

Optimizing Tooling Selection to Achieve Lowest Cost Per Foot Drilling-Case Studies

INROCK

A SANDVIK COMPANY



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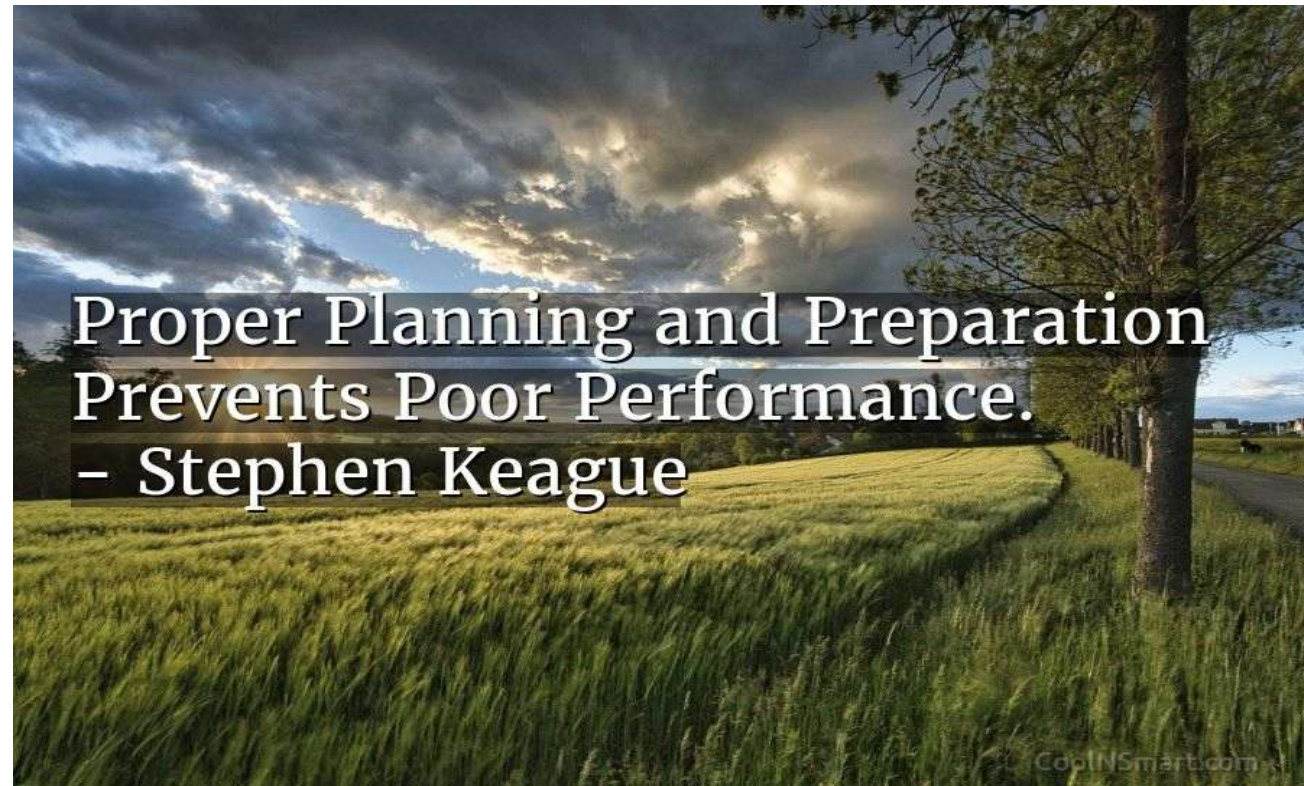
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The P's

- Project details
- Planning
- Process
- Performance
- Profit



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Project Details

- Site
- Bore length
- Product pipe
- Final hole size



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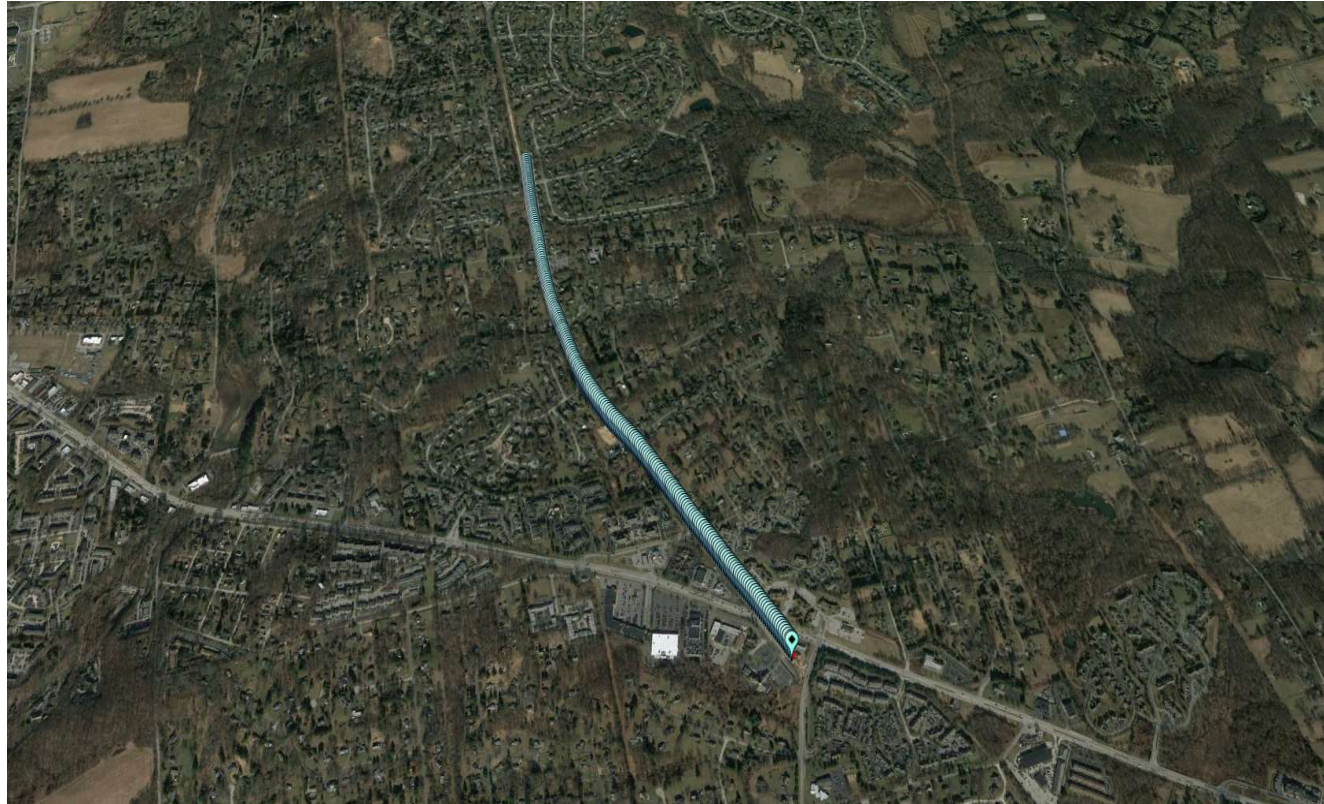
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Planning

- Rig selection
- Drill pipe
- Pump



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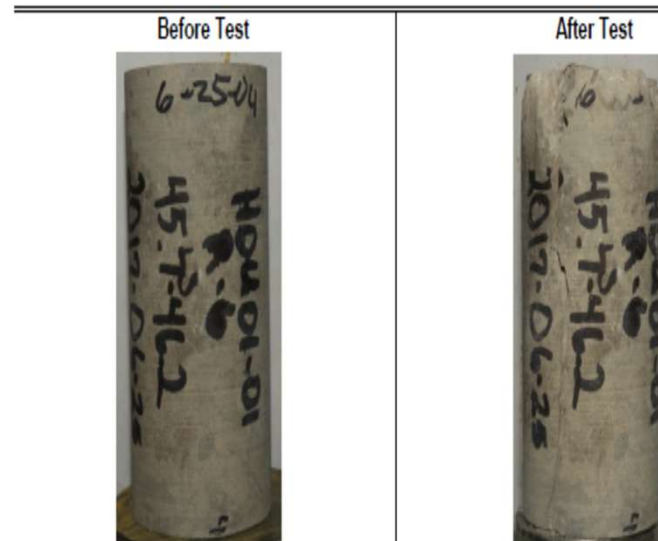


Process

- Type of rock
- How does it fail?
- How do we choose the right bit?

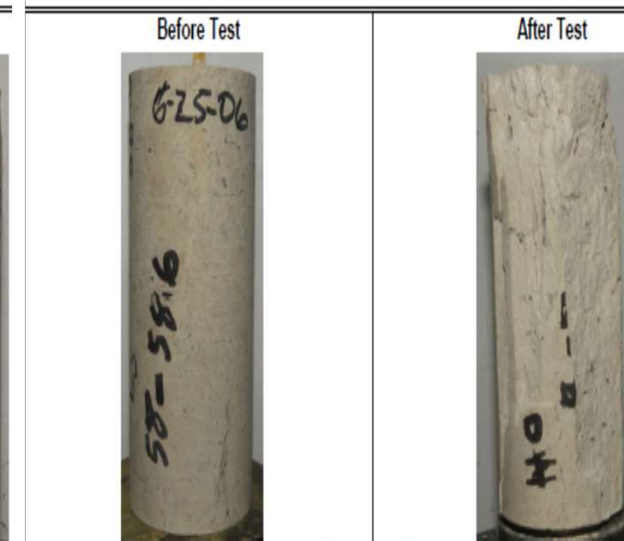
Test Results

Test Date: 21-Jun-17
 Load at Failure: 19,250 (lb)
 Unconfined Compressive Strength: 6,225 (psi)
 Dry Unit Weight: 150.6 (pcf)
 Load Rate: 0.28 (%/min)
 Tested by: TV
 Reviewed by: YM



Test Results

Test Date: 21-Jun-17
 Load at Failure: 37,000 (lb)
 Unconfined Compressive Strength: 11,940 (psi)
 Dry Unit Weight: 149.4 (pcf)
 Load Rate: 0.28 (%/min)
 Tested by: TV
 Reviewed by: YM



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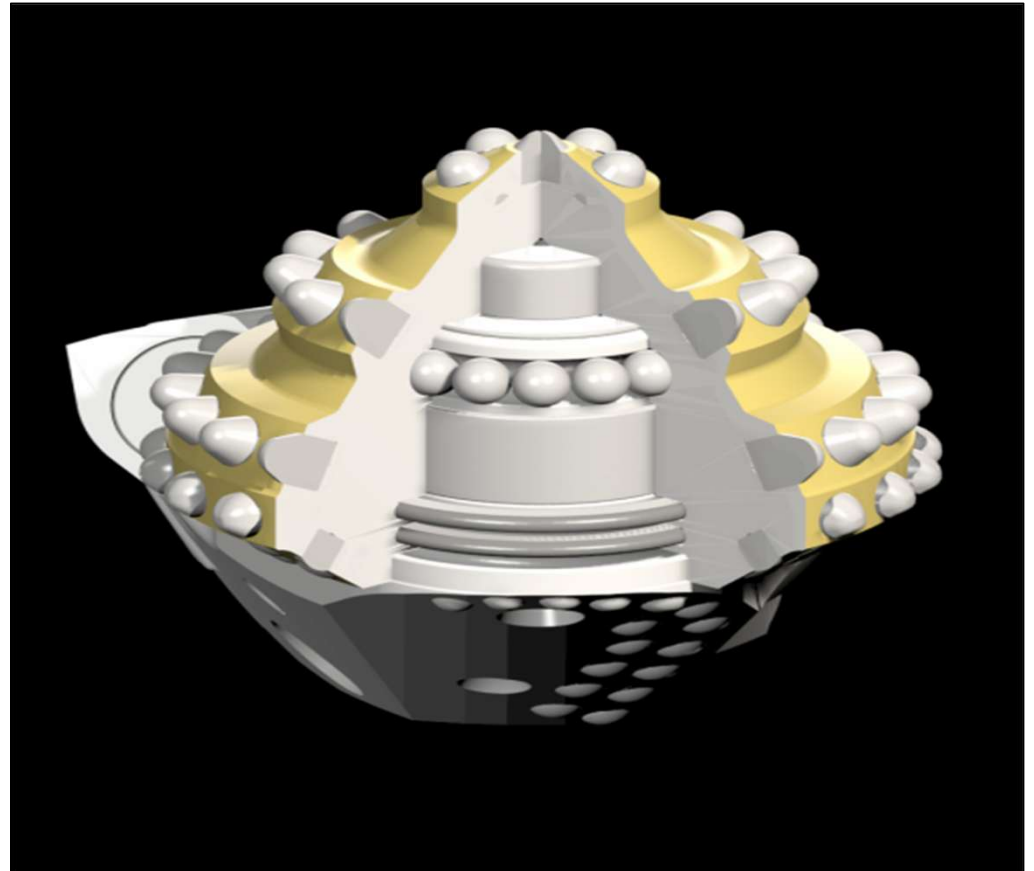
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Performance

- RPM
- Cutter ratio
- Tracking



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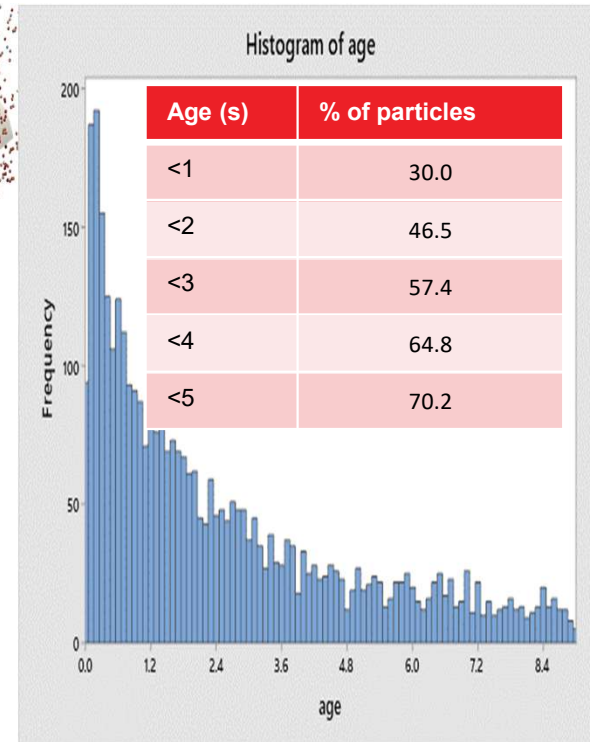
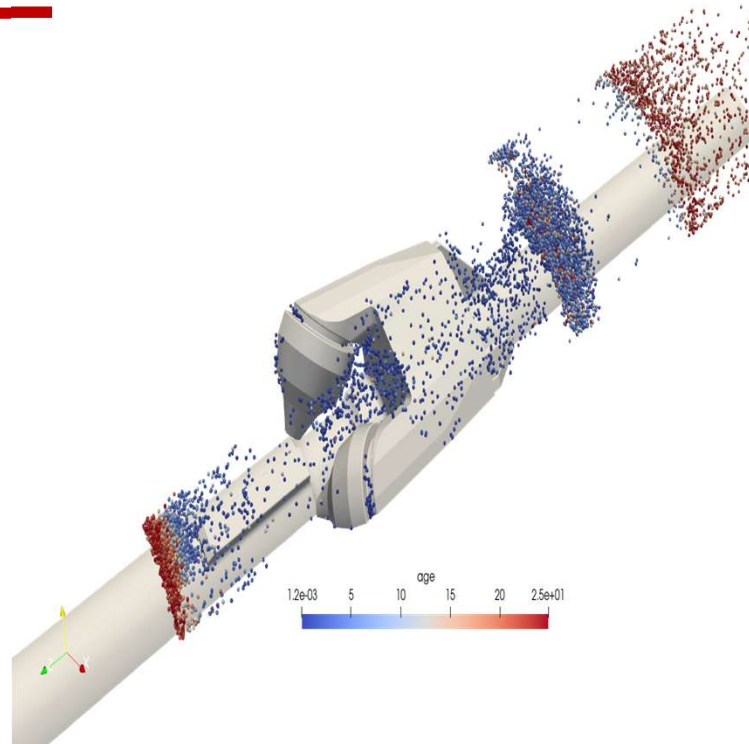
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Performance

- Hydraulics
- IF
- Velocities
- % of cuttings



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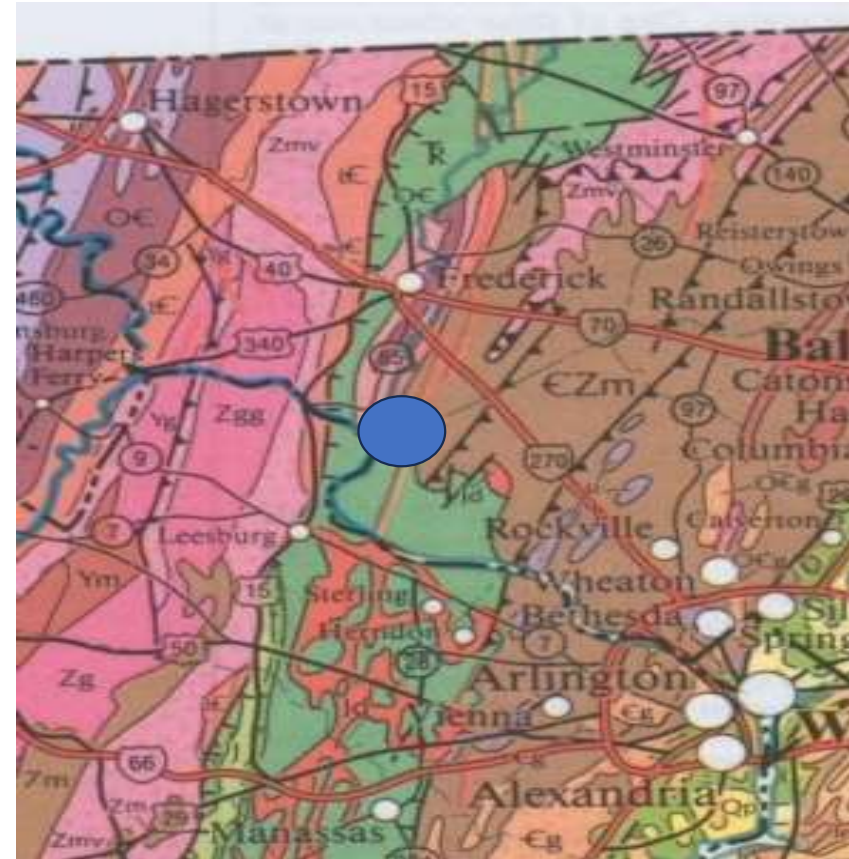
Profit

- Increase ROP
- Longer Tooling Life
- + Bottom Line



Job site Location

- Challenging Geological Makeup
- Metavolcanics-Metaryhyolite-Metabasalt-Granite
- Had experience in this area-did another bore last year right down the road
- Experience matters



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Our process

THE P'S-PROPER PLANNING PREVENTS POOR PERFORMANCE

- Rig Size (AA 440 on exit-AA240 on entry)
- DS55 Drill Pipe
- 600 GPM Capability-
Hydraulics
- Cutter Selection
- Expectations
- Arrive to site and inspect tool they've been running
- Discover (12) 20/32" nozzles in tool body
- Run Hydraulic #'s and share with client Jet Velocity of 52.3 ft/second
- Loaded MXR tool to achieve 198 ft/second



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Lowest Price per foot

Competitor 36" pass

- 27 Joints Drilled
- 134.64 Drilling Hours
- Average Rod Time of 299.19 min/jt
- Tripped for lack of performance

Inrock 36" MXR/HDX pass

- 86 Joints Drilled
- 115.1 Drilling Hours
- Average Rod Time of 82.24 min/jt
- 408,216 Cone Revolutions
- Beat the 24" competitor pass times of 143.9 min/jt



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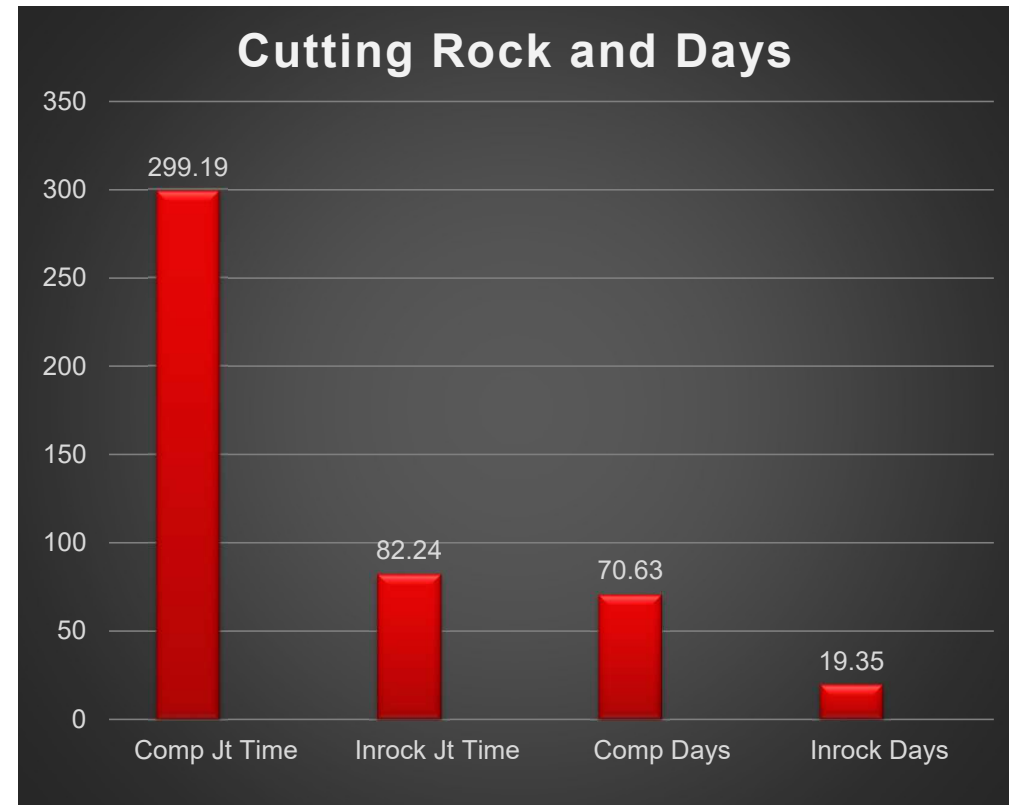
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Project Impact

- Head to head comparison-entry to exit MXR saved customer 51.28 days
- 2 rig spreads at \$25k/day each=\$2.56M in project savings
- 1 tool vs. 4 tools
- Exponential savings from trip outs for tool change



Can it be Done?

- 60K LB machine
- 6-1/2" PH to 18"
- Shale-Sandstone-Chert-Volcanics
- Normal process?
- A different solution



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Big Rig-Small Pipe

- 10" Pipe
- Reamer Options
- 8" motor
- 9-5/8" Bearing Stack
- 13-3/4" Bit



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Driving Forward

- HDD History
- Innovation
- Future Shaping
- Endless Possibilities



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Thank You!

Q & A

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