Operating Cost?

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

- Staff
- Mobile Equipment Parts
- Processing
- Camp and Travel
- Labour
- Services
- 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
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.
Mine Cost breakdown

- Technical Overhead
- Management
- Administration
- Overhead

- Maintenance
  - 19%

- Haulage and Crushing
  - 7%

- G & A
  - 13%

- Direct Mining
  - 33%

- Mine Indirects
  - 28%

- Other Costs:
  - 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

- Technical Overhead
  - Management
  - Administration
  - Overhead

- G & A
  - 13%

- Direct Mining
  - 33%

- Mine Indirects
  - 28%
Mine Cost breakdown

- Labour/Salary: 33%
- Maintenance: 19%
- G & A: 13%
- Direct Mining: 13%
- Mine Indirects: 11%
- Haulage and Crushing: 6%
- Power: 5%
Mine Cost Breakdown

- Direct Mining: 13%
- Maintenance: 19%
- Labour/Salary: 33%
- G & A: 13%
- Mine Indirects: 11%
- Haulage and Crushing: 6%
- Power: 5%

- Technical Overhead
  - Management
  - Administration
  - Overhead

- Lateral Development
- Shotcreting
- Cable Bolting
- Primary Ground Support
- Secondary Ground Support
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- UG Rail Haulage
- Mining Indirects
- Raise boring
- Muck Circuit
- Hoist and Shaft Services
- Training
- Roadway Upkeep
- Supplies Handling Services - Utilities
- Plant Security
First Principals – Stope Blasting

**Supply’s**

- Calculate number of Drill Holes and Number of Blasts
- List Supplies and Quantity Required
  - Bulk Powder
  - Boosters
  - Electric Caps
  - Slag
  - Miscellaneous (3%)
- Input Unit Costs
- Generate Total Supply Cost per Blast ton

**Services**

- List Services Required
  - Emulsion Truck
  - Service Contract Labour
  - Other Services
- Input Unit Costs
- Generate Total Services Cost per Blast ton

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

But…better to do a labour total requirement for the mine
## Factoring and Benchmark

<table>
<thead>
<tr>
<th>Activity</th>
<th>Benchmark (Mine) 2000 tpd</th>
<th>Variable</th>
<th>Factor</th>
<th>New (Mine) 1500 tpd</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>C$/t</td>
<td>%</td>
<td>0 to 1</td>
<td>$/t</td>
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<tr>
<td><strong>Production</strong></td>
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<td><strong>Services/Ancillary</strong></td>
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<tr>
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<td>UG Mobile Vehicle</td>
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<td>50</td>
<td>1</td>
<td>11.90</td>
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</table>
Factoring

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.
<table>
<thead>
<tr>
<th>Function/Activity</th>
<th>Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral Development</td>
<td>Lateral metre</td>
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<tr>
<td>Shotcrete</td>
<td>Equivalent dry bags</td>
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<tr>
<td>Standard Raising</td>
<td>Vertical metre</td>
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<tr>
<td>Raise Boring</td>
<td>Vertical metre</td>
</tr>
<tr>
<td>Ground Support</td>
<td>Lateral metre</td>
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<tr>
<td>Cable Bolting</td>
<td>Bolts</td>
</tr>
<tr>
<td>Top Hammer Drilling</td>
<td>Drill metre</td>
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<tr>
<td>In-the-Hole Drilling</td>
<td>Drill metre</td>
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<tr>
<td>Blasting</td>
<td>Production ore tonnes</td>
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<tr>
<td>LHD Mucking Primary and Retram</td>
<td>Mucked/trammed tonnes</td>
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<tr>
<td>Supplies Handling</td>
<td>Hoisted tonnes</td>
</tr>
<tr>
<td>Track Tram</td>
<td>Rail hauled tonnes</td>
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<tr>
<td>Truck Haulage</td>
<td>Truck hauled tonnes metre</td>
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<tr>
<td>Diamond Drilling</td>
<td>Drill metre</td>
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<tr>
<td>Hydraulic Backfilling</td>
<td>Poured tonnes</td>
</tr>
<tr>
<td>Muck Circuit</td>
<td>Hoisted tonnes</td>
</tr>
<tr>
<td>Hoisting and Shaft Services</td>
<td>Hoisted tonnes</td>
</tr>
<tr>
<td>Ramp, Roadway and Underground Upkeep</td>
<td>Hoisted tonnes</td>
</tr>
<tr>
<td>Level Maintenance</td>
<td>Hoisted tonnes</td>
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<tr>
<td>Surface Ore Handling</td>
<td>Hoisted ore tonnes</td>
</tr>
<tr>
<td>Surface Rock Handling</td>
<td>Hoisted waste rock tonnes</td>
</tr>
<tr>
<td>Mine Services</td>
<td>Hoisted tonnes</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Mine</th>
<th>Supply Handling</th>
<th>U/G Upkeep</th>
<th>Reconditioning</th>
<th>Drainage &amp; Pumping</th>
<th>U/G Services Cost</th>
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</thead>
<tbody>
<tr>
<td>Mine 1</td>
<td>$12</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
</tr>
<tr>
<td>Mine 2</td>
<td>$12</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
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<tr>
<td>Mine 3</td>
<td>$12</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
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<td>Mine 4</td>
<td>$11</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
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<tr>
<td>Mine 5</td>
<td>$9</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
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<td>Mine 6</td>
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<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
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<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
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<td>Mine 8</td>
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<td>$10</td>
<td>$11</td>
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<td>$12</td>
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<td>Mine 9</td>
<td>$9</td>
<td>$10</td>
<td>$11</td>
<td>$5</td>
<td>$12</td>
</tr>
</tbody>
</table>
Underground Mine Cost ($/t)
4 – Haulage and Skipping

Track Tram
+ Truck Haulage
+ Crushing
+ Skipping

= Haulage/Crushing Cost

Mine 1: $18
Mine 2: $13
Mine 3: $18
Mine 4: $5
Mine 5: $5
Mine 6: $6
Mine 7: $7
Mine 8: $5
Mine 9: $5
Underground Mine Cost ($/t)

5 – Mine Processing

<table>
<thead>
<tr>
<th>Mine</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine 1</td>
<td>$35</td>
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<tr>
<td>Mine 2</td>
<td>$35</td>
</tr>
<tr>
<td>Mine 3</td>
<td>$35</td>
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<tr>
<td>Mine 4</td>
<td>$22</td>
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<tr>
<td>Mine 5</td>
<td>$22</td>
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<tr>
<td>Mine 6</td>
<td>$20</td>
</tr>
<tr>
<td>Mine 7</td>
<td>$19</td>
</tr>
<tr>
<td>Mine 8</td>
<td>$19</td>
</tr>
<tr>
<td>Mine 9</td>
<td>$19</td>
</tr>
</tbody>
</table>
Underground Mine Cost ($/t)
6 – General and Administration

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

= General and Administration

<table>
<thead>
<tr>
<th>Mine</th>
<th>Mine 1</th>
<th>Mine 2</th>
<th>Mine 3</th>
<th>Mine 4</th>
<th>Mine 5</th>
<th>Mine 6</th>
<th>Mine 7</th>
<th>Mine 8</th>
<th>Mine 9</th>
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</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$33</td>
<td>$26</td>
<td>$33</td>
<td>$31</td>
<td>$31</td>
<td>$19</td>
<td>$35</td>
<td>$42</td>
<td>$42</td>
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</tbody>
</table>
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

Cost/Tonne

Monthly Production Rate
Operating Cost - Strategy

Cost Profile

Operating Costs

- Ore & Waste Movement
- Development
- Backfill
- Drill & Blast
- Mine General

Off site costs:
- Smelting
- Refining
- OH etc.

Capital

On site cost

Milling

Mining

Metal Price

Margin

Strategic Cost

Operating Cost - Strategy
Operational challenge
Operational challenge
Mine Cost vs Gold Price

Global Average Production Costs of Gold

Source: GFMS Gold Survey 2016, Metals Focus: Gold Focus 2015, Metals Focus Gold Mine Cost Service
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
Benchmark Sources

- 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

Benchmarked Single Heading

Development Cost/m

- Very Poor Ground
- Poor Ground
- Rapid Development

4.5m x 4.5m Development Cost
5.0m x 5.0m Development Cost
Ground Zero Cost

- 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.
Reclaiming efficiency and lowering costs

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
Reclaiming efficiency and lowering costs

To be successful focus:

- Operational improvement
- Minimize waste
- Increase volume
- Focus on outputs (not inputs)
Reclaiming efficiency and lowering costs

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 (carefull 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
Ground Zero Cost

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- Direct Mining (ITH, Blasting, mucking) is variable and difficult to reduce costs on supplies and parts
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Questions