Haul & Load – Practical Cost Reduction

Volvo Construction Equipment

Course Agenda

- Purpose and Goal
- A Test
- Where's the Money?
- Examples of practical cost improvement 'today'
- Examples of practical cost improvement for 'tomorrow'
- Conclusion

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Haul & Load

Practical Cost Reduction

Course Purpose

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

Course Goal

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

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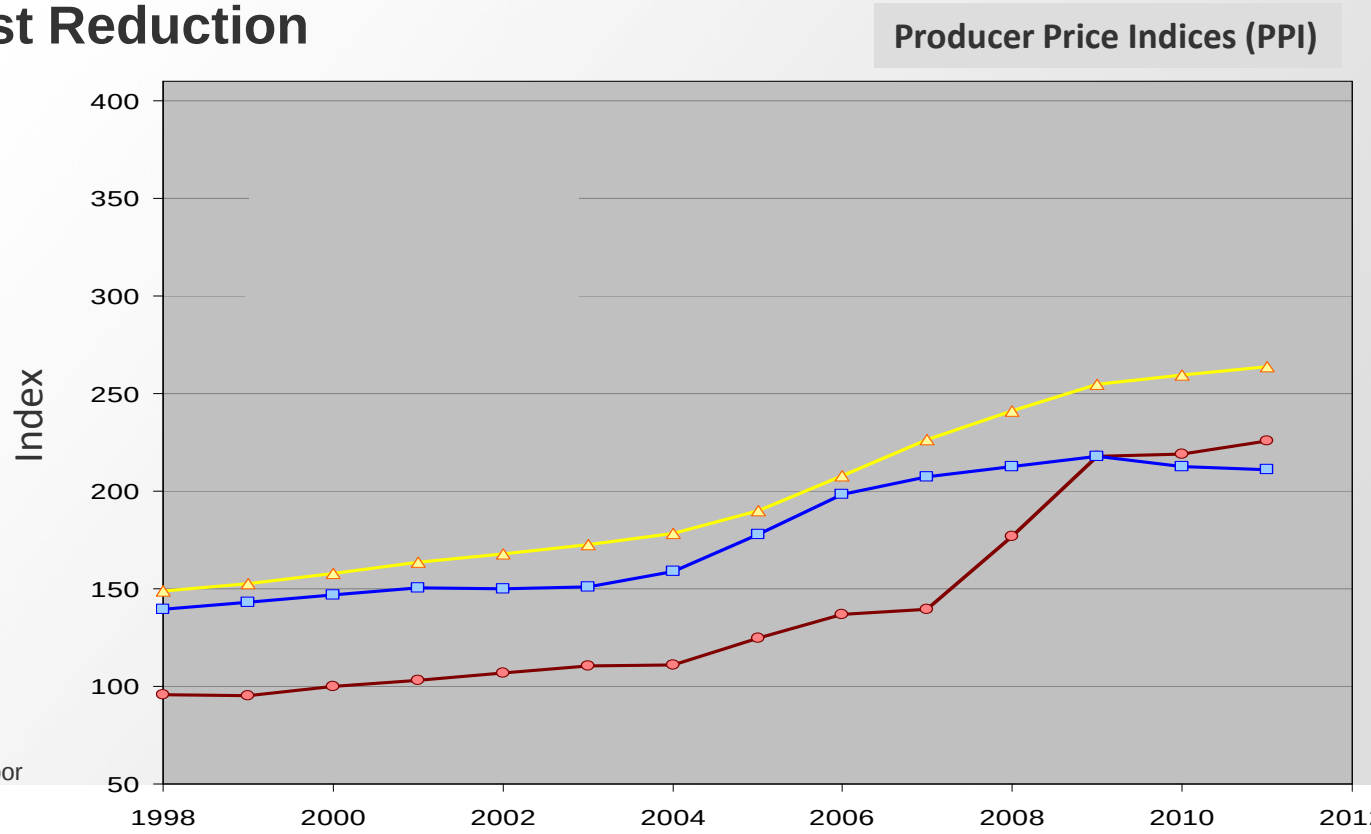
A Test



Source:
US Dept of Labor

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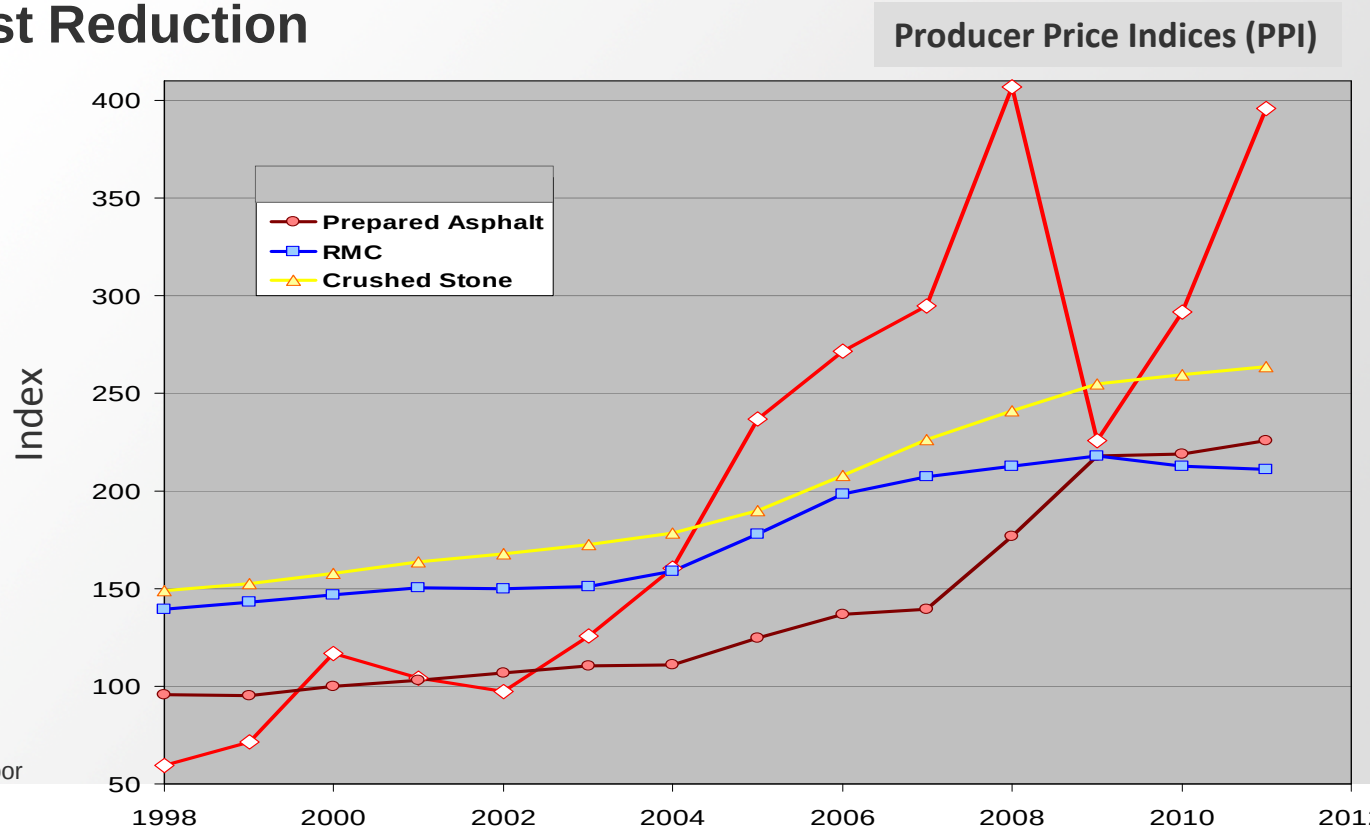
A Test



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Conclusion

- Prices >> Moving in the right direction
- Cost >> Moving also and with higher fluctuation

Managing Costs

- Business viability or Out of Business
- Competitive advantage ?

Ways to improve operationally

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

- Considering the tough market, your priority needs to be on what you can do “today” or in the short term.
- Success in this area should create breathing space for more long-term or structural improvements to your operations.

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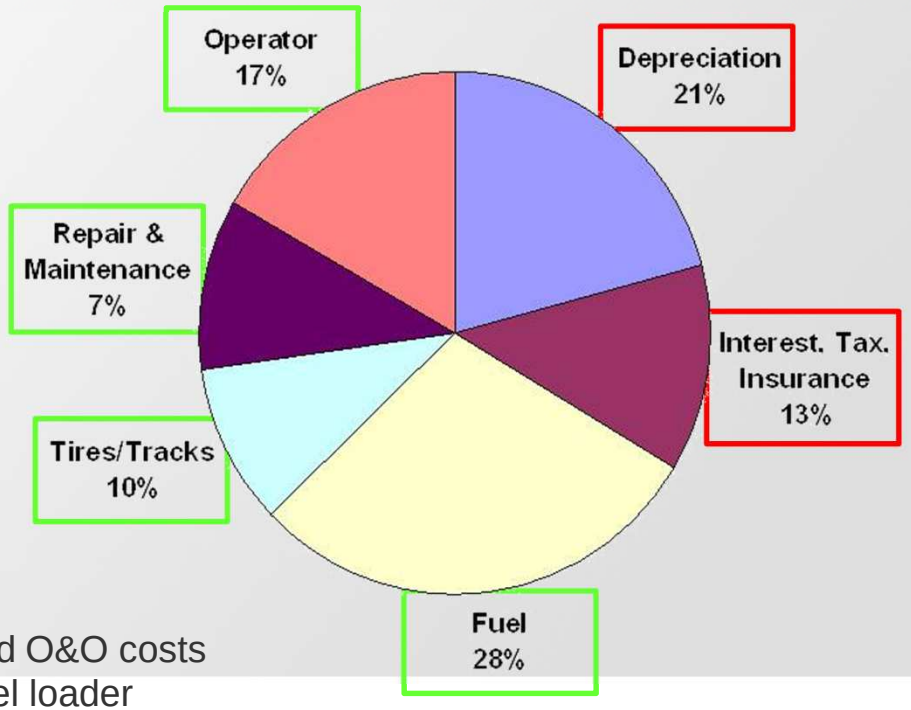
What is an O&O?

- Est. Ownership and Operating Costs

"Fixed" ▪ **Ownership** = Cost of capital or asset . . .

"Variable" ▪ **Operating** = Cost of operating the asset . . .



Estimated O&O costs
50 t wheel loader

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What influences the variable costs ?

- Application and environmental factors
- Duty cycle
- Maintenance program
- Consumption and price of diesel
- Operator wage
- Age of the machines
- Machine performance and characteristic
- Operator skills

- The operator skills impact every slice of the pie

- The operator is the key to improvement and costs reduction on your mobile equipment

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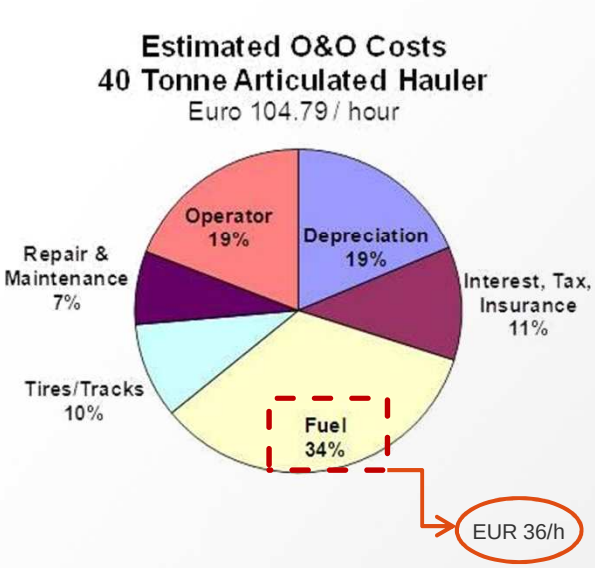
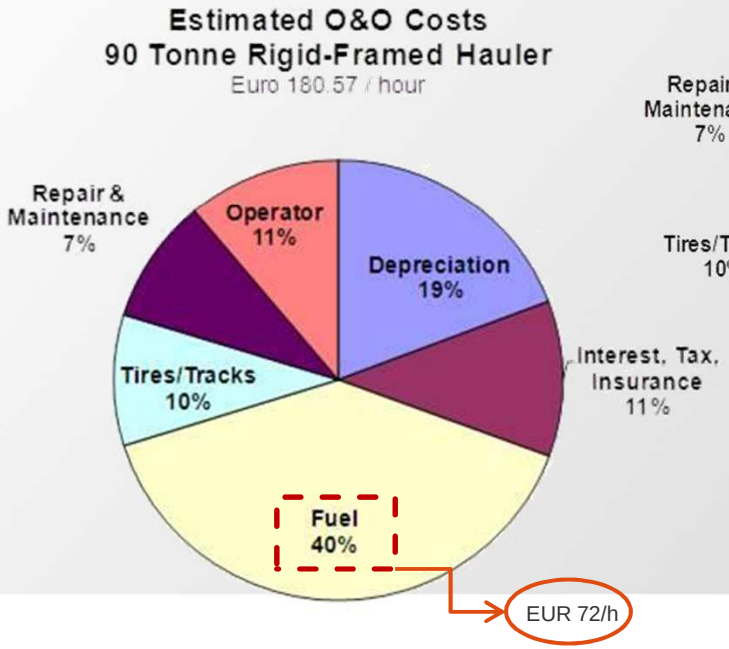
Where's the Money ??





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Operator Efficiency

The influence of the operator

- **Volvo comprehensive operator evaluation test 2012**
  - **73 operators tested, classified in 4 levels:**
    - novice, average, inside professional, external professional
  - **Metrics**
    - Measured productivity, fuel efficiency, performance metrics for each case.

Tested over 3 applications (all quarry related):

- Rehandling / Short cycle truck loading (stockpiled crush stone)

- Load & carry (crushed stone)

- Face loading (digging rock)

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Operator Efficiency

Volvo Comprehensive Operator Evaluation 2012

A. **Between ‘novices’ and ‘professional’ operators:**

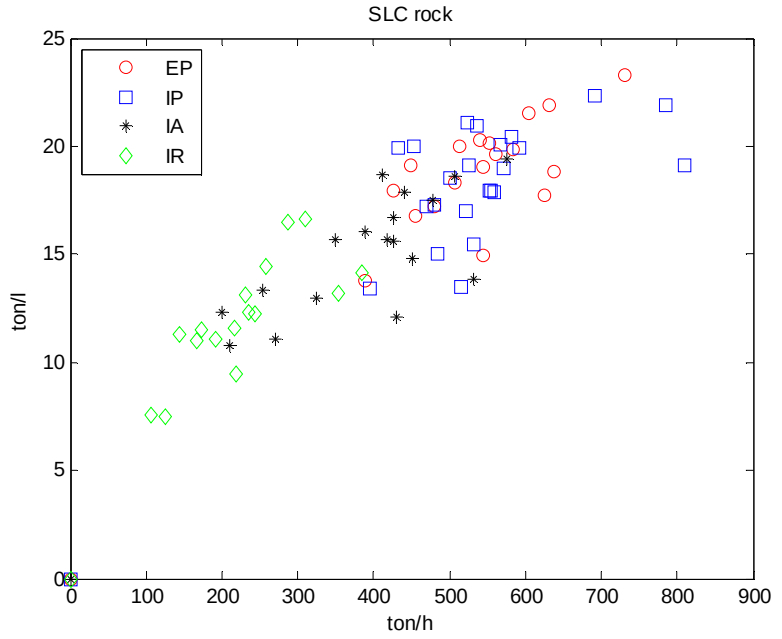
- Productivity could vary as much as 700%
- Fuel efficiency could vary as much as 200%

B. **Excluding ‘novices’:**

- Productivity still varies as much as 300%
- Fuel efficiency still varies as much as 150%

C. **Strong linear relation between experience and results**

- More experience (trained) = better results.



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Operator Efficiency

Volvo Comprehensive Operator Evaluation 2012

D. **Fuel efficiency**

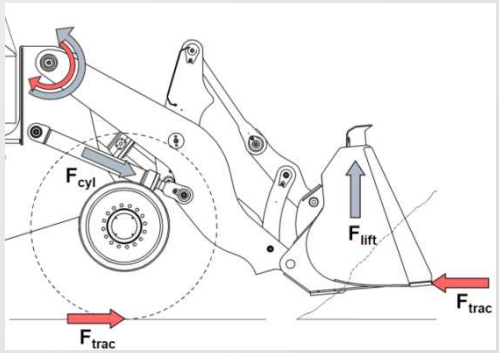
- Filling the bucket is most critical → fuel burn, fill factor.

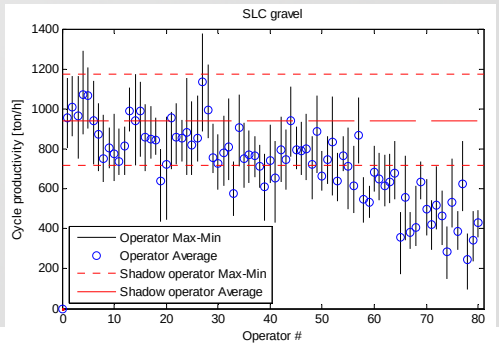
E. **Value of experience varies with application**

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

F. **Results can vary, a lot, for an individual operator**

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





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How to save money ??

Conclusions

- A large opportunity for savings is reducing fuel consumption
- Fuel consumption depends on the operator
- The difference between operators is **TRAINING**

What can you do about it ??

Operator Training

Measure

→ Benchmark

→ Continuous Improvement

= Lowered Costs

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Operator Efficiency

Operator Training

- Something you can control, **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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Operator Efficiency

Example #1 Sand Plant – 5 wheel loaders (L110)

- Cost improvement desired by owner
- **Actions Taken**
  - Contacted the local dealer
  - Reviewed machine data history
  - Made a plan

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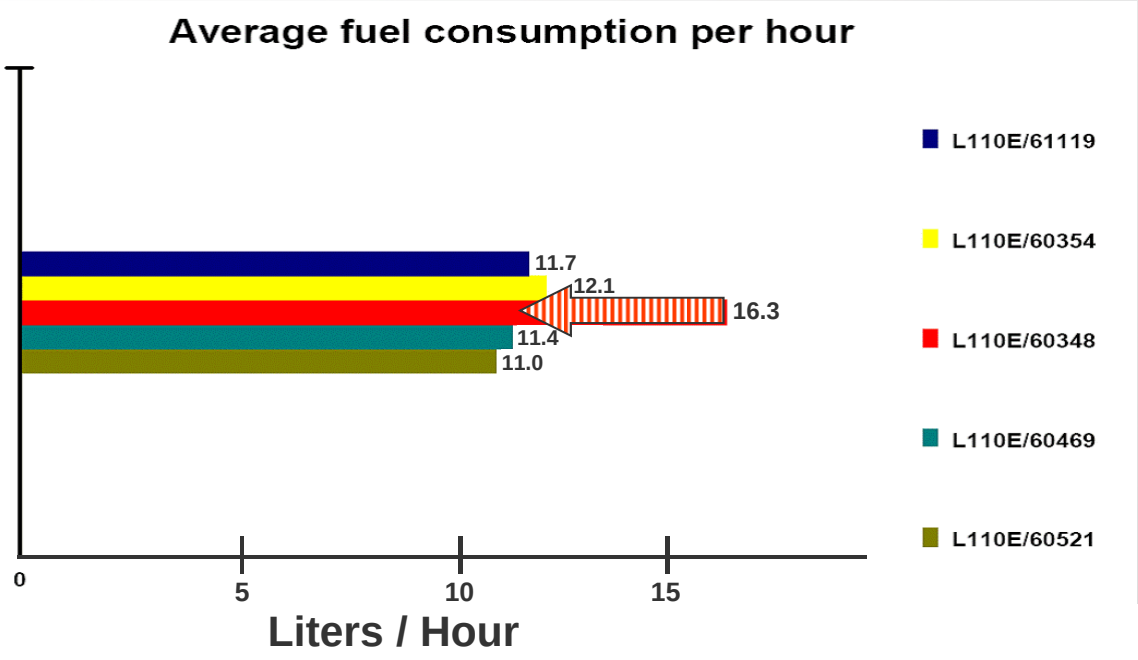
Operator Efficiency

Example #1 Sand Plant – 5 wheel loaders



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Operator Efficiency

Example #1 Sand Plant – 5 wheel loaders

- 1 loader consuming 4.7 lph more → **€ 10,340 more cost /year**
  - **Over 5 years** → **€ 51,700 additional cost.**

Next Actions Taken – with dealer

- Checked machine and operating conditions
- Provided operator training.

Result: pulled unit consumption back to fleet norm with no loss in productivity.

What Changed?

- Training – work **with** the machine, not **against** it.
- Outcomes: Better utilize high torque / low RPM engine, load-sensing hydraulics
  Better bucket loading while burning less fuel.

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Operator Efficiency

Example #2 Compost Producer– 5 wheel loaders (L180)

- Operator training provided as part of a continuous improvement program
- **Before** Operator Training
  - **Average Fuel Consumption** **23.8 liters/hr**
  - **Average Tire Life** **2,000 hr per set**
- **After** Operator Training
  - **Average Fuel Consumption** **17.8 liters/hr** **(6 liters/hr savings)**
  - **Average Tire Life (est)** **4,000 hr per set**
- **Result**: Fuel Savings for Fleet **up to € 66,000 per year**

  (6 liters/hr x 5 units / 2,000hr/year x €1.10/liter)

  → **Plus additional savings from improved tire life. . .**

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Operator Efficiency

Example #2 Compost Producer– 5 wheel loaders

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.

  → facts-based business case, not opinion.

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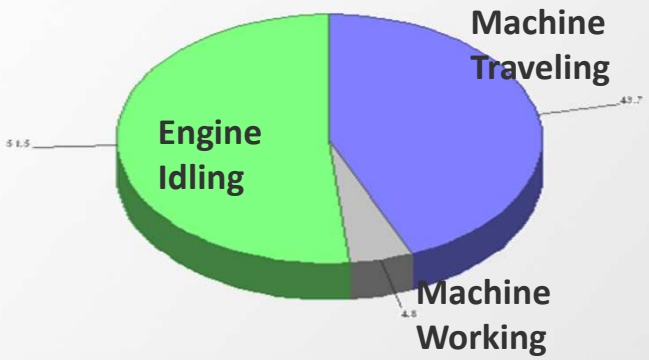
Operator Efficiency

Onboard Data

- Idle Time – what is a typical %, for a loader?



- **Idle Time – 30-55% typica**l on many jobsites.
  - Waits, smoke breaks, radio, shift change…adds up!

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Operator Efficiency

Example #3 – Idle Time Impact

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

➡ **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**
  - → **1,500** engine hr/year
  - **25%** idle time

⇨ **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: 2,500 l less?

= The difference $ _____ ??

Example

± € 16,000

± € 7,500

± € 2,000

= € 23,000+

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Operator Efficiency

Example #4 – Recycling Yard – 3 excavators (EC290)

- Working with grapples, busy jobsite, **3 shift** operation
  - Remote-monitoring showed 30% idle time.
- The owner made **an operator incentive plan**, to share any fuel savings over a **90 day test period**.

Results

15% reduction in idle time

→ saved 11.4 liters/machine/day → 3,078 liters over the test period.

Reduced max engine RPM and utilized the auto-idle feature

→ saved 18.9 liters/machine/day → 5,103 liters over the test period.

Total = 8,181 liters less over 90 days → € 8,999 saved (€ 1.10/liter)

→ extrapolate to 1 year = € 35,996. . . extrapolate to 5 years = € 179,982.

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Operator Efficiency

Conclusions - Training

- Expensive technology isn't necessary to reduce costs. Optimize operator performance TODAY:
  - Ongoing training is worth the effort
  - Use available data, partner with suppliers/dealers
  - Show ROI
  - Empower your operators to save?

In the 3 examples quantified, the savings potential per unit over 5 years:

- Example #1 **€ 51,700** saved per unit
- Example #2 **€ 66,000** saved per unit
- Example #4 **€ 59,994** saved per unit

. . . In fuel alone . . . Plus benefit to tires . . .

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

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Conclusion

- Prices >> Moving in the right direction
- Cost >> Moving also and with higher fluctuation

Managing Costs

- Business viability or Out of Business
- Competitive advantage ?

Ways to improve operationally

- **Change what you do**,
- Change how you do it,
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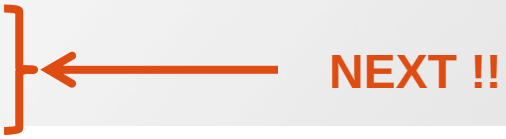

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Optimize Operations Tomorrow

Ideas for "Tomorrow"

- Long(er) term ideas to significantly change your operation to maintain future competitiveness.
  - Operational process
  - Invest wisely (machines)

Goal

- Take home at least one idea for potential improvement at your site.

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Optimize Operations

Example #5 – Truck Loading

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Optimize Operations

Example #5 – Truck Loading

As shown on the video

- **Max Production (approx) ***
  - 23 trucks / hour
  - 754 tonnes / hour

* 30 second spot time.

What if the spot time = 15 seconds?

- **Max Production (approx)**
  - 26 trucks / hour
  - 852 tonnes / hour

→ 13% improvement.

+98 tonnes/hr x 8 hr = +784 tonnes / day = € ____ ?

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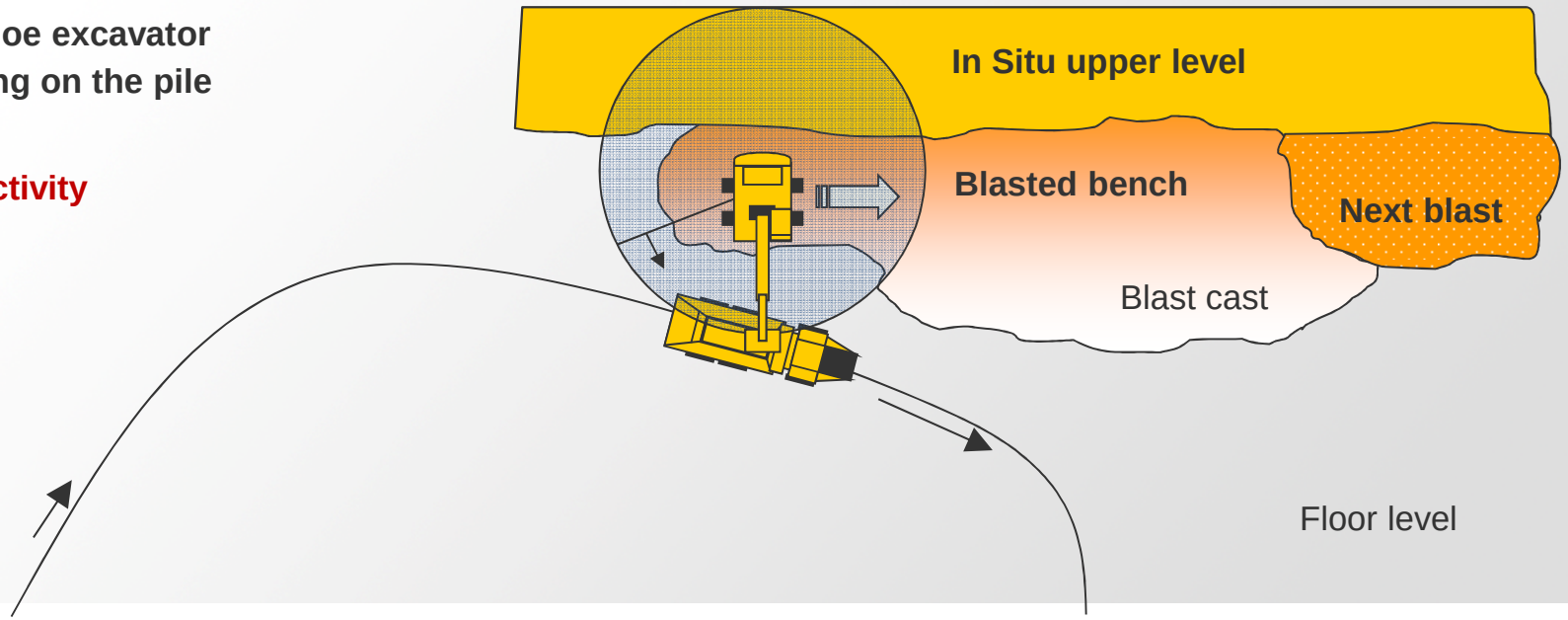
Optimize Operations

Example #5 – Truck Loading

- Backhoe excavator working on the pile

+ Productivity

+ Safety



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Optimize Operations

Example #5 – Truck Loading

- Backhoe excavator working on the pile

+ Productivity

+ Safety

15 second spot time

<20 second load cycle

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Optimize Operations

Example #6 – Truck Payload

- How many passes is best?

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Optimize Operations

Example #6 – Truck Payload

Coal mine, poor weather conditions

- Fleet of 90t rigid trucks
- 12m^3 face shovel with poor digging conditions
  - **5 pass loading (slight overload)**
- 2 km main ramp out of pit
  - 10% grade + 5-7% rolling resistance
- Truck fleet issues
  - **Operating costs**
  - **Unscheduled downtime**

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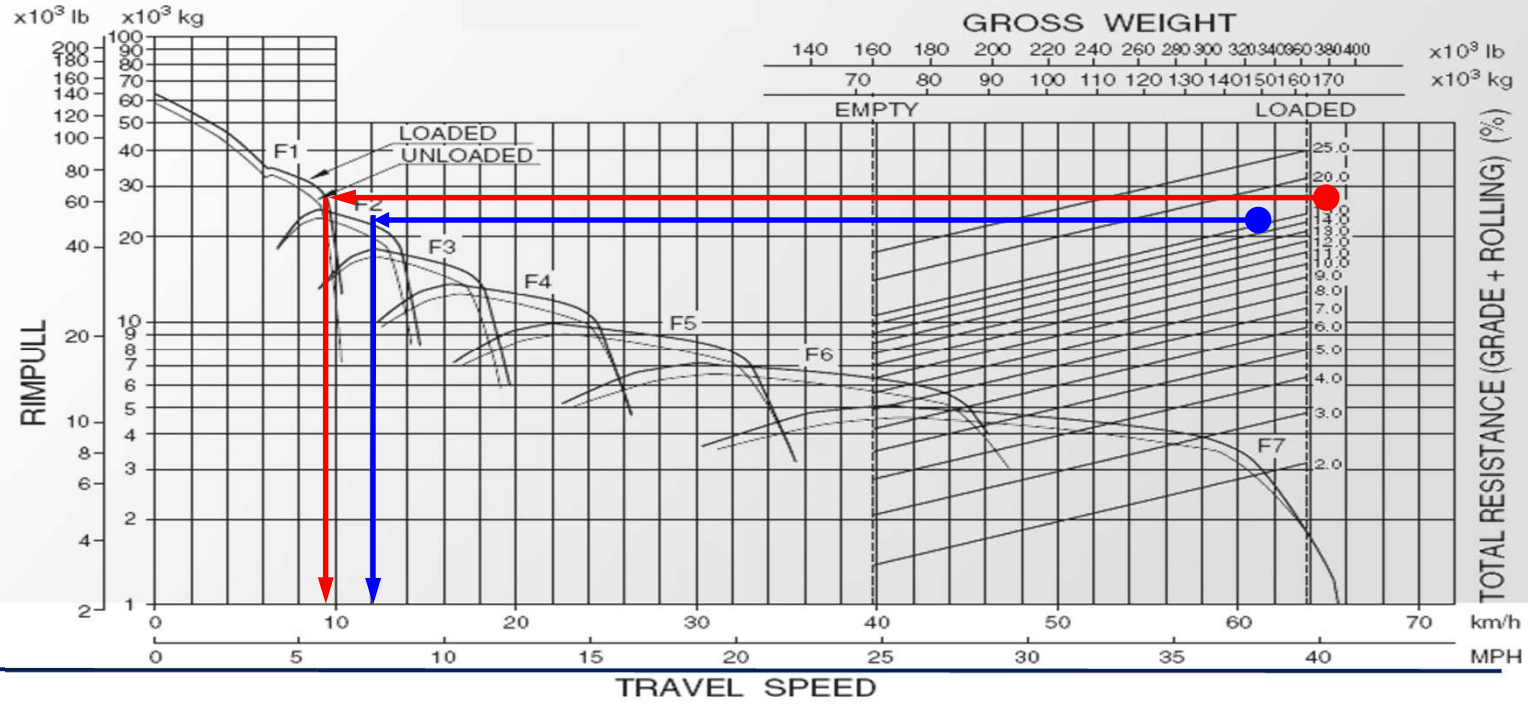
Optimize Operations

Example #6 – Truck Payload



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Optimize Operations

Example #6 – Truck Payload

Proposed Solution

- 4 full passes to 80t payload
  (compared to 5 'light' passes to 92t payload)

Effects

- Faster cycle time by 12%, dramatically less time on grade, using 2 gears.
- Despite lower payload, unit truck production nearly the same (99%).

Potential Upsides

- Better transmission life, higher uptime
- Higher shovel (fleet) production potential.

		Case A 5 pass	Case B 4 pass
Payload	**t**	**92**	**80**
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)		**148.4**	**147.2**
			99%
Theoretical Shovel Production			
Trucks/Hour Capacity		15	19
Hourly Production (tph)		**1,239.0**	**1,340.0**
			108%

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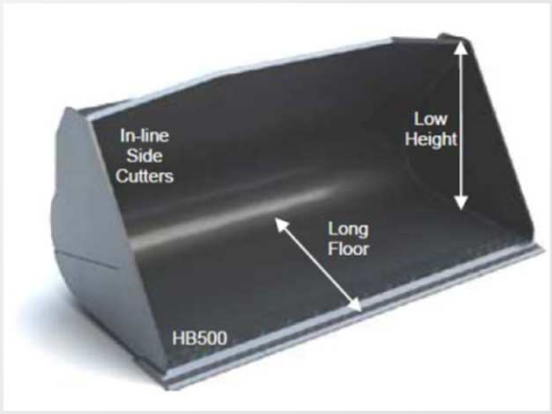
Optimize Operations

Example #7 – Yard Operations

- Re-Handling or Yard/Load-Out: is a unique application.



- Can you be more efficient? Old(er) machines often of GP or rock bucket in the yard.

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

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Optimize Operations

Example #7 – Yard Operations

THE REHANDLING BUCKET
FINE TUNED FOR REHANDLING

- What about tires for the application?
- If a loader consumes 25 lph: → **7% = €3,850 per year savings.**

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Optimize Operations

Tires Briefly – Tread Depth

- **L2** **Examples: Long load & carry, material handling**
  - When good traction is important
  - Sandy roads with few/no sharp stones
- **L3** **Examples: All types of load & carry, easier digging**
  - Stable roads, higher speeds.
- **L4** **Examples: Face loading in quarries, tougher digging**
  - Digging aggressive material
  - When cut protection is needed, ex: blasted rock.
- **L5:** **Examples: Face loading in the toughest quarries and mining**
  - Extremely difficult digging, maximum cut resistance
  - Low travel range and speed → no load & carry!

Increasing tread depth also increases weight and reduces TKPH!

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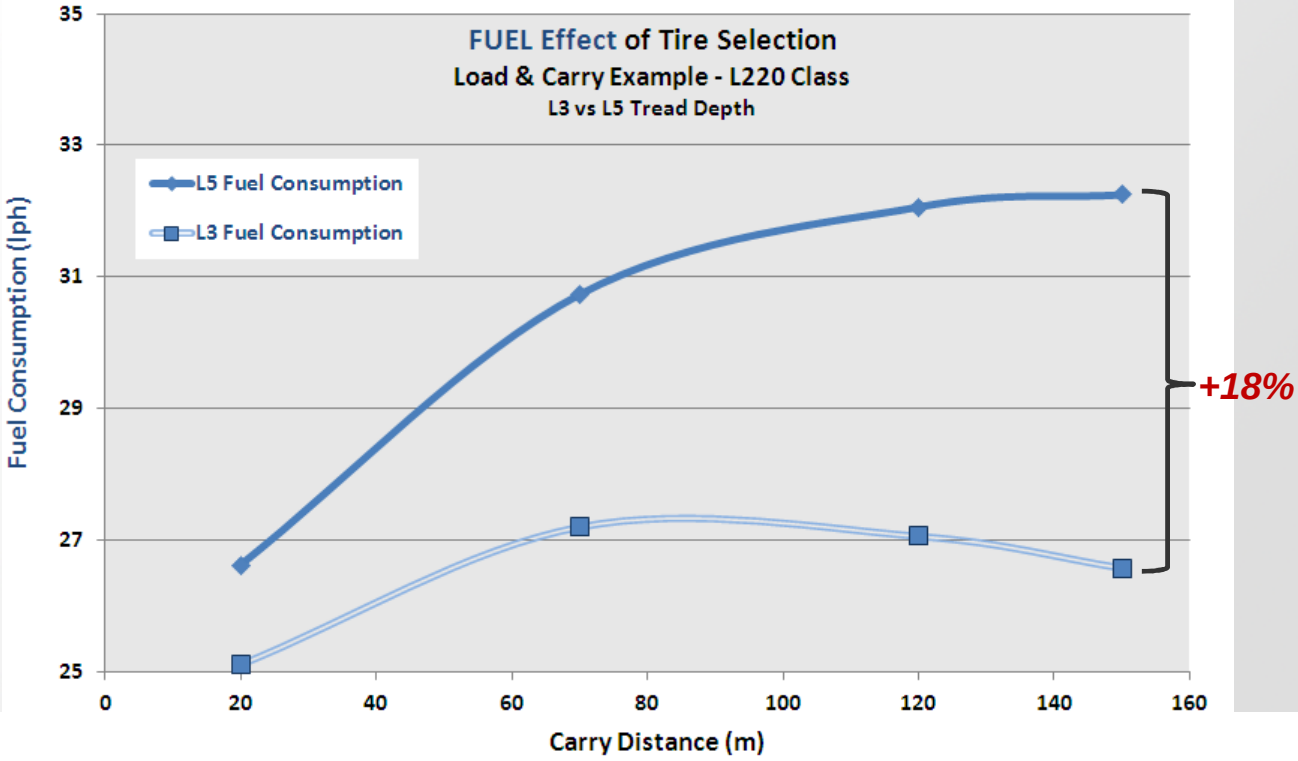
Optimize Operations

Tread Depth

What's the impact?



= €12,481 / year !

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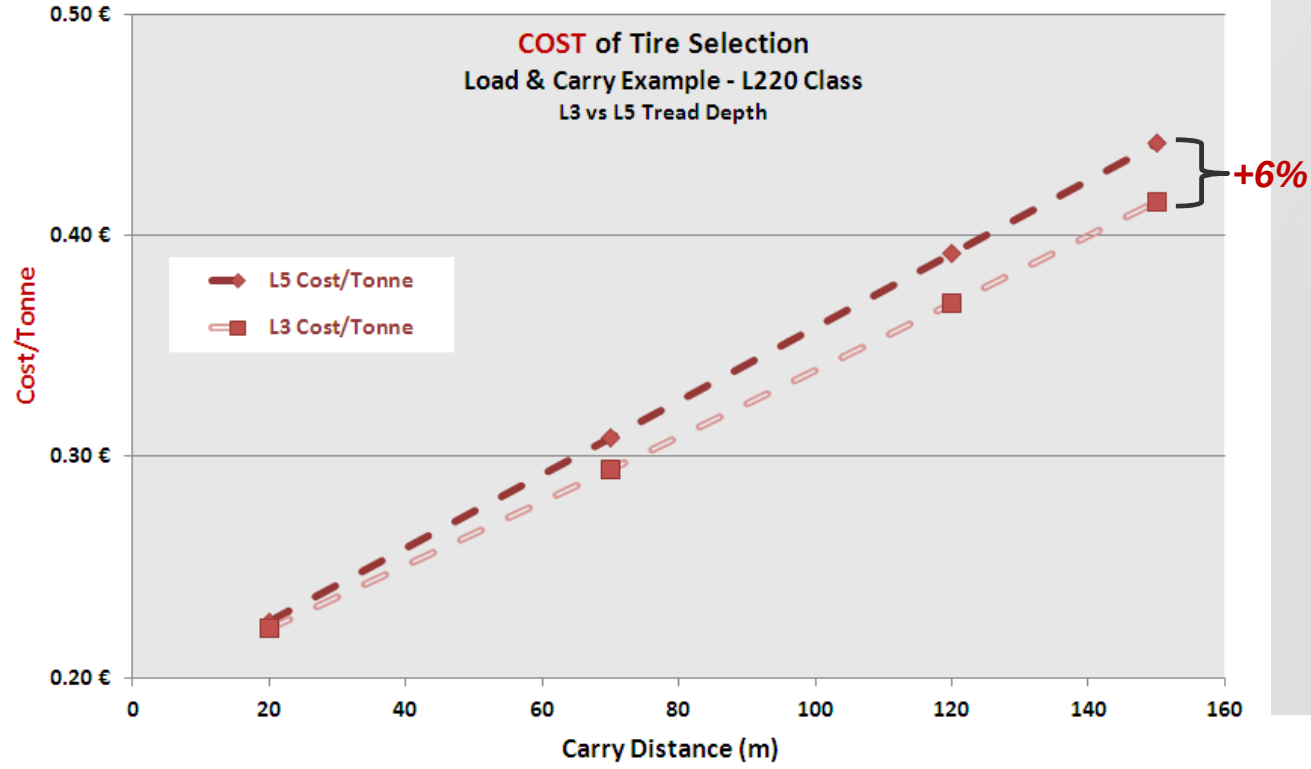
Tread Depth

What's the impact?



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Optimize Operations

Operational Layout

- **Load & Carry**
- **Specific to wheel loaders**

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Optimize Operations

Operational Layout

- **Load & Carry**
- **Specific to wheel loaders**

Needs

- Tire selection
- Bucket selection
- **Boom Suspension (ride control)**

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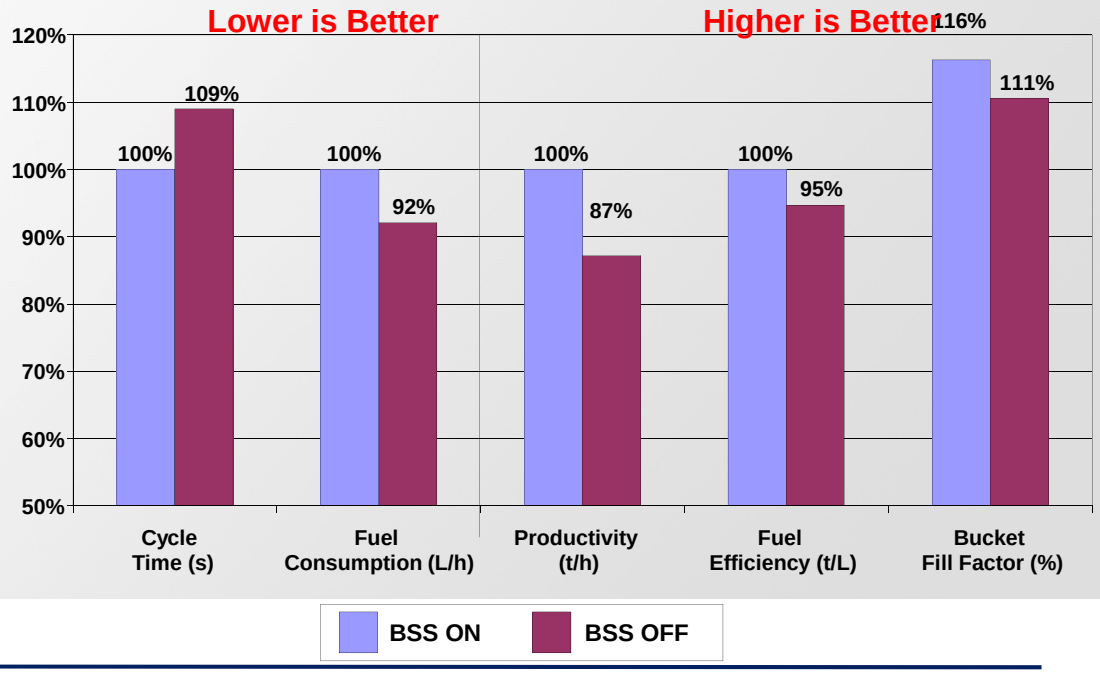
Haul & Load – Practical Cost Reduction

Optimize Operations

Example #8 - Load & Carry Test

- Volvo L120F - with and without BSS
- Road 60m one-way, 12% grade at end
- Carrying clay/gravel, 1.9 SG



Outcomes

- Faster cycle time
- Higher productivity
- Better fuel efficiency
- Better fill factor

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Optimize Operations

Operational Layout

- **Load & Carry**

Needs

- Tire selection
- Bucket selection
- Boom Suspension (ride control)
- **Lockup converter/transmission**
  - **Productivity/speed**
  - **Grade-ability up ramps**
  - **Fuel efficiency**

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Optimize Operations

Example #9 – Load & Carry

- **An application specific to wheel loaders:**
- **Lockup converter** / transmission is “a must”
  - Faster load & carry, better uphill performance
  - Less fuel consumption

  → **Lower unit cost of production.**

- **Testimonial**

150m (330’) load & carry - lime production

- **1st year savings** **= £20,000**
  = €25,000 / year

5 December 2011
Source: www.theconstructionindex.co.uk

A quarrying company has estimated that buying a new fuel-efficient wheeled loader has saved it £20,000 in diesel in the first year.

Lime supplier Singleton Birch took delivery of the Volvo L350F wheeled loader in February 2010 for its quarrying activities at Melton Ross Quarries in Barnetby, North Lincolnshire.

"We were swayed by Volvo's claim for their flagship loader of making a 10 litre per hour saving in fuel and they were right because the machine has done just that," said quarry manager Mark Sacker. "At today's cost for red diesel, the L350F has saved us in excess of £20,000 in its first year of operation."

The company has now taken delivery of a second L350F, making Singleton Birch the only UK quarry operator to run Volvo L350Fs side by side. Both machines are deployed on loading blasted chalk from the face and running to a mobile sizer on runs of up to 150 metres.

They operate a 12 hour shift, seven days a week delivering around 450 tonnes of material per hour to the primary.

The machines have been modified for the application, as per the Mineral Products Association specification

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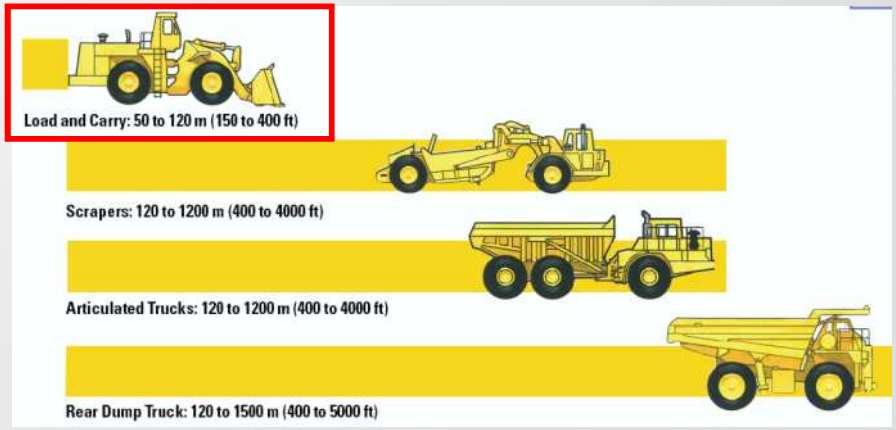
Optimize Operations

Operational Layout

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

Potential Benefits

- Less operators, less traffic (fewer machines)
- Lower investments
- More flexibility on ramp/hopper design



What is the break-even "carry" distance?

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

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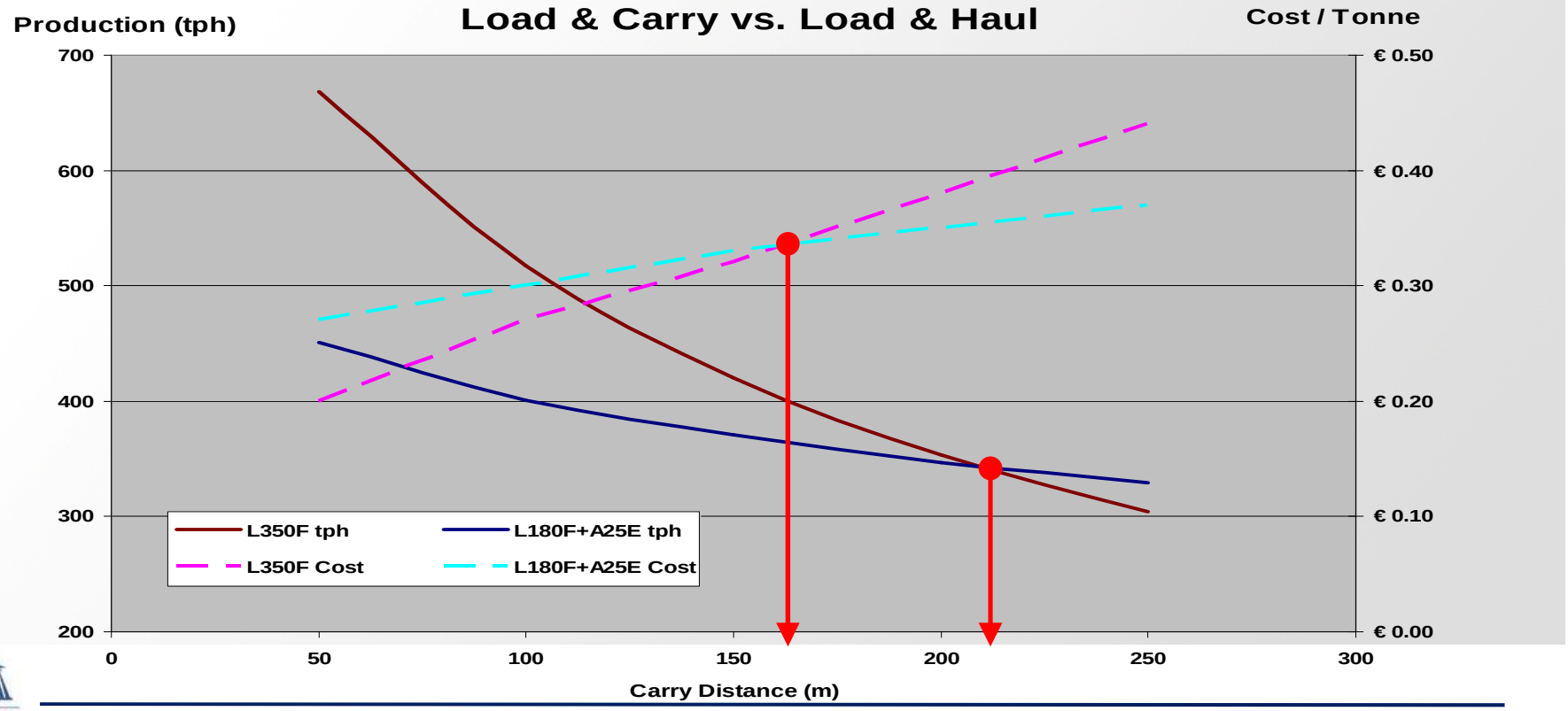
Optimize Operations



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Optimize Operations

Purchasing Criteria

- Ongoing training
- Monitoring systems
- Specifications
  - Lockup converter/transmission
  - Net vs. gross horsepower
  - Boom Suspension (ride control)
  - Bucket and tire selection for the job
- Fuel saving features
  - Auto-idle function
  - Auto-shutdown function
  - Load sensing hydraulics vs. gear pumps

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Haul & Load – Practical Cost Reduction

Optimize Operations

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)	886 100%	803 91%	771 87%	786 89%
Consumption (lph)	57.8	73.4	63.5	89.6
Efficiency (tpl)	15.2 100%	10.9 72%	12.1 80%	8.8 58%

- A little can mean a lot
- Consider an example: if the test loaders produce 750 tph over a period of 1 year (2,000 hrs)

Example: 750 tph	Loader A	Loader B	Loader C	Loader D
Liters Consumed	98,684	137,615	123,967	170,455
Annual Cost	€ 108,553	€ 151,376	€ 136,364	€ 187,500
Difference		€ 42,824	€ 27,811	€ 78,947

= See the difference, just in annual fuel cost!

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Final Conclusions

- Cost reduction
  - **Fuel consumption is key**
  - **Invest in your operators – it's worth it**
  - **Leverage monitoring systems and data**
- Optimize operations
  - **Traffic pattern fundamentals**
  - **Loading match/payload matters**
  - **Get the specs right for the job**
- Future considerations
  - **Test, if you can**
  - **Economic viability of load & carry**
  - **Use what you pay for!**

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www.quarryacademy.com

Thank You!

- **Guillermo Quezada**

  Extraction Business Development Manager

  guillermo.quezada@volvo.com

  M: +49 (173) 6163244

- **David Nus**

  Director, Global Mining & Aggregates

  david.nus@volvo.com

  M: +1 828.301.7654

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