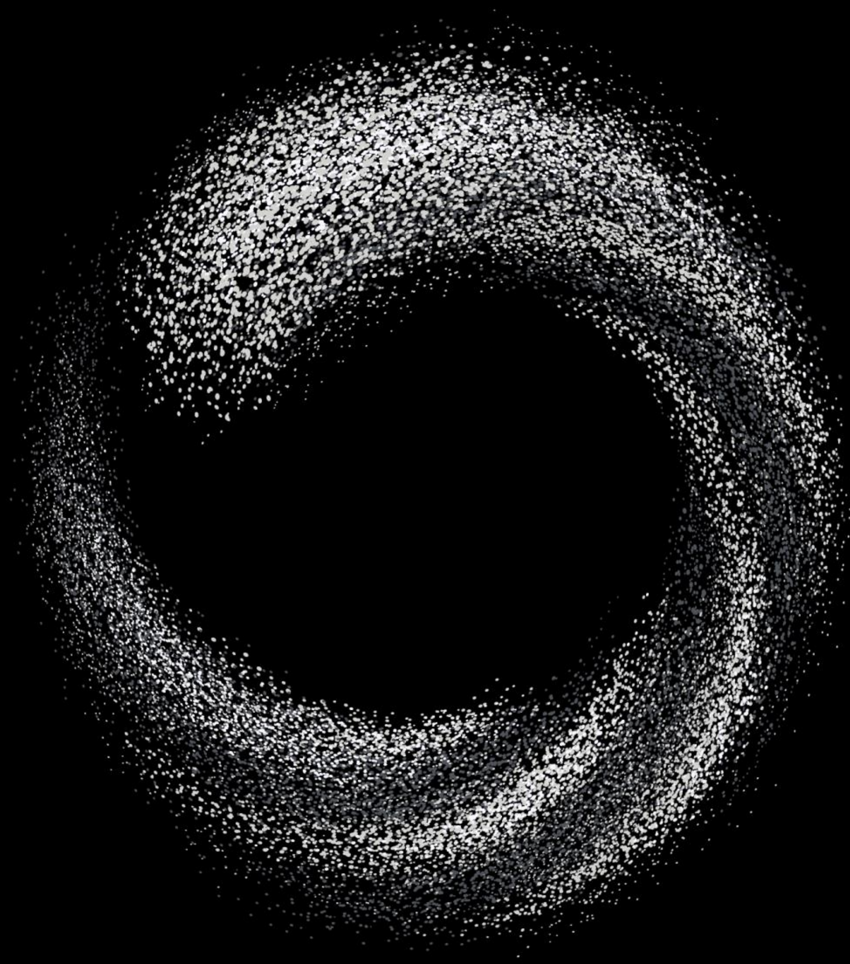
Engineering the Coal Transportation Chain

Pit to Port to Port

April 24, 2014



Mr. Gordon Zonailo, P.Eng.
Vice President Technology
Ports and Terminals

Ausenco

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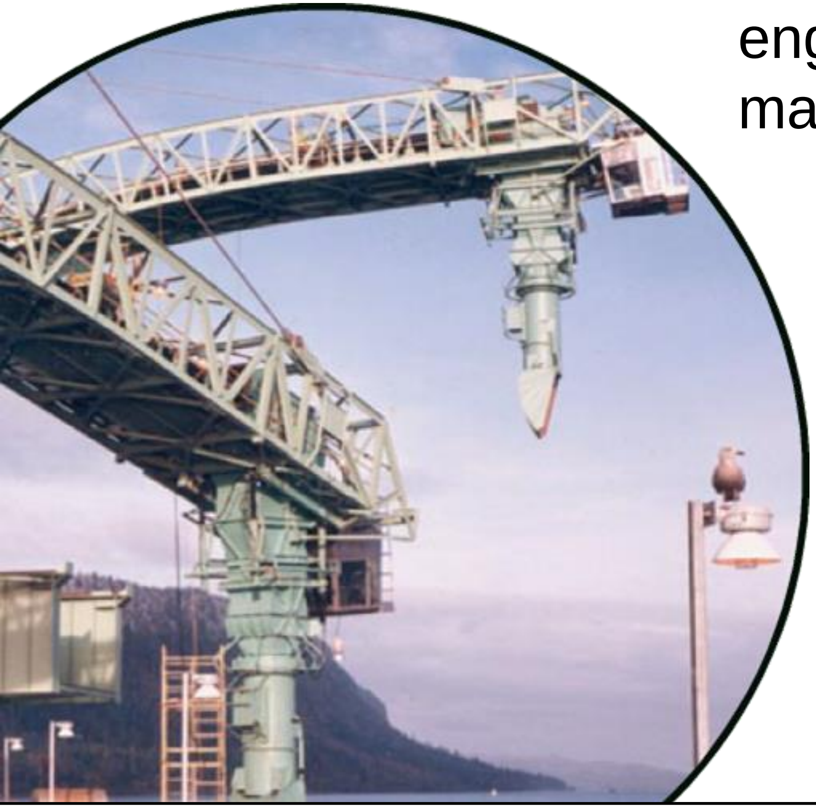
Corporate Profile

Ausenco is a leading engineering contractor operating worldwide in bulk handling, mines, transportation, ports, and marine terminals. History dates back through Sandwell and Swan Wooster to 1925.



Experience includes planning, optimization, engineering and/or construction management on:

- Over 10,000 port, terminal and transportation projects;
- Over 500 marine terminals;
- Terminals now handling well over 1 Billion t/y
- Planning of new terminals or expansions of over 1B t/y more
- Over 250 shiploader projects.

Topics

- Engineering the Coal Transportation Chain – Pit to Port to Port
- The Challenges – do it Faster, Cleaner, Better, Cheaper
- And do it now! Or wait??
- Some new terminal facilities and expansions in the pipeline
- “Pit to Port” efficiencies and the ship and terminal interface
- Achieving high shiploading rates with safety
- Pit to Port and end user simulation modelling
- Project examples
- The “new” Panama Canal – what will it mean?
- Ship trends and developments – will we move away from 50 year old designs?
- Mother Nature – At the Terminals and Ships in Rough Seas
- Conclusions

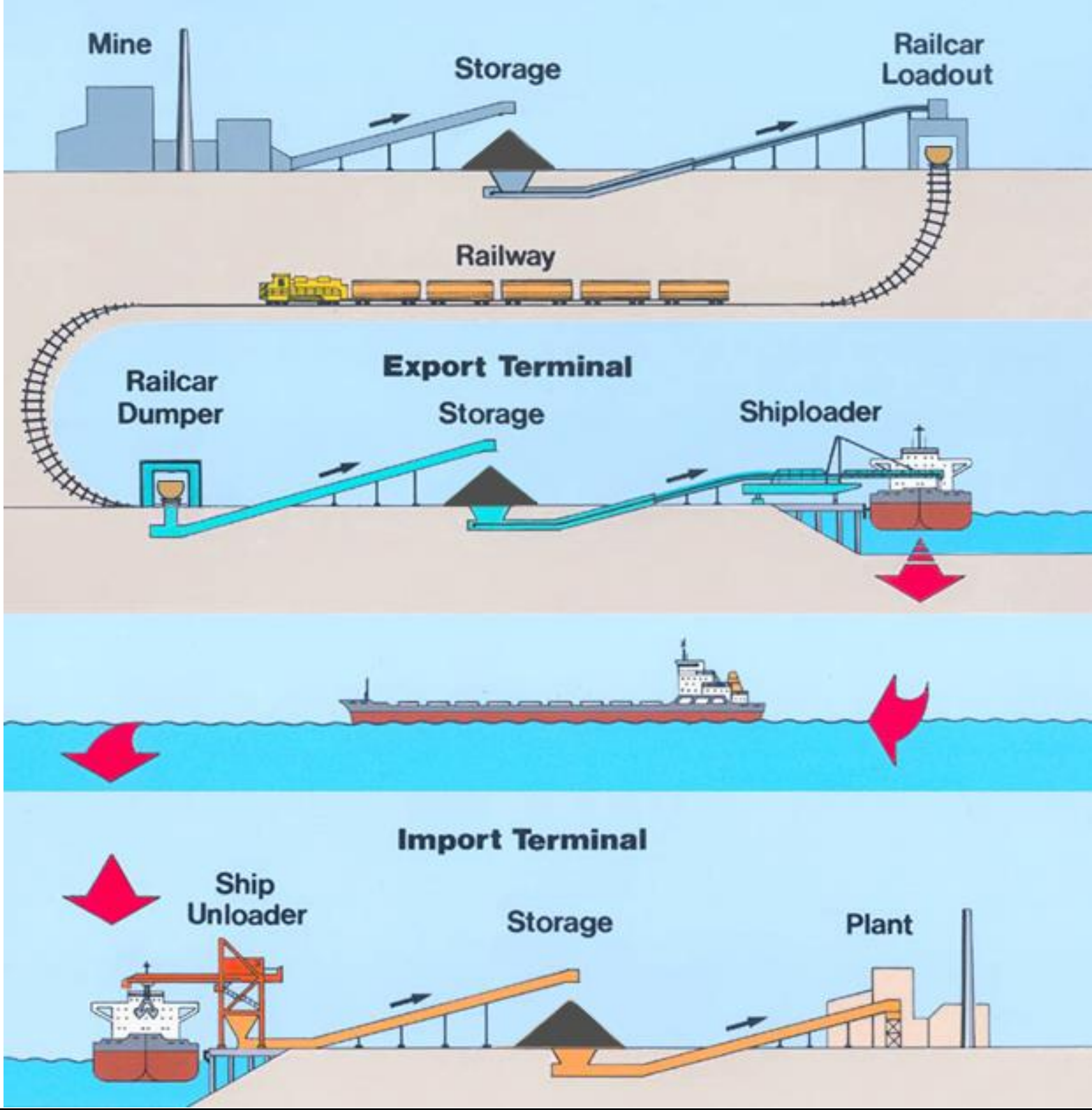
WORLD SEABORNE DRY BULK TRADE IN 3 MAJOR COMMODITIES (MILLION TONNES)

	2009	2010	2011	2012	2013	2014*
Iron ore	905	1005	1069	1124	1206	1269
Coal	**842**	**951**	**1013**	**1107**	**1176**	**1233**
Grain (including soyabeans)	295	297	313	326	338	345
Total major bulks	**2042**	**2253**	**2395**	**2557**	**2720**	**2847**
% growth from previous year		10.3	6.3	6.8	6.4	4.7

source: Bulk Shipping Analysis estimates and forecasts *forecast

- Iron ore, coal and grain comprise 2/3 of world's seaborne dry bulk trade.
- Iron ore and coal comprise approximately 58% of the seaborne dry bulk trade.
- Thermal coal is approximately 75% of the seaborne coal trade.
- Metallurgical coal's trade is affected greatly by steel production and thus the iron ore trade.

Typical Transportation System



The Traditional Challenges:
Faster, Cleaner, Better, Cheaper

Competitive and Environmental Challenges Force:

- More throughput
- Higher handling rates
- Less environmental impact
- Better management

And do it all at less cost!

From 2004 to 2008 it was "But Develop it More Quickly" !!

- The Chinese iron ore and coal opportunities evolved very rapidly
- This threw the major producers into a new mindset
- Produce the projects faster
- "Get tonnes to market" became the driver
- Project increments became 30, 50 or 100Mt/y instead of 5, 10 or 20Mt/y

Cost impacts were tremendous !!!

NO - STOP, STOP, STOP !!!
Became the Cry in late 2008

- **As we all know, the market fell with a resounding crash with the Global Financial Crisis and many projects were stopped**

- **Many of these projects were then analyzed more carefully and came back to life, often at a smaller or more cost effective scale or with slower timing between expansion stages**

We Then Were Back to "Do it Quickly" From 2010 to 3rd Q 2012!!

But with slightly more attention to internal due diligence and CAPEX control

– but not much!

Then in late 2012 it became STOP, STOP, STOP again !

Expansion and New Project Plans

These projects that Ausenco worked on in various stages between 2004 to 2012 add up to approximately:

Iron ore export capacity expansions and new mine, rail and ports

On more than 100 projects on 52 different facilities.

- over 1.1 Billion t/y throughput capacity

Coal export capacity expansions and new mine, rail and ports

On more than 50 projects on 25 different facilities.

- over 450 Million t/y throughput capacity

How many will actually proceed ???

BC Coal Terminal Expansion Possibilitis

In BC there are coal expansions or upgrades to the terminals underway at:

- **Ridley Terminals, Prince Rupert**
- **Neptune Bulk Terminals, North Vancouver**
- **Westshore Terminals, Delta**
- **Fraser Surrey, Surrey**

Several of the coal mines have looking towards expanding the export capabilities further or looking at alternative sites. All of these developments are under varying degrees of public scrutiny and environmental approval processes.

In addition now there are numerous potential LNG or oil export facilities examining West Coast locations and some of these are competing for potential coal export sites

U.S. West Coast Prospective Terminals

Gateway Pacific Terminal - Cherry Point, Bellingham - 24 to 54 Mt/y
Millennium Bulk Terminal - Longview - 5 to 20 Mt/y
Port Morrow/Port Westward - Boardman, St. Hetens - 5 to 20 Mt/y
Coos Bay ???
~~Grays Harbor~~

- Gateway Pacific Terminal
- Owned/Developed by SSA Marine
- Peabody commitment 24 mm tpy
- Announced capacity of 54 mm tpy

Future of U.S. Coal Exports

Washington Coal-Export Terminals Opposed By Seattle City Council
Posted: 05/30/2012 12:41 pm ~ Huffington Post

Drawing Battle Lines Over American Coal Exports to Asia
TIME Magazine ~ May 29, 2012

Terminal Developments: The Trends

- **Throughput increments have increased dramatically but may drop back more towards normalcy**
- **Train unloading rates have increased incrementally from 6,000 t/h to the 8,000 to 11,000 t/h range for high capacity tandem dumpers**
- **We are now considering 4 car dumpers with 16,000 t/h+ rates**
- **Train lengths have increased for iron ore trains from 200+ cars to 300+**
- **Coal train lengths to 150+ cars**

The Trends (cont'd)

- Stockyard capacities have been squeezed to provide more turns and there is more use of direct loading from trains to ship or "just in time" railing when possible
- Stacking rates have grown also to match train unloading
- Reclaimer rates have increased from 6,000 t/h to 8,000 t/h and even 10,500 t/h in coal and a few iron ore reclaimers up to the 7,000 cu m or 15,000 t/h range
- Reclaimer boom lengths have grown to as much as 65 m – but at high cost for the iron ore reclaimers in particular!

The Trends (cont'd)

- **Surge bins have grown to accommodate the reclaim and shiploading rates**

- **Shiploading rates have grown modestly in most cases but over a long period of time**

- **Vale Ponta Madeira and Tubarao iron ore terminals load at nominal 16,000 t/h and design rate 20,000 t/h and are current highest – from late 70's planning!**

- **Ausenco has recently planned Dual Quadrant or twin travelling loaders to 12,500 t/h to 16,000 t/h rates per loading boom for 25,000 to 32,000 t/h shiploading rates for some new iron ore terminals**

Cerrejon

Cerrejon

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Cerrejon Coal, Colombia

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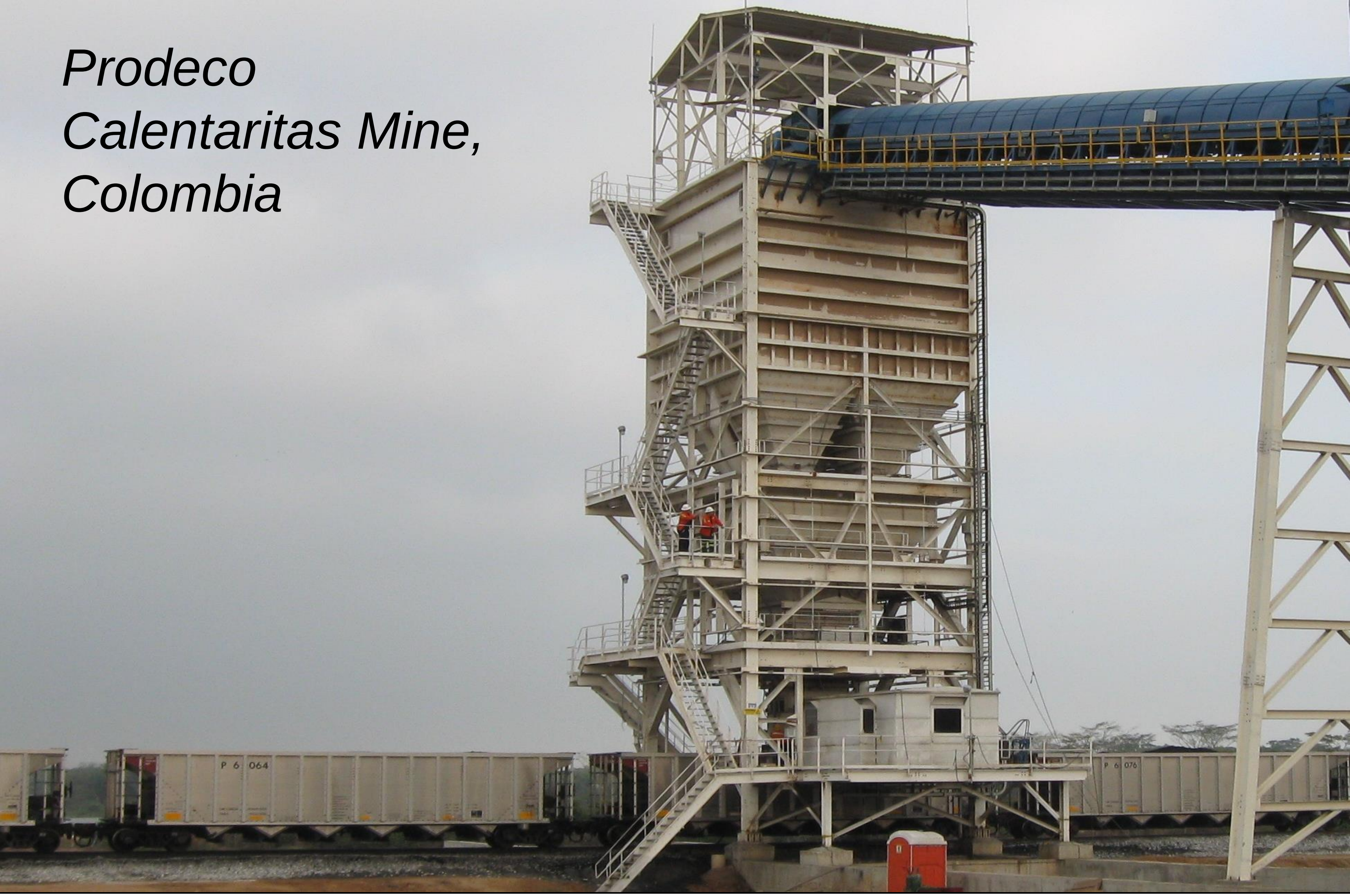
Prodeco Calentaritas Mine, Colombia



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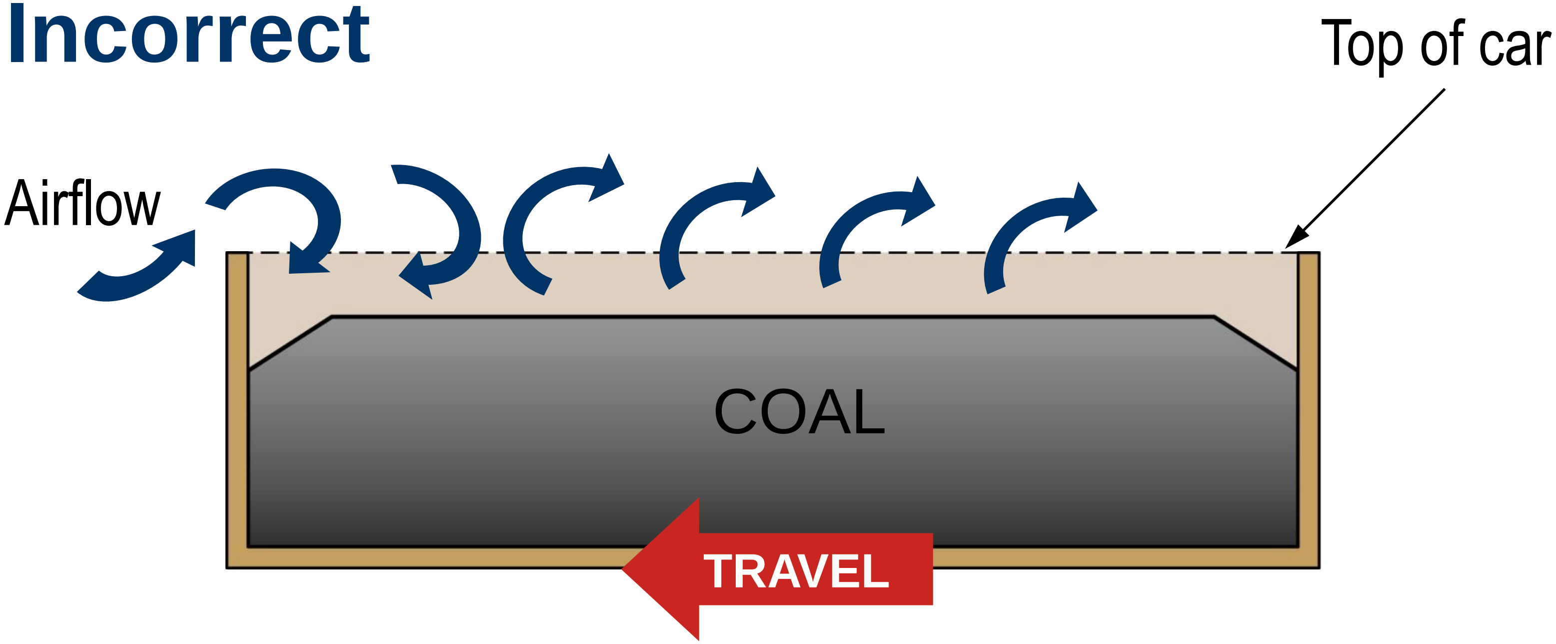
Railcar Loading Level at 80%

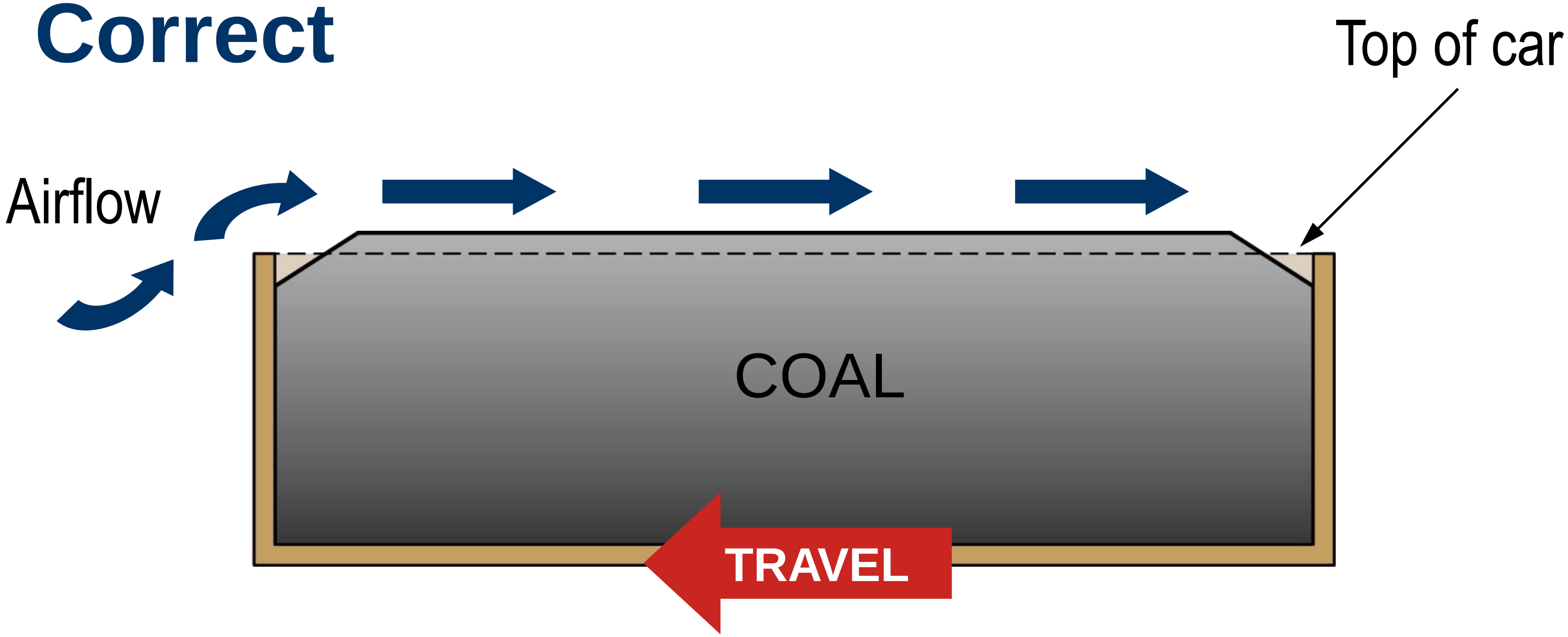
Incorrect



- With coal surface below top of cars more dust is generated
- Airflow is turbulent and can stir up dust
- More cars/trains are required to haul the coal

Railcar Loading Level

Correct



- Coal at top of car or 75 to 150mm above top
- Smooth top profile, with water spray or binder
- Airflow over top of car is smooth and creates less dust

Cerrejon Coal – Railcar Coal Profiling

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Incorrectly loaded railcars

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The Ship / Terminal Interface

Terminals – The Vital Link

- Terminals are vital links in the overall transportation chain
- They provide the buffer storage between transportation modes
- Affect the mine, railroad and ocean shipping costs
- Have a great effect on total cost of products delivered to customers
- Disproportionate to the actual terminal costs

The Ship / Terminal Interface

- The shiploader (or unloader) is the direct link from shore to ship
- Shiploader type and loading performance are directly affected by both the ships and shore facilities
- Overall project objectives, design parameters and site considerations generally govern the shiploader selection
- Selected shiploader type has a large influence on overall capital cost and loading performance

"Our entire cash-flow depends upon, and will pass through this tiny spout on it's way to the world markets."
Quote by clients CEO

Shiploading - Safety and High Rates
Is it Possible? – Loading Efficiency?

- Ship and terminal crew's safety are paramount
- Ship – management of hull stresses during loading is essential
- Avoidance of physical damage during loading and unloading is critical to ship and loader
- Loading and unloading equipment and operators safety – long term structural fatigue problems
- Environmental Safety – minimizing impacts
- Security is now an issue
- Cargo liquifaction is now a significant issue for iron ore fines and some coal fines
- Mother Nature – wind storms, waves and earthquakes can take their toll!!

Efficiency

Various measures/factors re shiploading and terminal efficiencies:

- Capital cost
- Operating cost
- Marine operations time for channel travel, berthing,
- de-berthing time
- Shiploading rate – net and gross
- Shiploading delays
- Berth Occupancy
- Ships total time in Port
- Demurrage/dispatch

Combined capital and operating cost of terminal and ship per tonne of throughput is the best measure of efficiency.

Design Issues

Shiploading is just one part of a terminal and transportation system

Shiploading planning parameters include:

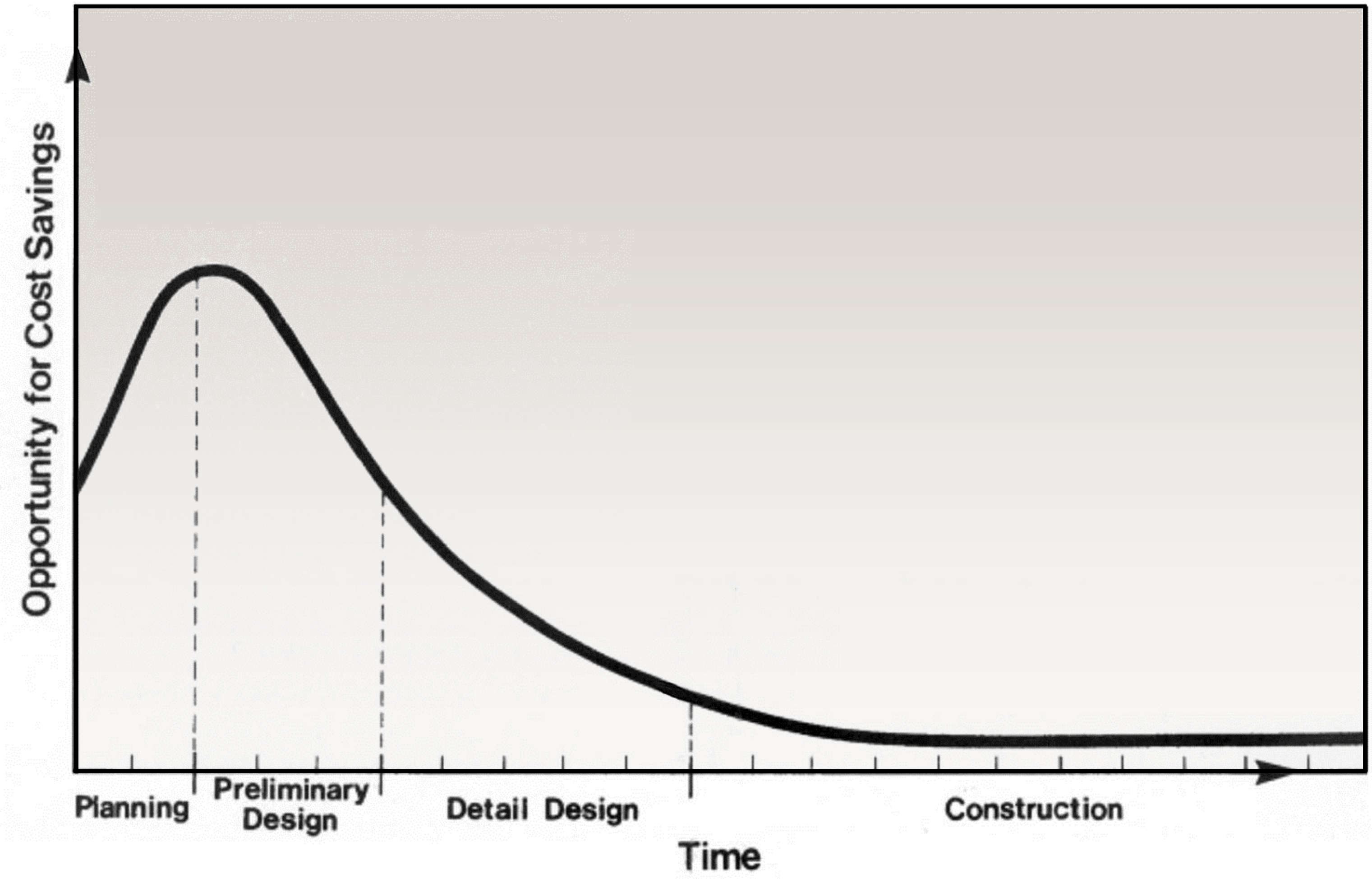
- annual tonnage and grades of material
- seasonal rates of mine or plant production
- distance from mine or plant to terminal
- size of rail cars and unit trains or trucks and truck fleet
- terminal handling rates and storage capacity
- size and distribution of shipping fleet and ocean
- shipping distances
- applicable freight, demurrage and dispatch rates

Design Issues

Design Variables for the shiploading system also include:

- climatic conditions, physical characteristics, geotechnical conditions, seismic conditions, and environmental sensitivity of the area
- train or truck unloading rates for direct loading
- handling characteristics for products
- number of stackers, reclaimers or combined stacker/reclaimers
- shiploading rates, number and types of berths
- draft constraints, ship anchorages and availability of tugs

The Importance of Early Planning
- greatest effects on project costs



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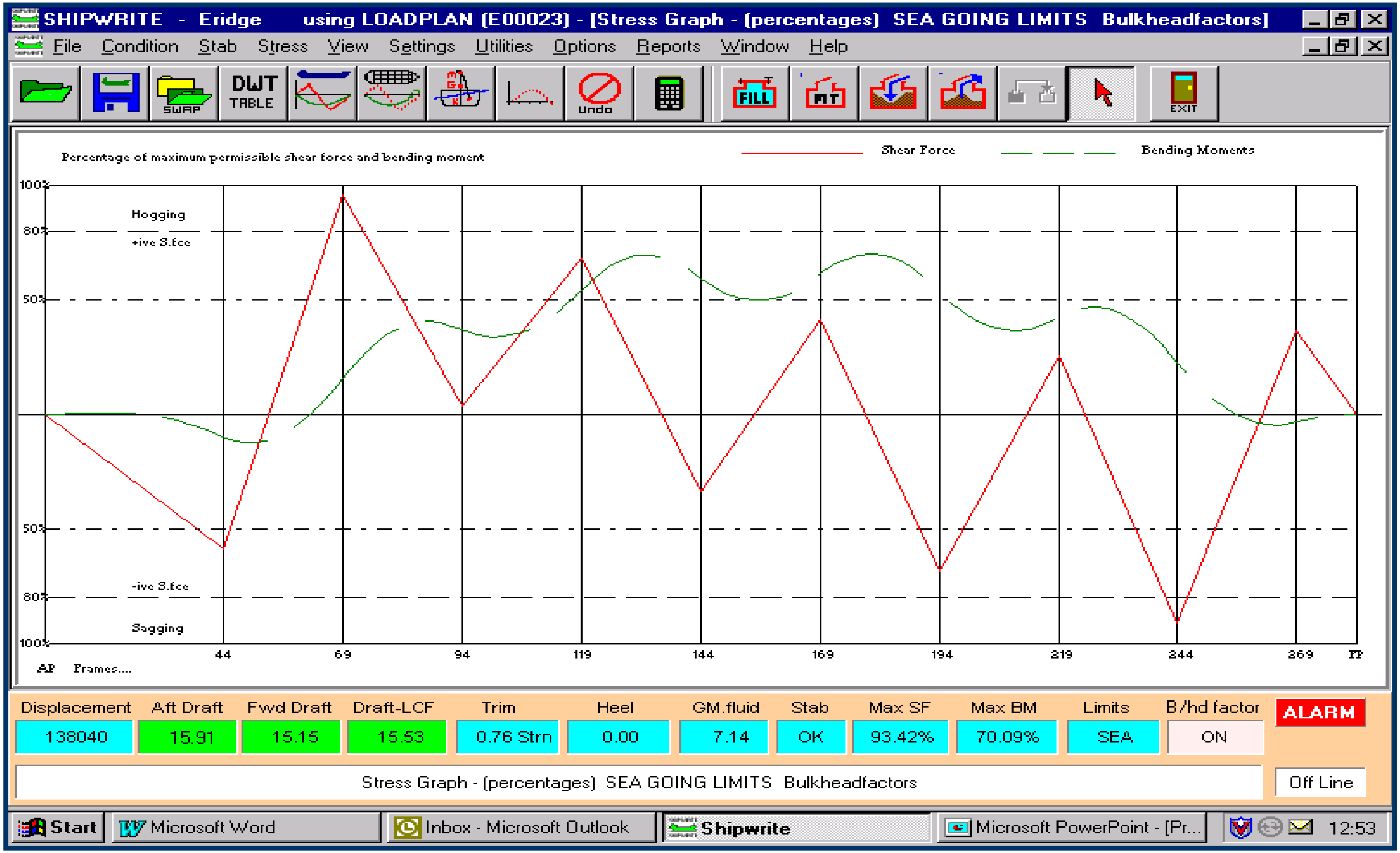
Shiploading Rates

Can you load ships too quickly ?

Well, that depends !

Alternate Load Stress



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Getting it wrong can be disastrous!

MV Trade Daring, Brazil

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Shiploading Rates Too High ?

- Shipping industry thinks so in many cases.
- The breaking of the "Trade Daring" while loading iron ore in Brazil focused attention on shiploading rates.
- There has been substantial investigative work done since 1990.
- Most evidence points to unsuitable vessel design details, poor fabrication, corrosion and hull fatigue due to long service.
- Stress and damage caused at loading and discharge – especially at old age – are contributory factors.

Rate of Structural Loading

- High capacity shiploading is actually a very slow rate of load application.
- Even 16,000 tph = 4.4 tps. Very slow re ships hull bending stresses provided the load plan is correct, within deballasting limits, and is properly distributed in the hatches.
- A railway bridge for instance sees load application rates of hundreds of times as fast.
- A ship on the ocean sees complete stress reversals in 8 to 20 second wave periods.

But higher loading rates require much more care in the loading control and procedures!

Key Shiploading Issues

- Loading plan agreement and accuracy of loading.
- Deballasting speed – predeballasting, possible?
- Monitoring hull stresses.
- Loading pattern within the holds.
- Height of drop and velocity of the material.
- The hatch pours must meet the loading plan!

First few minutes in the hold are the most critical – build a "cushion" of material.

Conclusion ?

Ships can be loaded incorrectly but not too fast structurally.

An industry wide training and accreditation program is essential!

The International Dry Bulk Terminals Group has developed one!

Shiploader Types

There are many types of shiploaders available.

For high loading rates, the following types are used:

- Travelling, luffing, telescoping or slewing boom
- Dual radial
- Dual Quadrant
- Linear and dual linear

Examples follow

Example Shiploader Types and Projects

Westshore Terminals – Travelling, Shuttle

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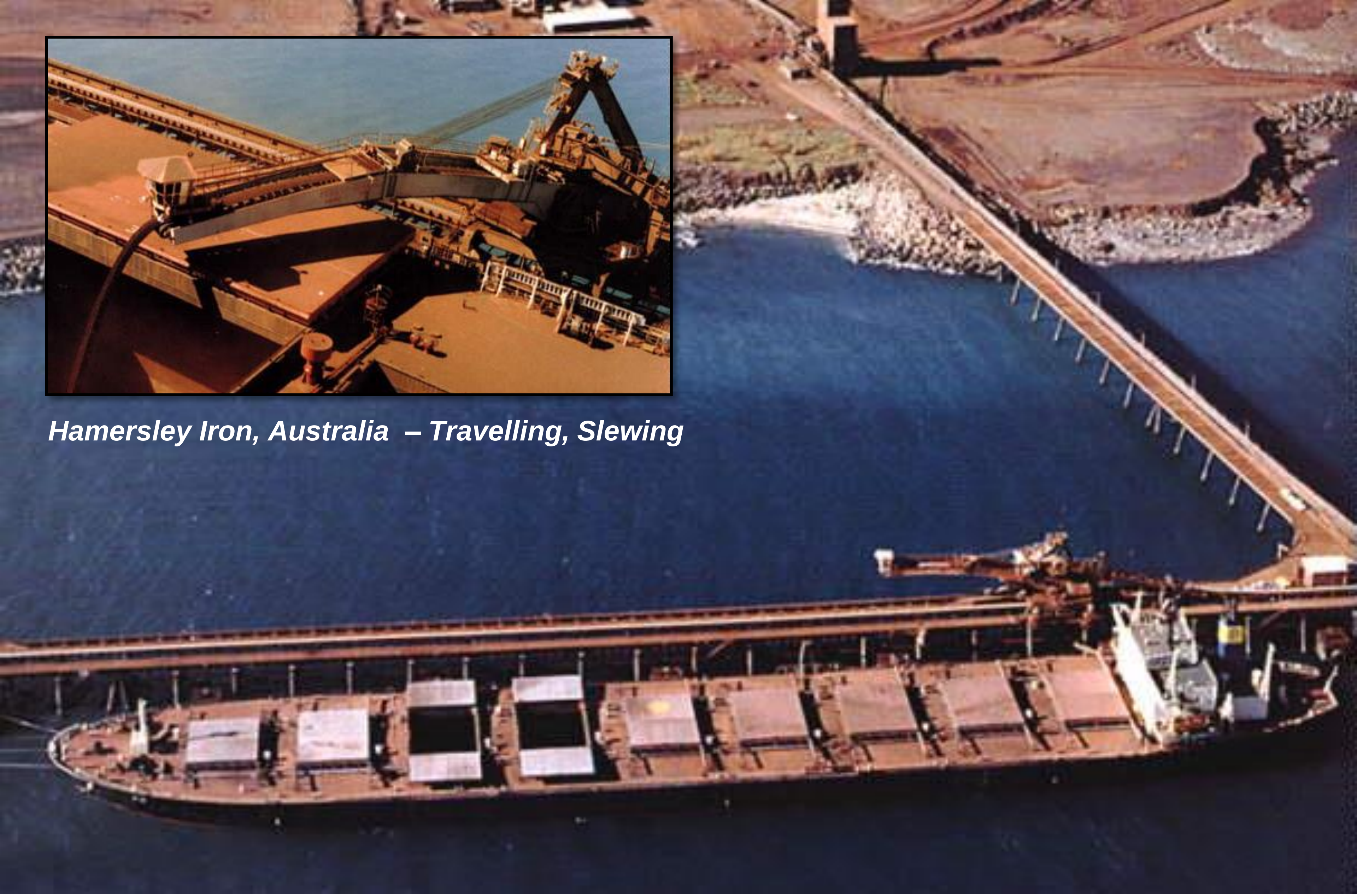


Hamersley Iron, Australia – Travelling, Slewing

Antamina, Peru Concentrate Export Terminal Radial Shiploader

Antamina Project, Peru – Radial Shiploader

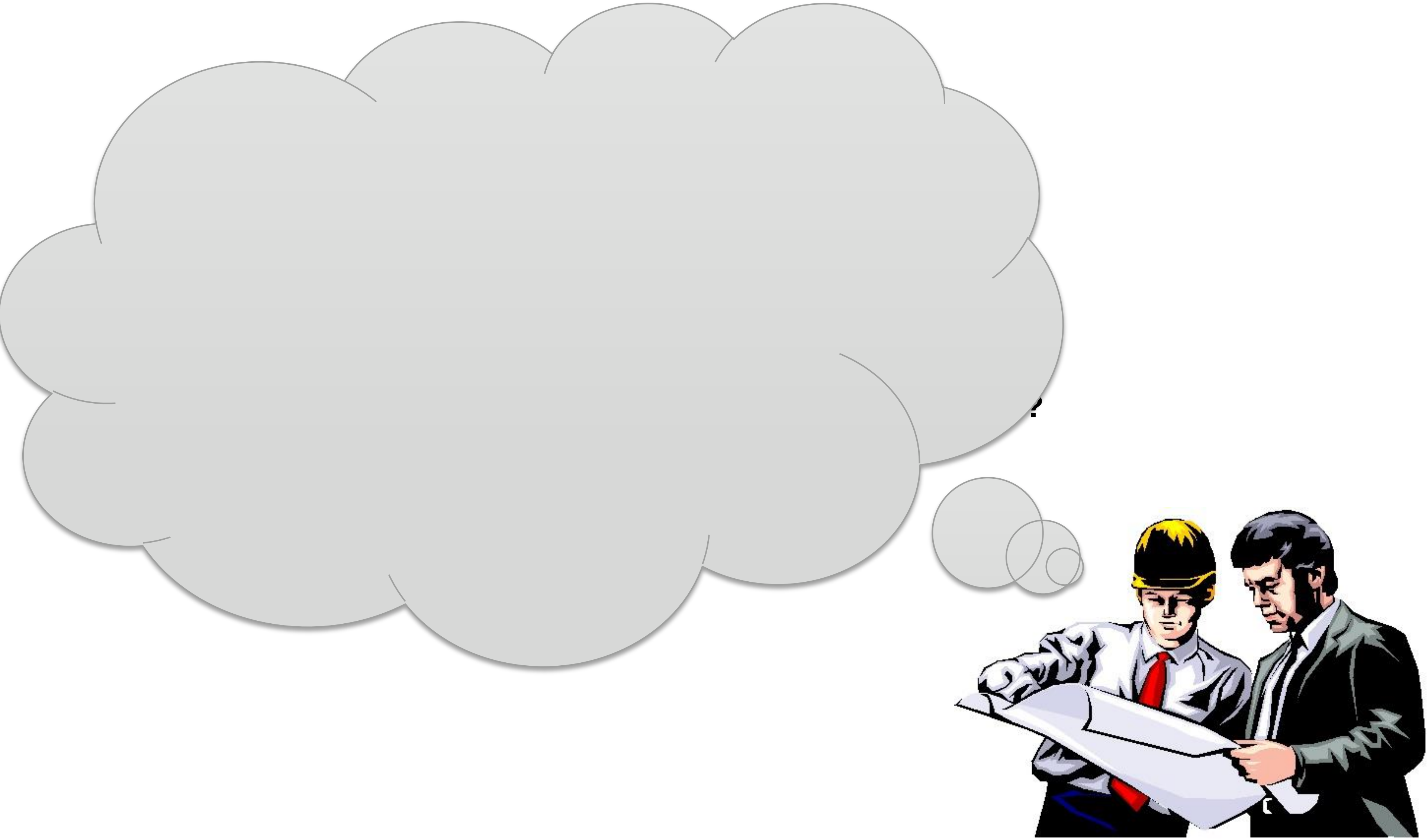
Ridley Coal Terminal, Canada
Dual Quadrant Shiploader

Bontang Coal Project – Quadrant Shiploader

Dual Linear Loader,
Ferteco,
Brazil

Linear Loader,
Cerrejon, Colombia

How can we solve problems?



Simulation Modelling

A good simulation model with experienced “interpreters” can assist in:

- identifying the bottlenecks
- assessing alternative solutions
- defining the value of “wins” by debottlenecking

and optimization of the shiploading system, terminal and the whole transportation chain.

Increase Machine and Outloading System Capacities

- Automatic reclaiming where appropriate
- Arrange and shape stockpiles for maximum reclaim efficiency
- Increase bucket wheel speeds
- Speed up conveyors and/or increase belt size within existing steelwork
- Consider Imperial belt size vs Metric size, often a bit larger
- 45 degree idlers vs 35 degrees
- On shiploaders increase travel, and luffing speeds, to minimize hatch change time
- Consider addition of a surge bin

Improve Maintenance

- Scheduled maintenance programs
- Modularity for components
- Interchangeability
- Improved accessibility
- Corrosion control
- Reduced spillage / clean up

Challenge the Operators

- Benchmark against competitors and other terminals
- Eliminate the “we’ve always done it this way” syndrome
- Challenge the “Status Quo”
- Bring in outside expertise to review operations
- Encourage new ideas
- Periodic re-training to upgrade skills

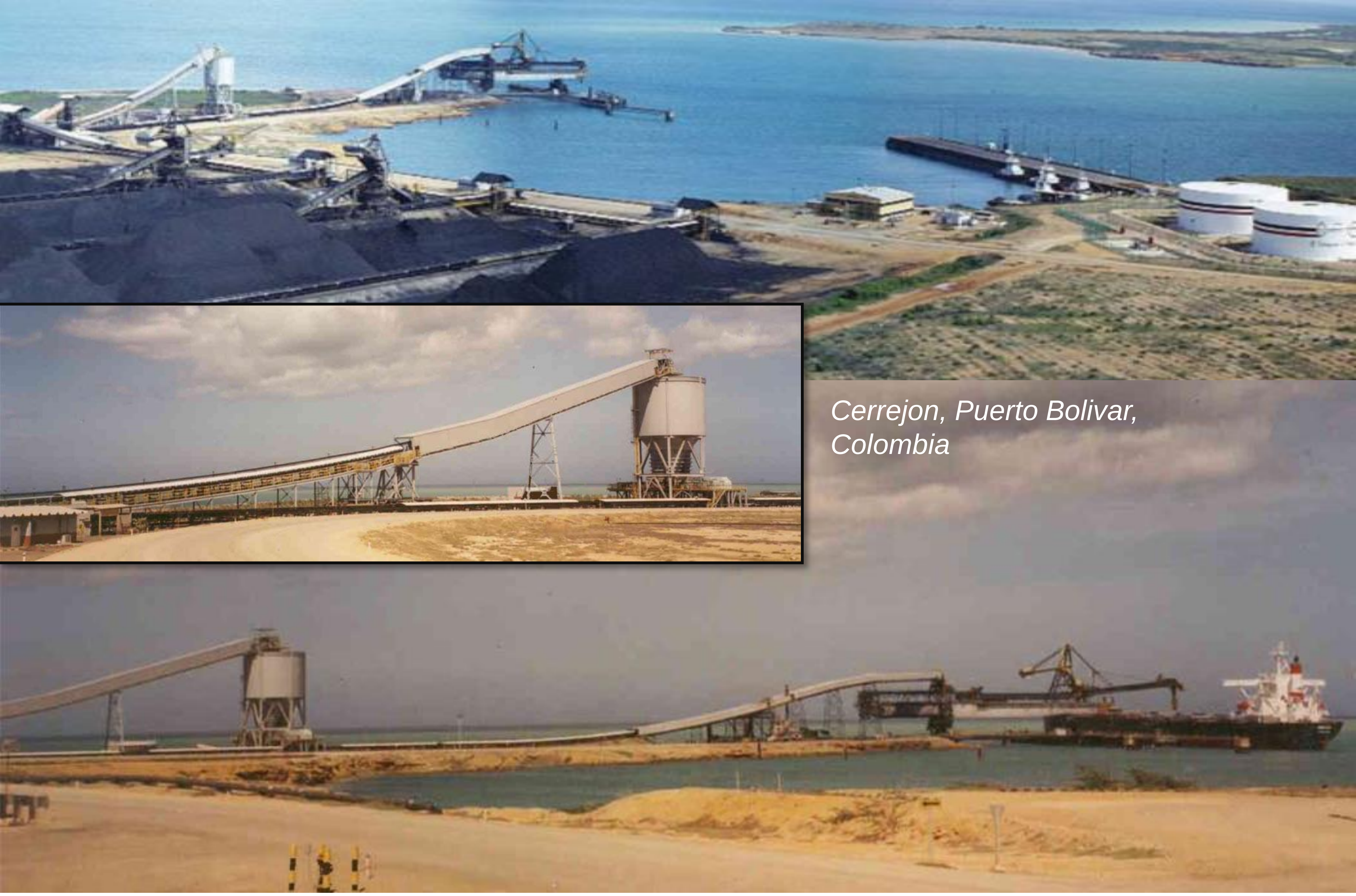
Work as a positive team!

Simulation Packages

- **Bulk import/export terminals**
- **Mine-to-port supply chains**
- **Port-to-port supply chains**
- **Trucking of bulk materials**
- **Open-pit mining**
- **Barge transportation and transshipping**
- **Shipping in ice**
- **Pipelines**
- **Mineral processing**

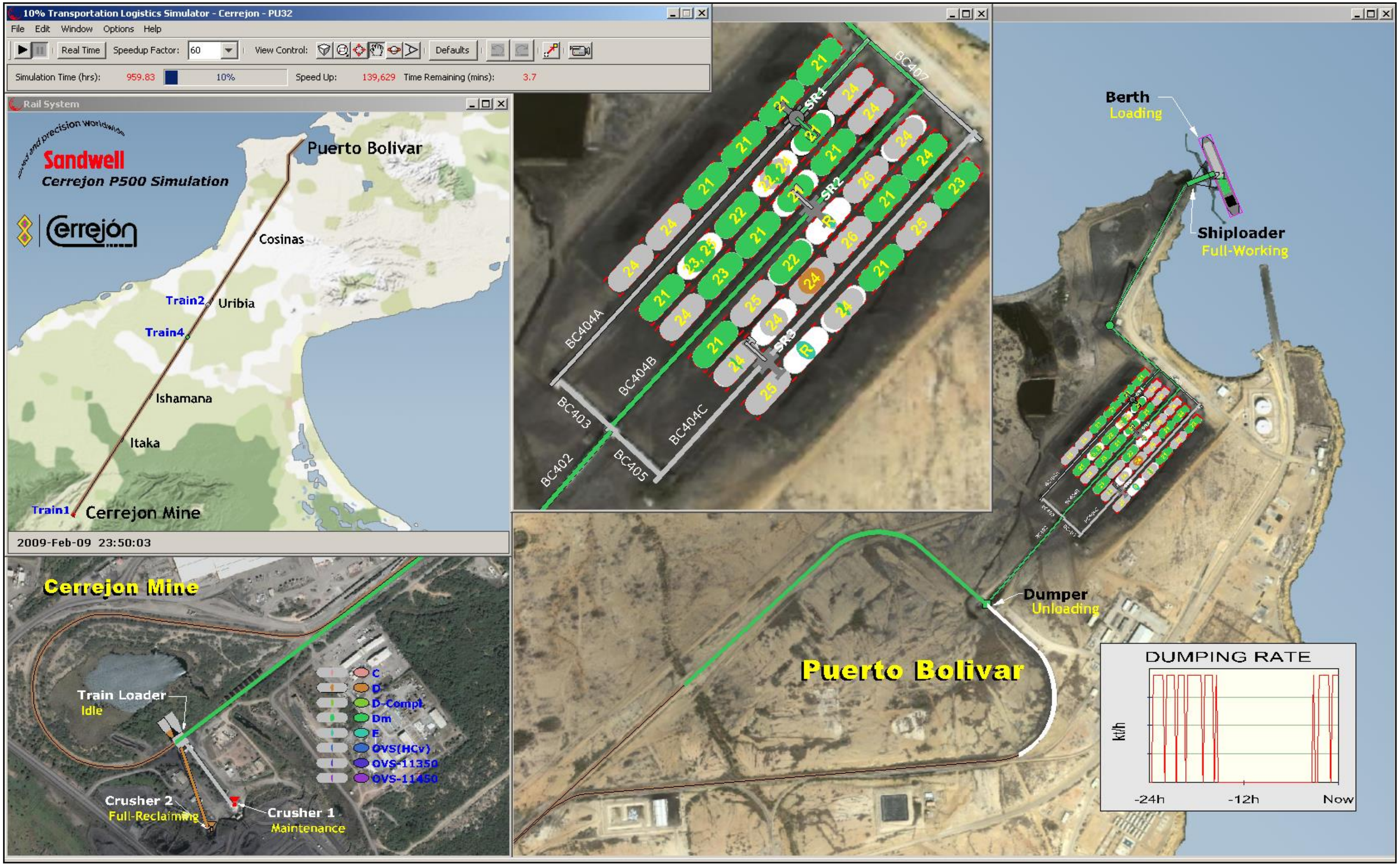
Coal Simulations

- **DBCT, AU**
- **Surat Basin, AU**
(RG Tanna, WICET, Barney Pt, Balaclava Island)
- **Hancock GKV Alpha Coal Project (Abbot Point) AU**
- **Cerrejon (Puerto Bolivar) Colombia**
- **Prodeco, Santa Marta , Colombia**
- **European Bulk Handling Installation, Spain**



Cerrejon, Puerto Bolivar, Colombia

Model Screenshot PU-32



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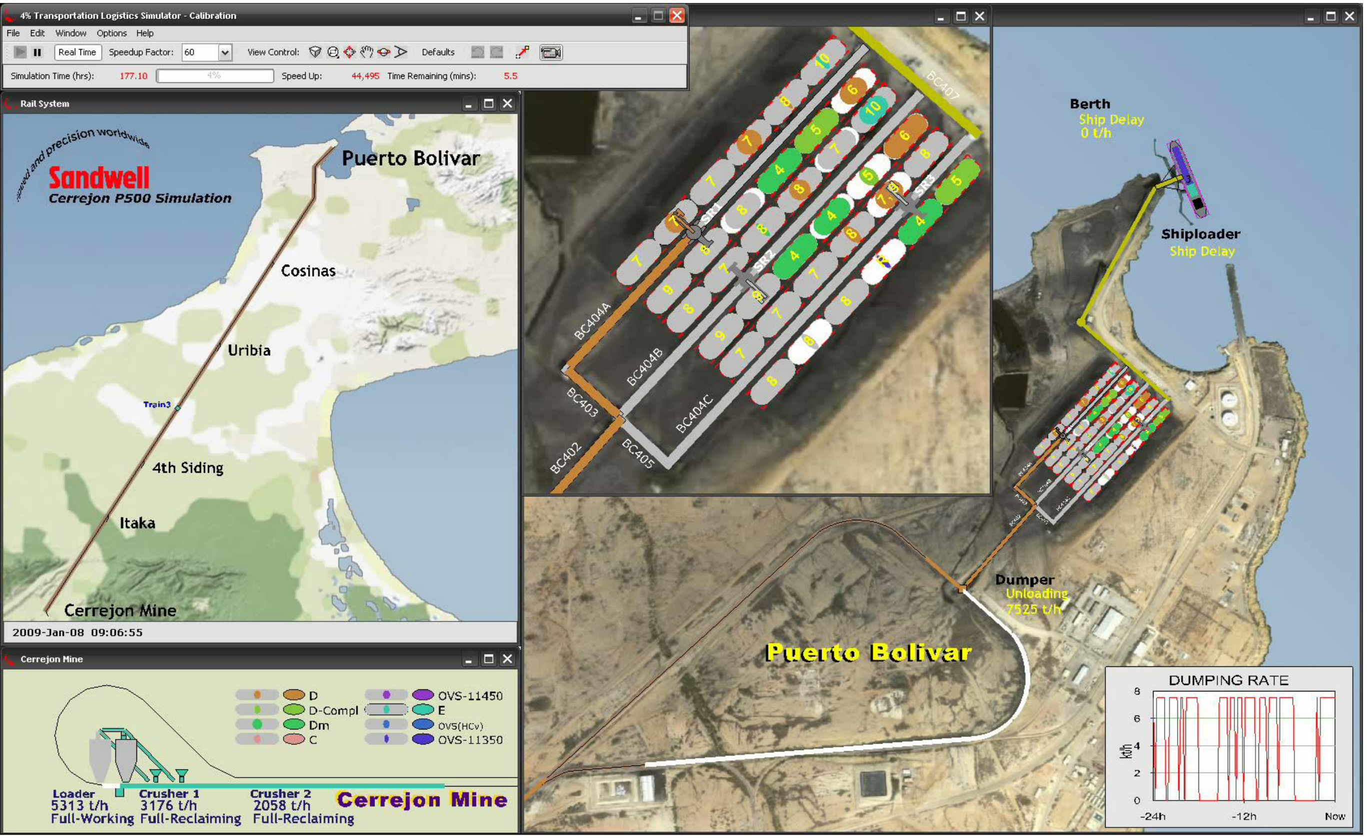
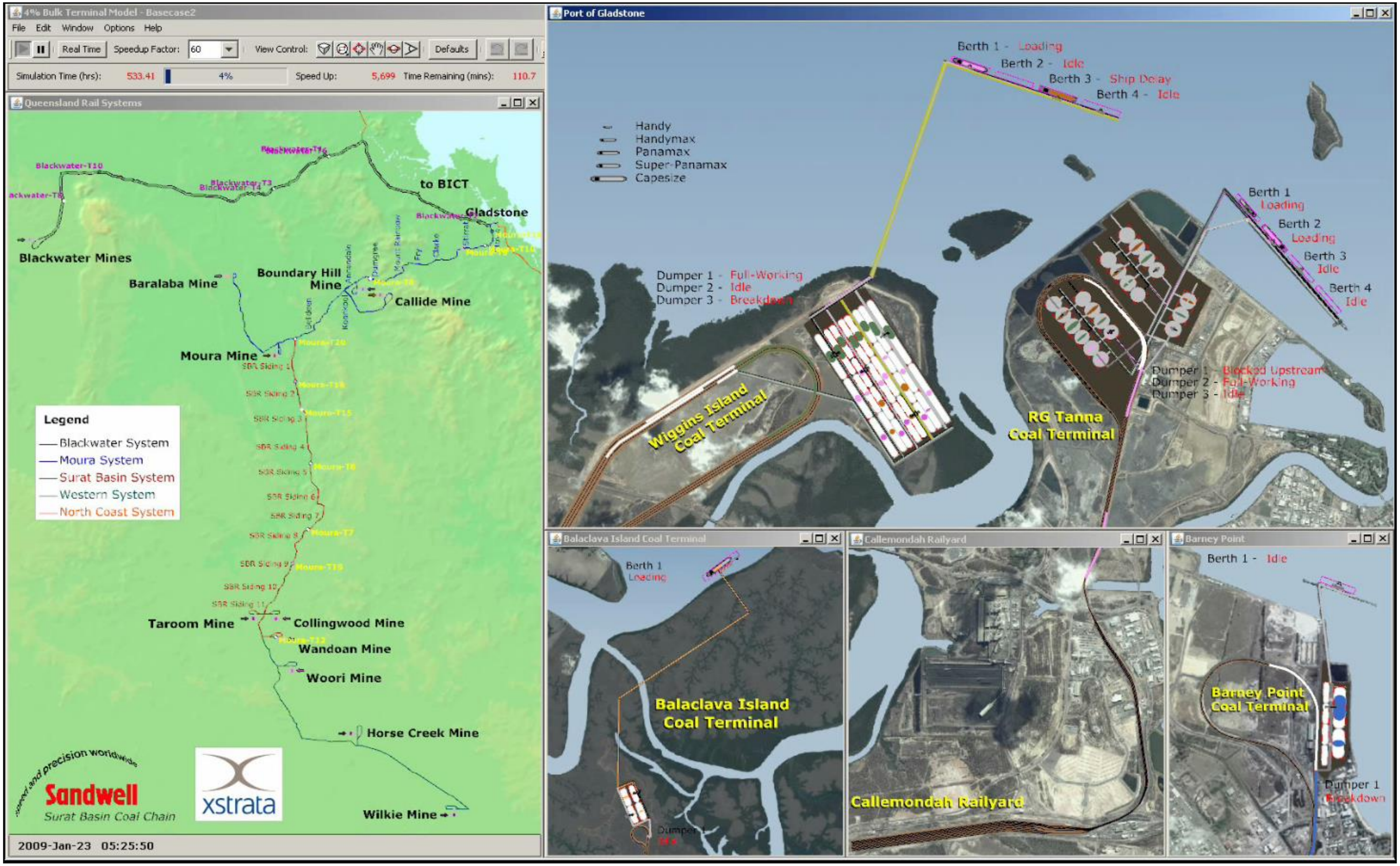
Cerrejón Coal, Colombia



Surat Basin Coal Chain Project Background



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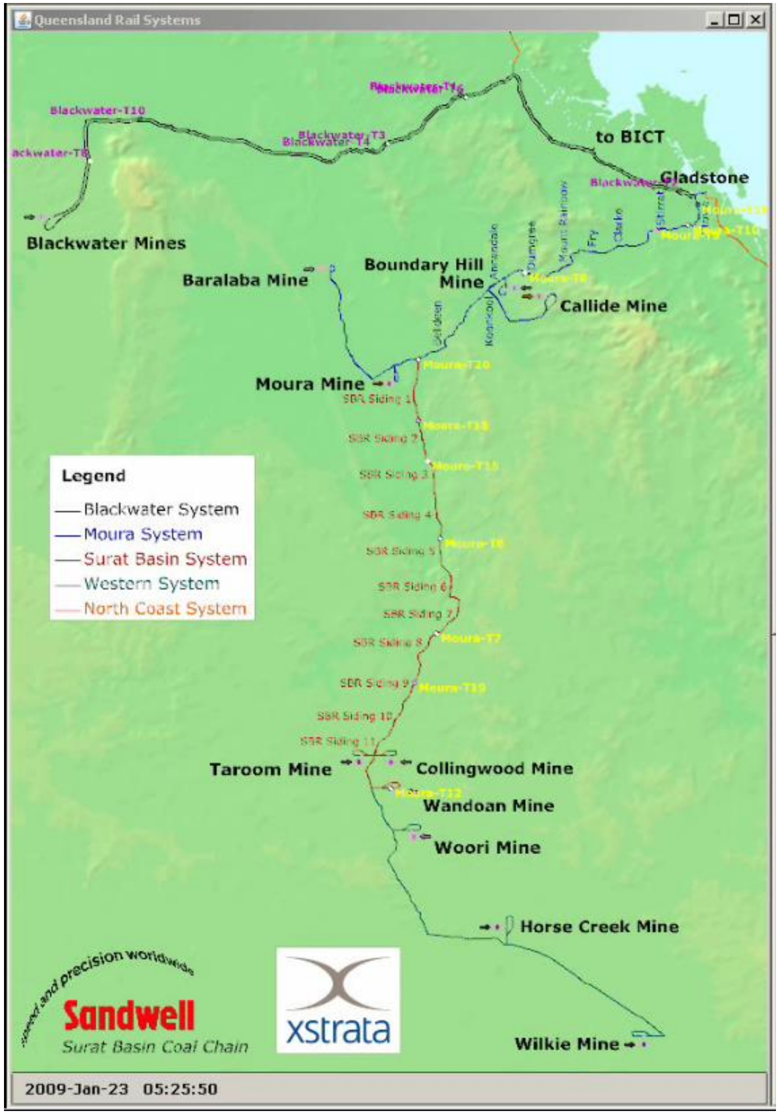
Many mines, not all sending product north.



Mines:

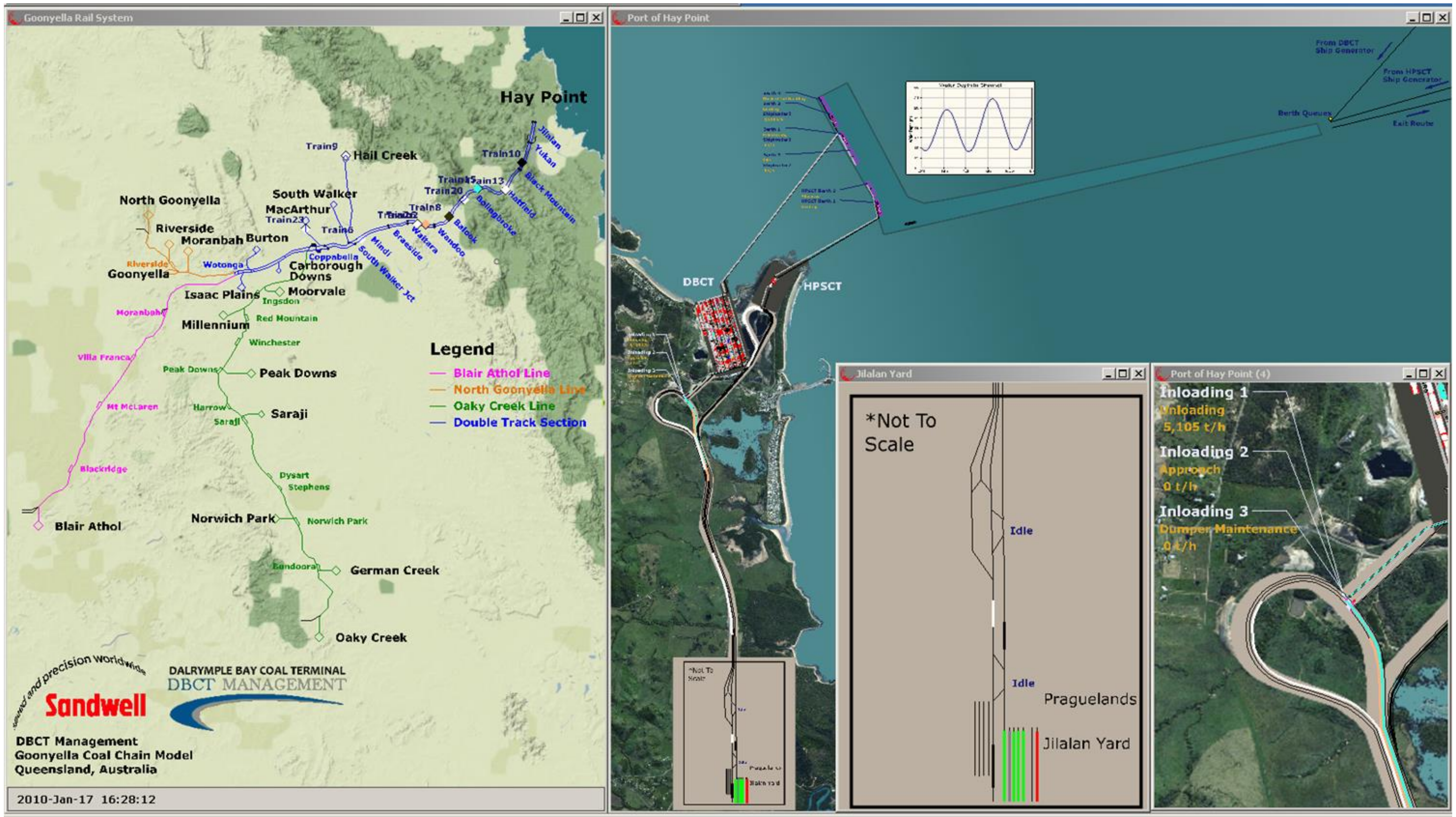
- Many mines along Moura Line, Blackwater Line, and Western Line
- Some mines exist already and will be diverting traffic to the Port of Gladstone
- Others, such as Wandoan, are greenfield sites and will be sending all mined product to the Port of Gladstone

Terminals - Overview

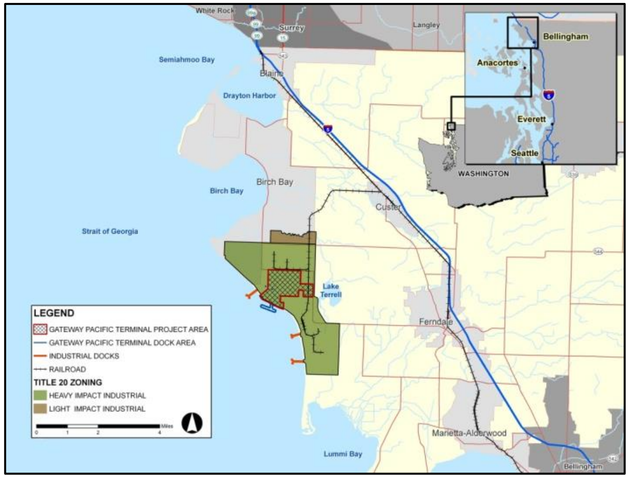
Terminals (4):

- RG Tanna
- Wiggins Island
- Balaclava Island
- Barney Point

Goonyella Coal Chain Model, Australia



Deep Water Bulk Export Terminal



Cherry Point, WA

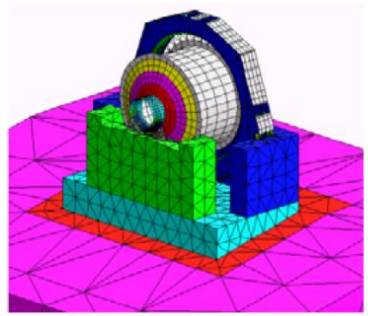
- Feasibility study for 54 Mt/y dry bulk multimodal terminal with coal the major commodity

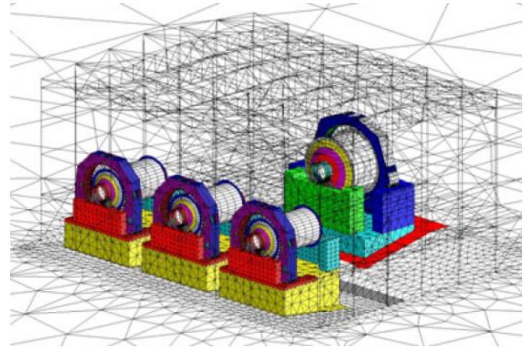
BHPB and FMG Port Hedland

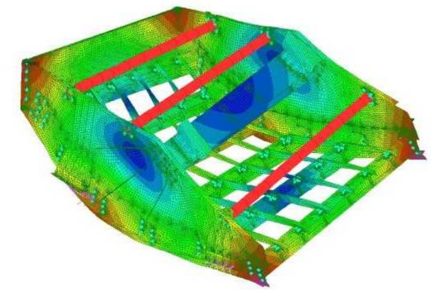
- BHPB shipped ~140 Mt/y at Port Hedland in 2007-08
- Expansions at Finucane Island and Nelson Point to ~240 Mt/y
- Port Authority opened the inner harbour to FMG to 155Mt/y and junior companies
- The BHPB Quantum Project is a feasibility study of a new outer harbour to 200Mt/y
- FMG Outer Harbour Project to 200Mt/y

Tools for Understanding the Unknowns

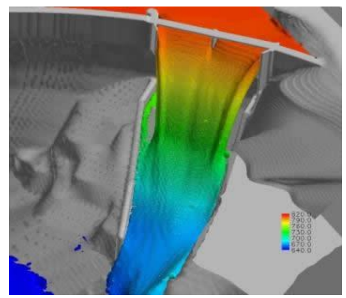
Finite Element Analysis

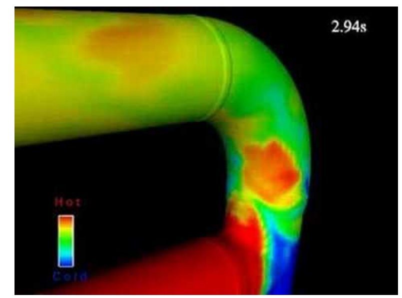




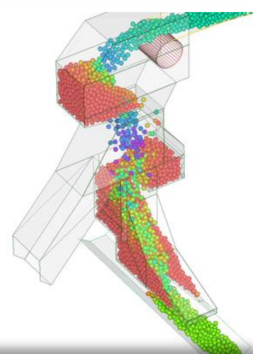


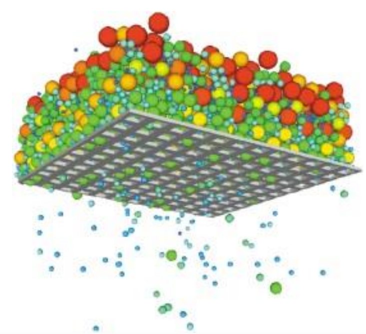
Computational Fluid Dynamics

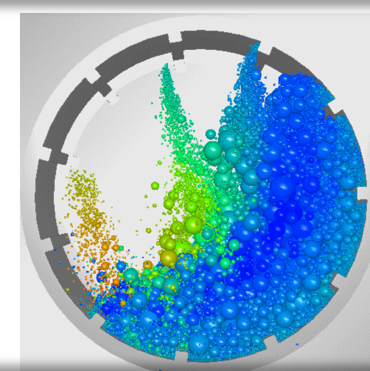




DEM

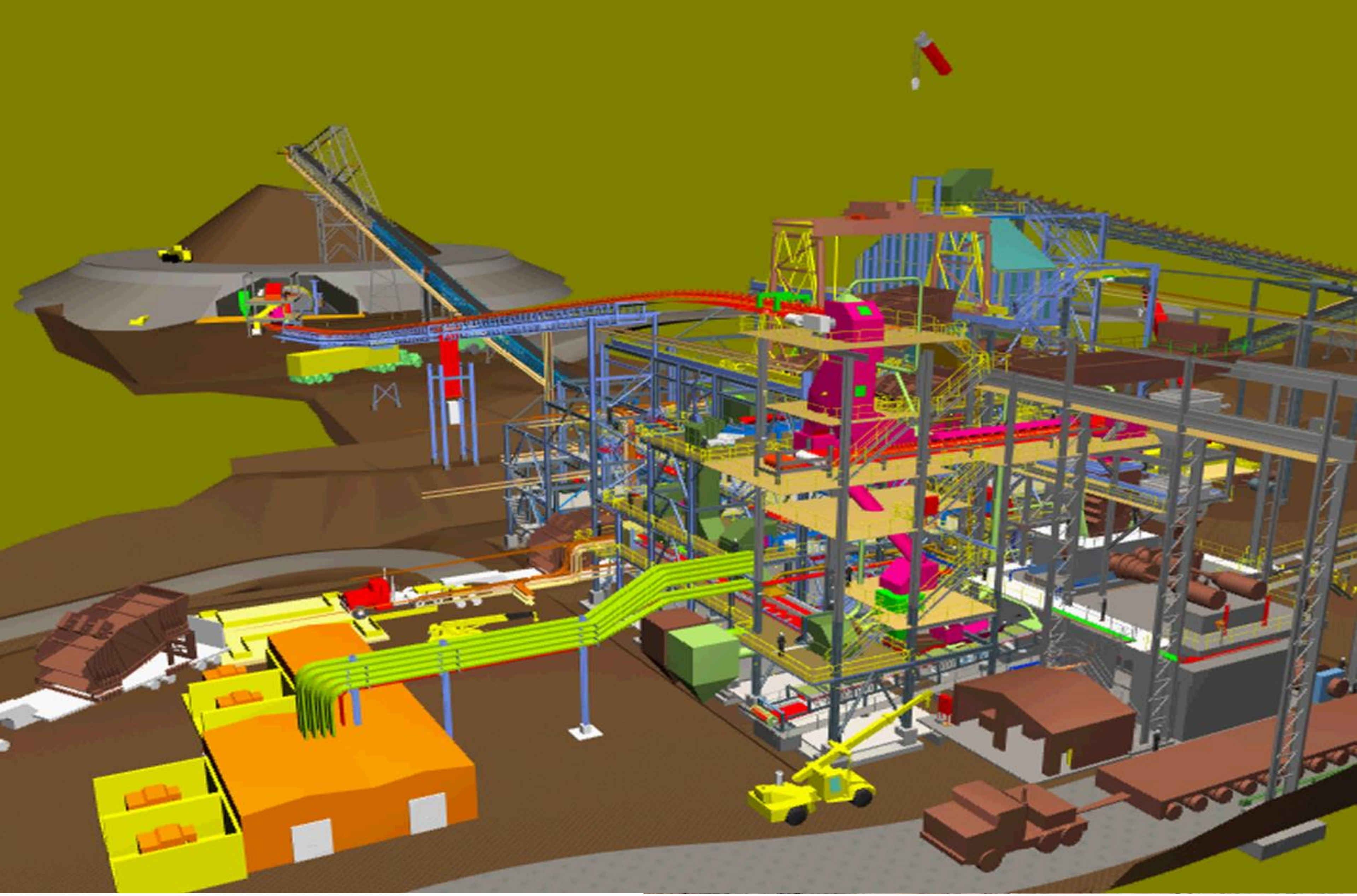






Collahuasi Project, Chile – Seismic and environmental conditions


V4
L6
C1
2.204
2.107
2.011
1.817
1.72
1.623
1.527
1.43
1.333
1.236
1.139
1.042
0.946
0.849
0.752
0.655
Y
X
Z
Output Set: Case 49 Time 23.999920
Deformed(3.524): Total Translation
Contour: Total Acceleration



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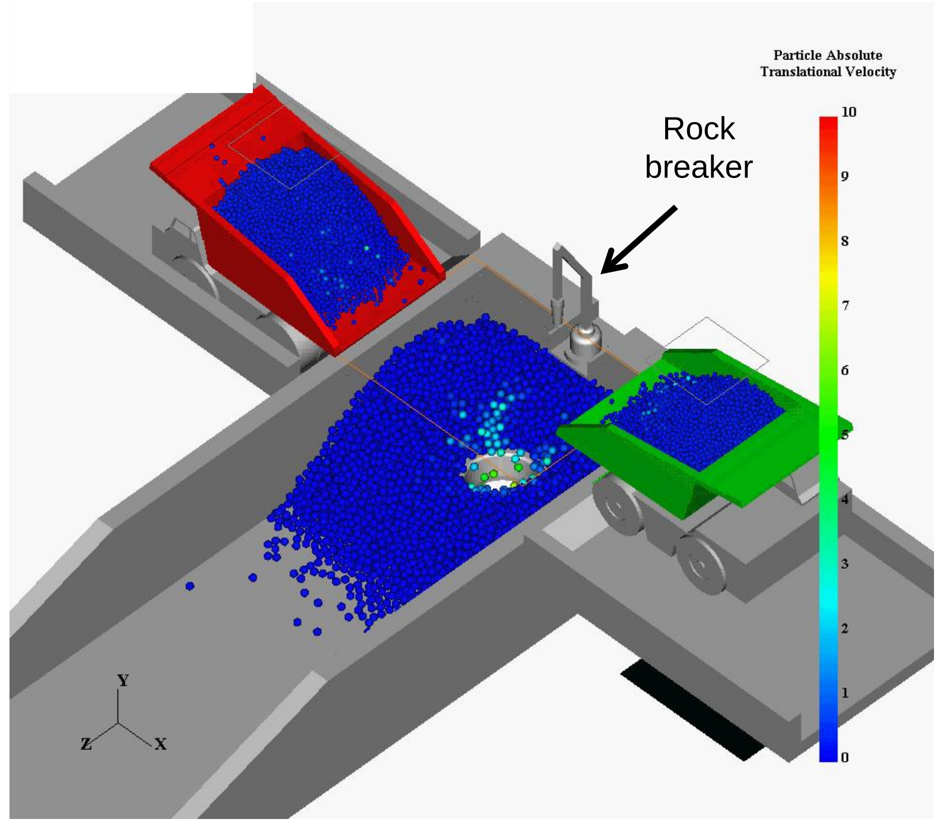
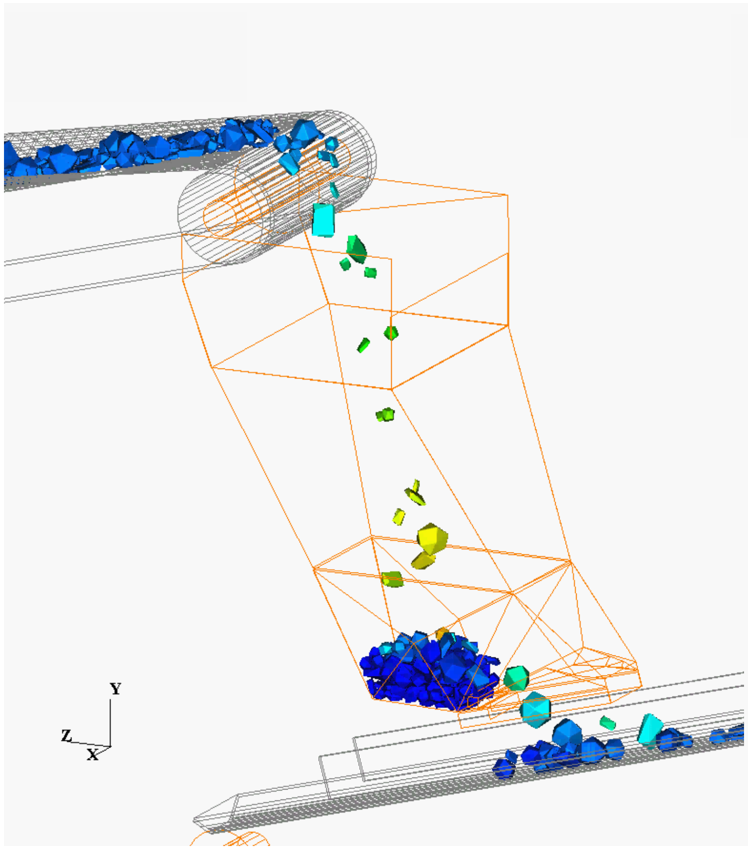
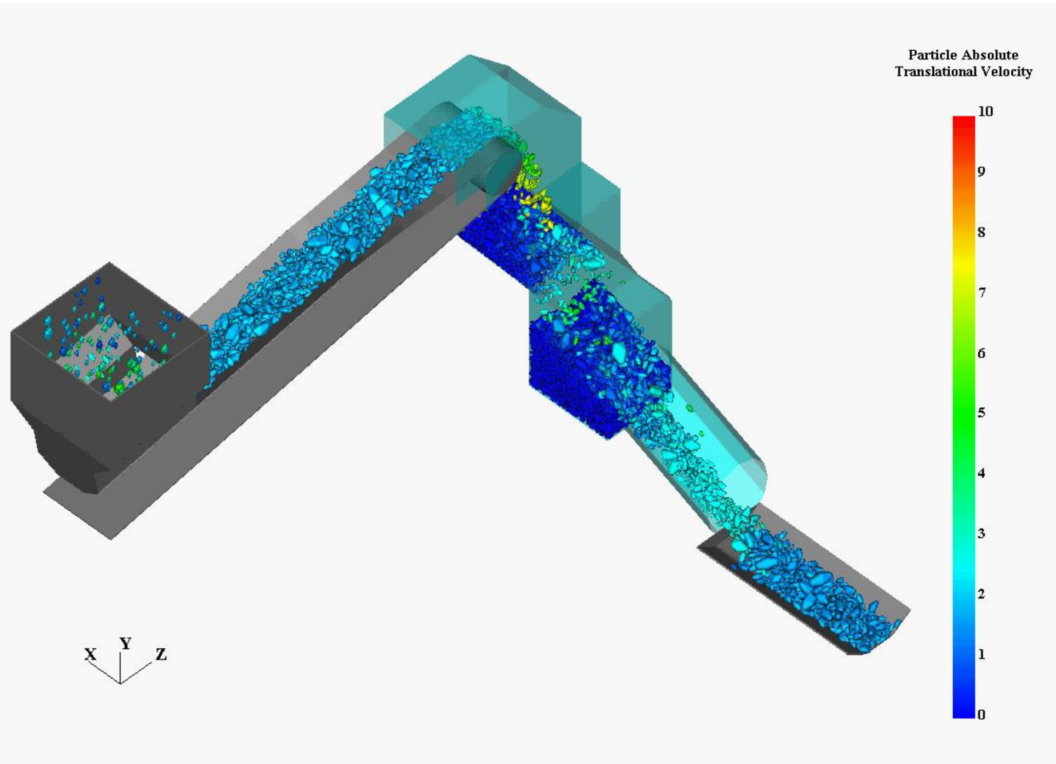
Understanding Reality



Lumwana Expansion Project

Solving Complex Problems

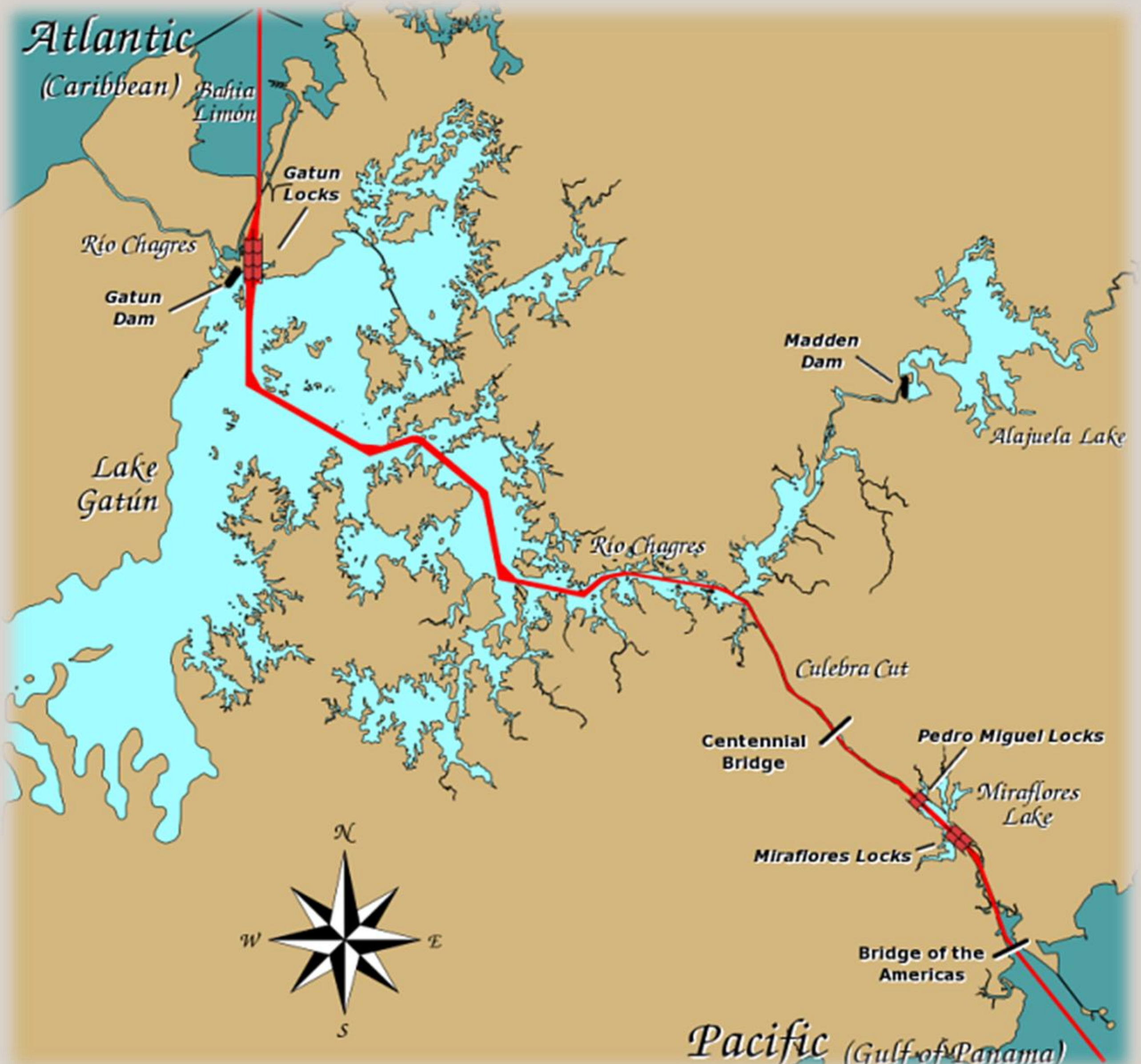




Tritton Expansion Project

Martabe Project

Panama Canal – A Key "Short-cut" for the World's Shipping Routes



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Panama Canal – Existing Facilities

Panama Canal – A Key "Short-cut" for Shipping - But with Significant Limitations

Current Vessel Size Restrictions:

- Length 294 m
- Beam 32.3 m
- Draft 12.0 m ± depending on rainfall and Gatun Lake Levels

The modern Panamax vessel has evolved into the 75 to 80,000DWT range with typical dimensions of:

- Length 225 to 230m
- Beam 32.3 m
- Draft 12.0 m ± through canal, and 57.9 m air draft
  13.8 m to 14.2 m ± when not transiting the canal

Canal

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Third Set of Locks Project

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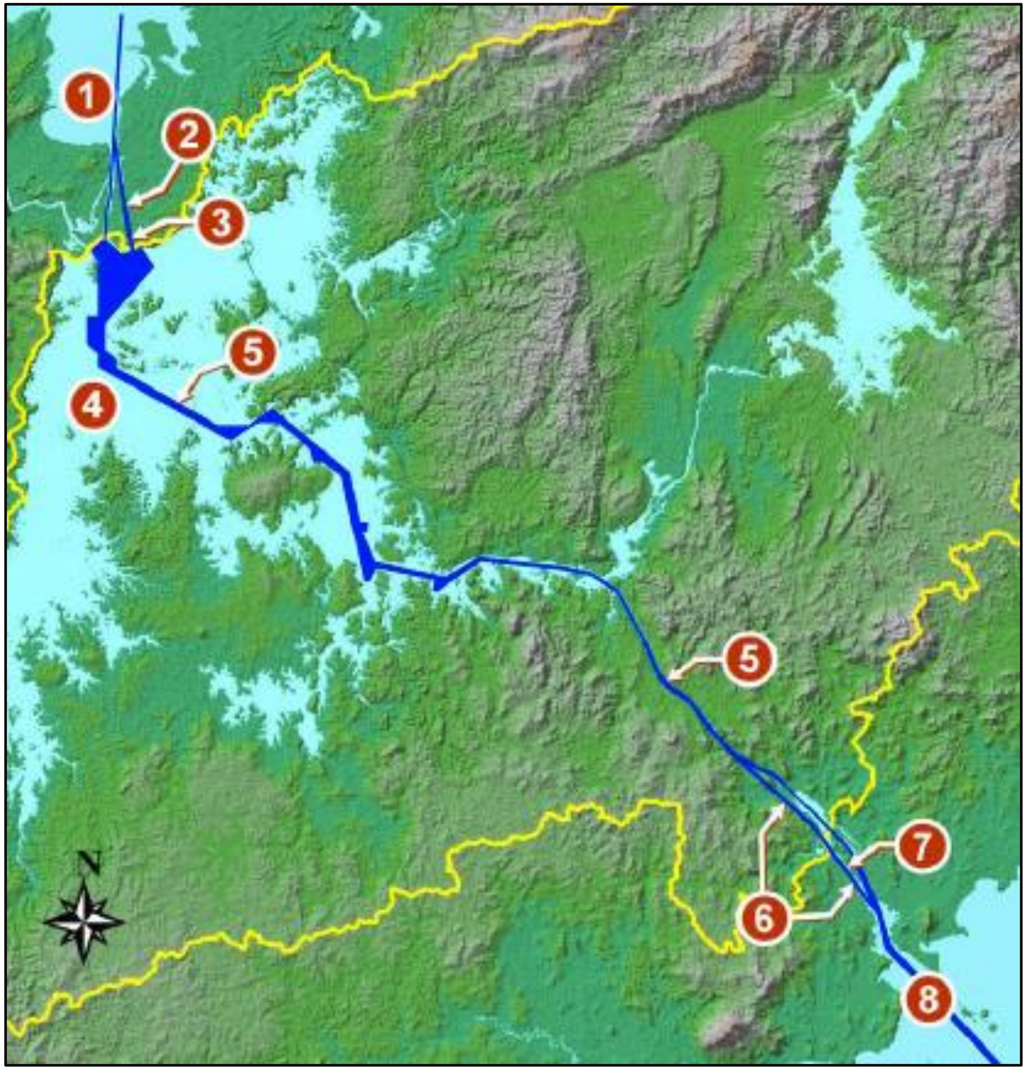
Components of Third Set of Locks Project



1) Deepening and widening of the Atlantic entrance channel
2) New approach channel for the Atlantic Post-Panamax locks
3) Atlantic Post-Panamax locks with 3 water saving basins per lock chamber
4) Raise the maximum Gatun Lake operating water level
5) Widening and deepening of the navigational channel of the Gatun Lake and the Culebra Cut
6) New approach channel for the Pacific Post-Panamax locks
7) Pacific Post-Panamax locks with 3 water saving basins per lock chamber
8) Deepening and widening of the Pacific entrance channel

Panama Canal - Third Locks Project

Key Aspects Include:

- Increased vessel dimensions to:
  - Length 336 m
  - Beam 49 m
  - Draft 15.2 m
- These vessel sizes will enable:
  - Cape-size ships to 190,000 DWT to transit with reduced load of 138,000 to 142,000 t cargo
  - Japanmax ships to add 9,500 to 17,000 t cargo
  - Panamax ships to add 13,000 to 15,000 t cargo

This will place downward pressure on the shipping rates

New Panama Canal Project - Program Components

New Panama Canal 3rd Locks

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Ship Trends and Developments

The Ships of the Future

– Will we move away from 50 year old Designs?

WORLD BULK CARRIER FLEET (MILLION DEADWEIGHT TONNES)

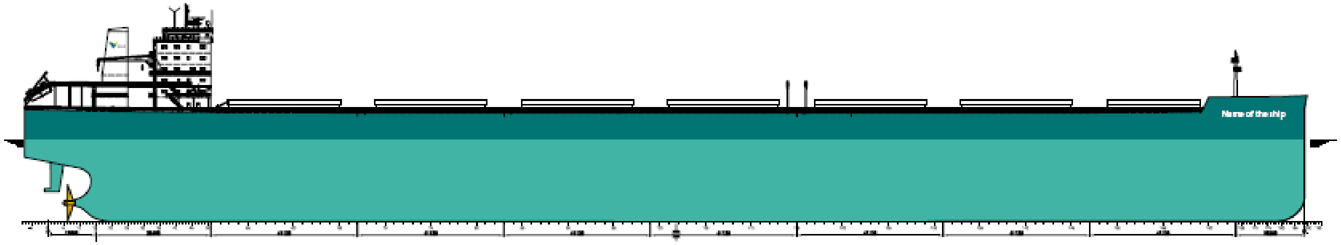
	2009	2010	2011	2012	2013	2014*
Newbuilding deliveries	43.6	80.4	98.9	99.3	63.0	55.0
Scrapping	10.6	6.5	23.2	33.4	21.6	18.0
Losses	0.3	0.4	0.4	0.1	0.4	0.3
Other adjustments/conversions	9.2	4.3	4.1	-1.2	-0.8	0.0
Net change in fleet	41.9	77.8	79.4	64.6	40.2	36.7
Fleet at end of year	**459.5**	**537.3**	**616.7**	**681.3**	**721.5**	**758.2**
% growth from previous year		16.9	14.8	10.5	5.9	5.1

*source: Clarksons (historical data) & BSA 2014 forecast *forecast*

- In the 2004 to 2008 period before the WFC rapid growth in seaborne iron ore and coal trades and large queues at the terminals drove a large increase in new ship orders.
- This has now lead to significant over-capacity in the fleet, particularly in Capesize vessels.

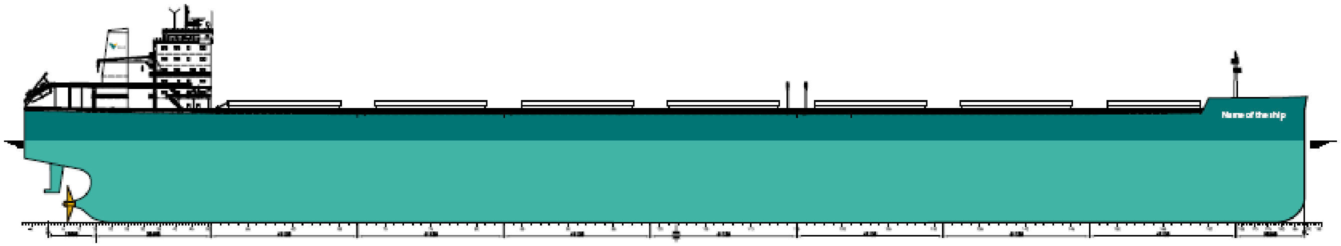
The Vale Chinamax

Vessels designed keeping the service in mind

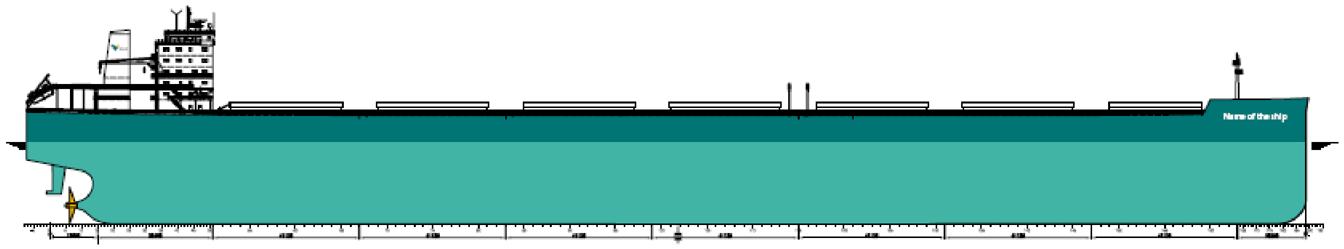


Chinamax characteristics

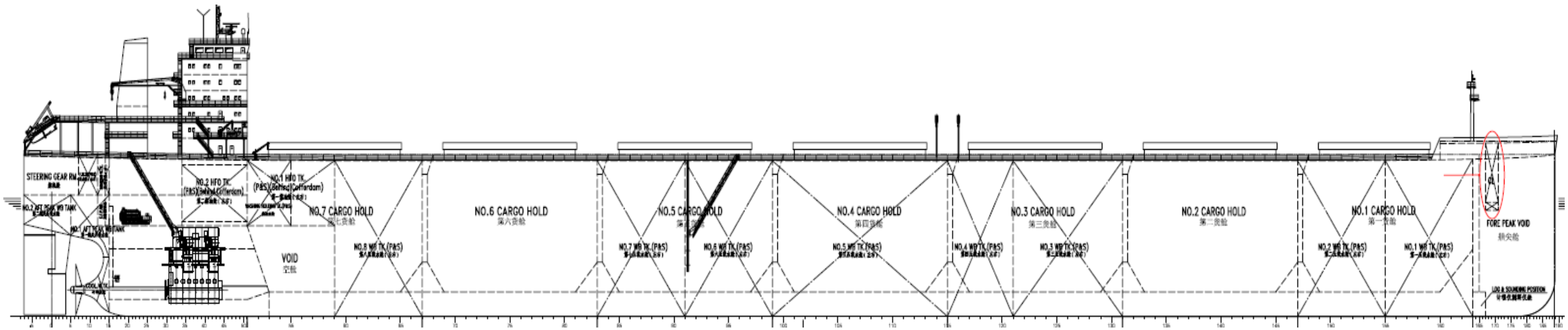
• Length overall	=	360.0 meters
• Breadth, moulded	=	65.0 meters
• Scantling Draft, moulded	=	23.0 meters
• Propelling Machinery	=	WARTSILA SULZER 7RT-flex82T
		MCR = 29,400 KW (39,426 HP) x 76 r/min
• Deadweight at Scantling Draft	=	400,000 metric tonnes
• Speed at design draft	=	14.8 knots at main engine output of
		21,730 kW (85% CMCR)
• Fuel oil consumption	=	96,7 tons / day HFO

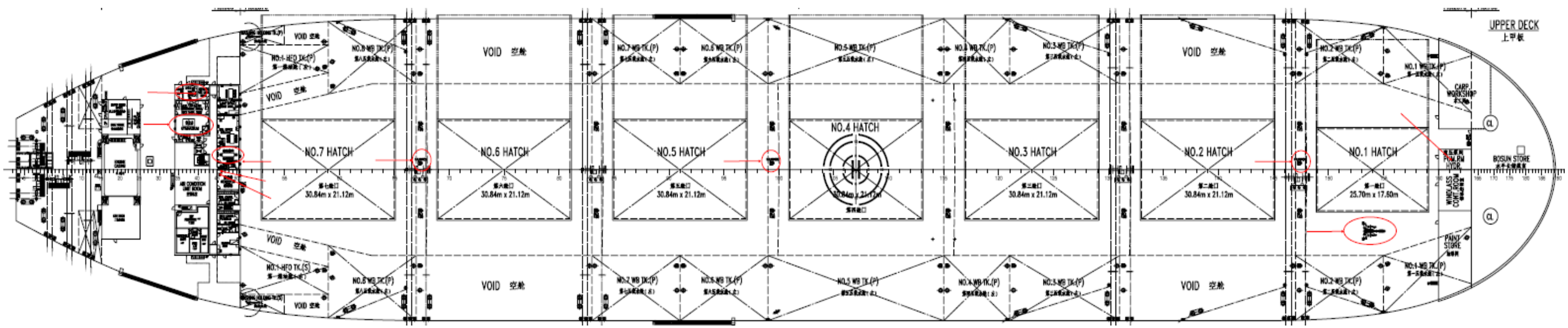


And importantly, the Chinamax reduces the Carbon footprint by 34% per tonne carried



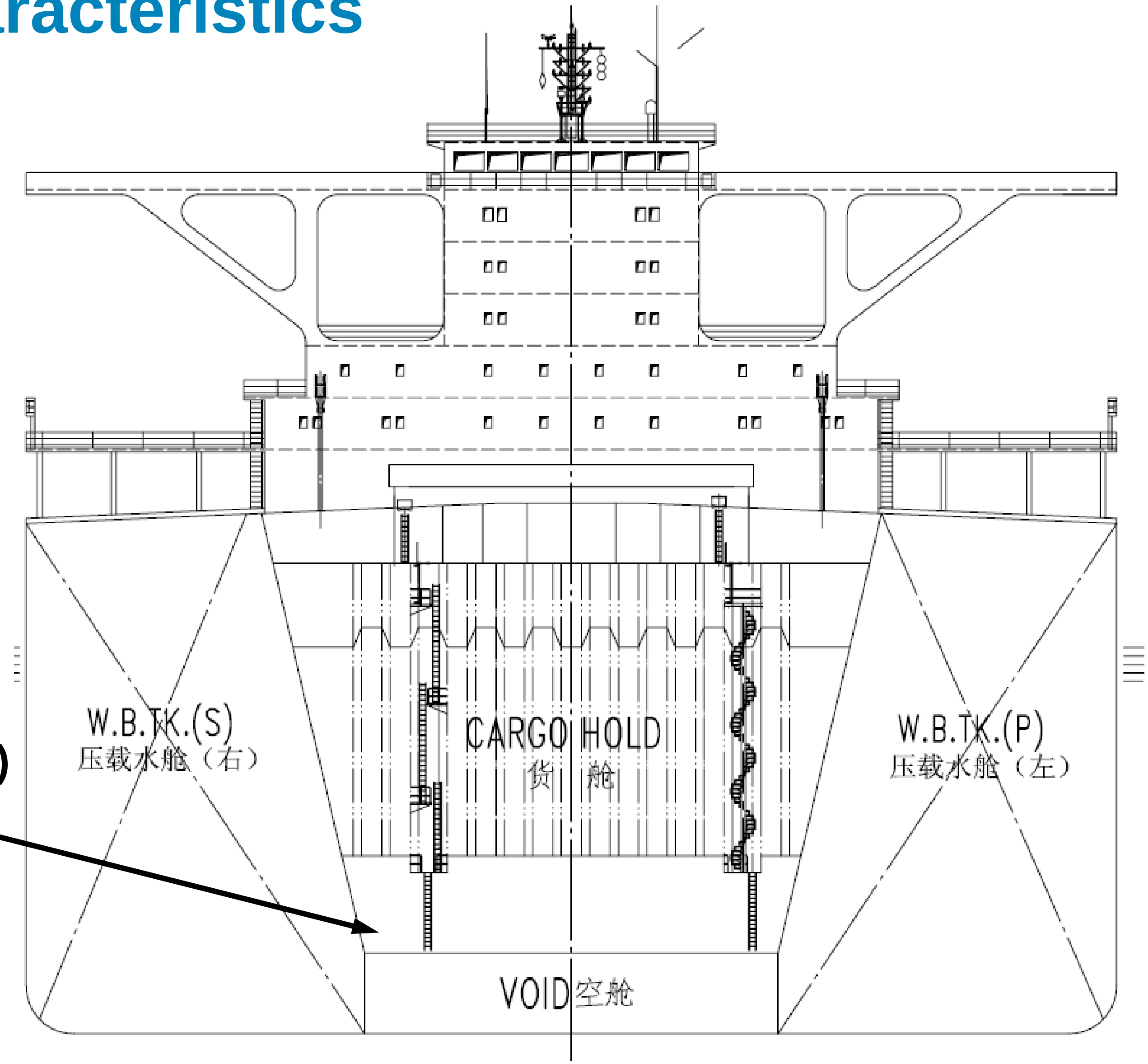
Chinamax characteristics





Chinamax characteristics

Reduction of space inside holds that can not be reached by grabs during discharge (Dead Spot)



Vale Brasil – Loading at Tubarao in Brazil

Chinamax Loading at New Berth 4
Ponta Madeira, Brazil

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Brasil Maru

The new 330,000 DWT class iron ore carrier

‘Newcastle Max - Coal Carrier

Capesize Bulk Carrier

●New Castle Maxim   **SHIN SETO**
300.0m x 50.00m x 24.10m   203,500 DWT(MT)

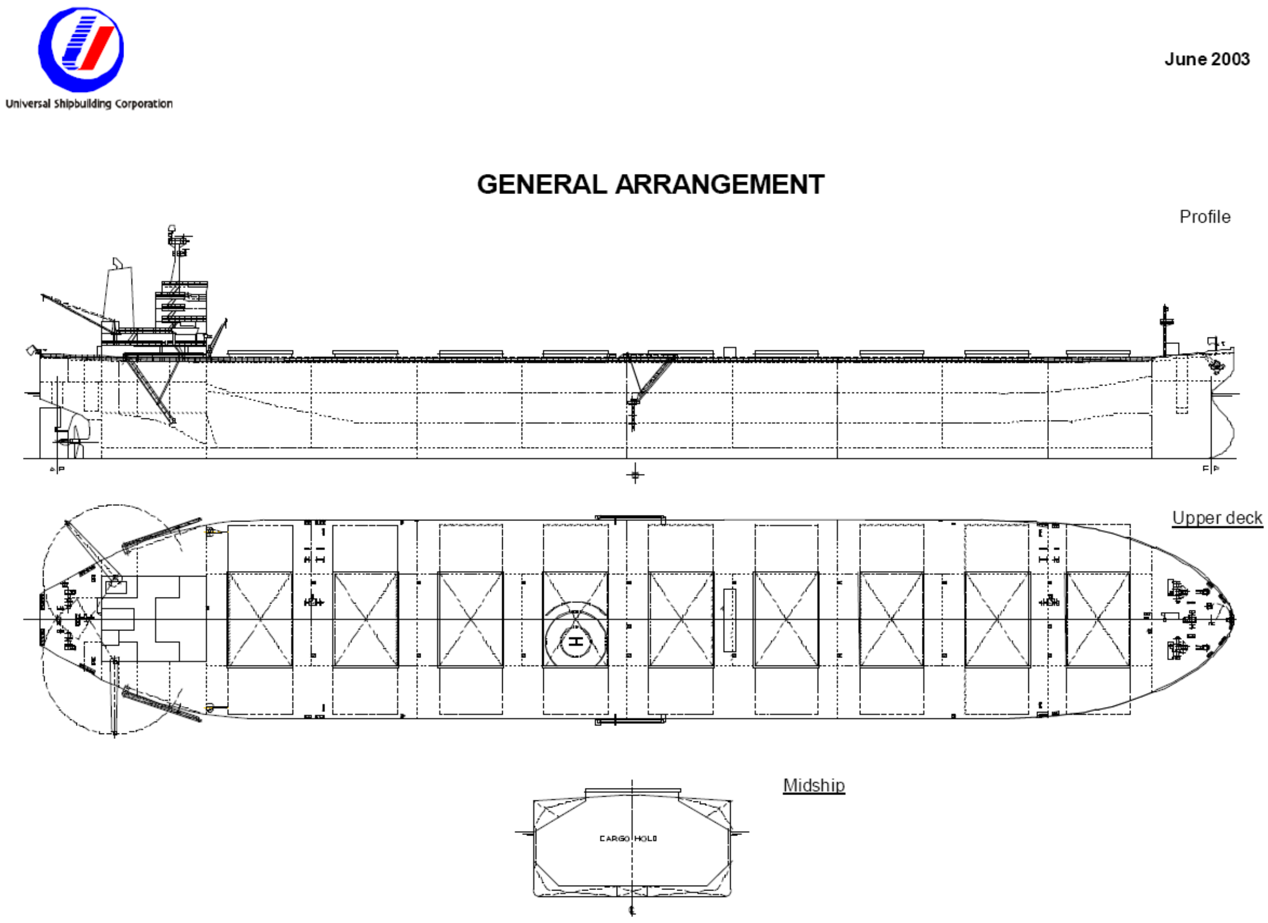
Newcastle Max's

New Castle Maxim **AZUL FORTUNA**

300m x 50m x 24.10m   203,500 DWT (MT)

New Castle Maxim AZUL FORTUNA
300.0m x 50.00m x 24.10m   203,500 DWT(MT)

General Arrangement



Ships in Rough Seas

Mother nature can be tough !!!

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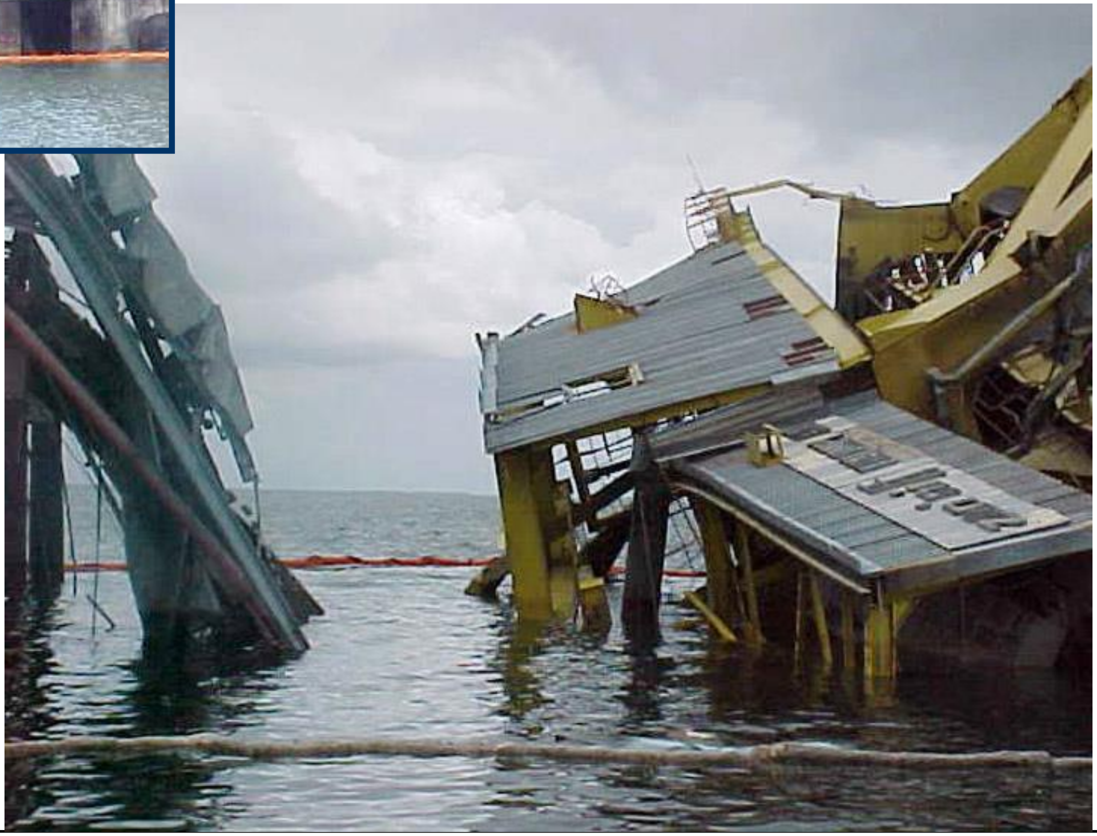
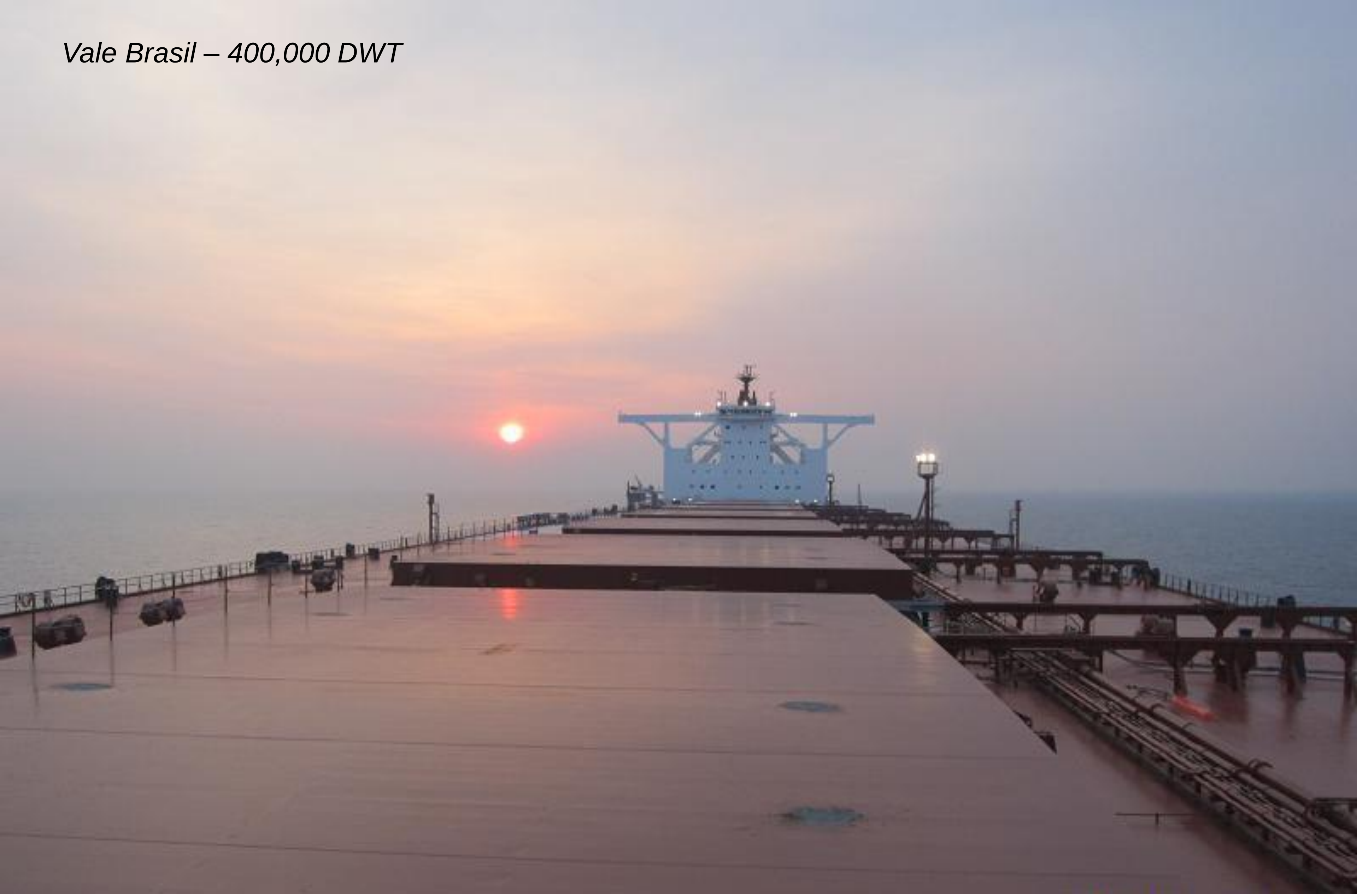
Westshore Terminals
Windstorm S/L collapse
January, 2003

CSN, Sepetiba
Grab unloader
Windstorm Collapse
January 2003



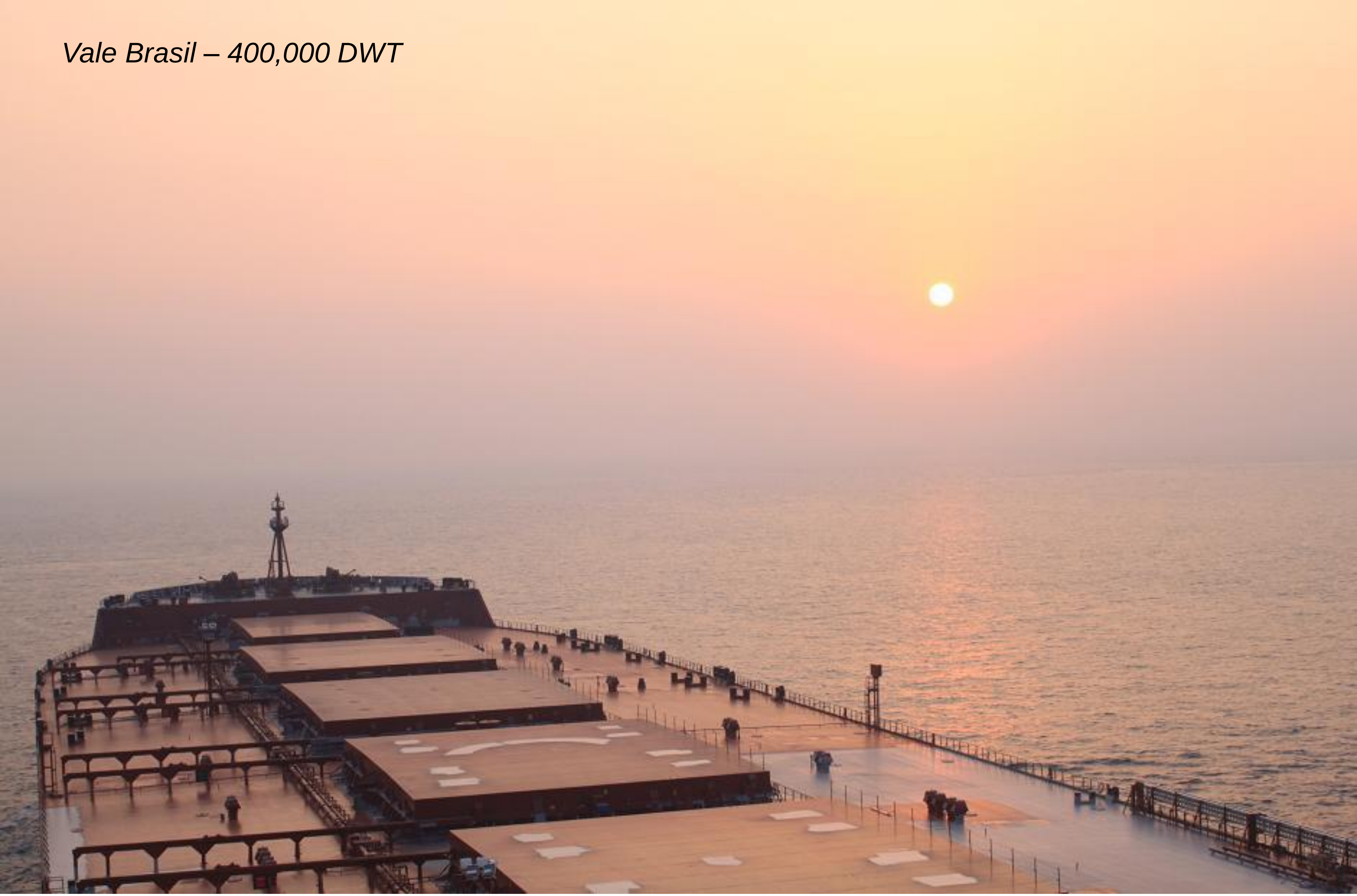
Conclusions

- A steady evolution of designs and handling rates over a 40 year period!
- With careful attention to design and operations you can have safety and high rate efficient loading.
- The general shipping industry must step up to develop "fit for purpose" ships.
- The drive for Faster, Cleaner, Better and Cheaper loading and unloading systems will continue.
- The issues/topics discussed apply to unloading also.
- The Panama Canal project will bring new shipping changes, benefits and challenges.
- Mother nature is not selective. She applies her power at loading and unloading terminals as well as the ships!



Vale Brasil – 400,000 DWT

Vale Brasil – 400,000 DWT



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Vale Brasil – 400,000 DWT

Some Ausenco Terminal and Mine Projects - Current and Recent

- Cerrejon Coal, Colombia, P40 Project 40Mt/y Mine, Rail, and Port
- Cerrejon Coal P500 Project, +/- 60Mt/y – Concept development
- Cerrejon Coal, long term concepts to 200Mt/y +
- Cerrejon Coal, 210,000DWT vessels
- Prodeco SA, Colombia, Puerto Zuniga Coal Expansion to 17Mt/y,
- Prodeco SA, Colombia, Puerto Nuevo Coal to 60 Mt/y
- MBR, Brazil, Iron ore expansions from 40 to 55Mt/y
- Vale, Brazil, Ponta Madeira and Northern Rail Iron Ore System to 260Mt/y
- Vale, Brazil, Tubarao Iron Ore Port Master Plan to 160Mt/y
- LLX Puerto Brazil New Port Concepts, Master Plan – Cancelled
- Anglo , MMX , Brazil ,new Acu iron ore port and pipeline project 30 Mt/y
- Several other iron ore projects in Planning, Feasibility, or Basic Engineering study work all in the 18 to 30 Mt/y first stage

Some Ausenco Sandwell Terminal and Mine Projects - Current and Recent (cont'd)

- Rio Tinto, Brazil and Argentina, Corumba Project - EPCM Mine, Overland Conveyor, Barging, Ports, Transshipment – 15Mt/y Iron Ore (cancelled) – Vale purchased and is now re-examining the project.
- Rio Tinto, Canada, IOC, Feasibility Studies, Complete System Simulation, Expansion to 30 Mt/y Iron Pellets and Ore – Cancelled, but now proceeding with studies for higher capacity.
- Rio Tinto, Australia, Port Dampier and Cape Lambert Planning Studies, 220 Mt/y Iron Ore Exp's – First stage in progress.
- BHP Billiton, Port Hedland, Australia 200Mt/y Expansion Plans, Inner and Outer Harbour – Inner harbour in progress, outer harbour and Boodarie stockyard - in studies.
- Dampier Port Authority, Anketell Port Project, Australia - Master Plan for new 350 to 400 Mt/y iron ore port and strategic industrial area
- Fortesque Metals Group, Anketell Port, Australia - iron ore exports

Some Ausenco Sandwell Terminal and Mine Projects - Current and Recent (cont'd)

- Dalrymple Bay Coal Terminal, Hay Point, Australia, Master Plans, simulation, operations analysis to 85Mt/y expansion and Goonyella Coal Chain model - Project completed
- BMA, Hay Point Coal Terminal, Operational analysis and input to Master Plan for expansion to 55Mt/y - In progress
- Xstrata, Australia, Wandoan Project and Surat Coal Basin simulation model including RG Tanna, Wiggins Island, Balaclava Island and Barney Point coal terminals 30 to 60 Mt/y level – Feasibility Studies and Basic Engineering in progress
- Hancock Coal , Alpha Coal Project, Queensland, Australia - Feasibility study and EPCM JV of new 30Mt/y Stage 1 and further 30 Mt/y Stage 2 coal mine , rail and port in progress
- Port Waratah Coal Services, near Newcastle Australia, has recently expanded to 113 Mt/y and will expand further to 145 Mt/y – by others
- NCIG Coal Terminal at Newcastle Au - first stage 30 Mt/y capacity is complete and expansions to 53 then 66 Mt/y will follow – by others

Some Ausenco Sandwell Terminal and Mine Projects - Current and Recent (cont'd)

- Arcelor Mittal, Liberia iron ore project rail and port, 15Mt/y – On hold but now is in progress
- London Mining Sierra Leone - 3 to 8 Mt/y iron ore mine, river transport and transshipment project
- 3 other iron ore projects in Africa ranging to 30Mt/y +
- 2 coal projects in Africa in progress ranging to 20 Mt/y first stage
- Teck, Quintette Coal Project, BC, Canada – Feasibility study and EPCM – 3Mt/y first stage and expansion planning beyond
- Gateway Pacific Project, Deepwater Bulk Export Port, Cherry Point, WA, USA – Feasibility Study for 54 Mt/y bulk exports including 24 Mt/y+ of coal
- Westshore Terminals, Neptune Bulk Terminals and Ridley Terminals all are planning expansions or upgrade stages by AS and/or others

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Bulkwayuu, Coe Clerici, Carbones del Guasare, Venezuela

Coeclerici transshipment storage vessel

Boca Grande Transfer Station

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