

Lateral Thinking and Teamwork What it has done for Randfontein Estates Ltd.

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SYNOPSIS

Maximising face utilisation is one of three statements in REL's Mission Statement along with Safety and Teamwork. JCI embarked on changing the process of mining (Business Process Re-Engineering or BPR) in 1996. This was followed by a further productivity initiative being introduced in 1997, namely Full Calendar Operations (Fulco). These two initiatives encompass safety, teamwork and maximising face utilisation - but certainly not without some failure.

INTRODUCTION

REL is situated 30km South West of Johannesburg (Figure 1 and 1A) and has a lease area of 17 279ha or 42 696 acres. Cooke 1 Shaft began production in 1972 exploiting four economic stratigraphic horizons in the Turffontein Sub Group. Cooke 2 Shaft was brought into production in 1977 and Cooke 3 Shaft in 1983 exploiting the Elsburg reefs. Doornkop Shaft was initially sunk in 1984 to exploit the Kimberley reefs, which proved uneconomical. In 1997 a Sub-Vertical Shaft was begun to exploit the South reef horizon at Doornkop. In the same year Western Areas North Shaft became part of the REL fold (now known as 4 Shaft REL). A stratigraphic column highlighting the economic reefs is attached (Figure 2).

The mining industry is increasingly reliant on improved productivity to contain ever-increasing costs, which is not helped by a low gold price. REL, being a marginal operation, relies on good productivity

and innovative thinking to ensure its strategic plan.

INTRODUCTION

During May 1997 the Chamber of Mines entered into wage negotiations with the various Unions and Associations and at this time it was agreed to afford each Mine the opportunity to negotiate an agreement for wage increases combined with a Productivity Agreement.

The team rose to the occasion, realising the urgency of the situation, especially as REL had experienced significant financial losses during the preceding 6 months.

With a great deal of negotiation, education and mutual understanding of the pending financial catastrophe, agreements were signed with the various Unions and Associations on 29 July 1997 to allow REL to embark on a Fulco working arrangement.

WHAT IS FULCO?

Full Calendar Operations Shift System is the mining of the normal production operations - 7 days per week. The tabulation (Table 1) describes the variances between a Fulco cycle and eleven shift fortnight cycle.

WHY FULCO?

Randfontein Estates had experienced difficulty over the preceding 12 months in achieving production targets as a result of:

- Non achievement of development targets resulting in greatly reduced projected ore reserves and face availability;

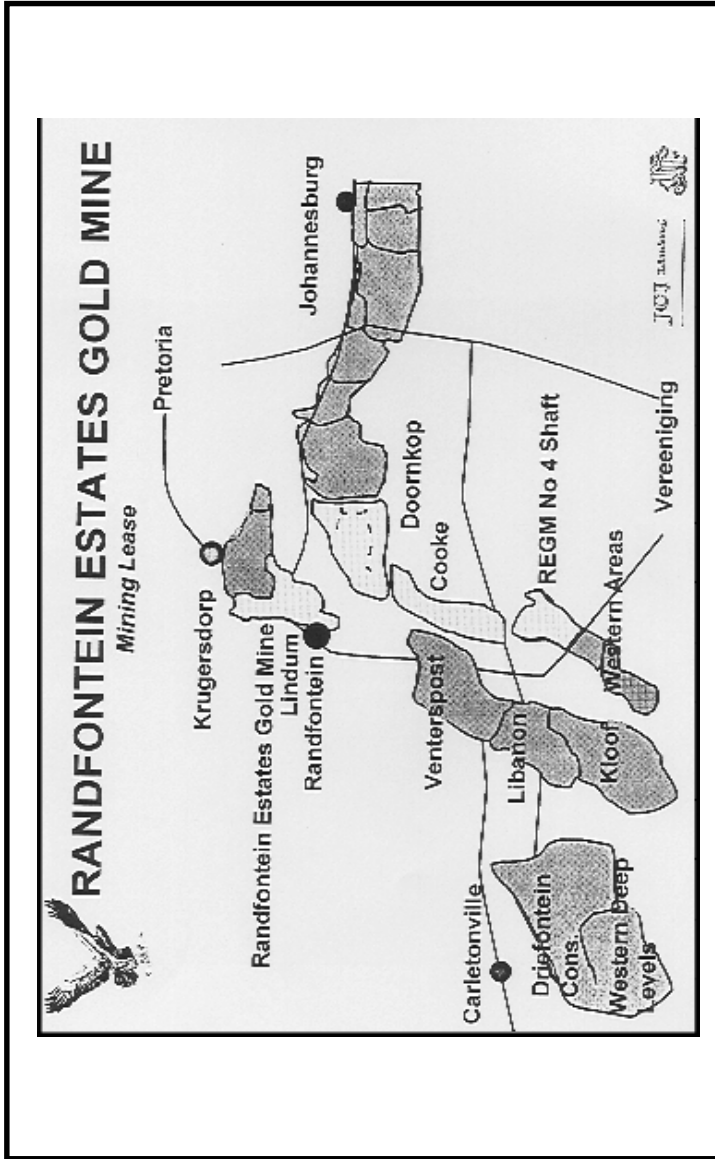


Figure 1
Randfontein Estates Gold Mine

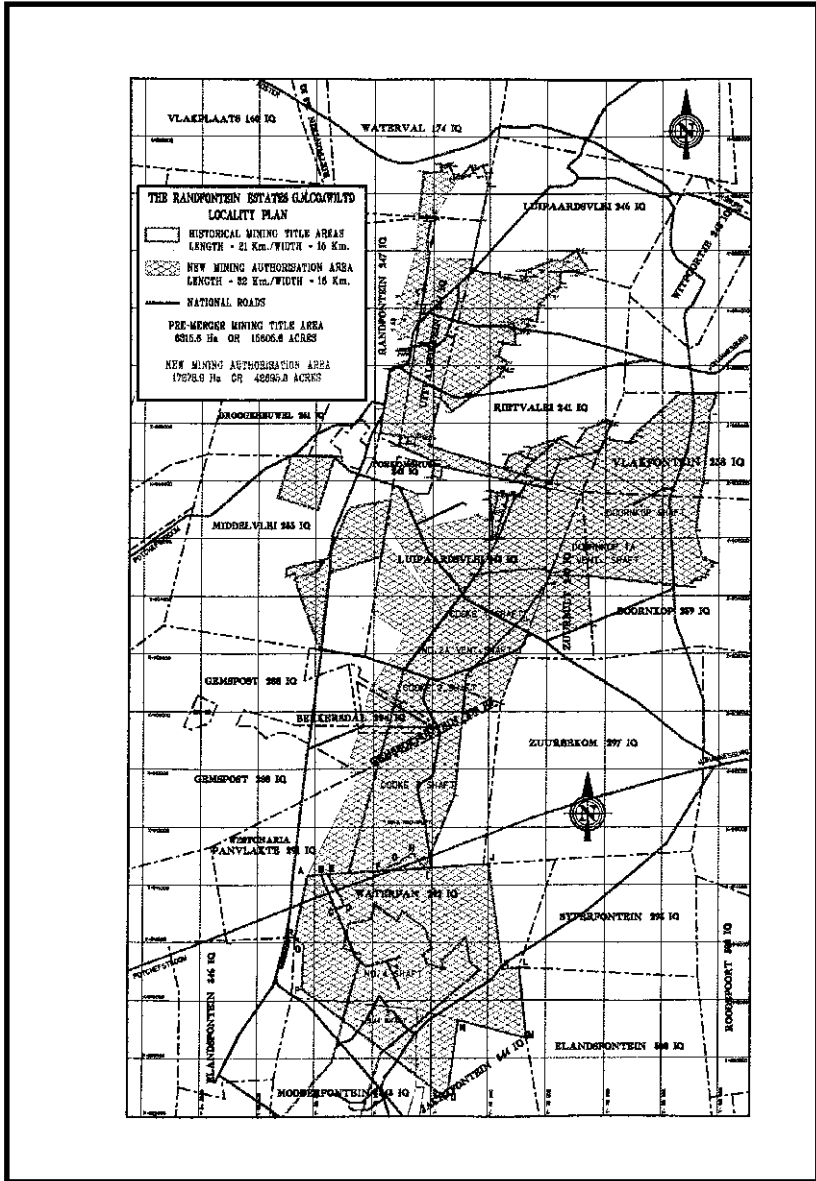


Figure 1A
 The Randfontein Estates - Locality Plan

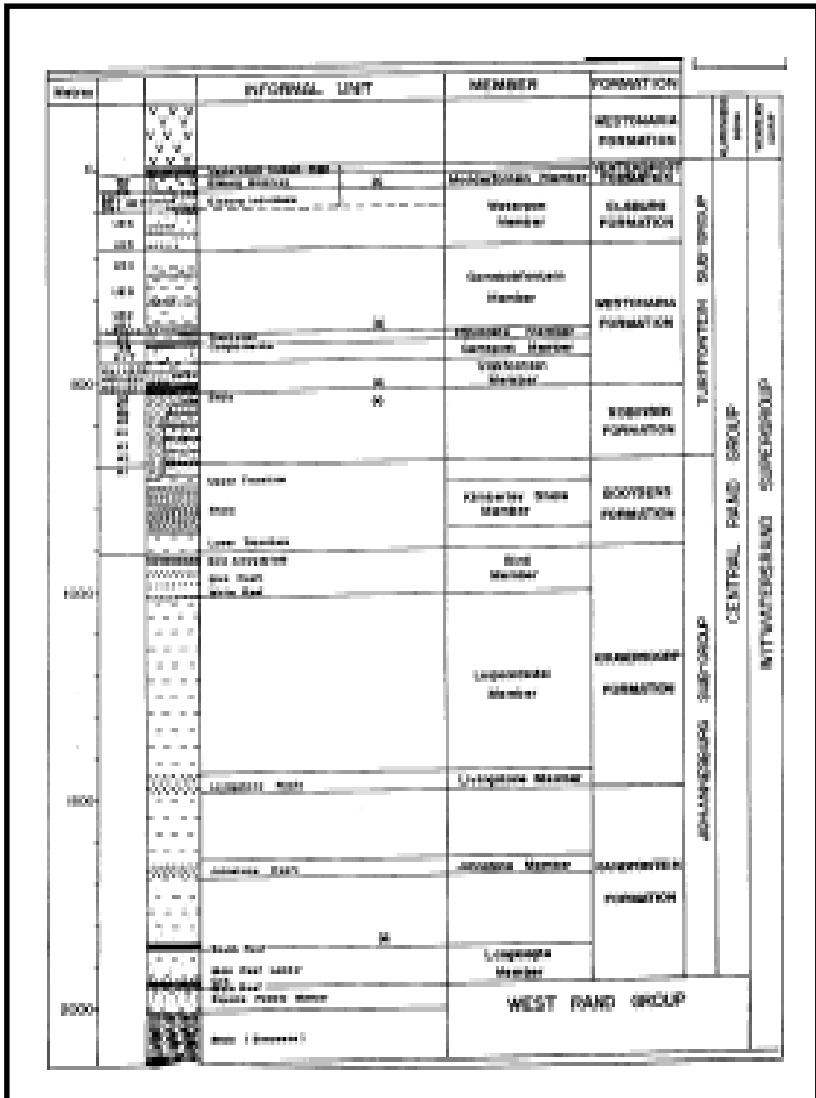


Figure 2
 Stratigraphic Subdivision of Central Rand Group indicating major reef horizons

Table 1

Details	11 Shift Fortnight	12/4 Cycle or an Equivalent Cycle (6/2 or 9/3)
Total Production Shifts	275	353
Annual Time Utilisation	75,3%	96,7%
Average Shifts Worked / Employees	253	239
Days per Cycle	14	16 / 12 / 8
Days Off per Cycle	3	4 / 3 / 2
Days of per Annum	112	126
Premium Paid (% of basic)	0	15

- Planned milling rate not being met;
- As a result of the low gold price, the problem of the limited face length has been aggravated by pay reserve becoming unpay.

By introducing Fulco it allowed for 6 additional production days per month, which increased production time by 25%.

The reasons for negotiating a Fulco arrangement were to:

- Increase the development rate to improve the ore reserve and create more face to mine;
- Mine less panels with improved face advance to create flexibility in the plan, should areas become unpay;
- Improve the production profile;
- Ensure short term production targets are met and avoid a very tenuous financial position.

The Fulco working arrangements differ from Union to Union as the negotiations mandate was an agreement on Fulco with the detailed mechanics being negotiated on an individual Union/Association basis (Figure 3).

Negotiations were completed with agreement within 6 weeks.

In October 1997 Fulco and partial Fulco was introduced at the Cooke Shafts.

FULCO RESULTS

The results of the introduction of Fulco are split into 4 main categories:

- Safety
- Production
- Efficiencies
- Personnel

The successes and failures are discussed with future direction where necessary.

Safety

Safety at REL has always been the most important key result area, as it is believed "A Safe Mine Is A Productive Mine". With lost time and reportable rates running at half the industry average, the team was not prepared to compromise the safety and health of our employees.

The tabulation (Table 2) shows the safety statistics before the introduction of Fulco and the results to date since the introduction of Fulco (6 months).

Table 2

	Lost Time <i>Rate / 1 000 / annum</i>	Reportable <i>Rate / 1 000 / annum</i>	Fatal <i>Rate / 1 000 / annum</i>	Average N° of Dressing Cases/Month
Industry Ave 1997	N/A	27,44	1,34	N/A
REL Ave 1996/1997	0,1	9,63	0,63	35
REL Ave since Fulco introduced	0,08	5,85	0,12	20

It should be noted from the tabulation that since the introduction of Fulco we have achieved improvements in all categories.

	Improvements (%)
Dressing station Cases	42
Lost Time Frequency Rate 1 000/Employees	20
Reportable Frequency Rate 1 000/Employees	39
Fatality Frequency Rate 1 000/Employees	83

These figures may be a little misrepresentative as Fulco results are only over a period of 6 months. These statistics will be closely monitored for any deterioration into the future and mechanisms will be introduced if necessary to combat any deterioration.

Production

With Fulco working arrangements, the number of production shifts are theoretically increased by 6 per month (2 Saturdays and 4 Sundays) which equates to 25% more production time.

In practice 25% improvement has not been realised. The table (Figure 4) is the results on Fulco compared to 6 months production results prior to the introduction of Fulco. This table shows an improvement of results attained since the introduction of Fulco in all key result areas.

Recovered kilograms had a 21,8% improvement which was obtained by 3,4% more tonnage at a 0,96 g/t grade improvement.

The improvement of grade is a result of more flexibility created by less face mined at better face advance. This has created more flexibility in ore reserve management.

Development has improved by an average of 13,9% which has in turn sustained our current ore reserve, which in time will result in further flexibility.

PRODUCTION EXCLUDING REGM 4#							
QUARTER	M2 BROKEN	TONS MILLED	REC GRADE	REC GRAMS	REEF METERS	WASTE METERS	TOTAL METERS
JUL 97 - SEPT 97	119,340	656,284	5.93	3,893,750	1886.5	1964.4	3850.9
OCT 97 - DEC 97	140,324	723,026	6.54	4,728,299	2469.9	2571.4	5041.3
JAN 98 - MAR 98	137,708	757,352	6.28	4,759,511	2425.4	2612.2	5037.6

Figure 4
Production excluding REGM 4#

Efficiencies

The tabulation (Table 3) shows the efficiencies achieved in m²/total man, tons/total man and kg/total man respectively (inclusive of all contractors).

Table 3

Comparison of Efficiencies to Industry Averages			
Quarter	M ² / Total Man	Tons Milled / Total Man	Grams / Total Man
Jul 97 - Sept 97	5.4	29.5	175
Oct 97 - Dec 97	6.2	31.9	208
Jan 98 - Mar 98	5.9	32.4	204
Industry Ave	4.43	32.5	160

It should be noted however, that lower stope efficiencies are to be expected with Fulco as 33% more labour is required to realise 25% improved production at best. Tonnage from vamping has assisted in the tons milled/man.

Efficiencies achieved are very comparable to industry averages.

Personnel

Fulco can be implemented using various cycles, namely 6/2; 9/3 or 12/4; each of which has pros and cons.

Randfontein Estates Limited currently works a 6/2 cycle as a result of an agreement with NUM, however, Management was concerned about this at the time, as the two day off period is too short for employees who live outside Gauteng to travel home, a 9/3 cycle is preferable.

What transpired was a major increase in absenteeism as anticipated (Figure 5). This absenteeism occurs either just before the 2 days off or more commonly just after the 2 days off.

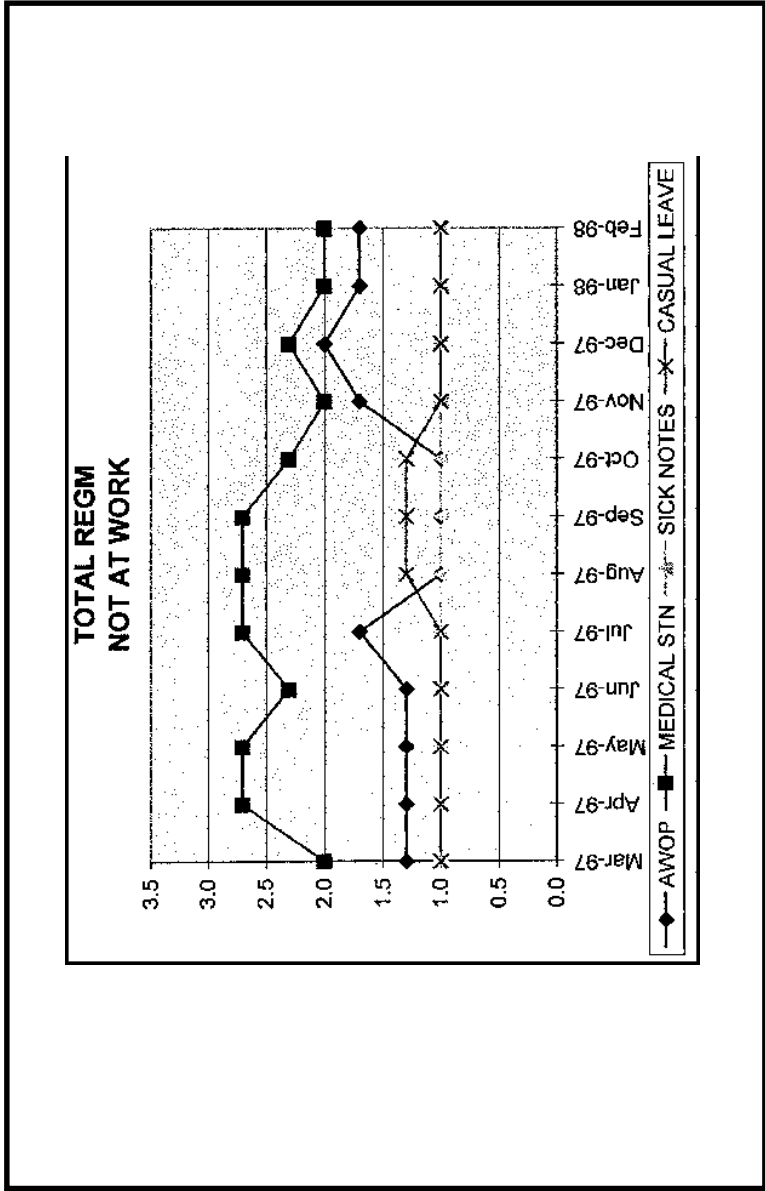


Figure 5

The decrease in February and March are as a result of a Union and Management intervention to curb the misuse of sick leave and stronger disciplinary action with habitual loafers.

The only major problem with a 6/2 cycle is the high absenteeism, caused primarily by people traveling to far destinations. This particular problem is alleviated by changing to a 9/3 or 12/4 cycle, but these cycles also have high absentee rates for a different reason.

It has been found that the absentee rate on a 9/3 and 12/4 cycle is similar to that of a 6/2 cycle, however, this most often occurs in the days prior to the off period, and this problem is particularly prevalent among machine crews, we assume that the underlying reason for this is simply fatigue.

Whatever cycle is used, the only major problem associated with Fulco is the high absentee rate. This problem is reduced by strict disciplinary measures and support from all role players concerned. In addition to this, with the introduction of BPR, substantial production bonuses are being paid, hence people are losing out on potential bonus earning by being absent, and this has gone some way to alleviate the problem.

REL NO. 4 SHAFT

REL No. 4 Shaft (formerly Western Areas Gold Mining Company Limited North Shaft) is located on the West Rand approximately 45km from Johannesburg.

REL No. 4 Shaft was commissioned in September 1961. The 8m diameter concrete lined shaft was sunk to a depth of 1 518m below surface, while the ventilation was sunk to 1 102m.

Both shafts are sited in a pillar, which takes the form of an ellipse approximately 480m on strike and 450m on dip.

The strike of the stratum is east - west and the strata dips at an average inclination of 16 degrees to the south.

Numerous reefs have been mined at No. 4 Shaft, all being located in the Turffontein Sub-Group.

The Upper Elsburgs, sub-divided into the massives and individuals, along with the overlying VCR (Ventersdorp Contact Reef), have been extensively mined. In some areas up to 13 payable horizons have been identified.

These are listed as follows:

- VCR - Extensively mined.
- Massives -
 - (i) MB Generally 3 - 4 payable horizons (Includes the lower VCR).
 - (ii) MI "Top", "middle" and "bottom" bands generally economic.
 - (iii) MA Extensively mined.
- Individuals -
 - (i) ED Horizons mined locally.
 - (ii) EC "Top", "middle" and "bottom" reefs mined, however, the "middle" band on a local scale.
 - (iii) EB } Poorly developed and generally uneconomic.
 - (iv) EA }

Lower in the stratigraphy, the Middle Elsburgs contain an economic horizon known as the E9EC. The horizon has been extensively mined, and in recent times, with the workings of Cooke 3 Shaft becoming ever closer, it has been correlated with the AI horizon of the UE1A package of Cooke 3 Shaft.

Ground instability has created problems in the main shaft since 1975. This is due to high stress and a weak rock-mass, which surrounds the shaft barrel. The problems resulting from this have compounded into other problems over the years. The current situation is as follows:

Ground Instability
(Figure 6)

- a) The concrete lining has been fracturing since 1982 and requires constant maintenance.
- b) Scaling of orepasses with resultant risk to the shaft integrity as well as production losses.
- c) Deterioration of the station brow on 38 Level.
- d) Misalignment of steelwork in the shaft.
- e) Poor sidewall conditions in the shaft below 38 Level.

Over the years, most of the time available for shaft maintenance was spent on addressing problems related to (a) above. Due to the large volumes of water pumped in this shaft (average of 76 Ml per day), the shaft is wet and corrosion has taken its toll. Currently 148 buntons and 37 king posts as well as 6 station steelwork sets require replacing in order to increase hoisting speed from 10 to 15 m/s.

Due to the current schedule of shaft work, Fulco could not be considered.

The production pressures as they are, more time was required both for shaft work and production.

The Unions and Associations were approached with a proposal, firstly to allow for one additional Saturday to be worked on a compulsory basis as opposed to a volunteer shift. This was welcomed by all as 6% rather than 5% was offered as an overtime payment for this compulsory days production.

The Shaft Engineering and Mining Team raised the issue of set up time in the shaft. One day shaft time meant that at least 25% of the available time was spent building and removing working platforms. Longer continuous work periods were the obvious answer to facilitate more efficient utilisation of repair time.

The calendar for the remaining eight months was revised with the Unions/Associations taking into consideration the compulsory Saturday and Public holidays and an agreement was struck to have the production teams work one Sunday a month and allow for one 3 day break per month.

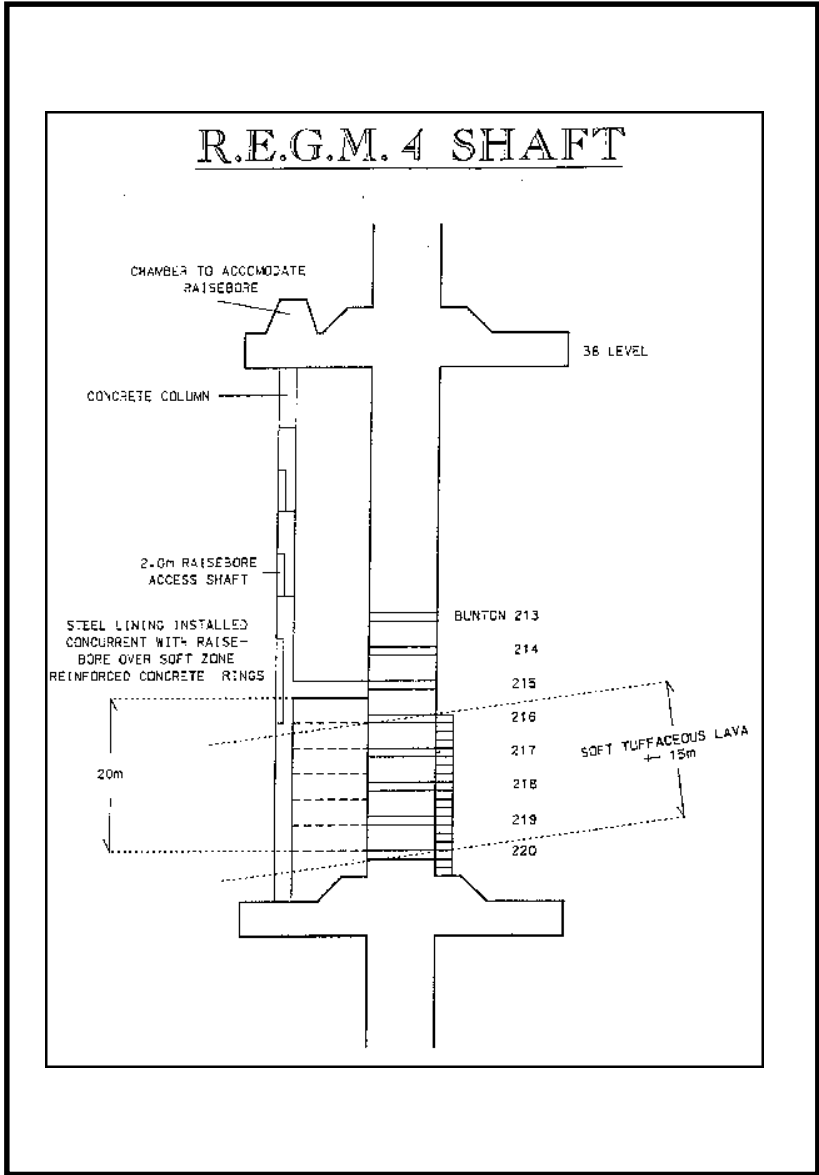


Figure 6

This arrangement has satisfied both required shaft work and production (Figure 7).

It is expected that an additional 160kg will be produced during this calendar year agreement, and that a large amount of shaft concerns will also be addressed.

BUSINESS PROCESS RE-ENGINEERING

BPR was initiated by JCI in 1994 and implemented on Cooke 1 Shaft in 1995.

The Vision

- To become the lowest cost gold producer in South Africa.
- To be competitive with more than 50% of world producers.
- To have highly sought after shares.
- To reduce working costs by 30%.
- To increase throughput by 30%.
- Develop proven ore reserves by >2,5 years.
- Double 1995 life of mine projections.

The Strategy

- Develop appropriate and effective planning systems and processes.
- Employ safe, cost effective mining methods/systems.
- Significantly develop logistics capabilities.
- Utilise technology in an effective manner to support the Mine's core process.

BPR focused on 3 core areas, Planning, Mining and Logistics.

Planning

The entire planning process needs to have a holistic, seamless approach leading to coordination of all factors.

Resource and core managers do resource planning while operational supervisors do operational planning. The planning process must be both process and strategy driven, and continuous and dynamic.

The planning process has been improved considerably by the implementation and integration of software systems such as Cadmine, Datamine and CPM.

Mining

The mining strategy concentrated on the following:

- All panels to be blasted once every 24 hours;
- Employ dedicated, multi-skilled panel crews on each panel. Miners only mine (separate logistics section);
- Optimise effective shift lengths;
- Concentrated mining focusing on face advance;
- Substantially enhanced bonus payments for high production achievements above a trigger point.

Logistics

The logistics function is separated from the mining function in order to allow the miners to focus on their core process.

The logistics section is responsible for vertical and horizontal movement of men from bank to work place, are from boxfront to plant and material from suppliers to workplace.

The logistics section is also responsible for the maintenance and repair of all machinery and equipment, including shafts, haulages and crosscuts.

BPR Roll-out

After the original implementation of BPR at Cooke 1, BPR is being rolled out to the other Randfontein shafts. This must be well co-ordinated and professional in order to ensure success.

The key areas are the sensitising and training of the panel crews, and the payment and control of bonuses.

The BPR panel crew training is done over 11 shifts.

Day 1	-	Sensitising
Day 2	-	Sensitising
Day 3	-	Cooke Plant Tour
Day 4 - 7	-	Theory training
Day 8 - 11	-	Practical training

Days 1 and 2 are the two most crucial steps in the process, the issues addressed during the 2 days of sensitising are:

- Meaning of BPR
- Why do we need BPR
- Why do we need to change
- Current trends vs mine's history
- Vision / way forward
- Fluctuating gold price
- Rising costs
- Pay limits
- Life of mine/ future job security
- Team building
- Bonus system

Results

BPR has been successful for Randfontein Estates, and the results speak for themselves (Figures 8 - 16).

Cooke 1 Shaft Safety

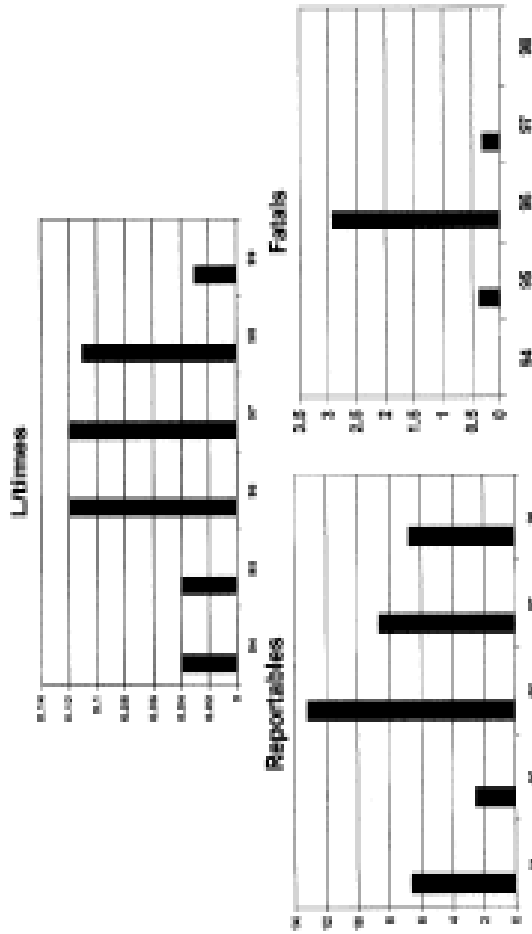


Figure 8

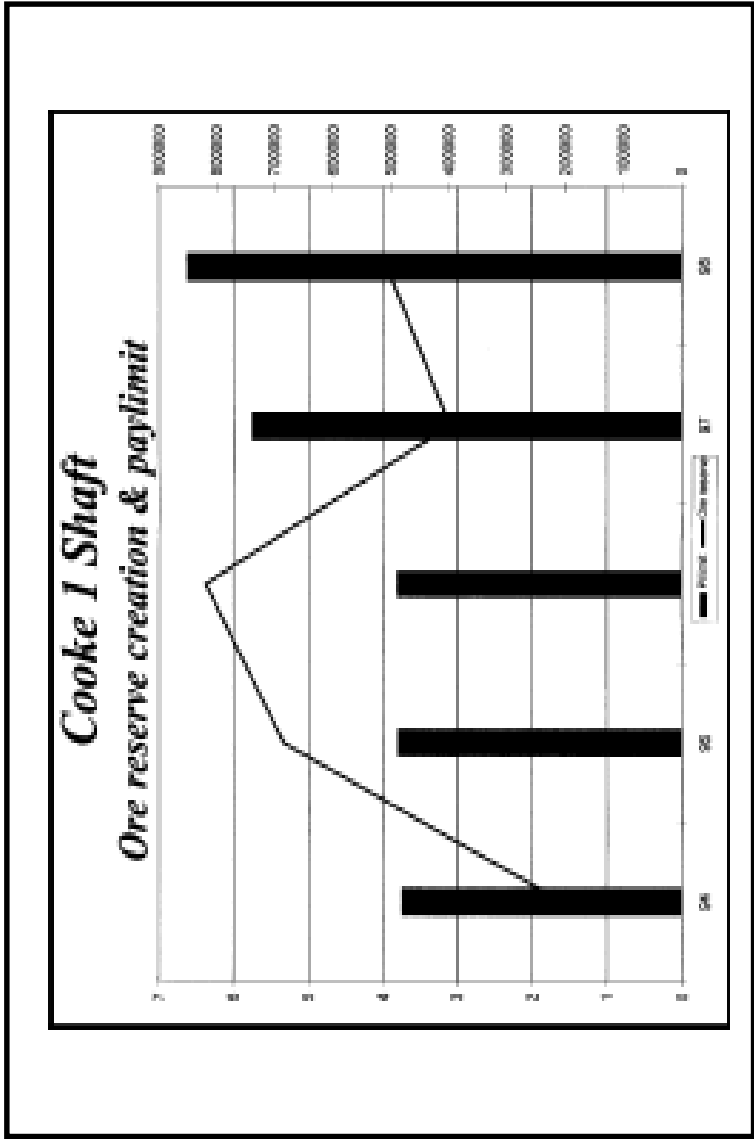


Figure 9

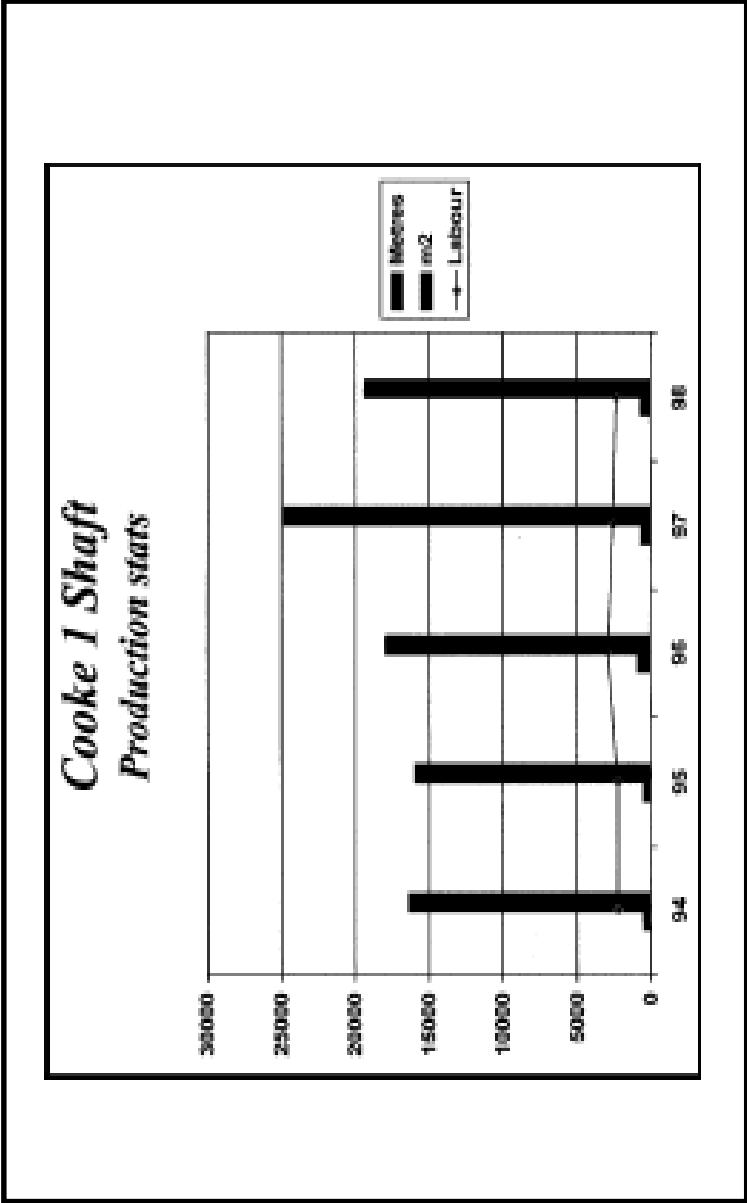


Figure 10

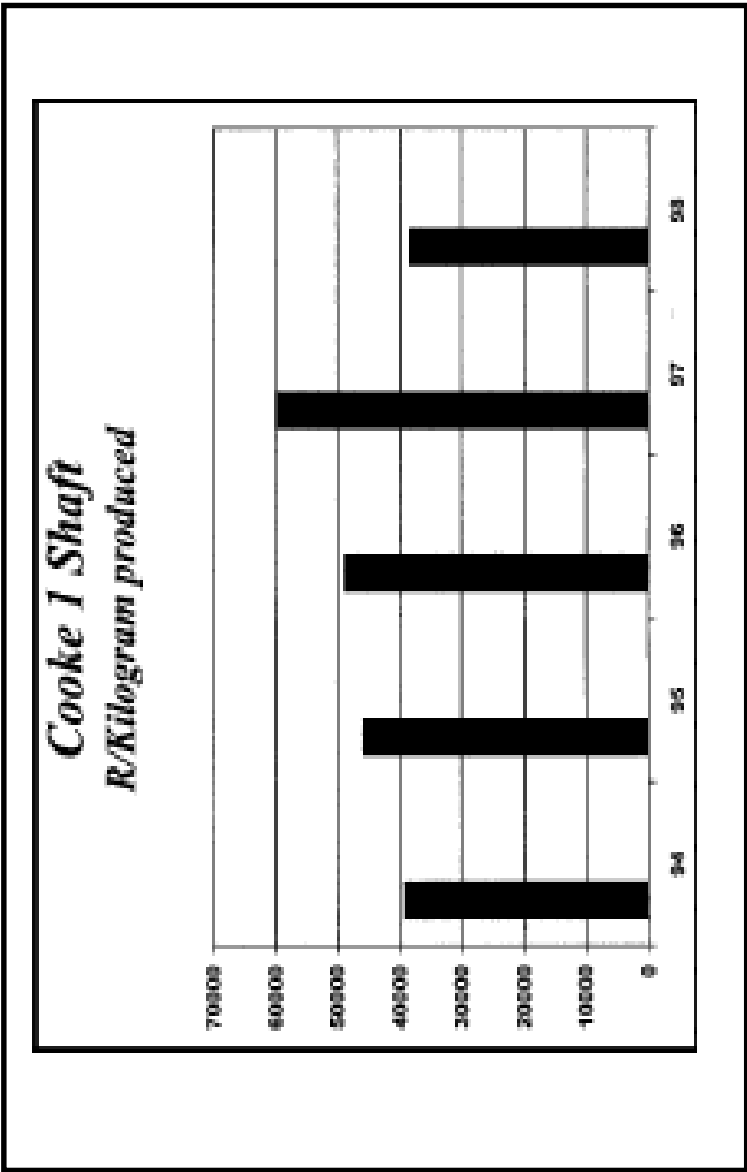


Figure 11

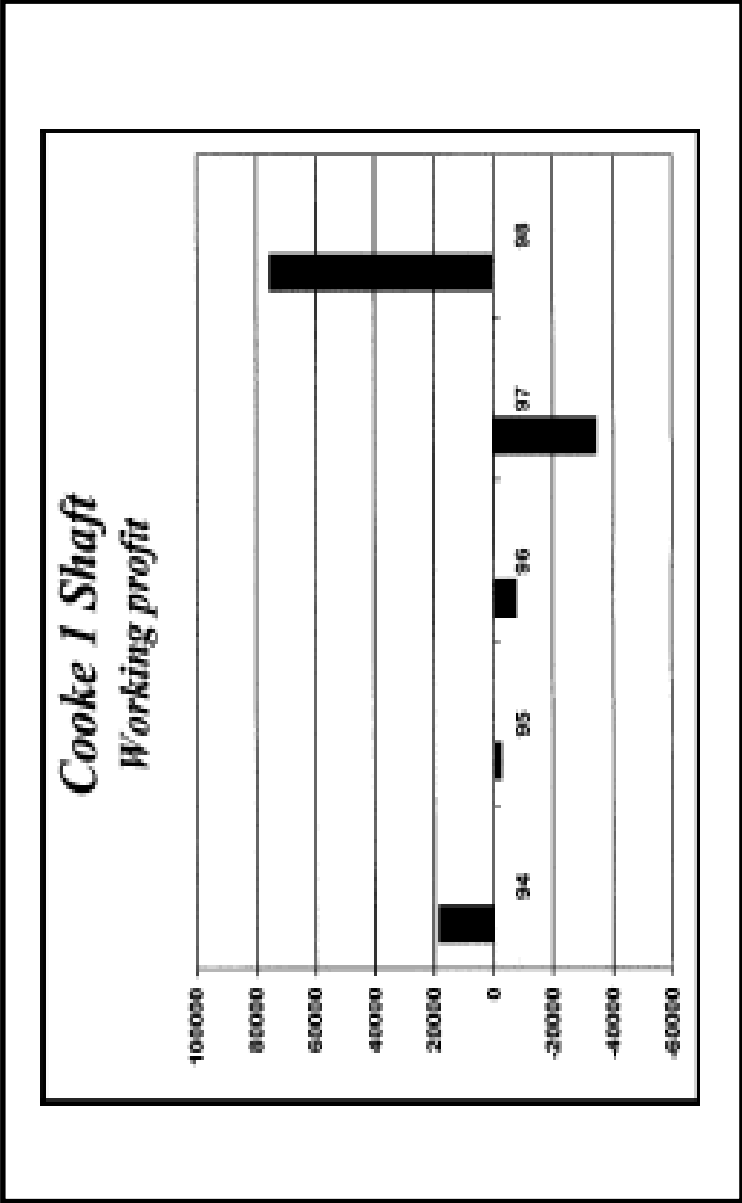


Figure 12

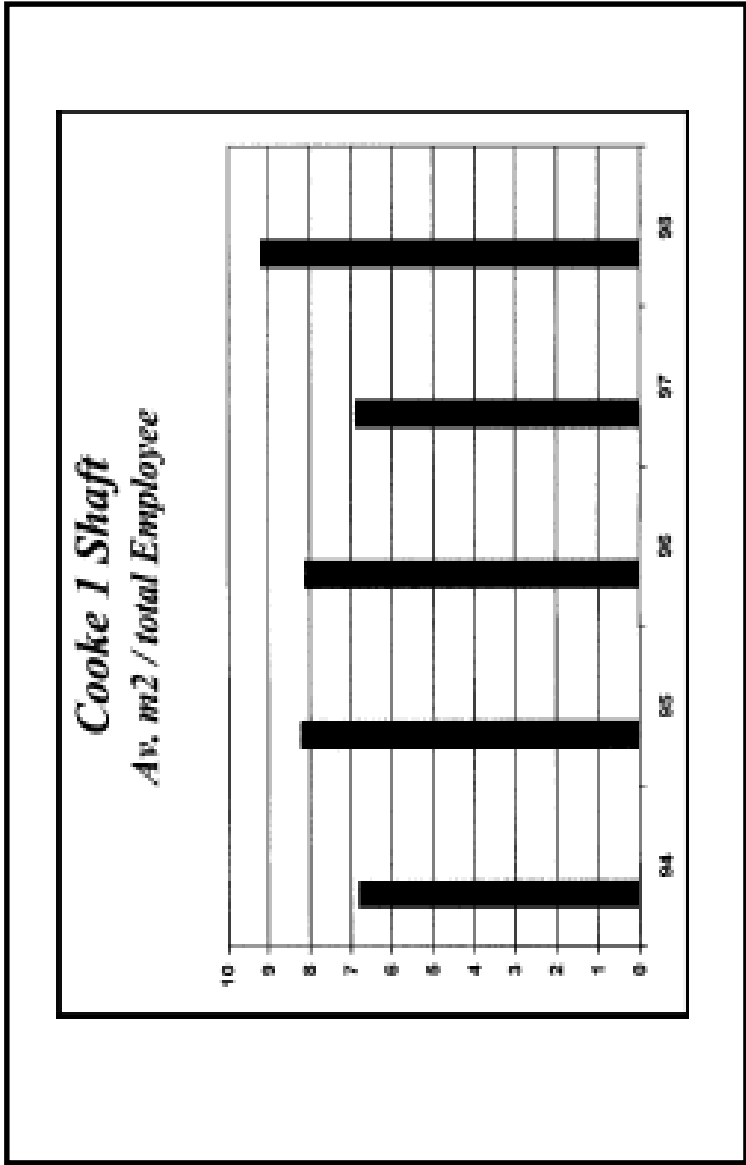


Figure 13

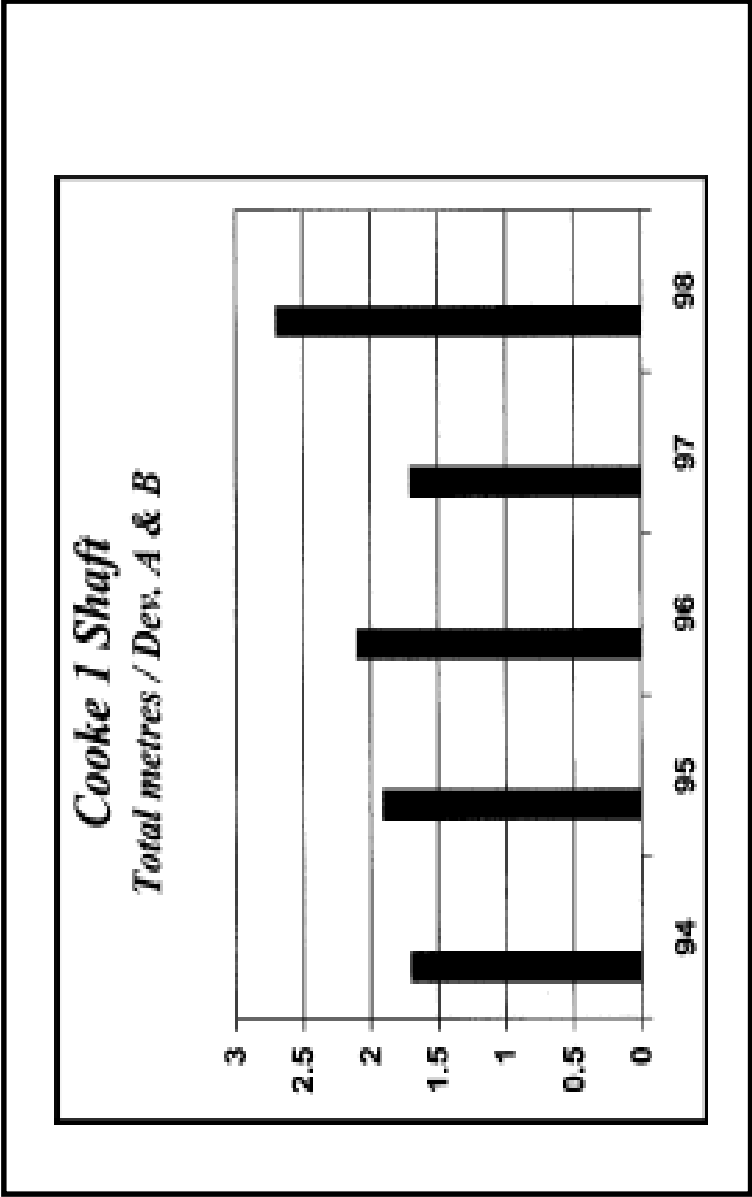


Figure 14

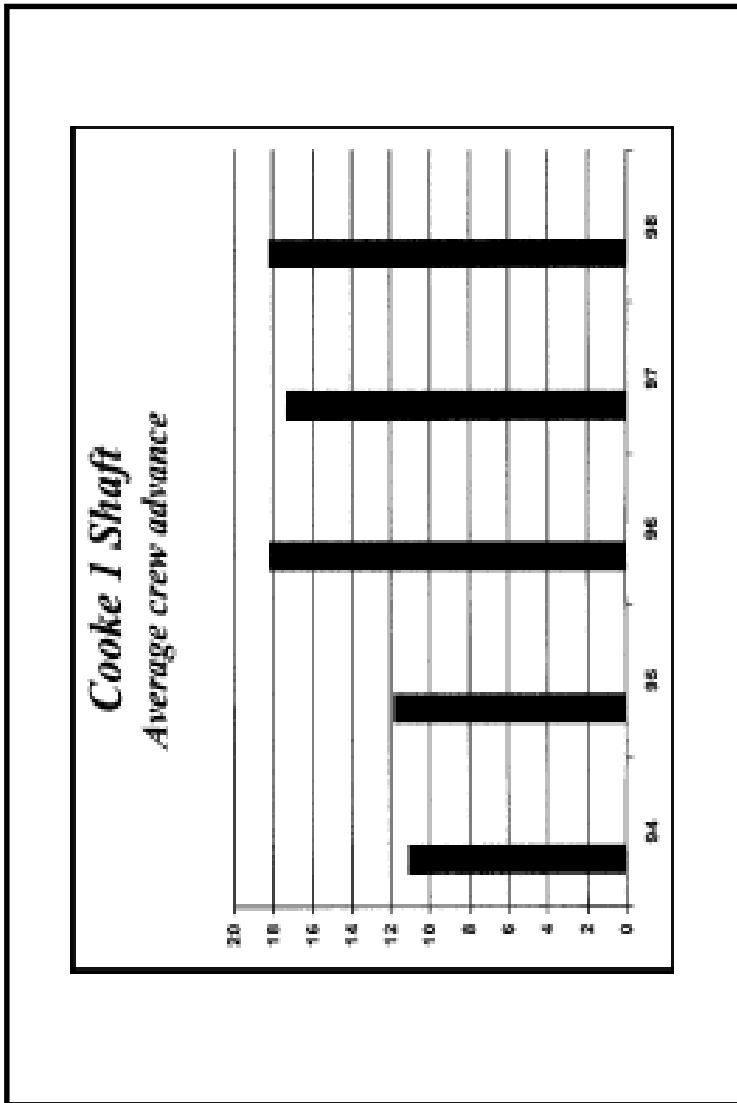


Figure 15

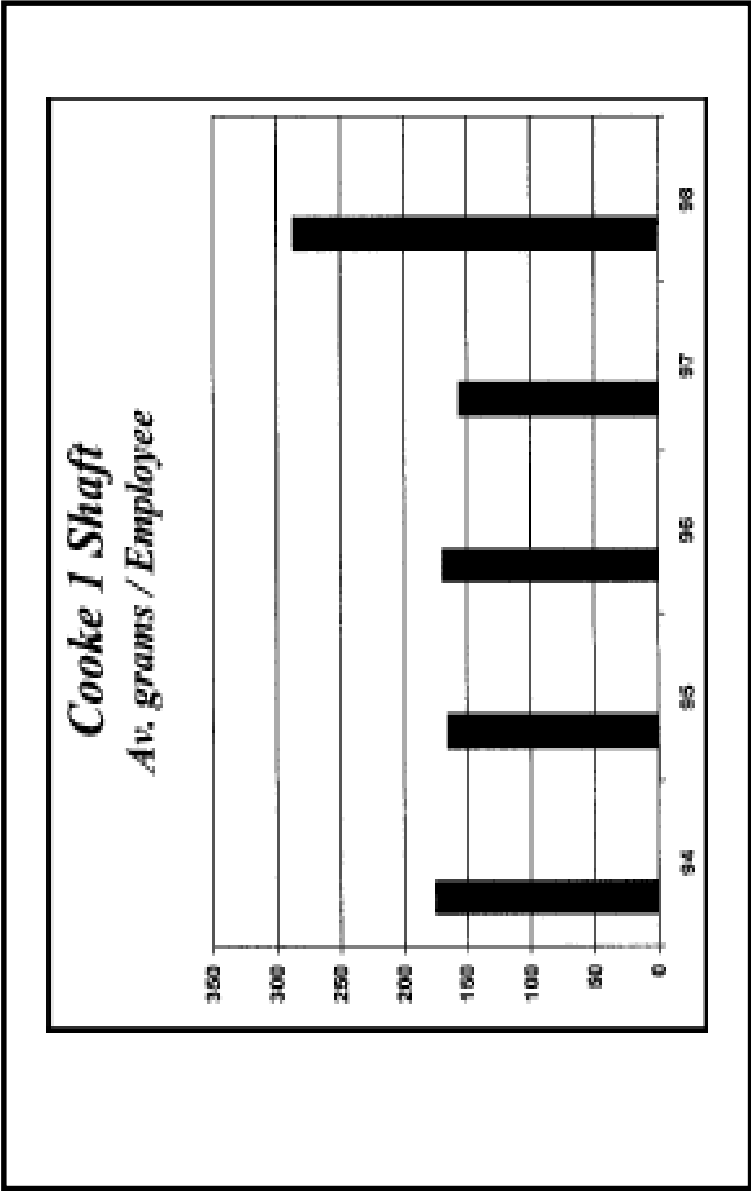


Figure 16

Concentrated teams have increased productivity considerably from an average of 12m to 20m, and a blast per panel per day is almost fully achieved.

Multi-skilled teams led to improved synergy within the teams and greater involvement of all team members, improving the effectiveness of raining.

Increased teamwork and bonus led to a reduction in absenteeism.

The only problem associated with BPR is a potential deterioration in standards, as crews are paid bonus for face advance, this needs to be strictly controlled by management.

TRACK MOUNTED DRILLRIG

Due to low productivity, ever increasing labour costs and the increase in Aids, it was decided to mechanise operations where practically possible.

This led to the building and commissioning of an Electro-Hydraulic, track mounted drillrig for drilling conventional development ends.

The rig was designed and built on Cooke 3 Shaft, and constructed largely from salvaged and redundant material on mine.

Initial Design Brief

- Must drill development end and support holes;
- Must be rail bound and transported by a loco;
- Must be able to travel in underground haulages and crosscuts;
- Only one person should operate and maintain the rig.

From the beginning of the project it was decided to use an artisan to build the rig, and he would then do the drilling and maintenance on the rig. He is paid a bonus for drilling and maintenance based on metres advanced. (See Figure 17).

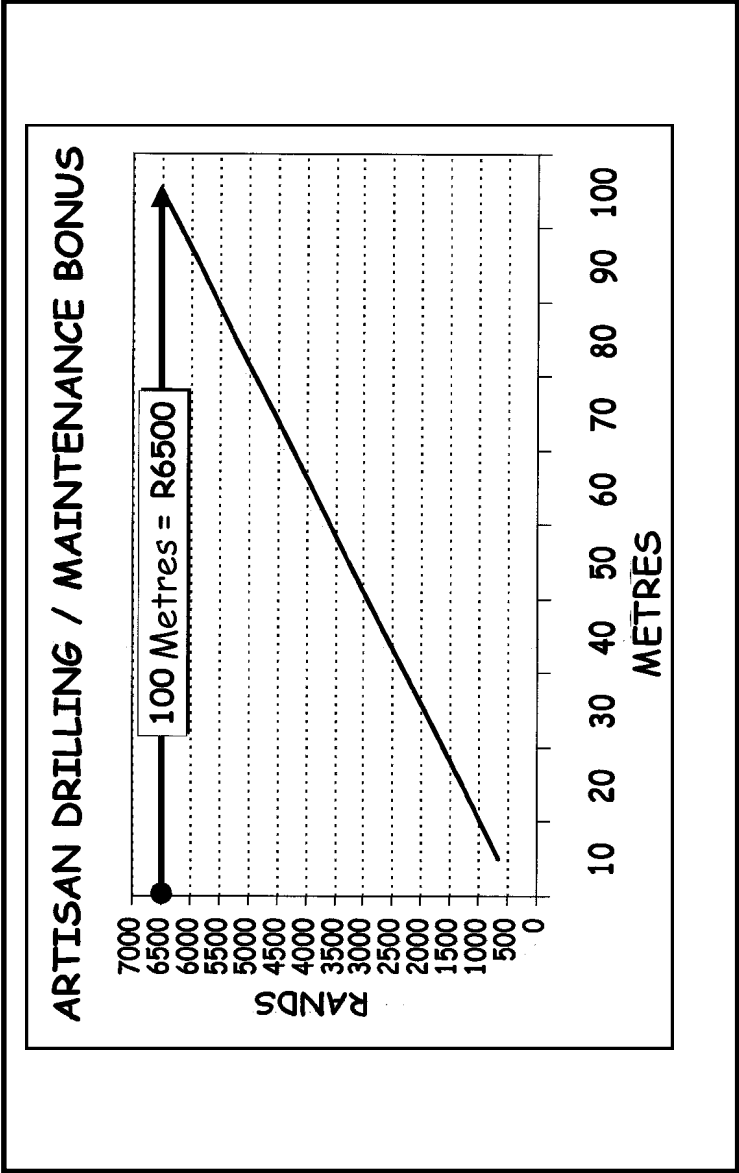


Figure 17

Features of the Rig

- Single boom electro-hydraulic rig;
- 2,4m Feed rail so support holes can be drilled;
- Hydrostar 200 drifter;
- Boom coverage area is 4,7m height and 4,4m wide.

Advantages

- Reduction of injuries: No persons on the face while drilling takes place;
- Reduction in labour from 11 man to 6 man crew;
- Better drilling accuracy resulting in better advance per blast;
- Low running costs due to artisan operating and maintaining;
- Increased productivity from 3,2m/man to 8,7/man.

Results

(See Figure 18)

Safety - to date no injuries have occurred on this project since it started in June 1998.

The rig is currently achieving approximately 50m of flat end development per month on a single end.

The Future

The development contract is currently run by a developer, in conjunction with the artisan/driller, however the intention is for the artisan to obtain a blasting certificate so that he can assume overall charge of the contract, thus eliminating the need for a developer.

The target is for the rig to achieve 100m face advance in a single month, this will be achieved by drilling more than one end, to introduce flexibility, and also by drilling longer rounds than the standard 2,4m round.

Achievements

M ach. Overbreak M/man Ends avail.

June	50.2	10.0%	8.3	1
July	40.6	14.0%	6.7	1
Aug	46.6	1.0%	7.8	2
Sept	36.1	1.9%	6.0	1
Oct	55.2	3.4%	9.2	1

Figure 18

Longer rounds of 3,3m and 4,0m can be drilled using extension steel, and the best advance achieved to date is 3,9m on a single round.

In order to blast a 4,0m round in a 3,4m dimension end, Nonel tunnel master sets are used to give accurate timing, with good results.

CONCLUSION

Poor production rates, limited or no flexibility, poor face availability and limited ore reserves were reasons for the initiatives discussed. In each of these categories we have realised improvement with no compromise to our employees from a safety or health point of view.

With the current situation regarding health, productivity and costs it is essential for every manager and his team to focus on innovations, which will lessen the impact of these concerns on our operations.

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