

CENTRE FOR SOCIAL
SCIENCE RESEARCH

Aids and Society Research Unit

**FROM THE COALFACE: A
STUDY OF THE RESPONSE OF
A SOUTH AFRICAN COLLIERY
TO THE THREAT OF AIDS**

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CSSR Working Paper No. 5

April 2002

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Introduction

South African exports of steam coal are the second-largest in the world and her collieries are the third-largest global exporters of coal per se. As such, the coal mining industry accounts for 34% percent of the total output of South Africa's mining sector. (Survey of Trade and Industry, 1996). The industry is making a valuable direct and valuable contribution to the development of the South African economy, because it provides thousands of jobs and has many backward and forward linkages. The effects of HIV/AIDS in this labour-intensive minerals sector are therefore likely to be devastating.

Sub-Saharan Africa has only 10% of the world's population, yet 83% of world-wide AIDS deaths reported last year were from this region. AIDS is expected to cost 10 million South Africans their lives by 2015 (Mining Weekly, 14/12/2001). The gazette also quotes Southern Africa's estimate in Mining, Minerals and Sustainable Development (MMSD) -that 27% of mineworkers will have died of AIDS by 2005. Gold Fields calculates that in its workforce, 26,4% of employees between the ages of 24 and 54 are infected. Platinum producer Lonmin reported a 26% infection rate, while Anglo Platinum test results showed an infection level of 18%-22% (Mining Weekly, 14/12/2001). It is unclear how the mining houses derived these figures, as testing may be done only with informed consent, and mining unions have advised their members against it. These estimates have led to an admission by the Department of Minerals and Energy that 'there is no clear indication of what the mineworker infection rate is at present...the infection rate cannot be determined on an empirical basis' (Mining Weekly, 14/12/2001). Given that the average national infection rate for adults at that time stood at 24,5%, these estimates do not seem unlikely. (Statistic quoted by Chamber of Mines health advisor Lettie la Grange in Mining Weekly, 14/12/2001).

This paper will give an overview of scenarios used so far, both in the mining sector and at the firm level, to predict the costs resulting from the

AIDS pandemic. A case study will be done at a South African colliery ('the firm'), which is one of many collieries that are a subsidiary of a major coal provider ('the holding company'). Various costs, that one would expect to indicate the effects of HIV/AIDS mortality and morbidity in the firm, will be examined. This analysis will be supplemented with anecdotal evidence from the firm studied. Responses of the firm to the threat of AIDS will then be discussed and directions for future research suggested.

Overview Of Cost Scenarios Used To Study The Impact Of AIDS On Firms

The economic impact of HIV/AIDS can be studied at three levels: the macroeconomic, household and the sector/industry level. The body of case study research on the economic impact of HIV/AIDS on firms is small (e.g. Baggeley, 1994; Forsythe, 1994; Lowenson, 1996 and 1997; Naidu, 2001; J.P. Morgan, 2001; Heard, 2001; Evian, 2000), but is slowly and steadily growing. Unfortunately, most studies 'rely heavily on estimated HIV epidemiology and costing or incomplete data' (Morris *et al*, 2000:942). Typically, this is done by imputing a level of HIV infection and associated deaths onto a firm via a demographic model (e.g. the Doyle Model, ASSA 2000). This was the approach taken by economists and consultants who provided briefing documents to the Chamber of Mines (Sadie, 1991; Evian, 2000.) Alternatively, since the level of HIV infection is not usually known and as it is not clear which deaths are AIDS-related or not, researchers have to rely on incomplete statistics of known or suspected AIDS cases, provided by medical personnel at the firm level.

The few studies conducted concentrate on prevalence of the disease and factors that increase the risk of infection. These studies are not done from an economic point of view, neither do they estimate the quantitative impact of HIV at the workplace (Mbizvo, 1996; Bassett, 1996; Gwanzura, 1998; Bassett, 1992; and Campbell, 2001). Besides those of Lowenson (1997) and Aventin and Huard (2000), quantitative assessments of the impact on costs at a firm level are uncommon. Morris *et al* (2000:942) believe that this data is important 'in determining the cost effectiveness of interventions aimed at this population, more accurately determining the impact of HIV on individual industries and in the planning and policy arenas.'

Most studies that tried to assess the economic impact of the pandemic concentrated on the direct and most immediate costs. These

included the cost of funerals, the value of production and remuneration sacrificed due to increased sick leave, the training and recruitment costs associated with replacing deceased or medically retired workers, as well as the additional costs associated with increased pressure on health care resources (such as medical aid or clinic services at plant level) and so on.

While these studies highlight trends in quantifiable costs, they are hampered in four ways. Firstly, to a very large extent, they are hindered by the fact that they are driven by assumptions. It is difficult to determine how many HIV-positive people there are and almost equally importantly, what their CD4 counts are. This is problematic in South Africa, because labour law requires an employee's informed consent before testing is done and only the Labour Court can compel employees to be tested.

Secondly, there is the problem of the counter-factual, or the impossibility of knowing how the firm would have progressed in the absence of HIV/AIDS. Estimates are based on the *ceteris paribus* assumption that there are no changes except the impact of AIDS. This assumption does not hold in the calculation of impact assessments, as firms react to the epidemic by altering their strategies. One would have to untangle what changes made at the firm level are a function of (or exacerbated by) concerns about reducing the impact of AIDS on the firm and which are a function of exogenous factors, such as technological change. It is, however, almost impossible to disentangle the impact of AIDS from other external forces affecting the firm.

Thirdly, the 'unquantifiable' factors (such as productivity losses, the impact on morale, the effect of fatigue on individuals and the functioning of teams) are not dealt with effectively. To cope with this problem, Aventin and Huard (2000) adopted a 'two-stage methodology' to look at the impact of AIDS on costs. They divide costs into 'direct' and 'indirect' costs. Each of these two classes are then further divided into 'quantifiable' and 'difficult to quantify' direct/indirect costs. The second stage of their analysis is to supplement the quantitative assessment with qualitative data, to give the reader a 'feel' for the situation at the firm level and to highlight the response of the firm for future use in impact assessments.

This paper pays particular attention to the second-stage approach used by Aventin and Huard (2000). In this study the quantitative assessment of a consultant (Evian, 2000) and internal data of researchers in the firm will be examined. The aim is to go beyond Aventin and Huard by taking a more dynamic approach in order to trace the impact of AIDS over time.

A Critical Overview of Existing Impact Assessments in the Mining Industry

Sadie *et al* (1991) have assessed the costs of AIDS to the mining industry, using the Doyle model and data from the Chamber of Mines. A division was made between direct costs and opportunity costs, the former comprising prevention, treatment, compensation, research and replacement costs. Treatment costs include medical care in the asymptomatic phase (before the worker has progressed to full-blown AIDS), as well as symptomatic treatment, but no antiretroviral drugs are included in their calculations. Under opportunity costs they have allocated an amount of R7000 per AIDS sufferer who is unable to contribute to production, although no methodology for estimating this cost is given in the document. They arrive at an estimated cost to the entire industry of R1509 million in the year 2010 (base year 1992).

A weakness of the paper as a whole is that no calculations are given for the costs mentioned. This is vital, especially in the case of opportunity costs - which can be very subjective - and leads the reader to view their results with a certain amount of scepticism.

Critical Discussion of Impact Assessments Done on the Firm Studied

Dr. Clive Evian conducted an impact assessment for the holding company and its subsidiaries in April 2000 and then again in April 2001. The firm studied is one member of the mining subsidiary. He based his estimations of accumulative HIV prevalence and incidence on several assumptions that do not hold for the firm studied - for example, that there is a period of seven years from the time of infection to the onset of AIDS and a further twelve months to the stage of full-blown AIDS. According to the AIDS director interviewed, the average time amongst coal mining firms is six-and-a-half to seven years (from infection to death.)

He also assumed that the firm's workforce would not be altered between 2000 and 2004. Employment is in fact decreasing due to project changes and improvement of work processes. Therefore, as the firm becomes more efficient, it means that the underground portion of the workforce is growing smaller, as the labourers who leave are not being replaced.

When the reported incidence of AIDS was found to be lower than at first predicted in the Evian (2000) scenario, Evian moved the prevalence

and incidence curves forward by eight years for the second prediction - for example, it was predicted that there would be 255 new AIDS cases in 2001, and this is now only expected to occur in 2009. This could be because he did not take the changing workforce numbers into account when making his second prediction. Alternatively, his predictions may have been correct, but the full complement of AIDS cases may not have been reported to management. Management may therefore have been led to the conclusion that the disease is not as prevalent as Dr. Evian estimated, as fewer cases were brought to their attention.

A cost scenario was then drawn up by the AIDS Director of the subsidiaries (refer to Table 1). It assumes that a minimum of 15% of the workforce will be lost due to AIDS, as per Dr. Evian's estimation of a 15-20% infection rate in the work force. Kramer (2001), basing his estimates on saliva tests, also cites this rate as being the prevailing one amongst his clients. The AIDS Director has considered both quantifiable and unquantifiable direct costs, as well as indirect quantifiable costs. No attempt was made to bring indirect costs that are difficult to quantify, such as 'work disorganisation, breakdown of social bonds, decrease of work rates, or know-how transmission disrupting,' (Aventin and Huard, 2000:171) into the cost scenario. In addition, the above costs did not take cognisance of 'down-time' due to fatigue, or any reimbursements for accidents due to fatigued or ill workers operating heavy machinery underground.

Absenteeism is by far the highest cost, accounting for R5036395 (43%) of total expected costs per annum. Replacement costs for 15% of the workforce are also sizeable, at 25% of annual costs. Funeral expenses due to AIDS are also significant, at 11% of the predicted costs. Human resources costs are by far the largest, and additional personnel that need to be hired will make up 7% of expected total AIDS-related costs. This percentage rises to 13% if the real increases in hired labour and contractor's costs are also considered. It must be considered that these figures are a conservative estimate of expected AIDS fatalities in the firm.

The cost of AIDS as a percentage of the total payroll was estimated by the firm, and is shown the table below. The estimated number of deaths due to AIDS (third column) against total number of employees (second column) is shown. A cost per AIDS victim is allocated to compute the fourth column of AIDS incurred costs. Finally, costs due to AIDS are shown as a percentage of the total payroll.

Table 1: Total Estimated Costs of AIDS to the Coal Mining Division of the Firm. *

Total Additional Costs Resulting From AIDS Deaths: 2000 to 2010				
YEAR	TOTAL EMPLOYEES	ESTIMATED AIDS DEATHS	TOTAL AIDS INCURRED COSTS	PERCENTAGE OF TOTAL PAYROLL
2000	8731	110	8,618,683	1.23
2001	8731	157	11,638,498	1.58
2002	8366	203	14,891,472	1.98
2003	8322	243	17,954,832	2.29
2004	8065	244	18,805,231	2.34
2005	7784	216	17,783,824	2.18
2006	7561	191	16,900,940	2.04
2007	7451	148	14,385,504	1.67
2008	7234	132	13,921,930	1.58
2009	7066	123	13,641,387	1.51
2010	6886	117	13,899,308	1.49
TOTAL 11 YEARS			162,441,609	

* Based on data taken from Evian (2000).

Sizeable as the AIDS-incurred costs at first appear to be, they are in fact a surprisingly small percentage of the total payroll. Aventin and Huard (2000) found that with an HIV prevalence of 15%, between 10.3% and 15% of the wage bill would be spent on caring for the HIV+/AIDS employees in manufacturing firms in Cote d'Ivoire. This leads one to believe that costing based on a 15% HIV/AIDS prevalence rate is far too conservative, or alternatively, that the firm has not considered vital costs. In fact the AIDS director and the mine doctor admitted that it is now believed that prevalence is at the 22% level, but it was not mentioned how this figure was derived. Costs not considered may be *ex gratia* payments for medical incapacity,

increased group life insurance premiums, or pension/provident fund increases. Most significantly, no loss of productivity or reorganisation was estimated, as in the Aventin and Huard study. Neither was a proportion of the wage bill for medical personnel (based on time spent on estimated HIV/AIDS sufferers) included in the cost scenario. Dismissals and severance pay have also not been accounted for. No overtime costs were taken into account, but then neither were they accounted for by Aventin and Huard, 2000.

These costs could increase the impact of the disease significantly for the firm. Aventin and Huard (2000), Morris *et al* (2000), Rosen *et al* (2000) and Naidu (2001) all mention qualitative but 'difficult to quantify' costs as a major component of impact assessments. Unfortunately, these costs are highly subjective and many assumptions have to be made when calculating them. This makes it a seemingly impossible task for management. The accuracy of these assumptions is also impaired by costing done by upper management or consultants, who are not always 'in touch' with work processes and employees 'at the coal face'. This may negatively influence perceptions of the impact of the disease on the firm and may explain the fact that existing studies have not taken this type of cost into account.

Tracing the Impact of AIDS: Investigation of Costs at the Firm Studied

Unlike Aventin and Huard, specific cases of HIV/AIDS in the firm could not be identified for the purposes of this case study. The result of this was that the costs associated with only these cases could not be examined. This paper will nevertheless try to examine the costs engendered by HIV/AIDS by studying the various cost categories that Aventin and Huard examined – i.e. those where one would expect the impact of the pandemic to be felt. These are: sick leave, compassionate leave and days absent without permission (AWOP's); health costs borne by the firm (including HIV/AIDS tests); funeral expenses and funeral attendance costs borne by the firm; prevention; invalidity pensions; recruitment and training; dismissals/severance pay; lost productivity/ reorganisation; and overtime.

1. Sick Leave, Compassionate Leave and Days Absent Without Permission (AWOPs)

Leave and AWOP paper records were converted into electronic format in March this year and stored on computer tape. Thus, quick retrieval of these records was not possible and the information they contain will not be used to analyse the effects of AIDS on the firm. In any case, the mine doctor at the firm studied believes that this data would not be helpful to me as an indicator, as he does not think that the effects of AIDS will show up in the records. An additional factor is that any worker who is absent without leave for five consecutive days can be dismissed immediately. These employees will be out of the system at once and no trace of any increase in their sickness (which may indicate HIV/AIDS) will remain in the mine records.

2. Health Costs Borne by the Firm (Including the Cost of HIV/AIDS Tests)

Health costs borne by the firm are particularly hard to estimate. Tuberculosis medication is supplied free of charge by the government, but no records of medication of sexually transmitted diseases, or vitamins supplied by the firm, have been kept by the mine hospital. The mine doctor believes that there is an approximate total, for all the mines, of 70 new cases of sexually transmitted diseases per week.

There are no records kept of the number or results of HIV/AIDS tests. According to the law, staff are not allowed to note an HIV test or its result on a patient's hospital record. Also by law, no records are allowed to be kept indicating whether a person is HIV positive or not. However, a nurse at the hospital confided to me that she and fellow nurses write 'PTC' or 'pre-test counselling' on the patient's record to inform each other of the status of patients. They were not prepared to share this information with me.

It does not seem likely that the mine will provide antiretroviral drugs to employees in the near future. This is due to the time-consuming cost of monitoring patients, the lack of infrastructure (such as laboratories to conduct the tests) and the strict regimen of medication that patients must follow (5% non-compliance with the dosage instructions leads to a 50% increase in resistance), which the mine doctor believes will be too impractical to implement. The only antiretroviral drugs kept on the premises are for use in cases where medical staff accidentally prick themselves with a needle which might be infected by the HIV virus. The AIDS director was also committed to making hospital antiretroviral drugs available to any rape victim, whether they were an employee of the firm or not.

A fully-equipped hospital is kept at the colliery and treatment is free for all employees and their spouses. Expenses are paid for by the mine, with the exception of tuberculosis medication, supplied by the government. Two full-time doctors staff the hospital and they have several nurses assisting them.

Walking through the hospital wards, there were plenty of unoccupied beds and the nursing staff were able to attend adequately to the patients. A nurse at the hospital who administers the AIDS tests reports that the majority of patients only come for tests when they are very ill and in the final stages of the disease. They have the tests done to confirm their worst suspicions that they may have AIDS. She says that the standard response of most patients, despite pre-test counselling, is to believe that they will pass away within the next few days. 'Most of them cannot handle the news, they just get up and run away. They say they are going to go and pack their bags, that they might as well go home now, as they are going to die soon. A very few (one or two) might come back to me for counselling and help, once they have had time to deal with the news and get over the shock, but in most cases, I will not see them again,' she concludes.

This may be for two reasons: It could reflect the severe stigma that surrounds AIDS on the mines, which Sadie (1991:5) calls 'an aura of death and defilement'. The hospital nurse cited the example of a hostel-dweller who was severely beaten by his peers and had to be hospitalised when his associates suspected that he had AIDS. She herself has been the target of verbal abuse from mine employees for her role in administering the AIDS tests. Secondly, she believes that most staff, who cannot afford a private practitioner, will go to the clinic in the township nearby. The workers seem to believe that their sero-status will not be kept confidential because the hospital sustains the hospital financially (and also fear that they might lose their jobs).

The above factors indicate therefore that the hospital expenses and the HIV tests performed reflect a gross under-estimation of the number of cases in the firm. These HIV/AIDS cases may nevertheless be affecting the cost structure of the company in other ways, yet their impact is unappreciated and therefore unaccounted for by management, since the full complement is not translating into increased health costs for the firm.

3. Funeral Costs, Pension and Provident Fund Increases

According to administrative staff interviewed, no changes were apparently made to pension or provident fund contributions as a result of AIDS on the

mine, nor to the length of employee contracts.

Between R2,50 and R10,00 per month is deducted from each employee of the firm and this amount is contributed towards a fund. Out of this fund, a cheque of R8500 is given to the family of a deceased employee to cover funeral expenses. Three years' salary is also paid out to the family, plus an additional R200000-R300000 if the employee was a member of the provident fund. The company will send representatives to visit the family to give them the cheque on the company's behalf and to attend the funeral of the employee. In 2001 a budget of R203790 was set aside to cover these costs, and the company contribution to the insurance fund is estimated to be R243 894. Thus, funeral expenses are estimated to cost the company a total of R447 685 per year.

4. Prevention

The firm has employed a full-time AIDS Director to manage the firm's HIV/AIDS program. He conducts AIDS education seminars for the company, liaises with the representatives of other companies to co-ordinate their response to AIDS in the surrounding community, and negotiates the company's HIV/AIDS retrenching agreement with the unions. He has a budget of R2.1 million, which includes the supply of condoms.

5. Invalidity Pensions and Lost Productivity/ Reorganisation

No employees are given invalidity pensions as such. Any employee who becomes too ill to work may take voluntary retirement. Most of the employees in the wage earner category cannot afford to do this and once they are unable to perform work underground, they take jobs as gardeners, or do maintenance work above ground. Approximately 20 men from all the mines owned by the firm were working in this category at the time of the study. These employees are paid the same salary as they were receiving for their job underground, until they choose to leave the firm. The difference between the wage they were paid underground and the wage payable for the surface job they now do represents the cost of AIDS to the firm.

6. Dismissals/ Severance Pay

The services of AIDS victims will eventually be terminated by the firm as a result of incapacity due to ill-health, and remuneration in this regard will

therefore increase. Four consultations must take place: with the employee, the employee's representative, the personnel officers from the Employee Services Department, and the Personnel Officer from the particular mine concerned. The aim is to seek alternative employment positions within the company before the services of the employee have to be terminated on the grounds of incapacity. The employee will receive a remuneration package from the firm if he is not a member of a pension or provident fund. This package consists of:

- Three weeks' basic salary for each completed year of service, as well as a pro-rata payment for an incomplete year of service.
- Four months' basic salary and a housing subsidy for four months (if applicable).
- Four times 32% of the basic salary the employee was earning.
- Hostel accommodation for one month after termination of services, if applicable.
- Furniture and removal costs, medical loans up to a maximum of R1000 and study loans will be written off.

The above information taken from an agreement in this regard between the firm and the union on the mine.

7. Recruitment, Training and Selection Costs

Recruitment and training costs should be decreasing if no more labour is being hired in the wage-earner category. Recruitment and selection are estimated by the company to cost R6501 per wage earner (WP), R20302 per mine salaried employee (MSP) and R25928 per salaried employee (SP). In 2001, Evian (2000) estimates that 128 wage earners, 13 monthly salaried personnel and 16 salaried personnel are affected by the disease. This brings the total annual cost to approximately R1,5 million. Training costs for new employees who replace the deceased mentioned above are R3612 (WP) R13535 (MSP) and R19206 per salaried person (SP). This is a total of approximately R1 million on selection alone and costs the firm R2,5 million per annum for recruitment, selection and training.

8. Overtime

Not all overtime incurred by the company is AIDS-related. A member of management reported that often middle management working underground would commission overtime in order to reach their production targets and therefore receive a higher bonus. Time lost by the mining sections due to

blasting out geological formations that are in the way of the coal can be made up by incurring overtime. No details on overtime were provided by the firm.

Problems Incurred in Estimating the Above Costs in the Firm Studied

The investigation into the costs of the disease to the firm being studied was hampered by lack of information and records which it kept. Information on sick leave, especially in the 'Absent Without Leave' and 'Compassionate Leave' categories would have been of interest, as one would expect them to show increases as HIV+ employees fell ill more frequently. A breakdown of hospital expenditure would also have been useful, as tuberculosis and sexually transmitted diseases (STD's) occur with increased incidence as the immune system is weakened by AIDS (Campbell, 1998 and 2001). This could be used as a rough measure of the increasing prevalence of the disease in the firm. More insight into employee turnover would be useful, particularly if one knew why employees were leaving the firm (e.g. whether due to illness and work incapacity or the employee being fired for not being at work for five days without leave – possibly also as a result of illness). The firm has only recently provided data on the different causes of turnover. The retrieval of pre-1998 data would be very costly and time-consuming to management and therefore they did not consider this a viable exercise. Data on overtime and the wage bill, for wage personnel in particular, would also have been useful.

Tracing the Impact of AIDS: Beyond the Aventin and Huard Methodology

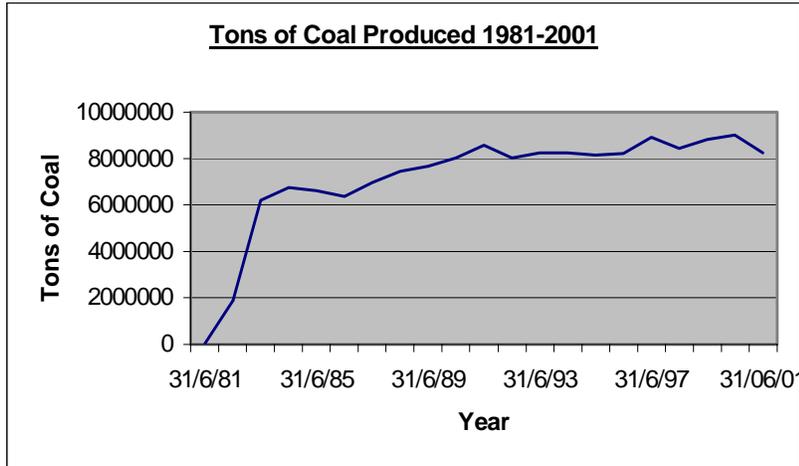
It was decided in this case study to look at the firm in greater depth in an attempt to estimate the impact of AIDS over time. This meant going beyond the methodology of Aventin and Huard (2000), who examined the detrimental effects of HIV/AIDS on a number of infected employees for between two and six years only.

1. Coal Output

Bearing in mind that the firm under study is a colliery, one might expect a decrease in coal output with the increased incidence in AIDS in the underground workforce, because workers will be weakened and production lowered. This should be particularly noticeable given that the majority of employees working underground are wage personnel, whom Evian (2000) expects to have the highest incidence of AIDS.

Figures 1 and 2 show the number of tons of coal produced since the inception of the mine, as well as the number of tons produced per machine. Production was low in the first year when the mine started operations (June 1981) and only six months' production are reflected. There was a steep increase in production from 1986 to 1993, as well as in 1997/98 and 1999/2000. Since 2000 though, a decrease in production can be observed. It would be too hasty to attribute this to the effects of the disease alone, because two production teams were not producing coal for six months each during the 2000/2001 financial year.

Figure 1: Tons of Coal Produced 1981-2001



However, it is clear from statements of geologists interviewed and the production reports of the mine that the factors affecting coal output are very varied – so much so that the belief is that examining tonnage produced over

the past twenty years would not give a clear indication of the effects of HIV/AIDS on the firm. Firstly, the mine's geologists point out that the mine is nearing the end of its 'lifespan'. The areas with the thickest coal seams and most easily accessible coal have already been mined out. Although the mine is still profitable, the production teams are increasingly mining further away from the main shafts and have to travel for a longer period of time before they can begin working.

In addition, the geologists explained that coal seams are now thinner and floors softer, so contamination¹ is likely to increase. 'Down time'² will increase whenever production teams do maintenance work on machines or move to mine in different areas; also when dykes and other geological features are blasted through in order to reach the coal. The interference of geological features is a purely random occurrence that interferes with production data. There is a myriad of other factors that decrease mining time, such as crew station talks, training and machine breakdowns. These factors all interfere with production and make it difficult to isolate the effects of AIDS-related fatigue and absenteeism.

Further decrease in overall production is dictated by the refinery to which the mine supplies coal. There have been work process improvements implemented at the refinery, which have led to a demand there for less coal. The demand for coal in the market place is also falling; it is met from stockpiles of coal on the mine, which are at a maximum. As a result, less is needed to 'top up' the stockpiles after the market demand has been met.

Technology in the mining industry in South Africa has also changed over the past twenty years. John Lang (1995:207) believes that 'the technology of cutting coal developed in Europe and the United States was applied with little adaptation. Collieries were able to step up productivity through mechanisation at a far faster rate than gold mines...There was a consequential swing to the employment of more skilled labour at the expense of the less skilled...Higher productivity flowed largely from improved technology.' At the firm of interest, technological advancement is reflected in its new machinery. Both single and double continuous miners³ have been used to a greater or lesser degree. The mine has experimented with five different types of continuous miners since the 1994/1995 financial

¹ 'Contamination' occurs when any other rock besides coal is mined.

² Time when the continuous miner is not mining out coal due to repair, cleaning, maintenance etc.

³ A 'continuous miner' is the mining machine used to mine the coal seam.

year alone. As a consequence then, one would naturally then expect production to fluctuate.

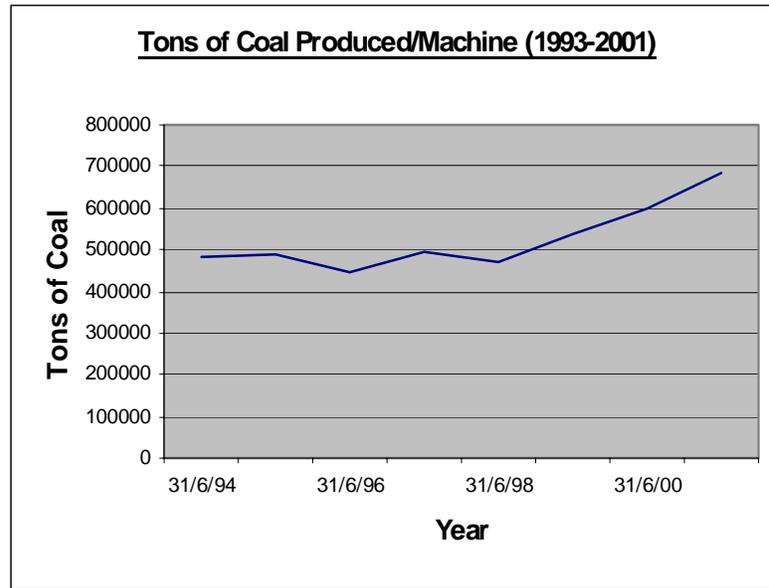
Taking the changes in production technology into account, a graph showing tons of coal produced per machine was drawn up for the purposes of this paper. Several different types of machine have been used over the lifespan of the mine, but data was available only from 1994 onwards. Since the 'single sections' with one machine mine out roughly half the amount of coal that the 'double sections' with two machines will produce, the former has been counted as one machine and the latter as two. Total production for each year was divided by the number of machines across all single and double sections to get a rough figure for production per machine, per year.

This gives one a very different impression of production (Figure 2). It appears that production per machine is increasing much more noticeably than in the past. This suggests that if AIDS is undermining productivity, the effect is being masked by technological improvements. In fact, it shows the benefits to the firm of employing more capital-intensive work processes. In support of this, one interviewee at the firm confirmed that they were then operating with twelve machines, with only a slight decrease in output compared with previous years, when they had twenty machines.

In an interview with a mine overseer he mentioned that certain production teams are more productive due to a change in their leadership. A good leader will inspire loyalty in a team (known as a 'section') and bring out the best in the men in the area of the mine for which he is responsible (also called a 'section'). Some men have been in the same section for ten to fifteen years and therefore work well together. Certain of the sections have been closed down (and the production team re-deployed to other areas of the mine) as it no longer became profitable to mine in those areas. Other sections have been opened up as the mine expanded, so the number of sections producing coal has varied over the years. Also influencing coal output levels is the on-going improvement process that the entire firm and its holding company has been undergoing for the past two years. According to the Mine Technical Manager, Mine Overseer and Geologists interviewed, the production teams were sent for training, processes were changed and improved, and more checks and balances put in place.

Production targets were set for each section, based on its maximum potential production, taking into account all factors that might affect this in 1997 (a very productive year). If teams managed to close 50% of the gap between their present production and 1997 levels, they were rewarded with payments of as much as five times their salaries. It was relatively easy for some teams to close this gap while still not producing at the same high levels compared with other teams, because their production had been so low before and conditions were now in their favour.

Figure 2: Tons of Coal Produced per Machine (1993-2001)



This resulted in low morale and poor production levels in teams who were already producing at maximum capacity, who felt that their targets were set too high and then became discouraged. On the whole though, production levels at the colliery did increase, but this was not uniform across all production teams.

Separating the effects of technology, geological conditions, demand for coal, morale and changing work processes from fatigue and sickness due to AIDS was almost impossible. Simply looking at tons of coal produced will not therefore give an indication of the effect of HIV/AIDS on the colliery, as production levels could decrease for the above-mentioned reasons.

2. Capital/Labour Ratio (1984-1996)

If one of the effects of the AIDS pandemic is that more labour is required to perform the same jobs, management might prefer to invest in mechanisation rather than hire extra labour. To see if this was occurring in the firm, the capital/labour ratio for the period 1984-1996 was calculated (See Table 1

below). Data is taken from the records of Statistics South Africa, using their 'Census of Mining' results. The census is conducted every three years and this may affect the inferences that can be drawn from the data. Only data up to 1996 is currently available, as 1999 data is still being analysed and has not been released yet. For the purposes of this study it is assumed that before 1984, the epidemic would not have made enough of an impact on productivity for management to consider investing more heavily in machinery instead of employing more labour.

Table 2: Capital/Labour Ratio 1984-1996

Capital: Labour Ratios (1984-1996)						
((Data taken from the 'Census of Mining Report' produced by Statistics South Africa))						
Year	Opening Value (Fixed Assets)		Employment		Capital/Labour Ratio	
	Coal	Gold (and Uranium)	Coal	Gold (and Uranium)	K/L Coal	K/L Gold
31/12/84	2851009	10000472	89696	499872	20.00607	20.006066
31/12/85						
31/12/86						
31/12/87	4563135	15960439	93759	531635	48.66877	30.021423
31/12/88						
31/12/89						
31/12/90	6117248	19732364	76321	477142	80.15157	41.355328
31/12/91						
31/12/92						
31/12/94						
31/12/95						
31/12/96	8266368	38650575	62956	345797	131.3039	111.77244

From Table 2 it can be seen that the capital/labour ratio of coal is higher than that of gold over the entire time period. This was an expected result as the coal mining process is more mechanised, whereas gold mining is relatively more labour-intensive. Both ratios have risen at a faster rate since 1988 (coal more so than that of gold), but it appears from 1996 data that the coal capital/labour ratio is falling. This may be due to the fact that the opening value of fixed assets decreased from R8,826368 to R8,266368,

while employment in the coal-mining sector rose from 61718 to 62956. It is also not known whether employment figures are declining due to mechanisation, the effects of the AIDS virus or to mines closing because of the declining profitability of coal. Unfortunately, since there is no recent data, it is unclear if this trend has continued or if the situation was temporary and machinery is now replacing labour in the coal mining industry. At the firm studied, no more labour is being hired for underground work (see later discussion under ‘Turnover Amongst Wage Personnel’). One might then expect the capital/labour ratio for the firm to rise. Moreover, the firm will soon be expanding the mine and the existing labour will gradually be moved into the new area (after they have finished mining out the coal in their existing areas). It will be interesting to note whether they hire more labour or use more mechanised processes, relative to the situation now.

3. Employment Levels Amongst Wage Personnel

If the AIDS pandemic were having an effect on the labour situation in a firm, one would expect an increase in turnover and employment levels. This would be as a result of labourers becoming incapacitated and leaving the firm, while more labourers would then be required to do the jobs of any workers who were fatigued as a result of HIV/AIDS.

Figure 3 below shows the number of employees of the firm from January 1997 until June 2001. All employees are categorised as salaried personnel (SP), monthly salaried personnel (MSP) or wage earners (WP). Salaried personnel consist of the senior levels of mine management (highly skilled). Skilled personnel, such as artisans, make up the majority of the mine wage personnel. Unskilled labourers, as well as semi-skilled and skilled miners, make up the wage personnel.

As can be seen from the graph, employment levels of both classes of salaried personnel have remained relatively constant over the time span covered by the graph. There is a decline in employment levels after August 1997 as retrenchment and retirement packages were offered to certain employees. A noticeable decrease in employment has occurred in the wage-earner category. However, it cannot be assumed that this is attributable to AIDS. Rather, as part of an improvement programme at the mine, increases in production are being attempted with fewer employees. Therefore, since the improvement process (which involves streamlining existing work procedures, as well as becoming more efficient and productive) has been set in place at the mine, no further staff have been recruited in this category, as a matter of policy. (This implies that no recruitment and training costs will be incurred for the wage-earner category).

Actual Employee Strength per Month
From Jan'97 to May'01

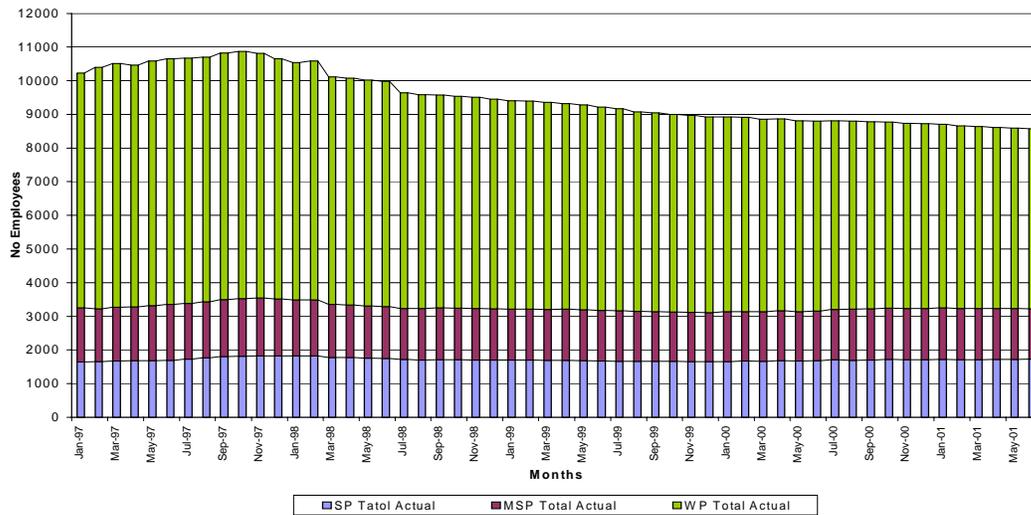


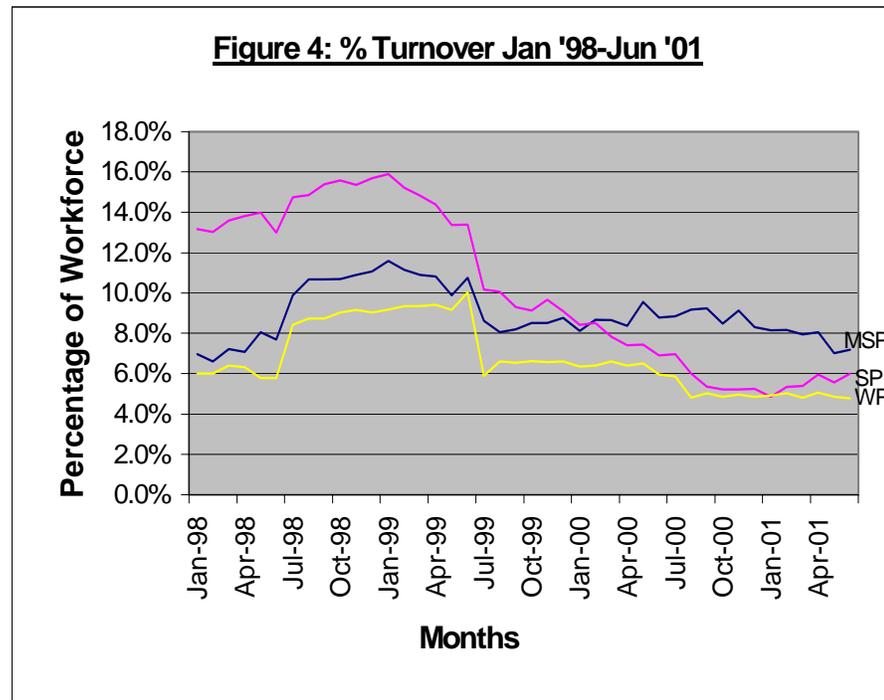
Figure 3: Actual Employee Strength from Jan. 1997 to May 2001

Any shortage in labour is supplied from sections of the mine that have closed down where there are no longer adequate reserves of coal left to make mining in those areas viable. This would explain the decrease in employment seen in the graph and would mask any impact that AIDS might have on employment, at current infection levels.

4. Turnover Amongst Wage Personnel

The company of interest no longer hires labour in the Wage Personnel category, which was confirmed by all the employment agencies for the firm. They also confirmed that there was excess labour in the skilled categories, such as artisans (boilermakers, for example) and shift bosses or mine captains.

I was able to attain turnover figures from the company for January 1998 to June 2001 (the number of employees leaving at the end of the month as a percentage of average number of total employees employed over the past year). See Figure 4.



Most noticeable in Figure 4 is the sharp increase in turnover in July 1998 which continued to July 1999, when turnover almost doubled from 5.8% to 10%. Thereafter it dropped to approximately 6%. Since July 1999, turnover has changed by approximately only 2%, dropping and stabilising from around 6% in the 1999/2000 year, to the 4.6% level from June 2000 to July 2001. This implies that approximately 5% of the average number of people that were employed in the previous year were leaving at the end of each month. There is no obvious increase in turnover that could be expected as a result of staff leaving the firm (due to AIDS illnesses) since July 1999. In fact, turnover has become even more stable in the wage earner category over the past year.

Since the colliery studied will soon be mining in a new area, present reserves of coal on this mine having been depleted, management was questioned as to why it is no longer hiring labour in the wage-earner category. The interviewee replied that two sections of the present mine would be closed down every six months and the labour from these sections

would supplement the existing teams who (are losing workers due to AIDS) in the new mining area. With this, as well as more efficient work processes and methods, hiring additional labour should not be necessary. It was implied that AIDS was not a problem as fewer underground workers were required.

5. The Impact of AIDS at the Coal Face

To ascertain if AIDS is affecting the production process, one of the mine overseers was interviewed. It appears that at the moment AIDS is affecting the coal extraction process because of increasing levels of absenteeism and fatigue. Following on from this, safety procedures and labour policies are also affected.

In the board-and-pillar mining method, coal is mined out of the underground seam by continuous mining machines, operated by remote control by the continuous miner operator. At the front of these machines is a cylindrical 'head'. Curved, metal, hook-like structures called 'picks' are screwed onto the head of the continuous miner machine. The head then rotates into the coal seam and the picks dig out the coal. Coal that is mined out is then scooped up by the continuous miner and taken by three shuttles to a feeder breaker that crushes the coal into smaller pieces. Conveyor belts then transport the coal to the surface of the mine.

The highest-skilled and most highly-paid position on the production team is a Continuous Miner Operator. It takes two months of training to learn to perform this job, but in the overseer's opinion it takes an average of one year's experience to achieve good, top quality production (six months if the worker is intelligent, literate and learns quickly). Skills that make a good operator are character, good co-ordination and 'a feel for the machine'. His opinion is that these are very uncommon characteristics.

If one team member of the five who are working on the continuous miner is sick, the machine has to be stopped. The men are therefore multi-trained and compensate for the sick member of the team by leaving a less important job to fill in for the sick member. This leaves a job undone and slows production down (though does not halt it). There are fourteen men in a section and at least one is sick per month, leaving thirteen men working. Over one 3km-long belt-conveyor area, only seven out of the usual ten men will be at work, cleaning 7000 top rollers. This slows production down more. Normally two workers per month are not at work, as they are on holiday or have sick leave. This used to be quite a problem, as a miner would store up three months' leave and want to take it all at once. (This occurs less frequently now as they can trade in their leave for money). Four

men will not be at work at any one time. The overseer estimates that he loses ten men per month from the area that he manages due to AIDS-related deaths. The effect of fatigue and missing members has become particularly noticeable over the past year and he is finding it increasingly difficult to meet production targets. If an operator is ill (especially if he is fatigued), the overseer will immediately take him off the miner and assign him to a belt-sweeping position (sweeping the belt carrying the coal) until he has recovered. (This is very low- skilled job, which under normal circumstances is paid half the operator's salary). The reason for this is that the overseer is very concerned that a sick, fatigued worker who cannot concentrate properly could make a mistake and not only damage a very expensive piece of mining equipment, but more important, kill or maim another miner. This is a real concern for him when any of his workers are fatigued. If there is an accident, he is responsible. There have been no accidents yet as a result of fatigue as far as he knows, but he is constantly worried about its possible occurrence. He has really noticed the effects of AIDS-related fatigue on his production teams and their output, especially over the past year, when it has become more obvious. Sometimes the men will be so tired, they can 'barely pick up their feet,' and will have to sit and rest for a while, as it is heavy work. It can also be difficult to tell who is genuinely fatigued and needs to be given lighter work and who is just 'loafing'.

The mine overseer suggests that the miners should be medically phased out earlier (so that they do not delay the production process) and be taken care of properly in a hospital until they pass away, as some of the miners have given twenty or so years of loyal service to the company. He feels that they deserve better, but realises that it would cost millions and that the mine would have difficulty financing such an option.

This situation puts him under immense pressure, as he has a less than productive team and still has to meet the production targets. He feels that management has not been very sympathetic to these problems and that they 'have their heads in the sand,' about the effect of AIDS on production, which are now starting to be felt. He feels he is sitting on a time bomb and that it is just a matter of time before management will be forced to take more serious notice of the issue, as things are steadily worsening and he cannot keep on trying to compensate for the missing workers.

Following on from the direct effects of absenteeism and fatigue are the negative effects that fatigue and absenteeism have on safety procedures in the mine. The overseer is also the leader of the mine's rescue team, in case of fires or accidents underground. The team is made up of eight men, but five will usually go out on an 'incident' (fire or accident underground). Initial training is one week, but it takes a year's worth of experience before the overseer is confident about the miner's competence in

paramedics and firefighting. He is very concerned about the effect of AIDS on this team, as a rescuer needs his full strength to perform the job properly. A fatigued team member will endanger the lives of his fellows and the other miners trapped underground. For example, if there is a fire and the fatigued member collapses, he will first have to be put on a stretcher and carried above ground by the rest of the team before they can carry on firefighting. This costs valuable time and endangers the lives of all concerned. The overseer recently had one of his members, whom he suspected was suffering from AIDS, ask to be excused from the team. The overseer gladly let him go, as he had been worried about this member's performance for a while.

Secondly, fatigue and absenteeism affect relationships between members of the production team and can be a source of conflict between employees when superiors give AIDS sufferers preferential treatment. The mine overseer was questioned about the team's attitude to a member whose workload had to be carried by the rest of the team (such as in the case of the sick supervisor that he mentioned). How do they treat him if he is always sick and do they isolate him if they suspect that he has AIDS? He said that they might call him a 'bosluis' (parasite) but will compensate for him if he is usually a hard worker and a well-liked member of the team. If the sufferer is usually a 'slacker', the other members of the team will discipline him verbally and if no improvement occurs, will ask management to remove him from the team. As a general rule team members try to help each other out. He was asked if tribal loyalties played a role in this and he said that in the past a team leader would gather members of the same tribe around him and production teams would consist solely of Zulus, Xhosas, Sothos etc. and that this still occurs to some degree today.

Conflict between employees arises when supervisors do not follow the correct labour procedure. This might entail sheltering the sick workers who are their favourites, or giving them leave unofficially, while not treating workers that they do not like in the same way. Such favouritism is apparently leading to labour disputes. Another labour problem that is manifesting itself has been labelled 'the Mix Problem'. This occurs when two workers are performing the same function, but Worker One is HIV+ and more highly skilled than Worker Two, who is less skilled, and HIV-. Worker One will receive the same remuneration that he did in his previous position, which is more highly paid than the job he is presently doing. Worker Two, who is receiving lower pay for the same job, then feels discriminated against. This also leads to 'promotion problems' when the more highly-skilled employee, who has been in a position for a shorter period of time, is promoted ahead of the less skilled employee.

Policy Responses Which Will Mitigate the Effect of AIDS on the Firm Studied

Since management has become aware of the severe threat that AIDS poses, several changes to policy which will mitigate the effect of AIDS have been observed in the firm studied. These policies can be categorised in two ways: either as direct and deliberate responses to the AIDS pandemic; or as changes that may be a function of (AIDS and) other exogenous factors, but which will influence the effect that AIDS has on the company. The first category consists of policy responses that have been suggested to firms by consultants and experts (see Evian 2000, Whiteside and Sunter, 2000; Campbell 2001; HEARD, 2001; Kramer 2001). Foremost amongst them are HIV/AIDS education programmes, the supplying of condoms in the mine and surrounding community, medical care of a high standard, peer counsellors, involvement in the community with youth and women at risk, and lastly, changes to labour policy. The second category consists of changes to work processes, which will help 'insure' the firm against the risk of AIDS. It is difficult to ascertain whether these policy changes were implemented because of the threat of AIDS or simply to increase productivity (although they will indirectly reduce the effect of AIDS) or for both these reasons. The second-category policies also include multiskilling the workforce, streamlining work processes and upgrading the technology used by the colliery in the mining process. This paper will examine the policy responses of the mine under study in all these areas.

1. Direct and Deliberate Changes to Policy to Mitigate the Effect of AIDS

These policy changes are aimed primarily at changing the behaviour of or providing care and support for HIV/AIDS sufferers who are employees of the company or members of the surrounding community.

Education Programmes

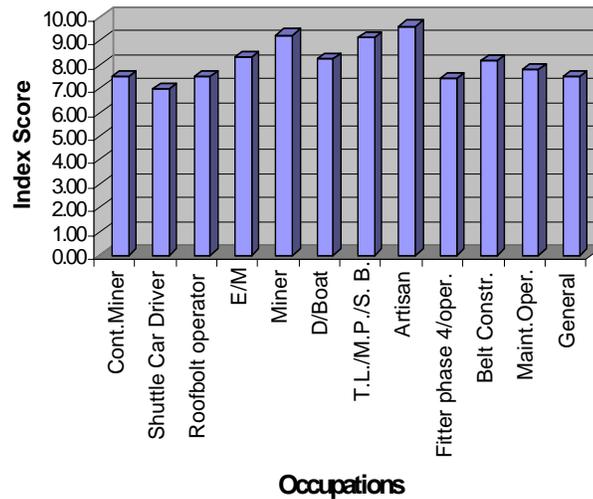
Typical policy responses to the epidemic are attempts to influence the employee's behaviour through education, in order to change the attitudes (and therefore the risk behaviour) of employees. This has been the approach recommended by consultants and experts (Evian, 2000; Heard 2001). The success of such interventions can be measured by so-called 'Knowledge, Attitude, Practice' (KAP) questionnaires.

This was done by management on the mine studied and the following questions and statements were answered by the underground mining workers (see Table 3 below).

Table 3: The KAP Survey Conducted at the Colliery Studied

	Question	Score
1	Have you ever heard of HIV/AIDS?	0.9
2	I could die of HIV/Aids	0.9
3	I have slept with more than one partner	-0.7
4	Using a condom is the best way to avoid getting HIV/AIDS	0.65
5	HIV/AIDS will impact my family financially	0.6
6	Some of my friends are likely to die of HIV/AIDS	0.7
7	I sweat a lot at night when sleeping	-0.8
8	I know the name of an HIV/AIDS counsellor at the shaft	0.55
9	I always use condoms when having sex	0.8
10	Men cannot get HIV/AIDS from other men	-0.65
11	HIV/AIDS is only spread by having sex with a HIV person	-0.75
12	Can one be dismissed from work for being HIV positive?	-0.7
13	How will you know your HIV status?	0.8
14	I sometimes feel very tired during the day	-0.8
15	Can the employer force you to reveal HIV status?	-0.7
16	Who is at risk of HIV/AIDS?	0.7
17	Does HIV affect blacks only?	-0.8
18	A person can get HIV/AIDS from condoms	-0.9

Upon my arrival at the mine, no analysis of the questionnaire had yet occurred. I agreed to process and analyse the results for them. An

Figure 5: Knowledge/Behaviour Index

answer to each question was weighted with a score between negative one and one, for the purposes of analysis. If a 'yes' response to a question showed that respondents had a good knowledge of HIV/AIDS or that the respondent were practising 'safe' behaviour in their relationships, then a high positive score was allocated - for example, a 'yes' response to question one yielded a score of 0.9. Responses showing harmful beliefs or practices with regard to AIDS were given negative scores. A 'yes' response to question eighteen (showing a belief in incorrect rumours about condoms) yielded a score of -0.9. The scores were then added up and divided by the number of respondents in a section, to derive an index for each occupation.

The results are shown in Figure 5. All occupations achieved reasonably high scores, ranging from 7 to 9.64 out of 10 and in no case was the result negative for any job group. Surprisingly, the shuttle-car drivers achieved the lowest score. Shuttle-car driving is the second highest paid and skilled job in the production team. The least skilled job is that performed by a worker in the 'general' category, yet the score for this occupational group is marginally better than those for the shuttle-car drivers. This indicates that safer behaviour does not seem to increase with an increase in level of skill or wage, as shuttle-car drivers are more skilled and highly paid than general

workers.

The artisans and leaders underground (team leaders or 'mpasopi' and shift bosses), who were electricians, engineers or who had some other tertiary education, achieved the highest scores. These workers are often highly skilled and are in the monthly salaried personnel salary bracket (MSP). On the whole though, there were not great differences between the scores of skilled, semi-skilled and unskilled employees.

It appears that all respondents have a good knowledge of AIDS and how it can be transmitted. From the scores on behaviour however, it can be seen that respondents are not necessarily acting in accordance with their knowledge of safe behaviour practices. For example, condom usage will be low, despite the respondent knowing that a condom will protect him from AIDS.

This raises the questions as to why respondents are not altering their behaviour, and following on from that, what management can do to influence behaviour in an attempt to stop the spread of the epidemic. The gap between understanding and practice, and the failure of education programmes to change behaviour, are well-documented (Campbell 1997 and 2001; Plimmer, 1995). Campbell (1997 and 2001) mentions several factors that may compromise condom usage, even when the person concerned is well educated about AIDS. Campbell argues that these factors include poverty, cultural identities about the role of men in society, the few recreational opportunities besides sex and drinking that are available on the mines and a need for intimacy, as most men are migrant workers who are away from their wives and families. Campbell quotes Mechanic (1990:280): 'In the final instance HIV is a social problem insofar as those with the poorest health experiences the world over are generally those who come from the most disrupted social settings and are the least constrained or protected by family and community expectations.'

Plimmer (1995) in Williams (1995) believes that the fault lies with the education programmes and argues 'They (education programmes) have tended to be Eurocentric and information-based, not skills-based. They don't take account of people's different cultures, values, literacy levels and so on...Education programmes need to address the lifestyles of the mineworkers.'

It is possible that different cultural beliefs between educators and their audience play a vital role on the mine investigated. It is a factor that has been unrecognised and underestimated in AIDS education to date, although Campbell (1997) has mentioned it. Many of the mineworkers are recruited from rural areas and have little education. The strong role of culture, tradition and superstition in their belief systems cannot be discounted. This may also explain why the results in the above KAP survey

were so similar for both the general workers and shuttle-car drivers. The only difference between the two categories is that shuttle-car drivers have received more training, or have worked for the mine for a longer period of time and have 'worked themselves up' into the position. Workers in both categories may have been recruited from the same rural area, with the same cultures and traditions probably playing a central role in their belief systems. Also, both are likely to be hostel or township dwellers. All these factors could give them the same risk profile if culture and tradition play an important role in determining behaviour.

The mine doctor mentioned in an interview that some of his patients believed that AIDS can be contracted through condom lubricants and healed by witch doctors. A mine overseer mentioned that one of his supervisors from Lesotho, whom he suspects is HIV+, believes that somebody who is jealous of his job is poisoning him and his family. These all point to the fact that superstition and culture are playing a role in workers' paradigms and this should be taken into account in AIDS education.

Education programmes may also lack credibility with their hearers because of possible distrust of the communicators of the information (management), especially considering South Africa's history of racism and apartheid - there is not a high level of trust between miners and management. In light of this, any information given by the latter may be viewed with some suspicion. On the mine studied, the mine manager himself went underground to encourage production teams to use condoms. This could have been the least constructive approach to take, given that the mine manager may be perceived as the head of a management structure that is deliberately trying to disseminate damaging information; the mine doctor and an overseer had both heard rumours that AIDS is a disease spread by white men from the 'previous regime'. The mine has now implemented a 'peer counselling' system, where employees are trained to disseminate AIDS information amongst their peers and be available for confidential counselling. This was implemented with success at Carletonville Gold Mine (see Campbell, 2001), and it is hoped that this will give AIDS education more credibility and make it more widespread.

It is the opinion of one of the mine nurses that workers do not behave responsibly, as there is a strong attitude of denial about the possibility of being affected by the disease. There is a feeling amongst employees that AIDS is something that happens to other people. In the KAP survey conducted, between half and a third of respondents thought it unlikely that some of their friends would die of AIDS, which could indicate denial that they and their friends could be affected by the disease.

This denial may be rooted in disbelief about the extent of the

disease. 'Although many mine workers know about HIV and AIDS, few believe in the seriousness of the disease. They have never seen anyone die of AIDS...The impact that HIV will have has not yet hit home and this is the crux of the problem. If the perception of mineworkers is that HIV exists but that they have never seen its effects, they cannot be expected to take it seriously and do something about altering their lifestyles,' (Plimmer, 1995:59 in Williams, 1995).

The mine overseer agrees that his employees attribute most deaths to tuberculosis only, for example, as opposed to AIDS-related tuberculosis. Until workers see the effects of AIDS, education programmes are not likely to result in a change in behaviour, and the AIDS epidemic will not be halted.

AIDS Prevention in the Community

The common consensus amongst mining houses and experts (Wilson in Campbell, 1995; Anglo American, 2000; Powerbelt, 2000; Evian, 2000; HEARD, 2001; and Steinberg and Smith, quoted in Financial Mail 2001) is that the fight against AIDS must be enacted in the communities where the mines are based. This especially includes AIDS education, peer counselling, and job creation amongst women at risk. Shebeens and other places of recreation, which have grown up rapidly during the past ten years in the townships surrounding the mines, are now being targeted by AIDS education programmes. Women are also proving to be more approachable and willing to listen to the HIV/AIDS prevention message than the miners. Statistics obtained from the AIDS Director (from a study done at Kriel colliery) showed estimates that if 500 men were educated, 88 HIV infections would be prevented. However, this figure rises to 10200 cases if the same number of sex workers can be reached. Focusing on commercial sex workers is estimated to be 40 to 200 times more effective in reducing HIV/AIDS than comparable programmes for the wider population.

In an attempt to deal with these concerns, the major collieries in Mpumalanga have joined forces with their associated industry partners and labour organisations to establish a campaign called 'The Powerbelt HIV/AIDS Project', which has the support of the South African Collieries Management Association. This is a long-term solution and it could be argued that the firm would benefit only indirectly; there is also no guarantee that this type of intervention will be successful at all.

2. Policy Changes that Will Indirectly Mitigate the Effect of AIDS on the Firm

The second category of policy changes that the firm is deliberately

implementing are those in work processes (such as multiskilling and training) or work policy changes which effect productivity. The latter may be a deliberate response to AIDS or be implemented due to an exogenous factor (which would have occurred in the absence of AIDS anyway) but which will in any case decrease the impact of AIDS.

Multiskilling the Workforce and Training Replacement Workers

As mentioned above, production teams have had to become more multiskilled as a response to the epidemic. Multiskilling is an option being considered by the mine, and the mining technical officer explained its advantages to me: twelve men make up a 'section' or production team. To prevent any loss in productivity in the short term, at least eight men are needed to perform the core functions otherwise drilling cannot occur at all. This is under a 'worst case scenario', as the team then has to manage without the cable handler for the continuous miner, which is difficult and will slow down the mining process, decreasing productivity. Preferably nine men should perform the core functions under a 'normal scenario'. This leaves three men remaining, of whom two are usually absent due to training or being on leave. This means that only one person (two under the 'worst case scenario') can fall ill. A summary is given in the table below:

Table 4: Illustration of the Number of Men that can be Lost to Illness under 'Normal' and 'Worst Case' Scenarios

	Normal Scenario	Worst Case Scenario
Complete Production Team	12	12
Minimum Requirement of Men	-9	-8
"Spare" Team Members	3	4
Members on leave/ training	-2	-2
Members that team can lose to illness	1	2

The mine is still negotiating with the unions about the wages to be paid if the entire team is multiskilled. This is necessary because then nine men would move up into the highest wage bracket on the team, that of continuous miner. 'To stop major losses, you have to start paying major

salaries now. You have to do a calculation to see if the higher salaries now are worth the losses that you might incur. They [management] know that AIDS is going to make an impact, but they don't know how hard it will be,' says the technical officer. Multiskilling also results in higher training costs for the company. Yet these costs may provide a cheaper form of 'insurance' for management, given the fact that AIDS can strike randomly across different skill levels, than the loss of productivity due to absenteeism.

Streamlining Work Processes

As part of a productivity improvement programme that has been implemented across the entire firm, mining procedures were streamlined and made more cost-effective. The technical officer devised a method whereby time at the coalface was saved through greater efficiency, which almost doubled production. This would certainly reduce the effect of AIDS on the productivity of the firm.

The Role of Technology

Technology has played a vital role in increasing the productivity and profitability of coal mining (Lang 1995). Anecdotal evidence heard on the mine, reportedly from mining engineers, points towards all machinery being operated by remote control, via computer and video screens on the mine surface, in ten years time. Very little underground labour will be employed, with the exception of maintenance staff. 'Automation will enable two to three operators to control and monitor an entire production fleet of LHD (load-haul-dumper) machines and dump-trucks whereas, in the past, it was a case of one operator to a machine...Once the machines have been assigned to carry out predetermined activities, the area will be isolated, meaning that mine personnel will be withdrawn from the working area.' ('Age of driverless mining machines in sight', *Mining Weekly*, 29/6/ 2001).

With this kind of innovation, management may decide that reducing their underground labour force, which is perceived to be more likely to contract AIDS, and replacing it with machinery, is the best way of reducing the firm's exposure to risk. Since this technology is being developed overseas, mines would not have to develop it themselves. This would make the implementation of such a decision easier, as would the attrition of the labour force due to AIDS. Fewer workers underground would also mean a decrease in the cost of safety procedures and compensation to workers injured in accidents. Money would also be saved because the machines work 23 hours a day, stopping for only one hour in 24 for refuelling and maintenance.

The shift towards capital intensity and the trend of replacing labour

with technology is crucial to understanding how the firm is responding to AIDS. Mechanisation may be perceived as a cheaper option to that of paying higher salaries to a multiskilled workforce, who can still fall ill. This may reduce the risk and cost of AIDS to the firm on one level, but raises it on another: if only three operators are controlling the entire fleet of LHD machines, the loss of a surface operator to AIDS will now result in several LHDs unable to function. Training costs and salaries of these operators will also be higher than a present operator's salary. This may be offset by the fact that these higher-skilled, -paid and -educated operators are less likely to get AIDS, or if they do, the physical demands of the job are not so strenuous, enabling an employee to be productive for longer. If the proportion of labour costs falls as a result of mechanisation, then this risk may not be so serious.

Conclusion and Recommendations

This paper has examined various methods of assessing the costs of AIDS in the mining industry. Firstly, the methodology and weaknesses of these methods was discussed, as was their application to the firm examined. A case study was then conducted within a particular colliery, examining it for areas where AIDS-induced costs were most likely to be observed, as found by Aventin and Huard (2000). Further categories not examined by Aventin and Huard (2000) were studied, in order to get an estimation of the impact of AIDS over time. Evidence 'from the coal face' was given in order to provide more insight into the situation on the mine, where it might not show up in the quantitative data. Lastly, responses of the firm to the epidemic and their effectiveness were examined.

I believe that AIDS is only just beginning to have a tangible effect on the firm, and that this is being felt primarily amongst the underground mining workers. This is causing tension to develop between the underground managers and upper levels of management, who are perceived as failing to appreciate the effects on productivity that AIDS is starting to cause underground. Future research still needs to be done on estimating indirect costs that are difficult to quantify, as this is the area where most current predictive models are floundering. The perception that technology is cheaper than labour needs to be investigated further, as do the costs associated with this change. This will give valuable insight into the response of firms to the threats posed by AIDS in an industry that is a large-scale employer of labour and a cornerstone of development in the South African economy.

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Special thanks to Stephen Kramer from Momentum Risk Management Consultancy, for his assistance in providing information and AIDS projections.

ISBN No.: 0 7992 2119 8

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