10th Anniversary Where Longwall mines meet FACE to FACE

LONGWALL 2011

24th - 25th October 2011
Crowne Plaza Hunter Valley

Post-Conference Workshop

Engineering Solutions for Continuous Haulage

Wednesday 26th October 2011: 8:30am - 12:30pm

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Workshop Protocols

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Objectives

- Opportunity to examine any problems experienced
- Suggest some engineering and operational solutions
- Share experiences of the problems encountered and the solutions found in mining operations.
- Examine case studies and site solutions currently in operation.
- Brainstorm amongst the participants to seek solutions to engineering and operational problems they may not have solved in their pit, benefiting from the experiences and expertise of others.
- Case study - Prairie Flexiveyor System used at the Cook Colliery and some of the experiences and the reengineering solutions the site developed.

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Batch Haulage

Shuttle Cars and cables….

The good old days!

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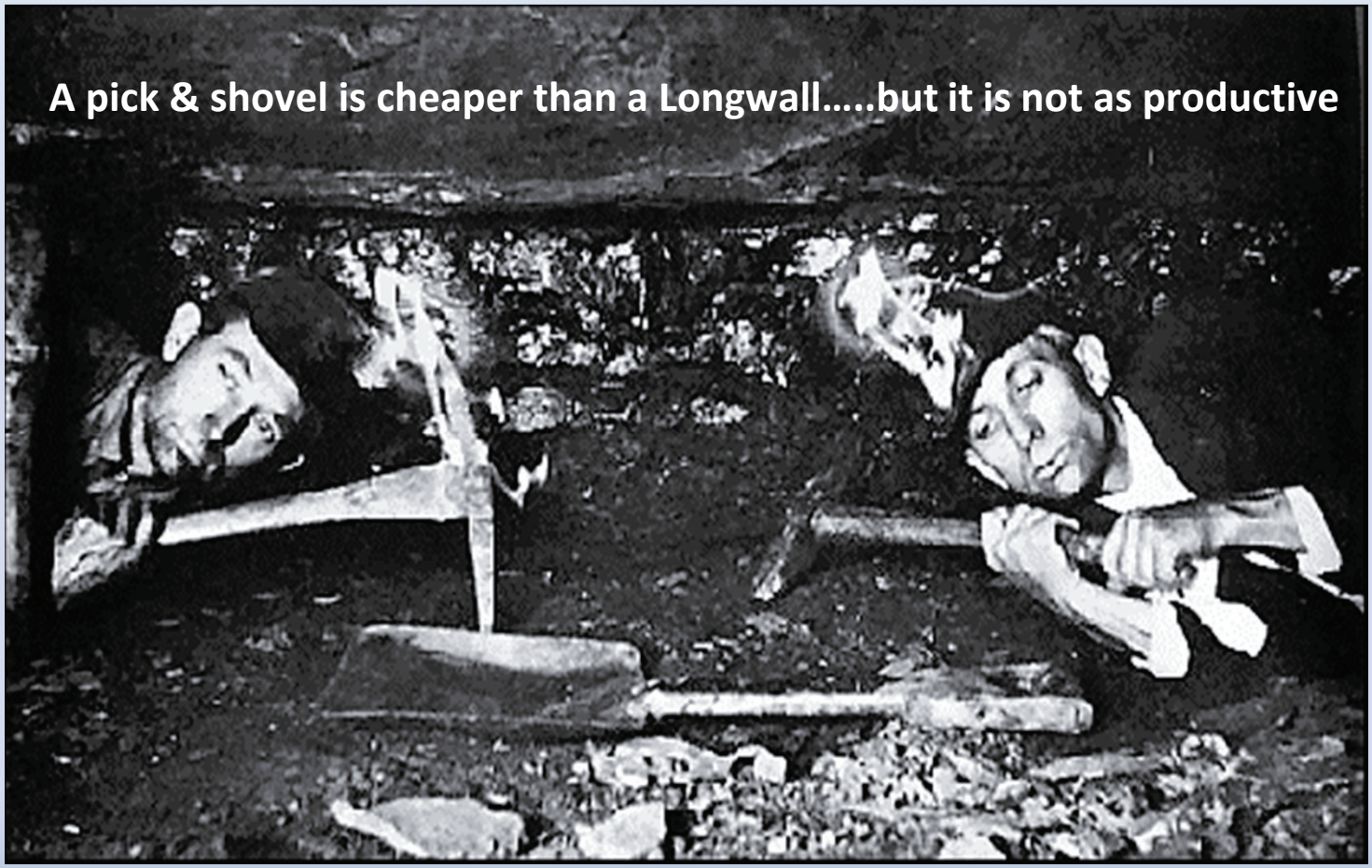
Engineering Solutions for Continuous Haulage

- Benefits, which are not always realized.
- Reluctance to publish - benchmarking.



Ground Support Services 2007 Self Drilling Rock Bolt – Advanced solutions

…it is all about productivity

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Engineering Solutions for Continuous Haulage

Overview

- Various designs
- Most are used in USA
- Need to meet Australian Regulatory standards

http://google-new.tk/about/careerbuilder/electrical-engineering, retrieved 08 September 2011

Bridge Conveyor

- Mobile bridge sections
- Track or wheel mounted chain or rubber belt conveying decks

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Bridge Conveyor (Cont)

- Bridge sections 6m - conveyor bridges and 16m - chain type self-propelled
- One Bridge Conveyer operated in an Australian mine during the 1990's
- One Bridge Conveyer experienced spillage where tramming was a problem.
- Each intersection, a crawler unit needed, an operator for each?
- Eighty metre pillar block - requires about eight segments and length of 180m.

CMTS Joy Machinery, retrieved http://www.joy.com/en/Joy/Products/Conveying/CMTS.htm, on 17 Oct 2011.

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The Flexiveyor System

- The Flexiveyor system is a self-deploying conveyor that straddles the panel belt and loop take up.
- The Flexiveyor - 16 cars to a total of 96m, a belt advance between 30 and 90 m.
- Flexiveyor is marketed and serviced in Australia by DMS

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Flexible Belt Conveyor

- Flexible conveyor trains - both floor and roof mounted
- Discharge end of the flexible conveyor runs over or next to the section conveyor
- The face end of the conveyor is attached to the rear of continuous miner or is self-propelled and kept at that position.
- Both roof and floor mounted systems trialled in Australia during the late 1980's with limited success.
- The Joy 4FCT01 is available up to 128m and needs one operator.

4FCT01 (Joy 2008)

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Chain Conveyor

- Breaker car module, conveyor bridge module, mobile bridge module, rigid haulage system.
- The system configuration depends on mine application and production requirements
- Up to 200m long.
- Coal via a belt interface onto section belt.
- Often lower profile and are more conducive to lower seam workings.

Joy Continuous Chain Haulage
(Joy 2010)

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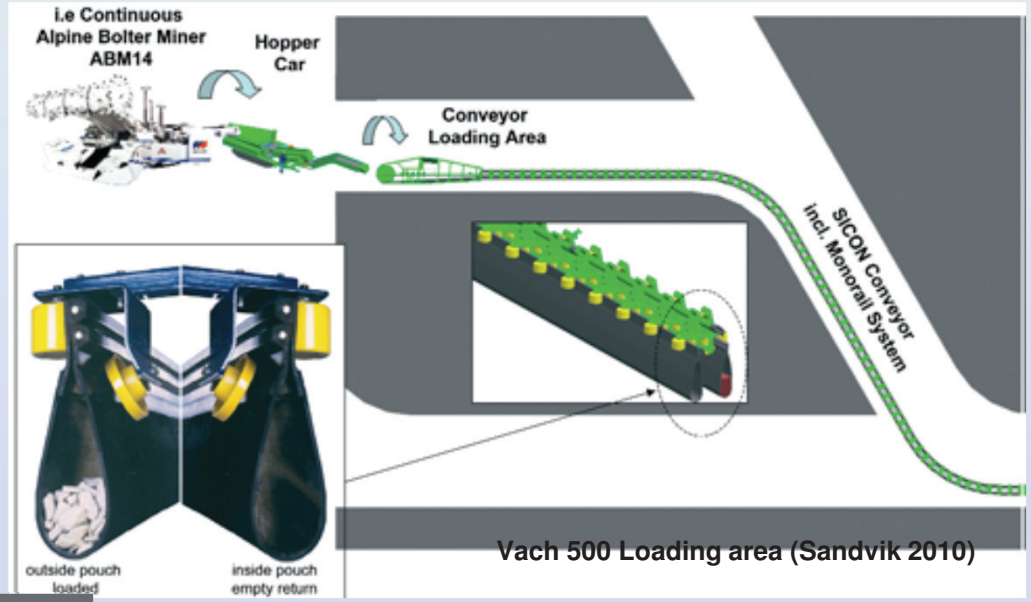
Temporary Belt Support

- Belt bending section and a collapsible A-frame belt supports mounted on skids.
- Belt extensions during belt operation - Allows for adding belt structure and idlers parallel to production.
- Joy's needs a take up unit - 12 m.
- CONSOL's - 80 metres long, has an optional take up unit.
- Can be connected to the section belt when driving the belt road.

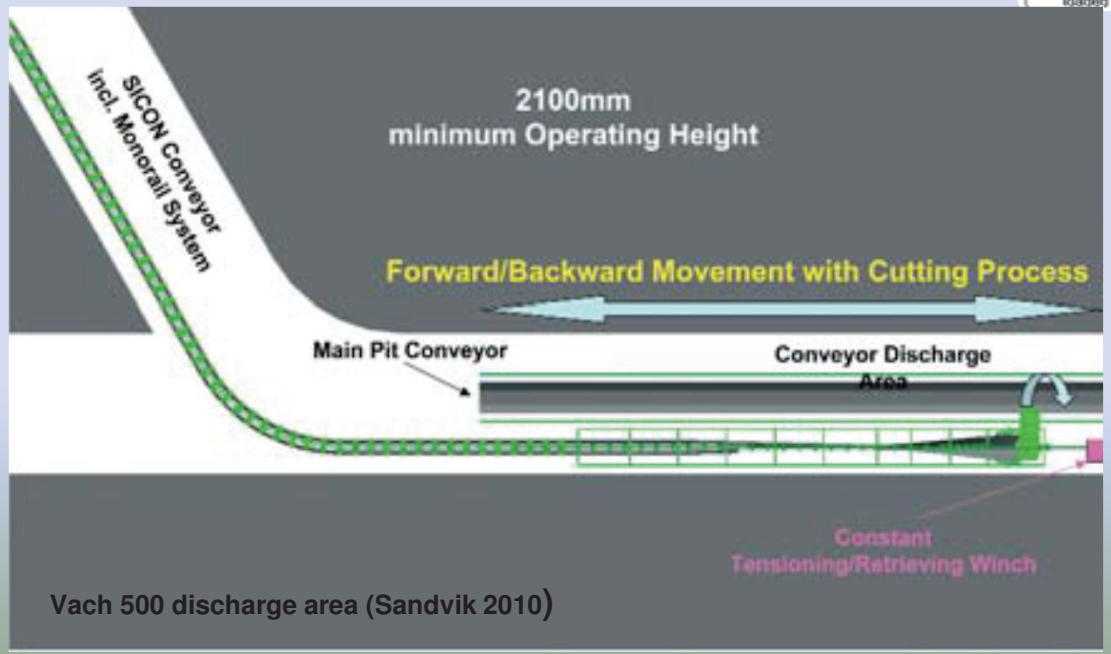
Temporary Belt Support (S&S Sliders 2011)

Pipe Conveyor

- Self-advancing and retreating via a monorail and hydraulic winch system.
- Up to 200 m in length.
- Closed conveyor concept - spillage non-existent.



Vach 500 Loading area (Sandvik 2010)



Vach 500 discharge area (Sandvik 2010)

- Design - a stretchable rubber belt using friction rollers on a vertically vulcanised drive strip.
- Moves by a track driven hopper car (the loading device)
- Hopper car can have a roof bolter, storage for 100m of monorail, inboard rock breaker.

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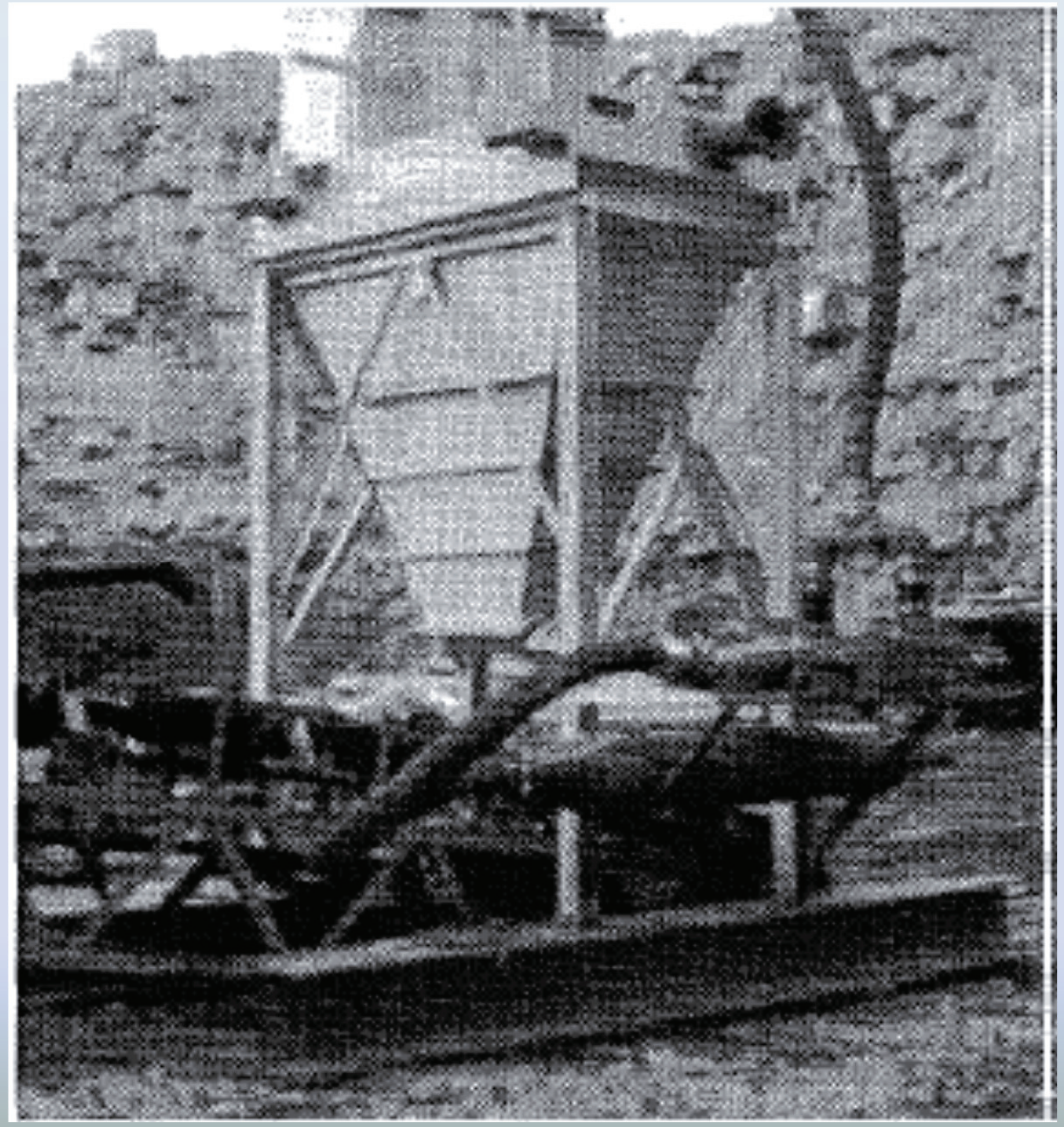
Pneumatic Conveyor

- Coal is loaded into the conveying system at the face by the vacuum action of the system.
- Vacuum loading hose is simple and suited for loading coal in all coal mining operations.
- Low seam, Appalachian Mountains. Also removed slurry and waste from sumps.
- Vacuum system reduces most of the health and safety hazards associated with coal mining by removing mobile plant from the mine.



Vacuum Coal Recovery Hopper and Air Injector Pumps (Pneumatic Coal Recovery systems, Bessemer, 1999)

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Pneumatic Conveyor

- Ventilation is improved by removing gas and dust
- Negative pressure system
- Uses PVC Pipe and flexible loading tubes
- High wear experienced with steel elbows and Y pieces. PVC anchored in concrete was found to be best for joints.
- The vacuum system is simple and inherently safe.
- Advantages: flexibility, low cost, quiet, ease of automation. Does not damage the coal , although a lump breaker is needed.
- Disadvantages: Production throughput limited, but not comprehensively tested.

·Bessemer 1999 *Pneumatic Coal Recovery Systems,* [Online] [Accessed 23 June 2011] retrieved from: http://www.onemine.org/view/?d=E442993C71348AA68693DC1D12A1F630A76F9AF8FDDE53CD0ED282AD4B2568FE177858

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Mine planning

- Mine planning
- Panel design, sequencing, productivity, recovery, utilisation for system and mining requirements.
- Selection process of continuous haulage
  - matching mining equipment
  - production compatibility
  - Optimise utilisation
  - Process driven culture
  - Maintenance and operational skills
- Continuous haulage systems are less flexible than batch haulage

ACARP Sandvik – Cutting a smarter metre

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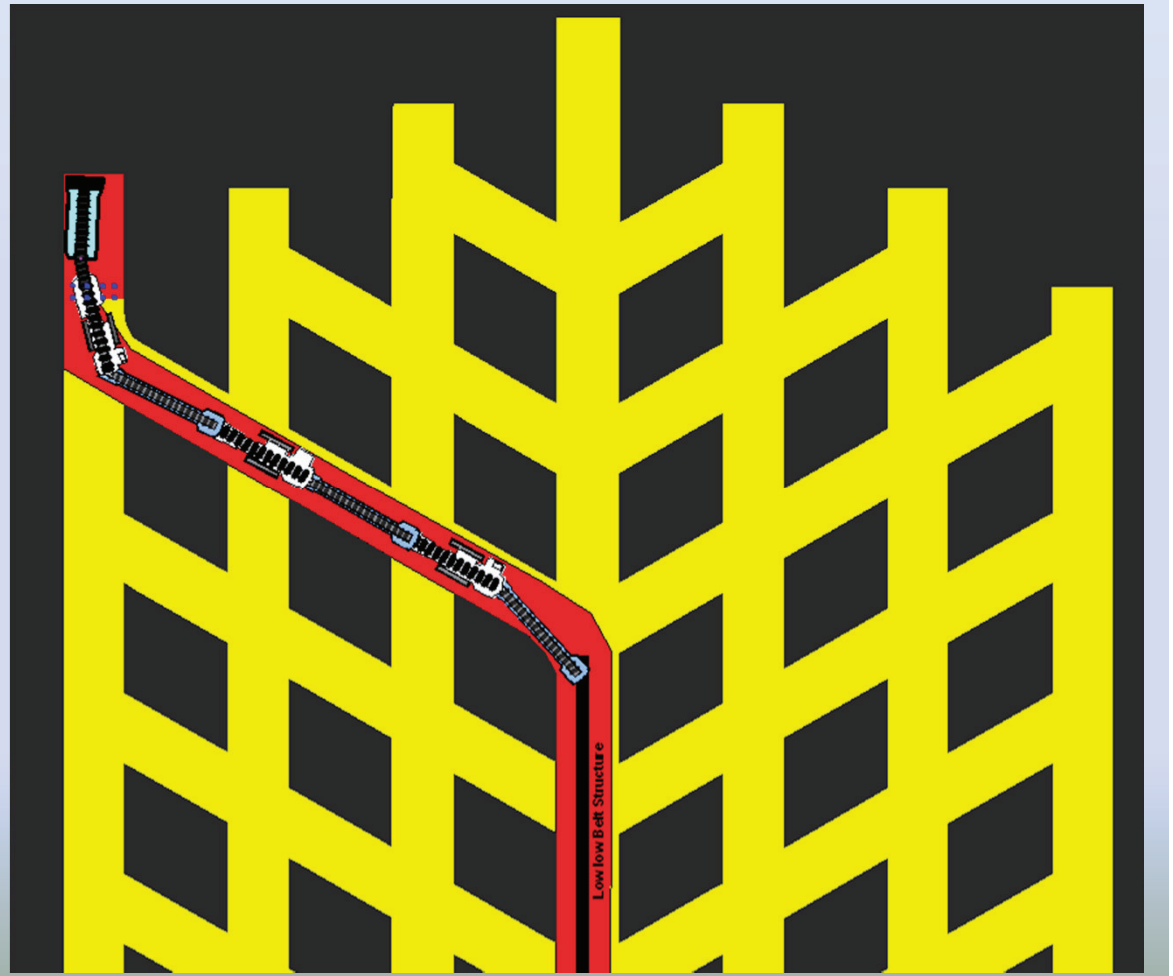
Mine planning

- Traverse 90º drivage
- Angled cut-throughs (70º) for material handling
- Diamond shaped pillars - prone to crushing and/or larger intersections.
- Considerations to improve cycle times:
  - dry and graded outbye roads
  - water management
  - panel move standards
  - mapping of tasks/resources
  - timely feedback
  - Single pass miners



Continuous Haulage Aquila Colliery 2009

Conclusions

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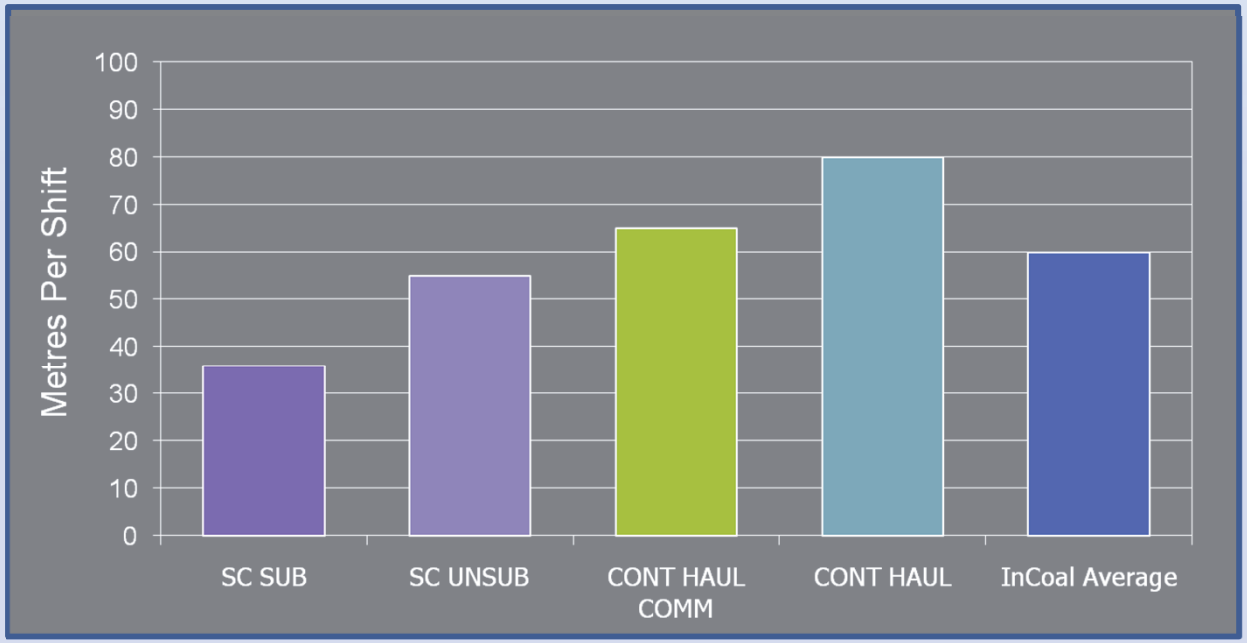
- The choice of the ‘better option’ is not always for financial reasons.
- Factors: safety, operational ease or engineering design optimisation.
- Thorough decision making, using an investment evaluation process model.
- Continuous haulage takes personnel out of shuttle cars, reducing OH&S issues.
- Safer operation, less relative movement of mine personnel vs mobile equipment.



Continuous Haulage Aquila Colliery 2009

- Remove the loading times, continuous haulage can increase utilisation time by 35% vs batch haulage, takes the bottle neck out of the coal clearance system.

Conclusions

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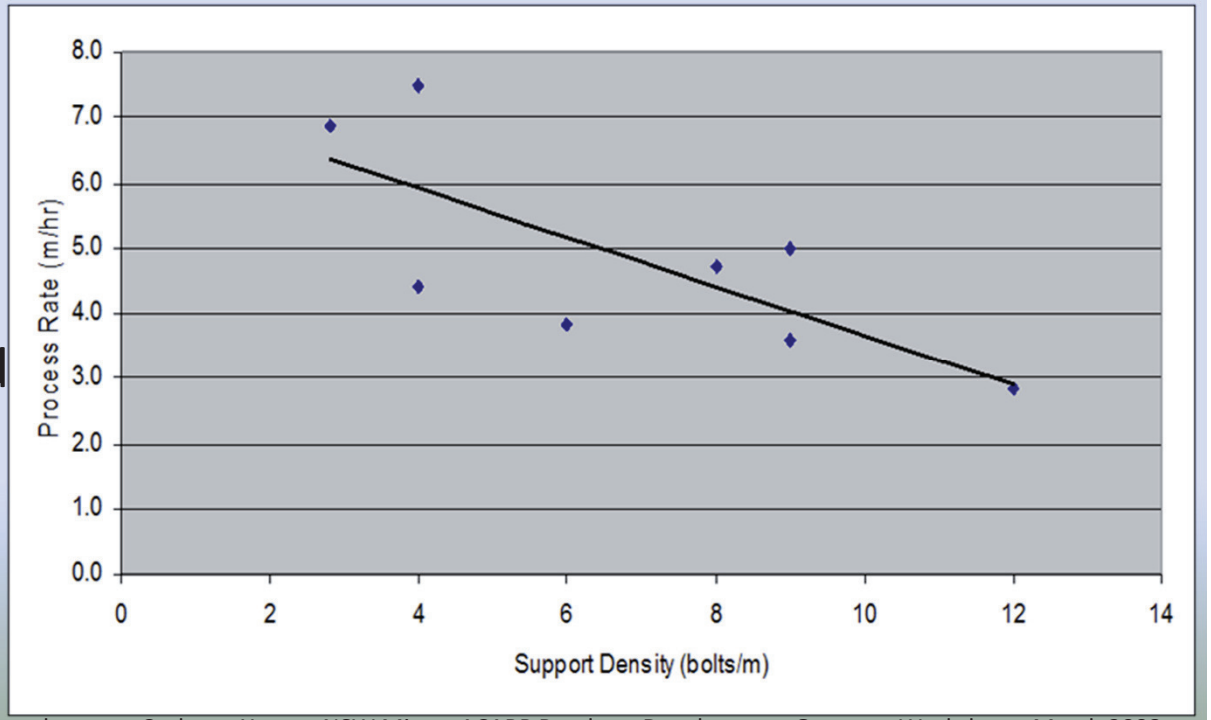
- Bolting constraints - "bolting machine that mines coal". Design - from peak throughput capacity, to consistent steady state production.
- Need to match current equipment and roadway dimensions.
- Cable/hose effective lengths – compatible pillar lengths vs monorail relocations.
- To improve continuous haulage, need to address issues on site: communication, training, scheduling of tasks.
- Benefits of scheduling analysis: show decreased costs, improved productivity, safety, increased return on investment.



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Conclusions

- Need to modify or reengineer the continuous haulage system as delivered by the OEM – to adapt to the mine conditions. Some modifications have proved productive.
- Issues with continuous haulage have been spillage and deterioration of minerals. The more transfers, the more fines. Chain conveyors cause a milling action - bottom layers of conveyed heap.
- Every transfer station is a potential source for spillage. Eg 10 000 t/ shift- 0.1% of spilled material (10t) = expensive cleaning exercise. Manual labour is often the only option.
- Rubber-belts are prone to retain materials and the cleaning stations in many cases are not feasible. Chain conveyors - are most in use and these are prone to wear and tear.

Patol Limited Fire-protection guidelines for Conveyors transporting coal, http://www.patol.net/conv_guide.htm, 26 Sept 2011.

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Conclusions

- Capital costs may be higher than batch haulage, increases in production and productivity offset these costs. Goal to increase production and reduce operating and accident-related costs to justify the purchase and use.
- Continuous haulage may the only means by which some coal seams can be extracted.
- Haulage costs makeup 15% to 25% of operational cost of a section.
- Steel on steel and transporting stone ores causes high wear.

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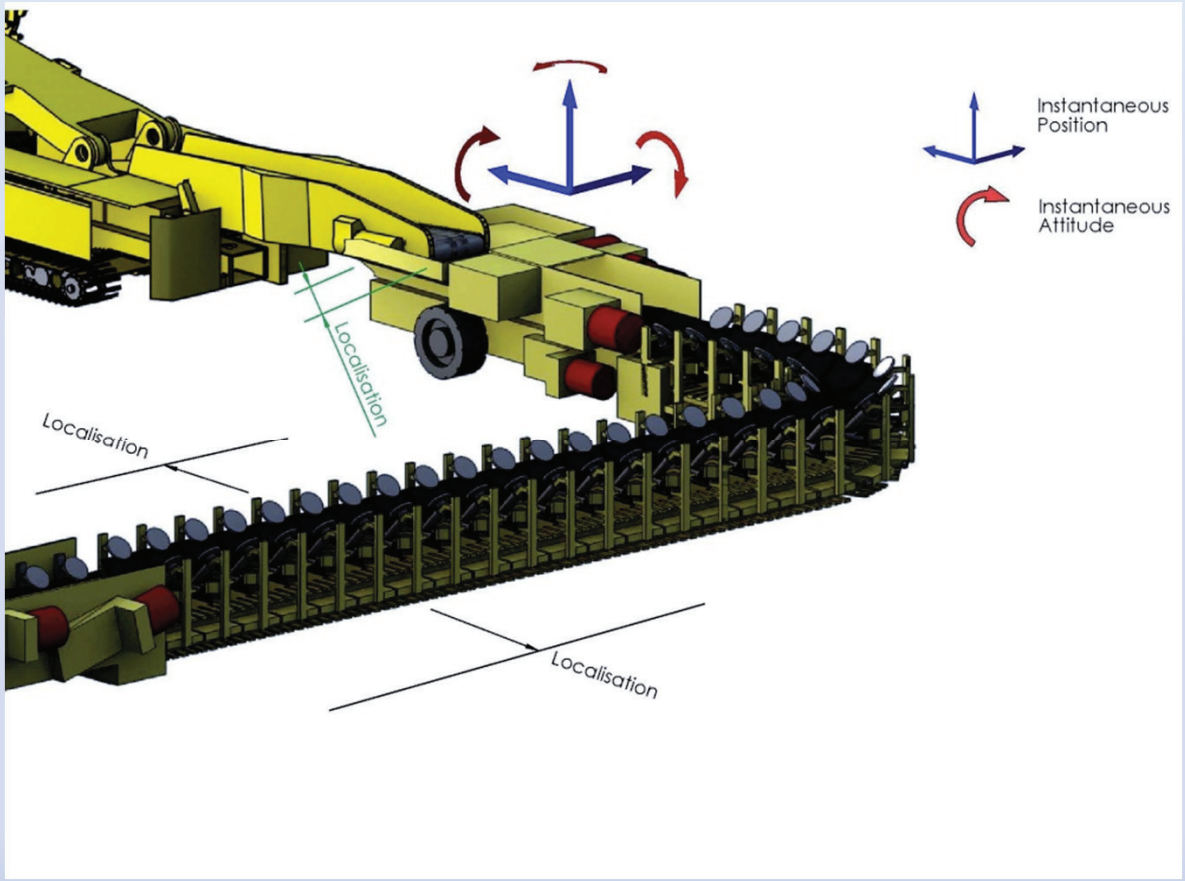
Conclusions

- Development can not now keep up with longwall production. It is necessary to adopt continuous haulage systems to improve the pace of development.
- If longwall is to reach the operational goal of being fully automated, then continuous haulage in conjunction with support services such as monorails need to be developed.



Roadway Development Operators' Workshop ACARP project C18023 CM2010 – Continuous Miner automation Dr David Hainsworth Dr David C. Reid 3-6 March, 2009

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Any Questions?

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