# Price and Foreign Exchange Forecasts

## Key Conclusions

- ***For each price forecast there must be a paired forecast of foreign exchange***
- ***Get inside the price forecasts and understand how they were created.*** (Rather than passively accepting each company price forecast from the 'experts')
- ***Use this understanding to create a business/project that is flexible and can adapt to the ups and downs of price – do this in addition to optimising the mid case.*** *(Each price scenario probably will require its own cut-off grade, mine schedule, cost structure, sales plan and economic evaluation case. Do not naively apply the new prices to the 'mid' case production plan)*
- ***It is thinking through the market drivers and being ready and able to positively exploit better market conditions or adapt and weather worse markets that may be more useful than the price forecasts themselves.***
- **Operations teams and study teams** should have as much awareness of the derivation of price as they have about the derivation of the all other key parts of the business plan. They should apply the same intensity of awareness to the price forecast as they do to the technical and operational inputs. Instead of mechanically inserting the set of price forecasts into the one final business plan, the team should re-engineer the business plan for each of the full range of possible market scenarios, and possibly beyond. The final business plan should have the flexibility to adapt to any price development as the market evolves.
- **Using easy-to-follow economic models** allows the mine to be steered through each of these market scenarios.

## Price and forex are two of the 'giants' of your business

Price and exchange rate forecasts are absolutely fundamental to planning and running a business. They are part of the 'two bookends' of your businesses value: 1. What is in the ground and 2. What the market wants. They rate along with head grade, recovered grade, sales volumes and life as the giants of the business.

NPV, IRR and payback are only as good as the underlying forecasts of price and matching foreign exchange. Remember that NPV and IRR are the simply the mathematical treatment of a suite of opinions/forecasts covering resources, production, sales, prices, life, costs, taxes, etc. The activity of computing NPV and IRR lets you grasp the importance of each of these key drivers to the business or project.

## Price forecasting can be an enormous weakness

Perhaps the biggest weakness in most companies planning and evaluation processes is the forecasting of prices and foreign exchange rates.

So many companies assign their forecasting to a specialist or two in a 'backroom'. Typically they assign the task to a marketing or mathematical specialist. Most of these companies would not tolerate what they do with prices and exchange rate, happening with geology, resource modelling, mining, metallurgy, risk, sales, production planning, cost estimating, etc, etc. It is a major anomaly.

Does your company have well developed procedures to plan your business and assess projects? Throughout these processes are there constructive interactions by various professionals where ideas and results are challenged, reviewed and audited? Do the operational, technical and study professionals around you work positively to fully understand and optimise the other four giants? Is this part of your business/project healthy?

But what about forecasts of prices and exchange rate? Are those created separately by specialists, confirmed by the management and Board then handed down formally to geologists, mining engineers, metallurgists, engineers and economic evaluation specialists?

These price and paired exchange rate forecasts may be sophisticated with minimum, low, mid, high and maximum forecasts, but are they taken by everyone as 'set', fixed, that is it!. This is crazy!

Obviously each professional cannot generate his/her own price forecast for his/her part of the overall business. Planning and operations must have co-ordinated sets of price and forex forecasts. Every mining operation and every mining study must adopt the company price and exchange rate forecasts as the starting point and fully satisfy all company activities using those forecasts.

But it seems to be the responsibility of operational, technical and study professionals to think through and beyond these forecasts. They each need to investigate what happens to the business if prices cycles up and down inside these forecasts, and how does the business cope with prices moving outside these forecasts for prolonged periods. If the business is being planned and managed to fit the 'mid' price forecast, how would it adapt and change to cope with very low prices and how would it move to fully exploit high prices? Does the production plan for the 'mid' case limit your company's ability to move to these more extreme market scenarios? Build in flexibility.

## Get inside the price and exchange rate forecasts

The best way to think outside the forecasts is to get inside how they were made.

Many professionals adopt the thinking that price forecasting and exchange rate pairing are areas beyond their experience and perhaps interest so leave it to 'experts'. They do not realise the experts can choose any of a wide variety of approaches and some are far better than others. The methods of forecasting price and foreign exchange range from crude to sophisticated. Each methodology can be performed objectively or subjectively. In the resources industry there does not appear to be a forecasting process that has proven itself to be overwhelmingly successful.

First let's look at how forecasts of price might be made, then consider the very important parallel forecasting of exchange rate.

## Price Forecasting - Motivations and Methods

Companies and organisations in the mining industry have used a wide variety of methods to forecast prices. Some are better than others but not one seems to be good enough yet. The mining industry has companies which boomed through no clever forecasting of their own, projects which commissioned just as prices sunk and investors who believed in poor price forecasts and lost badly.

**Prejudice or Bias Method:** Starting with the worst, but by no means rare methods. Unfortunately prejudice and bias seem to be popular methods. This is rife when a company or person has a pressing internal or external need that can only be satisfied by forecasting a certain price. Instead of working objectively from the bottom-up it knows the price forecast that is needed and manipulates the forecasting process to get it.
Sometimes the company/person is not conscious of its pressure, but usually the company/person is fully aware and therefore devious. It might employ pseudo-marketing research and/or selectively analyse demand-supply and/or recruit a compliant researcher and/or crush all negative research. To deflect any adverse attention the promoter may insist that a decision must be made urgently before a golden opportunity disappears.

Keep in mind the following motivations for bias or prejudice in price forecasting: -

a) A marginal project needs to be approved and financed, so the promoters know the type of price forecast that will make the investment appear attractive to the company/ investors.
b) A company's project development team have bonuses dependent on progressing a major project from one study phase to the next, so optimistic prices are adopted to get it through.
c) A company has a competent market research capability but when the price forecast is given to the most senior level of management/Board, the executives impose their own opinions based on their experiences and conservatism rather than on thorough market research. This happened in reverse in one major company where the CEO could not believe in-house forecasts that oil prices could ever get as high as they actually did so the company rejected several major M&A proposals that would have been spectacular.
d) A company releases to the stock exchange an ambitious production forecast, knowing it will be a challenge. Internally the company gives its mining engineers a forecast of high prices so as to lower the cut-off grades and inflate the output.
e) Every company has its assets valued in its accounts. If price forecasts are lowered then some of these assets may need to be devalued, and the company would have to report an impairment (write-down) that is likely to reduce its share price. To avoid or minimise, the company might adopt a forecast of price that is higher than it would otherwise – it would worry about satisfying its auditors later.

**Projection Method:** A common method is to graph the historical price, in nominal or real terms, and simply **project** it out. Projections of 'high' prices and 'low' prices may be added.

The trajectory of the projection may change dramatically depending on how many years are in the historical base and the starting year. Many commodities prices cycle up and down over the years so the projection can be made to increase into the future by starting in a low trough or to decrease by starting in a peak. A company wanting a biased forecast might use this method.

Some minerals and metals have a long history of low prices then a sudden peak and subsidence that allows various interpretations depending on the starting year. (tungsten, phosphate, nickel)

**Enhanced Projection Method:** The "projection method" above can be enhanced by experts interpreting the shape of the historical graph, explaining the up and downs and then adjusting the projection for the market it expects. (Before being proved very wrong by the commodity price surge in the late 2000's there was a strong belief that prices would continue to decrease by 1% real per annum and be matched by costs decreasing by 1% real.)

**Forecasting Methods:** Rather than mechanically projecting out historical prices, '**forecasting**' looks forward at demand and supply in the industry and synthesises the future market. It tries to understand the various opposing forces that will be operating in the industry and therefore how prices might move. These should be the best methods but are difficult to get right.

Forecasting can vary from crude to very sophisticated. Possibly the most important benefit to the mine manager or study manager is not the detail of the actual price forecast (as these seem impossible to get right consistently) but the understanding of the industry and its markets. There probably needs to be a central or mid case but the company needs its professionals to fully understand the market possibilities. The business and project teams need to be able to adapt their plans to however the market does evolve. (Of course the production plan for the mid case may need to be completely recreated, from the geological resource model up, when the low price forecast is developed and again when the high price forecast is developed.) ***Hopefully the company's operation or project can be developed with flexibility so it can adapt to whichever way the prices move and continuously optimise the business***.

**Demand/Supply Synthesis:** Forecasts of the market for any metal or mineral research future demand and future supply. As the study deepens then so does the Company's awareness of the difficulties of making reliable forecasts of each side.

a) Simple studies make broad generalisations about demand and compare these with the output expected from mines as they phase in and phase out.
b) Sophisticated studies use forecasts of world GDP, shifts in global economies, producer country economics, consumer country developments, structural changes in the industry, technology jumps in the end markets, exploration success, global resources and future reserves, technical changes at competitor mines, global political transformations, blockades, wars, tariffs – and much more. This is very challenging and lots more words and tables does not necessarily mean lots more accuracy.

## Market Research Organisations:

Market research can be done by a mix of in-house experts and external organisations. Bigger companies may be able to justify in-house staffing for their existing commodities and use external specialists for researching new commodities. Smaller companies tend to hire external market specialists for major research.

Care is needed when reading reports by external market specialists as they will vary in quality and objectiveness. You should not automatically defer to their expertise and accept their conclusions as

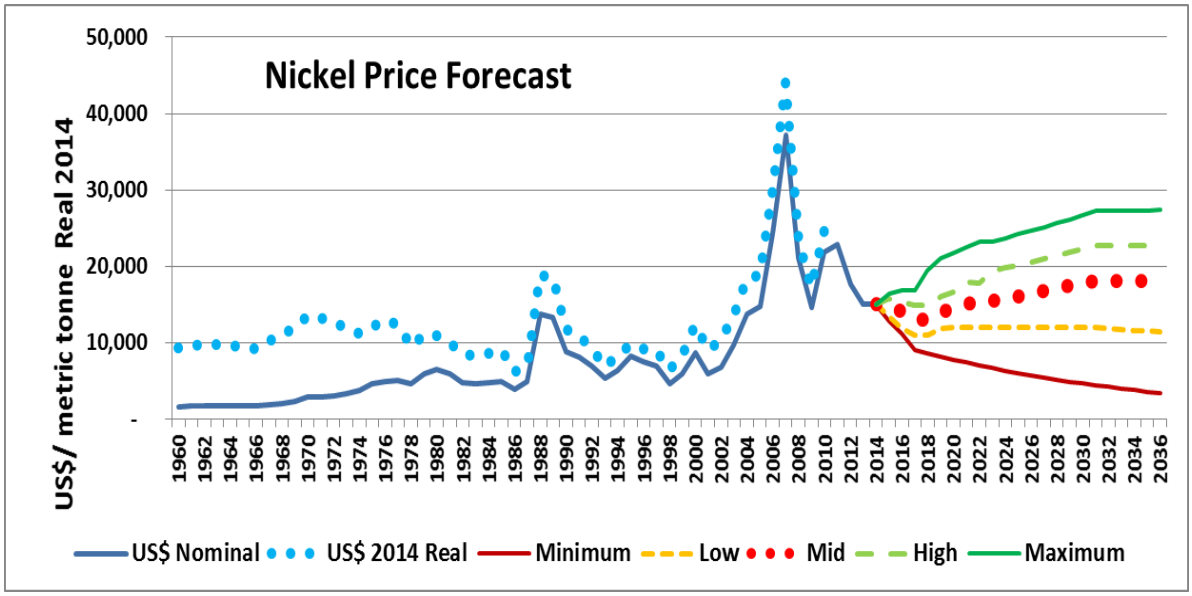
'the best possible advice'. There is sure to be a history of major, respected research organisations getting markets and price forecasts very wrong. Without being cynical, you should remember that external researchers are more likely to get further work if the market is made to appear attractive, at least in a special niche, and if price forecasts are higher rather than lower.

Instead, their findings should be treated as one set of opinions: as a base for the company to understand the key players in the market and to make its own market forecast. Large market research organisations should be able to develop rigorous research procedures and cultivate a wide network of contacts, but they face large corporate costs. In downturns some be forced to cut staff and hence their capability. Some small market research companies have proven very effective in focussing on special commodities or on a narrow segment of the market. Unfortunately in both big and small organisations some persons become aligned with a particular forecast and lose objectivity. Over the years respected individuals will change roles and change organisations. As with any research the output is only as good as the individuals undertaking the market study.

## The Form of a Price Forecast:

The form of a price forecast can range from simple to sophisticated. More complexity should not be taken as always being better. It is common for it to be in two parts: a short-term path that curves from the present day actual price to meet the beginning of the long-term forecast. Many companies then fit two more price forecasts above this 'mid' being 'high' and 'maximum', and two more below, being 'low' and 'minimum'.

The long-term, mid-price can be a flat real price, but some companies adopt a declining curve or an inclining curve in real terms. Some companies try to incorporate market cycles within these forecasts




A danger of the more sophisticated price forecasts is that people become overwhelmed by the mathematics and drop back into deferring to the experts. Rather than getting inside their derivation and understanding their limitations, the forecast is adopted mechanically. Instead the plant managers and project teams should be designing operations that match the price forecast but with the flexibility to adapt and evolve to whatever market might come.

**Recent History:** The experience of recent decades is that the forecasts have been unable to accept the magnitude of changes in global economics, especially on a regional basis, and so the mid-price forecast has been hopelessly out of touch. Not even the maximums/minimums enclosed the subsequent actual prices.

**Nominal or Real:** Either is OK but real is easier to understand and discuss. A surprisingly frequent deficiency of publically available forecasts is that the graph and table of numeric data omits whether the prices are in nominal or in real terms, and if in real terms it does not specify the year. It is dangerous to guess. In some broker forecasts the short-term is in nominal terms and the long-term is in real terms.

## Finding Historic Prices and Volumes

Most minerals and metals have very long histories of sales and prices which can be found by an Internet search. Some will show both quantities and prices for over 100 years. The World Bank Commodity Price Data (Pink Sheet) lists in Excel, monthly and annual prices in US dollars from 1960 for energy, raw materials, agriculture and metals & minerals. The US Geological Survey is another good source.

Usually prices will be in US$ of the day ("nominal" terms). To be meaningful they need US inflation pumped in backwards to convert them all into today's equivalent prices ("real" terms). These inflation factors are available in the World Bank Pink Sheet.

## Foreign Exchange Forecasts:

***Any price forecast must be simultaneously paired with a matching forecast of the foreign exchange rate ('forex').*** These two should be seen as a pair. The 'mid' price forecast should match the company's 'mid' foreign exchange forecast, the maximum price forecast needs its own forex forecast, the high price forecast needs its own forex forecast, etc. In many countries these pairs partly offset each other. For example a high copper price in US$ may typically be paired with a stronger A$ or C$.

Forecasting price alone is abrogating this responsibility, and by default is stating that forex will remain as it is. Even in countries where the forex is not related to commodities this relationship needs to be specified and not left undefined.

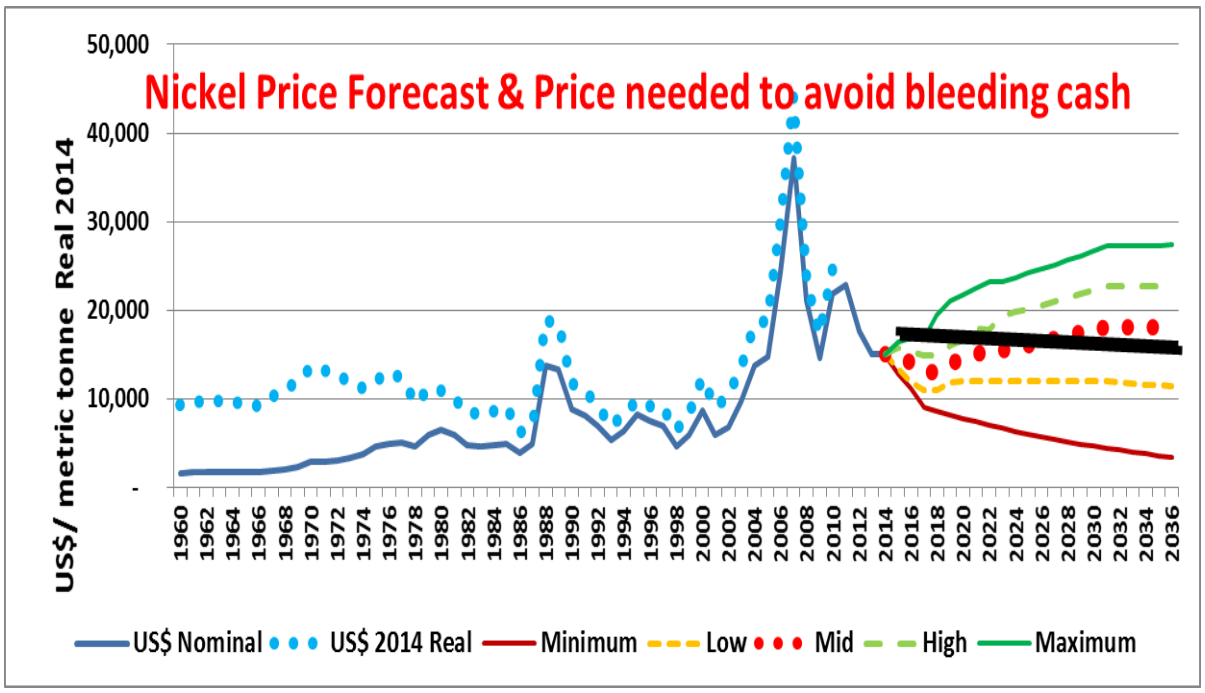
***One common source of major error*** has been to test production plans for the impact of price without matching the forex. Too often mine or study managers have thought of prices moving by a large percentage, forgetting that forex might offset a large amount and then taxes further reduce the impact.

This pairing cannot be avoided by modelling in US$ dollars. The capital costs, operating costs and taxes need to be modelled in local currency. The results and NPV should be the same in either way.

## Prices needed to avoid bleeding cash

Take a look at the graph below and decide if you would invest your own money. You are told the project has a healthy NPV over 20 years.

The heavy black line approximates the price needed to avoid bleeding cash. It indicates that the project/business will not generate enough cash in the first years to cover its operating costs, capital costs and taxes. It will bleed cash.




r this is comfortable, or as in the example below, a stretch.

## Thoughts on Detailed Price Calculations:

Most metals and minerals have a **global reference price** from which the actual price achieved by the mine must be computed. The adjustments commonly are producer's location and product quality.

**Sources of information:** Useful sources of advice are:

a) Marketing experts in that metal or commodity
b) Internet searches
c) The AusIMM publication:-"Cost Estimation Handbook, Monograph 20, 1993". Although dated, it gives the principles and history

**Producer's Location:** Many metals are based on the price delivered to a specific location, such as into an LME warehouse. So the producer has to adjust price for the logistics of the freight to the nearest LME warehouse and the handling costs both ends. The starting computation is to assume this reduces the price received (LME price less freight and handling), but in some locations this can be a positive if a producer sells into a local market where its main competition is buying from the LME (local price = LME price + freight and handling).

Commodities may have a global reference price based on the original or dominant trade route, such as free-alongside or loaded on to a ship at a certain location. Phosphate rock, for example, has its pricing reference as FOB a ship in a port of the world's dominant producer: Morocco.

Gold is an exception, where the costs of delivery and refining usually are irrelevant compared with the accuracy of its price forecasting.

**Quality:** Each metal and commodity adopts a standard physical and chemical specification. The price of each cargo is adjusted in price according to pre-agreed quality terms. These adjustments normally are based on a historical metallurgical cost in processing or a historical benefit/penalty in consumption. Increasingly, these quality adjustments will be refined by greater technical understanding and quantification of the positives/negatives in use. Raw diamonds have a reference price but individual rough stones vary from worthless to fabulous according to the carats, clarity and colour. Energy coal has a reference price then a major price adjustment based on calorific benefit. Nickel's price will be adjusted for it form as pure metal, as ferro-nickel or as pure hydroxide.

**Value-in-use:** It is common to compute the value of a raw material such as iron ore, concentrate, etc when used by the consumer. For example one common product quality can be taken as the base and then each other producer's product is compared with this to estimate its relative value in use. A lower grade product may be penalised $3.40/t using reaction chemistry, whereas its closer location may earn it a $2.90 benefit, etc.

**Two Major Dangers in Copper, Lead and Zinc Pricing:** Base metals have a long history of price mechanisms that ***share the contained metal value between the mine and the smelter***. These comprise a number of payment terms, which include the treatment and refining charges ("TCs and RCs"). They are negotiated periodically between leading smelters and leading mines. Their origins lie in the furnace recoveries and costs of over a century ago but their form has survived into the 21st Century. The computations are relatively simple but involve lots of steps.

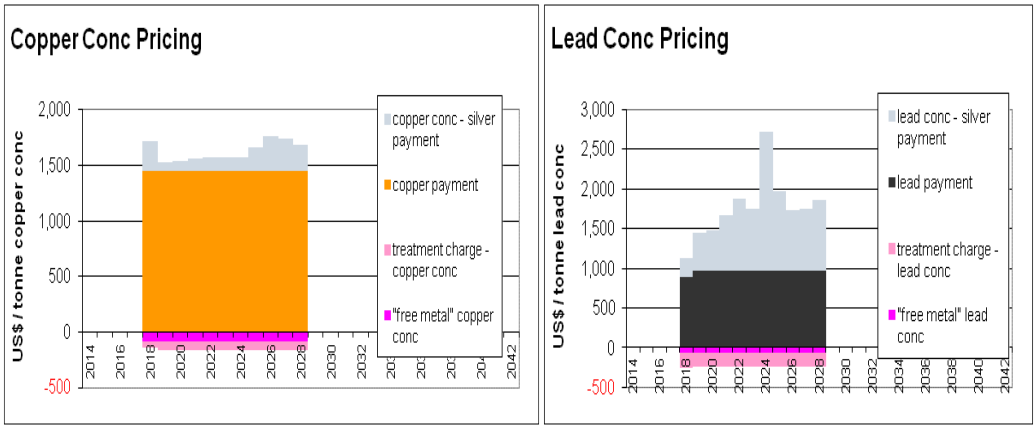
Most base metals companies put a lot of thought and effort into forecasting the "LME" prices of copper, lead zinc because these are so very important in managing the business. Incongruously, they then ask the marketing department to forecast the treatment charges and refining charges, as though they require little research and are of low importance anyway. The marketing department works with these two charges on a daily basis, has self-confidence and readily drafts a forecast. ***The first major danger is that the company fails to realise that the forecast of "TCs and RCs" into the long term is so important to mine economics; they partly determine what proportion of the LME price the mine will receive.***

Instead, forecasts of the TCs and RCs need an assessment of the balance between mines and smelters into the long term. Which will be in shortage and so have negotiating power over the other? Will there be overcapacity in smelter capacity so that TCs will fall, or will there be overcapacity in mines so that TCs will be high?

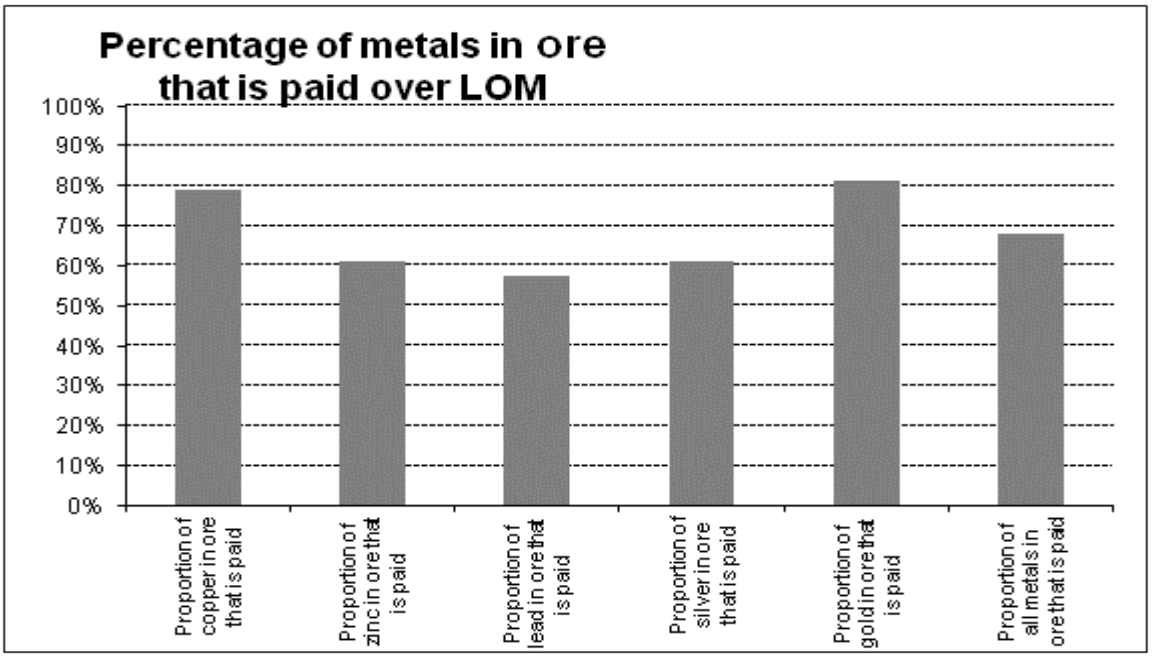
***The second major danger is that errors are made whilst computing the TCs, RCs, minor metals and penalties.*** This happens too frequently, and on occasions with disastrous effects. One major Australian mining company announced a project was being rushed into final feasibility only to find an error in the TC computation meant it was no longer economic. The person developing the economic evaluation model took pride in creating sophisticated algorithms that simultaneously performed many steps of logic. Unfortunately there was a 'little' error and the mine's revenue was badly overstated. People saw the final revenue amounts but there was too little detail to identify

the hidden mistake. The evaluation modeller was in too much of a rush to create graphs that would have exposed the error.

Your economic evaluation model must have these computations as a long series of tiny step-by-step calculations where every piece of logic is visible and is easily checked. Graphs should be created that show how the value of the metal in the concentrate is absorbed by payment terms, treatment charges and refining charges.




Most importantly there would be a prominent calculation and a graph of how much of the contained copper was received by the mine, and this could be sense checked. The same would occur for contained lead, zinc, gold and silver.




***An alternate and possibly superior forecasting method for copper, lead and zinc mines*** is to:

a) use concentrate payment terms (for example pay the minimum of 85% Zn or 8% deduction) to establish the basic pricing level that matches the quality of each concentrate quality.

b) Use research of the future balance of smelters/mines to forecast how the remaining sharing of contained value will move in the future. Back-calculate the TCs and RCs.

This is a mix of bottom-up and top-down forecasting with the company maintaining control rather than surrendering a key part of price forecasting.

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