



10th Anniversary Where Longwall mines meet FACE to FACE

LONGWALL 2011

24th - 25th October 2011
Crowne Plaza Hunter Valley

Future Longwall: Cutting Coal with Full Automation?

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Future Longwall – Cutting Coal with Full Automation?

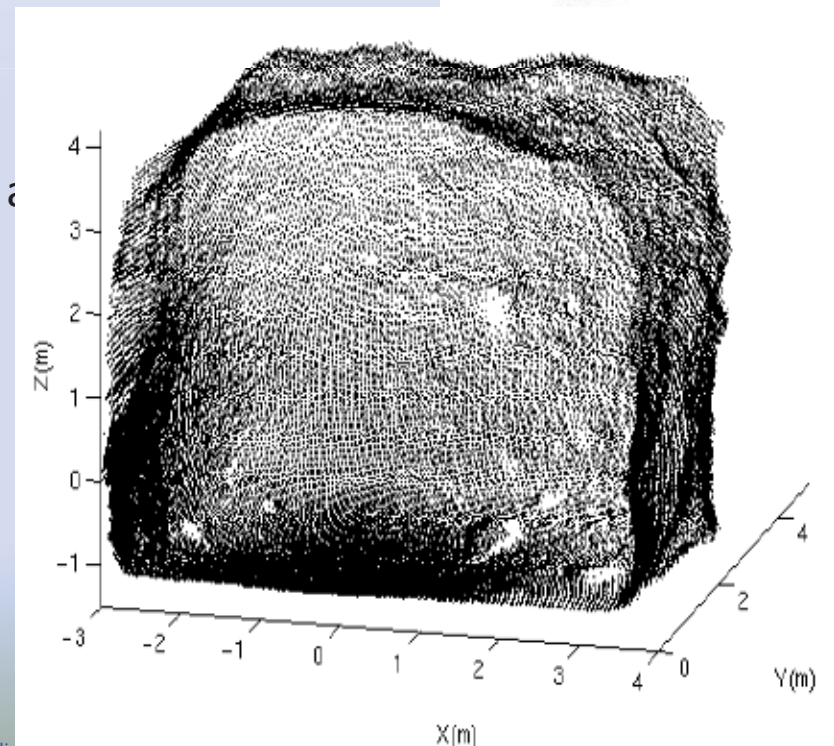
The short term objective:

The removal of people from the most hazardous face areas.

Where are we up to?

The Longwall Automation Steering Committee (LASC) automation systems, ACARP, CSIRO, OEMs and others have developed and tested:

- Creep/retreat systems;
- Horizon control sensors,
- Prototypes of more general sensors for face monitoring,
- Sensors managing exception and faulted conditions.



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What is now being developed?

- Control technology development projects;
- Subsurface radar sensing;
- Optimised inertial navigation;
- Machine localisation;
- Inertial navigation;
- High-end navigation technology;
- The LASC Information System (LIS)



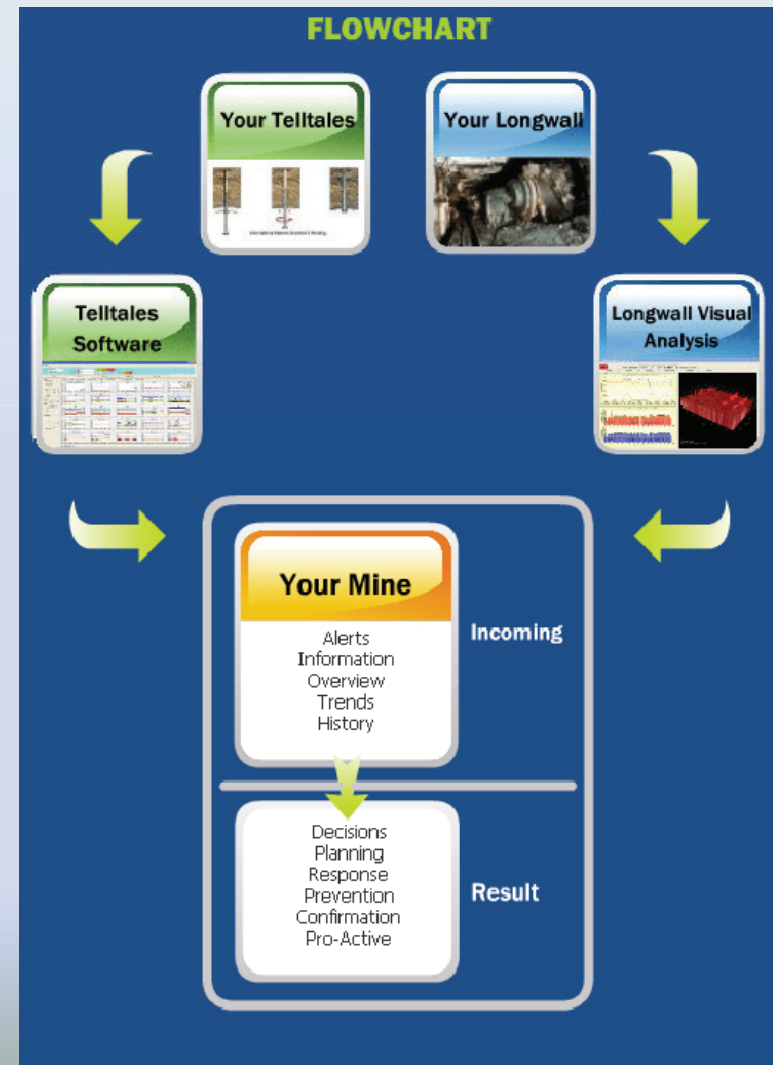
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What is now being developed (cont)?

- The Shearer Position Measurement System (SPMS) upgrade
- Horizon control innovations
- LASC Cut Model and OEM horizon control algorithms
- Shield convergence monitoring upgrade
- New techniques for coal flow optimisation and void monitoring



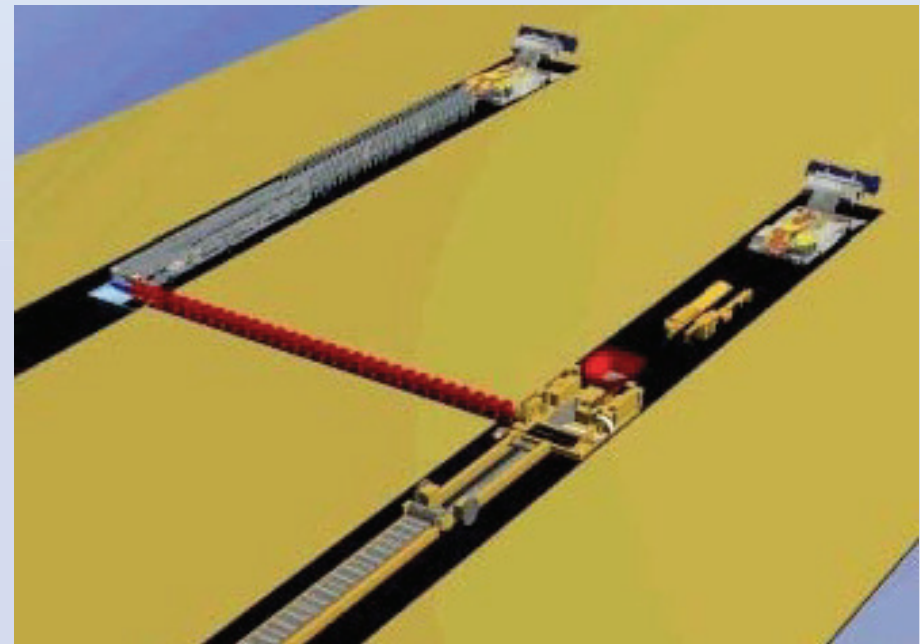
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The ultimate objective?

- Fully automated robotic panel development; and
- Fully automated robotic longwall mining.

The two are listed in that order because without panel development the best, fastest, fully automated robotic longwall

mining will have to **STOP** and wait until panel development catches up.



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So let us reword the question.

To fully automate panel development, what is now being developed?

- The 18 month \$1.3M ACARP CM2010 Continuous Miner Automation project (C18023) complete.
- The first half of demonstrated autonomous navigation (self steering) of a CM to proof-of-concept level.
- It took a decade.
- REMS project in America



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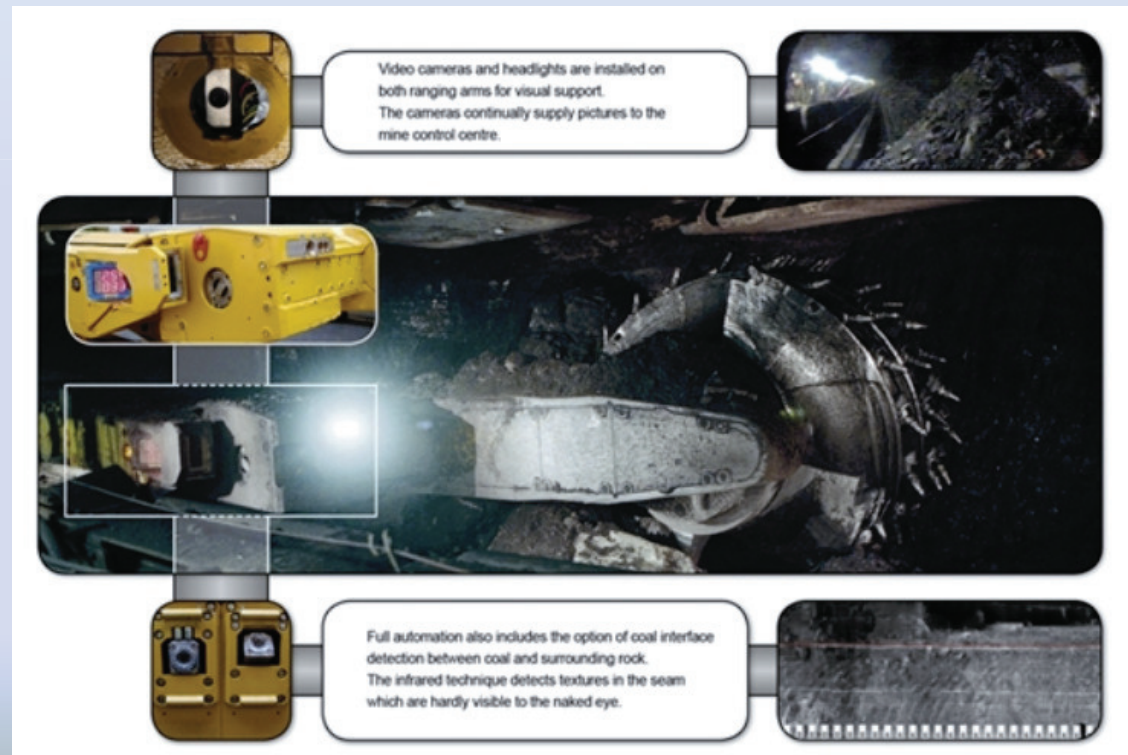
So let us again reword the question.

To fully automate panel development, what is now being developed and what are the problems?

David Hainsworth from CSIRO Exploration & Mining reported¹ that there were some major issues:

- Project structure
- Technical risk
- Resourcing

¹ David Hainsworth 2009. *Rapid Roadway Development* ACARP Project Number: C9017, retrieved from <http://www.acarp.com.au/abstracts.aspx?repld=C9017> on 04 September 2011.



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So let us revisit the question, to fully automate panel development what is now being developed and what are the problems?

- *Underground Coal Operators' Conference 2011 - A Major Step Forward In Continuous Miner Automation* by David C Reid, Jonathon C Ralston, Mark T Dunn and Chad O Hargrave, CSIRO Queensland.
- Focus on remotely supervised CM, to deliver a “self-steering” capability. To maintain 3D position, azimuth, horizon and grade control in a variable horizon.

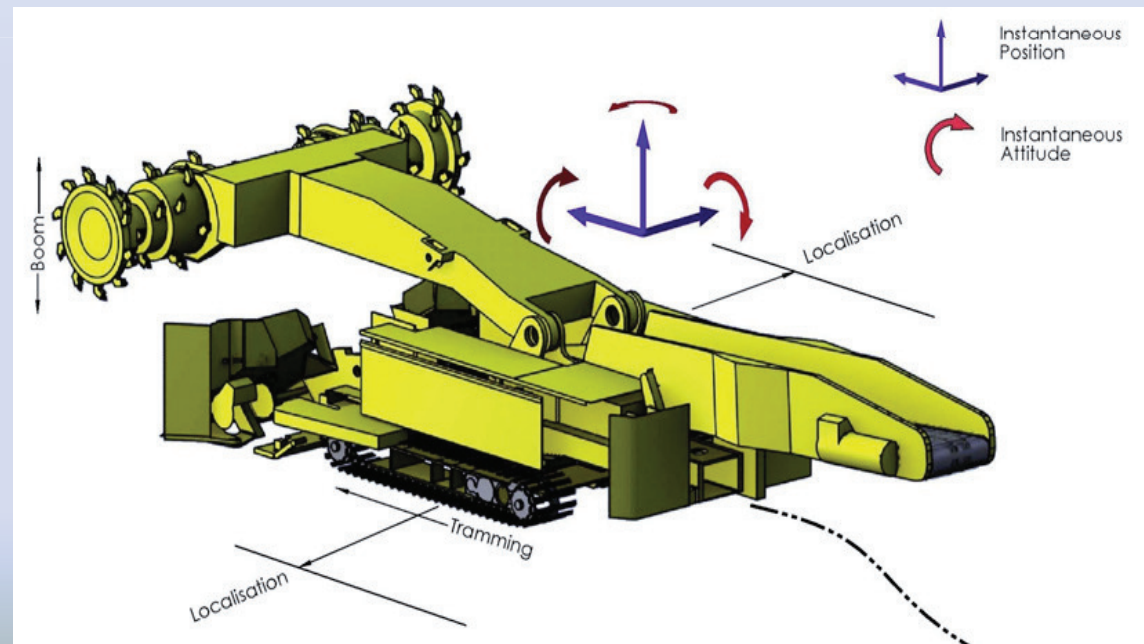


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David C Reid, Jonathon C Ralston, Mark T Dunn and Chad O Hargrave, CSIRO Queensland.

The CM2010 roadway development strategy was formalised in 2008 with four major technology categories: **remotely supervised continuous miner, automated installation of roof and rib support, continuous haulage and integrated panel services.**



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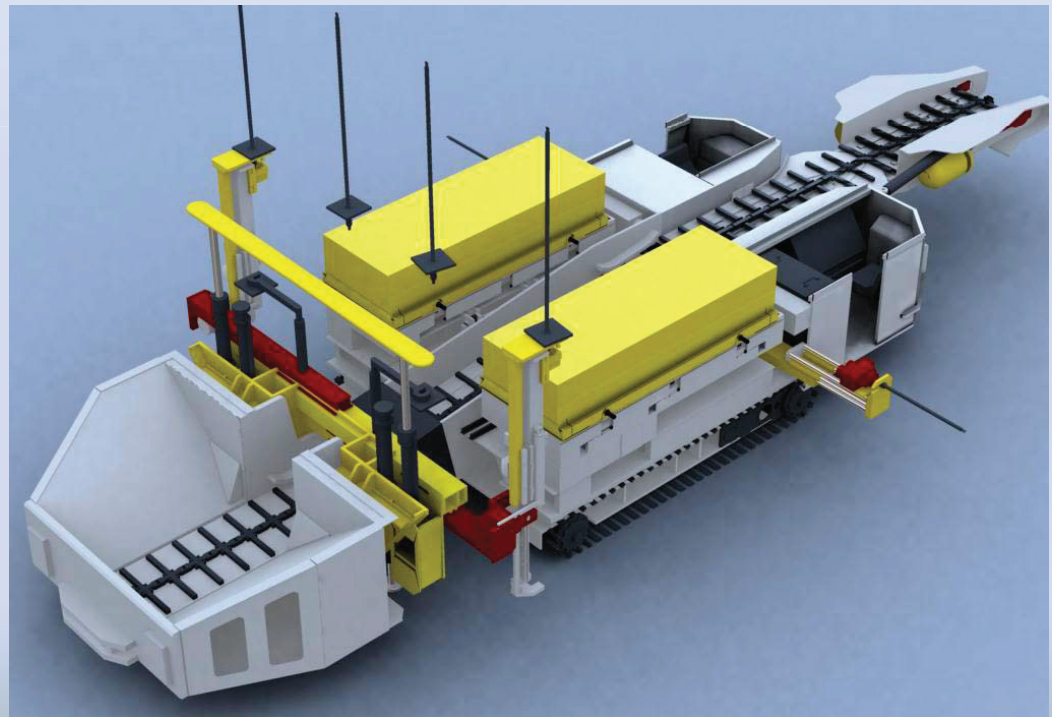
So let us reword the question.

To fully automate panel development, what is now being developed?

The ACARP C9017 Rapid Roadway Development Project commenced 1998. Collaboration between ACARP, CSIRO, JCOAL, Boart Longyear, The IHI Corporation, Taheiyo Komatsu and Hydramatic Engineering (now Sandvik).

Project C9017 is now complete.

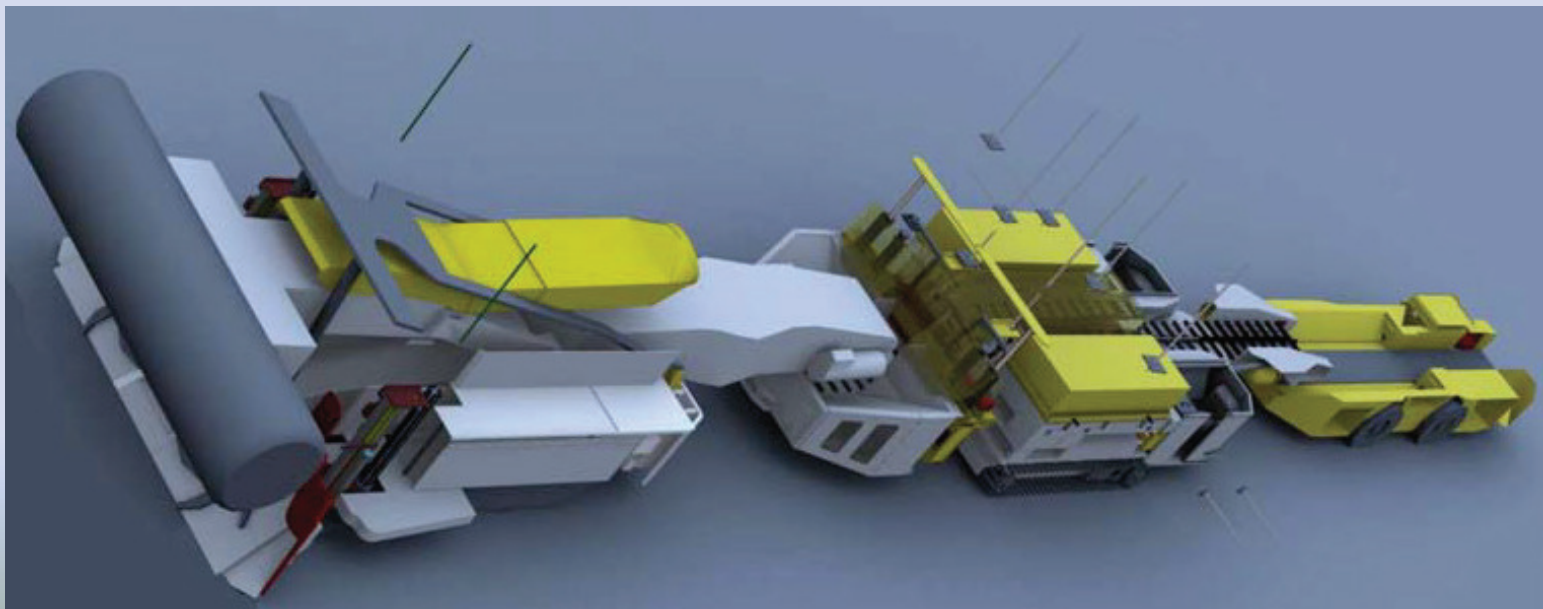
An Autonomous Conveyor Bolter Module (ACBM) that can operate for 20 hours per day at 10m per hour development rate is a great idea.



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So let us revisit the question, to fully automate panel development what is now being developed and what are the problems?

Where are we lagging behind? In all the things that come behind a remotely supervised continuous miner, **automated installation of roof and rib support, continuous haulage and integrated panel services.**



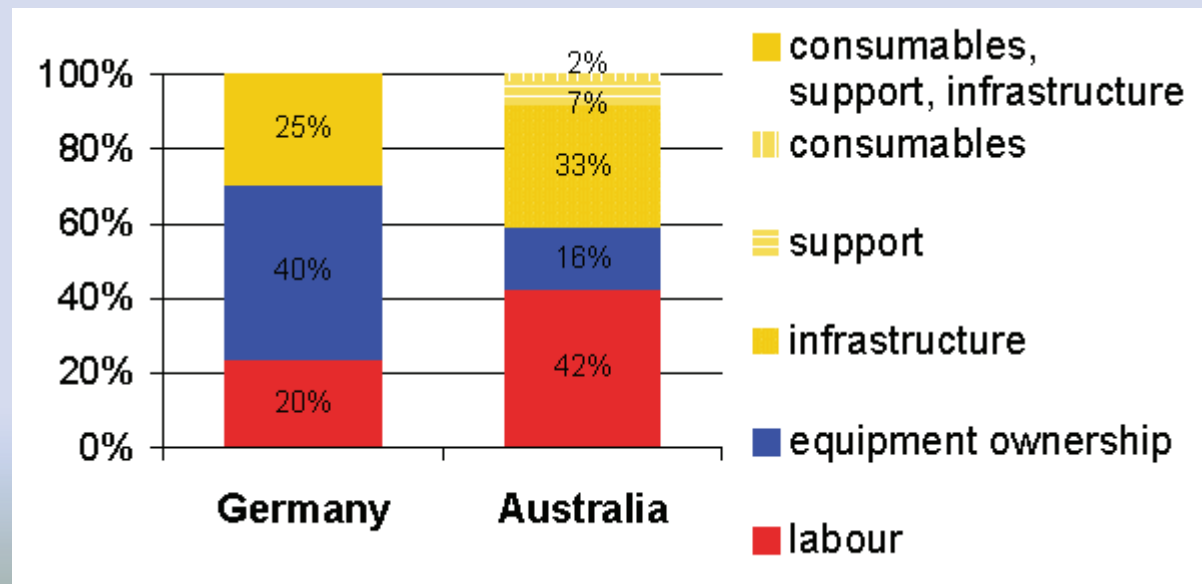
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Are we asking the rights questions?

Is a **remotely supervised continuous miner, automated installation of roof and rib support, continuous haulage and integrated panel services** the best technology?

Continuous miners were developed last century or the century before that? Can they be improved? Why not have a battery mode with interchangeable 'Plug&Play' batteries, so that the CM can unhook all services and tram to next sequence?

This may prevent the CM from backing over cables and services when retreating. Damage to cables alone costs some mines \$100k a week.

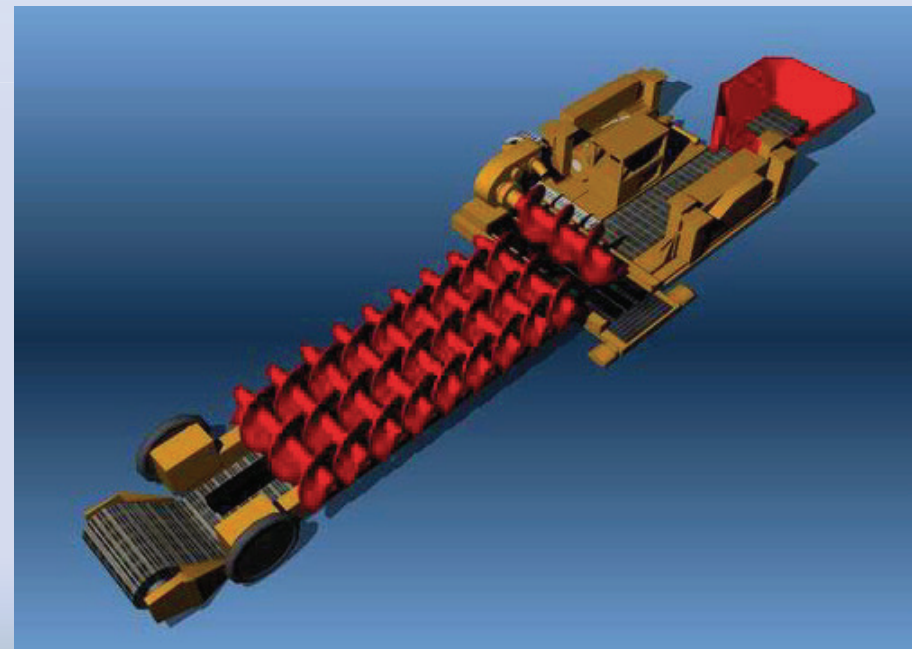


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Are we asking the rights questions (cont)?

Is a **remotely supervised continuous miner**, automated installation of roof and rib support, continuous haulage and integrated panel services the best technology?

- Is there a better machine than a CM?
We are now in the 21st Century.
- Should we look at machinery, from first concepts? Large tunnel borers have not proved to be very successful.
- Should we be seeking a smaller machine, but using augers or drills rather than picks? Automated plow systems? Bucyrus manufacture a fully automated longwall plow².



² Australian Journal of Mining 2011 *America's first modern automated longwall plow system*, retrieved from <http://www.theajmonline.com.au> on 04 September 2011.

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Are we asking the rights questions (cont)?

Is a remotely supervised continuous miner, **automated installation of roof and rib support**, continuous haulage and integrated panel services the best technology?

Automated installation of roof bolts is now well advanced, but automated rib support is lagging behind. Is there a better way than bolts? Should we be looking at roof and rib support again, back from first concepts? Steel arches and liners are used in coal mining in Columbia. What about machinery that follows the miner with steel arches and liners?



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Are we asking the rights questions (cont)?

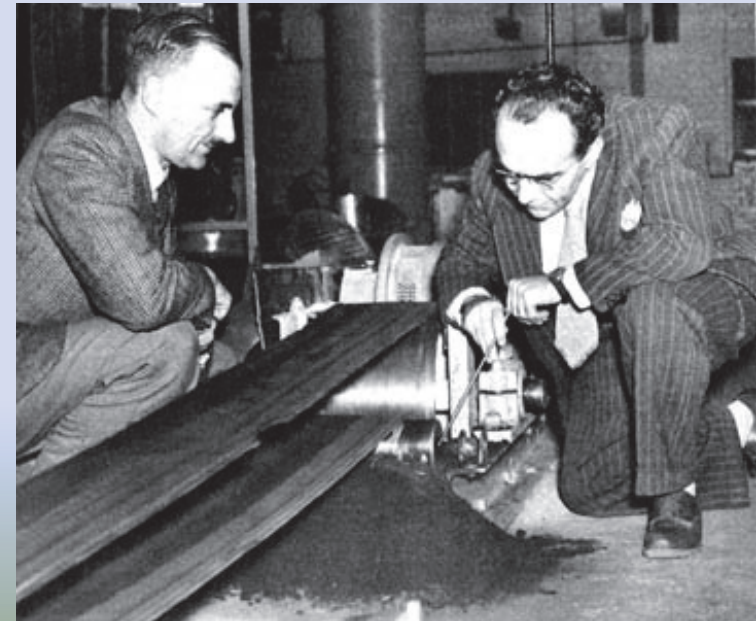
Is a remotely supervised continuous miner, automated installation of roof and rib support, **continuous haulage** and integrated panel services the best technology?

ILN *Continuous haulage: Worth another look*, looks at various methods of continuous haulage. I will not revisit the subject now. Come to the workshop to hear more.

Roadway development cannot be accelerated unless miner is supported by continuous haulage. The Long-Airdox Company sponsored the design and development of a 1/10 scale prototype of a Continuous Haulage System, for development, testing of path-planning, control algorithms for autonomous navigation, operation in underground coal mines³.

³ Wells 1999, retrieved from <http://www.WellsBCHShtt.p.scholar.lib.vt.edu/thesesavailableetd080499-155658unrestrictedetd.pdf>, on 04 September 2011.

Dr Bronowski studying coal dust collection and ignition under a scale model belt after the Cresswell Pit fire in 1950. (The Miners, Anthony Burgess), retrieved <http://bittooth.blogspot.com/2010/05/moving-coal-from-face-to-shaft.html>, on 17 Oct 2011.



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Are we asking the rights questions (cont)?

Is a remotely supervised continuous miner, automated installation of roof and rib support, continuous haulage and **integrated panel services** the best technology?

Integrated panel services are made vital by the species of machine we use for mining, bolting and haulage.

If we stick with the configuration of CM/ Autonomous Conveyor Bolter Module (ACBM) and they are electrically 'mains' powered, cables must follow, with water, compressed air hoses, ventilation tubes, supplies for the bolters and stone dusting. Are there better ways of delivering these services? Monorails?



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**What is now being developed?
Answer: Not a lot!**

We are in the midst of the biggest longest mining boom in living memory.

All the Global Mining Houses are reporting unprecedented profits.

More money, more quickly, needs to be invested in Research and Development.





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Thank you.
Any Questions?

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