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Productivity and Cost Management

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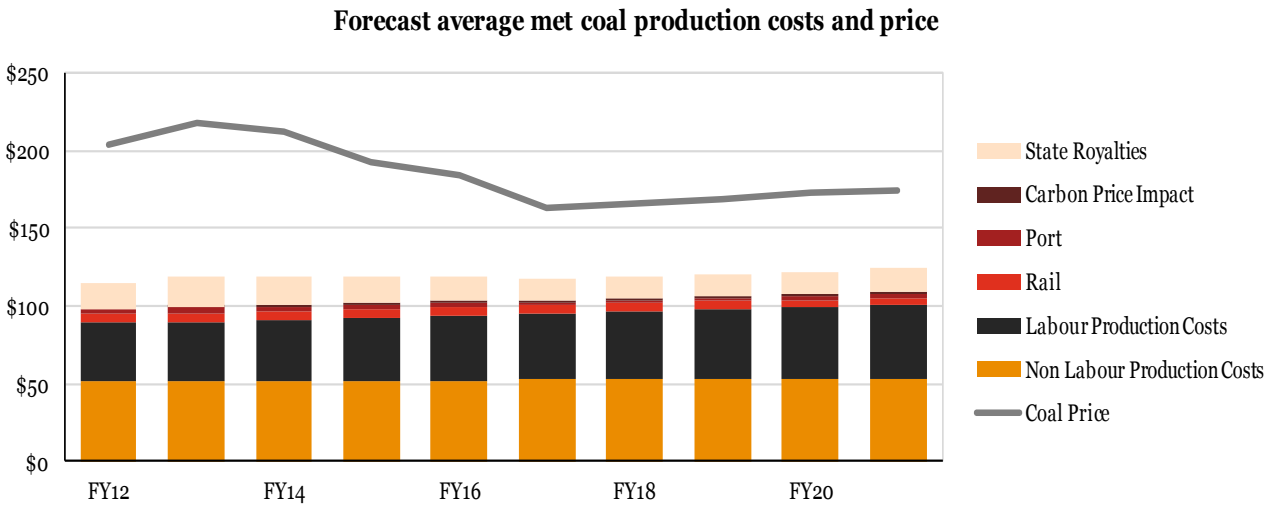
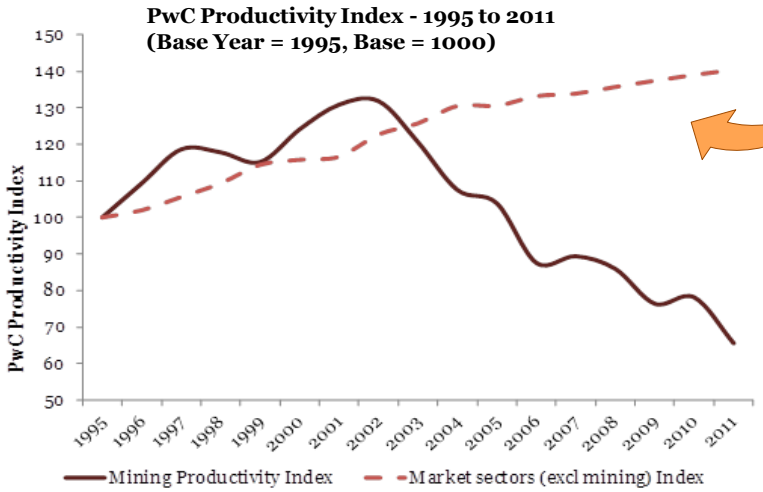
With prices falling and costs rising…



Australia has some of the world's largest coal reserves, but is struggling with maintaining mining profit margins….



… which is in large part due to the falling productivity of the mining industry

...improving productivity is the talk of the town

"In the broader mining industry, the opportunity cost of not producing a unit of production during this high price period meant that most miners took a "volume over cost" approach; the benefits of being able to produce more outweighed the increased costs that resulted"

Marius Kloppers, CEO BHP Billiton

Presentation to Brisbane Mining Club, 17 October 2012

"We are right at the bottom (of the cost curve), in the lowest quartile. That is incredibly important. That means no matter what happens in the business, we will be profitable"

"I have referred to it as an assembly line"

"We are operating in lean mode. People constantly say 'don't you have extra capacity between mine rail and port?' Well, we actually don't. If we had excess capacity we are wasting investment"

Sam Walsh, Rio Tinto Iron Ore Chief Executive

Australian Financial Review, 12 October 2012

Three industry focus areas of productivity

	Labour	Investment Capital	Operating Asset
What	Output generated per hour of work undertaken. It is measured in dollars of gross value added (GVA) per hour.	Real output($) per unit of capital services($).	Real output($) per resource.
How	• Identifying sources of talent • Disciplined workforce planning • Develop EVPs with a focus beyond monetary incentives.	• Ensure internal rigour in the CAPEX review process • Get the parameters for financial modelling right • Get the level of investment right	• Maintenance • Reliability • Asset utilisation • Operational cycle times • Operations planning and control
Why	Skills shortages have been driving rising labour costs.	Increase investment in profitable assets.	Increase margin

Low productivity in one stage of the value chain filters through to the subsequent stages

	Exploration	Extraction	Processing	Logistics	Support Services
Core Activities					
Discreet Activity Solutions	• Program Planning • Drilling Efficiency • Remote Logistics	• Pit Optimisation • Extraction Methodology • Fleet Productivity & Fit	• Plant Optimisation • Maintenance Strategy & Execution • Capacity Planning	• Intermodal Optimisation • Procedural Review • Capacity Analysis	• Benchmarking • Process Mapping • Resource Allocation
Cross Activity Solutions	←	• Outsourcing • Warehouse & Logistics Optimisation • Supply Chain Optimisation • Shared Services Analysis & Implementation	• Process Bottleneck & Constraint Analysis • Cost Reduction • Application Implementation	→	

We will focus on two main areas: extraction and processing

Extraction

Drill → Blast → Load → Haul

Processing

Crushing → Grinding → Sizing → Separation → Concentration → Disposal

Crushing / Grinding	Sizing	Separation	Concentration	Disposal
Reduce size to allow liberation of the material. (Comminution)	Separate wanted and unwanted material	Concentrate wanted material into a transportable form	Dispose of the unwanted material (tailings).

Focus area 1: Extraction

Exploration

Extraction

Processing

Logistics

Support Services

Having a blast

Having a better blast

Getting one stage wrong leads to inefficiencies in the following stages of the extraction process

Process

Drill	Blast	Load	Haul
Prepare ground for blasting	Break the ground	Load broken ground into trucks	Haul ore and waste

Issues can add 10 to 25% to downstream costs through:

- Damage to fleet, ore body, mine plan
- Inefficient processing
- Waste of explosive
- Re-work

There needs to be sufficient stock of broken ground to:

- Deliver preferred material blend to processing plant
- Achieve sizing within specification
- Ensure effective cycle time and utilisation of fleet

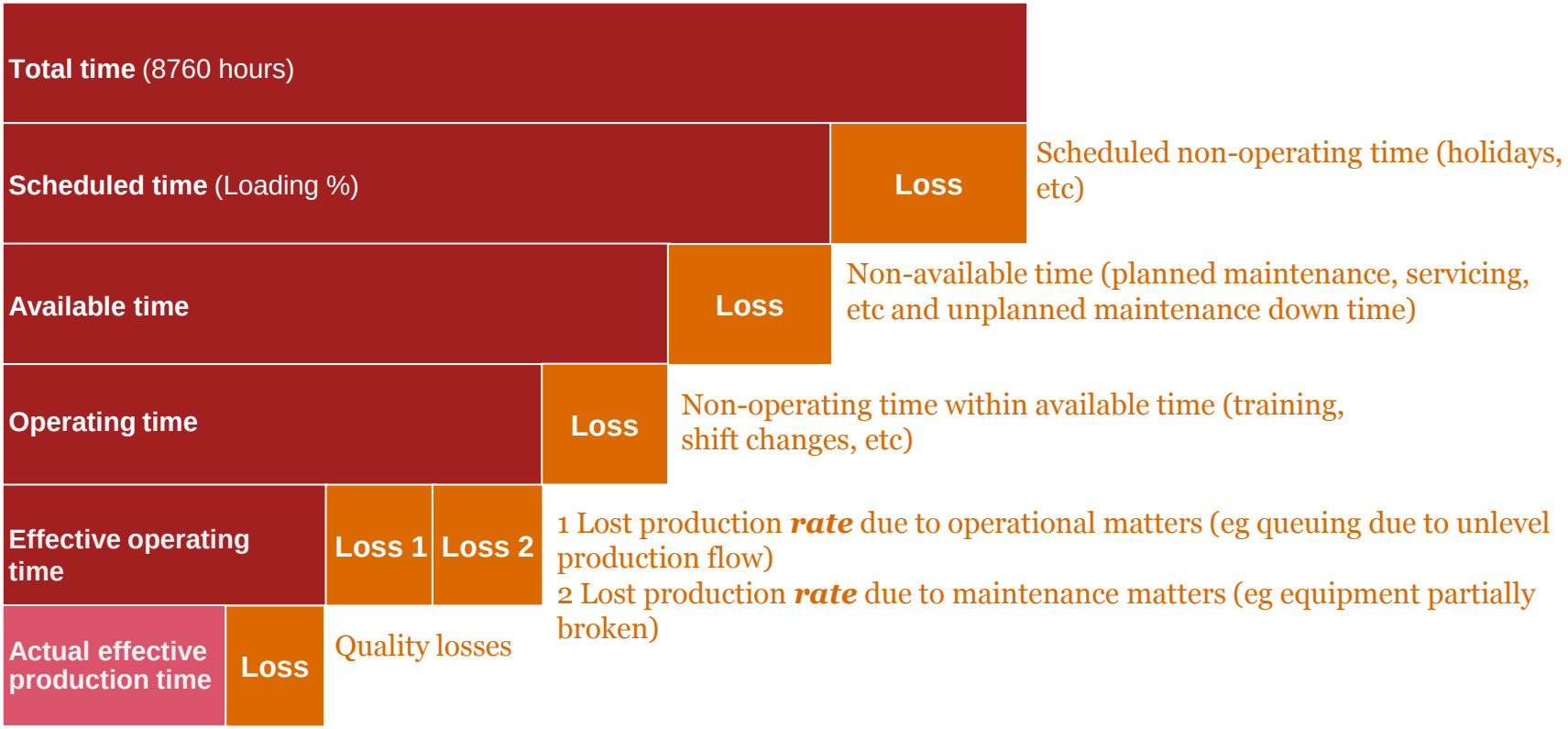
Inefficient loading can consume large amounts of capital and drive the operation up the cost curve

Critical success factors:

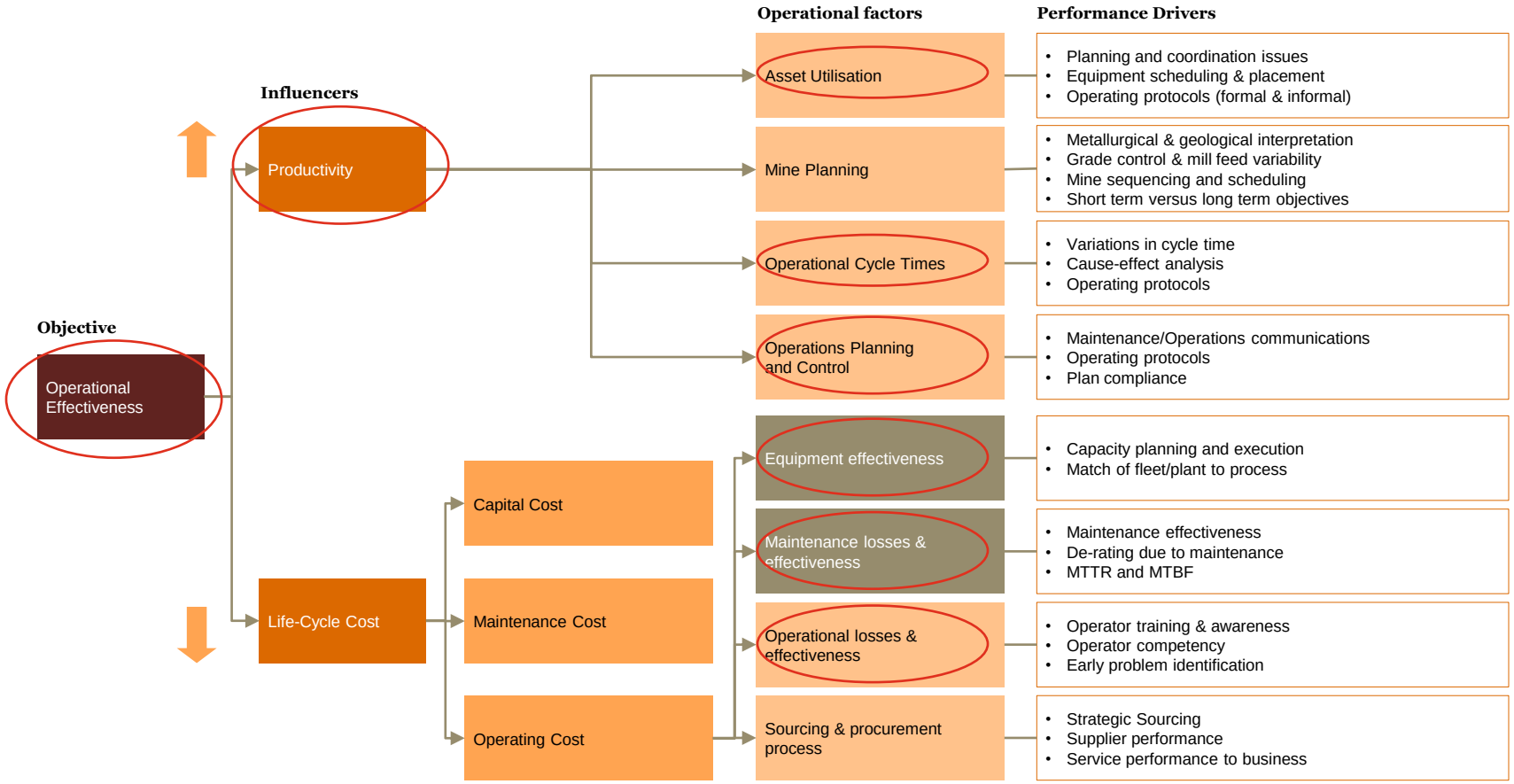
- Loading efficiency - matching haul truck size with loader size
- Operational efficiency - matching fleet disposition and mine plan
- Avoiding queuing at the loader or dump/crusher
- Avoiding double-dipping from inefficient loading practices
- Reducing tyre impacts from road conditions
- Reliability from schedule and plan compliance

Mobile Fleet

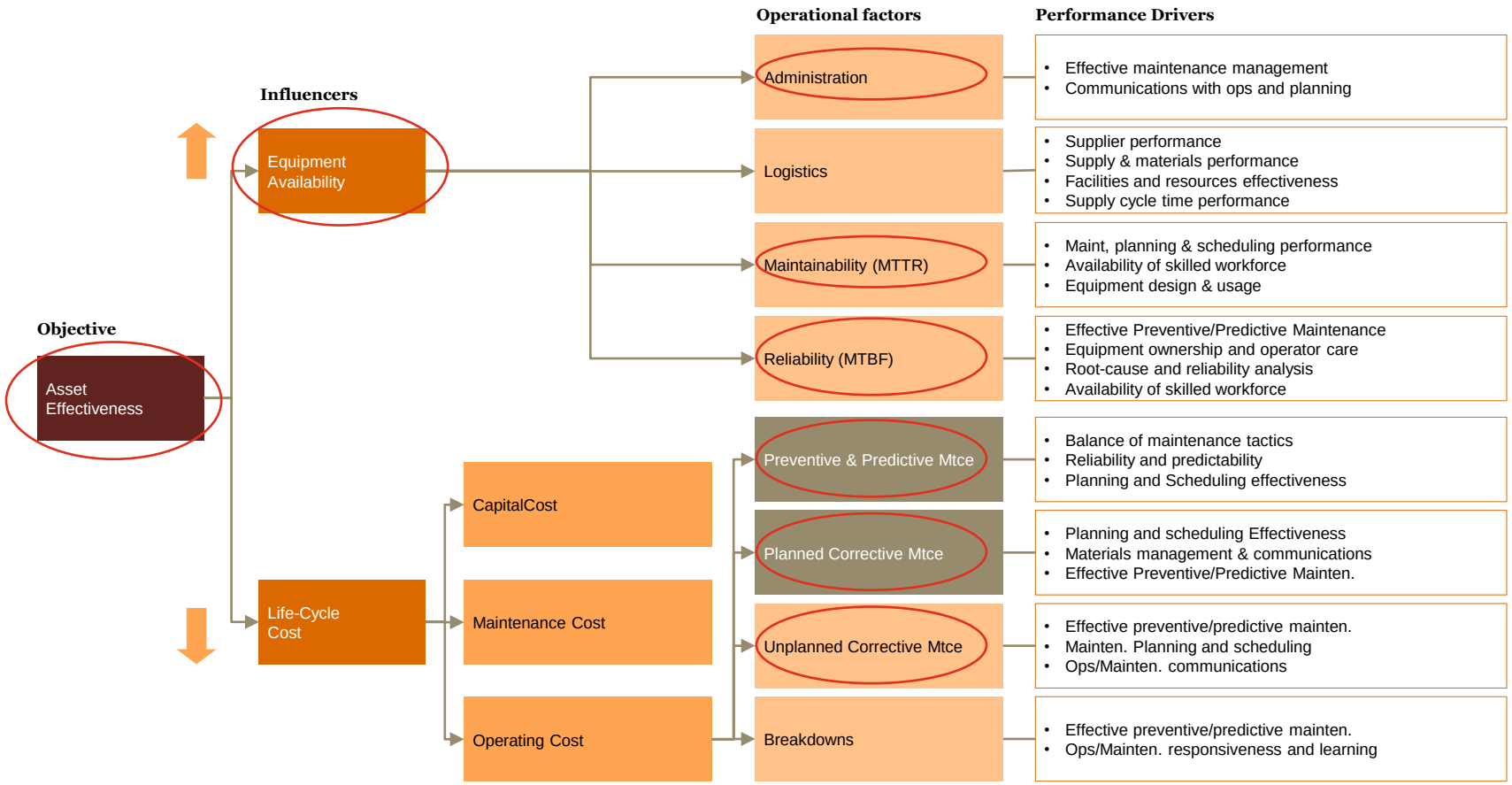
Improving equipment utilisation increases productivity



Identify latent capacity by using value driver trees to verify Performance Drivers against operational constraints…

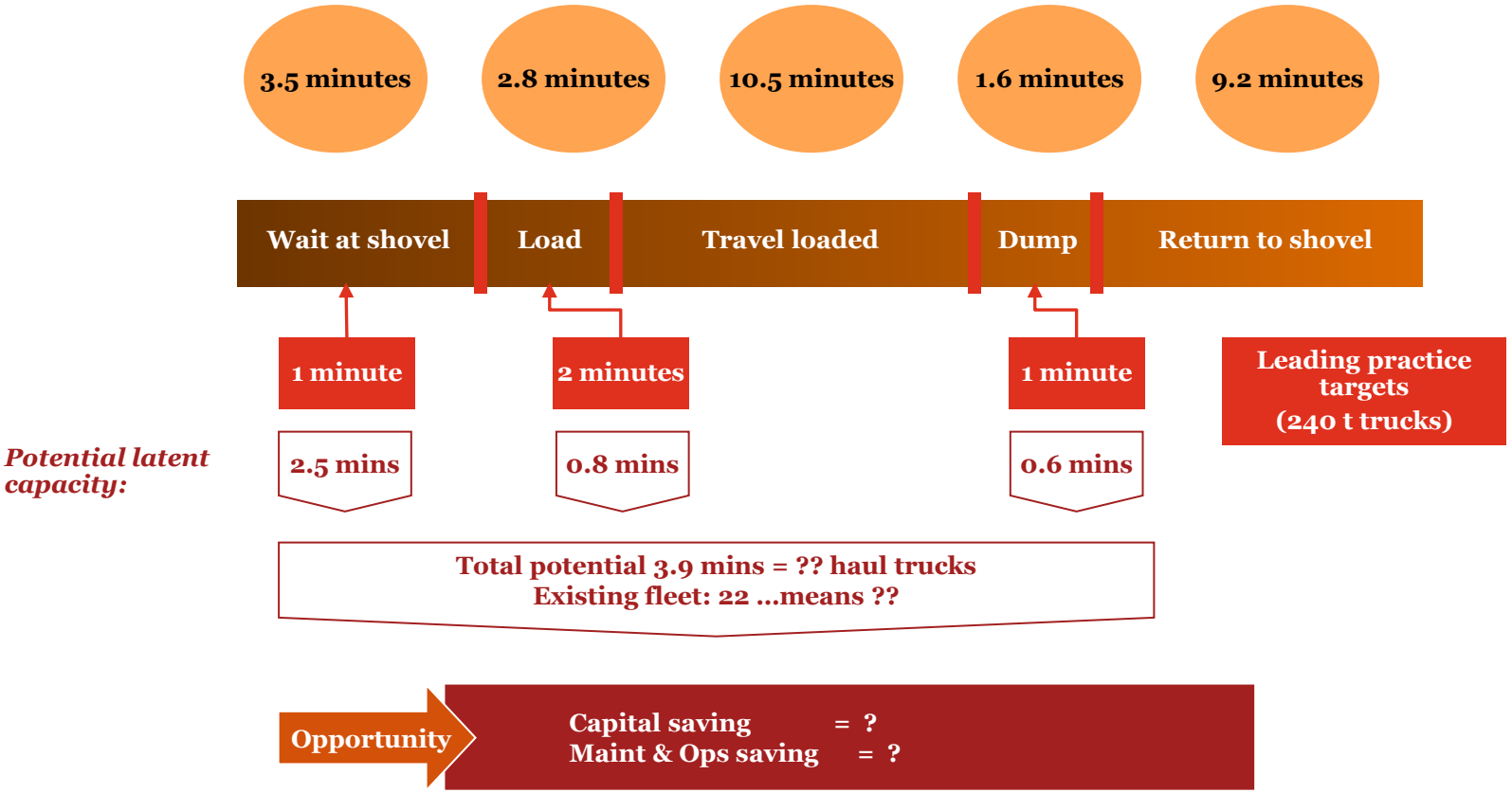


...and Asset Management definitions and restrictions



What is the impact of poor haul truck cycle time performance?

Actual site averages...



Example: This approach can unlock significant cost benefits as indicated by initial analysis of limited data from an operating mine…

Observations (fleet of 22 haul trucks)

Operations

Utilisation	71%	(or equivalent to 16 haul trucks)
Effective operating time	52%	(or equivalent to 11 haul trucks)

Maintenance

Availability	90%	*(leading practice 92%)*

But the assets are not being stressed by operations as shown by

Asset Utilisation	71%	*(85%)*
Operational Effectiveness	52%	*(70%)*

And we are concerned about Maintenance performance:

Unplanned maintenance	51%	*(20%)*
Scheduled maintenance	49%	*(80%)*

Caveats

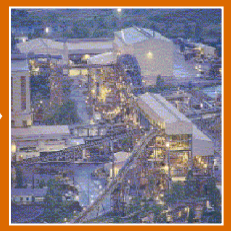
- Data definitions to be confirmed
- Only Q1 data available
- No Constraint analysis performed
- No Fleet matching performed
- Geological and mine planning not incorporated

	Equivalent haul trucks locked up	% of fleet	Est. Value ($M p.a.)	
			Opex	Capex (unutilised)
Asset Utilisation	6.3	29%	16	20
Operational Effectiveness	8.4	38%	21	28

Focus area 2: Processing

Exploration

Extraction



Processing

Logistics

Support Services

The basic steps of mineral processing

Crushing	Grinding	Sizing	Separation	Concentration	Disposal
Reduce size to allow liberation of the material. (Comminution)			Separate wanted and unwanted material	Concentrate wanted material into a form that can be transported	Dispose of the unwanted material (tailings).

Objectives

- Remove waste products mixed with the commodity during mining to reduce the overall tonnage to be shipped to the market
- Produce a concentrate from the mined ore to reduce downstream transport costs
- Produce a final product for shipping to the customer

Improves productivity of shipping and logistics

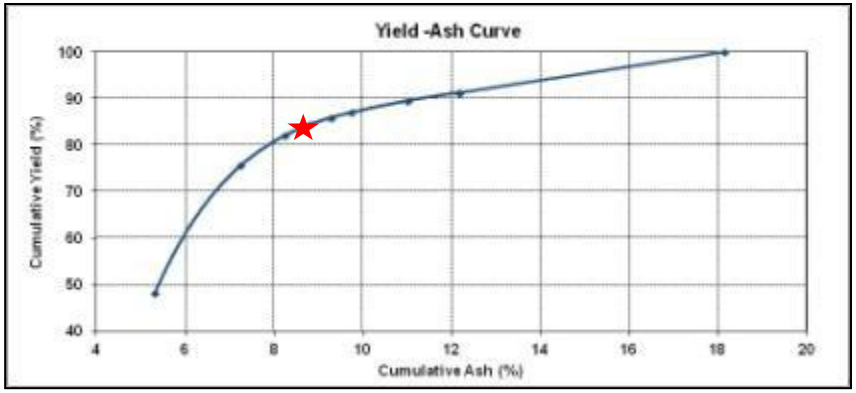
There are opportunities for improvements throughout the process

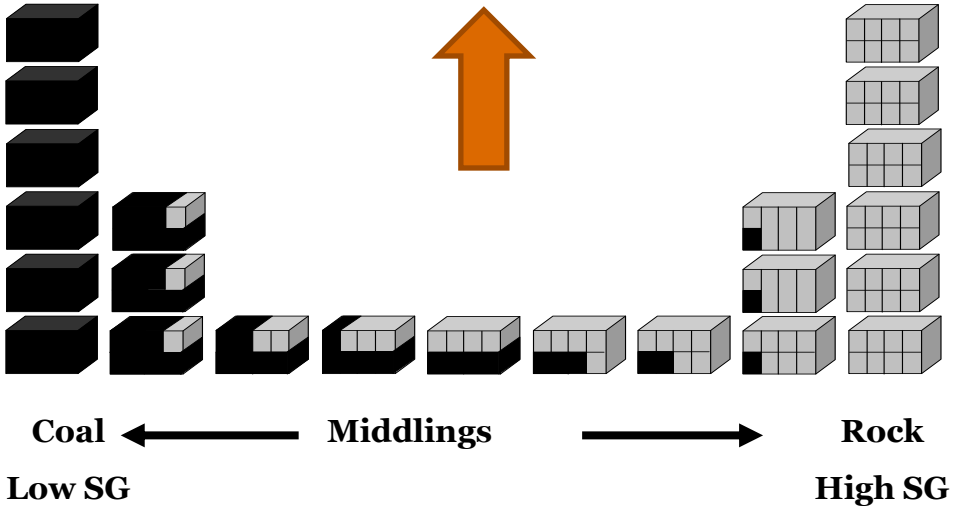
Typical CHPP Facility

Waste to reduce	Problems / Causes
Motion	• Inefficient truck paths • People moving • Shovels making too many passes
Waiting	• Information or materials not complete or ready to go • Idle equipment and resources
Over-production	• Large batches • Making for the sake of it • Ignoring CHPP constraints • Ignoring customer demands
Processing	• Adding more value than the customer wants • Unnecessary process steps
Defects	• Incorrect action, out of standard • Requires remediation and costly rework
Inventory	• High material stockpiles • Excessive space requirements
Transportation	• Unnecessary movement and stockpile shifting • Extra handling
Unused Creativity	• Limited tools or authority available to employees to carry out basic tasks • Lost ideas or knowledge

Through coal handling & preparation the optimal product mix can be developed

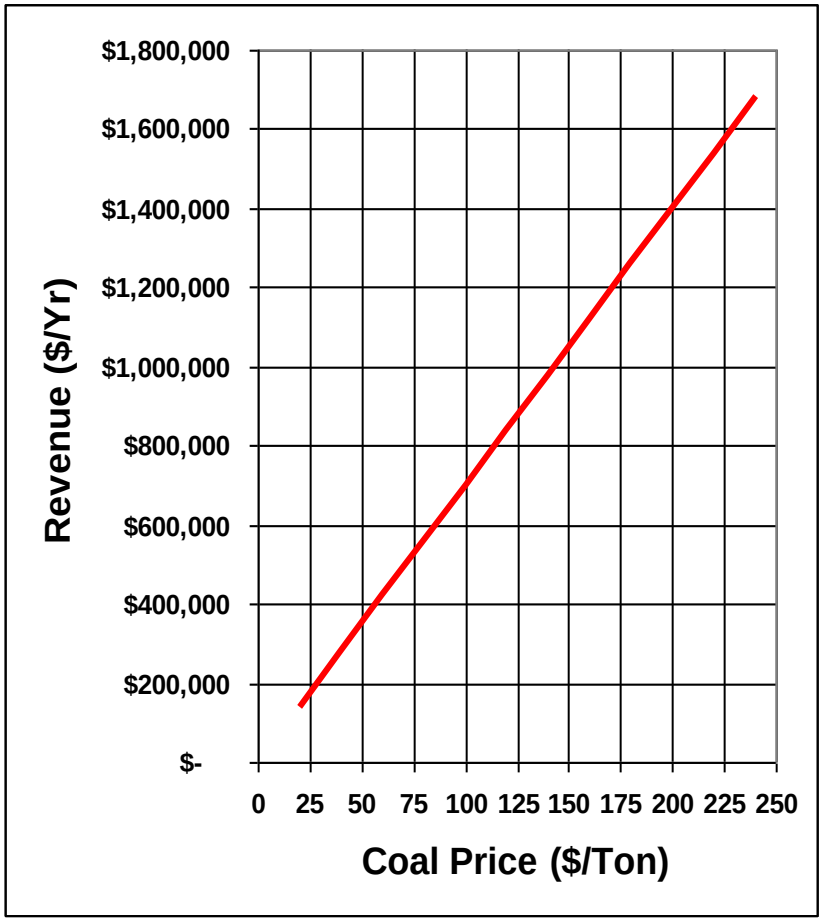
- Each pile of raw coal can be separated into groups according to density
- As these groups are added together, an "Yield-Ash" curve is formed
- Every coal has a unique Yield-Ash curve
- Ideally, we desire a low ash, high yield product
- The "elbow" of the curve is usually the optimum operating point





Coal Handling & Preparation
What will we do to make it better?

What is the value of just 1 TPH of additional coal recovery?



Coal handling & preparation
Coal quality - trivia

Heating Value

- How many BTU's are in one match head ?

1 BTU

- How many BTU's are in a 50g lump of Thermal Coal?

1425 BTU's

- How long could a 100 watt light bulb run from the energy in a 50g lump of coal?

4.2 Hours

Unlocking the benefits from improved extraction and processing

Exploration

Extraction

Processing

Logistics

Support Services

Combining improvements to the extraction and processing stages can unlock substantial benefits…

Observations (fleet of 22 haul trucks)

Operations

Utilisation	71%	*(Best practice: 85%)*
Effective operating time	52%	*(Best practice 70%)*

Maintenance

Availability	90%	*(Best practice: 92%)*

We are concerned about Maintenance performance:

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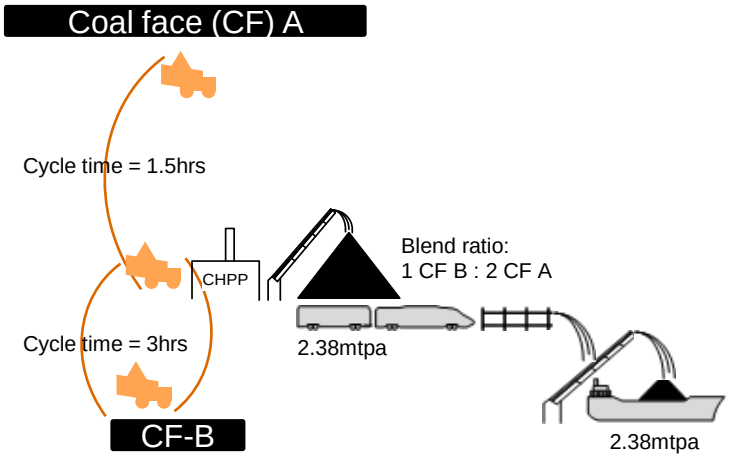
Scheduled maintenance	49%	*(80%)*

	Equivalent haul trucks locked up	% of fleet	Est. Value ($M p.a.) Opex	Capex (unutilised)
Asset Utilisation	6.3	29%	16	20
Operational Effectiveness	8.4	38%	21	28
If only 50% of opportunity is accessible				
Asset Utilisation			8	10
Operational Effectiveness			10	14



Example of setting cycle time for customer or constraint demand

- A coal mine has a rail capacity constraint of 2.38mtpa.
- Cycle time = 1,440 minutes / 6,849 tonnes (customer/ constraint demand)
- The mine needs to produce one tonne of blended product (1:2) every 12.6 seconds.
- CHPP capacity only needs to be 320tph at 85% yield.
- The CHPP could receive a 320t load from CF-B once every three hours, and a load from CF-A once every 1.5 hours.

We have used our knowledge and experience to help our clients realise substantial cost savings

50% increase in BCMs with half the CAPEX requested, identified >70% latent capacity

Board approved 50% of the proposed CAPEX but required the original mine plan to be fulfilled, which called for an increase of 50% in BCMs moved.
The mine management team was required to meet the increased production within 18 months.
Following an analysis of the operations, latent capacity of 77% was identified in haul truck cycle time and maintenance practices – target was achieved with capacity left over.

Identified >50% latent capacity in existing mobile fleet

At a time of high commodity prices and increased demand, the client wanted to test the effectiveness of current operations – we identified spare capacity of over 50% in haul truck fleets at a number of mine sites.

Saved $250m capital & generated $300m additional revenue

An Australian mining company wanted a major rail capital expansion proposal ($250m to increase capacity by 10-15%) tested for value – as a result of our work, the capital was not spent and we developed means to release increased rail capacity of 60-80% from the existing infrastructure; when tested, the system ran at the high rate and delivered an additional spot revenue over 3 months of approximately $300 million.

Iron Ore

- *Focus on improving mechanical unplanned downtime and meantime between failure*
- *Project resulted in a 7% uplift in the availability of the shovels and a 40% increase in the mean time before failure*

Gold

- *Start up operation was underperforming in comparison to estimates put forward in the DFS and the client needed additional margin from across all other assets to support*
- *More than 100 initiatives totalling >A$90m were approved by the steering team and $70m delivered within four months*

Thank you!

Want to learn more about how you can beat the cost curve?

1. *Contact*

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2. *Available resources*

Thank you.