Load & Haul

Practical Cost Reduction

Volvo Construction Equipment

QUARRY ACADEMY

Improving Processes. Instilling Expertise.

Course Agenda

- Purpose and Goal
- A Test
- Where's the money??
- Practical cost improvement
  - "today"
  - "tomorrow"
- Conclusion

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Load & Haul – What can you affect “today”

Course Purpose

- Quick hitting ideas to Improve productivity or lower costs of your current mobile fleet.
- **Important** - This is an open dialogue , not a lecture.

Goal

- Take home at least 2-3 ideas for basic but significant improvement in your operations.

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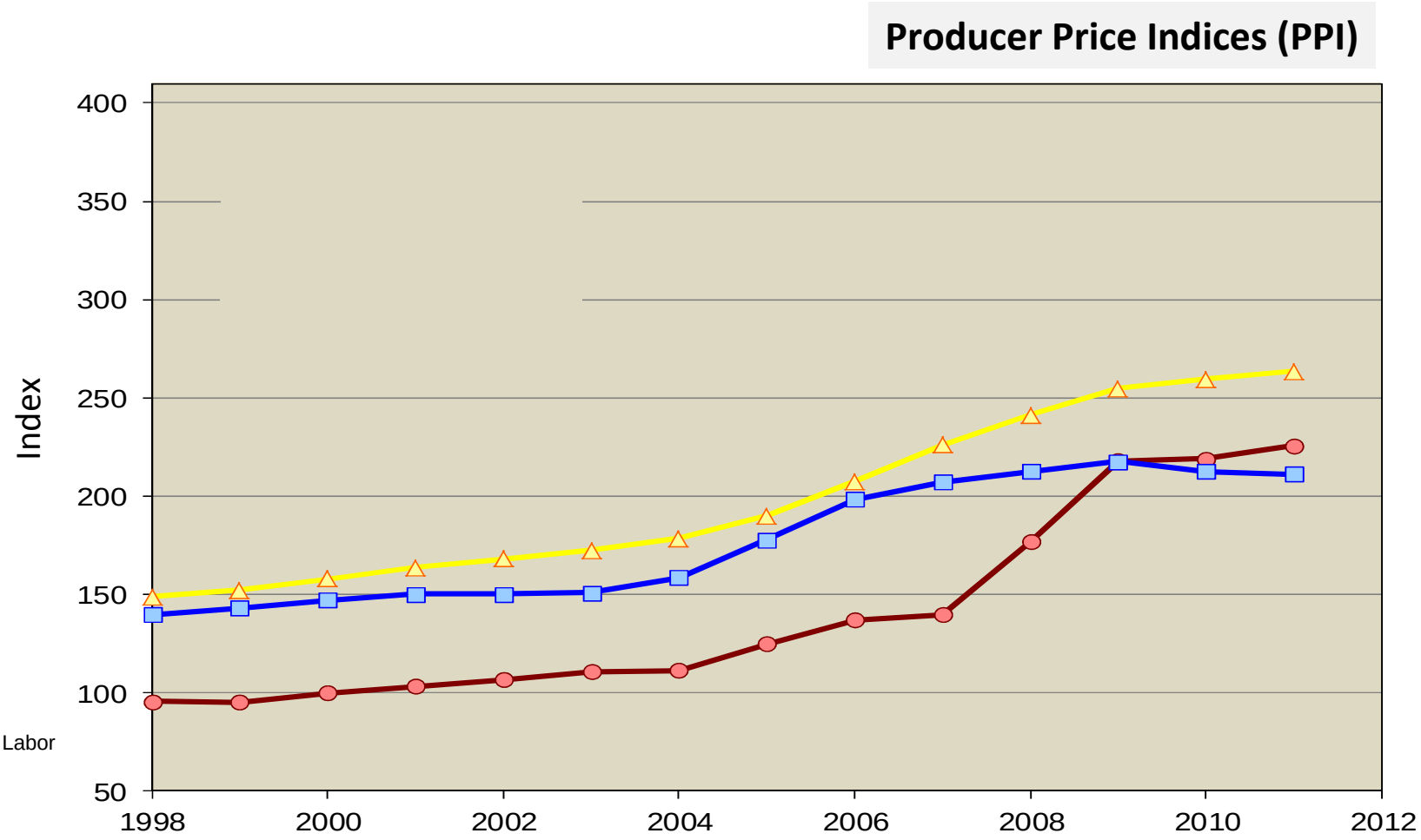
A Test



Source:
US Dept of Labor

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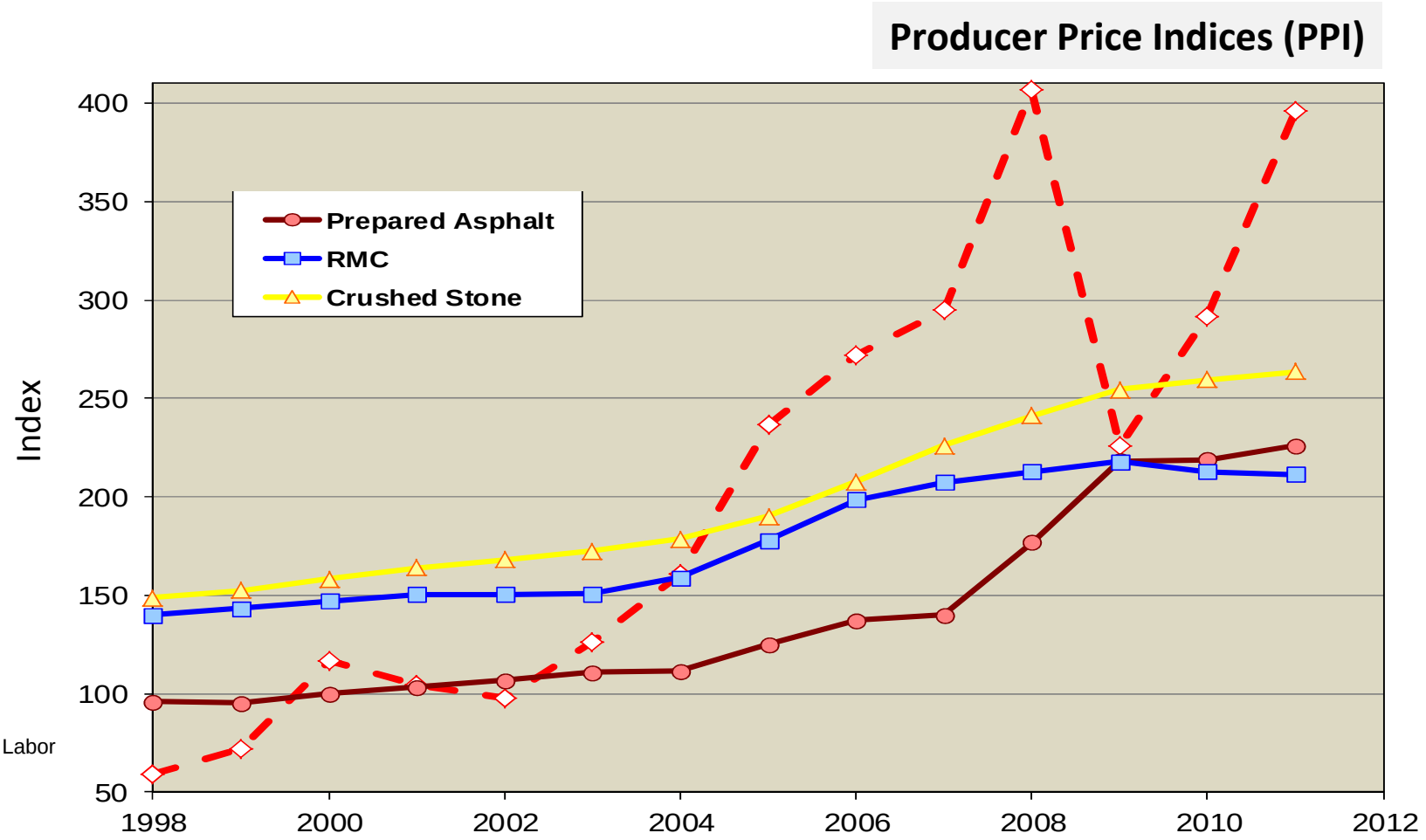
A Test



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Conclusion

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

Managing Costs - Key to:

- Business viability ?
- Competitive advantage ?

Ways to improve operationally

- Change **what** you do,
- Change **how** you do it,
- Change what you **use** to do it.

- **Focus for "today" or the short term.**

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What is an O & O ?

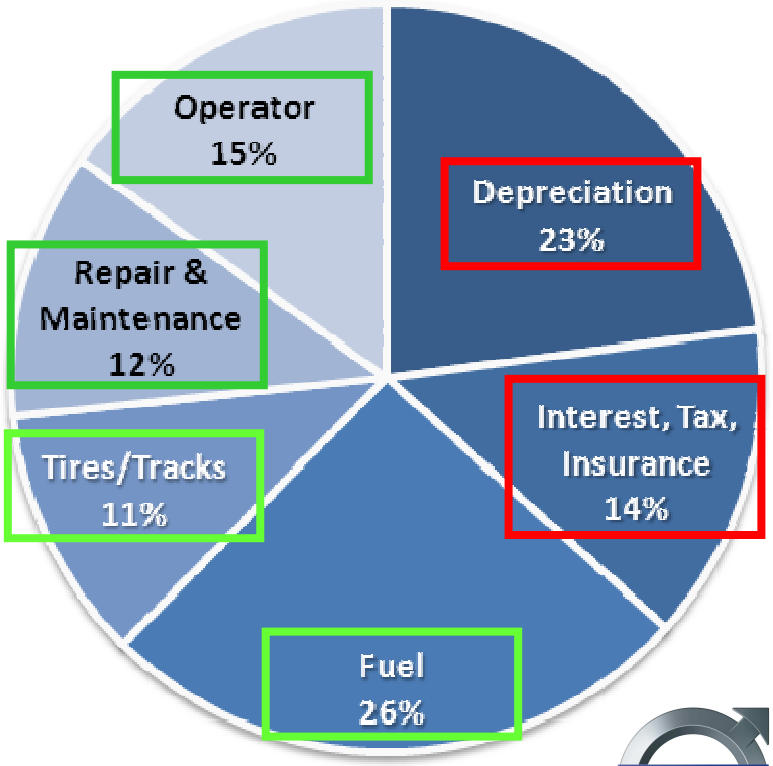
- Est. Ownership and Operating Costs

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

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

.

Usually expressed as $ per hour.



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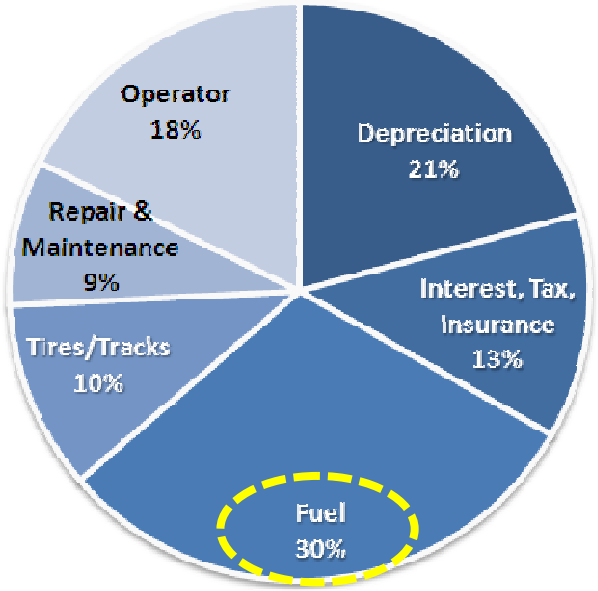
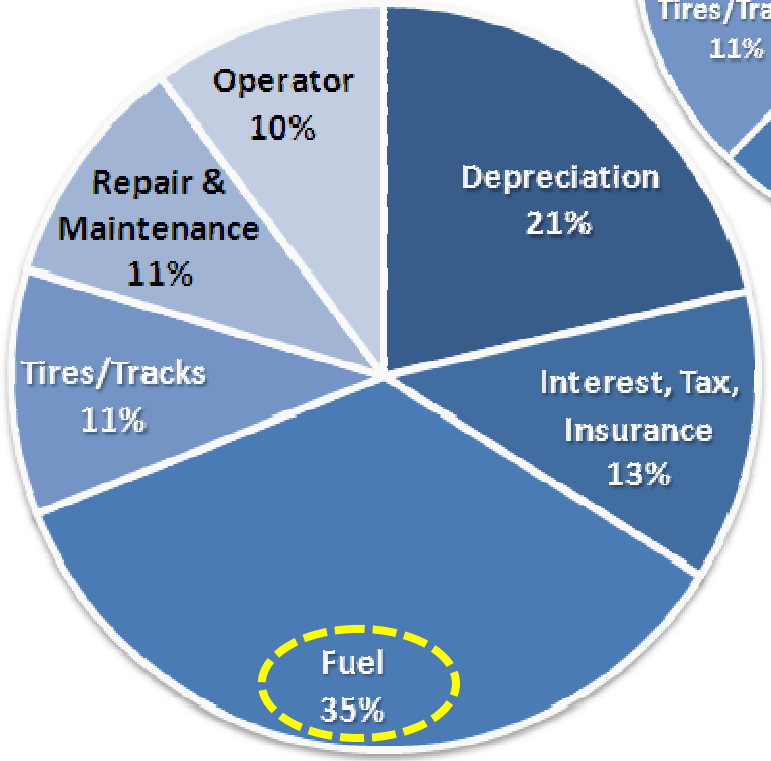
Where's the Money ??

Estimated O&O Costs

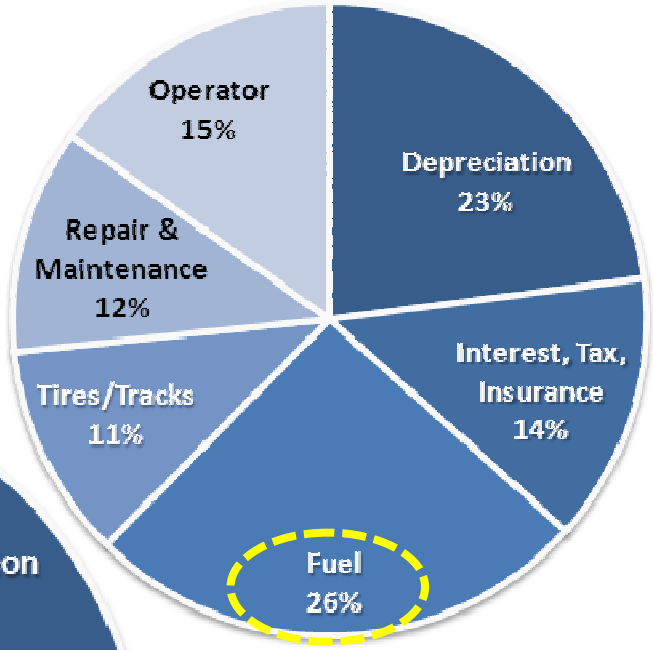
40 ton Articulated Hauler
$113.19/hr



100 ton Rigid Truck
$195.59/hr



50 ton Wheel Loader
$132.08/hr



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

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Where's the Money ??

- **Fuel** → Consumption is your #1 opportunity, **TODAY**

What can you do about it ???

Operator Training

Measure
→ Benchmark
→ Continuous Improvement

= Lowered Costs

Conclusions

- Fuel consumption depends on:
  - What machine is doing
  - Operator efficiency.
- Operators competency depends on:
  - Experience
  - **TRAINING.**

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Practical Approaches - TODAY

Operator Training

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

Success Stories

- Where real, tangible cost reductions were made.
- Common themes:
  - Measurements
  - Evaluation
  - Fleet benchmarking

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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.

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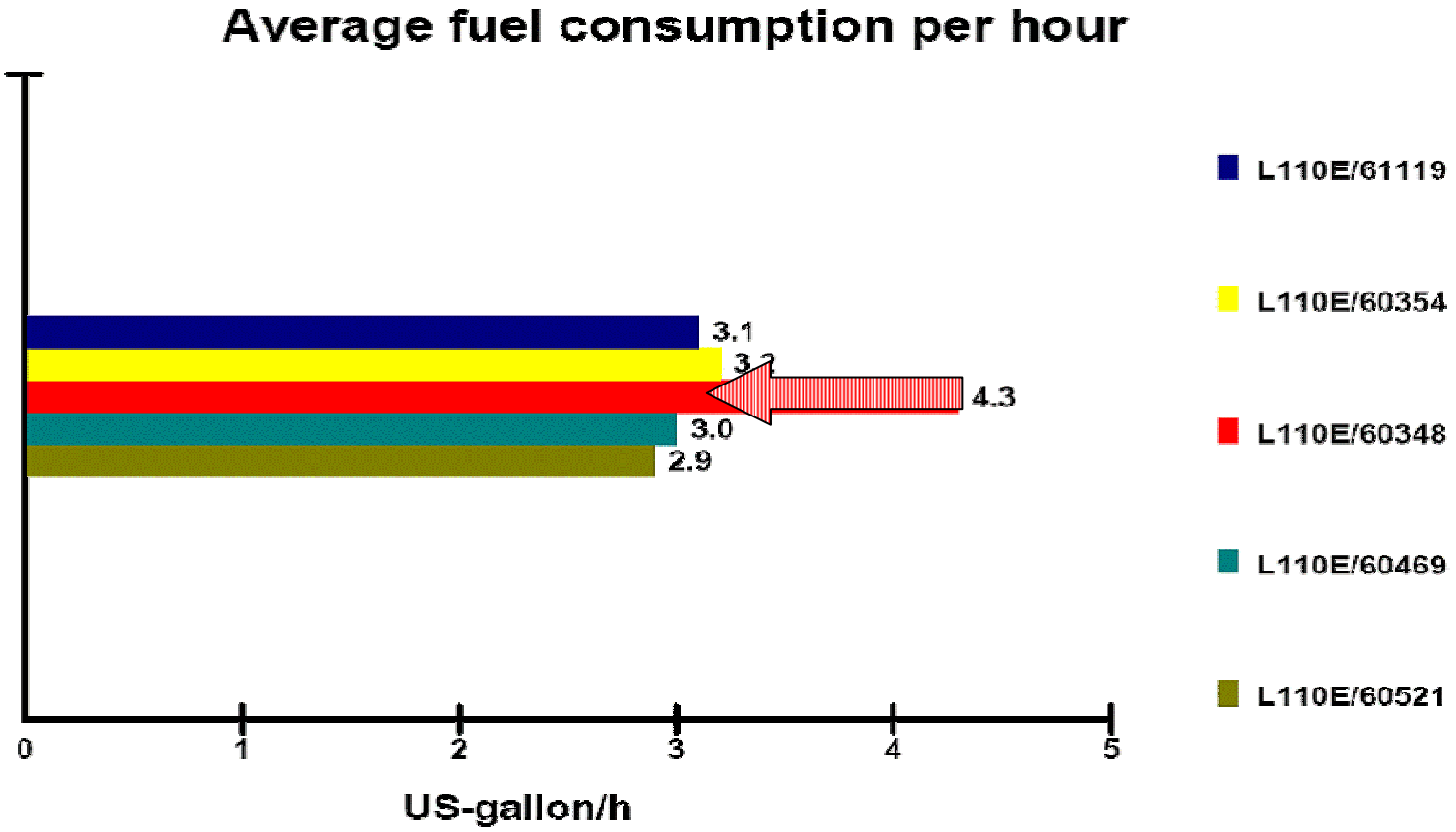
Load & Haul – Operator Efficiency

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



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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.**
- **Next 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.

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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. . .**

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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.

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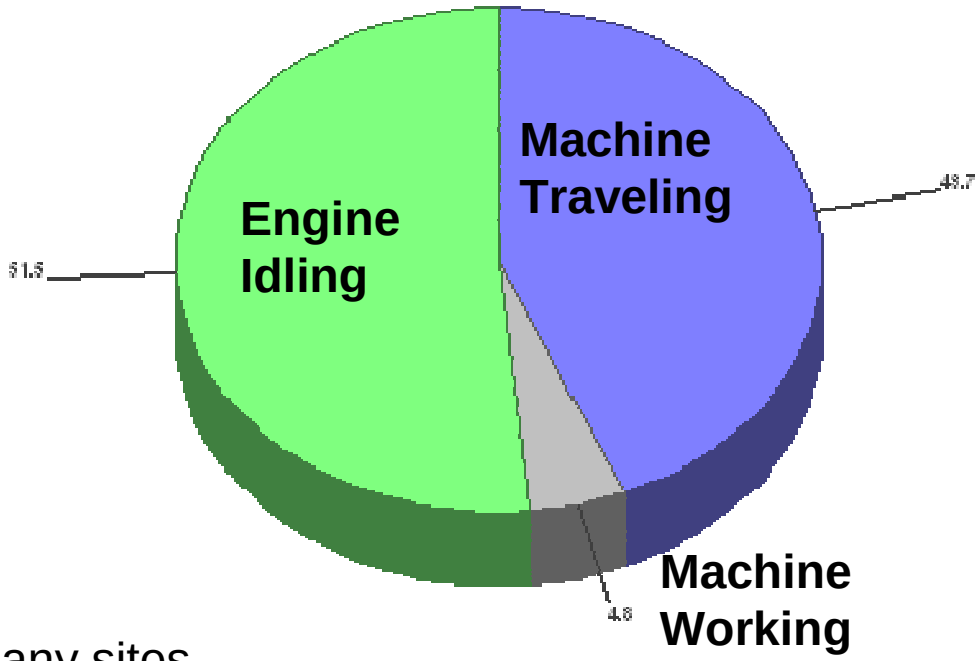
Load & Haul – Operator Efficiency

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!

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Load & Haul – Operator Efficiency

Example #3 – Idle Time Impact

- **Typical Case**
  - 50% idle time
  - 2,000 engine hr/year

After 5 years:

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

- **Improved Case**
  - **25%** idle time

→ **1,500** engine hr/year

After 5 years:

  - **7,500** hrs
    – 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+

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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 made 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.

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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 the training examples, savings potential per unit over 5 years:**

  Ex #1 **$ 48,000** saved per unit

  Ex #2 **$ 64,000** saved per unit

  Ex #3 **$ 57,600** saved per unit.

  …in fuel alone. Plus tires and other benefits . . .

- **How does this compare to your annual training budget??**

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Load & Haul – Operator Efficiency

But . . . ?

- "My operators are all professionals . . ."
  - "They get training whenever they need it . . ."
    - "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 2012

- Comprehensive, empirical study on behavior, variability, and outcomes
- **Tested** 73 operators, classified in 4 skill levels:
  - Novice, average, inside professional, external professional.
- **Metrics** Productivity, fuel efficiency, and performance in wheel loader 3 applications.

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Load & Haul – Operator Efficiency

Volvo Operator Evaluation 2012

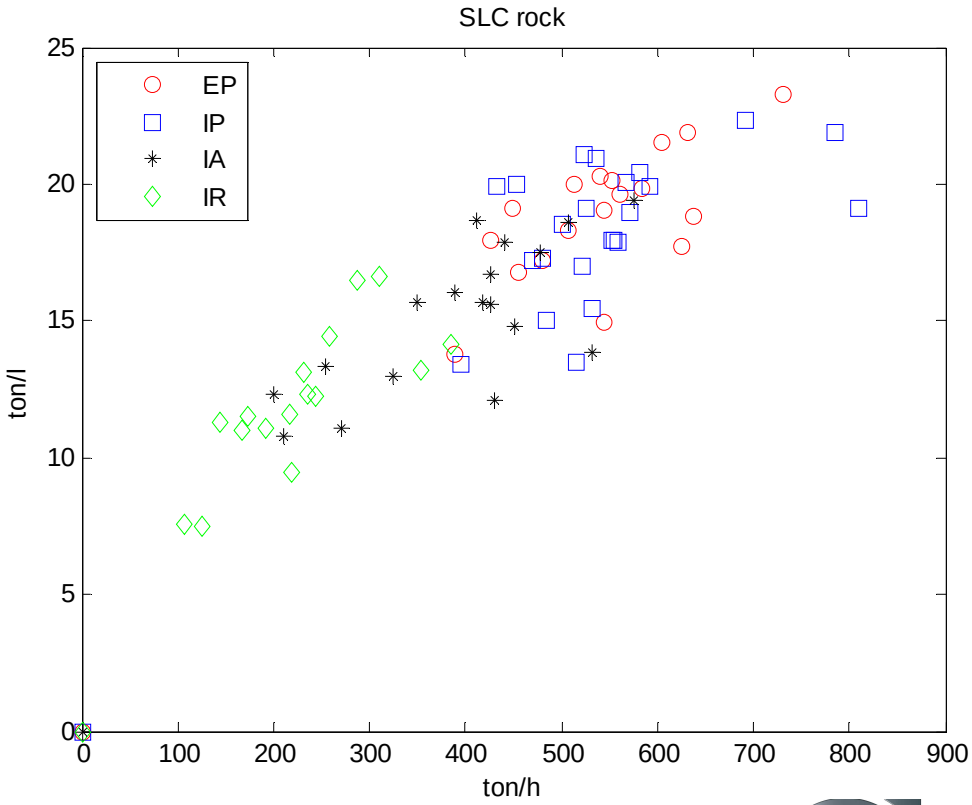
- 73 operators : Novice, average, inside professional, external professional.

3 Quarry Applications Tested

1. **Rehandling**
   (crushed stone)

2. **Load & Carry**
   (crushed stone)

3. **Face Loading**
   (blasted rock)



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Load & Haul – Operator Efficiency

Volvo Operator Evaluation 2012

- 73 operators : Novice, average, inside professional, external professional.
- 3 quarry applications: rehandling, load & carry, face loading.

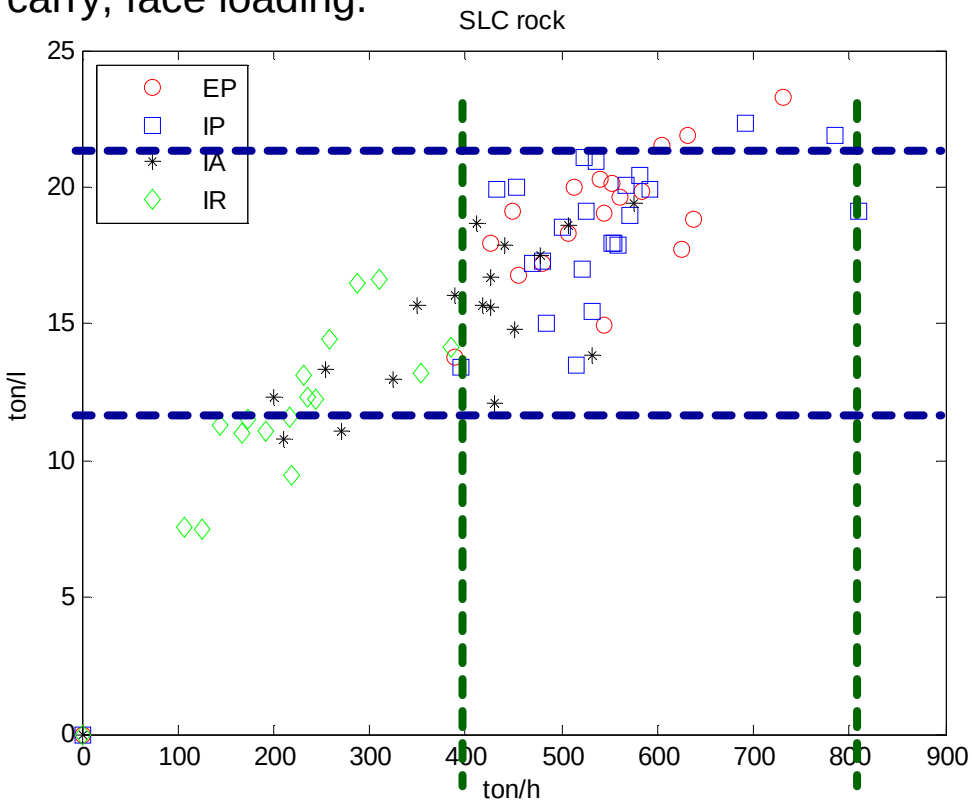
Some Conclusions I

A. Between 'novices' and 'professionals':
- Productivity varied as much as 700%
- Fuel efficiency varied as much as 200%

B. Excluding 'novices':
- Productivity still varied as much as 300%
- Fuel efficiency still varied as much as 150%

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

D. Variability within 'professionals' only!
- Productivity varied **over 100%**
- Fuel efficiency varied **over 70%.**



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Load & Haul – Operator Efficiency

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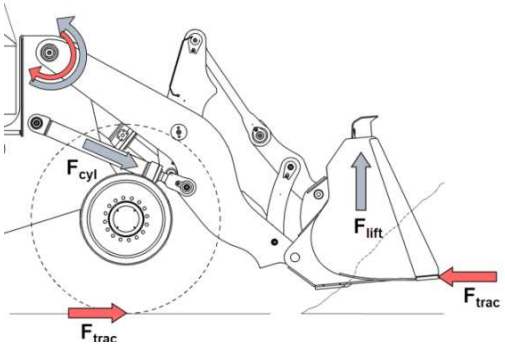


Some Conclusions II

E. Fuel efficiency

- Filling the bucket is most critical
  → fuel burn, fill factor.

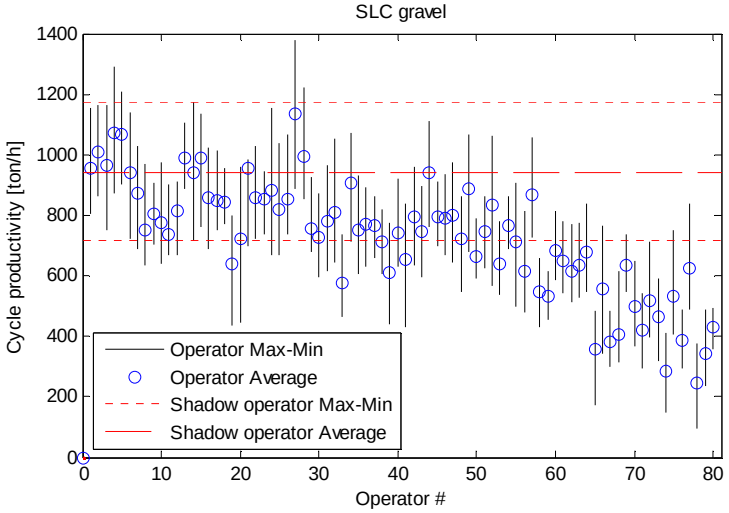
F. Value of experience varies with application

- Face loading – most affected → fill factor and time
- Load & carry – strongly affected (same reasons)
- Rehandling – least affected (easy to fill bucket)

G. Results can vary, a lot, for an individual operator

- Productivity can vary +/- 10%
- Fuel efficiency can vary +/- 15%

[END 1st portion]



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Load & Haul – What can you affect “tomorrow”

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- Quick hitting ideas to Improve productivity or lower costs of your current mobile fleet.
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Ways to improve operationally

- Change **what** you do,
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- **Focus for “tomorrow” or the long(er) term.**
- **Optimize operations.**

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Load & Haul – Optimize Operations

Example #5 – Truck Loading

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Load & Haul – Optimize Operations

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 = $ _____ ?

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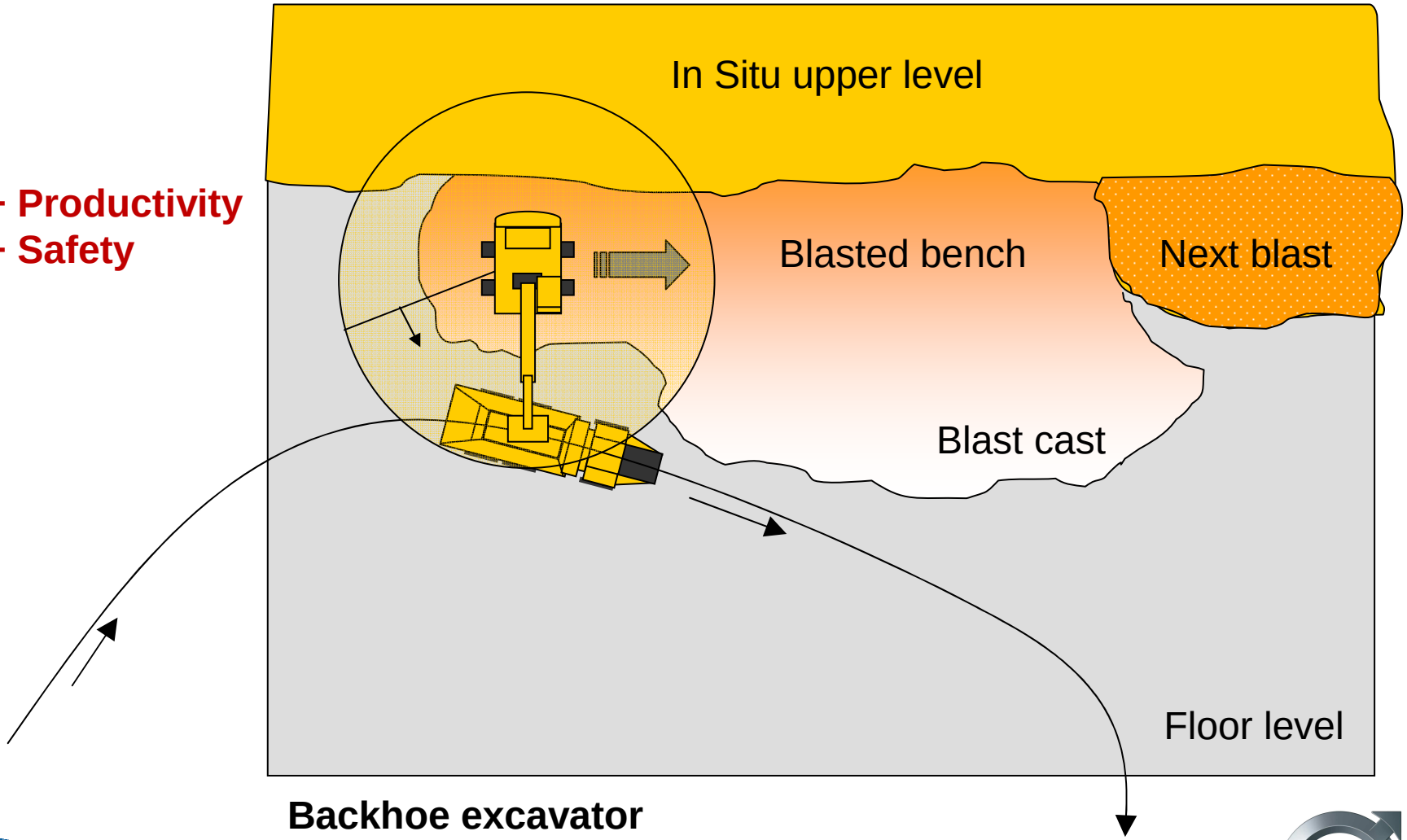
Load & Haul – Optimize Operations

Example #5 – Truck Loading

+ Productivity
+ Safety



Backhoe excavator working on the pile

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Example #5 – Truck Loading

- Backhoe excavator working on the pile

+ Productivity
+ Safety

15 second spot time
<20 second load cycle

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Example #6 – Optimal Truck Payload

- How many passes is best?

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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.

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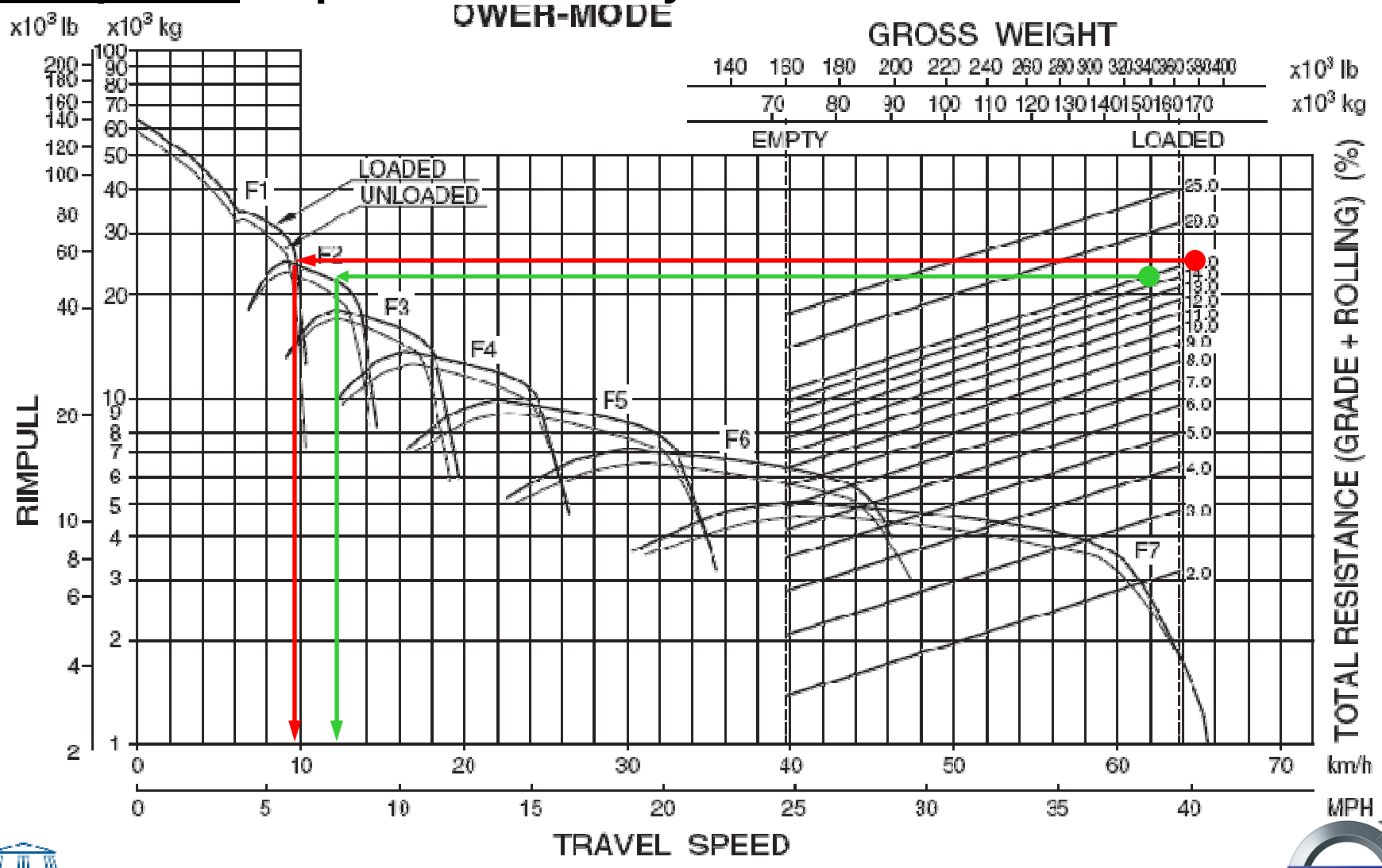
Example #6 – Optimal Truck Payload



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Example #6 – Optimal Truck Payload

Proposed Solution

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

Results

- Faster cycle time by 12%
- Dramatically less time on grade, utilizing 2 gears instead of one.
- Despite lower payload, unit truck production the same (99%).

Potential Upside

- Higher shovel production

→ more fleet production potential.

	Case A	Case B
	5 pass	4 pass
Payload T	**101**	**88**

Truck Cycle Time		min	min
Load Time		**2.7**	**2.2**
Haul	pit floor	1.0	1.0
	main ramp	**13.3**	**10.0**
	top road	2.0	2.0
Turn/Dump		1.5	1.5
Return	top road	2.0	2.0
	main ramp	7.0	7.0
	pit floor	1.0	1.0
Spot Time		0.5	0.5
Total		**31.0**	**27.2**

88%

Unit Truck Production		
Cycles/50 min hour	1.61	1.84
Unit Production (Tph)	**162.9**	**161.9**

99%

Theoretical Shovel Production		
Trucks/Hour Capacity	15	19
Hourly Production (Tph)	**1,239.0**	**1,340.0**

108%

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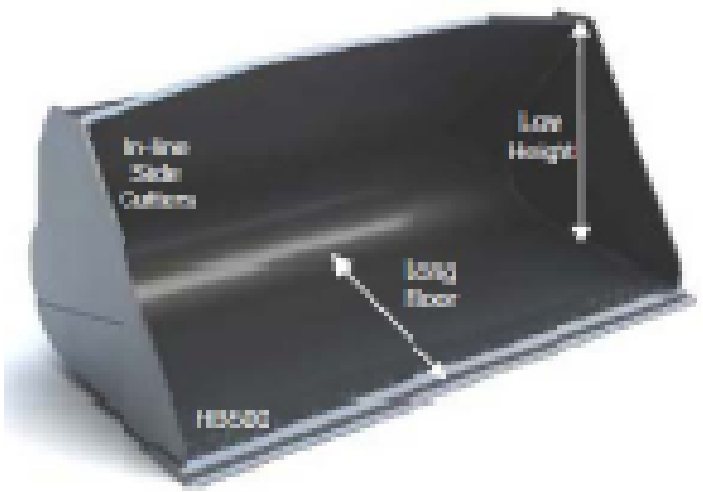
Example #7 - The Impact of Attachments

Consider Yard Operations

- Loading crushed stone from a stockpile



- **Rehandling = a unique application**
  - Old(er) machines, often with a GP or rock bucket?

→ A purpose-built re-handling package = 7%+ efficiency vs. GP bucket.

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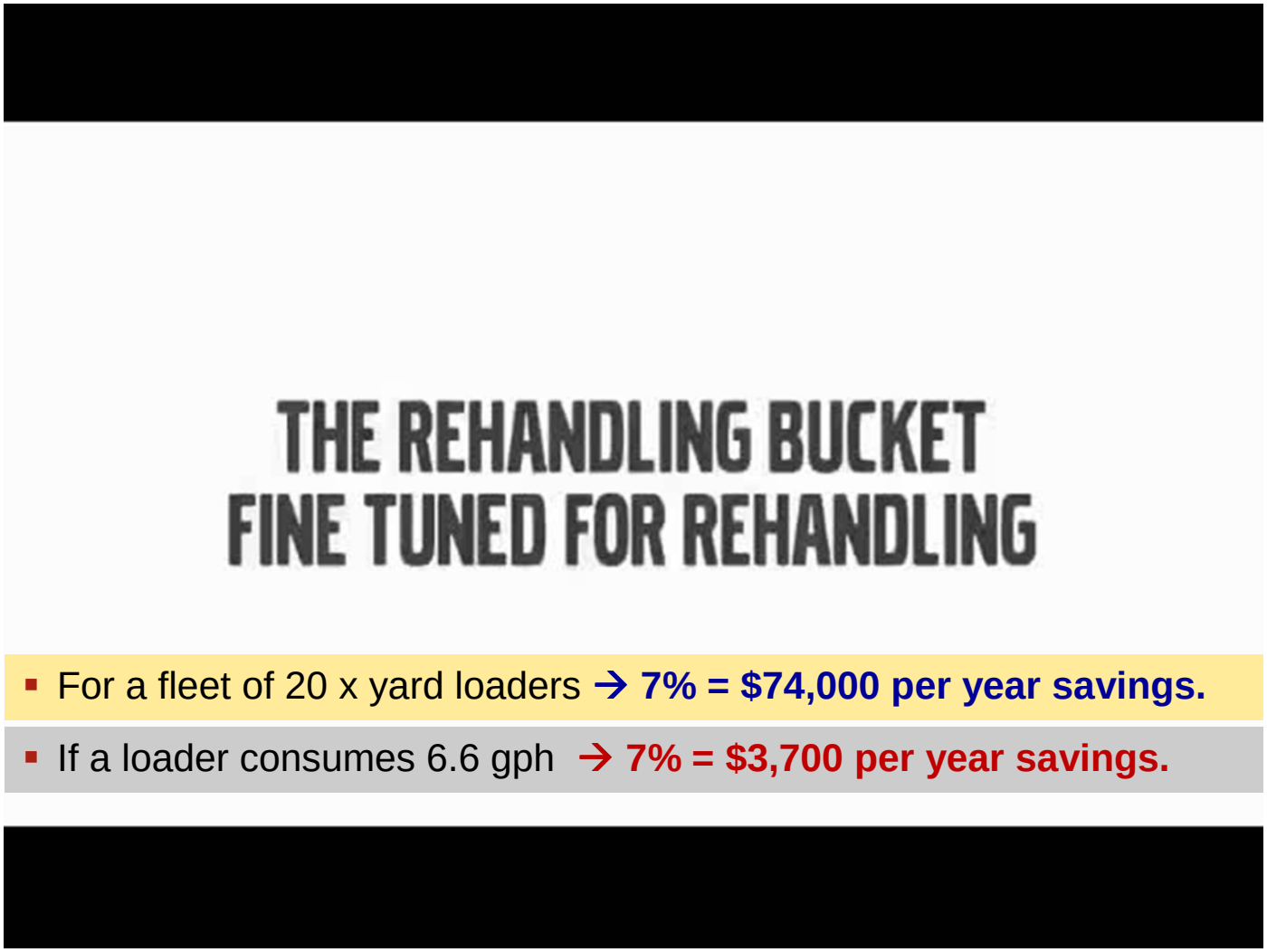
Example #7 - The Impact of Attachments



- 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.**

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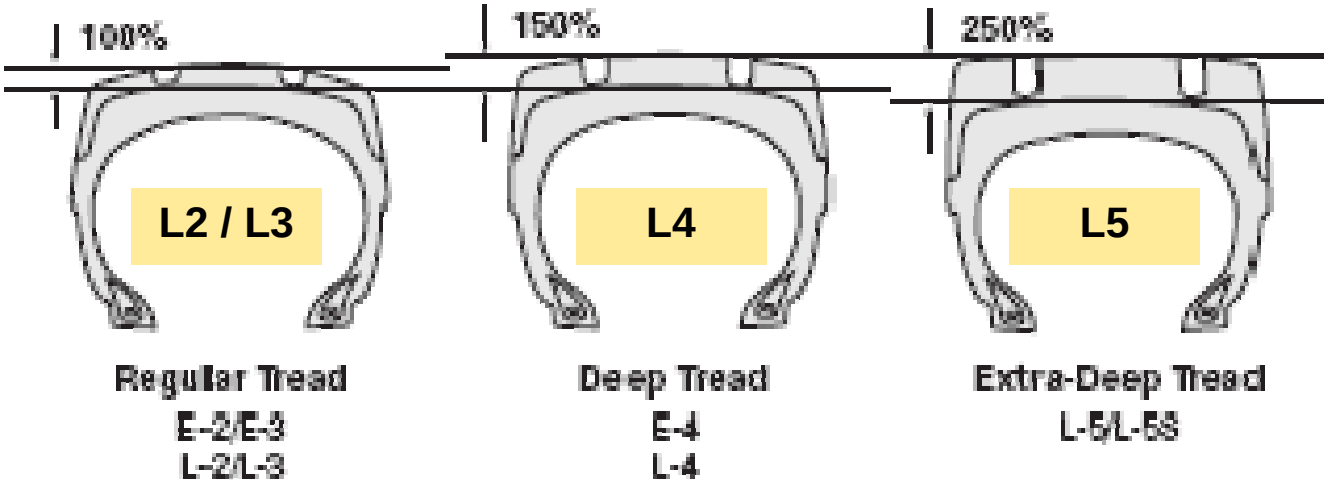
Example #8 - The Impact of Tires

Match the Tire to the Job

- Tread pattern, tread depth, rubber compound.



Consider Load & Carry

- Which is 'right' for this job?
- What's the cost of misapplication?

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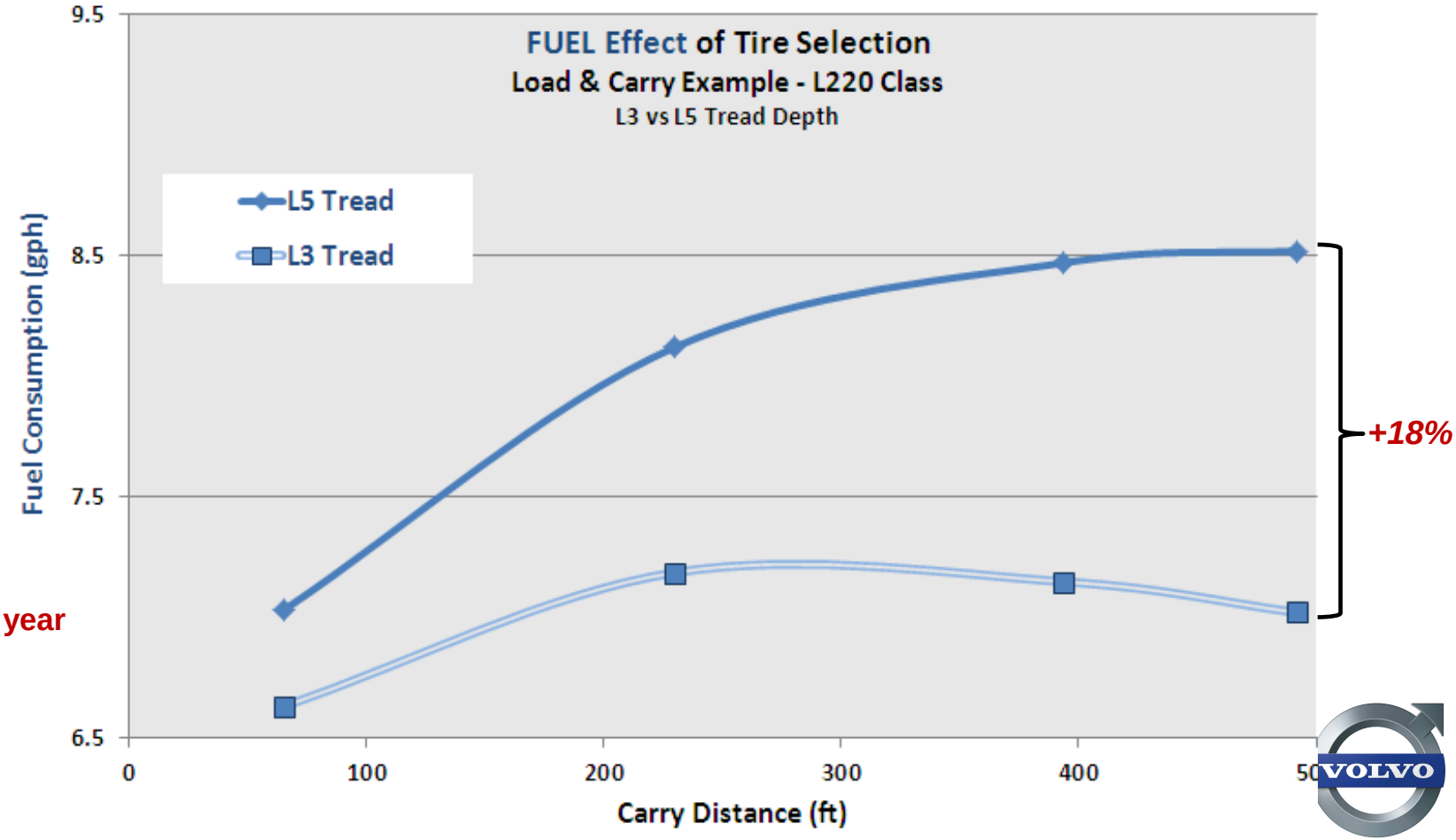
Example #8 - The Impact of Tires

Match the Tire to the Job – Load & Carry



= $11,989 / year !

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Load & Haul – Optimize Operations

Example #8 - The Impact of Tires

Match the Tire to the Job – Load & Carry

Load & Haul – Optimize Operations

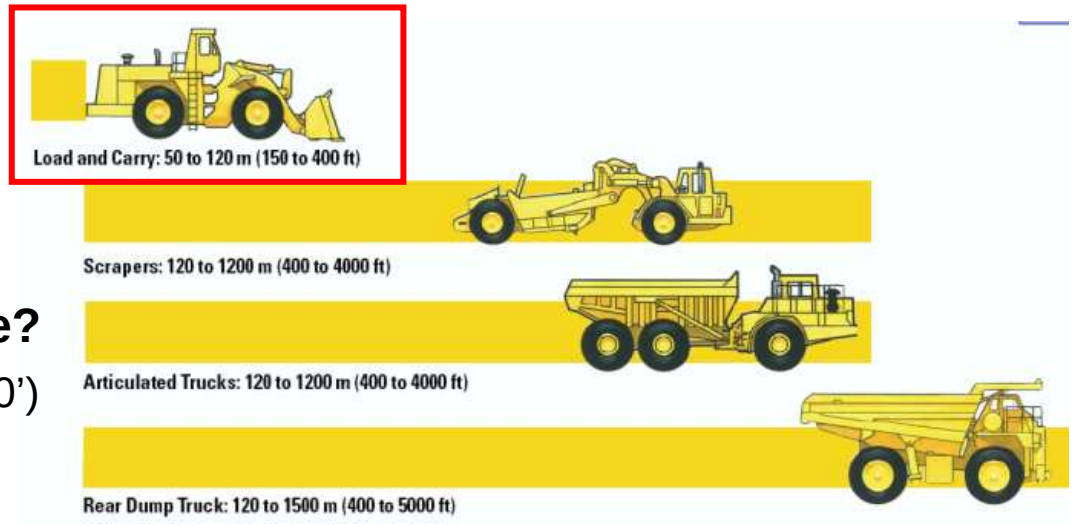
Example #9 – Operational Layout

- Load & Carry vs. Load & Haul

  → Do you need trucks?

Potential Benefits

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



What is the break-even distance?

- Traditionally: 50-120m (150-400')
- **Today: +/-200m (650').**
  Why?

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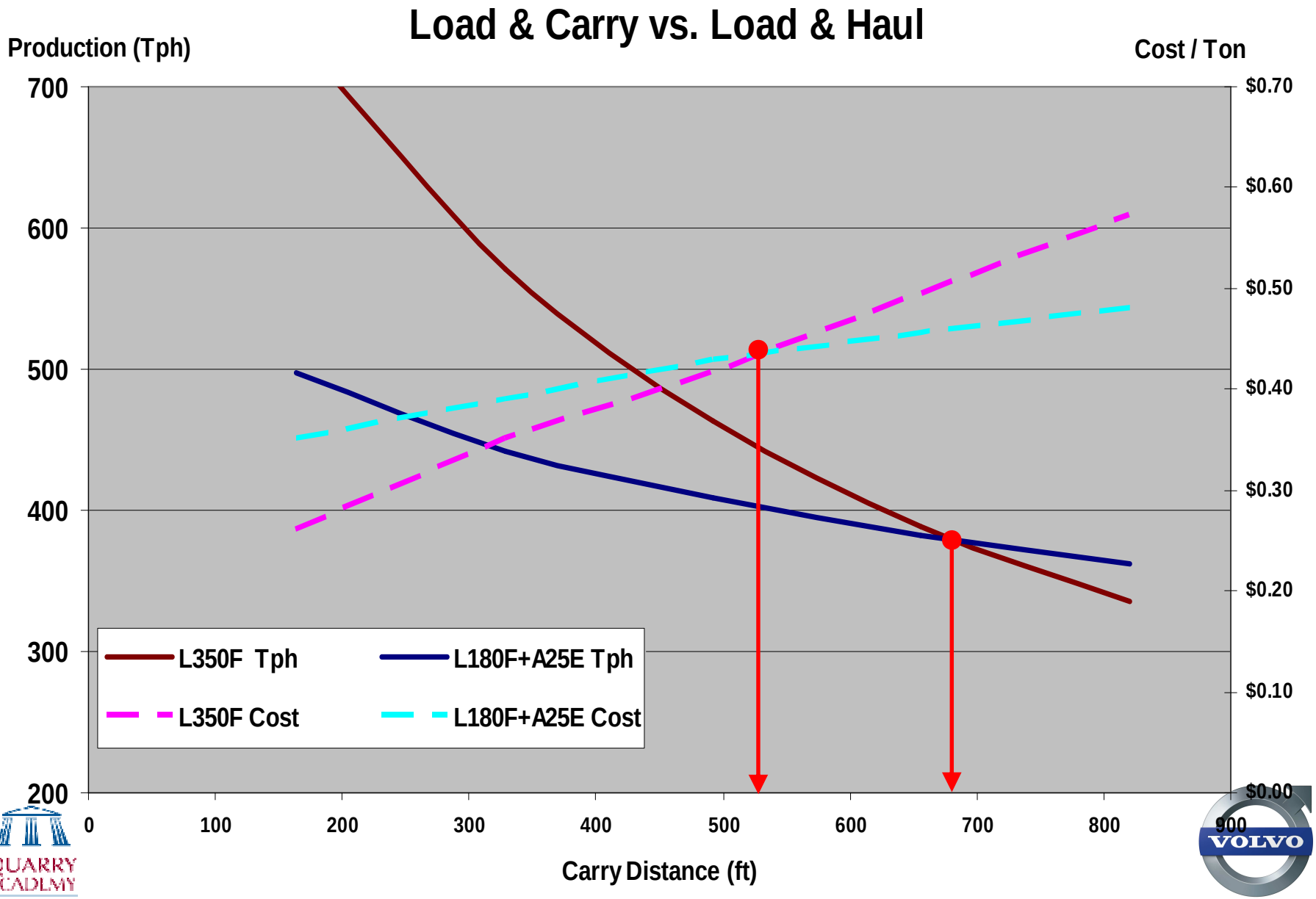

Load & Haul – Optimize Operations

Last Example! – Operational Layout

Purchasing Criteria

- Do you test or demonstrate?
- It can pay to do some homework …

Pit Loading Test Results	Loader A	Loader B	Loader C	Loader D
Production (Tph)	**975** *100%*	**883** *91%*	**848** *87%*	**865** *89%*
Consumption (gph)	**15.3**	**19.4**	**16.8**	**23.7**
Efficiency (Tpg)	**63.9** *100%*	**45.6** *71%*	**50.6** *79%*	**36.6** *57%*

- A little can mean a lot. Do the math!
- Example:
  - 825 ton per year
  - 1 year (2,000 hr)

Example: 825 Tph	Loader A	Loader B	Loader C	Loader D
Gallons Consumed	25,834	36,197	32,615	45,142
Annual Cost	**$ 103,335**	**$ 144,789**	**$ 130,459**	**$ 180,568**
Difference		$ 41,454	$ 27,124	$ 77,232

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Load & Haul – Optimize Operations

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 pattern fundamentals
  - Loading match/payload matters
  - Get the specs right for the job
    - cost vs. benefit
- **Future considerations**
  - Viability of load & carry for short hauls
  - Test, if you can!

Thank You! Questions?

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