figure 1 Coordination structure EPWP (Department of Public Works, 2004)

Results of EPWP so far

Before the start of the programme several projects with labour intensive construction methods were already up and running. At the start of EPWP the lessons learned from these test projects were used for new projects. At the end of the first year the government declared that EPWP was a great success and published it nationwide. After the first two years and after all the media attention people (for whom the programme is intended) started to ask questions about the effectiveness of the programme. Most people never saw the programme in their neighbourhood or never heard somebody work for the programme. The intended multiplier effect of the initial projects is not visible or present yet. The problems for not reaching this effect are very divergent. The backward linkages to local communities may not be present, no new projects are initiated (or fail during execution or initiation), the scale of the programme is too small, the job opportunities are not present, etc. One of the main goals for the EPWP is to achieve the multiplier effect to make the programme a success and cut down the unemployment rate.

The WORK research centre is part of the University of Witwatersrand and is an independent research facility for labour intensive research questions. It works in close cooperation with the government and is funded trough the research budget of the university and its clients (EPWP, DPW). From the WORK research centre a commercial subsidiary called LITEWORKS was developed. LITEWORKS sets up and develops training and educational programs for emerging contractors.

Conclusion

There is a large political drive and high economic need to make labour intensive construction methods successful. While the political drive is high, the rural culture hampers its implementation and offers the conventional industry grounds to delay implementation of these methods in their practices. Culture has been defined and is still ruled by the old regime. Low educational levels, missing work ethics and opportunistic behaviour of politicians influence the success of labour intensive construction in South Africa. The power of the conventional industry delays the implementation and use of LI construction methods.

3 Problem definition

The introduction and context gave a brief overview of the research question and the general approach that will be followed. In this chapter the problem and research approach will be made more explicit.

3.1 Problem identification and formulation

Conventional industry and labour intensive methods
In South Africa attempts are made to convince the powerful first world construction industry to get involved in Labour Intensive (LI) construction projects. The large backlog of projects asks for a more integral approach and thus for bigger contracts. It is the goal to do this with LI construction methods. Therefore, the big contractors need to be involved to provide the management skills for contracts of these sizes. Contractors that have been trained in LI techniques can profit from the management skills of these big contractors. This may lead to a more mature LI construction industry. The conventional industry has a preference for machine based construction still and argues that labour intensive methods are more costly that their own methods, that they are less efficient and that the LI methods do not provide enough benefits.(Mosch, L.P.J., Boer, S.J., Rietjens, S.J.H., Vis D. van de,2000)

Because this scepticism several attempts, internationally and in South Africa, have been made to prove that labour intensive construction is a viable option. Therefore comparisons were made of machine based projects with similar projects done labour intensively. Almost all of these comparisons have been made on the overall level of projects, looking at financial costs, economic costs and social costs. Financial costs are the tender costs and the actual realized costs, economic costs are the financial costs but adjusted for real wage rates and social costs adjusted the costs for benefits to the surroundings.
Often these comparisons show that machine based projects were financial better than labour intensive projects, but that labour intensive projects outperformed the machine based projects almost in all situations on social costs and in some situations on economic costs. These comparisons prove that labour intensive projects create more job opportunities than MB projects, but at the same time the comparisons are criticized for the way that they compare these projects. Projects are difficult to compare because of locations, ground conditions, contractor skills, differences in design and the differences of the use of technologies. They are also difficult to compare on costs because of differences in start-up costs, differences in productivities, imbedded procedures of MB technologies & the already existing investment in machines.

Comparison of Labour intensive methods with machine based methods
In the past, several studies have been conducted to see how LI projects should be compared and how conclusions can be drawn from these comparisons. One of the conclusions was that not one of the methods is the best for all situations. Projects have to be evaluated on their own merits (IBRD, 1986). In order to compare project costs, a case study in Benin showed that they had to compare the projects on activities instead on costs per km (IBRD, 1986). The breakdown of costs in activities makes it possible to compare different types of projects with each other. Activities remain (almost) the same for different projects.

To assist EPWP in their effort to compare MB with LI, the WORK research centre has the goal to be able to objectively compare individual projects. Their goals officially state:

- *To carry out multi-disciplinary research into technical, organisational, management, economic, social political and institutional aspects of labour-intensive construction.*
- *To disseminate the results of the research, particularly the implications for the planning and implementation of employment creation programmes; and*
- *To develop skilled human resources in the field of labour-intensive construction in particular and in the field of development in general.*

The research of S.D. Philips (1993) done at the WORK research centre showed that comparison of activities needs to concentrate on potential labour intensive activities that have a high proportion of the direct project costs.

The activities that have been identified as potential labour intensive are the Excavation, Load, Haul, Unload, Spread activities (ELHUS). The WORK research centre started to compare projects on standard ELHUS activities and tried to establish a labour cost ratio for LI and MB methods. They tried to establish this for items on the Bill of Quantities. Each item on a Bill of Quantity consists of several activities and only the items that contain the ELHUS activities are used. The Bill of Quantities that is referred to, is the standard Bill of Quantities designed and used by most of the Sub-Saharan Africa countries. It is regularly adapted and improved. Large amounts of data on projects have been gathered and several attempts have been made to draw conclusions about the labour ratios and costs in projects using this data. However, no clear conclusions have been drawn yet about labour costs and labour ratios.

Problems with the comparison
Several problems arise when these comparisons are made. The comparison is based on rates and is therefore influenced by different calculation methods, e.g. overheads, profit allocation. There is no new information on rates of machine based activities. The current industry is reluctant to provide this information. The available information on machine based activities does not provide any information on the build up of these rates; what is included in these rates? Also, LI projects do not have this information and do not keep this information consistently. South African LI projects do not have information on productivities and the amount of labour used for each item or even for each activity.

Not only are projects difficult to compare, in practice EPWP has problems to prove that the investments into their projects and in their LI construction projects, do provide extra job creation. They have to prove to the public and to the government that the investments generate enough employment. Therefore they need to be able to see how much employment is generated for each amount of money invested. This has to be compared with machine based construction projects in order to see the extra benefits. Now EPWP is not creating enough sustainable employment with labour intensive projects. They do have information on the amount of labour created, but they are not able to steer this or to see whether the amount created is sufficient for the amount of money spend. An analysis of the projects can lead to more insight how employment and especially sustainable employment can be improved.

Research goals
EPWP needs to find a method that will help them ascertain the labour creation of labour intensive projects so that they will be able to inform the public about their progress. Because of the difficulty to compare MB and LI projects, they concentrate their efforts on the Labour Creation (LC) in LI projects only. One of the problems is the way how this labour creation should be measured. The WORK research centre started a preliminary research about how to do this.

WORK research centre Framework
In 2005 Bonnard, Smulders & De Vries designed a Net Job Calculation Framework (Framework) which can be used to recalculate Machine Based (MB) items into Labour Intensive (LI) items. Their Framework takes the Bill of Quantities as a starting point and calculates the labour content for different items. The labour content is given in person days. It only looks at items that are potential labour intensive. These items have a high portion of the project costs and contain ELHUS activities. They calculate the labour content by looking at the rates for those items and dividing these rates by the wage rate. They compared this with MB labour content. The difference between both labour content is the net job creation.

In their research they gave a critical review on the reporting process of EPWP Infrastructure projects which resulted in this framework. They argued that this framework could be used by the government, private contractors and consultants to plan monitor and evaluate infrastructure projects on labour content. Each project has a monthly Bill of Quantity that can be used to say if enough labour is created in that project for that month. They tested the Framework on available data from different sources. Their findings were that there is no data available about how the rates are derived. How

much of the rate goes to labour? The framework can only compare the difference between 100 percent machine based use in projects and 100 percent labour based. This is because the rates cannot be broken down into a labour component and machine component. This information is not available in the Bill of Quantities. Also, the rates differ per project because of their uniqueness and they found it difficult to find a standard rate for each item. The direct goal of the new framework was to become a planning, controlling and evaluation tool that can be used by different stakeholders to assess what the labour intensive targets (job creation) of their projects should be.

Although the WORK research centre started this research with this direct goal, their ultimate goal is to compare the LI projects with MB projects. They realised that they first have to concentrate on the amount of labour in LI items of LI projects.

Research objectives
The overall goals are to obtain the LC of LI projects and to be able to compare this with the LC of MB projects in order to prove the effectiveness of the LI construction techniques and principles.
Translated into our research, the following contributions to the overall goals are being envisioned:

1. *To design a system by which LC of random LI projects can be planned, steered and evaluated in different phases of the construction.*
2. *To give recommendations on how to implement this M&E system in an effective, efficient, reliable and consistent way.*

In order to design the M&E system it needs to be aligned with practice to ensure its success. The Gundo Lashu project is a project in the Northern Province Limpopo that can provide correct and accurate project data for further analysis and for the setup of the M&E system.

3.2 Research model/strategy
To reach the objectives as stated above, a research model based on the research design by Piet Verschuren and Hans Doorewaard (2003) was constructed. Below the research goals of our subjects are stated.

An analysis of international literature on the calculation of productivities within labour intensive construction projects, international standards on monitoring labour productivities, ILO calculation methods for LC and other additional documents, will provide the criteria for the calculation of LC.

Monitoring & evaluation theories and organisational theories will provide the design and implementation criteria for the M&E system. Together with the LC calculation criteria these will provide the theoretical design criteria by which the M&E system has to be developed.

Available projects documents and interviews with relevant actors will provide insight in the project construction process. These insights will be combined with the theoretical design and implementation criteria to obtain the criteria for the design of the M&E system.

With the help of these criteria several alternative M&E systems will be designed and evaluated. This will lead to the choice between these M&E systems.

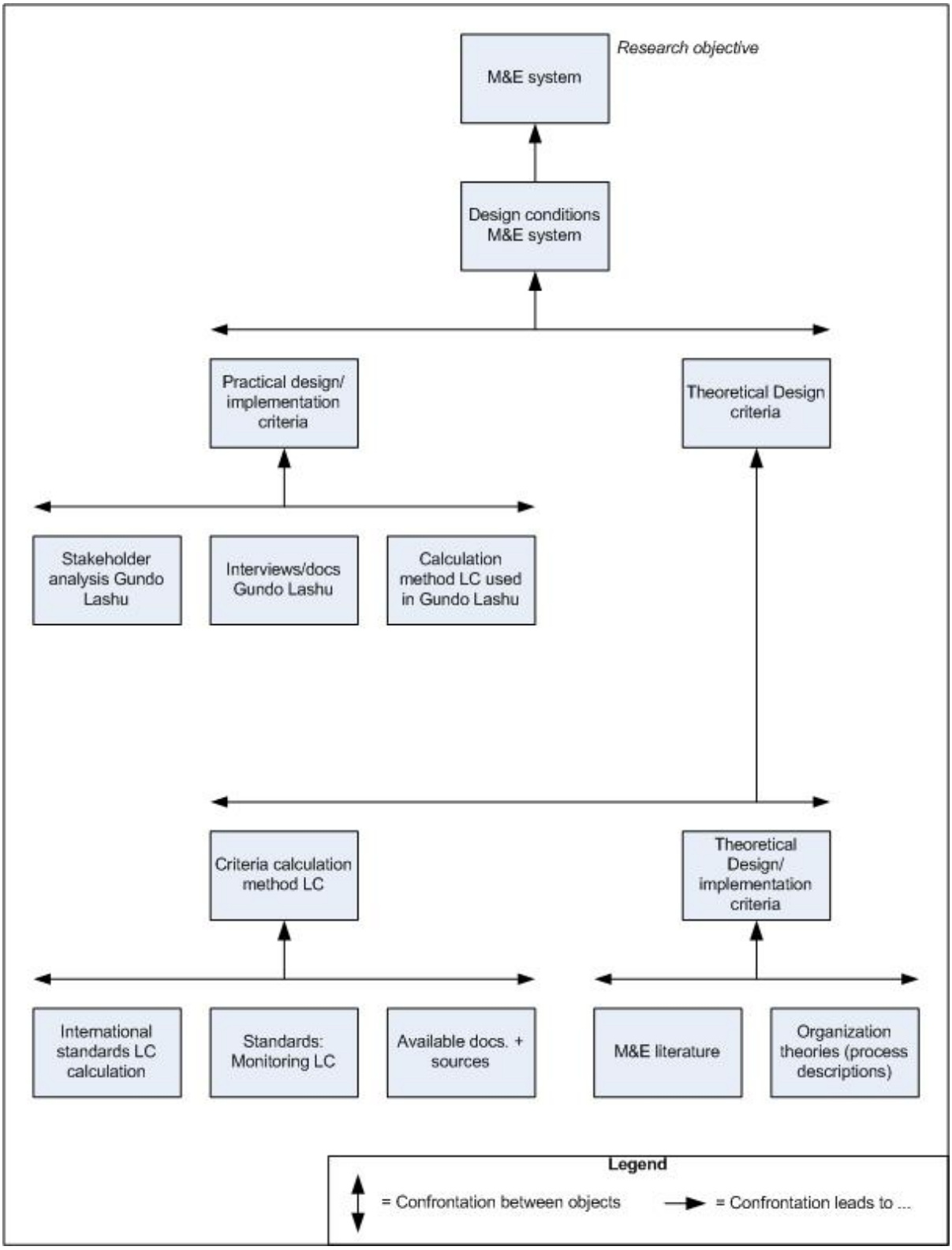


Figure 2: research model

3.3 Research questions

Main research questions
The objective is to design an M&E system for the labour content of Labour intensive road construction projects that can be implemented in practice. The following research questions are derived from the model and the objective.

The main research question is: What are the design/implementation criteria for a M&E system of LC in LI projects?

Sub research questions
To answer the main research question, sub research questions have been formulated. These are:

1. What are the theoretical design/implementation criteria for a M&E system
2. What are the practical design criteria?

Sub sub research questions
The sub sub research questions have been derived to help answer the sub research questions and were used as a general guideline in the research. These questions are not answered directly in this report.

4 Literature study

To design and implement a method which can establish the labour content for LI projects, literature and past experiences are reviewed. This chapter will describe and explain these findings. They will be used to compile a set of conditions by which the method will be designed.

Literature on the calculation of task rates for LI projects is concentrated in ILO literature and practice. This is the main source of information on this subject as the ILO is the leading research institute for labour intensive construction methods.

The literature research on Monitoring & Evaluation (M&E) systems concentrates on design criteria for M&E systems and on criteria for the successful implementation of this system. An initial search for available literature delivered a wide range of literature on M&E systems. With the time available, and the method being specific, the search had to be restricted further. The literature research concentrated on benchmarking criteria, information systems requirements and strategic management issues for the following reasons. Because the method has to act as a baseline, its function is similar to that of an internal benchmark. Experiences in benchmarking and benchmarking techniques provide helpful guidelines for the design of this method. Information systems requirements provide criteria for data collection and data processing as this literature body focuses on actual implementation of Information Systems. Strategic management is concerned with the planning, execution and evaluation of strategies. Because implications of strategic management are visible on operational level it is also concerned with the planning, execution and evaluation of methods on operational level. Because the goal of the method is to work on operational level specific parts of strategic management literature can be used to see how this method should be implemented in practice.

First, the international task productivities will be reviewed. This will provide insight in how they are derived and which are important. Second, ILO literature on monitoring and the assessment of productivities will be reviewed. This will explain the current situation of monitoring of labour content. Third, international literature about M&E systems, information systems will be reviewed that will provide conditions by which the M&E system will be developed. Fourth, organisational theories will be reviewed in order to find a method to describe relevant aspects of the project organisation. This will provide conditions for the implementation of the method.

In the following chapters different notions are used that are closely correlated. These notions are defined in appendix H. The relations between the most important definitions are explained in figure 7 on page 32. Below, the most important notions are defined.

4.1 International standards LC calculation

Each road construction project in South Africa is built up around different items. These items are defined as the standardised parts of the construction project used by all consultants. Each item can consist of a single or several different activities. An activity is either a single task, team task or a group of tasks. A task is a measurable amount of work done by a single worker per day for a certain activity, a team task is a measurable amount of work that is completed in one day work by a certain number of workers for a certain activity. The choice of setting tasks is with the constructor and depends on the nature of the activity and, or the production process. In the following figure a decomposition of an item is given.

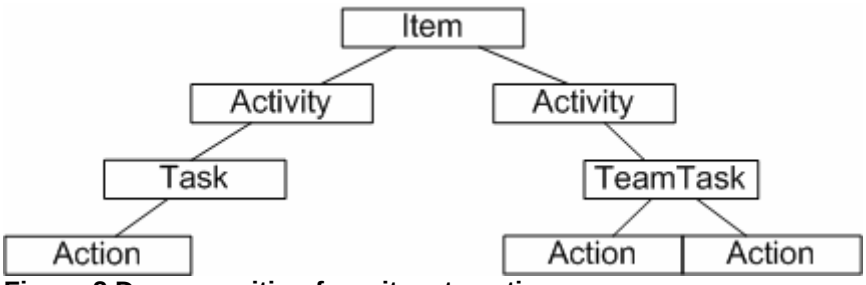


Figure 2 Decomposition from item to action

For each different activity, in this case the activity being the same as a task, a different productivity is assumed. This depends on the nature of the activity, the process that is used for this activity, the environment and the tools used. The productivities are differentiated, but do not state enough information about the circumstances under which these productivities have been derived. It will be a random guess to determine the correct task rate. Important is to determine which level of productivity can be used as a general measurement as projects differ in nature and productivity rates vary accordingly.

Comparing international productivities
Several sources are available about productivities for labour intensive construction activities. The most described activities are ELHUS activities. Most documents get the productivities from several well known field studies: the Kenya rural access road programme (RARP), Lesotho, Nepal, etc. These productivities are somewhat ambiguous as they do not state under which conditions these have been achieved.

Most productivity has been measured on activity level such as excavation, loading, unloading & spreading. These activities can be linked directly to items such as pavement layering or gravelling. The activities have several different actions included which are too difficult to ascertain, but do have a considerable effect on the productivity of the activity. E.g. excavation exists of digging, lifting and throwing or even loading. It matters if the lifting has to be done under or above waist. Also, the soil where to dig in differs per situation and can influence the productivity substantially. Other conditions that influence productivity are the tools that are used. Some activities require machines in order to get the right quality or to achieve an optimum process flow. The problem with the identified activities is that they do not take into account the differences in productivities caused by circumstances for each action. E.g. excavation included throwing distances in s2ome instances, but in other cases the productivity rate only states 'including loading'. This makes comparing the productivity rates difficult as causes for differences between productivities are hard to identify.

International productivity rates for excavation per day

Source	Soft m^3	Medium m^3	Hard m^3	Very Hard m^3	Rock m^3
ILO productivity. Norms (Stiedl D. (1998))					
Recommended value	5.0	3.5	3.0	2.0	0.8
RARP	5.5	4	3	2	-
Lesotho	4.5	3.5	2.75	1	0.5
McCutcheon & Simpson					
Excavation to level (<0.25m)	5.0				
Excavation to level (>0.25m)	4.0				
De Veen					
Throwing distance (0-4m)	5.0 – 6.0	3.5 – 4.5	2.0 – 3.0		
Throwing distance (4-6m)	4.5 – 5.5	3.0 – 4.0	1.8 – 2.5		
Throwing distance (6-8m)	3.5 – 4.5	2.5 – 3.5	1.7 – 2.5		
*ILO Supervisor manual Zambia (*Stenström T. (2004))					
Task rate for excavation to level	3.0 – 4.0				
ILO contractors manual Zambia (Tembo S., Blokhuis F. (2004))					
Excavation insitu gravel	1.6 – 2.4				
Excavation loose gravel	2.0 – 3.0				
Exavation to level	3.0 – 4.0				
CETA contructor supervisor manual (CETA,(2005)					
Throwing distance (0-4m) loose	5.0 – 6.0				
Throwing distance (4-6m) loose	4.5 – 5.0				
Throwing distance (0-4m) sticky	2.0 – 3.0				

Throwing distance (4-6m) sticky	1.5 – 2.0		
Throwing distance (0-4m)		3.0 – 4.5	1.5 – 2.0
Throwing distance (4-6m)		2.5 – 4.0	1.0 – 1.5

Table 1 International productivity rates for excavation

The table above is a compilation of productivities per day from different sources for excavation. It shows that different norms are upheld to measure productivity. Differences between productivities are categorized, but these categories differ per source. E.g. ILO norms use a very hard soil type as a category while the RARP does not. De Veen and CETA include throwing distance while others do not. The CETA upholds the same productivity norms as the Construction Industry Development Board (CIDB), actually they are identical. There are different types of excavations that need to be considered. Excavation of gravel in a borrow pit has other productivities than excavation along the roadside that is thrown on the centre line of the road. However, as in normal economics, it is not worthy to investigate all these little differences. E.g. while ILO says that discharge circumstances are not of great influence, there are larger differences visible looking at the productivities measured by De Veen and CETA.

Looking at other activities such as spreading and unloading the productivities are often combined and measured together. A plausible reason for this can be that these activities are dependent on each other. If the truck or donkey cart arrives, unloading can start. Looking at these activities separate, the unloading is influenced by the type of truck used. A tipper trailer can unload without help of labour. A trailer without side doors has a significantly lower unloading productivity than one with side doors. Also if wheelbarrows are used, unloading is included in the haul and not in the spreading. The use of the transportation means must be left to the contractor as he or she has to decide which option is most feasible and cost effective. Spreading can be seen separately if there is enough supply of material. Again, enough supply is the responsibility for the contractor. Spreading of different substances for different purposes have different productivities. Spreading of chips for seal requires more attention to the distribution of the material because of the riding surface, than the spreading of a sub base.

The productivity rates for the different tasks differ considerably as well as the aggregation level that is used to measure the productivity. There is no standard method on the level of measurement and the differences are large enough to make a difference in practice. The conclusion is that project circumstances influence these general productivity rates considerably and they should be taken into account.

4.2 Monitoring LC in LI projects

Earlier experiences with labour intensive construction projects are available from programs executed in different countries which can provide useful insight into the best practices for management and evaluation systems. One of the most important and successful implementation of labour intensive construction projects was the Rural Access Roads Programme (RARP), Kenya. This project is seen as one of the best in Africa and it has been evaluated intensively by the ILO and other institutes. ILO literature is reviewed to see if practical information about labour management and monitoring systems is available.

The ILO produces extensive literature on labour intensive programs. The most information about labour intensive project structures, monitoring & planning techniques is found in manuals for supervisors and contractors (2004). These manuals are recent and provide detailed information about daily worksheets, activities and the execution of work. Also the ‘green book’ has guidelines for contractor development which contains best practice guidelines on the relationship between the contractor and the contracting agency. There is information available on a management reporting system developed for Kenya (unfortunately no evaluation of this reporting system could be found) which could help see what kind of system is needed in practice.

*ILO green book (*Bentall P., Beusch A. & De Veen J., 1999)
The ILO ‘green book’ underwrites the importance of action and feedback by the appropriate manager. Good planning, monitoring and reporting (and it is the authors opinion that feedback should be

included) is seen as a important, but often forgotten, function of effective management. The experiences with reporting and monitoring procedures are:

- The procedures need to be standardized;
- They have to be adapted to the private sector;
- They must be informative and comprehensive on essential issues;
- They need to target for action;
- They need to be given importance;
- They need to be produced on time;
- Computerized systems should be used with caution; and
- Omissions in data can hamper decision making.

This means procedures for reporting have to be standardized in order to provide information that is reliable and comparable with information from other projects without having to convert the information first. Standardizing procedures conflicts with several of the other experiences. Standardization can have the effect that situations falling outside the procedure cannot be measured and information will not be available for decision making (e.g. some missing productivity figures cause the contractor to adjust the number of equipment needed for the next day too high, loosing money). The procedures must provide information on essential issues and must be comprehensive as that it can lead to appropriate action. The following design criteria are derived:

- The contractor must be able and willingly to use it;
- The data must be on time, complete, informative for decision making and reporting to EPWP (on different levels); and
- The data capturing process must be standardized and integrated in the construction process.

*ILO Management reporting system Kenya RARP (*Ove Arup & partners Cipfa Services Ltd., (1987))
The management reporting system developed for Kenya shows some interesting features. The document gives an overview of documents used by different actors in the construction process on different hierarchy levels. The following interesting points were observed:

- The standardization is done by providing the foreman on site with a field book which he or she uses to keep track of the project;
- The muster roll (with all payment data) is separated from activities;
- Although the document concerns gravel road construction project (making it easier to compare activities with items), the gang sizes per activity are kept per day to make adjustments accordingly to measure progress. The progress is kept in the same document. However, it is noticed that this document is signed by the supervisor once per week questioning the truthfulness of the captured data;
- The planning calculation is spelled out for the local overseer and the supervisor can adjust the planning according to productivities;
- For every activity different types of forms are used because of the different type of calculations needed;
- Productivities for activities are aggregated to man days per kilometre for further analysis;
- Productivities for costs and machinery are calculated per kilometre and not per item;
- Causes of decline in productivities are not kept in the documents;
- The use of labour is separated in support and primary. Support are people not actively involved in producing, but nevertheless necessary for the process. People such as watchmen and water carriers;
- Labour content needed is adjusted to availability equipment; and
- Productivity circumstances are also not provided. The productivities are assumed without looking at all circumstances that can influence the productivities;

This document shows that productivities can be obtained with easy measurements and field books. However, the information about productivities is general and does not provide insight in how this productivity has been established. The included monthly report, did state the man days achieved but without the amount of achieved activity. It is assumed that it was done in this way because the goal of this system was to report on kilometre basis instead on activity basis. To calculate the productivities per month per activity, daily field reports with achieved quantities are needed. If this would be included directly, this would save an extra data request.

ILO small contractor & supervisor manuals

The small contractors' manual of the ILO for Zambia is an overall guidance manual for contractors constructing gravel roads. It provides information on project planning, execution and control. It uses a simplified reporting system than stated above. It captures data about item, activity, quantity output planned and quantity output achieved per day. It does not provide calculations for the best combination of equipment and gang sizes. It also lacks a proper feedback structure to higher hierarchies. And the origins of the productivities are unclear. The contractor manual states that knowledge about productivities is essential to the contractor for further tenders, claims and to adjust the process to optimum. The contractor should derive its own productivities from experiences and uses the international standards with caution. Opposite to the reporting system of Kenya (that is double checked by supervisors) the reporting system of Zambia is not double checked and prone to mistakes. The contractors' manual shows the following interesting points:

- It is the site engineer who is responsible for the cost control and measures this using productivity figures;
- The site engineer has to analyse the overheads as they are deemed established randomly for tenders;
- The daily site report that is sent to the project manager provides an overview of the work item and the used labour. This report is checked and approved by several actors before it is being sent to executive engineer. This report is made per work item.

The Labour Based Technology (LBT) supervisor manual of the ILO for Zambia (for the same type of projects as the small contractors manual explained before) provides some interesting details on the designed processes and the required productivities (unit of tasks per man day).

- They use a productivity table that has a range of productivity rates for a certain activity. It says the consultant (in their case supervisor) and the contractor have to agree on the task rates that will be used. The consultant has to check if these task rates are actually set. In this way the constructor is given the choice to use different processes to execute the activity. It is however strange that the consultant has to advise on task rates after tendering when the tender rates themselves are build up using task rates.
- Communication between the consultant and the contractor on site is usually done with site instructions, kept in a site instruction document. The purposes of the Site Instructions are to control the project, delegate authority and to order the use of provisional items to be carried out by the contractor. Instructions to the contractor are always given by the consultant and only given to the contractor. The consultant can make the people stop doing their job when responsible contractors' staff is not on site.
- Additional work (variation orders) can only be authorized by the client's approval. Variation Orders (VO) are works which have a big effect on the contract sum.
- Site meetings are conducted to review the progress of work executed in a time span of a month. The consultant is responsible for arranging this meeting and representatives of the client, contractor and consultant attend. Before the meeting these parties first take a look at the site to check progress. The consultant makes minutes and sends those to all relevant stakeholders. The consultant makes monthly, quarterly and yearly reports. These include:
    1. Contract details
    2. Summary of important dates
    3. Schedules of plant, personnel and materials on site
    4. Work quantities completed during the period under review
    5. Materials reports
    6. Programmed versus actual progress
    7. Financial progress
    8. Cash flow forecast.
- The contractor will be paid at monthly intervals. The work done will be measured and valued. After this, the Supervising Consultant will make an Interim Payment certificate, which is useful to maintain liquidity for the contractor as well. Final payments will be done after a joint inspection of the Supervising Consultant and the Contractor. Final payments are either done after termination or completion of a contract. The Final Payment Certificate is also made by the Supervising Consultant.

- The Supervising Consultant must regularly check the Contractors payment sheets to ensure that the Contractor does not underpay his workers. To check these payment sheets are true, workers have to confirm the amounts they got paid.
- Disputes can arise during a contract and need to be solved to keep up productivity. Disagreement is in most cases about issues related to Quality, Quantity, Payments, or programme of the work. The formal requirements of handling a dispute are:
  1. Time limits for rejection of decisions and referral of the dispute to a higher level; and
  2. All communication to be in writing and with notice to the other party.

  If the dispute cannot be resolved, they might appoint an adjudicator, and the arbitration procedure will usually solve the matter. If not, they may refer to take the matter to court.

Employment and high standard infrastructure
The book Employment and high standard infrastructure by RT McCutcheon & FLM Taylor Parkins deals with many issues related to employment based, or labour based, construction works. Several aspects of this book are important for the management & reporting system. These are:
- Several different types of organisational structures are presented with conditions of clear responsibilities, communications and roles. This might help identify the current sector but it is not the goal of this report to advice on this. It is only used to see how this method of measuring labour content can be implemented into the project environment.
- Their division of items into activities shows potential for planning and thus for the contractor and consultant.
- In their example they make the assumption that almost everything is done labour intensively, but they lack to mention which tools are used, distances between load and spread & etc. This shows the vulnerability of their method. Without knowing the tools and conditions no accurate productivity rate can be set and tasks are set unrealistically.
- Their method shows an easy way to calculate achieved tasks. Multiply the number of workers per activity with the days worked at that activity and you will get the number of tasks done. Divide output with this and you will get the productivity achieved.
- To give feedback of achieved productivities to higher levels of management, as to make adjustments for further use, this should be done with the mentioning of certain circumstances. The example stated in the book does not provide which are these circumstances.
- To determine the correct task description the following point should be included: What and Why? With what? How? How much? The ‘How question’ is considered an important question as it determines which level of investigation is needed to find correct productivities. E.g. is every loose action an activity? Do motions that belong together form an activity? Or is a set of groups of motions one activity? At which level should productivity be measured?(McCutcheon R.T.& Taylor Parkins F.L.M.(2003))

The reviewed literature gives several conditions that are important for the design of the system. It should provide the management with feedback. Information should be available, timely and accurate. It should be able to measure the labour content and plan the labour content even when machines are used. It should incorporate the difference between support and primary labour. When implementing this in practice it shows that the following elements are to be considered: The measurement of labour can be done easily with the help of field books and the monthly payments / current BoQ system can be used to steer the project.

4.3 M & E Theories
The designed method can be characterized as a monitoring & evaluation information system that provides labour content figures for several large labour intensive items. These labour content figures act as planned objectives for the involved actors in the process. A sharp contrast between monitoring and evaluation can be seen. Monitoring is the measurement and adjustment of the performance to the planned objective, while evaluation is the measurement and adjustment of the objective to the strategy, internal and external environment.

The calculation method to find the labour content can be adjusted to practice in order to work as a monitoring system. The data collection to set a target is about the same as the data collection for monitoring a target. The link between the monitoring system and the method to find a reasonable planned objective can provide information about how to set up the last step: the evaluation system.

Several characteristics of the project organisation need to be considered to answer these questions. However, it is unclear which characteristics are important for this method. A first glance gives some information about where to look. The method will be used by different actors involved in a labour intensive construction project. The information needed to adjust and measure the method will have to come from the operational site and therefore from the contractor and partly from the consultant & client. So their input needs to be combined to be able to adjust and measure the labour content during construction.

Monitoring and evaluation frameworks
Performance measurement frameworks of organizations have been developed and improved during the last forty years. The best known framework is the balanced scorecard developed by Kaplan and Norton (1992). This one focuses on the performance of the organization in respect to the stakeholders' expectations. More narrow views of performance measurements are also available with the frameworks developed by de Beer (1972) and Otley (1999). To make performance measurement framework, an effective control mechanism at least needs to (Tan K.H., Platts K.(2003)):
- Be able to predict future performance;
- Be actionable, by providing information on causes or solutions to the problem;
- Be able to capture key business changes; and
- Be able to aggregate information at a level that can help guide managerial actions.

In respect to the characteristics of 'construction' projects, temporary project life and differences in products, the impact of time is an important factor for the above conditions.

Information system requirements
Information system requirements literature has been studied but revealed no additional conditions for this system as it concentrates on digital information systems.

Benchmarking requirements
Benchmarking is a systematic and continuous measurement process.
In the manufacturing industry Benchmarking became integrated in its production process. Benchmarking can be a good tool to measure and improve you construction performance. However the construction industry seems to be unable to adopt is. Problems which conduct to this adoption according to the Agile Construction Initiative (ACI) are:
- Misunderstanding of the benchmarking concept; for many practitioners it simply means measuring everything;
- Confusion surrounding what is required to take up a benchmarking exercise: what to measure? How is it measured? Against what should these measurements be compared?
- Unavailability of data mainly because the structure of the construction process does not allow data associated with field-based operations, to be collected readily;
- Application of benchmarking seems to require radical changes in the way information is handled and documented.; and
- Lack of relevant conceptual models to support and guide data collection (Mohammed S.(1996)).

In the EPWP programme there are problems with the data gathering. For Benchmarking it is important to gather the correct data (what data do you want to measure) and complete data. Because of the constructions' industry nature, where different projects differ very much, it is hard to collect the right data. Of course this means if an LI road construction project is evaluated, it is important the right data is collected.

"A benchmark is the best or highest measure achieved by any company on a given metric and it represents a level of performance on a particular metric that all companies can aspire to or exceed"

(Madigan D.(1997))

This definition can also be read as the baseline which will be researched in this report.

To benchmark the LI road construction projects, it is important to identify what types of benchmarking there are. There are three types of benchmarking:

- Internal Benchmarking, where an organization aims at improvements within their own organization or in comparison with organizations who do better, and sets new targets to meet
- Project Benchmarking, where an organization assesses the performance of projects
- External Benchmarking, where an industry as a whole attempts to increase productivity through making tools and techniques.

To gather the correct data it is important for the new framework to start with a Project Benchmarking. First data has to be collected, compared and verified, so a baseline can be established. A database will be filled with those baselines and can be remeasured if performance gets better.

4.4 Organisational theories

Organisational theories are used to find relevant characteristics of the project structure and the different types of organizations involved. Organizational theories try to explain the behaviour, existence and development of organizations. However, a complete overview of organisational attributes has never been done and is considered to be impossible. Strategic management provides more insight in which characteristics are important for organizational changes. Strategic management is defined by Johnson & Scholes (Exploring corporate strategy, 2004) as:

Strategy is the direction a scope of an organisation over the long term: ideally, which matches its resources to its changing environment and in particular it's markets, customers or clients so as to meet stakeholder expectations.

Strategic management

Although Strategic management is concerned with the planning and execution of a strategy on the long term, it does say that changes are interrelated and that particular changes in an organisation do affect other parts of that organization, even operational changes. It provides a framework for the planning of a strategy, it discusses the conditions for the implementation of a strategy and it provides a framework to analyse important characteristics that can influence the implementation of a strategy. Strategic management is used as a guideline to find characteristics that are important for the implementation of this method because the design and implementation of the method influences operational decision making; it affects multiple actors in the project environment and it might change the use of a successful implementation. Because the interrelations between the different actors and the dependency of this method on the willingness of these actors, this method must be seen as an operational implication of the EPWP strategy.

Because this is an implementation on operational level and not a strategy on corporate level not all characteristics are deemed relevant. It is an operational action derived from the strategy initiated by EPWP. The operational level is situated within a project environment (tactical environment) which is situated within the general environment. Because strategic management assesses external influences (from the general environment) for changes in the future it is not of importance for the implementation and design of this method. It is important for the strategy of EPWP. The method operates within a stable general environment which is represented in the internal characteristics of the organisation. The project environment however is subject to change (they change each project) and is considered relevant. Common knowledge about labour intensive construction projects show that each project has a different product process or end product due to design differences, but that projects are build up using standard specifications and uses standard (little differences between) organisational structures.

The method needed to find a reasonable planned objective has to be linked to practice in order to see whether the objective has any practical relevance (is just) and to see whether the method can be used as a monitoring system. The implementation of the method to measure and adjust the objective in practice has three steps. These steps are derived from the framework used to evaluate strategic strategies. Step one is the suitability check of the method. Is the information of the method useful for each actor? What are the benefits for each actor? The second step is the feasibility check. Is required data available to plan, measure and evaluate the method regularly? Are the results accurate and are enough resources and capacity available to implement this tool? The third step is the acceptability of

the method. Are they willing to use this tool? What extra work does it cost them to implement this tool? And what are the benefits or disadvantages for them? What are the effects of this tool for them?

To answer these questions successfully requires knowledge about the environment where it will be implemented. Questions that can be asked are: Will the method be of any use? And will the method be used? These questions need to be answered to design and implementation this method correctly.

Suitability check

The stakeholders' analysis is used to analyse interrelationships of organisations involved. However, there is a discussion going on about whether to follow an agent-monitoring approach or the stakeholders approach. This discussion is not relevant for the implementation of this method as the stakeholders' analysis is used for the identification of the relationships between the different actors only and not for the control of these relationships or to design or execute an appropriate strategy.

The stakeholders' analysis will provide the different attitudes of and power struggles between actors which can help to assess which actors are important to consider and to see what benefits the method should provide. The method should be aligned with the available resources and culture to ensure that it will be used. These resources are finance, people, information and technology. The culture of the organisation needs to be assessed whether to see how the method should be designed in order to work. The information needed for the method to work should be aligned with the information available or information system. This information system needs to be able to work within the boundaries of the finance and technology resources.

A stakeholders' analysis maps the influences and interests of each involved stakeholder. The definition of a stakeholder according to Freeman(1999) is:

A group or an individual who can affect or is affected by the achievement of the organisational objectives.

They need to have a relationship in the organisation that is either legitimate or urgent, or they need to have power to influence the firm. In general the classification is made in the amount of power and the amount of interest. The assumption behind the stakeholders' analysis is that the stakeholder with the most power needs to be kept satisfied. And that the involvement of the stakeholder with the greatest interests and power is critical for success of the implementation. A more detailed overview of the stakeholders' analysis and its question is given in Appendix B

Feasibility check

This check looks at the requirements (costs, effort, technology) needed for this method to work in practice. It also discusses which additional elements of the construction processes need to be analysed to find out how the method can be implemented and work.

As previously discussed, the method can be seen as an information system that helps the consultant assess the correct labour content. On the other hand the method will have to benchmark itself in order to optimize the labour content. In order to perform both these functions the method has to meet the requirements from monitoring and evaluation frameworks, information systems requirements and requirements from benchmarking techniques. These conditions have been mentioned previously.

The acceptability check

This phase will check if the designed method will be accepted by the organisation. According to Johnson & Scholes the focus will be on the acceptability of the method by actors which can be mapped using the stakeholders' analysis done during the suitability check. The actual implementation should be done with the help of the involved actors, but this falls outside the scope of this report.

4.5 Design conditions for M&E system

The relationships and mutual interests of the actors involved in the construction process will be identified with the stakeholders' analysis, to see whether the method fits the organisation the method needs to be aligned with the resources finance, people, information and technology. People (culture) are closely linked with the structure. Because of the nature of the project (labour intensive, low technology grade) the emphasis is on the culture with its beliefs and norms and less on the technology of the method. The technology does not need to be underestimated as the method must be developed according the available technology level and knowledge. The financial implications of this strategy might me detrimental for some involved actors. This must be taken into consideration, although it is the expectation that this has no important consequences for this method.

The theoretical design conditions are stated in the table below. The organisational characteristics that are of importance to the M&E system will be derived using the literature explained earlier and the stakeholder analysis of the Gundo Lashu project. The findings will be explained in chapter five.

	Condition	Source	Paragraph
	System requirements		
1	Standardized processes	ILO green book	4.2
2	Must lead to action	ILO green book, M&E frameworks	4.2; 4.3
3	Integration in current construction processes	ILO green book	4.2
4	High acceptance rate by actors in construction process	Strategic management	4.4
5	Involve key players in design	Strategic management	4.4
6	Careful implementation of the system	Strategic management	4.4
	Data requirements		
7	Calculate LC considering different productivity rates	International productivity rates	4.1
8	Objective must provide information on causes	ILO green book, M&E frameworks	4.2; 4.3
9	System must provide data on time	ILO green book	4.2
10	System must provide complete data	ILO green book, benchmarking	4.2; 4.3
11	System must provide accurate data	ILO green book, M&E frameworks	4.2; 4.3
12	Objective must be able to Plan future	M&E frameworks	4.3
13	Continues improvement of objectives	Benchmarking	4.3

Table 2 Design conditions of M&E System

5 Case study

Chapter 4 discussed the theories and models of a monitoring and evaluation system and the methodology to analyse the Gundo Lashu project. This chapter continues with the adoption of the theory to the best practice results of the Gundo Lashu project. The information was gathered via interviews with the RAL, three different consultants of different consultant companies: Mosomo, BKS and M&G, the training company LITEworks and the contractor Maraka Pula. The contractor was selected on the basis that the client considered this contractor to be the best performing contractor in the Gundo Lashu project.

5.1 Approach Gundo Lashu

The Gundo Lashu programme started in 2001 as a pilot programme for labour intensive construction projects in the Limpopo province situated in the north of South Africa. With the help of ILO and DFID (UK department for international development) the Road Agency Limpopo (RAL) implemented the programme between 2001 and 2004. Contractors were trained by the Lesotho department of rural roads on technique and management skills.

After their training in Lesotho the contractors were given a start-up capital (money and initial equipment). As part of their training they tendered (also against each other) on contracts issued by the RAL. Each contractor was awarded at least one contract. After the training, the contractors continued tendering on contracts issued by the RAL but because of the low availability of other contractors the contractors were able to tender in the same way as they had done during their training period.

The Gundo Lashu programme continued under the umbrella of the national EPWP programme and funds have been made available to continue the execution of labour intensive construction works. The majority of the works focuses on rehabilitation and upgrading of local gravel roads. However, the contractors were initially trained on the construction of gravel roads and with the introduction of sealed roads, due to higher quality standard of the RAL, they needed to undergo a training on a practical pilot project to let them familiarize with new techniques and procedures.
The programme provided critical input for the formulation of national policies, implementation models and guidelines for the national EPWP programme.

Because of its importance and its relevance to the EPWP programme the Gundo Lashu project is examined more closely to find aspects that can help design the M&E system and to see how the LC is used and calculated in practice. The Gundo Lashu is examined for two purposes: To find the best way for the identification of the labour content in practice and to find a way to set up a monitoring and evaluation system for EPWP in practice. The Gundo Lashu project will have to provide detailed information about managing processes, relations and productivity measurements. Because this requires detailed information & explanations and questions require lengthy explanations, the Gundo Lashu project will be analyzed using interviews. These interviews will be held with important actors in the construction projects; client, consultants and contractors. The actors are interviewed separately to identify differences and to prevent the alignment of opinions and data. Unfortunately, there are not enough capable contractors available. The most capable one (identified by the client) was chosen as a best practice case. The interviews provide detailed information on the management processes and productivities, while documents from earlier executed programs provide information on these processes should be executed. Unfortunately there was insufficient time to observe practice, especially in the case of observing real productivity rates.

5.2 Findings Gundo Lashu
The interview questions discussed the establishment of the correct labour content and the organisation of the project. The organisation of the project was analysed with the help of a stakeholders' analysis. The establishment of the labour content was checked against the ILO documents.

The purpose of the field trip was to find out:
- How the contractors work with the consultants?
- How the different parties report to each other?
- Who controls who and how & why?
- How contractors organise their administration?
- What difficulties contractors, consultant experience in the establishment of productivity rates?
- Productivity rates of certain items/activities in Limpopo?

The field trip gathered information about the topics above, but it also gathered information about general problems of the programme. The general problems according to the consultants, clients, and contractor are explained below.

General problems

Inexperienced and unmotivated contractors
The selection of contractors for the training was not based on previous experiences with running a business (either in construction or something else). They did not possess a business attitude that helped them do negotiations with suppliers and clients, helped them see improvements in production that helped them save money. The contractors started their work on large contracts without having any experiences with running projects. The chance of, and the consequences of bankruptcy increased for the contractor. There was not enough consideration for the social side of these big contracts. Contractors never had so much money and the temptation to use it for other purposes other than investing it into the business proved to big for many of them.

Bad cash management

A contractor decided to hire an excavator to excavate hard material from the borrow pit. He agreed to hire the excavator on a dry rate (400R per hour) (dry = supply own fuel) and started working. Soon after this, he ran out of money and he had no money to pay for the fuel. He negotiated with the supplier of the excavator to hire it on a wet rate (500R per hour). At least the excavator could work for certain days. However, after a day the contractors' bakkie (Pick-up truck) ran out of fuel and the contractor took some fuel from the excavator to fill his bakkie. Unfortunately the contractor was caught by the supplier and he put the contractor back on a dry rate against 500R per hour. The contractor could have saved a lot of money by fuelling the bakkie at a filling station. 200R against 700R.

Contractors lack the experiences with machines and the way how they should calculate the costs of these machines. With the higher quality standards, the problems in the borrow pit, machines have been introduced in some parts of the projects. Contractors were not trained to calculate the costs of these machines and they proved unable to do so in practice. Another problem with the contractors is their motivation to guide and manage their projects. Contractors have project managers to handle the projects, but this project management does not have the authority to make decisions. The contractor is not interested in these problems and steers away from them.

Unavailable and uncommitted local workforce
Although the low commitment of the local workforce is a fact, as the roads are primarily not meant for them, it creates a problem within the programme. The productivities are assessed beforehand and the contractor bases his prices on these productivities, but as the project starts these productivities turn out to be lower than expected which in turns creates progress problems for the contractor. As the workforce does not see the implication of this problem, and the client only pays them for the work conducted, they are not inclined to care about it. The view of the contractor is to inform the

community upfront with the expected productivities and rules as to prevent these things from happening. Another indicated problem, not supported by the interviewed contractor but supported by the consultant, is the availability of the workforce. Some communities have unmotivated workforce. They will not show up if needed, which causes delays and cash flow problems for the contractor. Other communities do perform well. In the interviews with the contractor and consultants, they say that the pre-selection (the social feasibility study) should be done more carefully in order to select the performing communities.

Unbalance between responsibility, power and knowledge

There is an unbalance in responsibility, power and knowledge of the contractor. He has not enough knowledge but has the power and responsibility. It is the job of the consultant to steer the project as to get the correct quality within budget and time limit. The consultant has the knowledge and the unofficial authority to steer a project. As stated earlier, the contractor lacks knowledge of the process and technologies used. This creates friction as the final responsibility of the project lies in the hands of the contractor. The consultant gives direct orders to the project manager. This means that wrongly executed orders by the contractor are blamed on the consultant. “He gave the order, so he is responsible”, is the contractors motivation. But because of the lack of knowledge of the contractor the consultant needs to interfere. Consultants have indicated to back out of labour intensive construction projects because of the time involved to manage these projects. One consultant indicated that contractors do not take their advice because of pride, trust and political reasons.

Client (RAL) gets competition from municipalities and districts

Because of the high quality standards and their intensive involvement in the projects, contractors are turning to other clients. Instead of doing Labour intensive projects for RAL, they are doing machine based and labour intensive projects for municipalities and districts. Municipalities and districts do not uphold these high standards which make it easier for the contractors to make money. In combination with the decline in the number of consultants, it is the opinion of the writers that the number of Labour intensive construction projects will decline in the future.

Communities and politics

The consultants and contractor have different opinions about this, but communities (thus the workforce) cause some problems for the project. According to some of the consultants the communities agree to the conditions of the labour intensive construction projects, but as soon as the project starts they reconsider and oppose the operations. The contractor said that the communities do not pose a problem and that he can work with them without problems. Because this contractor is considered as a skilled contractor it might be unfair to say that this is happening with every contractor in the field. The role of the community liaisons officer (CLO) is critical as all labour related problems are passed through him. Indications from the consultant, not confirmed by the contractor or client, tell the CLO is partially subjective and on the side of the community. Another indication tells that some communities also use ‘play stupid’ tactics to get their way. They say something in their interests and argue as long as possible. If the contractor or consultant says something else they play stupid and act as if they do not know anything. This truthfulness of this observation should be approached with great care as the problem has not been confirmed by multiple sources.

High quality standard demanded by the clients is difficult to uphold by solely labour intensive construction techniques

The quality standards of the RAL are set high and for some activities it has become unfeasible to use labour intensive construction techniques. E.g. the spreading of the chips on a seal by hand is a delicate task that requires good hand eye coordination and good production process. In most cases the distribution of the chips is uneven and not up to quality standards. To overcome this problem they use manual pushed ‘chippies’ or turn to cold mixed asphalt.

Or when OTTA seals are used the seal follows the base. A smooth base is required to get a smooth riding surface. Consultants opt for the use of a machine based approach for the formation in order to get a smooth base. It helps to improve the quality of the riding surface and it cancels the need to set different task rates for the formation. Because of the good results with cold mixed asphalts the need for the machines to do the base is not there. However, the base is often constructed poorly with variations in the camber.

Reservations about the use labour intensive construction techniques

It is observed that consultants opt to go back to machine based techniques & processes and to do only specific portions with labour. They see unavailability of good labour, low quality, low knowledge of contractors, problems with the community, setting the right tasks and time & financial constraints as the biggest problems for the programme. They find it frustrating that trained labour is not utilized, while at the same time they have to train new labour again. Their vision is the used of labour intensive subcontractors that employ labour (e.g. to do guardrails) for a specific task as a solution to this problem.

Observed LC and productivity rates Gundo Lashu

The establishment of the productivity rates for the Gundo Lashu project focused first on the pavement layer works. Layer works are labour intensive and measurable quantities. It is a routine activity and thus standardized. It also has easy identifiable actions. It turned out that productivity figures are not documented or easily accessible. Some of the consultants and even the contractor work with the productivity figures established by the ILO still. This is a strange observation as communities have to be informed on the task rates before the start of the project. There are differences in the processes of the construction of the base, although the processes are based on ILO guidelines. The productivity figures are general and do not state any information about actions within a task. This shows the contractor is not concerned about improving his productivity.

The layer works include the following tasks:

- Laying shutters: by hand
- Mixing: with shovel
- Mixing: second round of mixing needed when stabilized base is required
- Placing: with shovel
- Levelling: with boom
- Compacting: with pedestrian roller

The obtained data is from three sources without backup from data. The productivities are not derived from a large sample database, as they are not kept by neither the consultants nor contractor. The productivities are not established by detailed work studies and are therefore considered as rule of thumb used by the industry. As seen above the hauling is taken out of the equation. Hauling is considered by all actors as a different task that is carried out by a different team. It is even stated in a different section in the COLTO. The differences in processes occur within the mixing and placing activities. The contractor first places the filler and than mixes the aggregate with water, while the consultant opted for doing it in heaps. This must be taken into consideration as the productivity figures differ because of this.

Laying pavements is an easy task without that much variance. The material is the same, production techniques are standard because the situation is standard (the formation is standard, except for bridges and intersections) and the productivity rate can be set easily. However, with the formation of the road surface it is different. The situation is not the same and the output differs per chainage. This causes difficulty in setting task rates. The interviewed contractor does set tasks for this activity but because of the differences in cubic meters per chainage, the task rate (in meters length) differs for each labourer. This causes problems between labourers and contractor because labourers do not grasp the concept of cubic meters, they only see the length of formation that somebody has to do. The contractor has to explain over and over again the concept of cubic meters before they can continue.

It is a long and burdensome task to record the task rates, but according to the contractor, the supervisor and each labourer keep a book with the achieved tasks per day. The contractor looks at the amount of people paid because this will tell him how many tasks have been done that day. Each payment is a task. He does not look at how much can be achieved within a day, but he looks at what has been achieved. To make sure that the productivity is reached, he increases the task rate a bit so he is on the safe side. He can pay the workers that have not met their target without losing money (e.g. he calculates with 2.5 cubic meters, but he sets for 3.0 cubic meters).

For the formation he sets an individual task rate, but for layer works he sets group tasks with assigned tasks. For example the task rate is set at 60 meters of half width per day.

Source	Item	Task	Task rate	Tools	Remarks
Maraka Pula (contractor)	Base	Mixing placing	2.5 m^3 pppd	Hand tools	Mixed on floor, first spread than mix. Set as group task
M&G (consultant)	Base	Mixing placing	?	?	
BKS (consultant)	Base	Mixing placing	2.5 m^3 pppd	Hand tools	Unknown production method
MOSOMO (consultant)	Base	Mixing placing	5.5 m^3, 2 ppd	Hand tools	Mixed in 2 heaps per half width. Spacing according to truck dimensions

Source	Item	Task	Task rate	Tools	Remarks
Maraka Pula (contractor)	Base	Laying shutters	240 m, 6 ppd	Hand tools	
M&G (consultant)	Base	Laying shutters	?	?	
BKS (consultant)	Base	Laying shutters	?	Hand tools	
MOSOMO (consultant)	Base	Laying shutters	?	Hand tools	

Source	Item	Task	Task rate	Tools	Remarks
Maraka Pula (contractor)	Cut to fill	excavation	5 m^3 pppd	Hand tools	Loading of truck at borrow pit, but is the same as Cut to fill
M&G (consultant)	Cut to fill	excavation	6 m^2 ppd	?	Teams of 6 persons
BKS (consultant)	Cut to fill	excavation	?	Hand tools	
MOSOMO (consultant)	Cut to fill	excavation	?	Hand tools	

Table 3 Task rates Gundo Lashu

The table above shows the productivity rates kept by the contractors & consultants. No clear administrative system is used to gather and evaluate productivities. There is no incentive to keep these productivities as consultants are not responsible and contractors are not paid on these rates.

Although these actors do use productivity rates to set task rates and to calculate their productivity they do this mostly with a little guesswork. This means that the labour content is not optimised for the task as there is no system to do this. It also means that contractors and consultants cannot see how to improve the labour content of certain items when looking at the productivities. Due to set productivity rates, the lack of a penalty system they are not stimulated to improve productivity and simultaneously to search for ways to improve the labour content.

Stakeholder analysis
The following relevant actors have been identified that influence or are influenced by operational project processes. Appendix C gives an overview of the dependencies between the relevant stakeholders.

Actor	**Role**	**Interests**	**Power**
Client; RAL	- Mediator between conflicts - Decision maker on design guidelines	- End product - Training of contractor Gundo Lashu - Construction based on COLTO	- Financial - Knowledge - Hierarchy
Consultant; engineer	- Consultant for client as supervisor on quality, schedule and budget - Consultant for contractor on technical and process details	- Process flow - Meeting product requirements: quality, costs and time - Making profit against lowest costs	- Hierarchy - Knowledge
Resident engineer	- Acting engineer for consultant on site	- Quality and progress control	- Knowledge - Hierarchy
Contractor	- Entrepreneur - Planner of finance, work - Decision maker	- Profit making, income - Continuing business with lowest effort possible	- Hierarchy
Project manager	- Site planner - Logistics & resource manager - Supervision, productivity control - Project responsibility	- Concluding project - Process control	- Restricted Hierarchy
Technical assistant; TA	- Quality controller - Preparatory work for daily tasks	- Less rework as possible - Smooth daily operations	- Knowledge - Hierarchy
Community; workforce	- Execution of operational tasks	- Earning money	- Control of resources
Community liaisons officer; CLO	- Mediator between workforce and employer - Supervising workforce treatment	- Earning money - Keeping workforce happy	- Influence
Secondary actors			
Environmental consultant	- Controlling on environmental aspects	- Meeting environmental standards	- Knowledge
Social consultant	- Consulting on social issues before commencing project	- Aligning community interests with employers needs	- Knowledge - Influence

Table 4 Stakeholders' analyses

Compared to the proposed organisational structure in Employment and high end infrastructure the structure of the Gundo Lashu projects is slightly different. Instead of the consultant, the contractor communicates with the community. The functions and responsibilities within the Gundo Lashu project are about the same as stated in the supervisor manual of the ILO.
The organisational structure of the stakeholders is given in the next framework:

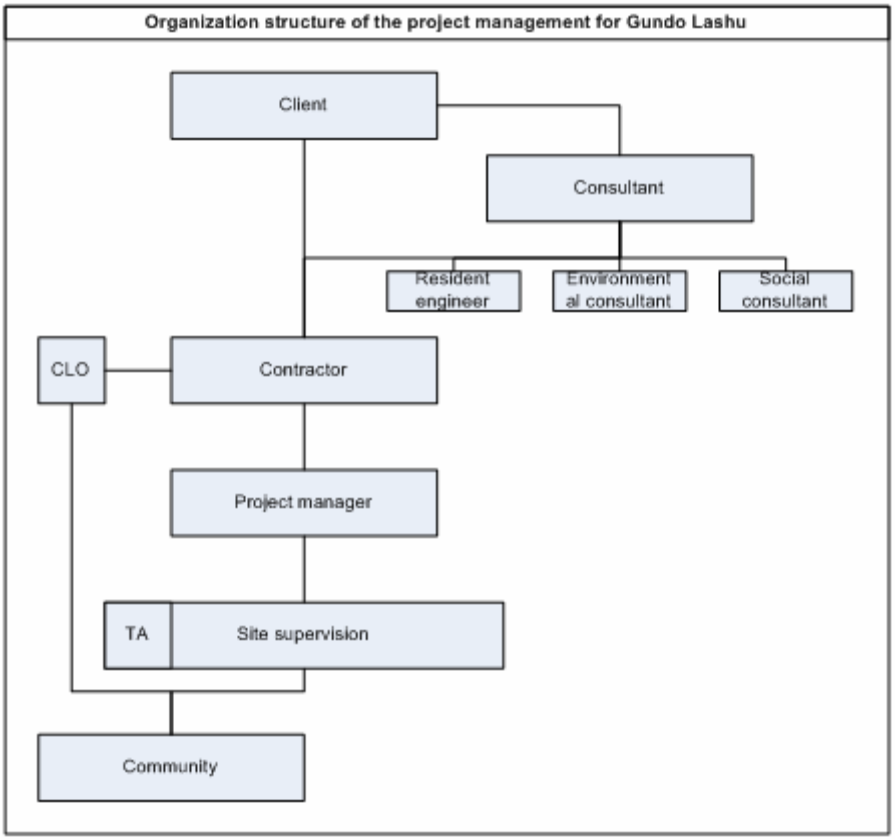


Figure 3 Project management structure

The contractors company is an organisational structure on its own. The following framework shows how this organisational structure usually is and what the main responsibilities are within the organisation. This framework is comparable with organisational structure of a Gundo Lashu contractor.

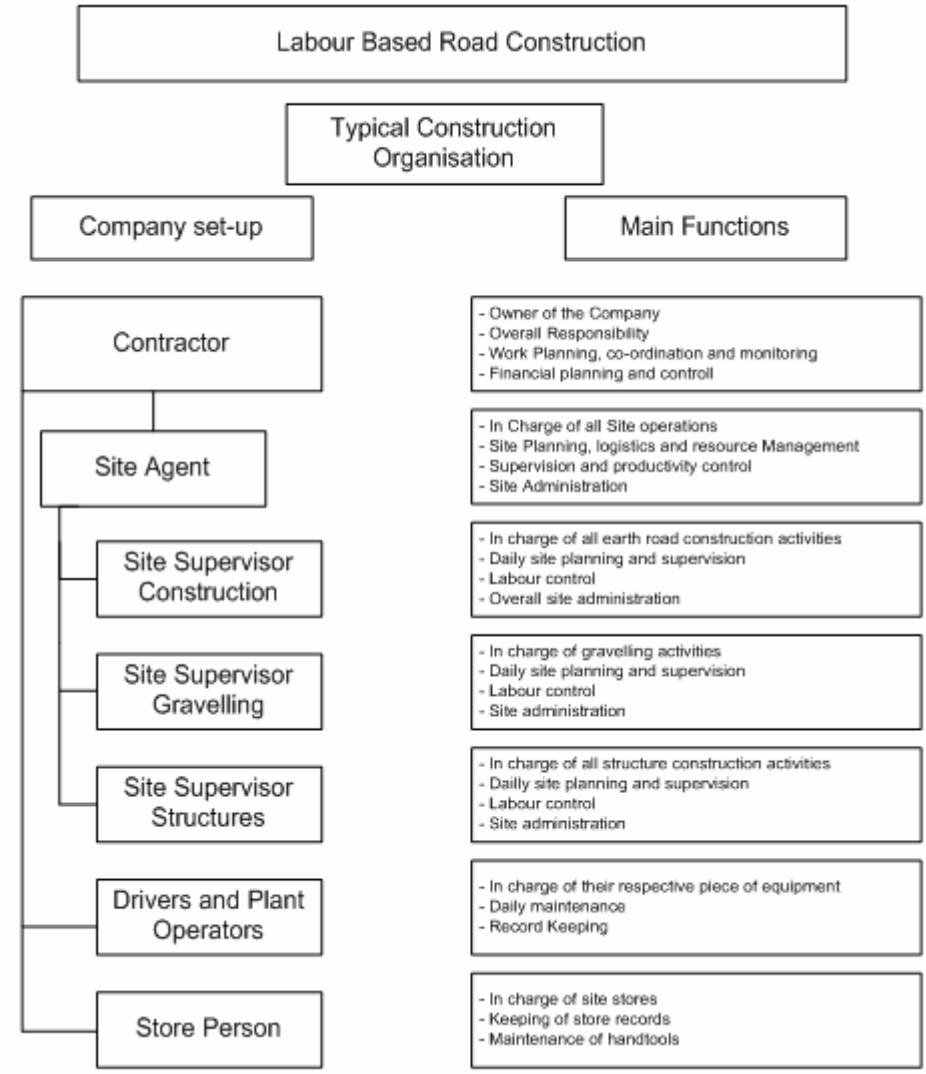


*Figure 4 Construction organisation structure (*Contractor's Handbook Labour Based Road Works, 2004)

Because the contracting companies in the Gundo Lashu project are small & developing it is not possible to talk about a company culture. As the above figure shows, the contractor steers three persons directly: The Site Agent, the drivers and plant operators and the store person. The Site Agent steers all supervisors on site. This hierarchy structure makes it possible for the contractor to manage the project and his company at the same time.

Communication
Communication is often done on site and between the consultant, contractor and sometimes the client. However, direct orders are given only by the consultant and not by the client. The contractor is responsible for the execution of these orders and is ultimate responsible for the project. Communication between consultant and contractor is officially once per two weeks, but can increase depending on the project progress. No documents are kept of these meetings. Once per month a site meeting is held with the contractor, client, consultant, social & environmental consultants, Technical assistant and the CLO. At these meetings the progress and any problems are discussed and solved. Within the Gundo Lashu project the contractor often neglects to attend these meetings.

Authority
The authority of the consultant is restricted to the ability to stop work, to order rework, to advice on planning and even to instruct the contractor how to execute the work. Because of their knowledge of the design and construction techniques their advise is often considered as an order. They do not have the authority to decide on financial matters if even their decisions have financial implication.

Contractors have control over every aspect of the construction process but are bound to the decision of the consultant on process and product. Authority of the client is restricted to altering design conditions. They wish not to interfere in the process, but are sometimes forced to when they are confronted with contractors with cash flow problems.
The project manager and the TA have limited authority as they are restricted in almost all decision making. They have to complete the project within the boundaries set by the contractor and consultant. Their low independence makes it hard (as the contractor is not involved in the projects) to alter project processes.
The dependency of the contractor on the work force is large, as it is labour intensive. Some communities have large influence on the project progress but have no interest in the project, which makes them difficult to convince and to steer.

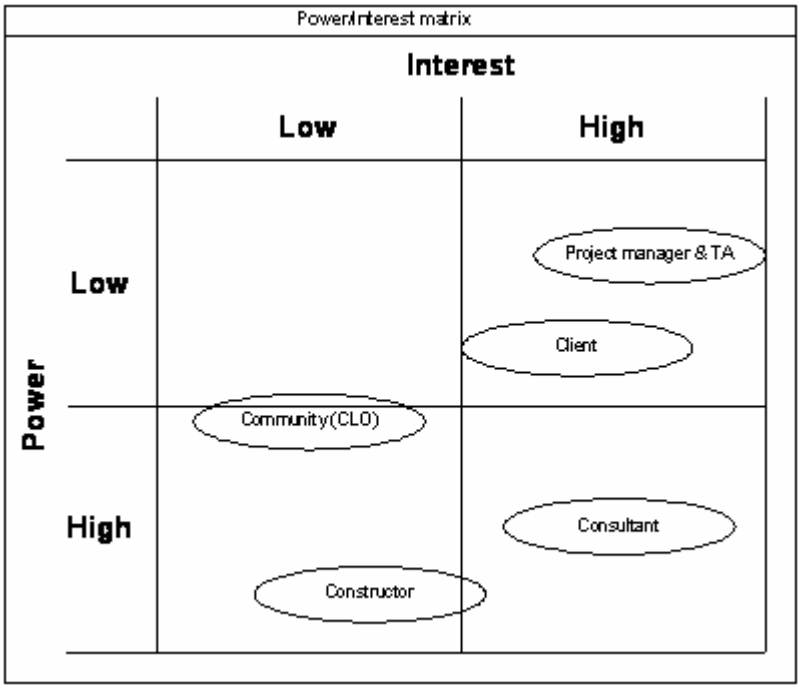


Figure 5 Power/Interest matrix

The power/interest model identifies the actors who have to be considered in the design process of the method in order to have it accepted and used. The model is applied on the Gundo Lashu project and stated the figure above. The contractors take an unexpected place in the model because they are influenced by the introduction of new methods, have the most power to implement it, but lack interests. They are not concerned with new ideas and look at short term profits only. Because of the power and the central role they posses they need to be involved in the implementation of the new method or the contractors' needs to be satisfied. The same principle upholds for the community. However, their power is more limited than the contractors and therefore they only need to be informed.

5.3 Characteristics organisation LI construction project

The stakeholders & dependency model clearly shows the importance of the consultant in the construction process if a GL trained contractor (or even a CIDB rated contractor) is used. Also, the relationship of the client with the trained contractor is close and dependent. To implement this method, the consultant should be involved as he or she has most insight in the project circumstances. The most important operational stakeholders are clients, consultants, contractors, project manager (working for the contractor) and the CLO or workforce. For these actors the method should meet the following conditions.

Stakeholder conditions
Client
Enable further training developing contractors
Labour creation figures
No deviation from COLTO (approach of Machine based systems)
Consultant
Easy identification of progress
Help ease process flow
Low as possible effort
Contractor
Financial opportunities
Competitive position
Project manager
Day to day process control
No tedious work
CLO/community
No abuse of workforce
Measurable payments

Table 5 Stakeholder conditions

Looking at the literature explained in chapter 4.2 it shows that the method should use the available daily sheets and muster rolls as these capture the most important data useful. Also the current practices should be included as much as possible. These are: working with V.O. (variation orders), holding weekly & monthly progress meetings, monthly remeasurement and subsequently payments.

- Differentiation of labour into support and primary (KRARP)
- Causes of productivities are not kept in data (KRARP)
- Muster roll is separated from activities (KRARP)
- Every activity requires different types of forms (KRARP)
- Task rates, if unknown, should be made clear BEFORE tendering (LBT)
- Use of monthly meeting points and visits (LTB)
- Combine financial payments with control on labour, quantities and qualities (LBT)
- Use of commonly known Variation Orders (V.O.'s) (LBT)

The conditions derived in chapter four and in the previous paragraphs lead to the following design conditions for an M&E system that monitors LC in labour intensive road construction projects.

	Conditions M&E system
	System requirements
1	Standardized processes
2	Must lead to action
3	Integration in current construction processes
4	High acceptance rate by actors in construction process
5	Involve key players in design
6	Careful implementation of the system
	Data requirements
7	Calculate LC considering different productivity rates
8	Objective must provide information on causes
9	System must provide data on time
10	System must provide complete data
11	System must provide accurate data
12	Objective must be able to Plan future
13	Continues improvement of objectives
	Stakeholder requirements
14	Enable further training developing contractors
15	Labour creation figures
16	No deviation from COLTO (approach of Machine based systems)
17	Easy identification of progress
18	Help ease process flow
19	Low as possible effort
20	Financial opportunities
21	Competitive position
22	Day to day process control
23	No tedious work
24	No abuse of workforce
25	Measurable payments

Table 6 Conditions for the M&E system

6 Design monitoring & evaluation system

The design is concerned with the methods to measure the objective (labour content) and with the M&E system that will plan, measure and evaluate this objective. The goal is to create an easy to use data flow that will provide the government with the correct labour content figures. This means that established practices need to be incorporated. The labour content figures need to be able to be updated and to act as indication for future projects. First, the calculation of the labour content will be explained and an example of how the calculation can be done is given in appendix G. Second, the M&E systems are developed with the help of the criteria on page 30. The low educational level, the high political drive and the effects on the conventional industry are incorporated as much as possible. Especially the clarity and power of a LC target needs to be stipulated.

6.1 Calculation method labour content

The objective is fixed as the minimum labour content for 'labour intensive' marked items in the conventional bill of quantities. The conventional bill of quantities used for conventional machine based construction projects. Because each project is build up around these items it is conceived that if a general labour content per item can be established or measured, the labour content for each project can be ascertained. With the desegregation of the labour content into items, future project can be planned using the information from old projects. After this current projects can be steered on this planned labour content.

Labour content is captured in an independent 'man days' figure. A man day is the summation of the number of workers used each day. One man day is the use of one worker for one day. With the use of man days the time factor is taken out of the equation. This gives the contractor the freedom to plan their operations more efficient. The labour content of an item is the amount of man days used for that amount of item produced.

The labour content used to construct an item (amount of item done) is equal to the sum of the number of man days used for each activity that is needed for that item. One activity is one task completed. A task is a measurable amount of work done by a single worker per day for a certain activity. See the figure below for a graphical explanation. If tasks cannot be measured efficient (or at all) they are often combined into a team task. One team task is a measurable amount of work that is completed in one days work by a certain number of workers for a certain activity. In the examined item (pavement layer) the team task rate equals the item constructed. It is possible a task is a sum of different actions. E.G. Cut to fill can be a task set for 2 m /day, but within this task a different set of actions have to be done, like digging, throwing, and spreading.

Tasks or team tasks are set with the use of planned productivities. In the case of Gundo Lashu these productivities are derived from the ILO standards.

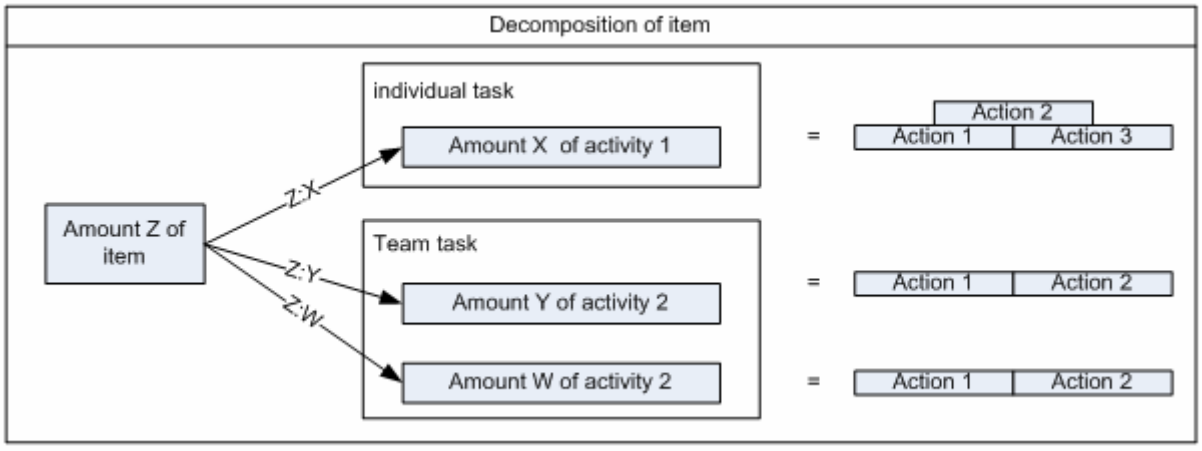


Figure 7 Decomposition of items

To calculate the labour content for an item at least the following data is needed:

1. The task rate of each activity or team task rate of a group of activities that are included in the item.
    - Information about the product and the activities that are paid for the item (COLTO)
    - Production process: which steps are needed to complete the item to obtain required quality
    - The project conditions (climate, height, soil type, etc.)
    - The number of tasks or team tasks needed to complete the item
    - The balancing of the teams (time schedule, available resources, processes etc)
    - The actions within the activity (how?)
    - The tools used with that activity
    - Productivity rates of labour
    - Material and equipment availability

2. The ratio between the amount of the activity and the amount of the item
    - What is the spillage?
    - Measurement of the quantities (e.g. loose against compacted, cubic metres against square metres)

The information about the product and production process can be determined independent from the project characteristics, as the product has quality standards that have to be reached using standardized activities. The COLTO does not specify the activities which are included in the rate, but does say if some extra activities are included (e.g. the haul from borrow pit for pavement layers is sometimes included in the pavement layer item). The normal activities within an item are determined with the use of handbooks developed by ILO or CIDB. How these activities are carried out or are paid is determined by the contractor and by the parameters of the project specifications.

Unknown productivities for an activity in a specific project will lead to assumptions about productivities. Average productivities will be used (that can be accurate) from ILO studies that can be too high for that region, resulting in a low labour content. Productivities can also be too low, resulting in a high labour content and costing either the contractor or the client money.

The ratio between an amount of an activity produced and the amount in the item measured, can be more easily defined. The normal assumption is an ‘one on one’ relationship. This is not always true as there is often an amount of spillage involved. The effect of this on labour content is unknown, as ratios are unknown. Each contractor sets these ratios differently.

ILO literature showed that productivities have to be measured to ensure that workers complete their task and that payments are done correctly. Therefore the foreman keeps track of the tasks set for each day and writes down the achieved tasks for each day. The contractor (or project manager) pays them accordingly. He calculates the amount of an item completed with the help of the number of people paid and the used task rates. The training manuals give indicative task rates for certain tasks and give productivity tables for specific activities. The training modules do not provide training on how to improve these productivities, or how to set tasks sizes in accordance with costs management. Contractors are not given calculation methods for the calculation of the correct task sizes, as the ILO standards are used. They are not trained how to improve their task rates. It is however understandable that the contractors are not able to perform these calculations because it is a NQF level 7 exercise, but they are not stimulated to keep records of these. The Gundo Lashu projects shows that contractors are not motivated to keep track of their productivities, but that they are also not knowledgeable to do so.

The calculation of the labour content depends on the activities and tasks associated with each item in the BoQ. This means that labour content can differ subsequently for each item

6.2 Design of the M&E system

The M&E system for the project consists of three phases, that of planning, monitoring and evaluation. Because a tender document is the official document for almost any construction project the labour content should be included in this document. Three methods have been identified to get the labour content for each item.

1. Setting of a labour content as an item target

2. Tendering on labour content as well on tender rates for each item
3. Setting conditions that will guarantee correct labour content

A short explanation of each method is stated below. The methods are explained in more detail in appendices D, E and F.

Setting of a labour content as an item target
If the consultant has to plan the labour content for each item, he or she can design the project in such way that the most labour content possible is achieved against the lowest price. The minimum labour content figure will be included in the tender as a condition for the LI marked item. The contractor has to meet the labour content for each item. He or she will have to plan the process is such way the labour content is met against the lowest possible price. If tender rates turn out too high the design and/or the calculation of the labour content can be incorrect. The design might not be appropriate for labour, or the labour content is set too high for labour. If the tender rates turn out too low the labour content could be set to low or opportunities for more labour content are missed. In both cases the consultant needs to check if the design could be improved further. If the contractor does not meet the labour content target he or she will be paid against a discount. Not when the contractor can show that the cause of this decline is not her or his fault. E.g. the workforce availability is so low the production needs to be done machine based in order to complete the item before rainfall. On the other hand, if the labour content is set too high the contractor might ask for compensation. He or she has to show that the lower labour content is caused by something outside the reach of the contractor and is the fault of the client or consultant. E.g. the productivity turns out lower than expected due to problems with the community.

The labour content is set as a target in the same way as the quantities are set as a target. So the payment of the contractor should be based on the same system by which the quantities are measured. The quantities are measured at the end of each month. This is done by the consultant in cooperation with the contractor. The same process has to be used with the measurement of the labour content. There are several ways to measure the labour content. An option is to calculate the amount of labour used, by looking at the achieved items and looking at the labour used in that month. Then allocate the labour to each done item with the help of a ratio. This ratio can be predetermined or set by the consultant. Another way to measure it, is to keep data of the labour used for each item. This data should come from the daily sheets with the persons name stated on it, the activity he or she carried out and the item that that activity belongs to. At the end of the month the consultant can add the numbers to check the labour content. The total of this number should equal the total of worker days on the muster roll. The easiest way is to include the activities on the muster roll at once so that data is captured at once. The muster roll should be standardised for all contractors in the Gundo Lashu project.

At the end of the project the balance is made up and amount of persons used is checked against the muster roll to see if it coincides. The labour content for that item should be communicated with the client. If the labour content differs, the reasons why it differs should be attached. The client can communicate the labour content of that item, and the project, to the EPWP which can make an average of the labour content for that item and can investigate the extremes.

The advantages of the method are that a clear objective can be set and the objectives can easily be determined during the construction process. It is a clear objective for the contractor to achieve and it forces the contractor to measure its productivity. However, to improve the planning of the labour content per item, regular work & method studies have to be carried out. Therefore projects need to be followed in detail causing delays in the adjustments as these feedback loops are long. Also, a standard system of labour content calculation, with a standard process is needed upfront. Differences between projects need to be considered as labour content can differ dramatically due to this.

Tendering on labour content as well on tender rates for each item
When the contractor plans the labour content, he or she can plan this labour content in such way that it suits the project organisation and can match its other resources. The contractor has to fill in a labour content figure together with the tender rate for the LI item. The objective is stated as a labour content figure per unit of item. The consultant can see whether the amount of labour created justifies

the tender rate. If the tender rates turn out high and the labour content stays low the design is not properly designed. If the tender rates are low and labour content is also high the design is properly designed. The contractor has to be able to meet its own labour content standards and deviations of these standards are acceptable on predetermined reasons. Again these reasons might concern the progress of the project or other unforeseen reasons.

The same measuring and evaluation process is followed as for method one.

This method has the same benefits as the method above, but does not need regular work studies and standard calculation methods of labour content. The feedback loop to consultant is not that important. It is the responsibility of the contractor to set the correct labour content. This should not pose a problem as he needs to be able to do this in order to determine his rate. The problem with this system is its need for experienced contractors and moderate to fierce competition in order to optimize the labour content per item.

Setting conditions that will guarantee correct labour content
This method is the easiest method to implement but lacks goals and cannot be steered that easily. The EPWP guidelines are to be translated into specific conditions for labour intensive items. This means that each item has its own set of conditions. The consultant only checks if the conditions are met and the contractor works within the conditions. The conditions provide the contractor with enough freedom to choose the most effective and economic production method while ensuring that enough labour is produced. The labour content is measured each month and the labour content is evaluated against the same items of other projects. The projects with extreme labour content can be investigated to see if conditions need to change. The contractor can request to change conditions if the contractor cannot operate within these conditions due to external problems. These conditions proved to difficult to determine as projects differ. Also it was unclear how this should be integrated in the tender and how projects could be steered. There was not enough time to investigate this opportunity.

The method is easy to monitor, but still needs to provide labour content per item in order to adjust the conditions. The adjustment of the conditions is a long process as it has to go via EPWP. Also the conditions have to be set in such way that every project is able to use it.

The easiest method to implement is the second one, the method of tendering on labour content. This method has the benefits of using a clear and adjustable objective without the need for a large amount of data that has to be captured. It leaves the contractor with the freedom to plan his project and it makes comparison between machine based and labour based construction methods possible.

Choice of method
Unfortunately it proved difficult to set weights to each design criteria, but the system criteria are considered to be qualifying criteria as these are essential for the usefulness of the method. The method that keeps the most control is the first method as minimum labour content is predetermined irrespectively of the contractors. It is adapted to the project circumstances because the LC is established by the consultant who also designs the project. The biggest problem is the improvement of the LC over time. As one of the design criteria is ‘the continues improvement of the objective’ this is a critical part of the development of an optimum LC for each item.

To improve the objective the minimum labour content has to be adjusted. This adjustment needs to consider project circumstances, productivity rates and the assumptions (best practices). It is unclear how the adjustment could take place. Items which show high deviation or projects with identified deviation in LC have to be identified. These projects should be evaluated and conclusions should be fed back to the consultants who can adjust their practices accordingly. Also, the establishment of the LC by the consultant has to be monitored. He should be capable of defending his choice of minimum labour content when the labour content is not reached, when it is much higher or when the tender rate is disproportional to its volume or labour content. Therefore the consultant has to keep a large administration of his design of the labour content for LI marked items. Also the consultant will be inclined to help the contractor improve the LC to the minimum. As seen in the Gundo Lashu project this leads to conflict of interests as the consultant should act as agent of the client.

The third option has not been investigated properly, but seems unpromising as it does not provide guidance. It does not optimize the conditions to the maximum amount of labour. Also, the conditions are an additional burden to the contractor and are difficult to implement in the tender document. The distinction between structural problems of the conditions or incidental problems with the condition could not be determined in time and more research is needed to identify this. It is however not recommended to pursue this option as it is estimated to use a large feedback system and does not provide clear goals to steer on.

6.3 Implementation of the M & E system

To implement this system developing contractors need to be guided to not only learn to tender, but also to keep track of their labour content. A system that might be considered is one where a team of experienced actors guide the contractor. This system is the management-agency model, and guides LI contractors after they finished their training programme.

The implementation phase could be a combination of the first two methods. The consultant sets a minimum LC, but the contractor has to tender on his LC (must be higher than minimum) and on the rate for an item. As the first tenders are done still according ILO/CIDB methods and based on ILO productivities the consultants should be able to define a minimum LC without a proper feedback system. After a while method 1 could be fazed out as contractors are more developed and can optimize the project themselves. This means that the consultants does not have to measure the productivity rates.

As labour content becomes a criterion to get paid, fraud is imminent. People showing up on the payroll that have never worked can be become a fact. Also, abuse of labour should be prevented. It is noticed that productivity will stay low or non-existing if communities are pushed too hard. There should be a safeguard in place to protect the community. As fraud is a more dominant consequence of this method it should be made clear that the contractor stand much too loose if he frauds. Fraud is a criminal offence and can lead to jail time. Nevertheless, a system must be in place to double check the labour content. A system must be developed to ascertain the correct created labour content. A premature suggestion is that this is done by randomly visiting sites and checking day charts at the beginning of the day with the charts at the end of the day. Because this would make it possible for the contractor to put family or friends on his daily sheets without even have them working for him. The contractor would manage his labour content at the right rate without having people working for him.

Careful attention has to be paid to the contractors falling outside the normal range of LC or tender rates. They might be more inclined to fraud if they win the tender.

It is also important that the consultant has a clear view on the construction process of the item so it is easy to estimate if the labour content is correct or deviates much from normal practice. Therefore work and method studies remain useful for consultants to carry out. They do depend on the work and method studies as in method 1.

The amount of labour created can differ each month and a certain amount of variation has to be taken into account due to start up and closing down problems. Therefore during high peak months the item might create a lower amount of labour while the average stays the same. This should be taken into account by using allowing a percentage of lower labour content. If the contractor does not meet the average in the end, the retention can be withheld to create the missing jobs on other projects.

Enough competition needs to be created in order to lower the rates and to increase the labour content. Low competition, even without tendering on labour content, leads to high rates. More competition means the contractors have to improve their processes to get lower rates and to increase their labour content.

A system must be created to compare the labour content of items between projects and to establish a general labour content which can help clients to evaluate their tenders. As labour intensive construction techniques are standardizes it is assumed that a general labour content can be devised. If the labour content differs a lot between projects it might indicate that the item needs to standardized

further or external factors differ a lot between these projects. At least the item needs to be investigated.

Standardized forms must be implemented to keep track of the labour content created. This makes it easier for the consultant to check the data and helps digitize the forms for use by the client or EPWP.

Variation orders must be adjusted so that it can be used to request an adjustment of the labour content due to changes. It is important that both the consultant and contractor keep track of the labour content created.

7 Conclusions and recommendations

In the previous chapters the theory was combined with practice to lead to a design of a monitoring & evaluation method of the labour content of labour intensive marked items in labour intensive construction projects. This chapter gives an answer to the research questions stated in chapter 3. It gives an overview of the most important characteristics and consequences of the selected method. Recommendations are presented to help implement this method in practice and what needs to be researched to guide this implementation. General experiences from the Gundo Lashu project lead to recommendations about improvements of and research areas form labour intensive construction projects.

7.1 Conclusions problem analyses

The first research goal was:
"To design a system by which LC of random LI projects can be planned, steered and evaluated in different phases of the construction."

The initial approach was to disaggregate each LI item into standard activities with standard task rates. The assumption behind this was that a standard LC for each item could be built up with the help of these standard activities. Therefore the attention turned to the standard task rates for each activity within these LI items. These could be obtained by looking at the international productivities and the productivities obtained from the Gundo Lashu project. It was found that the labour content is project & contractor specific and depends of numerous different conditions that influence the labour content. Also, productivities have not been documented in the Gundo Lashu project. Productivities are used from ILO literature and are adjusted to local circumstances, but without documentation. Labour contents have to be established for each project individually and cannot be established as an overall figure due to lack of input and because of the differences between projects and operations. An initial labour content for each project and item could be set with the use of ILO documentation, but the accuracy of this labour content is questionable.

It was found that Labour content could be measured easily (but not predicted) for each item. The contractor has to keep field books with names, signatures, activities (task and rate) and items. It is the combination of the muster roll and the daily sheets. This document should be standardised and implemented in every project.

The second research goal was:
"To give recommendations on how to implement this M&E system in an effective, efficient, reliable and consistent way."
An analysis of international literature on monitoring & evaluation systems, benchmarking, strategic management and design conditions for information systems provided a set of design criteria by which the calculation method could be implemented effectively and would act as a method to steer projects. The stakeholders' analysis was used to analyse the current organisational structure on how the method should be implemented. The data and system condition were the qualifying conditions on which the system should be able to operate. These conditions were further adapted to the findings from the Gundo Lashu project.

In dialogue with the findings about the design of the method to develop an LC for each item, three different methods for measuring and evaluating the labour content in labour intensive projects were designed.

The methods were tested on the conditions and method 2 satisfied almost all conditions. To be effective it has to be used by mainstream contractors. They know how to keep track of their productivity. It should help to improve developing contractors on how to run their business. And after training they should be able to keep track of their productivity as well. Because the method uses a small adjustment in output for the contractor it should be easily fit into the current construction processes.

Because method 2 costs the least effort to implement & maintain, it is integrated within construction processes and gives the correct labour contents it is the best option. Method 1 is less effective as

method 2 as the planned objective should be established by the consultant who would have to work with standard procedures that need to be readjusted over time. Method 1 could be used to set targets that will help introduce method 2. Method 1 would be used once or twice in order to provide these labour content targets.

7.2 Problems designed M&E system

Method 1 does have some disadvantages. It needs a competitive market and knowledgeable contractors to be implemented effectively. As labour content becomes a measurable condition to be paid on, the labour content for each item is subject to fraud. The measurement of the labour content is easy to do with the help of field books but might prove a large administrative task for the contractor. The method has not been developed in detail and some questions have to be answered still. Which reward system to use? Which tendering procedure the most suitable is? And will it work in practice? It also needs to sort out whether the agreements between communities and client about productivities need to be upheld as these agreements might hinder the effectiveness of this system.

7.3 Problems labour intensive construction

- No structural employment is created in South Africa with this programme. Communities have the opportunity to work once or twice in their lives on such programs but no opportunities are offered to provide them with structural employment. Shocking was the fact that CETA, the learning organization for the department of public works, is incapable to train the employers for other occupations than in the construction area. Investments in education should be priority number one.
- The need to create employment is so great that projects are carried out labour intensively even when they can be executed faster, with better quality against a lower price with machines.
- The employment figures should reflect structural employment and not temporary employment. In our opinion too much attention is paid to temporary employment while the benefits of this type of employment do not justify the investments.
- The reservations of the current construction industry about labour intensive construction methods in combination with lack of knowledge on the client side poses a threat to the EPWP programme. As the EPWP programme will increase the percentage of funding that has to go to labour intensive construction projects it must be able to spend this money efficiently. Without knowledge the money will not be spent or spent inefficient. There must be institutional capacity to spend this money effectively otherwise the amount of labour created will not be justified by the amount of money spend. This threatens the concept of labour intensive methods as the industry is eager to show this it is ineffective.

7.4 Recommendations

This research focused on the establishment of a general labour content figure for each labour intensive marked item with the help of the Gundo Lashu project. This program gave new insights into general problems concerning labour intensive construction problems. The method developed also introduced new research questions that have to be answered in order to implement this method.

Although the outcome of this study is that method 2 has the best opportunities for success in the future, a combination of method 1 and method 2 in the implementation phase might be considered. So method 2 should be investigated. the following aspects should be considered for further research.

- Research on how to train contractors for this method
  Developing contractors should be trained on how to establish a correct minimum labour content for each item. They should be trained on how to tender on an accurate minimum labour content in order to win the tender.
- Research on tendering procedures
  A transparent method should be developed on which the winning tender is selected. The tendering procedures have to be redesigned in order to accommodate tendering on labour content. The different methods to tender on labour content should be investigated for practicability and effects.
- Research on the influence of fixed productivities
  Current practice shows that before a project starts the client and the communities agree on productivity rates. These fixed rates influence the amount of labour content needed. The influence of these agreed productivity rates on this method is unknown. It should be investigated

if these fixed productivity rates have an effect on the tendering on labour content and their influence is on the tender rates. Other methods of setting productivity rates should be researched.

- Investigate feedback loops for method 1
  To implement method 2 it is advised to use method 1 simultaneously to create a shadow labour content for each item. Therefore the implementation of method 1 should be investigated. The feedback loops that enable the calculation of the correct shadow labour content should be researched.
- Investigate reward system for the method 2
  No research has been done on how to use method 1 in practice. The way to penalise contractors when they do not meet their labour content each month needs to be investigated. Are they allowed a certain percentage under their tendered labour content due to start up problems? How are they penalised? Is there an amount deducted from their monthly payments or is the fine deducted from the retention money? In what situations can a contractor ask for a variation order to adjust the tendered labour content or rate?
- Investigate system to prevent fraud
  The remeasurement of labour content is done with the use of the field books kept by the contractor. As the contractor gets paid on the labour content he or she might be prone to edit the field books. A system should be developed (e.g. surprise site visits) to prevent fraud. Correct and just penalties should be investigated to help prevent this.
- Use method in competitive environment
  This method will be ineffective when the market is not competitive because it depends on market dynamics to produce the optimum labour content & rate ratio. This is not the case in an uncompetitive environment. It should be investigated how to ensure the best labour content and tender rate ratio in such a case or how to get a competitive environment. The use of a shadow method 1 could be considered in this case, but this should be investigated further.
- Test method in practice
  This method has not been tested in practice. A testing phase should take place on field level. The recommendation is to start to tender on labour content of one labour intensive marked item and to see whether the EPWP guidelines are followed still, how the labour content is measured, which tendering system works the best and which reward / control system should be used.

For the Labour intensive construction projects the following point should be considered:

- Do not let clients train contractors
  The Gundo Lashu project showed a clear and understandable bias toward their trained developing contractors. The contractors were kept alive longer than necessary in order to train and assist them. Because of conflict of interest the client should be separated from the training program. Finance control is separated from operational control.
- Development contractors
  The Gundo Lashu project showed contractors did not possess the correct characteristics and knowledge level to tender on these big projects. Therefore the consultant partially took over the responsibility of the contractor when the contractor lacked knowledge or interests. It is recommended to develop contractors that already have a minimum sense of how to control cost and how to deal with people.
- Carry out a more careful pre-feasibility study
  The investigation into Gundo Lashu project provided with different views of the pre-feasibility study. These differences in opinions need to be investigated further.
- Use managing-agent project structures
  Contractors in the current labour construction industry do not have enough experience to run their business on their own. A managing-agent organisational structure can provide guidance of the contractor. This guidance helps the contractor to develop his management and business skills in order to run his company and construction processes efficiently and effectively.
- Bias of consultants towards labour intensive construction projects
  The outcome of the interviews with the consultants' is they have still reservations toward labour intensive construction projects. This needs to be investigated further as they are the designers of the projects and can therefore opt for machine based approaches while labour based approaches might be feasible.

References

1. McCutcheon R.T.& Taylor Parkins F.L.M.,2003,Employment and High Standard Infrastructure, Johannesburg, WORK Research centre for employment creation in Construction
2. Department of Public Works, June 2004 Consolidated Programme Overview and Logical Framework P20,21
3. Mosch, L.P.J., Boer, S.J., Rietjens, S.J.H., Vis D. van de,2000, Employment-Based Civil Engineering
4. IBRD (World Bank). April 1986. "The Study of the Substitution of Labour and Equipment in Civil Construction. A Research and Implementation Project Completion Report" Washington : Page 21, 29,31
5. Philips S.D., 1994, Theoretical analysis of Labour-Intensive Construction of Waterbound Macadam Roads, Johannesburg p96
6. Bonnard E, Smulders M. & De Vries M., December 2005, A Critical analysis of the reporting process of the Expanded Public Works Programme for Infrastructure projects, Johannesburg
7. Verschuren P. & Doorewaard H., 2003 third edition, "Het ontwerpen van een onderzoek", Utrecht. publisher Lemma,
8. Stiedl D. (1998) Productivity norms for labour-based construction. Technical Brief No 2, ILO ASIST, Nairobi Kenya
9. Stenström T. (2004) Contractor's handbook for Labour-based Road Works, Republic of Zambia, ILO ASIST
10. Tembo S., Blokhuis F. (2004) Manual for Labour Based Road rehabilitation works, Republic of Zambia, ILO ASIST
11. CETA, 2005, Contractors' manuals.
12. Bentall P., Beusch A. & De Veen J., 1999,, Employment intensive infrastructure Programmes: capacity building for contracting in the construction sector, Geneva, ILO.
13. Ove Arup & partners Cipfa Services Ltd., 1987, Management reporting system for the Kenya minor roads programme, construction technology programme series, Geneva, ILO
14. Rouse P., Putterill M., 2003, An integral framework for performance measurement, Management decision 41/8, P791-805.
15. Tan K.H., Platts K.,2003, Building performance through in-process measurement Toward an "indicative" scorecard business excellence, Institute for Manufacturing, University of Cambridge, Cambridge, UK, and James Noble, Columbia, Missouri, USA , Department of Industrial Engineering, University of Columbia
16. Mohammed S., Benchmarking and Improving construction productivity, , Queensland, Australia
17. Madigan D.,1997 Benchmark Method, Building on CESMM, , University of Bath, United Kingdom
18. Johnson G., Scholes K.1993, Exploring corporate strategy, 3rd edition, Prentice Hall International.
19. Shankman N.A., 1999, Reframing the Debate Between Agency and stakeholder Theories of the firm, Journal of Business Ethics 19, p319-334
20. Contractor's Handbook Labour Based Road Works, Zambia 2004, Intech Beusch & Co, ILO ASIST, P56

Appendices

Appendix A Research Questions

Main research question:
What are the design/implementation criteria for a M&E system of LC in LI projects?

Sub research questions:
1. What are the practical design criteria?
2. What are the theoretical design/implementation criteria for a M&E system

Sub sub research questions

1. What are the practical design criteria?

1.1. How is LC in the Gundo Lashu project calculated?
   a. What are the task rates according to the contractors in Gundo Lashu?
   b. What are the task rates according to the consultants in Gundo Lashu?
   c. What does the contractors uses to calculate its productivities and task rates?
   d. Which method does the consultant uses to calculate the rates per LI item?

1.2. How can relevant actors in the construction project be identified

1.3. What are relevant aspects of these actors

1.4. What are the general problem with LI construction that can hamper the effectiveness of the M&E system

1.5. What are the relevant organisational characteristics of a LI project, with Gundo Lashu as a basis which influences the implementation of this method?
   a. What are the aspects of an organisation structure and operation according to management literature?
   b. What is the organisational structure for a LI project described by these aspects?
   c. What organisational characteristics influence the changing of an aspect in an organisation according to management literature?
   d. What are the specific LI project characteristics that influence the implementation of this method?
   e. Which aspects of an organisation are important for changing the organisation according to literature?

2. What are the theoretical design/implementation criteria for a M&E system

2.1. What are the theoretical design/implementation criteria for a M&E system
   a. What are the design conditions according to monitoring and evaluation theories?
   b. What are the implementation conditions according to management theories?

2.2. What are the criteria for the calculation of LC
   a. What are the labour intensive activities according to international literature?
   b. What are the labour intensive activities according to EPWP?
   c. Which method is used to calculate the productivity for LI activities according to international literature about LI projects?
   d. What calculation method does the ILO uses to calculate costs and productivities?
   e. What are the task rates according to international standards?
   f. What are the task rates according to ILO information?
   g. What are the LI activities within LI items for projects and what are the characteristics of these LI items?
   h. Which items are labour intensive according to the EPWP guidelines?
   i. What are the v
   j. olumes of the BoQ provided by RAL?
   k. What are the activities of the items on the BoQ provided by RAL according to the general definition?
   l. What are the specific characteristics of the items stated on the BoQ of the Gundo Lashu project according to the site meeting document?
   m. What are the characteristics of the items stated on the BoQ of the Gundo Lashu project according to the consultants and clients?

Appendix B Stakeholders analysis

This appendix gives a more detailed overview of a stakeholders' analysis.

A stakeholders' analysis is carried out to identify relevant stakeholder, their relationship to the organisation and their power over the organisation. The following questions are asked to identify the stakeholders:

- Who has an interest in the project?
- What are their interests?
- What are their influences?

Their interests are closely linked to their functions and their behaviour and attitude. Influences are identified with the help of power mechanisms. Power can come from different sources the following power sources have been identified:

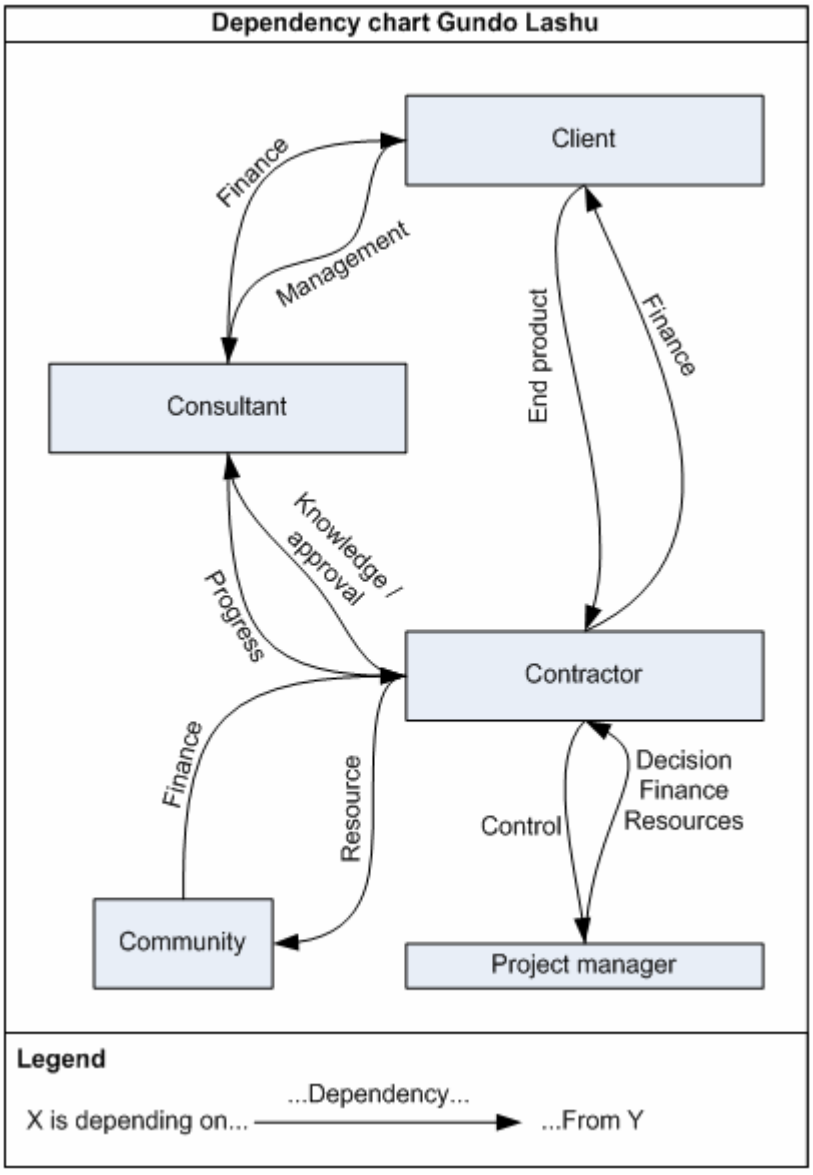
Sources of power for internal stakeholders

- hierarchy
- influence
- control of resources (control of important resources)
- knowledge or skills
- Control of the environment (control of external factors due to linkages)
- Exercising discretion (the possibility to give own interpretation to a decision)

Sources of power for external stakeholders

- Resource dependency
- Involvement in implementation
- Knowledge and skills
- Internal links

Appendix C Dependency chart Gundo Lashu



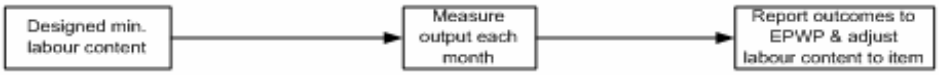
Appendix D Method 1 Setting of a labour content as an item target

Method 1

Method description

The establishment of a minimal labour content per individual LI item as a condition of contract. With each item marked as LI a minimum wanted labour content is demanded. For this min. labour content the contractor has to set the rate. The contractor is bound to this minimum.

Process



Process description

For each LI marked item in the tender a minimum labour content is calculated. The agreement with the communities on productivity rates and the standard production processes (normally ILO or CIDB) are used to calculate this. These standard production processes are chosen on the basis of the design. The contractors have to tender on the items and their minimum labour content. The tender rate will partially reflect the effectiveness of the design. The tender rate will be higher when the minimum amount of labour used is set too high. The tender rates are also influenced by strategy, material costs and construction processes.

During execution the labour rate will be checked and the contractor is fined (a discount on the rate) if he does not meet the minimum labour rate. This check is done together with the remeasurement of the quantities and the remeasurements of the labour are included in the monthly payment certificate.

At the end, the totals are calculated and compared with the initial planned labour content. When the LC is higher the contractor gets fully paid. The differences have to be explained in order to see in standard practices have to be adjusted to set the minimum LC higher. When the LC turns out lower a percentage of the contractors retention money, usually his profit, is deducted.

The following discussion point arise:

- How can the consultant decide on correct standard procedures are eligible for the design or location?
- How can the consultant adjust standard procedures?
- How are productivity rates refined and adjusted?
- What if the contractor puts in a Variation order for adjustment of the labour content? How can it be checked that the LC should be set lower? Or that he needs to be compensated for his higher LC?
- What if the contractor achieves a higher LC, how can this be translated to the improvement of the standard LC? How should this be documented?
- On what does the contractor needs to be fined? On overall LC (for the project), or on the LC for each item? And when? Each month or at the end of the project?
- The consultant decides on the labour content and thus in project costs but without practical information on costs?

Advantages

- Clear objective and adjustable
- Gives 'small' contractors a good indication of needed labour per item unit
- Provides EPWP with a good insight the effectiveness of the programme
- Indicator provides labour creation figures for EPWP
- Design more streamlined towards labour creation because of attention to labour
- Use of current practices; tendering and remeasurements

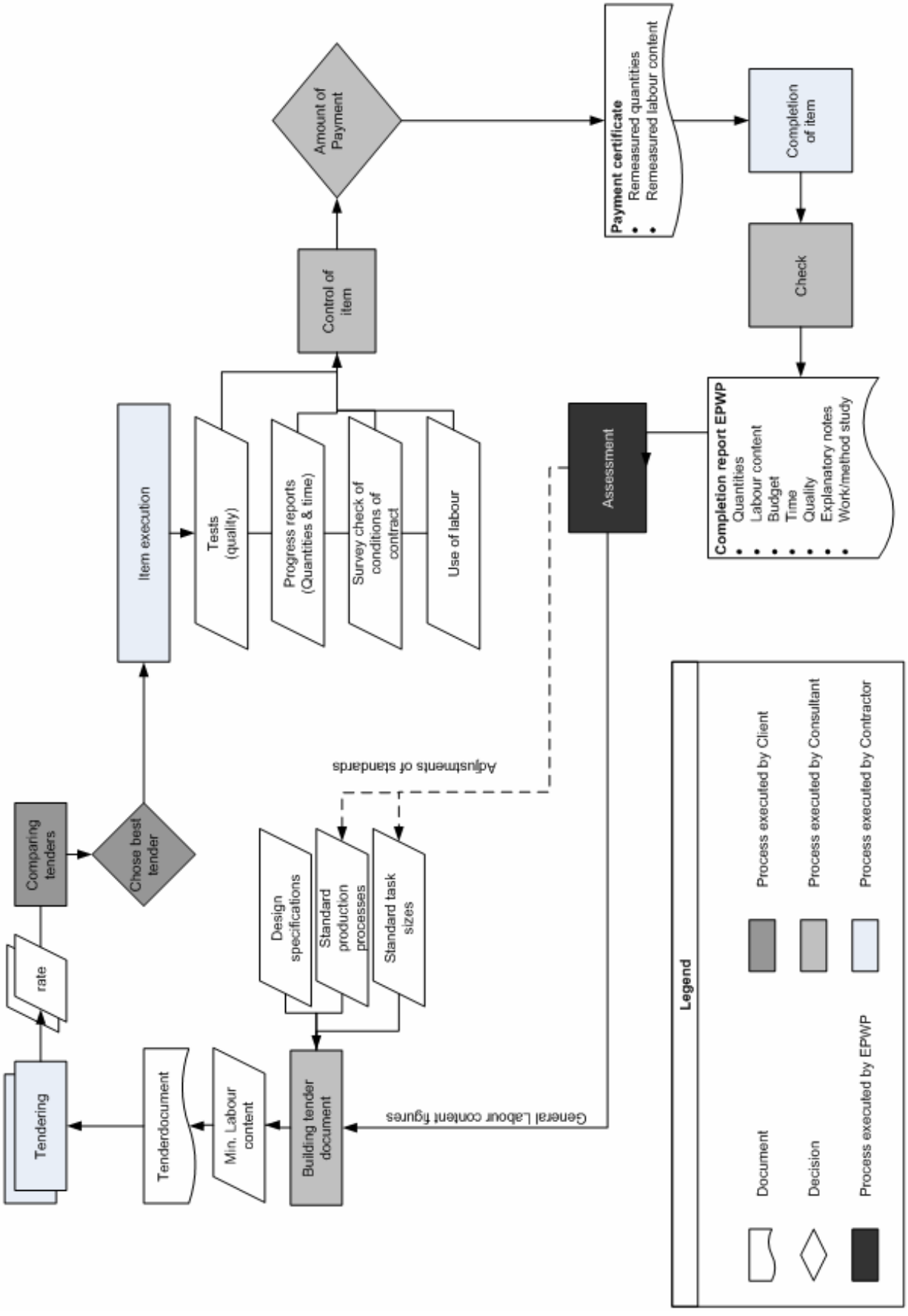
Disadvantages

- High data requirements for consultant to adjust min. Labour content to a higher level
- High insight in project characteristics and design needed to derive correct minimum labour content
- Difficult to measure each month
- Large administrative procedures for consultants
- No incentive to improve productivity of labour or to streamline processes by contractors
- Long feedback loops to consultant, client and EPWP.
- Hard to standardize labour content planning due to differences in labour content. No guidelines for consultants, difficult to control consultants planning of labour content.
- Reliability of captured data

Conditions for implementation

- Create standardized ways to identify correct minimum labour content for consultants
- Create feedback loops for information needed to plan labour content via EPWP or client
- More capacity for consultants
- There must be a method designed to ensure correct labour content data
-

Dataflow chart method



1

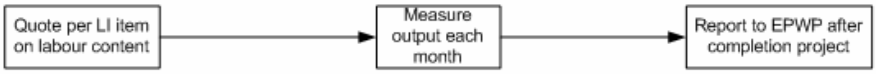
Appendix E Method 2 Tendering on labour content and tender rates per item

Method 2

Method description

Enforce tendering on labour content. Contractors have to tender on Labour content in the same way as they have to tender on rates. Each tender is judged on costs and labour content. Labour content per cost unit per unit item.

Process



Process description

The tender is designed with the use of standard COLTO item. Contractors have to tender on tender rates and they have to tender on labour content for the LI marked items. Thus for each LI marked item the constractor specifies the amount on money he wants for an item unit and how much minimum labour he is planning to use. The responsibility for the LC is put with the contractor. With the tender rates, agreed productivity rates between client and community are also communicated. The contractor can use his own experience and knowledge to optimize his processes and to lower costs and improve the LC.

The tender is evaluated on both merits. The labour is compared against the costs per unit item and the tenders are compared on overall costs and labour creation. If the LC is low and the costs are high (it must executed LI still) the material costs might be too high, or the processes inefficient. It might be a design fault or a procedure fault. If the LC is high and the costs are also high, the volume of the item, or the item itself, might not be suitable to have it carried out Labour intensively. Again, the problem may be with high material costs. If the LC is high and the costs are low, the item is correctly marked as LI or the contractor might be winning the contract by strategic tendering.

The quantities and labour content are measured during the construction process at the same time. The current practice of monthly remeasurements are used to measure both objectives. If the contractor is using a higher LC than planned, he might be in a start up phase or he might be working inefficiently. If he is using a lower LC he is discounted on the rate of that particular item. The contractor can apply for an adjustment of his LC. They can only apply for this if they have sound reasons for this. Reasons can be design changes, unforeseen changes in project conditions or problems with workforce that falls outside his control. E.g. the workforce is unavailable due to heavy drinking and the contractor has to finish his work before rainfall. The adjustments are done with the help of V.O.'s
Totals are calculated after the completion of the project and the contractor is awarded accordingly. The Labour content per item (planned and final) are sent to EPWP for comparison with other projects. EPWP calculates an average LC for each item and communicates this with the consultants. The consultants can use this for the evaluation of their tenders.

Discussion points:
- When to deduct money if LC is not up to minimum LC? Monthly or at the end of the project?
- What reasons can the contractor give for adjustment of his LC for a certain item? How can these reasons be checked and documented?
- How can deviations from standards in LC and rates be identified?
- Are work and method studies needed still to find the best productivity rates?

Advantages

- Clear objective
- Freedom for contractor to chose method of work
- Output forces to act and explain
- Conditions of EPWP guidelines apply still
- Output can be aggregated to find average LI input per item on programme level
- Enforcement of tendering forces the contractors to look at productivities
- No high data requirements for consultant or client
- Use of current practices; tendering and remeasurements

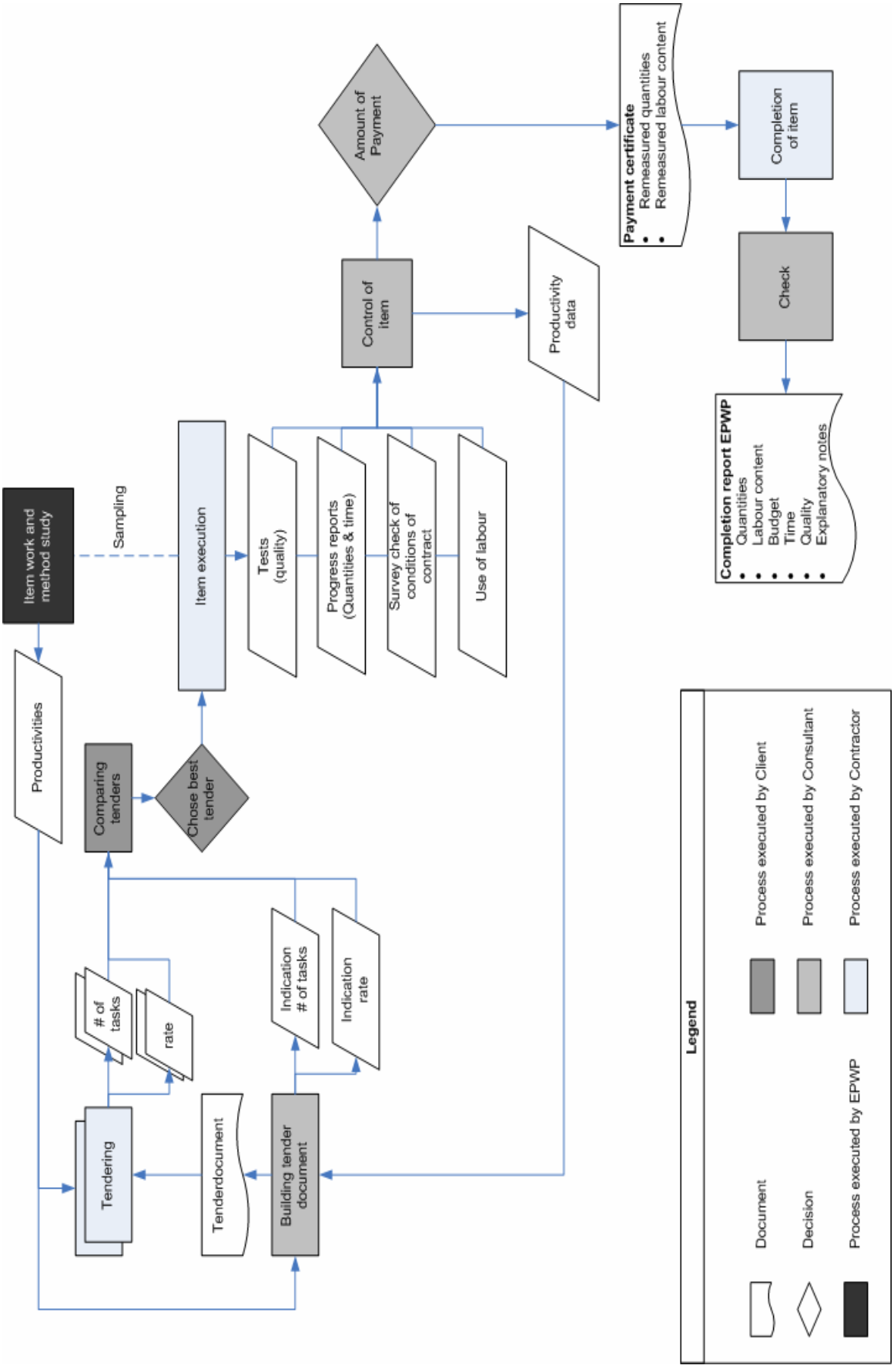
Disadvantages

- Low knowledge level of contractor can cause difficulty in tendering on labour content
- Unknown legal issues
- Measurement of labour content per item per month
- Adjustment of labour content per LI item in the planning phase relies on contractor ability and monitoring system
- Planning of correct labour content at the beginning of each project.
- Possibility of Variation Orders for unforseen conditions that influence labour content
- The problem of low competition leading to high rates and low labour content
- there Is No direct link between tender rates ($) and labour content because other costs are also included in the tender rates.
- Reliability of captured data

Conditions for implementation

- This method works only with an experienced contractor,
- Developing contractors need to be assisted.
- There must be enough competition to ensure fairness in rates and labour content
- There must be effective supervision from consultant to ensure correct and accurate data about labour content
- There must be a method to ensure correct labour content data
- Measure of LC only above a certain threshold of quantities

Dataflow chart method 2



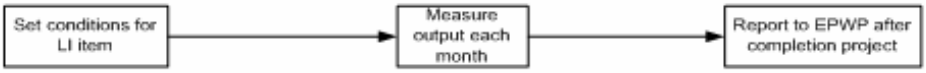
Appendix F Method 3 Conditions that will guarantee correct labour content

Method 3

Method description

Set conditions per LI item in the tender. Set conditions under which the operations of an item can take place. The labour content is measured accordingly and adjustments to these conditions are made after careful consideration.

Process



Measurement of labour content

The conditions per LI item are set by EPWP. These conditions are derived from work and method studies are general enough to provide the contractor with enough lean way to carry out his project. These conditions are standard per item, and can even be set for a group of items. Unfortunately it is not clear how these conditions should look like, but they should guide each item enough that LC's for a certain item carried out in different projects does not differ that much and that enough LC is created each time. The LC's should differ that much so that the LC can serve as a planning objective for future projects. The conditions are included in the tender.

During the project the consultant checks the created LC per item and checks the project on the compliance with these conditions. Each month they reassure that the contractor has complied with the conditions and include this in the remeasurement. If they do not comply, the contractors are not paid. If the contractor wants to have a condition removed they have to do this with a Variation Order. The consultant has to check the reason and has to see if this condition has to be revised at all. If so, they need to communicate this with EPWP so that the condition can be removed or altered.

After completion of the item they can measure the amount of labour created per item and send this to EPWP. EPWP can obtain an average of the LC and can send this average to the clients. They can use this as an guidance for the planning of future projects.

Discussion point:

- How to set these conditions?
- Are these conditions project specific?
- What reasons can be used by the contractor to change these conditions?
- If the conditions are altered during the project are LC created still useful to establish an average
- If the conditions are changed at EPWP, what happens to the planned LC per item? Does it has to be adjusted or does it have to be derived again?
- How can the consultant have the general conditions changed?

Advantages

- If conditions are set broad enough, there is maneuverability for the contractor in the way he or she wishes to execute the work
- If conditions are set narrow enough, an general labour content figure for each LI item can be derived.
- No high level of data collection.
- Conditions easy to control for consultant.
- No productivity figures needed

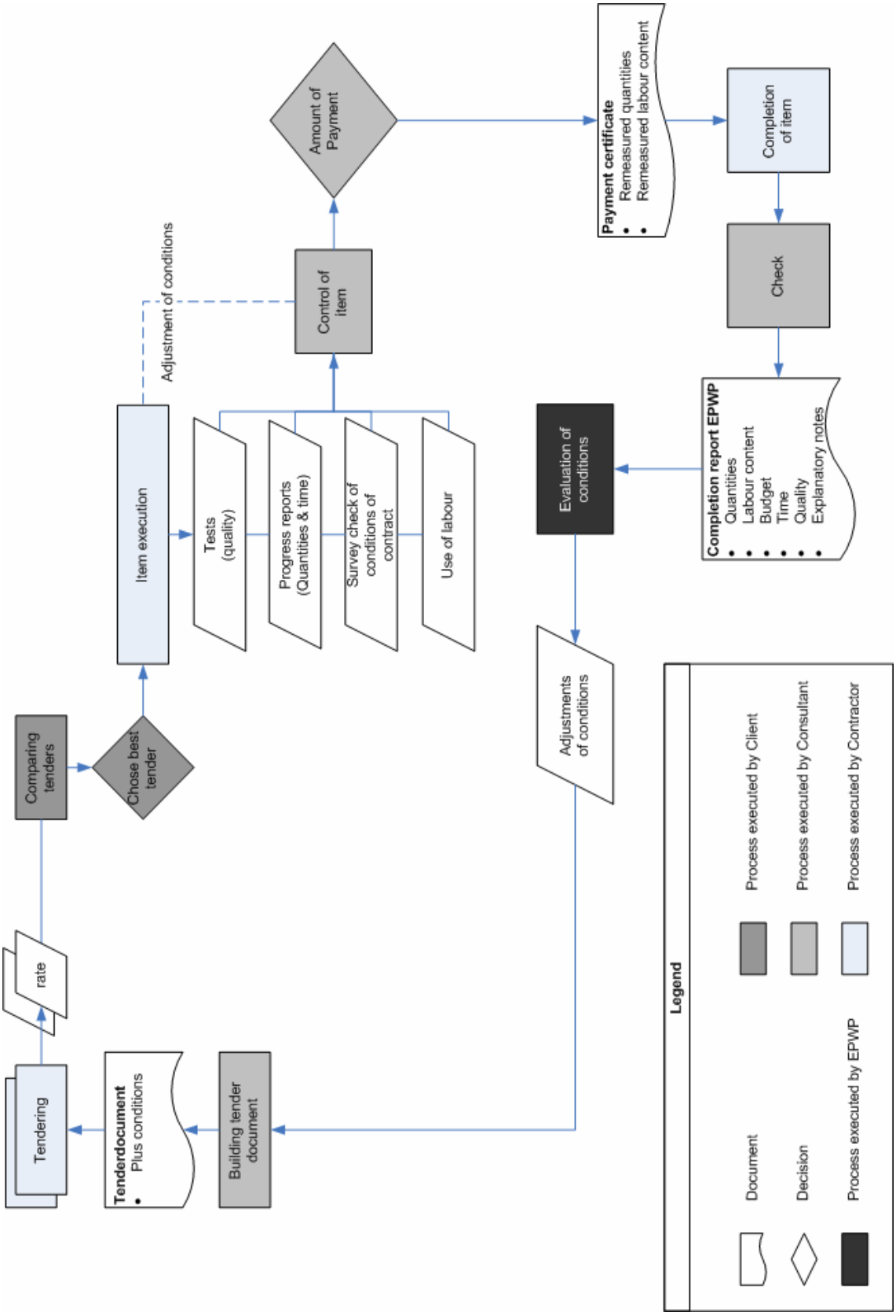
Disadvantages

- Setting conditions is difficult due to differences in projects
- No planning mechanism for future projects. Adjustment of conditions during project makes comparison of labour content between projects more difficult.
- Labour content figures for each month needed still
- No clear objective, difficult to steer during project
- Difficult to see if conditions have to be changed
- Conditions hard to implement in current system of tendering, additional documents needed
- Reliability of captured data
- There must be a method to ensure correct labour content data

Conditions for implementation

- Feedback system on the usefulness of the conditions needed
- Standardized items with standardized conditions needed
- Establishment of conditions per item
-

Dataflow chart method 3



Appendix G Activity sheet item 34.01 C i

This appendix gives the activities of an item in the Bill of quantities of a Gundo Lashu projects. It also states which sources have been used to compile the activities within this item.

Item description
Pavement layer constructed from gravel taken from cut or borrow, Gravel sub base (unstabilized gravel) compacted to 95% AASHTO density (150mm) thickness.

Activities
1. Shuttering (a)
2. Mixing & placing (b)
3. Levelling and screeding (c)
4. Compaction (d)

Task rate A, Placing shutters is a Gundo Lashu specific activity that might not uphold for the other parts of the country. Shutters are often stolen or bend during use. Some persons prefer the use of profiles to measure the camber. For a team of 2 persons the can place and level 240 m of shutters (half width). This task rate is more easily to establish that the one for unloading.

Task rate B, The production of the actual base is a team task rate which is set on 27,4 m half width per day for a team of 3 persons.

Calculation example for stabilized cement:
Productivity: 5,5 m3 mixing per 2 persons per day (loose), mixing twice and placing
Width road: 3,15
Length road: depends on productivity, road and wheelbarrow spacing.
Wheelbarrow spacing depends on production process used!
Road length assumed is 13,7m
Team size: 3
2 * 13,7 = 27,4 as they can process it twice.
Plus 1 water carrier
27,4 m, half width, stabilized, per team

Task rate B depends on the type of product and on the production process used. The calculation of the labour used per m3 per item can be approached productivity rate if support labour is taken out of the amount of labour used. Other consultants use machine mixers to mix the cement as it is hazardous to labourers and the quality of mixing by hand is often poor. The activities in the item (L.I.) are done in a different way.

Task rate C, Levelling material:
3 members per team, 60 metres. No additional data about process is provided.

Task rate D, Compaction is done by machine.

From the Gundo Lashu no data could be retrieved to give an accurate task rate for A. It is not included in this item. The amount of persons used for 240m or 50,65m3 (compacted) = 24 persons (8 teams of 3). Shuttering and levelling is included in the item for the unstabilized base. The labour content could not be checked against other projects and variances in content could therefore not be measured.

Appendix H Definitions

This list of definitions is used in this project report. Some has been sourced in scientific documentation.

Baseline: The Baseline mentioned in this report is a reference point for a certain task rate which was tested to real project data for a certain activity and will be used as a baseline in an M&E tool for projects in the future.

Bill of Quantities (BoQ): The BoQ is a list of items which have been tendered by the contractor and will be remeasured for payments during a construction project

Activity: An activity is an amount of tasks

Task(rate): A task is a measurable amount of work done by a single worker per day for a certain activity. A task is generally set to be achievable in 70 percent of a working day, but often completed in 50 percent.

Team Task(rate):One team task is a measurable amount of work that is completed in one days work by a certain number of workers for a certain activity.

Item: An item is an activity, or a set of activities which is listed in de COLTO and is a guideline for tender documents.

Productivity(rate): The productivity rate is the number of activity done per day.

Framework: With framework is meant the Net Job Calculation Framework designed by Bonnard, Smulders & De Vries in 2005. It can be used to recalculate Machine Based (MB) items into Labour Intensive (LI) items. Their Framework takes the Bill of Quantities as a starting point and calculates the labour content for different items. The labour content is given in person days. It only looks at items that are potential labour intensive. These items have a high portion of the project costs and contain ELHUS activities. They calculated the labour content by looking at the rates for those items and dividing these rates by the wage rate. They did this for both MB and LI projects. The difference between both labour content is the net job creation.

Machine based: A machine based project is a project which primarily uses machines to do their activities. The labor content in a machine based project is low, and mostly only to operate the machines.

Labour intensive: A Labour intensive project primarily uses labor for executing its activities. Machines are only used when it is not possible to do an activity with labor.

Benchmarking: Benchmarking is a systematic and continuous measurement process; a process of continuously measuring and comparing an organization’s business process against business process leaders anywhere in the world to gain information which will help the organization take action to improve its performance(International Benchmarking Clearinghouse (IBC))

Labour Content: Is the amount of man days used in a certain item.