Load & Haul
Practical Cost Improvement
Volvo Construction Equipment
Course Agenda

• Purpose and Goal
• A Test
• Where’s the Money??
• Practical Cost Improvement
  • Big Idea
  • Additional Ideas
• Conclusion
Course Purpose

- Provide simple, but tangible ideas to improve productivity or costs of your current mobile fleet.

- Important - This is an open dialogue, not a lecture.

Course Goal

- Deliver at least 2-3 ideas for basic but significant improvement in your operations.
Load & Haul

A Test

Producer Price Indices (PPI)

Index

Source: US Dept of Labor
A Test

Producer Price Indices (PPI)

Source: US Dept of Labor
Load & Haul

Observations
- **Prices** → Moving in the good direction
- **Cost** → Moving also, which direction? → with higher fluctuation.

Managing Costs - Key to:
- Business viability?
- Competitive advantage?

Ways to improve
- Change what you do,
- Change how you do it,
- Change what you use to do it.
Load & Haul

What is an O & O?

- Est. Ownership and Operating Costs

  “Fixed” Ownership = Cost of capital or asset . . .

  “Variable” Operating = Cost of operating the asset . .

  Usually expressed as $ per hour.
Load & Haul

Estimated O&O Costs

Where’s the Money ??

40 ton Articulated Hauler
$113.19/hr

Operator 18%
Depreciation 21%
Repair & Maintenance 9%
Tires/Tracks 10%
Fuel 30%

100 ton Rigid Truck
$195.59/hr

Operator 10%
Depreciation 21%
Repair & Maintenance 11%
Tires/Tracks 11%
Interest, Tax, Insurance 13%
Fuel 35%

50 ton Wheel Loader
$132.08/hr

Operator 15%
Depreciation 23%
Repair & Maintenance 12%
Tires/Tracks 11%
Interest, Tax, Insurance 14%
Fuel 26%

Assumptions
- 20,000 hrs
- $20/hr operator wage
- $4.00/gal diesel

QUARRY ACADEMY
Load & Haul

Where’s the Money?

- Fuel → Consumption is your #1 opportunity, TODAY

What can you do about it???

- Fuel consumption depends on:
  - Machine applications,
  - Operator efficiency.
- Operators competency depends on:
  - Experience
  - TRAINING.

Operator Training
Measure
  → Benchmark
  → Continuous Improvement
  = Lowered Costs
THE BIG IDEA

Operator Training
- Something you can affect, today
- Good for safety, production, and accounting
- Good for operators career and well-being.

Training Success Stories
- Where real, tangible cost reductions were made.
- Common themes:
  - Measurement
  - Evaluation
  - Fleet benchmarking
Load & Haul – Operator Efficiency

Example #1  Sand Plant - 5 x wheel loaders (L110)
- Cost improvement desired by owner.

Actions Taken
- Contacted the local dealer
- Reviewed machine data history
- Checked assumptions
- Made a plan.
Load & Haul – Operator Efficiency

Example #1 Sand Plant - 5 x wheel loaders (L110)

Average fuel consumption per hour
Load & Haul – Operator Efficiency

Example #1  Sand Plant - 5 x wheel loaders (L110)

- One machine = +1.2 gal/hour more  →  +$9,600 more cost /year
  - **Over 5 years**  →  +$48,000 additional cost.

- **Actions Taken** – with dealer
  - Checked machine and operating conditions
  - Provided operator training.

**Result**  →  Pulled fuel burn back to fleet norm - with no loss in productivity.

**What Changed?**

- Training – work **with** the machine, not **against** it.
  - Better utilize high torque / low RPM engine & load-sensing hydraulics
    →  Noise/smoke don’t equal production.
  - Better bucket loading while burning less fuel.
Load & Haul – Operator Efficiency

Example #2  Compost Producer - 5 x wheel loaders (L180)

- Operator training provided as part of a continuous improvement program.
- **Before** Operator Training
  - Average fuel consumption 6.3 gal/hr
  - Average tire life 2,000 hr per set.
- **After** Operator Training
  - Average fuel consumption 4.7 gal/hr  (**1.6 gal/hr less**)  
  - Average tire life (est.) 4,000 hr per set.

- **Result** Fuel Savings per fleet **up to $64,000 per year**  
  (1.6 gal/hr x 5 units x 2,000 hr x $4.00/gal)
  → **Plus** additional savings from improved tire life...
Load & Haul – Operator Efficiency

Example #2  Compost Producer - 5 x wheel loaders (L180)

What changed?

- Recurring “pedal-to-the-metal” mentality:
  - Expensive in fuel and noise, but
  - Also tire life and component life.

- Utilized on-board data
  - **Targeted** the training
  - **Validated** the improvement
  - **Quantified** the improvement
  → Supports a fact-based business case, not opinion.
Load & Haul – Operator Efficiency

On-board Data
- Idle time and Engine speed
  What is a typical idle time (%) for a loader?
- Idle time – 30-55% typical on many sites.
  … Waiting on trucks, smoke breaks, lunch, shift change … it adds up.
Example #3 – Idle Time Impact

- **Typical Case**
  - 2,000 engine hr/year
  - 50% idle (1,000 hr work)

  After 5 years:
  - Hourmeter 10,000 hr
    - warranty status?
    - residual value?
    - engine/component life?
  - **Service Expense**
    - 20 x 500hr services
      (40 x if 250hr intervals)
  - **Operating Expense**
    - Fuel burn?

- **Improved Case – What If?**
  - 1,000 hr work + 33% idle
    → 1,500 engine hr/year

  After 5 years:
  - Hourmeter 7,500 hr
    - warranty status?
    - residual value?
    - engine/component life?
  - **Service Expense**
    - 15 x 500hr services
      (30 x if 250hr intervals)
  - **Operating Expense**
    - Fuel burn: 1500 gal less?

= The difference $ ___??

- **Example**
  - $20,000
    ± $ 9,000
  - ± $ 6,000
  = $35,000 +
Load & Haul – Operator Efficiency

Example #4 - Recycling yard 3 x Excavators (EC290)

- Working with grapples, busy jobsite, 3 shift operation
  - Remote-monitoring showed 30% idle time
- The owner proposed a trial operator incentive plan:
  - Share any fuel savings over a 90 day period.

- Results:
  - 15% reduction in idle time
    → saved 3 gal/machine/day → 810 gallons saved over the test period.
  - Reduced max engine RPM and utilized the auto-idle feature
    → saved 5 gal/machine/day → 1350 gallons saved over the test period.
- Total = 2,160 gallons saved over 90 days → $8,640 saved ($4.00/gal)
  → extrapolate to 1 year = $34,560
  → extrapolate to 5 yrs = $172,800.
Load & Haul – Operator Efficiency

Conclusions

- Expensive technology isn’t necessary to save fuel
  Optimize operator performance, TODAY
    → continuous training, monitor data and evaluate.
    → a little training $ can save a lot $$ in fuel.
    → Make an ROI!

- In these examples, savings potential **per unit over 5 years:**
  Ex #1  $ 48,000 saved per unit
  Ex #2  $ 64,000 saved per unit
  Ex #4  $ 57,600 saved per unit.
  ...in fuel alone. Plus tires and other benefits . . .

- How does this compare to your annual training budget??
Load & Haul – Operator Efficiency

But . . . ?

- “My operators are all professionals . . .”
  - “They share experiences and help each other . . .”
    - “I can rely on them to know what is best . . .”
    - “My guys have 20 years experience. They’ve seen it all . . .”
    - “We train every year . . .”

Separate Fact from Opinion!

Volvo Operator Evaluation

- Empirical study on behavior, variability, and performance:

  - **Tested** 73 operators, classified in 4 skill levels
  - **Metrics** Productivity, fuel efficiency, and performance in 3 wheel loader applications.
Load & Haul – Operator Efficiency

Volvo Operator Evaluation 2012

- 73 operators, self-graded 4 categories: Novice, average, inside professional, external professional.

3 Quarry Applications Tested

1. Rehandling
   (crushed stone)

2. Load & Carry
   (crushed stone)

3. Face Loading
   (blasted rock)
Load & Haul – Operator Efficiency

Volvo Operator Evaluation 2012

- 73 operators, 4 categories: Novice, average, inside professional, external professional.

Some Conclusions

A. Overlap between categories – reliable self-evaluation?

B. ‘Novices’ vs ‘professionals’:
   - Productivity varied up to 700%
   - Fuel efficiency varied up to 200%

C. Excluding ‘novices’:
   - Productivity still varied up to 300%
   - Fuel efficiency still varied up to 150%

D. Strong relation between experience and results
   - More experience (trained) = better results.

E. Variability within ‘professionals’ only!
   - Productivity varied over 100%
   - Fuel efficiency varied over 70%.
Load & Haul

Observations
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Managing Costs - Key to:
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- Change what you use to do it.

Operational Improvement
Load & Haul – Operational Improvement

Example #5 – Truck Loading
Example #5 – Truck Loading

As shown on video

Max Production (approx) *
- 23 trucks/hour
- 920 tons/hour (835 tph)
* 30 second spot time.

What If spot = 15 seconds?

Max Production (approx)
- 26 trucks/hour
- 1040 tons/hour (943 tph)
→ 13% improvement

+120 ton/hr x 8 hr/day = +960 ton/day = $ _____ ?
Example #5 – Truck Loading

+ Productivity
+ Safety

Load & Haul – Operational Improvement
Load & Haul – Operational Improvement

Example #5 – Truck Loading

- Backhoe excavator working on the pile

+ Productivity
+ Safety

15 second spot time
<20 second load cycle
Load & Haul – Operational Improvement

Example #6 – Optimal Truck Payload

- How many passes is best?
Example #6 – Optimal Truck Payload

- Coal mine, poor weather conditions
  - Fleet of 90t rigid dump trucks
  - 15.5 yd\(^3\) face shovel, poor digging/fill factor
    - 5 pass loading, slight overload
  - 1.2 mile main ramp out of pit
    - 10% grade + 5-7% rolling resistance.

- Truck Fleet Issues
  - Operating costs
  - Unscheduled downtime.
Load & Haul – Operational Improvement

Example #6 – Optimal Truck Payload
Example #6 – Optimal Truck Payload

Proposed Solution
- 4 full pass to 88 ton payload (vs. 5 lite passes to 101 ton).

Results
- 12% faster cycle time
- 25% less time on grade, utilizing 2 gears instead of one.
- Per unit truck production the same (99%) despite lower payload each cycle.

Potential Upside
- Higher shovel production → more fleet production potential.

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<th>As-Is</th>
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<td>Top road</td>
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<td>Turn/Dump</td>
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<td>Spot Time</td>
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<tr>
<td><strong>Total</strong></td>
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Unit Truck Production
- Cycles/50 min hour: 1.61 vs. 1.84
- Unit Production (Tph): 162.9 vs. 161.9 (99%)

Theoretical Shovel Production
- Trucks/Hour Capacity: 15 vs. 19
- Hourly Production (Tph): 1,239.0 vs. 1,340.0 (108%)
Example #7 - The Impact of Attachments

Consider Yard Operations

- Loading crushed stone from a stockpile = “Rehandling”

- **Rehandling is a unique application**
  - Flat, maintained area
  - Consistent material and digging conditions
  - Varied loading points
  - Traffic Zone?

- Old(er) machines, often with a GP or rock bucket?
  - GP = General Purpose

→ **A purpose-built re-handling package**
  = +7% efficiency vs. GP bucket.
Example #7 - The Impact of Attachments

- For a fleet of 20 x yard loaders → 7% = $74,000 per year savings.
- If a loader consumes 6.6 gph → 7% = $3,700 per year savings.
Example #8 - The Impact of Tires

Match the Tire to the Job

- Tread pattern, tread depth, rubber compound.

Consider Load & Carry

- Which is ‘right’ for the job? What’s the cost of mis-application?
Load & Haul – Operational Improvement

Example #8 - The Impact of Tires

Match the Tire to the Job – Load & Carry

![Graph showing fuel consumption vs. carry distance for L5 and L3 tread depths.]

L3
Regular Tread
E-2/E-3
L-2L-3
G-2/G-3

L5
Extra-Deep Tread
L-5/L-5S

Fuel Consumption (gph)
Carry Distance (ft)
0 100 200 300 400 500
6.5 7.5 8.5 9.5

L5 Tread
L3 Tread

+18%

= $11,989 / year!
(6% of cost/ton)
Example #9 – Operational Layout

- Load & Carry vs. Load & Haul
  - Do you need trucks?

Potential Benefits
- Less operators, less traffic
- Better utilization
- Different ramp/hopper design

Economics – depends on travel distance
- Traditional Break Even: 50-120m (150-400’)
- Today: +/-200m (650’).
  - Why?
Load & Carry vs. Load & Haul

Production (Tph) vs. Carry Distance (ft)

L350F Tph vs. L180F+A25E Tph

L350F Cost vs. L180F+A25E Cost

Load & Haul – Operational Improvement
Final Conclusions

- **Cost efficiency**
  - Fuel consumption is key
  - Invest in your operators – it’s worth it!
  - Leverage monitoring data
  - Continuous, systematic training

- **Optimize operations**
  - Traffic fundamentals
  - Payload matters
  - Get the specs right for the job
    - cost vs. benefit

- **Fleet considerations**
  - Viability of load & carry vs. short hauls.

Thank You!  Questions?

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