# WELCOME

Kent Clifton Sr. Marketing Professional Caterpillar Global Mining

# LOADING



#### **Global Trend**

# Indexes of labour productivity, capital productivity and unadjusted MFP, mining sector



#### Tools

MineEIA

**Fleet Production Calculator - FPC** 

Value Estimating Tool (VET)

**Job Studies** 

Site Assessment

**Facilities Review:** 

- > Preliminary Sizing
- > Shop Efficiency & Layout Support
- > Detailed Design Support

Maintenance Strategy Review Equipment Management Review Haul Road Design Analysis



# The Big Picture





# **Mining Costs**





# Inefficient operations result in lost revenue

#### **Estimated Lost Revenue Per Truck**

TRUCK MODEL	797	793	789	785
Target payload ton	394	250	198	151
GOLD Revenue / Hr	\$21,500	\$13,700	\$10,800	\$8,300
OIL SANDS Revenue / Hr	\$17,500	\$10,900	\$8,600	\$6,600
COAL Revenue / Hr	\$3,450	\$2,200	\$1,750	\$1,300
COPPER Revenue / Hr	\$1,280	\$815	\$645	\$490





# **Annual Production Calculation**

Scheduled Time/Year	Max Theoretical Production	HMS Availability Factor	HMS Utilization Factor	Job Efficiency Factor
SMU Hrs/Year mine estimates will be occur assuming 100% availability	Max theoretical machine production rate with 100% efficiency	Unplanned downtime as a percentage of scheduled time	Includes items which occur less frequently than "Job Efficiency Factors"	Includes items which are constant or occur frequently during the working shift
<i>"Hrs the mine could operate the HMS for loading &amp; non-loading activities assuming 100% availability"</i>	"Production rate as if HMS, in ideal conditions & with skilled operator, continuously loaded a bottomless hole w/o repositioning"	<i>"%age of time the machine is mechanically available to work during scheduled operating hrs"</i>	<i>"%age of time the machine is able to operate but is not utilized for loading activities"</i>	"The % of Max theoretical production rate which mine personnel, on a specific job sit can achieve when HMS is utilized for loading activities"
Lost Time due to: <u>Off –Time</u> Weather Non-Working/Holidays <u>Schedule Loss</u> Ready but unmanned Scheduled D/T & PMs Fueling Shift Change	Assumptions: •100% machine availability •100% machine utilization •Skilled Operator •Geological conditions as specified by mine •Proper Machine matching •Ideal Topology •No traffic issues - (Truck delays removed)	Lost Time due to: •Unplanned Downtime •Accident	Lost Efficiency due to: •Operational Delays •Standby •Non-loading activities •Lunch & Breaks •Meetings •Blasting •Pre-start Inspection •Toilet •Act of God •Machine relocation •Strike/Dispute	Lost Efficiency due to: •Operator Efficiency – Clean up pass technique – Bank engagement style – Repositioning during loading – Swing angles etc •Delays from job layout •Topology/Altitude •Clean-up •Machine Condition •Traffic/Bunching •Weather Effects (Slippery) •Visibility (Dust/Fog/Rain) •Minor Repairs/Adjustments •Personnel Delays •Operating at night •Machine Matching •Crusher capacity





# Small changes:



A 5% change in each of the factors results in the above reductions in cost per tonne



### **Selection Guidelines**



<u>Electric Rope Shovel</u> Reliable Low cost-per-ton 0.10 – 0.16 CPT



<u>Wheel Loader</u> Mobility Utility tool 0.23 – 0.28 CPT



Hydraulic Front Shovel

Breakout force Selectivity



Hydraulic Backhoe Breakout force Selectivity 0.20 – 0.25 CPT

- High capital \$
- 20+ year life
- High production rate
- Electric power
- Hard floor
- 10 20m face height
- Good fragmentation
- Needs clean-up
- Limited mobility

- Low capital \$
- 5-10 year life
- Low production rate
- Diesel power

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- Good on most floors
- 10m max face height
- Well shot material
- Does own clean-up
- Excellent mobility

- 0.20 0.25 CPT
- Medium capital \$
- 8-10 year life
- High production rate
- Diesel or Electric
- Good floor
- 15m max face height
- Minimal fragmentation
- Needs clean-up
- Good mobility

- Medium capital \$
- 8-10 year life
- Medium production rate
- Diesel or Electric
- On top of bench
- 9m max face height
- Minimal fragmentation
- Needs clean-up
- Good mobility



# **Support Requirements**











# **Caterpillar Production Systems**

C	ost Saving:	994H & 789D	
	Production	2700 Tons (2410 mt)	2500 Tons (2270 mt)
	CPT (\$/ton)	7%	-
	Production	3000 Tons (2680 mt)	2500 Tons (2270 mt)
	CPT (\$/ton)	17%	-
	Production	3200 Tons (2900 mt)	2500 Tons (2270 mt)
	CPT (\$/ton)	22%	A CONTRACTOR OF THE OWNER OWNER OWNER OF THE OWNER OWN

Assumptions:

- 50 min hour
- 22.5 yd3 (17 m3) bucket
- 8760 Scheduled hours per year
- Overburden

### **Truck Loading / Pass Match**



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#### TARGET payload = 195 Tons (177 mt)





#### Bucket Fill Factor= 66 Tons (60 mt)

	<b>Bucket Fill Factor</b>		100%	90%
	C	PT (\$/ton)	3.0%	-
606	Example: 0 FS loading 793F	1	Pe	ercent Improvement
Bucket Fill	Hourly Production		118-59	
100 %	4900 t	100%		
95 %	4650 t	95%		
90 %	4400 t	90%		
	e	ssion		CAT

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# **Truck Exchange**

Avg Dump Time (min)	0.0699	
Avg Swing Empty Time (min)	0.1661	
Avg Load Time (min)	0.2437	
Avg Swing Loaded Time (min)	0.1090	
Avg Loader Cycle Time (min)	0.5888	
Avg Bucket Payload (mt)	78.36	
Avg Bucket Fill Factor	86.11	
Avg Passes/Truck	4.00	
AvgTruck Payload (mt)	313.45	
Truck Fill Factor	74.32	
Avg Truck Load Time (min)	1.84	Equalized Exchange
Avg Truck Exchange (min)	0.91	0.70
Avg Trucks/Hour	21.86	23.66
Total bcm /60 min	3011.77	3259.41
Total mt/60 min	6851.77	7415.15
Theoretical Loader Production (mt/60 min)	7985.49	
Efficiency	85.80	



# **Are Haul Roads Impacting Production ?**





#### Target

#### Assuming 3% Rolling Resistance (RR)





#### Worst Case vs. Best Case Comparison

	Constant Grade at 3% RR	Non-Constant Grade at 6% RR	Potential Improvement
Haul Time	6.32 minutes	9.03 minutes	30.01%
Haul Fuel Burn	41.99 liters	56.22 liters	25.31%
Trans Shifts	10	12	16.67%



#### **Truck Dumps**

Things to watch for:

- Always enter the dump area in a clockwise direction
- Approach the dump from the left
- Keep the dump edge on the operator's side of the truck

- Drive parallel to the dump edge
- Observe the dump edge for cracks
- Work dump from cab side to the right with support tractor following





#### **Truck Dump Efficiency**

TRUCK DUMP	Truck Dump - 1	Truck Dump - 2
CPT (\$/ton)	3%	
Assumptions:		
50 min hour		
8760 Scheduled hours per year	Percent Improvement	
• Overburden		
Truck Dump – 1: 30 second cycle		
time improvement		
.25 minute on the haul cycle and	and the second	
.25 on the return cycle		
	Key Facto	ors:
	Decrease	d cycle time





# Loading & Hauling Optimization

