

OPTIMISING THE GROWTH PORTFOLIO OF KUMBA RESOURCES, A DIVERSIFIED SOUTH AFRICAN MINING COMPANY

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ABSTRACT

This paper describes the application and benefits of Monte Carlo simulation in optimizing the growth portfolio of Kumba Resources, a diversified mining company domiciled in South Africa. In the run up to the 2003 annual strategic review, the risk return relationship of Kumba's commodity portfolio was analyzed, highlighting the importance of the iron ore business to enhance returns and the coal and mineral sands businesses as risk reducing components. Analyzing the business drivers with the use of Monte Carlo simulation demonstrated the dominant role that the South African Rand / US Dollar exchange rate has on business returns. Finally, a forward looking investment frontier map is presented, indicating the increased importance of coal as a component to enhance corporate returns, while underscoring the need to critically assess the role of the base metals business in the portfolio.

1 INTRODUCTION

Kumba Resources is a diversified mining company based in South Africa. It was formed in November 2001 with the unbundling of the mining assets of Iscor Ltd (now Mittal Steel South Africa), South Africa's largest steel manufacturing company. From the time of Iscor's foundation in 1928 until its privatization in 1989, the mining operations were focused to supply raw materials to the Iscor steel works, including iron ore, coking coal and metallurgical dolomite. After privatization, Iscor's mining division made major investments in order to diversify its business as a precursor to the demerger in 2001. The investments included the supply of steam coal to ESKOM, the national electricity supplier, increasing its stake in the Gauteng-based Zincor refinery and entering the heavy minerals industry with the development of a mine and titanium slag smelter complex at Empangeni, Kwa-Zulu Natal. Despite severe foreign exchange control restrictions, it also managed to increase its foreign footprint, by investing in Ticon Ltd (Australia), Hongye zinc refinery (China) and the Rosh Pinah zinc/lead mine (Namibia).

Kumba follows an integrated planning cycle, starting with the annual strategic review which is followed by strategic target setting, business planning and finally, the budgeting process. For the strategic review session in 2003 the major focus was to define the nature of Kumba's business. Following a rigorous process with numerous management interviews, a strategic alternatives table was defined and populated with the highest ranking alternatives (Figure 1).

Portfolio Diversification	Commodity Focus	Value Creation Mechanism	Value Chain Focus	Management style
Focused (one commodity)	Iron ore	Alliances / Partnering	Project development	Holding company
	Heavy minerals		Mining & beneficiation operations	
Focused diversified (current)	Coal	Mergers/ acquisitions	Logistics chain	Strategic architect
	Zinc	Turnaround agent	Forward integration	
	Industrial minerals	Greenfields	Product development	
	Platinum	Brownfields	Marketing/trading	
Diversified	Diamonds	Margin enhancement	Redefine the business	Operator
	Manganese			
	Copper			
	Nickel			
	Gold			

Figure 1: Strategic Alternatives Table
Source: Kumba Annual Strategic Review, 2003

Upon finalizing the strategic themes to be debated, the strategy support team had to prepare a fact pack supporting the various arguments. To ensure credibility, it was vital that this information pack was fact based, accurate and unbiased. Apart from including articles that highlighted current external business trends, it was also necessary to focus internally, thereby creating a common understanding of the present and future business scenarios.

For the first two strategic dimensions (the degree of diversification and the commodities Kumba should focus on), we decided to follow a three step approach: Analyze a) the historic portfolio, b) the business drivers and the impact thereof on Kumba’s performance and c) the forecasted results of the future portfolio. The analysis process is illustrated below (Figure 2).

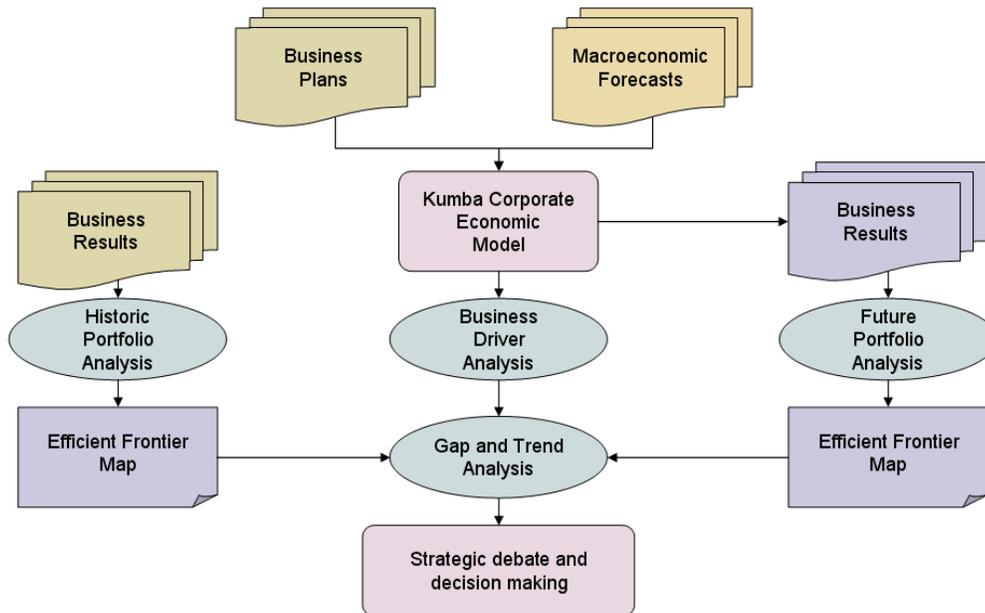


Figure 2: Strategic Analysis Process
 Source: Kumba Annual Strategic Review, 2003

For the historic and future portfolio analysis, we decided to follow an investment frontier approach. This was done by using the historic and forecasted business results as inputs and adjusting the portfolio weights, thereby creating a risk-return map. The boundaries of this map would then highlight the investment horizon that Kumba is currently operating in, thus providing insight towards how the portfolio weights should change in order for Kumba to increase its returns and/or decrease risk.

2 THE NEED FOR MONTE CARLO SIMULATION

Creating a risk/return investment map called for aggregating the results of different portfolio weights. The number of potential combinations were simply too large to contemplate a manual search for the efficient horizon. This called for the use of Monte Carlo simulation. Although Kumba had been using this technique for more than ten years and in particular the Crystal Ball® software, its use wasn’t widespread within the company. Fortunately our top management and in particular our CEO, Dr Con Fauconnier, understood the benefits of this technique.

The other area in which we saw the benefits of applying Monte Carlo simulation was in the analysis of the business drivers. As all business managers know, the future is never a given and forecasting the future is extremely difficult, if not impossible. This is demonstrated in Figure 3, which illustrates the forecasting error of the South African Rand (ZAR) / US Dollar exchange rate that our company had to deal with over the past few years.

While a depreciating currency is a normal phenomenon for a developing country, the ZAR embarked on an accelerated pace of depreciation during 2000 and 2001, reaching catastrophic levels by December 2001 with an all time low of ZAR13.55/\$. Then abruptly, the ZAR started to appreciate against all currencies, but most notably against the US Dollar. The extent and duration of this trend change not only caught our business executives by surprise, but also government and the

entire local financial community. It was considered simply inconceivable for the currency to strengthen the way it did - and continues to do.

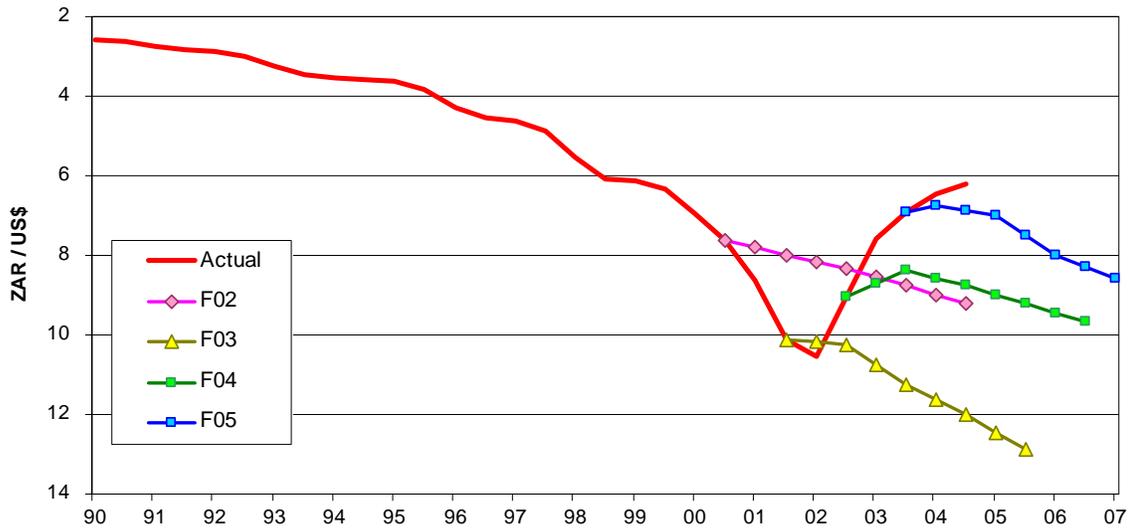


Figure 3: Annual ZAR/US\$ Exchange rate Forecasts
 Source: Kumba Annual Budget Reports, Sharenet

Therefore, in order to main credibility and neutrality, the strategy support team decided to include alternative viewpoints of the fundamental macro-economic factors and commodity prices in our business driver analysis by using Monte Carlo simulation.

3 HISTORIC PORTFOLIO ANALYSIS

For the historic portfolio analysis, we collated the financial results of our strategic business units (Iron Ore, Coal, Heavy Minerals, Base Metals and Industrial Minerals). We calculated the average returns and standard deviation of returns over two overlapping four year periods. Using Crystal Ball, we assigned uniform distributions to the portfolio weights and performed the simulation.

The first obstacle that we encountered was the choice of a proxy for financial return. Ideally we would have used return on equity, but with the recent unbundling of Kumba from its parent company, the balance sheet was not representative of a normal going concern. For various reasons, including the need for a tax efficient structure, the debt assigned to each business unit was not comparable with its return potential. Accordingly we ignored the debt component and used return on total assets and return on net assets as proxies for financial returns.

The second obstacle was that we did not have a model of the past, so modeling the interaction of the business drivers in order to calculate a realistic version of the standard deviation of returns, was impossible. We therefore had to revert to portfolio theory to calculate the portfolio standard deviation for each set of portfolio weights, using the following formula for 2 assets, expanded appropriately for 5 assets:

$$\sigma = \sqrt{w_i^2 \sigma_i^2 + w_j^2 \sigma_j^2 + 2w_i w_j \rho_{i,j} \sigma_i \sigma_j}$$

Where

σ = standard deviation of portfolio (Kumba)

σ_i = standard deviation of returns for business i

w_i = weight of business i in portfolio

$\rho_{i,j}$ = correlation coefficient of returns between business i and j

3.1 Results

From the correlation coefficient matrix of Return on Net Assets (Table 1), it was evident that Kumba is indeed blessed with a well diversified portfolio of businesses. This is illustrated by the presence of numerous negative correlation coefficients as opposed to the relatively small number of highly positive correlation coefficients. Somewhat disappointing was the high positive correlation in returns between our two largest businesses, iron ore and heavy minerals, as the diversification effect of the latter was one of the major reasons for motivating an entry into this commodity.

Table 1 Correlation Coefficients of Return on Net Assets

	Iron Ore	Coal	Base Metals	Heavy Minerals	Industrial Minerals	Average '99-'02
Iron Ore		0.38	-1.00	0.76	-0.81	-0.17
Coal	0.11		-0.42	0.21	-0.57	-0.10
Base metals	0.29	-0.45		-0.79	0.85	-0.34
Heavy minerals	0.99	-0.04	0.33		-0.92	-0.19
Industrial minerals	-0.82	-0.52	0.27	-0.76		-0.36
Average '00-'03	0.14	-0.23	0.11	0.13	-0.46	

Top Right = Correlation coefficients for period 1999-2002
 Bottom Left = Correlation coefficients for period 2000-2003

The most important result of the historic portfolio analysis was the risk/return map, or investment frontier map, depicted below in Figure 4.

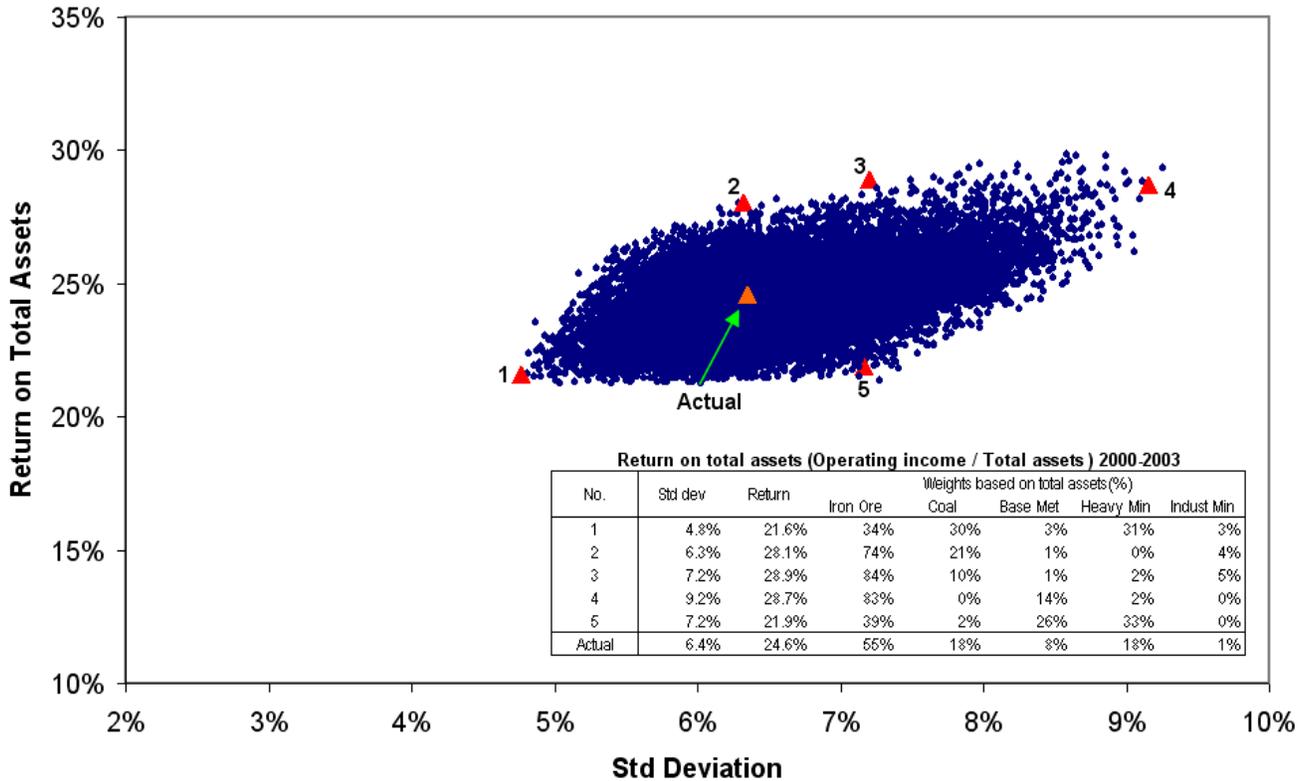


Figure 4: Historic Investment Frontier – Return on Total Assets
 Source: Kumba Annual Strategic Review, 2003

This chart illustrates several important findings:

- a) The iron ore business is the main driver for high returns as the portfolios on the efficient frontier (points 2 and 3) contain high weights for this commodity (74-84%).
- b) Our coal and heavy mineral businesses, while delivering lower returns than iron ore, are the most efficient risk decreasing component in our portfolio, as demonstrated by their high weights on the lowest risk point of the graph (point 1), 30% coal and 31% heavy minerals.
- c) The highest risk portfolio (point 4), is essentially a two commodity one consisting of 83% iron ore and 14% base metals.
- d) The most inefficient portfolio (point 5) is one with a low weight in iron ore (39%), no coal and high weights of base metals (26%) and heavy minerals (33%).

In debating these findings, it was pointed out that our heavy minerals business is a relatively new operation and during the ramp-up phase it is to be expected to deliver lower returns. However, the main finding of this analysis was the question mark that was raised about the future of our base metals (zinc) business. Not only are the returns low but the business also increases the overall risk of our portfolio. Clearly, a strategy to address this concern would need to be developed during the forthcoming session.

4 BUSINESS DRIVER ANALYSIS

The Kumba corporate economic model was used as the main tool for this analysis. Inputs to the model consist of business planning (production and sales tonnages, capex and opex estimates) and macro-economic factors, including exchange rates, inflation and commodity price forecasts. The model also takes into account new projects approved by the Kumba board.

4.1 Method of Analysis

The model is comprehensive, so to minimize disruption to the model, we elected to superimpose the Monte Carlo simulation using sensitivity factors, which is a standard feature of all our economic models. The second reason for doing so was the large number of forecast variables that would otherwise be required – we identified 19 variables, comprising the ZAR/US\$ exchange rate, US and SA inflation rates, commodity prices and sales tonnages. Simulating these forecasts for each of the 5 forecast years would have been a formidable task.

The use of a single sensitivity factor played an important role in the selection of forecast variable distribution curves. A sensitivity factor affects all values in the time series and therefore represents a deviation of the expected mean. Our commodity analysis team compiled a table with the historic annual standard deviations, which we converted to standard deviations over a 5-year rolling period by division with the square root of 5. These values were then adjusted to compensate for industry capacity expectations, demand / supply trends and different scenarios on China's economic growth. The output for each macro-economic variable consisted of two figures – an expected positive deviation in the mean forecast and an expected negative deviation. So, while the average expectation for the FY2004 exchange rate was ZAR8.36 per US\$, we anticipated a 15% positive (weaker rand) and 30% negative (stronger rand) deviation. Given this approach, we favored a combination of triangular, normal and extreme value distributions.

Another important factor that we had to consider in designing the Monte Carlo simulation model was the correlation amongst the forecast variables. Again, for simplicity's sake, it was deemed inappropriate to enter a correlation for each variable combination – for the 10 price variables alone this would have called for more than 40 different correlation coefficients! Accordingly we determined the correlation of each commodity price variable with the change in global industrial production (IP), as this is the most important driver of commodity prices. This delivered a few surprising results; for instance, that coking coal and iron ore prices are negatively correlated with change in IP (-0.26 and -0.14 respectively), while zinc, titanium dioxide pigment and zircon prices exhibited the highest positive correlations (+0.49 to +0.58).

4.2 Results

Although the fact pack compiled for the strategy session contained numerous financial trend charts and other outputs, only two results are discussed in this paper. The first is a trend chart of the headline (or basic) earnings per share (Figure 5), comparing the results of the Monte Carlo simulation with actual earnings 18 months later. (Kumba changed its reporting period from June to December during this time).

The first observation was that there was a very real chance (15 to 20 %) that Kumba could end up with negative earnings per share, solely as a result of an adverse exchange rate trend. This created a lot of concern amongst our top management. As a result of this and other analysis, extensive plans were made during the strategic session to protect our returns. This included the initial planning of a major business improvement program, targeting an R800 million improvement of operating profit through cost savings and revenue enhancements.

The second observation is that our actual earnings of 258 ZAR cents per share achieved for the 12 months ending December 2004 was very much in line with the picture that had been painted 18 months earlier. This not only reflects the value of business planning, but it also is testament to the joint efforts of our management team to initiate plans to protect Kumba's profitability against the adverse effects of external economic factors.

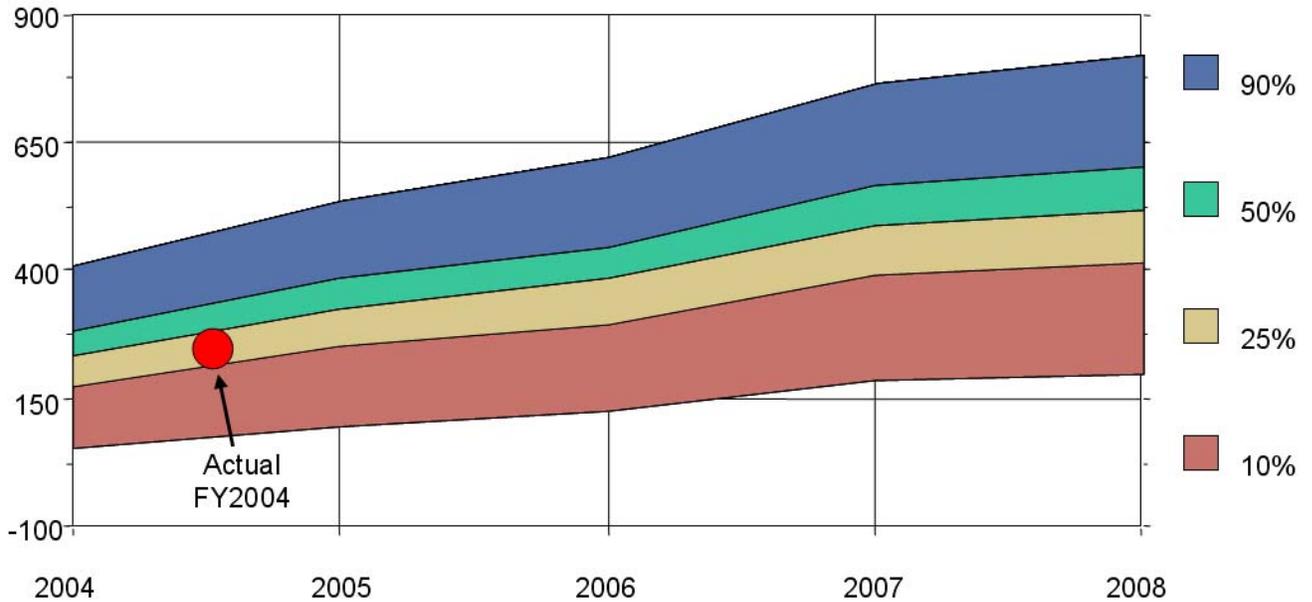


Figure 5: Trend Chart of Headline Earnings Per Share (ZAR Cents)
Source: Kumba Annual Strategic Review, 2003

The next figure highlighted the root cause of the problem. Although it was widely known that our business is very dependent on the ZAR/US\$ exchange rate, it was still a surprise to see the extent of this dependency. The tornado chart shown in Figure 6 illustrates that the exchange rate is responsible for more than 78% of the variance in earnings before interest and tax (EBIT). The iron ore price with 5.7% and SA producers inflation rate (SA PPI) with 5.6% are the next largest contributors, rather insignificant in comparison to the exchange rate. It is also worthy to note that variances in expected production/sales volumes had virtually no influence at all. This was ascribed to the stable nature of our mining operations, for which Kumba is widely accredited.

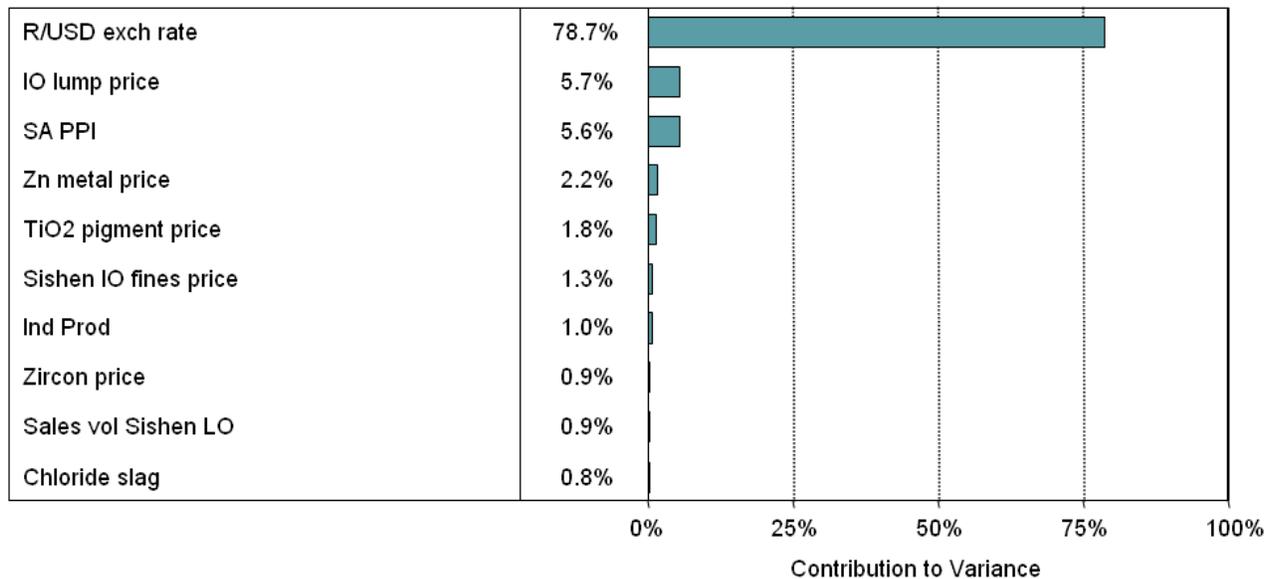


Figure 6: Contribution to Variance in 2006 EBIT

Source: Kumba Annual Strategic Review, 2003

5 FUTURE PORTFOLIO ANALYSIS

The last piece of analysis that the strategy team prepared was a portfolio analysis based on expected returns for the next five years. The corporate Monte Carlo simulation model was used to estimate the future returns and expected standard deviation of returns for each business unit. Thereafter the same process was used than the one for the historic portfolio analysis.

5.1 Results

Table 2 shows the expected correlation in Return on Net Assets among the business units for the period 2004 to 2008. Comparing these results with the historic values it is interesting to see that high positive correlation between the iron ore and heavy minerals businesses are expected to turn around, supporting the original motivation that the heavy minerals business, being unrelated to the steel economic group, is a valuable diversifying component.

Table 2: Expected Correlation Coefficients of Return on Net Assets (2004-2008)

	Iron Ore	Coal	Base Metals	Heavy Minerals	Industrial Minerals	Average
Iron Ore		-0.60	-0.65	-0.84	0.77	-0.33
Coal	-0.60		0.51	0.27	0.01	0.05
Base metals	-0.65	0.51		0.50	-0.42	-0.02
Heavy minerals	-0.84	0.27	0.50		-0.85	-0.23
Industrial minerals	0.77	0.01	-0.42	-0.85		-0.12

The portfolio analysis chart for the period 2004-2008 is shown in Figure 7.

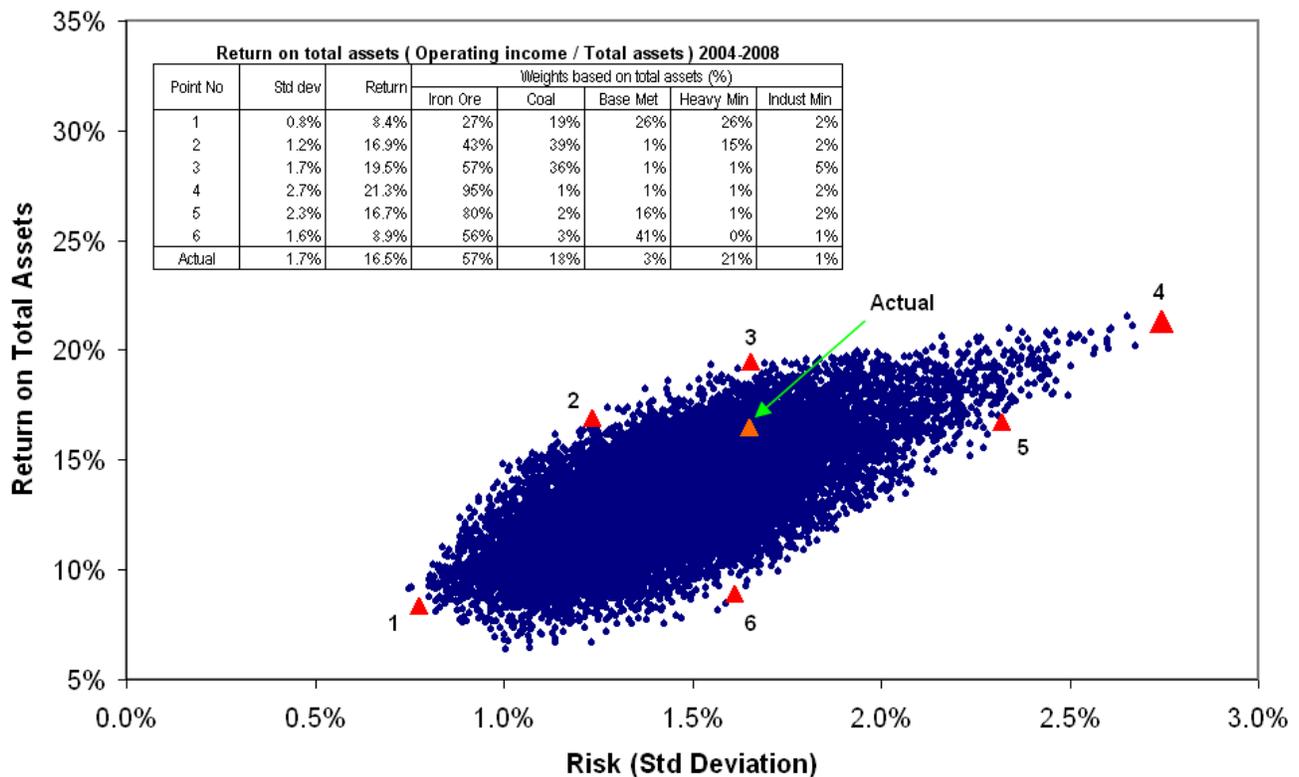


Figure 7: Future Investment Frontier – Return on Total Assets 2004-2008

Source: Kumba Annual Strategic Review, 2003

Comparison with the historic chart reveals that in general the frontier of investment returns was expected to move downwards, from 22% to 29% previously to between 9% and 21%. This once again illustrates the impact of the strong rand on our future business results. (Since then iron ore and coal prices have soared as a result of China's insatiable appetite for raw materials, causing the whole frontier to return to historic levels).

The various extreme points on the investment frontier once again provide valuable insight:

- The iron ore business is expected to retain its status as the largest contributor to higher returns (Points 3 and 4)
- Coal remains an important risk decreasing component (Point 2) but appears to increase its contribution to higher returns (36% portfolio weight as opposed to 10% historic – point 3)
- The Base Metals business will remain the problem child by increasing portfolio risk and decreasing returns (Points 1, 5 and 6)
- The risk reducing influence of the heavy minerals business is expected to increase in importance, but to the detriment of returns (Points 1 and 2)

While the general picture remained the same as the historic portfolio analysis, the trends highlighted above sparked a very healthy debate, which allowed the strategy development team to conclude with the following findings:

- Grow the iron ore and coal businesses, in particular concentrating on the exciting domestic green-fields and brown-fields expansion opportunities;
- Grow the heavy minerals business once the current investment has proved itself
- Consider the divestment of the base metals (zinc) business

6 CONCLUSIONS

The benefits of Monte Carlo simulation have further been entrenched by the application thereof in the strategic planning process of Kumba Resources. Not only has it enabled the creation of a risk-return investment frontier map, but provided valuable insight into the underlying business drivers and the causes of variance in corporate business returns. Its future use will be rolled out in other sections of other business activities, including project optimization, capital expenditure planning, continuous improvement and corporate finance.

BIOGRAPHY

Tom de Lange, a metallurgical engineer by profession, has been in the employment of Kumba Resources for most of his professional career. After spending 10 years at the Grootegeluk Coal mine as a process development engineer, he spent five years in the Corporate Technology division, followed by a brief period at Information Management before joining the Strategy and Business Development division as Manager, Corporate Strategic Process. Upon completing his CFA, he joined the Corporate Finance team in March 2005 where he is involved in strategic target setting and business valuations. Tom can be contacted by telephone at +27 (12) 307-4074 or by e-mail tom.delange@kumbaresources.com.