

LESOTHO: CONSTRUCTION UNIT SUCCESS

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INTRODUCTION

This paper deals with a Client's, Lesotho Highlands Development Authority, view of a success story, of how to manage a construction unit and its benefits to the client and the country as a whole.

EXECUTIVE SUMMARY

The Katse Feeder Roads project has not been a project run in the normal way where Engineering Consultants were appointed to supervise a Contractor who has tendered for the project.

The task force principle has been adopted, with the assistance of a Project Manager to lead, advise, control and train the team on site. In other words the created organization called the "Project Management Services" had to fulfil the function of:

1. The Supervision Consultant, as well as
2. The Contractors on-site Management

This required the management team to fulfil the function of the supervision Consultant as well as the Contractors on site management.

PROJECT DETAIL

Budget Amount	M 51 800 000
Final Amount before sale of assets	M 57 326 254
Final Amount after sale of assets	M 49 357 145
Length of Road	54 km, three diff. roads, gravel surface
Construction Start	September 1997
Construction Period	24 Months
Scheduled Completion Date	August 1999
Delays not planned for	2 month + 6W.D.
Substantial Completion Date	8 th November 1999
The Client	Lesotho Highlands Development Authority
Project Managers	RBPM (PTY) Ltd
Funding Agency	Development Bank of Southern Africa

PROJECT FINAL RESULT

TIME

Unplanned delays amounted to 2 months plus 6 w.d., due to:

1. Additional inclement weather days
2. Stoppage due to the September 1998, SADC Forces insurgency
3. Disruption in pay-out due to theft of wages and industrial action
4. Increase of rock quantity

COST

The first Business Plan predicted an overrun of M 1 474 307, this situation has been turned around to an under expenditure of M 2 442 855.

QUALITY

The quality as was specified to achieve, has been achieved. At the time of writing of this report, snag lists were drawn up by the LHDA, DBSA and LCU, which have been attended to.

MENTORSHIP & TRAINING

Judging from the above, it is obvious that the training and mentorship has been successful. Especially if one considers that at the time of the project start in September 1997, only one person on site had six months' experience in contractor type road construction.

COMMUNITY INVOLVEMENT

People from the community were employed from villages wherever the construction was happening. Employment statistics are:

1.	People-days employed	253 704
2.	Total income generated	M 7,4 mil.
3.	Income per People-day	M 29.17

PLANNING PHASE

The objective during this planning stage was to compile a workable Business Plan for submission to the Lesotho Highlands Development Authority for approval.

BUSINESS PLAN METHODOLOGY

We considered the Project Management Services to be run like a private sector construction company. For this we required a Business Plan/Tender on how to run the business of constructing the Katse Feeder Roads. The Business Plan would then form the basis of monitoring actual performance and reporting to a steering committee.

Project Objectives

The project objectives had to be defined in order for all to understand the reasoning behind certain decision-making processes. The Project Management Services team came up with the following objectives, which were displayed at strategic points in the camp:

1. COMPLETE WITHIN BUDGET
2. COMPLETE WITHIN TIME
3. MEET QUALITY NORMS
4. COMPENSATION TO KATSE DAM COMMUNITIES
5. BUILD THREE FEEDER ROADS
6. TRANSFER SKILLS – TRAINING
7. DISCIPLINE
8. BE HAPPY.

GLOBAL DECISIONS

In order to produce a Business Plan, certain global decisions had to be taken:

1. Target number of people from the community to be employed – approx. 600
2. Hire-in additional machines
3. Labour Construction Unit of Lesotho specification to be used
4. TRH 20 specification to apply to wearing course gravel
5. Concrete pipes to be replaced by Armco nestable pipes
6. Mini bridge typical design to be altered
7. Certain items in the bill of quantity, it was decided, were over estimated
8. Sub-contractor to be used for the bulk drilling and blasting
9. Rock quantities to be kept to a minimum, even if it resulted in realignments
10. Finishing and beautification works to be of a practical approach

LABOUR INTENSIVE versus PLANT INTENSIVE

The decision of what to do “labour intensive” and what to do by means of machines was directly linked to the available funds as well as to the time constraint.

An example of the consideration of what to do by means of labour and what by machine is the gravel wearing course:

1. Cost:	By machine	M 1 400 000
	By labour	M 3 655 272
	<u>Increase</u>	<u>M 2 255 272</u>
2. Time:	By machine (500 m per team per day)	108 days
	By labour (3 teams at 90 m per day)	200 days
	<u>Increase</u>	<u>92 days</u>

The construction with labour would have been financially feasible at a later stage of the project, however at that time, the August 1999 completion date was critical, therefore the decision to do the wearing course by machine. Quality & logistics also played a major role in the decision making process.

The following operations were planned for labour intensive methods:

1. Rock collection
2. Rock trap construction
3. Storm water pipe installation
4. Headwall and wing wall construction
5. Mini bridge construction
6. Fill over mini bridges
7. Erosion channels through fields
8. Oversize removal from layers

The Zero Based Budget

Other models with different circumstances, for the purpose of deriving financial cost figures for the Feeder Roads, were not used. The circumstances as found on site of the different Feeder Roads were evaluated and allowed cost figures were calculated for all items, utilizing at all times the zero based budgeting principle and lots of practical experience.

The Project Management Services overhead costs were established, resulting in reducing the number of people to the optimum. The overheads were a substantial cost factor on the project.

The following step-by-step procedure was followed:

1. Determine appropriate bill of quantities (not Colto format) for all roads with a split between earthworks and drainage works
2. Calculate the people cost to the Project Management Services, including leave, U.I.F. and incidental costs
3. Calculate the material and small tools cost, taking cognisance of wastage and price increases
4. Tender for all plant items taking account of preventive maintenance actions as well as the refurbishment and incidental repair that may arise
5. Tender for all items, as a contractor would do, to calculate the allowed cost for an item
6. This allowed cost was then transferred to the bill of quantity resulting in a total cost per item, per activity, per road
7. Determine the number of working days available, after deducting estimated days for rain, snow, cold weather, industrial action etc.
8. The number of working days, the production from the tender, then determined the time frame for the project and dictated the number of resources required to do the work in time

The Program

With all the above information the Business Plan program could be compiled. It is this program that has become the contractual program for the Project Management Services. Monthly, the program was monitored and status reported at monthly site meetings as well as the steering committee.

ID	Task Name	Duration	1997												1998												1999											
			J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S								
1	Feeder Rds. RBPM Program	543 d	[Gantt bar spanning from start of 1997 to end of 1999]																																			
2	Planning Period	20 d	[Gantt bar in early 1997]																																			
3	Construction Period	522 d	[Gantt bar spanning from mid-1997 to mid-1999]																																			
4	N.E. Feeder Rds.Constr.	305 d	[Gantt bar from mid-1997 to end of 1998]																																			
5	Mini-Bridges	77 d	[Gantt bar in early 1998]																																			
6	Drainage	240 d	[Gantt bar from early 1998 to mid-1999]																																			
7	Roads	283 d	[Gantt bar from early 1998 to end of 1998]																																			
8	C.E. Feeder Rds.Constr.	282 d	[Gantt bar from mid-1998 to end of 1999]																																			
9	Mini-Bridges	172 d	[Gantt bar in early 1999]																																			
10	Drainage	218 d	[Gantt bar from early 1999 to mid-2000]																																			
11	Roads	248 d	[Gantt bar from early 1999 to end of 1999]																																			
12	C.W. Feeder Rds. Constr.	348 d	[Gantt bar from mid-1999 to end of 2000]																																			
13	Mini-Bridges	109 d	[Gantt bar in early 2000]																																			
14	Drainage	152 d	[Gantt bar from early 2000 to mid-2001]																																			
15	Roads	304 d	[Gantt bar from early 2000 to end of 2001]																																			

The program had to illustrate how the works could be completed in 24 months:

The program methodology was to:

1. Pioneer the road to give access to mini-bridge teams
2. Bulk blasting of cuttings
3. Cut to spoil rock
4. Place drainage pipes with site related design
5. Pioneer layers over rock and black cotton
6. Layer works
7. Finish and trim

This Business Plan program illustrated how substantial completion could be achieved by the end of August 1999, based on the available information on quantities as well as the hiring of plant to have road works operations run concurrently.

CONSTRUCTION PHASE

This is the period from 2nd September 1997 to 8th November 1999.

THE PROJECT SYSTEMS

As previously mentioned, the objective was to manage the project like a contractor would. This required contractor type systems to be introduced and maintained.

The Financial System

A decision was taken to use "Pastel Accounting" which was found to be user friendly, for the accounting control. Business Plan target figures were set up in Pastel in order to produce actual vs. budget variances.

This information was:

1. Tabled monthly at the monthly site meetings
2. Used as the cost to date, for the forecast to completion

The Costing System/Performance Measurement System

The Project Management Services installed a costing system for on-site use. From daily reports, as compiled daily by the supervisory staff and fed into the costing system, daily/weekly/monthly profit or loss against the allowed cost was calculated for each and every operating team.

This information gave the Project Management Services staff the managerial information to concentrate on, and improve, operations not meeting the allowed cost as per tender.

The Forecast to Completion

In order to be able to determine if the project is still on track, a forecast to completion has been compiled every 6 months.

This forecast to completion was compiled as follows:

1. Using the known financial figures to date
2. The under stated cost figures for the same period
3. The value of the materials on site
4. The estimated quantities still to be completed
5. The newly tendered production rates
6. The newly tendered unit cost

This resulted in the Project Management Services team at all times having targets to meet, resulting in an improvement of the forecast Business Plan results. Targets became stiffer to meet.

The Plant Management System

The preventive maintenance system as recommended by the suppliers was strictly adhered to, this resulted in minor mechanical break-downs. The plant mechanical availability was always above the set industry norm of 84%.

From the tender as compiled for the Business Plan, the allowed cost for each plant item was determined, this was compared to the actual cost.

During the construction period the plant operation produced the following profit:

1. Period Sep. 97 to March 98	M 384 529
2. Period April 98 to Aug. 98	M 667 715
3. Period Sep. 98 to March 99	M 481 217
4. Period Apr. 99 to Sep. 99	M 364 053
5. <u>Total Period Plant Profit</u>	<u>M 1 897 514</u>

The Site Communication System

The site communication system was not only for the purpose of informing the Project Management Services staff of the day to day happening on site, but also gave the required exposure to the project's inexperienced people.

The following meetings achieved this:

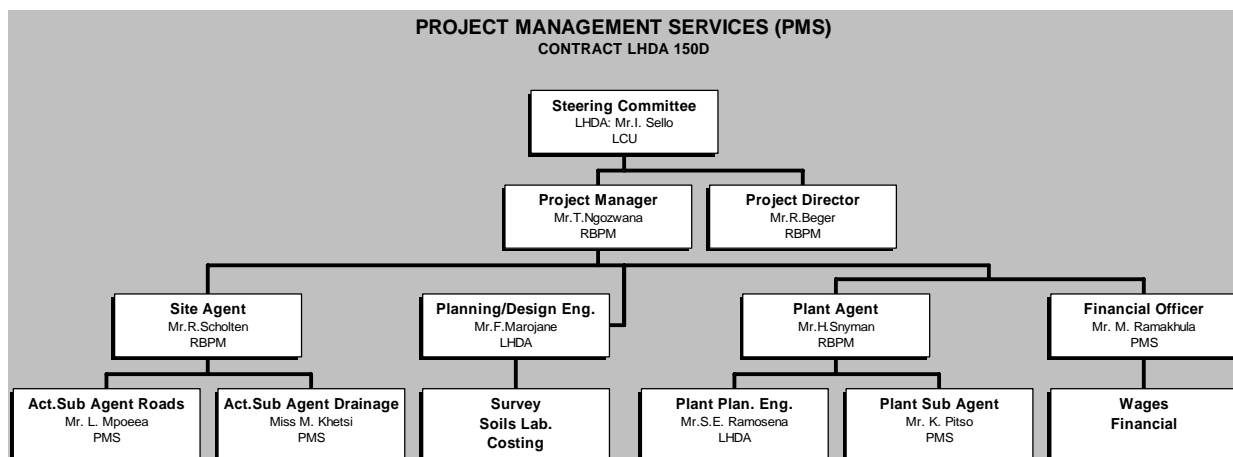
1. Daily site meetings
2. Weekly cost meetings
3. Weekly planning meetings
4. Monthly site meetings
5. Monthly Pitso's
6. Special meetings – like in September 1998

These meetings also ensured that the decision making process was not autocratic but the Project Management Services staff did participate in the process.

THE MANAGEMENT STRUCTURE

The management structure was a structure, which was developed and changed as individuals performed and developed. The one shown below was the structure that was in place for the longest period of construction.

The Project Management Services



THE PEOPLE AND COMMUNITY PARTICIPATION

The original objective was to employ on average 600 people from the community. This was achieved in most cases. In order to be fair towards all the villages along the route of the feeder roads, people were employed as and when the construction activity passed the village. This also alleviated the otherwise tremendous transport of people that would have been required.

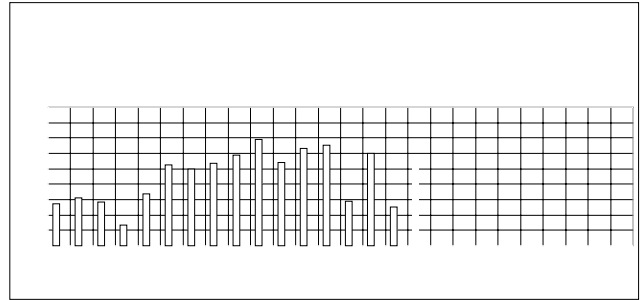
People-days employed

The total number of people-days people from the community were employed on the project was:

253 704 People-days vs. 225 000 planned
Average employment of 574 people per month

Money generated for the community

A total amount of **M 7,4 m** vs. planned M 6.2 m, was paid out to the community during the course of the project, resulting in an average wage per person per day of M 29.17 or M 3,65 per hour, this being inclusive of all overtime.



Protective clothing and tools

The following protective clothing and tools were issued:

Overalls	2769	Picks	460
Gumboots	2337	Shovels	530
Rain Coats	1593	Wheelbarrows	382
Freezer Suits	149	Crowbars	60
Gloves	4034		

From the above it can be seen that:

1. The high glove consumption due to a lot of rock hand work
2. Gumboots is a favourite footwear in Lesotho
3. Tools were collected and re-issued to the different village teams

THE PLANT

The Business Plan was based on the hiring in of plant, resulting in a time saving because operations could be done concurrently. Then the decision was taken to purchase the additional plant required. This decision could only be supported and produce a lot of financial benefit if continuation for the plant could be guaranteed, or the suppliers could guarantee guaranteed buy-back.

Plant purchased

All the plant items are available for sale or for transport to a new project. Some suppliers have quoted on the re-purchase of the plant items and have classified the plant condition as very good.

THE RE-DESIGN

As is common with projects like the Feeder Roads, numerous re-designs had to be actioned. This has placed an additional load onto the Design/Planning Engineer Mr. Marojane. The as-built drawings have been completed. A summary of re-designs is as follows:

1. Road construction

- (a) Horizontal alignment to by-pass graves, fields and villages
- (b) Vertical alignment, in order to fit in with the horizontal
- (c) For gravel wearing course the TRH 20 specification was used
- (d) The proposed lime stabilization of sharp curves, over mini bridges and on steep grades was not accepted
- (e) An additional 1m cut from centerline into the mountain on central west & east
- (f) Rock traps were constructed to catch majority of rolling rock down the mountain and to serve as a key to the fill slope

2. Mini Bridges as built drawings

- (a) Armco multi- plates have replaced the corrugated roof sheeting
- (b) Fill over multi-plates was imported insitu material
- (c) Position of bridges had to be adapted to new road alignment
- (d) Bridge openings were standardized
- (e) Foundations had to be adapted to circumstances

3. Storm water structures

- (a) Armco pipes replaced the concrete pipes
- (b) Minimum size of pipe used was 600 mm dia.
- (c) Positioning of structures was adapted to circumstances
- (d) Headwall, wing walls and in-and outlets was done with stone work
- (e) Drifts replaced some culverts for ease of maintenance

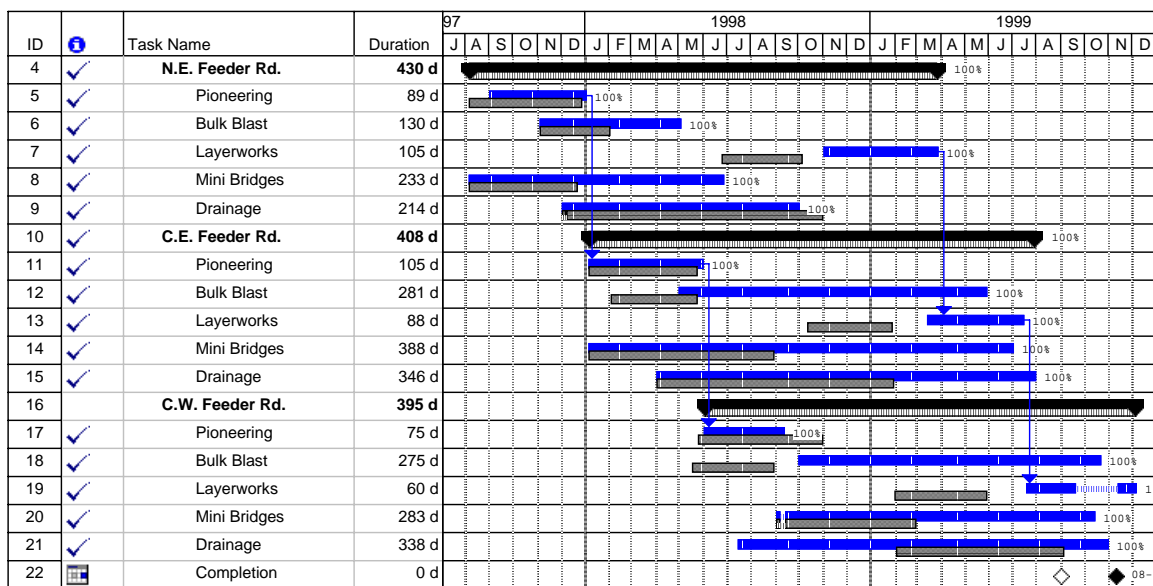
SUB-CONTRACTORS

The only sub-contractor used was Blasting and Excavating (PTY) Ltd, for the bulk blasting on the roads. The Project Management Services Blaster did most of the minor blasting whilst the explosives were obtained from B&E and their explosives magazine. This quantity increased from 85 000 m³ estimated for the Business Plan to 120 000 m³ actual, at a total cost of M 3 055 662 or M 25,46 per m³.

THE CONSTRUCTION TEAMS

The construction teams were configured and produced as was expected per the Business Plan, with constant adjustment in order to meet the project objectives. Constant changes to the labour force from the community, as previously explained, the supervisors of the teams stayed relatively constant. Here cognisance has to be given to the LCU trained technicians!

The tracked Business Plan program indicates that the program drawn up by the Project Management Services team was realistic and workable.



From the tracked program it can be seen that:

- (a) The pioneering, at the beginning of the project was on the critical path in order to:
 - 1) Provide the access for the mini-bridge teams
 - 2) Expose the bulk rock for blasting
 - 3) Finalize the vertical alignment

The same basic plant was used for the pioneering as well as the layer works, with the addition of four newly purchased dump trucks and two newly purchased water trucks.

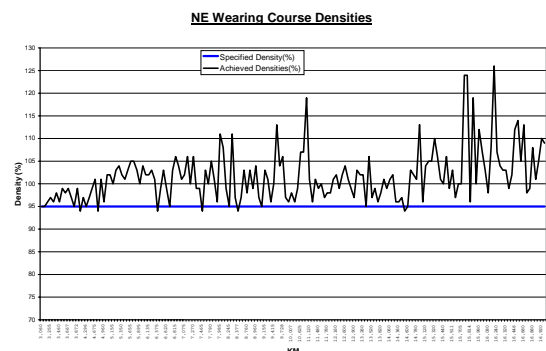
- b) The bulk blasting as well as the spoiling over the side of the blasted rock, then became the critical path operation in order to:
 - 1) Provide access to the mini-bridge teams
 - 2) Install the storm water pipes
 - 3) Be able to start with the layer works

The increase in the planned bulk blasting on Central West and East because of it being on the critical path has delayed the final completion dates although the sub-contractor has accelerated by doubling his resources.

QUALITY CONTROL

The Asst. Project Manager, Mr. F Marojane, managed a fully equipped on-site soil laboratory. Materials were tested before and after usage. The testing method was in line with the recognized specifications.

During the month any reported failures were repaired and rectified. The wearing course density line graph was included in the site meeting information, as well as all other testing done.

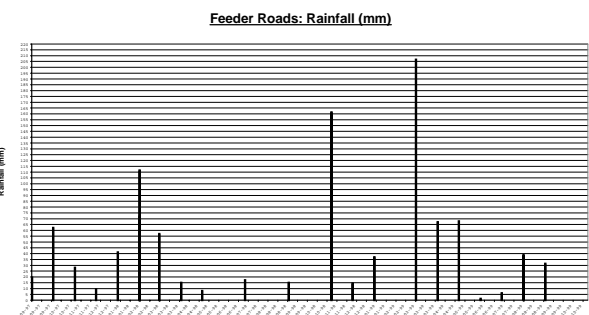


CLIMATE AND HYDROLOGY

Lesotho is a mountainous country whose largest resource is its abundance of water, which results from an annual precipitation of approx. 1000mm in the Highlands Area.

The actual average rainfall experienced on the project was 44mm per month.

The approx. maximum and minimum temperatures for the project area are 29°C and -7°C, with a mean monthly temperature of 12°C. The actual average maximum and minimum temperatures were 31°C and 3°C.



INSITU MATERIALS USED

In general the insitu materials found were of an excellent road building quality. The borrow pits for the wearing course were within easy reach, some next to the road to be built. We have experienced only one short section where the material brought onto the road had a high shrinkage product or PI, this section was rectified.

THE MATERIAL PURCHASES

Several suppliers were made use of to supply the different materials to site:

Diesel	1 203 743 lit.	600mm dia. Armco pipes	1 236m
Petrol	7690 lit.	750mm dia. Armco pipes	111 m
Re-bar	22,9 ton	900mm dia. Armco pipes	1 280 m
Cement	35 230 pkts	600mm dia. Concrete Pipes	66 length
River sand	7 690 m ³	750mm dia. Concrete Pipes	30 length
Concrete Aggr.	2 100 m ³	Survey y-standards	1 900 no

The supply of diesel to the machines at an average rate of 2 723 lit per day was a major logistical operation, especially before access was provided.

Cement use was on average 80 pockets per day; this was used only for the grouting of rock for mini-bridges, culvert in- and outlets, erosion channels and stone pitching.

THE TRAINING, MENTORSHIP AND DEVELOPMENT

Considering the inexperience of the people employed by the Project Management Services it was a given that a fair amount of training would be required. Prior to commencement of the project the technicians received training by the Labour Construction Unit of Lesotho. People who did receive training performed well on site.

To supplement the managerial capabilities of the senior staff on site a Project Management course was conducted. Project Management as a management discipline looking at the three elements of Time, Cost and Quality was demonstrated in a very practical manner. Certificates were issued to the successful participants.

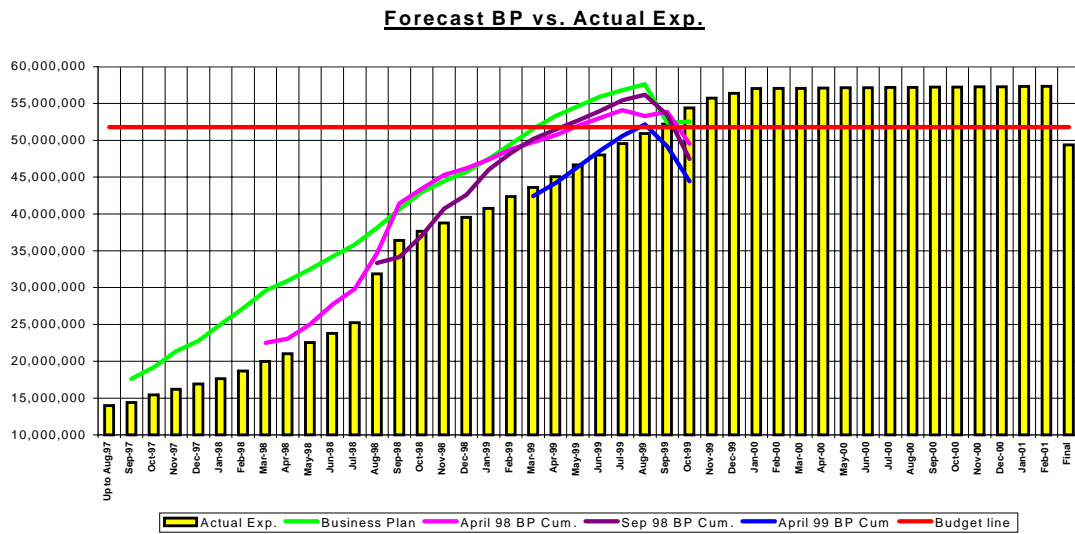
ENVIRONMENTAL MATTERS

1. Environmental management on the contract has followed the guidelines set out in the Environmental Management Plan (MWC, 1997) and subsequently, the Recommendations for Rehabilitation (MWC, 1999).
2. The Environmental Management Plan had four components:
 - Requirements for the protection of natural assets during construction
 - Requirements for the prevention of community nuisance and protection of public safety
 - Dealing with compensation issues
 - Rehabilitation

FINANCIAL FINAL RESULT

The independent Commission of Lesotho and the Republic of South Africa on completion, calculated the difference between this Construction Unit and a Contractor working at the same time and same conditions, to be a saving of M600 000 per km.

GRAPHICAL PRESENTATION



REASON FOR SUCCESS

A previously unknown process to the management of a Construction Unit was applied. To put it in a nutshell, a contractor's type of management was applied. This is due to the hands-on type approach of the Project Management Team.

MANAGEMENT

- The Client Representative was intimately involved and positively assisted in the running of the project
- The Project Manager was a practical, contractor oriented and experienced person
- The Project Manager has to have defined responsibility and the appropriate authority
- The Client Lesotho Highlands Development Authority Representative has a financial authority to operate within the framework of the agreed Business Plan
- A hard hand is required from all in management to maintain and apply discipline, without interference

PERSONNEL MANAGEMENT

A proper contractor type personnel system, taking cognisance of the Country's laws, has to be in place from the start of the project.

Points that require attention before the start are:

- 1) Letter of appointment hourly paid
- 2) Letter of appointment monthly paid
- 3) A position structure for all categories linked to wage/salary scales
- 4) Disciplinary code to be implemented
- 5) Disciplinary committee, with authority to be in place

CONSTRUCTION METHODOLOGY

- The Business Plan is the equivalent of the contractual program and is considered as such
- Changes in the critical path operations are considered fully prior to implementation
- In order to shorten the learning curves in the beginning of an operation, full training was given

LABOUR INTENSIVE OPERATIONS

To execute a project of this nature on the labour intensive method is a function of time and money. It was originally planned to be a three year project, with an additional 12 month in hand a lot more could have been done labour intensively.

MENTORSHIP & TRAINING

Training should be a separate function on a project of this nature, it should be structured, accredited to be able to issue diplomas/certificates, and should start before the contract start.

The emphasis should be on practical skills training in order to reduce the long learning curves on the different operations as was experienced.

Computer type training has also been done, however, computers do not build roads and is only a tool to achieve the overall objective.

With training also goes recognition, like more senior position, better salary etc. training for training's sake must at all times be avoided.

CONCLUSION

1. The project objectives were met
2. This Project Management Services team with expertise management can do further similar projects
3. A project of this nature, with no claims, must be a record for any Client
4. This is the only economic method to construct projects of this nature

Compliments go to the decision makers.

LESOTHO: CONSTRUCTION UNIT SUCCESS

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Mr **Rolf Beger** (pronounced Beeger) was born in Dresden in the then Eastern Germany during the Second World War. Dresden was virtually destroyed by bombs during the war whilst he was a young boy still living there.

At the age of 12 he and his family emigrated to South Africa where he grew up on a farm in Natal.

In 1963 he obtained a NHD and started working for a Civil Engineering Consulting firm. Two years later he joined a construction company. The original Ben Schoeman Highway was one of his projects.

During 1979 he was transferred to Namibia and in 1982 was promoted to Managing Director of the company. He served as Managing Director of various companies in Namibia and South Africa.

In 1988 he founded the company RB Project Management and still serves as Managing Director on the board of directors. The company specialises in Project Management, the training and development of small contractors (SMME's) and Commercialisation/Service Delivery Improvement Process of Government Departments.

Mr Beger is a South African citizen and speaks German, Zulu, English and Afrikaans. He is married to Ellen and has two children. He is also an outdoor fanatic.