Drill Selection – What Do I Pick?

Bill Hissem

QUARRY ACADEMY

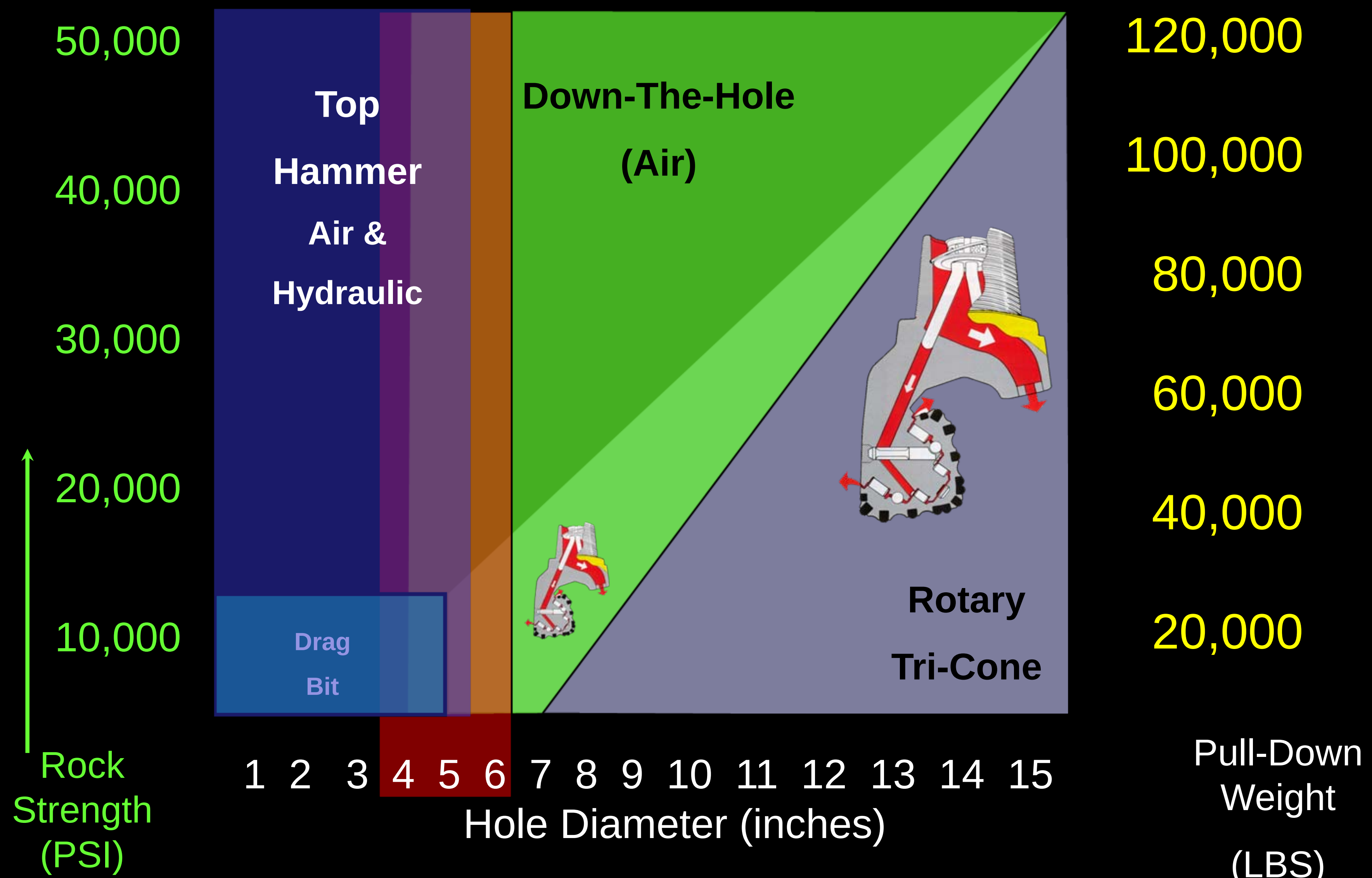
Improving Processes. Instilling Expertise.

DYNO Dyno Nobel

SCHOOL OF MINES 1874 COLORADO

SANDVIK

* Hole Diameter



Drilling Domains

* General Configuration

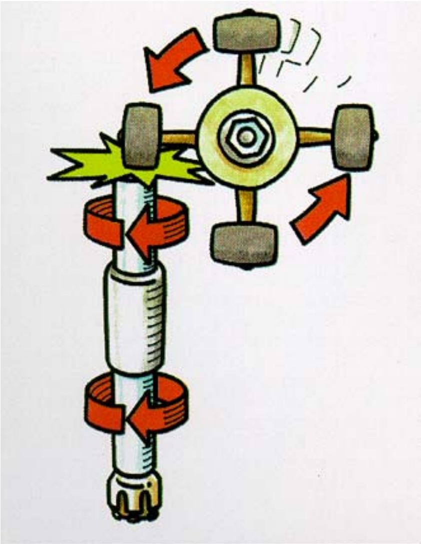
Top - Hammer

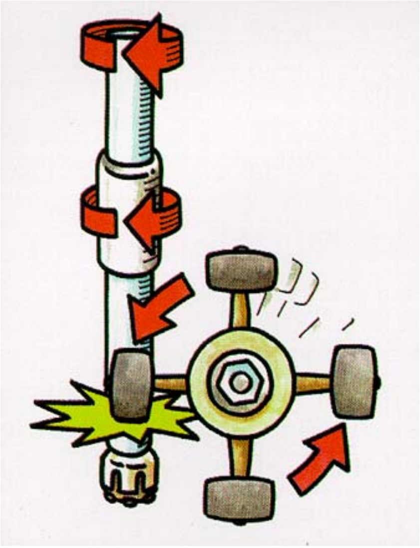
DTH - Trackdrill

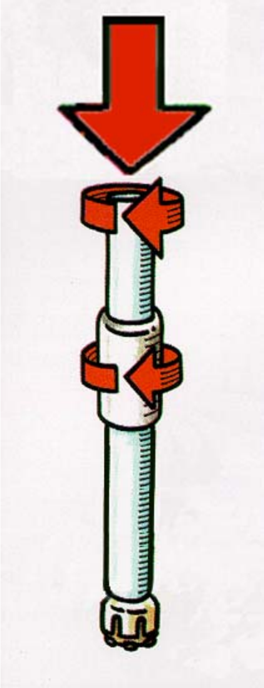
DTH

* Primary Difference

Top - Hammer	DTH	Rotary
Puts more	Puts more	Puts more
percussion energy	flushing air	flushing air
in the hole	in the hole	in the hole

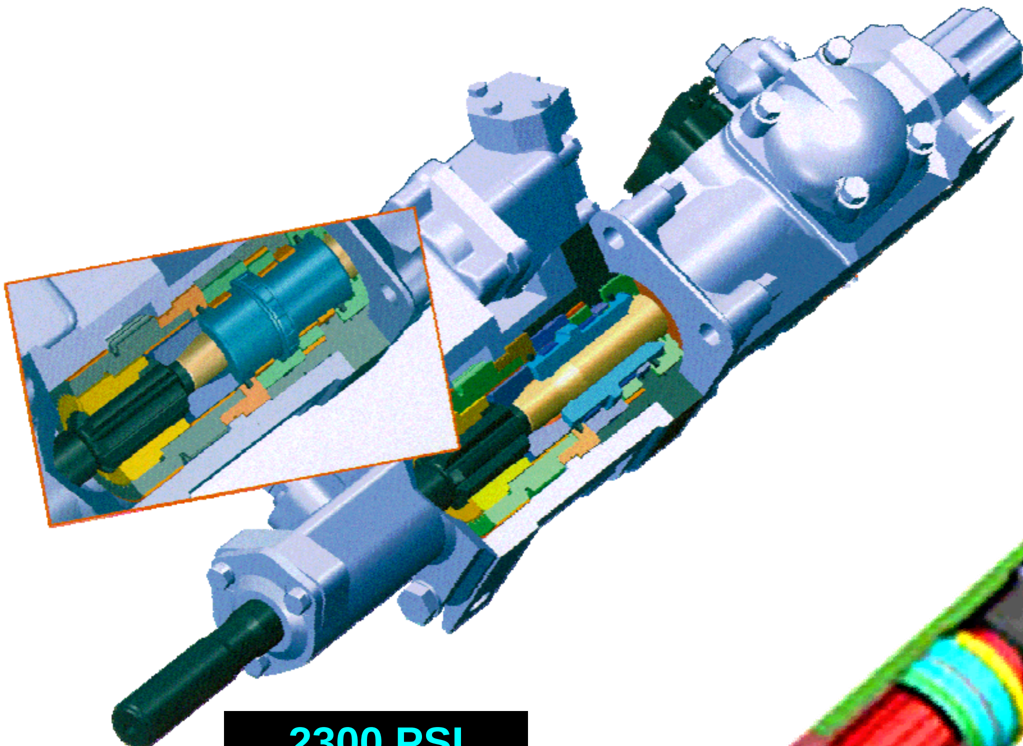






* Hammers

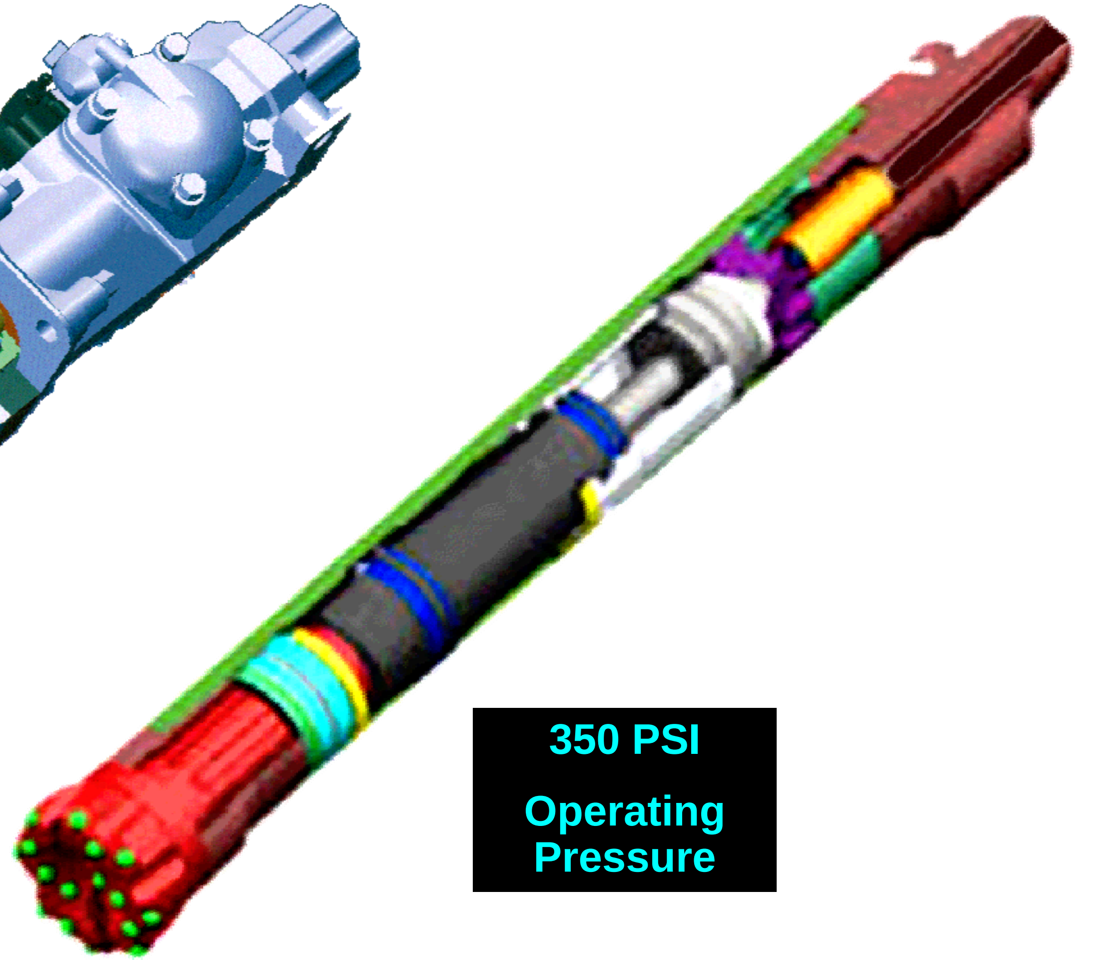
Top - Hammer



2300 PSI

Operating Pressure

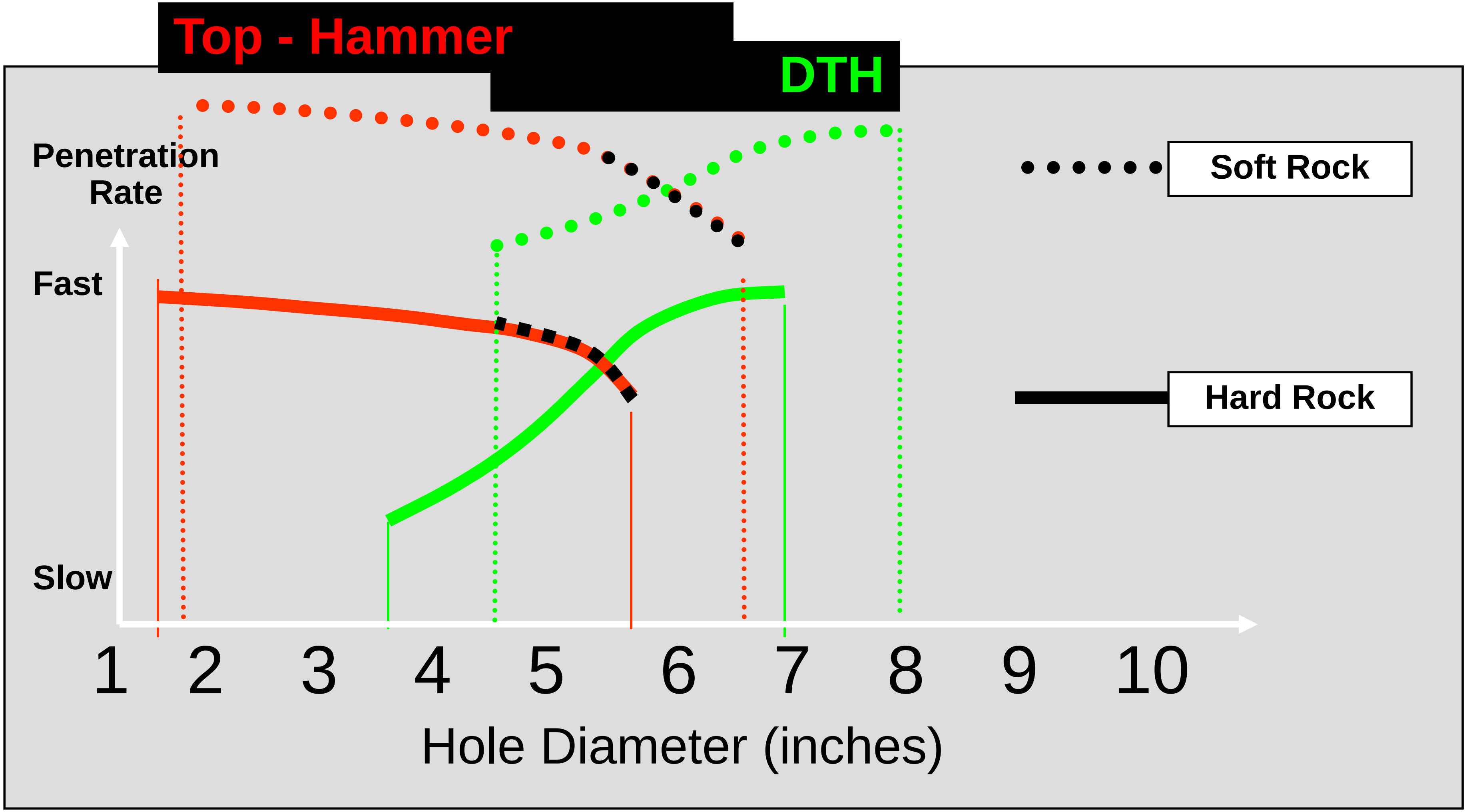
DTH



350 PSI

Operating Pressure

* Bit Penetration Rates



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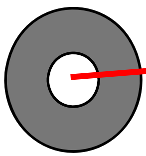
* Drill String Elements

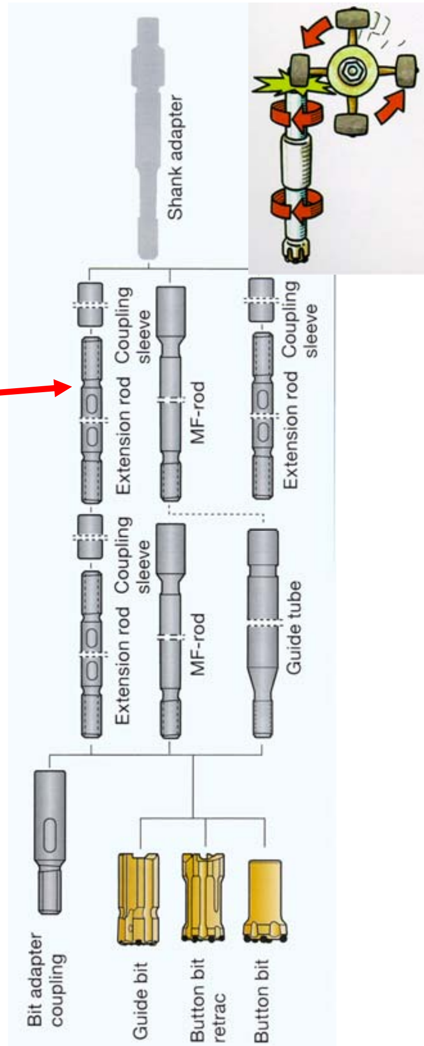
Top - Hammer

Drill

Rod



X-Section



DTH

Lift Plug

Top Sub

Drill Pipe

Bit Sub

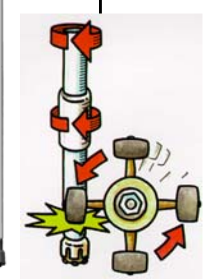
Rotary Bushing

DTH Hammer

Petol Tong

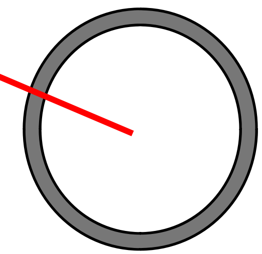
Petol Chain

Bit Basket



Drill

Pipe



X-Section

OK – How do I pick out a drill? Or Not?

Drill ownership and **operation in-house**

or

Contract Drilling

OK – How do I pick out a drill?

Drill type determines energy distribution within the shot:

- **Hole diameter**
- **Hole straightness**

Explosive energy + rock fabric determine fragmentation:

- **Charge diameter**
- **Drill pattern**

Ownership or Contract Drilling requires an understanding of true costs, effect, and outcome for each case

Drilling is the foundation for explosives distribution in the shot

Typical desired outcomes:

- **Easy to load muck pile**
- **Little or no oversize**
- **Controlled muckpile shape**
- **Minimum fines and overburden material content**
- **Safe blast event**
- **Minimum off-site disturbance in urban neighborhoods**
- **Minimum overall quarrying costs**
- **Maximum overall quarrying productivity**

OK – How do I pick out a drill? Or Not?

Whether you own the drill or not, drilling is required.

So the real question is whether I can get the quality and quantity of drilling I need at a cost equal to or less than the expense of an in-house drilling program.

Drill Selection for Quarry Applications*

	Drill Selection for Quarry Applications*				
	* - Assessments are generalized - case specific exceptions are common	**Top Hammer Trackdrill**	**Down-the-Hole Trackdrill**	**DTH/(Rotary) Track-Mounted Drill**	**DTH/(Rotary) Truck-Mounted Drill**
1	**Hole Diameter:** (Consider geology, blast dynamics, fragmentation)	**2.5" to 5"**	**4" to 6"**	**5" to 8"**	**5" to 8"**
2	**Hole Size Range:** (Flexibility)	**Good to Very Good** (up to 4 hole size steps)	**Medium to Poor** (2-3 hole size steps)	**Medium to Poor** (2-3 hole size steps)	**Medium to Poor** (2-3 hole size steps)
3	**Bit Penetration Rate** (when comparing at equal hole diameters)	**Faster in smaller hole diameters and harder rock**	**Faster in larger hole diameters and softer rock**	**Faster in larger hole diameters and softer rock**	**Faster in larger hole diameters and softer rock**
4	**Hole Straightness/Accuracy - (to 40')**	**Medium to Good/Excellent**	**Excellent**	**Excellent**	**Excellent**
	Hole Straightness/Accuracy - (to 120')	**Medium to Bad/Good**	**Good**	**Excellent**	**Excellent**
5	**Productivity in broken ground conditions**	**Good to Fair** (can back-hammer out of hole)	**Good** (high flushing capacity - but can't back hammer out of the hole)		
6	**Speed Between Holes** - (Tram speed/spotting/set-up)				
	Smooth benches - solid rock	**Excellent**	**Excellent**	**Excellent**	**Medium**
	Rough benches - broken rock	**Good to Excellent**	**Medium to Good**	**Medium to Poor**	**Poor to Bad**
7	**Rough Terrain** (Rig stability for speed and safety)	**Good to Excellent**	**Medium to Good**	**Poor to Bad**	**Bad**
8	**Small Benches** (Minimum working space for rig positioning)	**Good to Excellent**	**Good to Excellent**	**Medium to Poor**	**Poor**
9	**Boom reach from carrier position** (Reach affects speed/accuracy/safety)	**Good to Excellent**	**Good**	**No**	**No**
10	**Stand-off from crest & highwall** (Operator relative to hole position)	**Good to Excellent**	**Good**	**Poor**	**Poor to Bad**
11	**Safety as a function of hole size** Shot event control - high wall/crest line shear	**Good to Excellent**	**Good to Medium**	**Good to Poor**	**Good to Poor**
		Small hole = tight spacing = more shot control - Large hole = wide spacing = less shot control			
12	**Mobilization speed site to site**	**Fair to Good** (requires truck - legal width)	**Fair** (requires truck - legal width)	**Poor** (requires truck - not legal width)	**Excellent** (truck mounted - stack and go)
13	**Cost to purchase and operate**	**Scalar to hole size/rig class** Look at balancing rig cost with annual tonnage requirements and mechanical utilization => drill cost analysis.			
14	**Maintenance and mechanical support** (Parts - service support - trouble shooting)	**This depends on your organization - dealer support - manufacturer support** Look at balancing rig cost with annual tonnage requirements and mechanical utilization => drill cost analysis.			

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		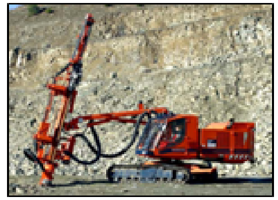			
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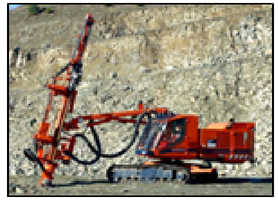
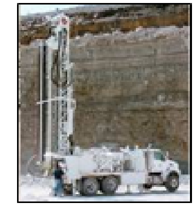
	Drill Selection for Quarry Applications*				
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	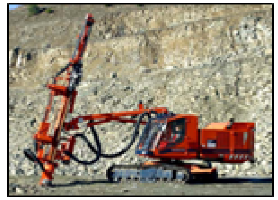			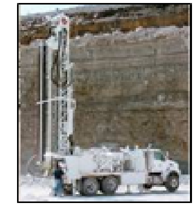
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Consider each of these criteria as they apply to your site and organization, assigning value according to your priorities.

There are 3 approaches taken in drill selection:

	Operations priority	Methodology
1	Focus on budget and invoice costs	Buy the largest hole diameter and the cheapest drill you can find. Or Sub-contract the drilling on a competitive bid - lowest cost/dr-ft basis.

There are 3 approaches taken in drill selection:

	Operations priority	Methodology
2	Balance budget imperatives with applications issues	Committee consensus drives selection

There are 3 approaches taken in drill selection:

	Operations priority	Methodology
3	Find lowest overall cost/ton operating scenario	Create a working operating economic cost model that demonstrates full process sensivity and incorporates internal and external factors

Drill Selection

1) Establish your criteria
2) Eliminate drill alternatives that don't fit the application
3) Evaluate support issues
4) Run cost analysis for each scenario for comparison

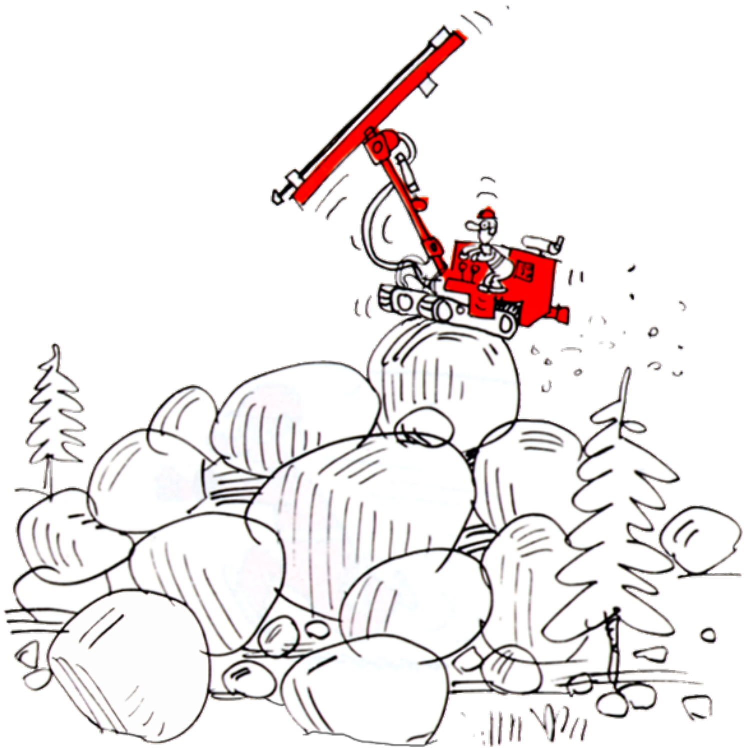
What are the advantages of drill ownership?

Operational

- Control of Training
- Schedule as needed
- Daily driller communication

Economic

- Low $/ton with good utilization
- Specialized Drilling
- Better if no viable contractors are available



What are the advantages of a Contract Driller?

- Can backstop spot production demands
- Requires no mechanical support
- Fewer operators required (more staff ?)
- More predictable operating $ budget forecast ?

What to look for in a Contract Driller

- MHSA/Safety Compliance - Part 46
- Well trained, dependable staff
- Internal back-up fleet capacity
- Insurance/bond capacity
- Equipment in good order - reliable
- DOT concerns – compliance
- Schedule response availability
- Ability to deliver required production - accurate holes

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