Collaborative Logistics:
The Hunter Valley Coal Export Supply Chain

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- Objective
- Hunter Valley coal chain
- Collaborative coal chain planning
  - Hunter Valley Coal Chain Coordinator
  - Planning overview
  - Simulation tools
  - Optimization tools
- Conclusions
Objective

• Present an example of a successful collaboration of a large number of stakeholders in managing a complex logistics system
• Highlight the factors that were critical to the successful collaboration
• Highlight the role that simulation and optimization technology has played in the success
Where is the Hunter Valley?
Australia is the largest exporter of metallurgical coal (about 60% of world market)
Australia is the second-largest exporter of thermal coal (about 20% of world market)
Coal exports make up about 15% of Australia's export earnings
The Hunter Valley coal region is the primary source of thermal coal exports in Australia
The Port of Newcastle exports more than 10% of the world's total trade in thermal coal
The Port of Newcastle exports a greater volume of coal than any other port in the world
**Hunter Valley Coal Chain**

**Producers**
- 40 coal mines
- 11 producers
- 30 load points
- >80 different brands of coal

**Track**
- 4 train haulage operators
- Further smaller train haulage operators
- 53+ trains/18,000 trips per year
- 2 track owner/operators
- Haulage distances up to 364km

**Export Coal Terminals**
- 3 coal loading terminals
- 8 dump stations
- 9 ship berths and 7 loaders
- 2.2 Mt of rapid cargo build stockpiles at PWCS
- Longer horizon dedicated stockpiles at NCIG

**Port/Vessels**
- Approx 1,500 vessels per year
- Average vessel size is 89,000 tonnes
- Average 1 to 4 cargoes per vessel
- Tidal constrained river port

**End Buyers**
- 10% domestic consumption
- 90% export – mostly thermal
  - 54% to Japan
  - 19% to China
  - 13% to Korean
Hunter Valley Coal Chain

Ulan
- 15 paths/day
- 276km from Port
- 22-24hr cycle time
- 30t axle load
- PN: 91wagon (8,500t)
- QRN: 74wagon (7,200t)
- FLA: 96wagon (9,000t)

Hunter Valley
- 50-62 paths/day
- Up to 100km from Port
- 8-14hr cycle time
- 30t axle load
- PN: 91wagon (8,500t)
- QRN: 74wagon (7,200t)
- FLA: 96wagon (9,000t)
- SSR: 46wagon (3,450t)

Gunnedah
- 8 paths/day
- 364km from Port
- 25-35hr cycle time
- 25t axle load
- PN: 82wagon (6,150t)

Stratford
- 10 paths/day
- 170km from Port
- 13-15hr cycle time
- 25t axle load
- PN: 42wagon (3,000t) & 72 wagon (5,400t)
Hunter Valley Coal Chain: Terminals & Port
Dump Station
Bucket Wheel Reclaimer
Bucket Wheel
Conveyors
Ship Loading & Berths
Hunter Valley Coal Chain Growth

ARCT since 2002 have released capacity to the system via the following projects:

- Bi-directional signalling from Maitland to Whittingham,
- Provision of additional and extending existing train crossing loops on both the Ulan and Gunnedah Basin Zones,
- Duplicated the main North line from Granstree to Athene and through to Muswellbrook,
- Major infrastructure implementation via the third roads at both Nundah Bank and from Whittingham to Maitland, and
- Reconfiguring the Kooragang Arrival and departure roads including removal of the Provisioning facility.

- 70Mtpa
- Rail/terminal co-location
- IPS Project commenced
- IPS implemented
- HVCC incorporated. Membership includes producers.
- HVCC Government review: contractual alignment focus
- KCT stage 1 expansion completed, combined capacity of both Terminals =80Mtpa
- 1st whole of coal chain plan published
- KCT completion of a further 1500 metres of stockyard, fourth stock yard stream and fifth stacker, combined capacity of both Terminals =110Mtpa
- KCT introduction of a fourth reclaim car and sixth stacker and operatng the dump stations, combined capacity of both Terminals =113Mtpa
- KCT completion of Project step 1, introduction of a fourth dump station and new berth K7 giving a combined capacity of both Terminals =145Mtpa
- Live Run Service Provider Co-location
- Live Run Day of Operation Integration commences
- 2013 Pacific National commences operations at its Creta Train Provisioning Centre
- 2013 NCCG final stage comes online increasing capacity to 68Mtpa
- Slot management implemented

Whole of coal chain Improvement initiative (ICT)
HVCCC:
An independent and impartial organization providing centralized planning, coordination, monitoring and capacity alignment services to maximize coal chain efficiencies and exports.
HVCCC:
A cooperative planning and operating model

- Originally formed in 2003 (known then as Hunter Valley Coal Chain Logistics Team)
- A legal entity since 2009 funded by the coal industry, for the coal industry, with ~57 direct employees and 22 co-located service provider operatives (Live Run Integration Team)
- The only organisation with a ‘helicopter-view’ of the entire Coal Chain
- A focus on day-to-day and long-term performance and efficiency improvements
- Utilizes state-of-the-art modelling techniques to identify and recommend action to address Coal Chain constraints
- Recommends where investment and infrastructure delivery activity should be occurring
- ~$20 million committed to planning and technology investment since 2009
HVCCC is a company limited by guarantee and its governance is regulated by its constitution.

HVCCC Board comprises 20 Directors including independent Chair.

19 HVCCC Members (8 Service Providers and 11 Producers) currently meet the constitutional eligibility requirements to appoint a Director and all have elected to do so.

HVCCC and every HVCCC Member has signed the Members Agreement, which addresses matters such as the sharing of commercial in confidence information. The Members Agreement forms part of the HVCCC Constitution.

HVCCC provides its planning services to Service Providers under HVCCC’s Service Agreements with each Provider.
HVCCC: collaboration and innovation for the best imaginable supply chain

**Vision:**

- **EFFICIENCY**
  ~ enabled the delivery of an increasingly efficient and effective coal chain operation

- **CAPACITY**
  ~ defined real options and delivered capacity as required via operational innovation and/or infrastructure

- **INFORMATION**
  ~ information management integrating and transforming industry data to enable conscious and proactive decision making

- **PEOPLE**
  ~ an engaged and motivated workforce

**Customers will say:**

- ‘I ordered it and I got what I wanted when I wanted it’
- ‘I have confidence that I can get what I want in the future’
- ‘I receive quality predictive information, scenarios and options’
- ‘They get it, they truly understand my needs. Their innovation and insight adds value’
HVCCC - The Functional Roles

### Strategic Capacity Planning
- Developing a rolling annual 10 Year Hunter Valley Capacity Master Plan
- Identifying and advising on capacity constraints
- Reporting progress against Coal Chain planned capacity expansion

### Annual Capacity Alignment
- Provision of a co-ordinated annual Coal Chain capacity plan
- Provision of an aligned, monthly capacity plan with daily targets
- Developing and implementing business rules for annual co-ordination of Coal Chain

### Operations Planning and Scheduling
- Provision of rolling monthly, optimised and co-ordinated coal delivery and loading plans
- Provision of daily centralised and co-ordinated coal delivery and loading schedules
- Assist with daily schedule recovery

### Monitoring, Analysing and Reporting
- Monitoring utilization of Coal Chain capacity including the impact of variations in demand, asset availability and transfers of capacity between load points
- Monitoring and reporting on daily, weekly, monthly and year-to-date planned and actual Coal Chain performance
- Development and maintenance of support services and systems to HVCCC
Step 1: An order is placed for a vessel to be loaded. The order is accepted or declined.

Vessel Nomination:
- Size
- Type
- Arrival Date
- Cargoes
- Components
- Rail Operator
- Load Plan

Step 2: A vessel stem is prepared, allocating vessels to berths and setting loading time and sailing times.

Step 3: The stockpiles at the port are planned to ensure the cargo is assembled ready to load the vessel at its appointed time.

Step 4: A first cut of the Cargo Assembly Plan is prepared, identifying how many tonnes and on which days the coal will be moved from the mines into the port.

Step 5a: The Cargo Assembly Plan is turned into a rail schedule specifying exactly what trains will run at which times to which load points. This schedule is handed over each day to the train operators.

Step 5b: A set of plans is provided each day to identify exactly what assets are required to do what task at what times, maximising system throughput. This includes plans for stackers to assemble stockpiles, reclaimers, shiploaders, and Newcastle Port Corp to move vessels.

Coal Chain plans are continuously revised in response to:
- Changes and events that occur during the Live Run
- Changes (e.g., blends) initiated by customers
A VESSEL STEM IS PREPARED THAT ALLOCATES VESSELS TO BERTHS AND SETS LOADING TIME AND SAILING TIMES
A first cut of the cargo assembly plan is prepared which identifies how many tonnes and on which days the coal will be moved from the mines into the port.
THE STOCKPILES AT THE PORT ARE PLANNED TO ENSURE THE CARGO IS ASSEMBLED READY TO LOAD THE VESSEL AT ITS APPOINTED TIME.
THE CARGO ASSEMBLY PLAN IS TURNED INTO A RAIL SCHEDULE WHICH SPECIFIES EXACTLY WHAT
TRAINS WILL RUN AT WHICH TIMES TO WHICH LOAD POINTS – THIS IS THE PLAN THAT IS HANDED
OVER EACH DAY TO THE TRAIN OPERATORS
A set of plans are provided each day to identify exactly what assets are required to do what task at what times in order to maximize system throughput. This includes everything from stackers to assemble stockpiles through to reclaimers, shiploaders and requests to the Newcastle Port Corp to move vessels.
TRIMS (ARTC VALIDATION OF COAL DELIVERY PLAN), FOLLOWING VALIDATION COAL DELIVERY PLAN GOES LIVE AND IS THEN EXECUTED BY LIVE RUN OPERATIVES
## Modeling Approaches

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<th>Simulation Modeling</th>
<th>Optimization Modeling</th>
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<tr>
<td>• Considers variability, process and operating rules</td>
<td>• Uses average values, and system constraints</td>
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<td>• Can get into details</td>
<td>• Can’t consider a lot of details – modelling at high level</td>
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<td>• Focussed on “what if” type analysis</td>
<td>• Analysis is tailored to find the optimum</td>
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<td>• Requires a large number of runs</td>
<td>• Optimum solution for a given set of inputs is found in one run</td>
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<td>• Excellent for understanding sensitivities and explaining reasons</td>
<td>• Difficult to explain why a certain solution is the best, as the governing algorithms search and find the best.</td>
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<td>• General purpose modelling tools – Arena, Extend, GPSS-H/SLX, ….</td>
<td>• MILP, CP approaches – ILOG/Cplex, Opturion/CPX</td>
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HVCCC has been using an inhouse-built Arena based simulation model

HVCCC has been widening its analysis capability through joint development of optimization models
Industry – Government - University Partnerships

• To develop optimization capabilities the HVCCC has partnered with
  - The Commonwealth Scientific and Industrial Research Organisation (CSIRO)
  - The Center for Optimal Planning and Operations (University of Newcastle)
Optimization Tools

- Vessel stem generation
  - Generate vessel arrival streams with various characteristics (for analysis of potential future demand scenarios)

- Annual capacity planning optimization
  - Generate and evaluate system-wide preventive maintenance schedules (to be used in negotiations with stakeholders)
Optimization Tools (Cont.)

• Rail scheduling
  - Plan train trips for a day (typical one or two days in advance)

• Capacity expansion planning
  - Determine the least cost infrastructure upgrades/expansions necessary to meet expected coal throughput requirements
• Stockpile planning optimization
  - Cargo assembly planning (stockpile location and reclaiming scheduling)
• Whole-of-coal-chain optimization
  - Analysis of alternative supply and demand management models
Conclusions

- The HVCC represents a system with enormous challenges in terms of scale, complexity of subsystems, integration and coordination of planning and execution activities.
- The HVCC has established a unique and effective approach to planning and coordination of shared infrastructure.
- Simulation and optimization tools are critical to infrastructure investments and operational excellence.
- The HVCC has made a significant investment in research activity to develop innovative technology that can significantly increase their planning and execution efficiency.