



Operating Costs for Miners

Prepared for:

MeMO 2016 - Reducing Mining Costs and Value Optimization

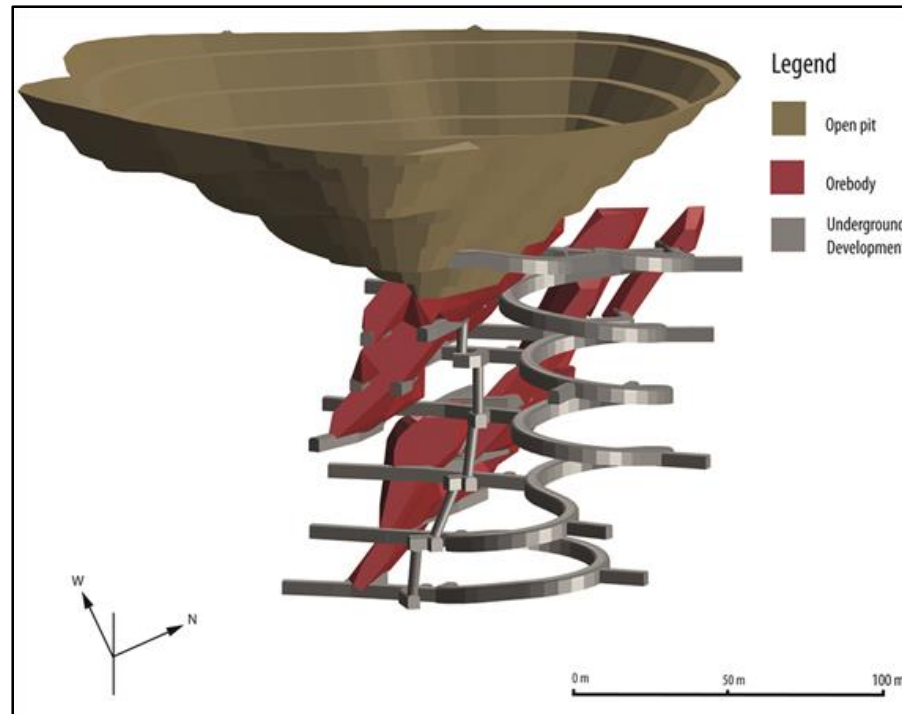
Prepared by:

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Typical day to day production expenses incurred in running a business...



Typical Costs Includes...

Staff



Camp and Travel



Labour



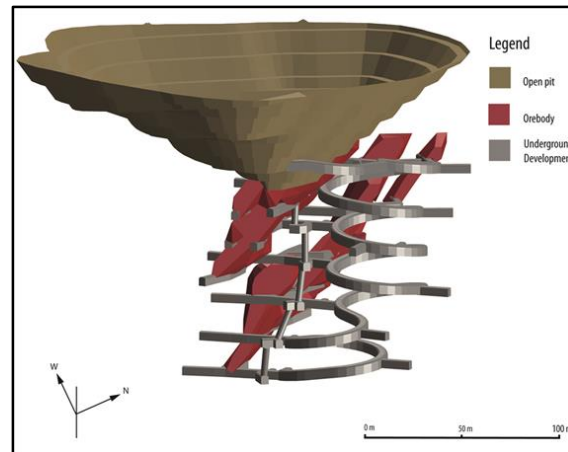
Mobile Equipment Parts



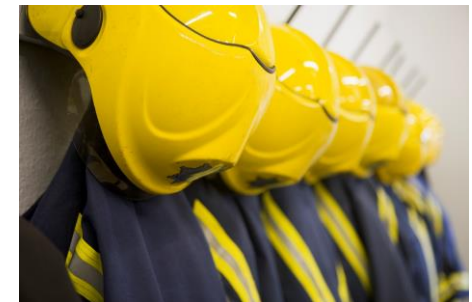
Services

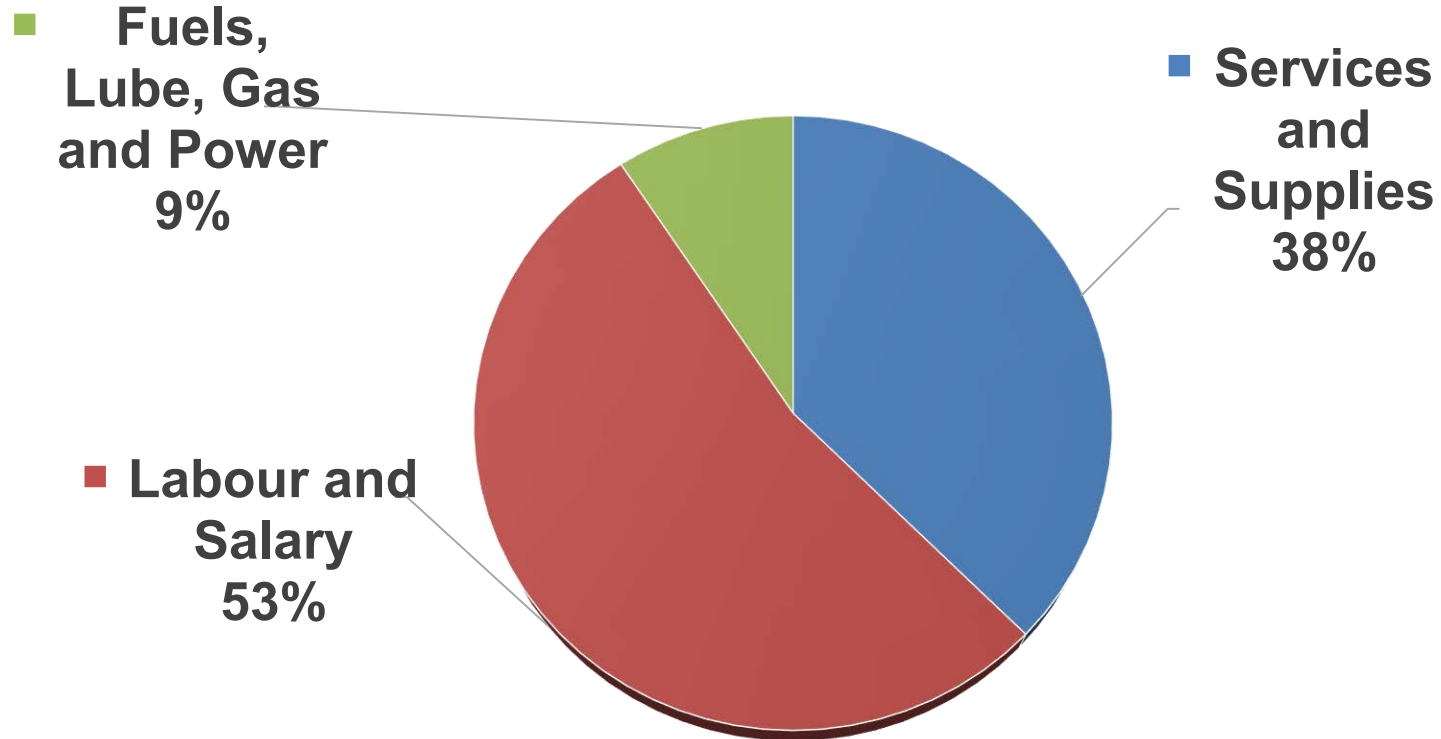


Processing



Supplies





Traditional Costing – Unit Based

Traditional cost accounting methods simply allocate costs, down onto the cost objects without considering any 'cause and effect'.

Breakdown by Labour costs, Materials and Supplies

Activity Based Costing

- ABC is an accounting method that allows mines to gather data about their operating costs
- Costs are assigned to specific activities including:
 - Drilling
 - Engineering
 - Truck Haulage
- activities are associated with the generated overall average tonnes produced per day.

$$\text{Activity-Based per (Unit) tonne} = \frac{\text{Total Activity (Process) Cost}}{\text{Total Number of units (tonnes)}}$$

- Enables the mine to decide which activity may be increasing their profitability, and which are contributing to losses.
- able to generate data to create an improved budget and gain a greater overall understanding of the expenses that are required to keep the mine running.

Activity Based Cost

Technical Overhead
Management
Administration
Overhead

G & A

Direct
Mining

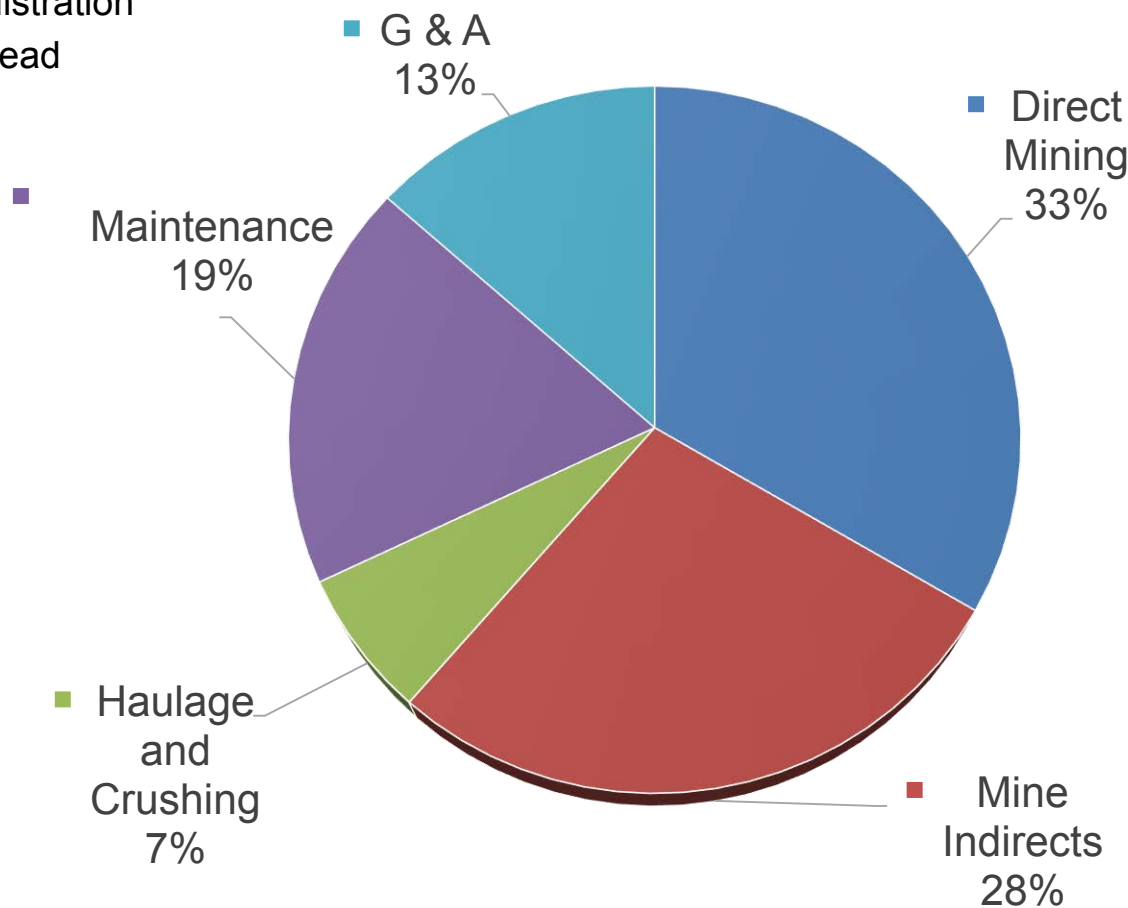
Lateral Development
Shotcreting
Cable Bolting
Primary Ground Support
Secondary Ground
Support
Hydraulic Fill
ITH Drilling
LHD Mucking
Production Blasting
Standard Raising
Top Hammer
UG Truck Haulage
UG Rail Haulage

Haulage and
Indirect
Mining

Raise boring
Muck Circuit
Hoist and Shaft
Services
Training
Roadway Upkeep
Supplies Handling
Services - Utilities
Plant Security

Mine Cost breakdown

Technical Overhead
Management
Administration
Overhead

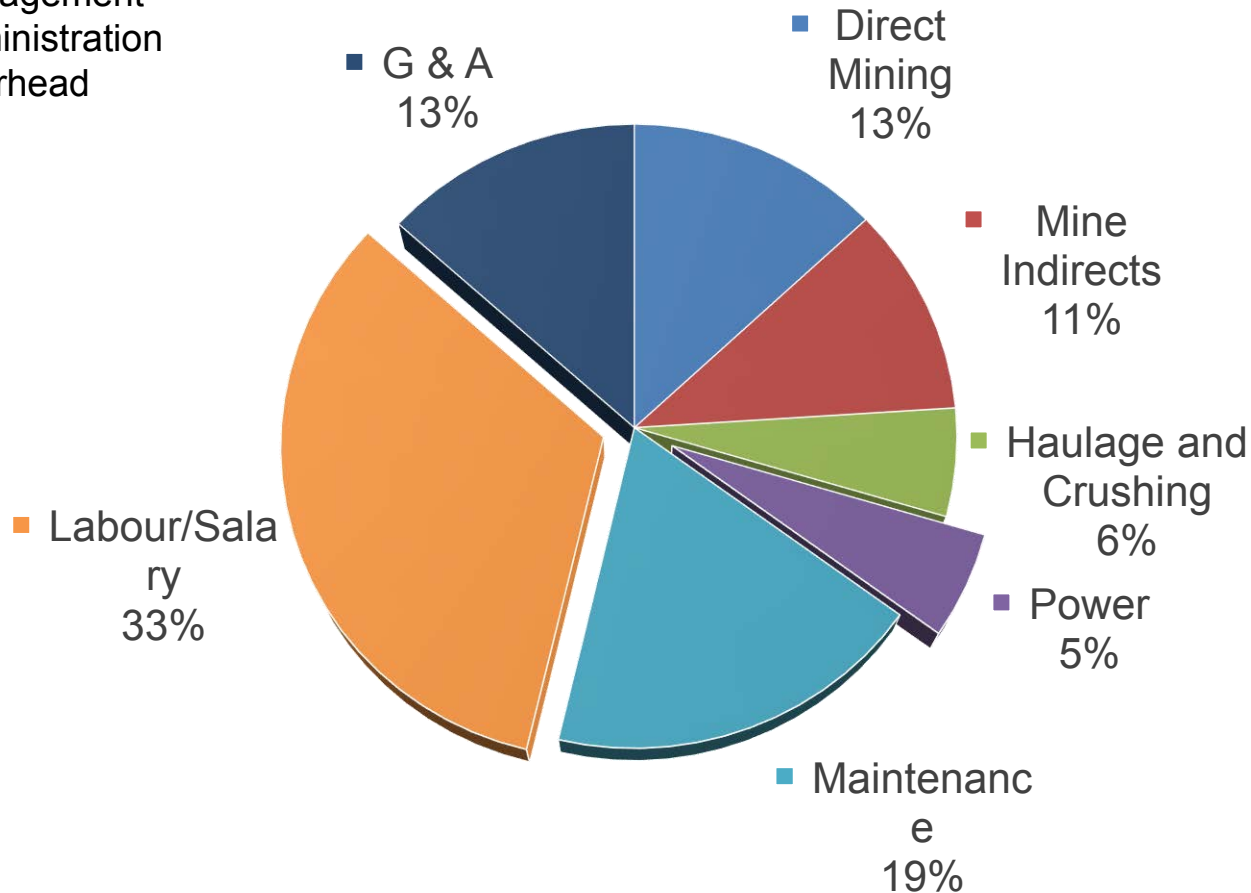


- Lateral Development
- Shotcreting
- Cable Bolting
- Primary Ground Support
- Secondary Ground Support
- Hydraulic Fill
- ITH Drilling
- LHD Mucking
- Production Blasting
- Standard Raising
- Top Hammer
- UG Truck Haulage
- UG Rail Haulage

- Raise boring
- Muck Circuit
- Hoist and Shaft Services
- Training
- Roadway Upkeep
- Supplies Handling
- Services - Utilities
- Plant Security

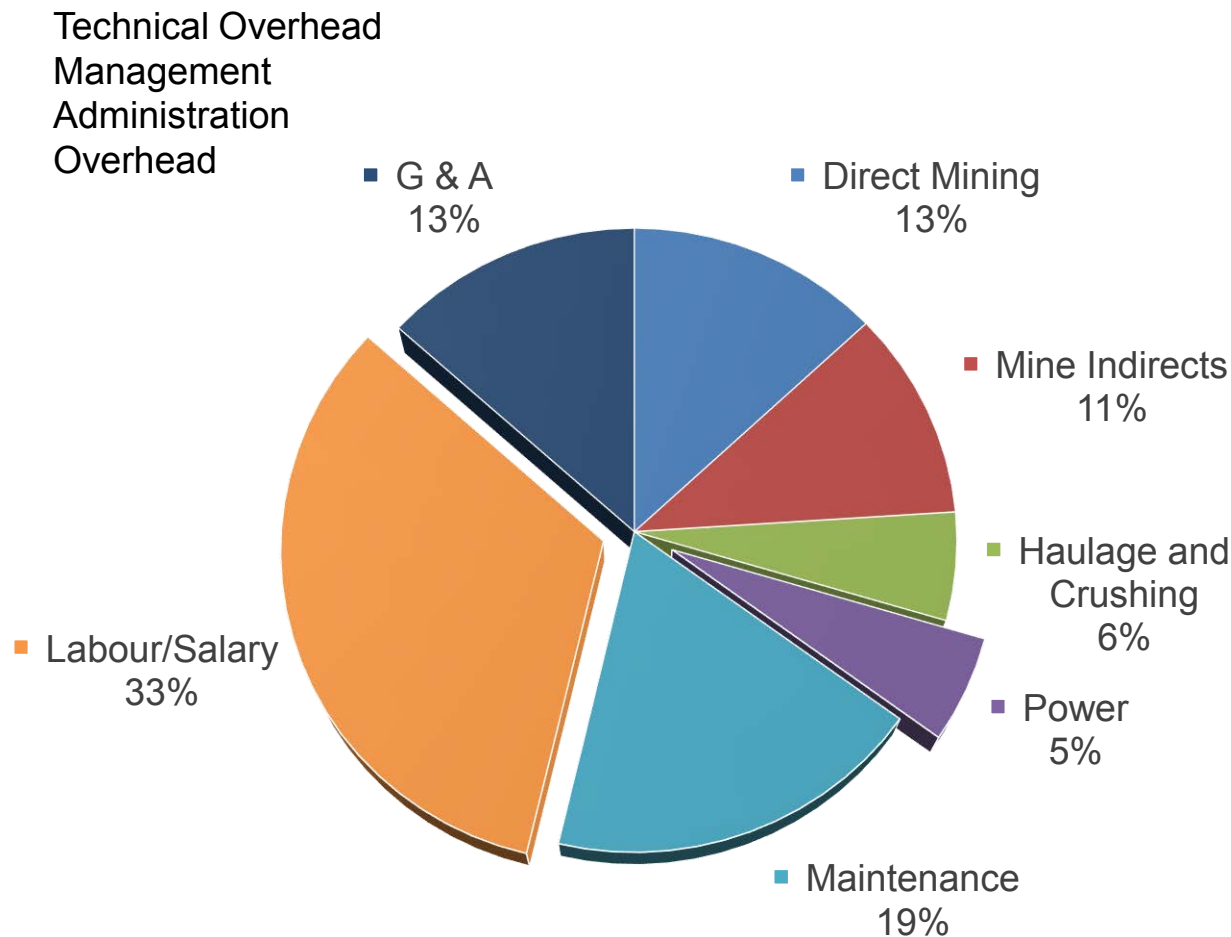
Mine Cost breakdown

Technical Overhead
Management
Administration
Overhead



- Lateral Development
- Shotcreting
- Cable Bolting
- Primary Ground Support
- Secondary Ground Support
- Hydraulic Fill
- ITH Drilling
- LHD Mucking
- Production Blasting
- Standard Raising
- Top Hammer
- UG Truck Haulage
- UG Rail Haulage
- Mining Indirects
- Raise boring
- Muck Circuit
- Hoist and Shaft Services
- Training
- Roadway Upkeep
- Supplies Handling
- Services - Utilities
- Plant Security

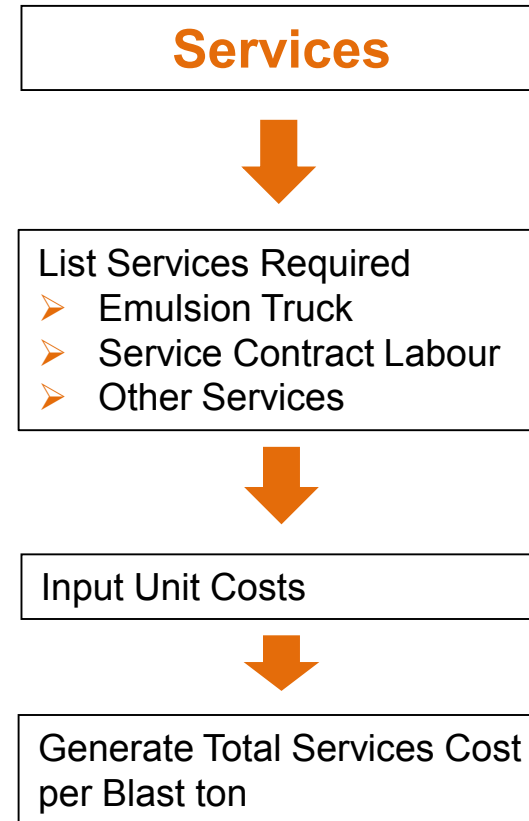
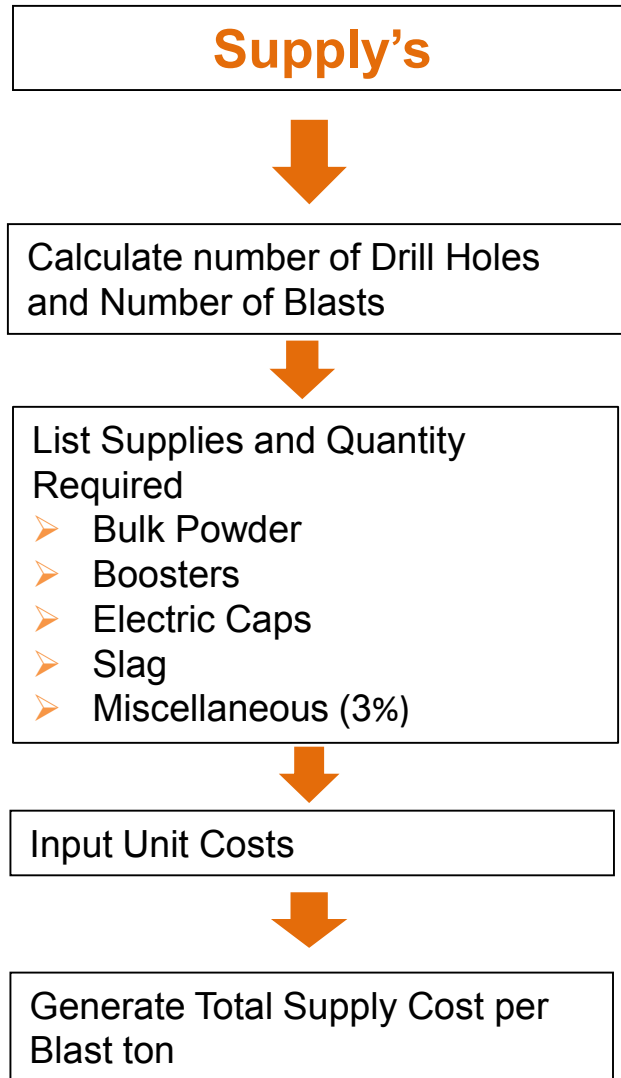
Mine Cost Breakdown



Technical Overhead
Management
Administration
Overhead

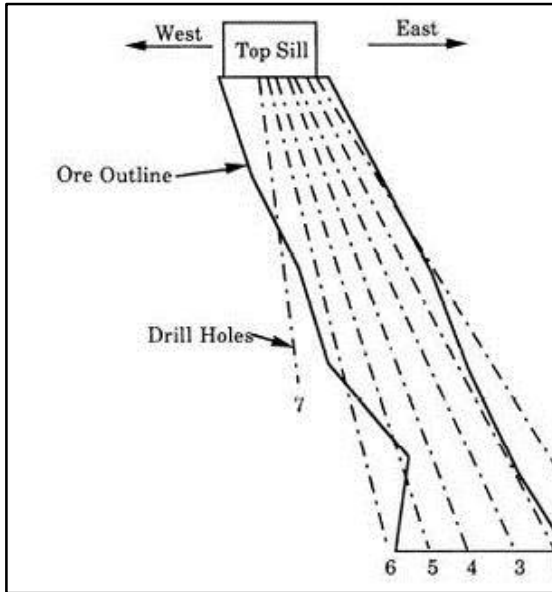
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- Shotcreting
- Cable Bolting
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- Secondary Ground Support
- Hydraulic Fill
- ITH Drilling**
- LHD Mucking
- Production Blasting**
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- UG Rail Haulage
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- Hoist and Shaft Services
- Training
- Roadway Upkeep
- Supplies Handling
- Services - Utilities
- Plant Security

First Principals – Stope Blasting



Based on Typical Stope Layout – 18,000 tonnes
Discussion with Production Crew
Suppliers

Operating Cost - Basis



ITH Supply Drill Costs

Stope Size – 24,000 tonnes

Total Drill Footage – 6500 metre

Drill Tools (bits, steel, hammer, etc.) – (total per stope or foot) - \$3.00/ft

Equipment Cost – (based on \$/hr) \$4.00/ft

Allowance (10%) – \$0.70/ft

Total Drill Cost - **\$7.70/ft**

or - **\$2.10/ton**

ITH Labour Costs

ITH Driller - \$50/hr

Include: Travel time, drill time, set-up time and down time, re-drilling

Total Drilled time: 20 days

Total Cost - \$50/hr x 20 days * 12 hrs/d hrs = \$12,000/stope

Total Drill Cost - **\$1.85/ft**

or - **\$0.50/ton**

ITH Service Costs

ITH Rental - \$10,000/m

Drill footage per month – 3,000 ft

Total Drilled tonnes – 10,000 tonnes

Total Drill Cost - **\$3.33/ft**

or - **\$1.00/ton**

But...better to do a labour total requirement for the mine

Factoring and Benchmark

Activity	Benchmark (Mine) 2000 tpd C\$/t	Variable %	Factor 0 to 1	New (Mine) 1500 tpd \$/t
Production				
Mucking	6.00	90	1	8.37
Backfill	5.00	85	0	0.00
LH Drilling	12.00	85	1	19.11
Cut and Fill	0.00	85	0	0.00
LH Blasting	4.00	85	1	6.37
Ore/Waste Handling				
Surface Crushing	4.00	90	1	5.58
Truck Haulage	4.00	90	1	5.58
Ore Sorting	2.00	85	1	3.18
Services/Ancillary				
UG Services	9.00	80	1	10.00
Road Maintenance	2.00	80	1	3.58
Material Handling	2.00	80	1	3.58
Maintenance				
UG Maintenance	5.00	50	1	14.87
UG Mobile Vehicle Maintenance	4.00	50	1	11.90

It mirrors current practice in a similar environment.

Minesite operators can participate when choosing what scaling factors to use.

It's a quick and easy way to consider many mine design possibilities.

However ...

It doesn't challenge current behavior.

It is increasingly inaccurate as mine design is changed.

It doesn't reflect how operating cost may change over life of project.

It doesn't explore the relationship between operating cost and production rate.

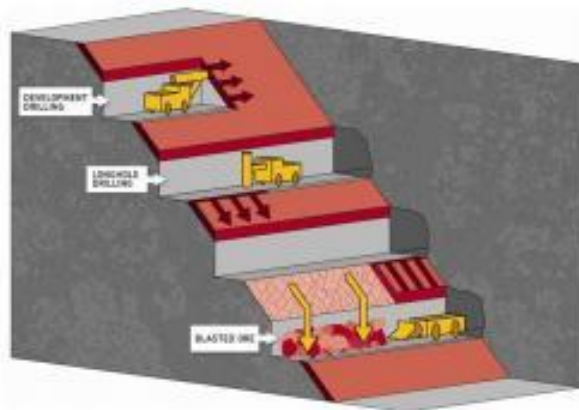
Functions/Activities with Drivers

Function/Activity	Driver
Lateral Development	Lateral metre
Shotcrete	Equivalent dry bags
Standard Raising	Vertical metre
Raise Boring	Vertical metre
Ground Support	Lateral metre
Cable Bolting	Bolts
Top Hammer Drilling	Drill metre
In-the-Hole Drilling	Drill metre
Blasting	Production ore tonnes
LHD Mucking Primary and Retram	Mucked/trammed tonnes

Function/Activity	Driver
Supplies Handling	Hoisted tonnes
Track Tram	Rail hauled tonnes
Truck Haulage	Truck hauled tonnes metre
Diamond Drilling	Drill metre
Hydraulic Backfilling	Poured tonnes
Muck Circuit	Hoisted tonnes
Hoisting and Shaft Services	Hoisted tonnes
Ramp, Roadway and Underground Upkeep	Hoisted tonnes
Level Maintenance	Hoisted tonnes
Surface Ore Handling	Hoisted ore tonnes
Surface Rock Handling	Hoisted waste rock tonnes
Mine Services	Hoisted tonnes

Underground Mine Cost (\$/t)

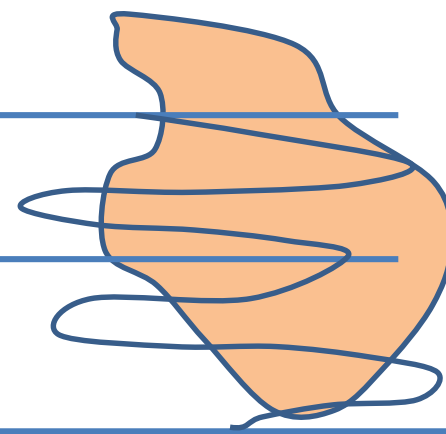
1 - Direct Mining



Operating Development

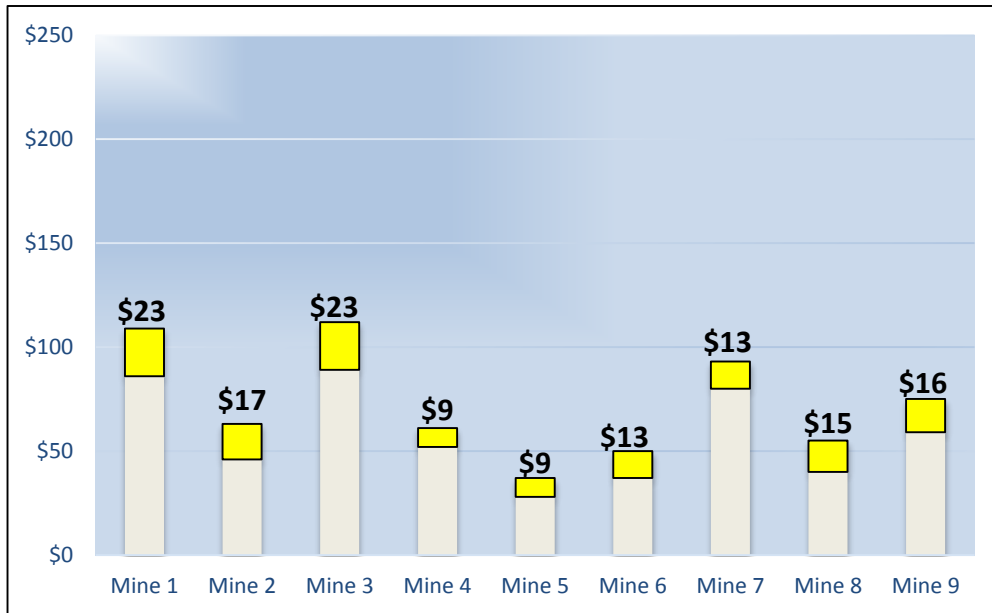
- + Drilling
- + Blasting
- + Mucking
- + Backfilling

= Direct Mining Cost



Underground Mine Cost (\$/t)

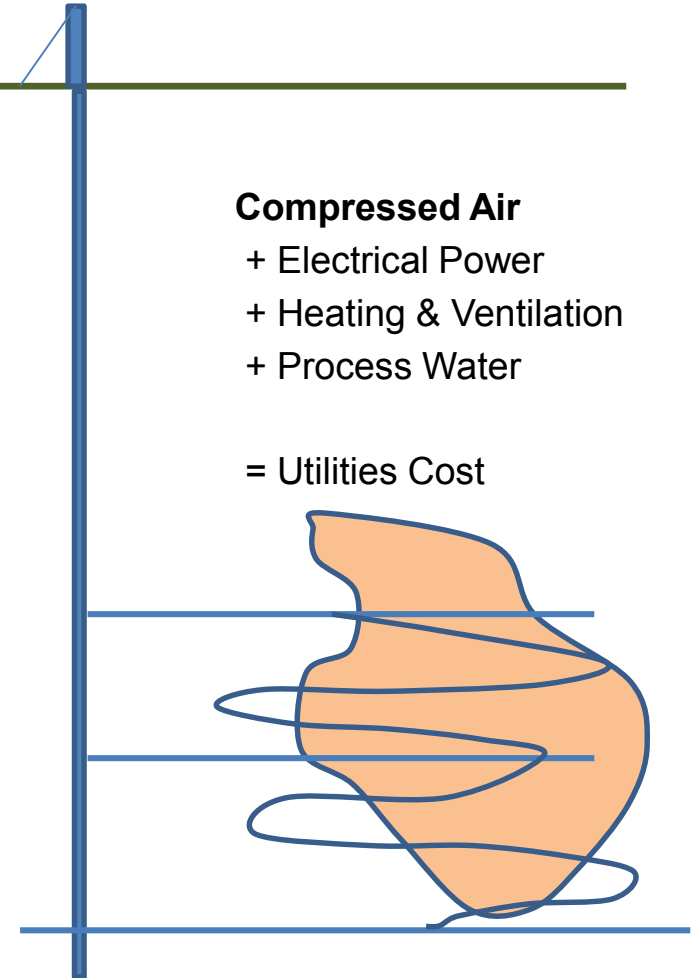
2 – Utilities



Compressed Air

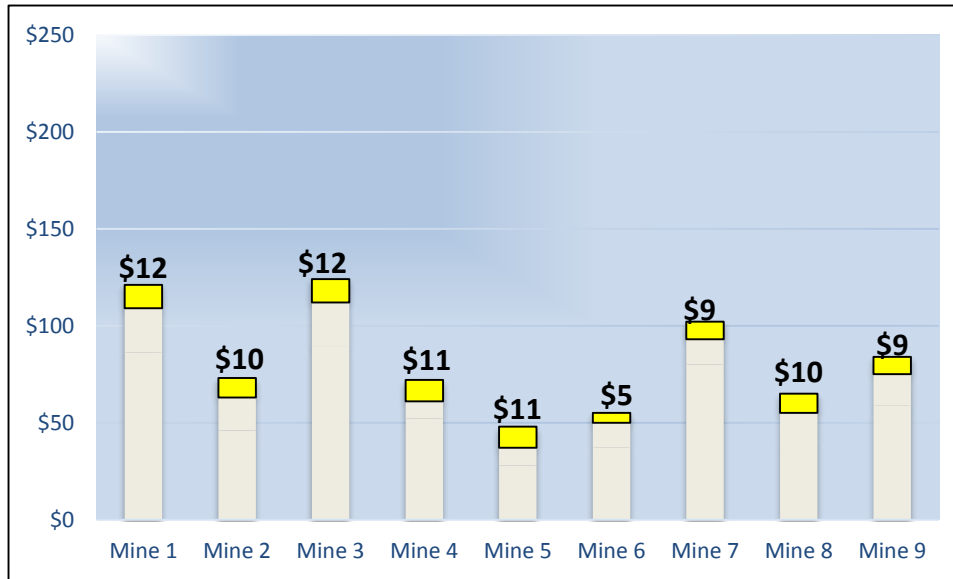
- + Electrical Power
- + Heating & Ventilation
- + Process Water

= Utilities Cost



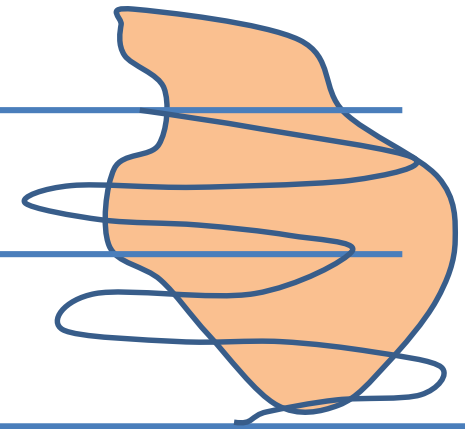
Underground Mine Cost (\$/t)

3– Services and Supply Handling



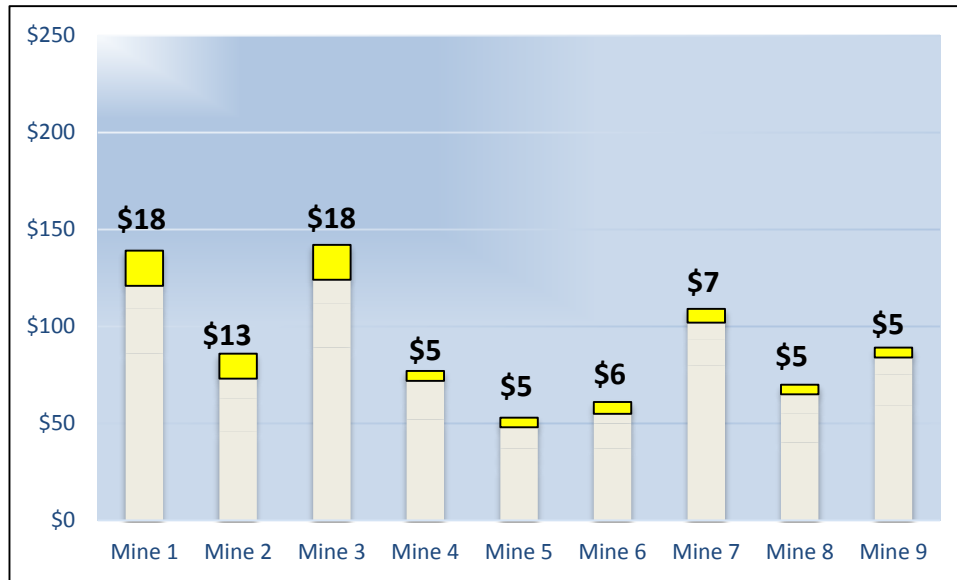
Supply Handling
+ U/G Upkeep
+ Reconditioning
+ Drainage & Pumping

= U/G Services Cost



Underground Mine Cost (\$/t)

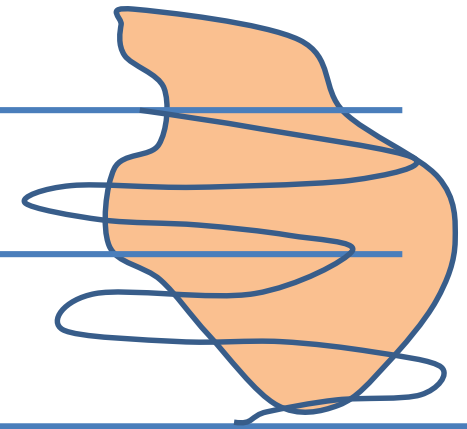
4 – Haulage and Skipping



Track Tram

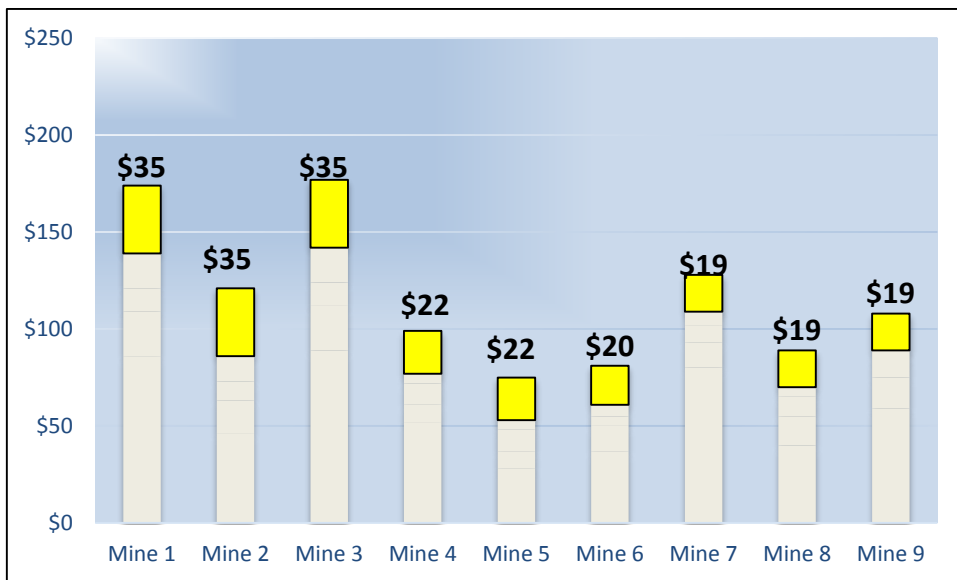
- + Truck Haulage
- + Crushing
- + Skipping

= Haulage/Crushing Cost

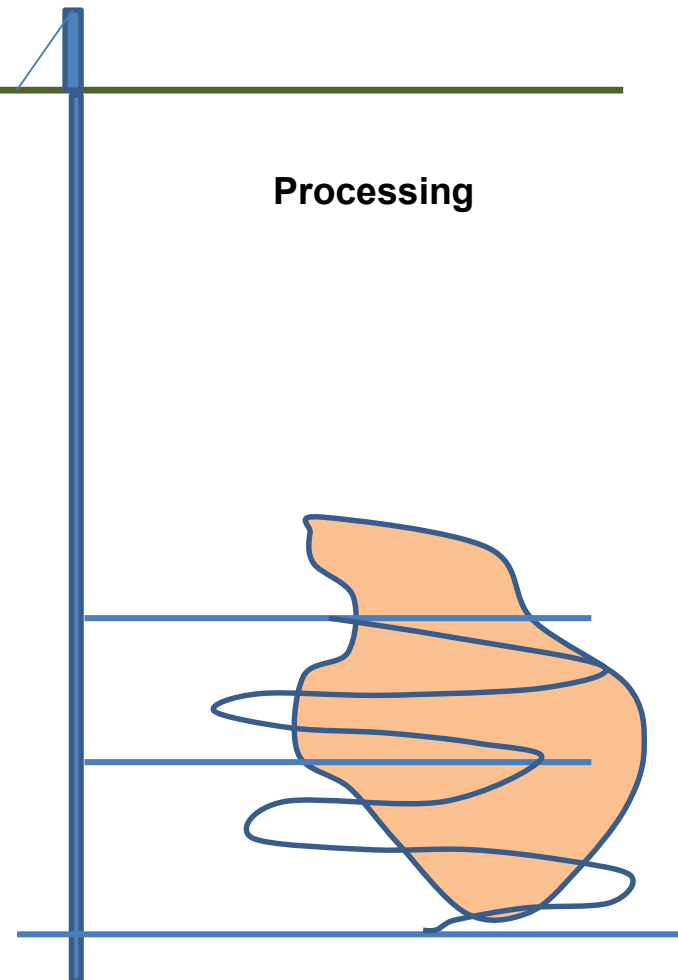


Underground Mine Cost (\$/t)

5 – Mine Processing

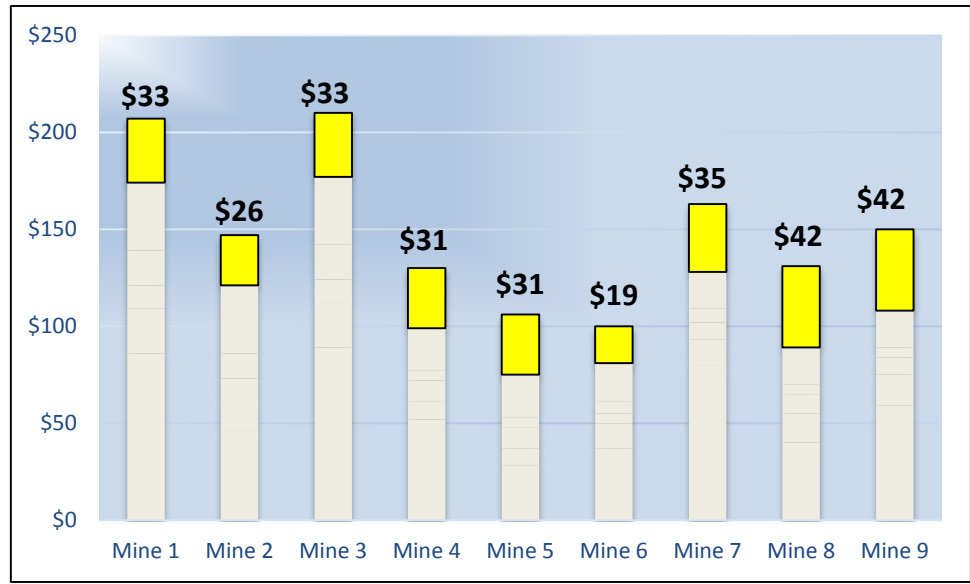


Processing



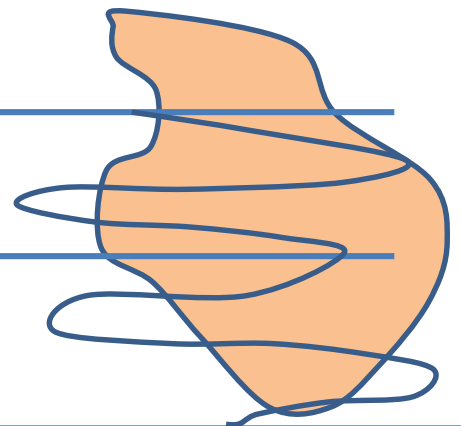
Underground Mine Cost (\$/t)

6 – General and Administration

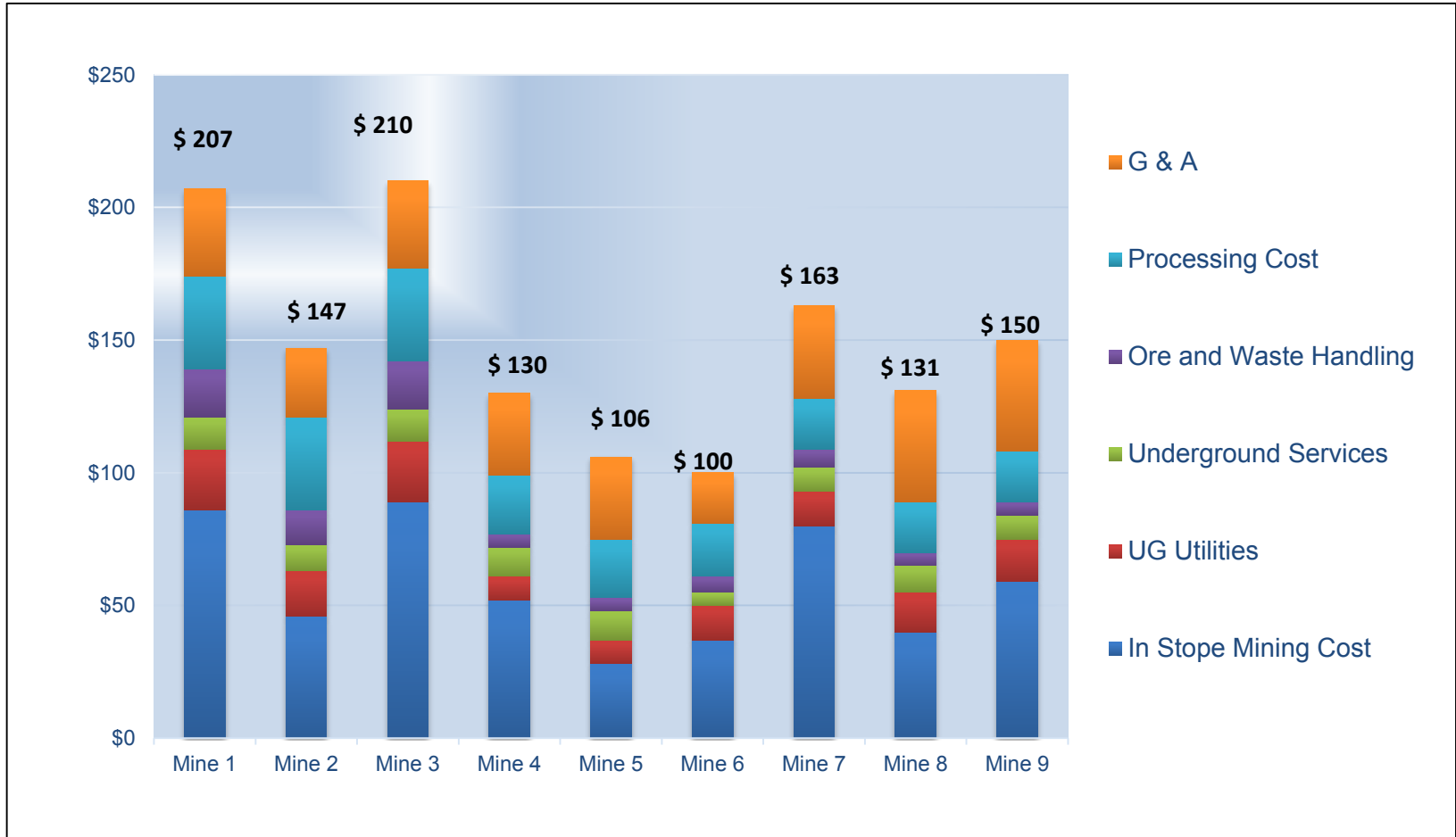


Mine Management
+ Administration
+ Water Treatment
+ Environment
+ Camp Costs

= General and Administration



Underground Mine Cost (\$/t) Total





Fixed Costs are costs that don't change based on the activity:

Property taxes on site, camp costs, G & A and Labour(!)

Variable Costs are costs that don't change based on the activity:

Drilling, Loading, Mucking

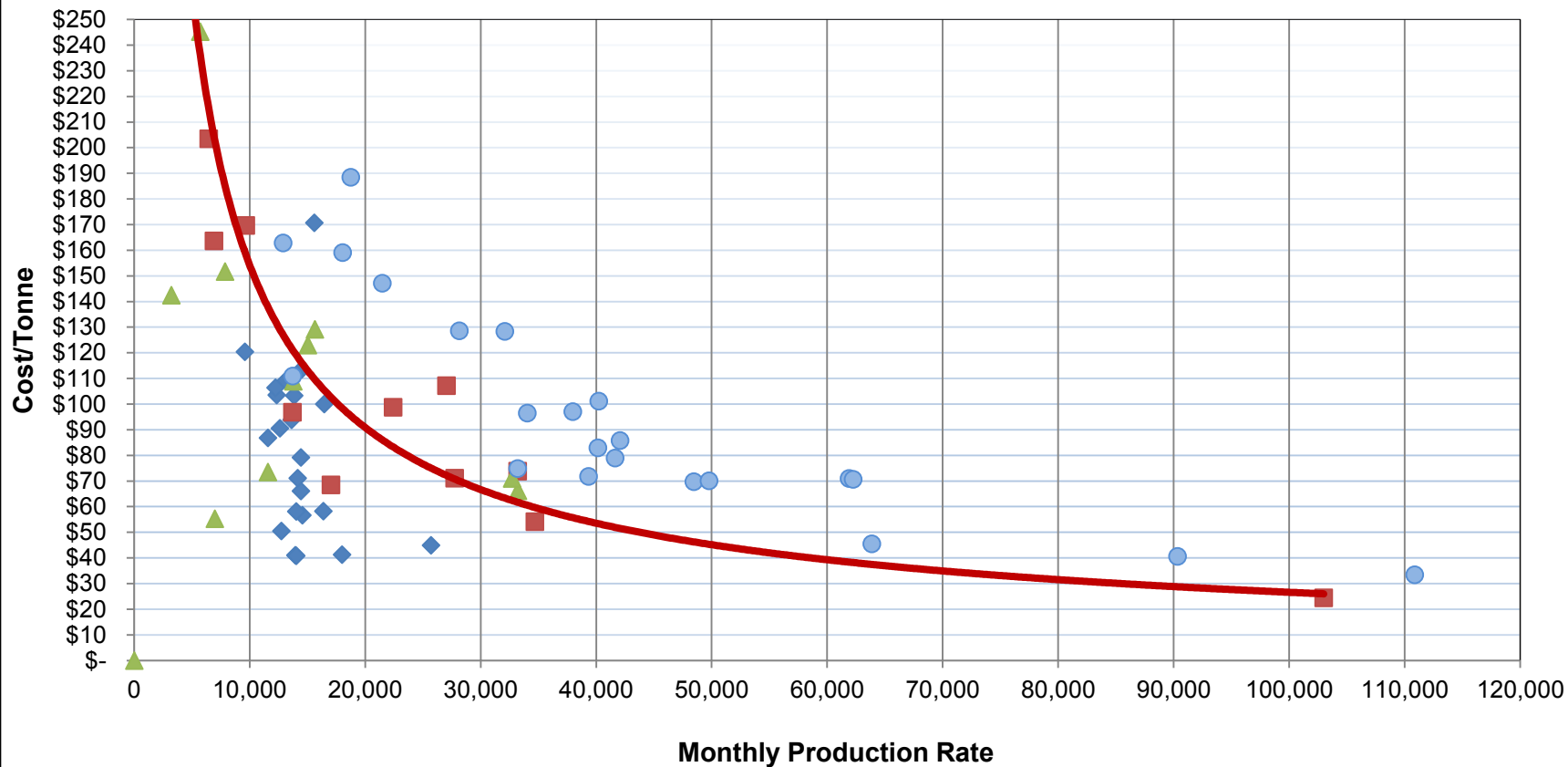
Combined Costs: Most Mine Costs are a combination of the two. *Milling (50/50)*



Depending on production tonnes these costs can change a lot! Because of the fixed cost component!

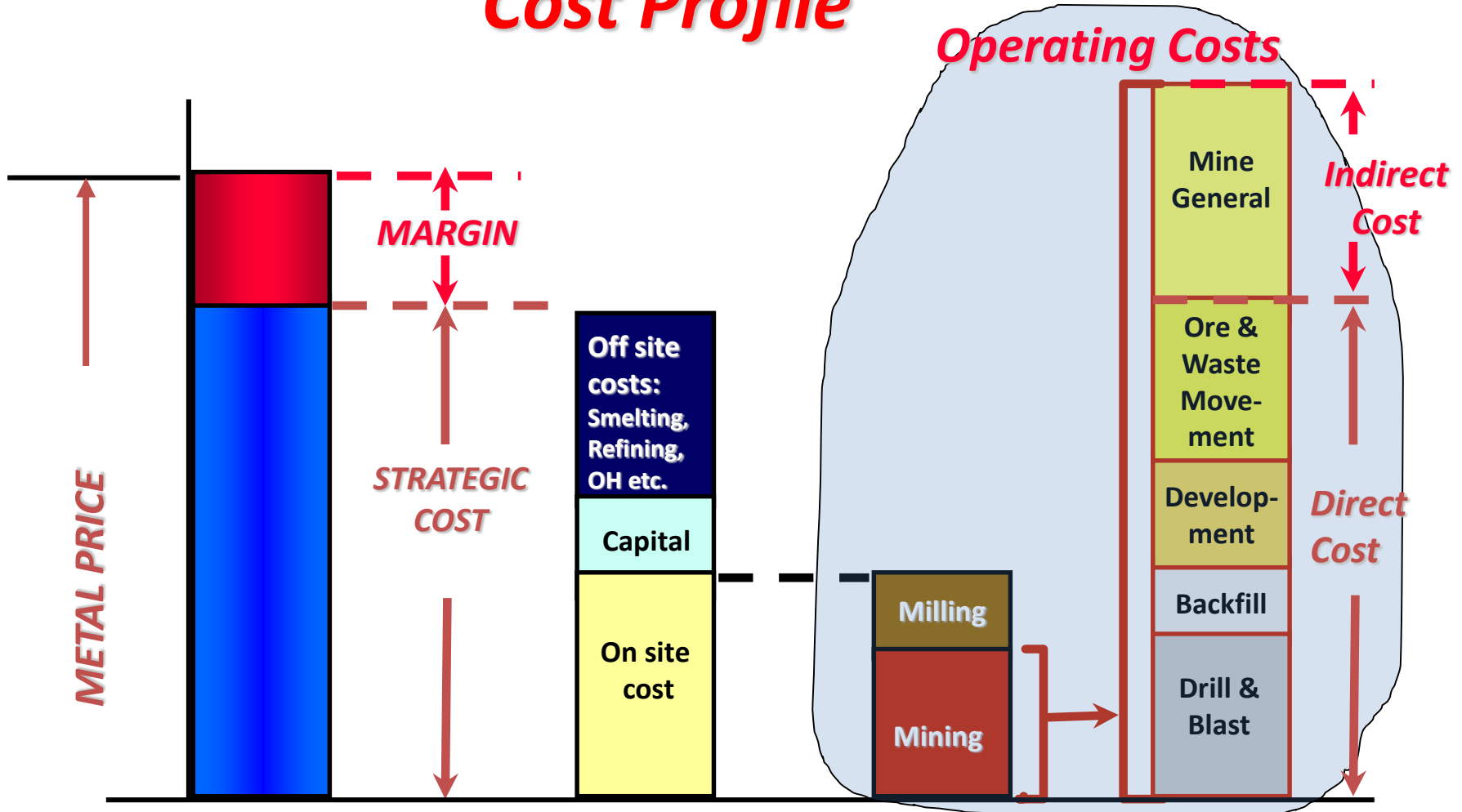
Fixed and Variable Costs

Mining Costs

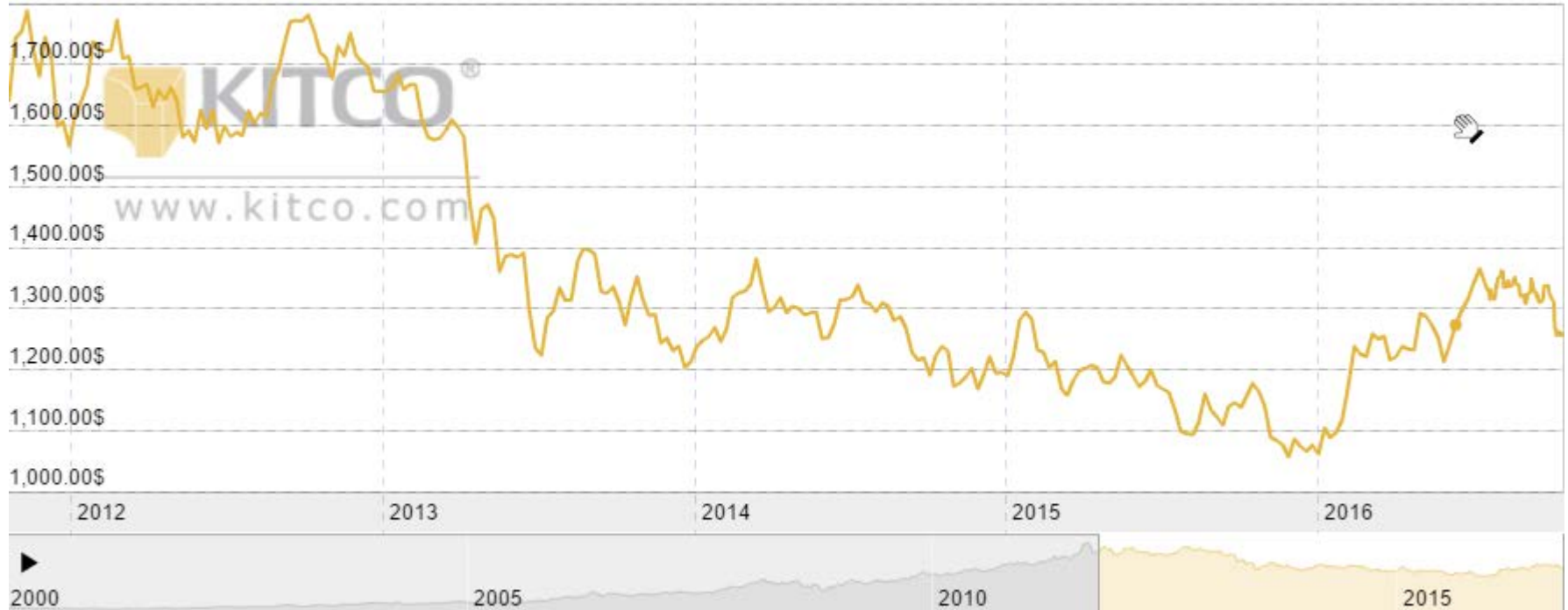


Operating Cost - Strategy

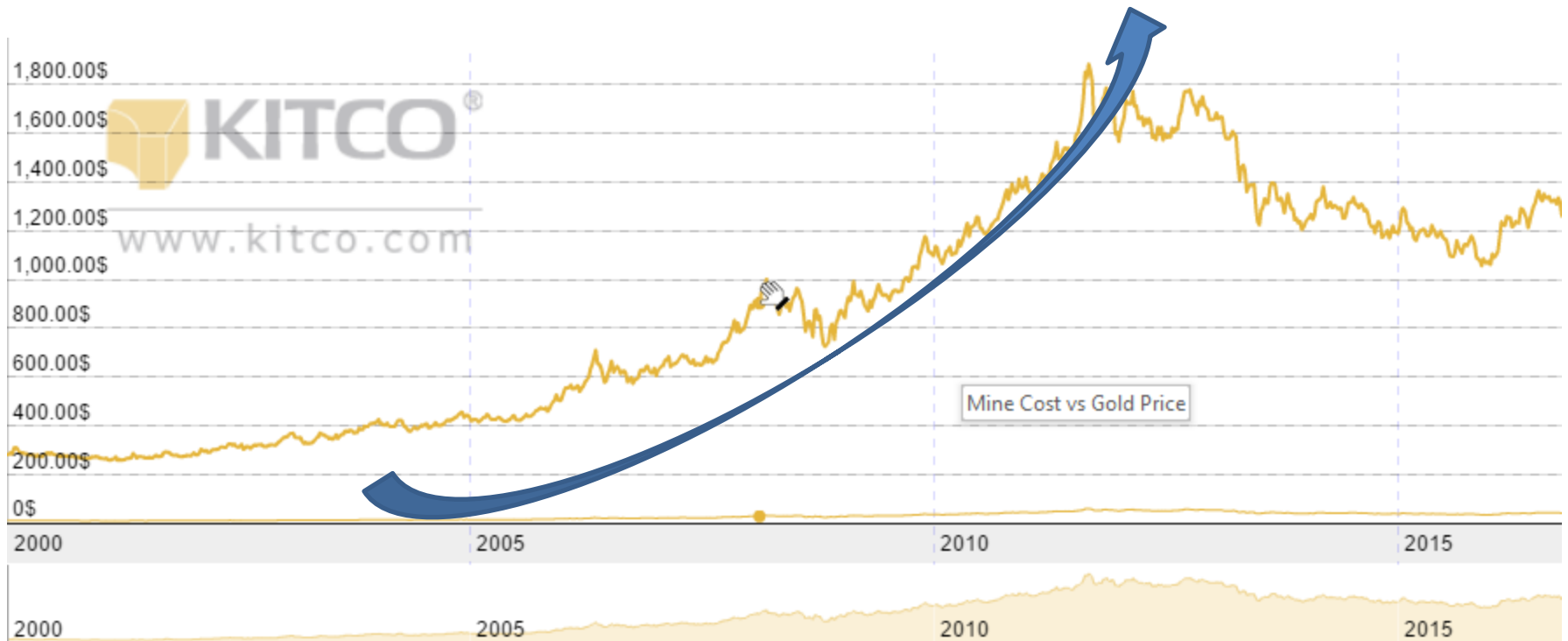
Cost Profile



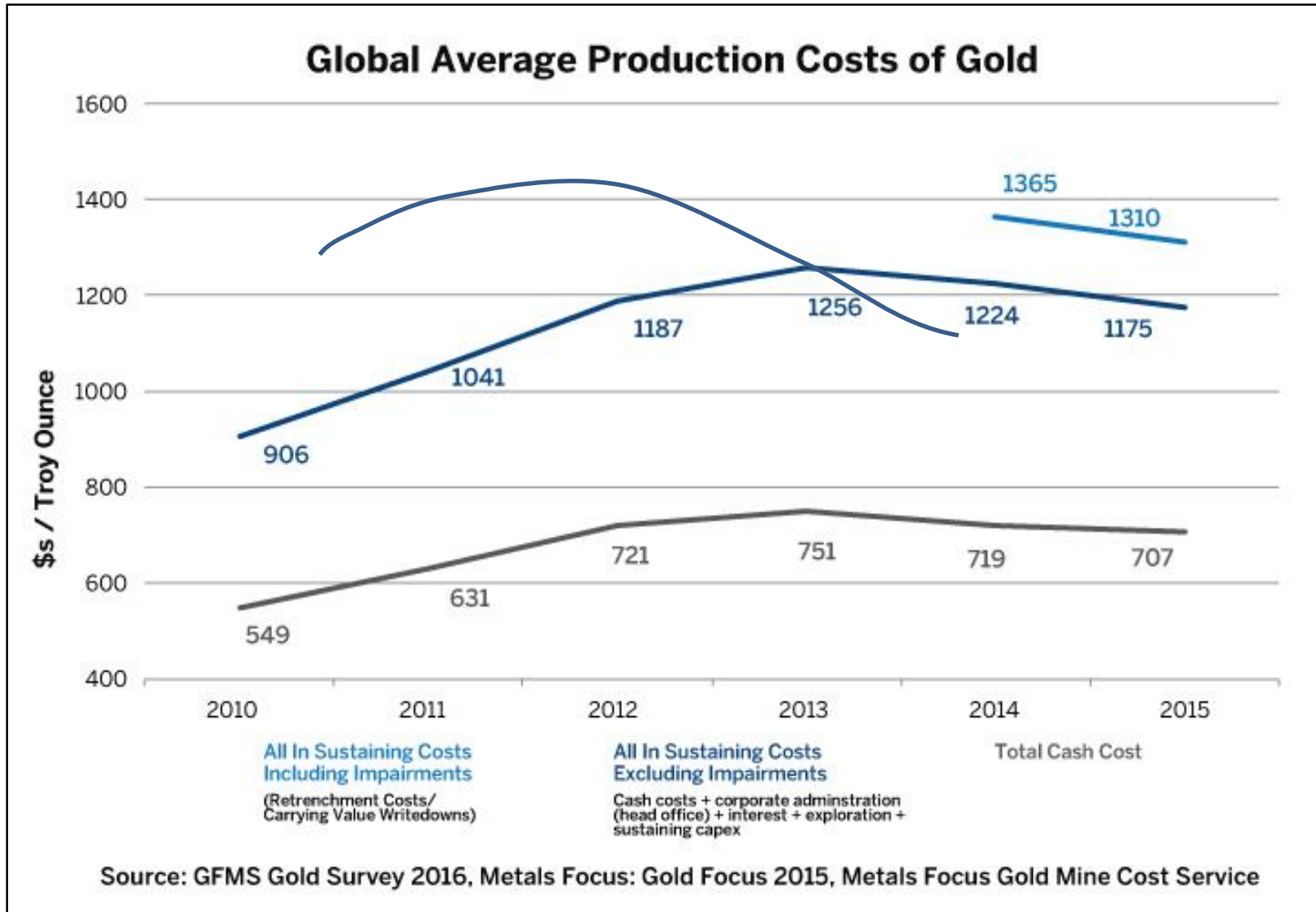
Operational challenge



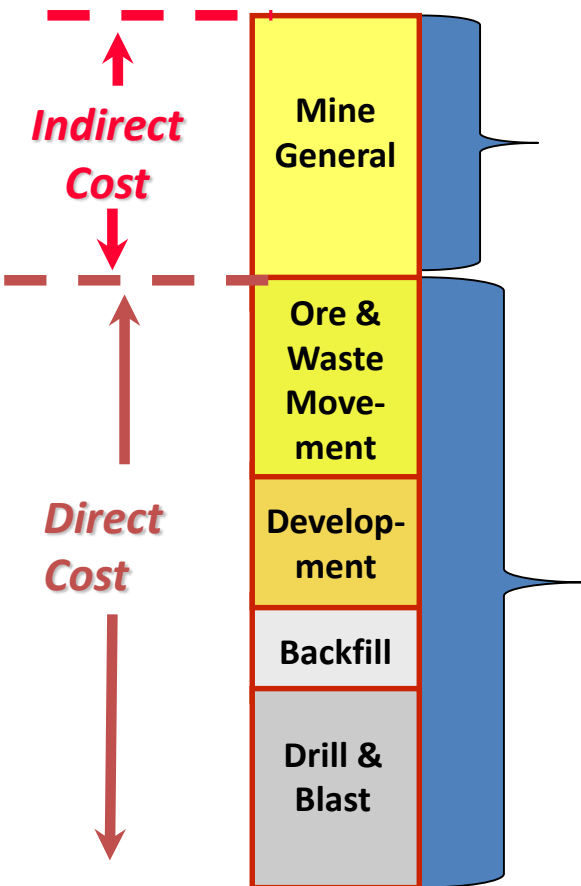
Operational challenge



Mine Cost vs Gold Price



Operating Cost – Breakdown



- Crushing & Hoisting
- Underground Services
- Utilities
- Surface Services
- Mine Management
- Transport to Mill
- Diamond Drilling

- Operating Development
- Cable bolting
- ITH Drilling
- Solo Drilling
- Blasting
- Raising
- Mucking
- Secondary Mucking
- Backfill
- Supply handling

By grouping the costs you can then look at opportunities for savings and determine the

“Ground Zero Costs”
(The lowest reasonable costs)

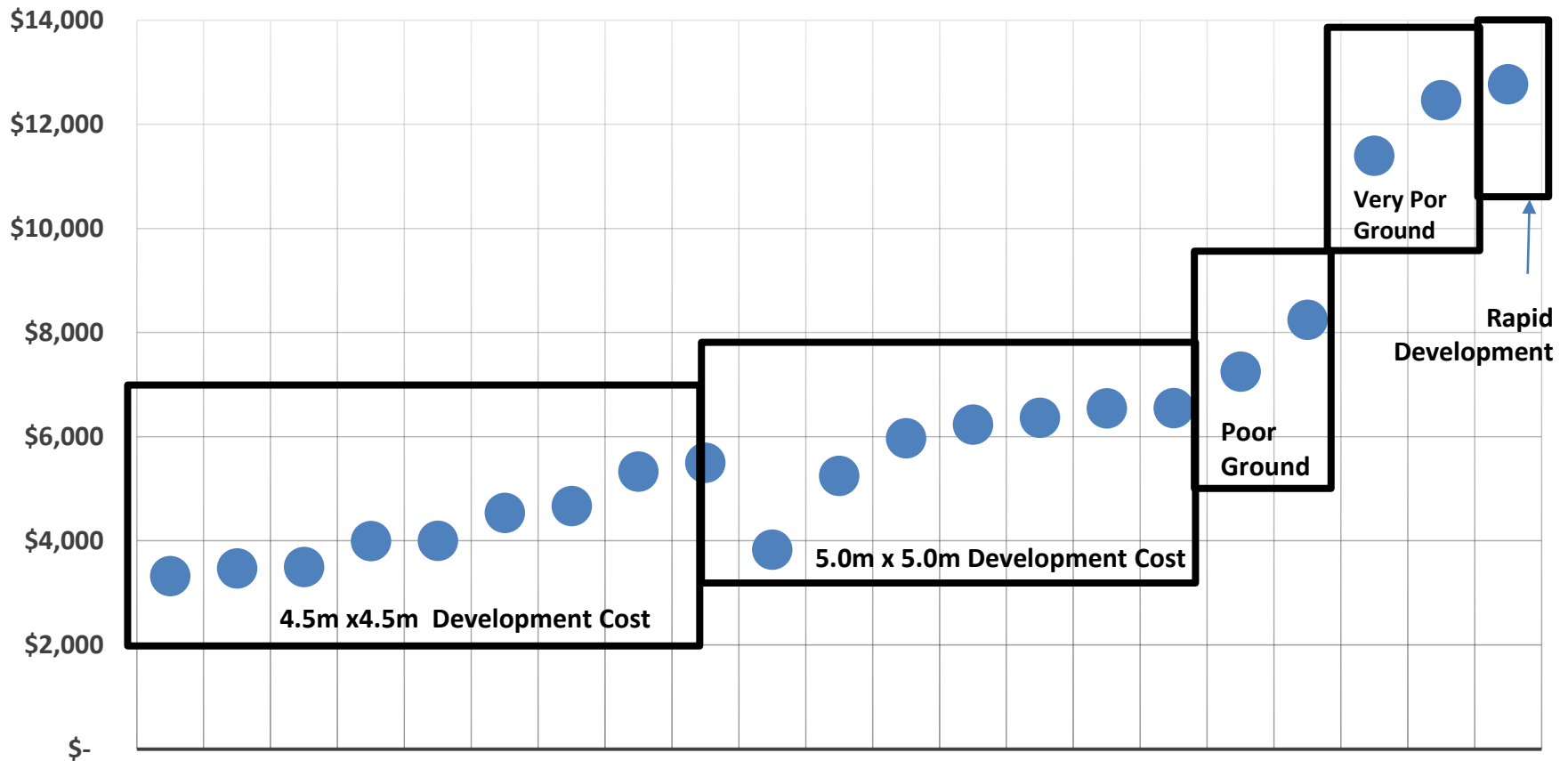
You may also benchmark those costs against your mine’s costs

Utilizing: Benchmark Data and First Principals

- Cost Mine
 - World Mine Cost Data Exchange Inc
 - CRU International
 - Brook-Hunt Associates
 - Annual reports
 - Sedar (technical reports)
 - SNL
- * Best info is from operating mines

Development - Cost

Development Cost/m Benchmarked Single Heading



- Fixed rate component will bottom out your costs.
- Direct Mining (ITH, Blasting, mucking) is variable and difficult to reduce costs on supplies and parts.
- Mining is material handling and rock breakage exercise only...streamline processes to reduce ore and waste handling.
- Labour cost is difficult to change.
- Service contracts should be reviewed, there is often opportunity there.
- Trim out the “fat” accumulated by the high price years and from mining lower grades.
- Mines often run in silos so have a 3rd party look through your costs with someone on site familiar with the mine.

Common Approaches that don't work:

- **Top-Down:**
 - Simply slash costs without addressing the downside risk and sacrificing opportunities.
 - the single solution mind-set
- **Slash and burn (cut 10%)**
 - Arbitrary targets, Reactive and survival focused
 - negatively effects morale and risk loosing your strongest people.
 - Focus on short term cost cutting and one-off savings
 - Pushing contractors to the wall for steep concessions that may not be sustainable, instead build a partnership model, look for opportunities-what is it you really need
- **Bottom-up: analysis across all departments to identify opportunity**
 - Departments personally invested in their own budgets, negative impact on morale, produces lists, greater investment, lacks urgency

To be successful focus:

- Operational improvement
- Minimize waste
- Increase volume
- Focus on outputs (not inputs)

Mine Planning:

- Focus on high quality ore with higher Cut-off grade (low cut-off isn't always good)
- Ramp up production – e.g. mining methods, better fill, increasing stope cycle time (careful of implications of increasing mining fronts and sequencing)
- Attract and retain experienced mine planners (out-of box thinkers and interested in improving operational performance and tracking performance)
- Monitor that the priority headings are being realized (development drives production)
- Streamline material and ore/waste handling in your mine (mining is a material movement exercise)
- New low-cost stream-lined technology

Costs:

- Understand and be clear on your unit costs of your operation.
- Compare current costs with “ground-zero” costs and benchmark data.
- Set realistic targets of KPIs
- Share metrics with everyone in your group and have everyone track them. Post it
- Ramp up production – e.g. mining methods, better fill, increasing stope cycle time (careful of implications of increasing mining fronts and sequencing)

Operation Analysis:

- Access all costs items to uncover your actual cost base and identify outliers
- Meet with operations and discuss targets and mine plan. Look for ideas

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Questions

