Autonomous Haulage
An owner/operator story
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About this presentation

I will broadly address three points in this brief presentation:

1. The owner operator view of introducing technology
2. A Pit, our journey to the world’s largest autonomous fleet
3. Observations about change, adaptability (and evolution)

The audience can draw conclusions and ask questions
Understanding Rio Tinto the owner/operator

• Rio Tinto is a large globally diverse mining company
• We were formed in 1873 and have seen many changes
• We are owners and operators of mining assets
• Excellence in operations delivers excellent outcomes
  – Safety and environment
  – Productivity
  – Stakeholder value
• Autonomous Haulage System (AHS) is one (more) innovation we take pride in operating

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A core belief – people and operations

- We operate in a world of fast moving technology
- Have a demonstrated our ability to safely introduce advanced technology
- Rio Tinto people **are the operational glue**
Busy with Innovation in Australia

2007
Trials starts on the Operations Centre and Automated truck project in Western Australia

2008
Atlas Copco Alliance

2008
Automated train trial

2009/10
Automated trucks Pilbara 'A Pit' trial

2010
Drillers Aid trial

2010
Operations Centre commissioned

2010/11
Komatsu MOU for 150 autonomous trucks deployment

2011
Automated truck deployment

2012
Announcement of autonomous train deployment in 2014 / 2015

2012
Deployment of the Autonomous Drilling System (ADS)

2012
Advanced Survey

2014
Launch of the Processing Excellence Centre in Brisbane

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Rio Tinto – our AHS journey since 1997

1997/8
Tarong Coal
Komatsu
AHS
tests

2006/7
Codelco Radamiro
Tomich
industrial trial

2008/10
Rio Tinto Iron Ore
/Technology & Innovation
A Pit Mine test programme

2011–
Rio Tinto
industrial AHS
deployment

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The story of “A Pit”

In 2007 we committed an investment of $50M – $100M to the trial of owner-operated Komatsu AHS trucks in the Pilbara – you may ask what questions were we trying to answer?
The questions we needed to answer

Safety and people
Can this technology provide equal or better safety performance in our operations and can our people operate this new platform?

Performance and value
What are the performance metrics for the technology and can we generate more value than other options from this technology?

Learning organisation
Can we capture learnings from operating autonomous vehicles and embed this in both our people and business operating model?
A Pit Trial Site Location
The answer - AHS is a complex challenge

• Must introduce the change safely into a traditional industry
  – Interacting with manned machinery
  – Working under computer dispatch
  – Human supervision but not human operation

• New operating paradigm for mining operations
  – Haulage systems under autonomous control
  – Multiple machines in close proximity some weighing > 500 tonne
  – “Robots” moving at up to 50km/hour

Complex Challenge
Our A Pit experience told us that safety and value could be improved by use of AHS, but, we should plan very carefully to manage a high level of complex change!
Today – AHS deployment footprint Q3 2014
Rio Tinto and Autonomous Haulage (today*)

We own and operate the world’s largest autonomous haulage fleet operating in full production mode on three mine sites.

Our autonomous fleets have covered ~3,900,000 km hauling material in our operations (x 5 trips to moon and back).

We have moved >200,000,000 tonnes using autonomous technology (~ 3,500 Sydney Harbour Bridges or 540 Empire State Buildings).

We have over 1,000 Rio Tinto person years of experience operating autonomous haulage embedded in our business.

*Correct as of August 6th 2014

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My personal reflections

• I have led the implementation of a range of high-tech systems
  – Introducing any high technology into operations is challenging
  – Underpinning the technology lies the critical world of the human

• Some things to think about very (very) carefully
  1. Safety, safety, safety then safety (listen to the operators)
  2. Human systems interaction
  3. Social acceptance of the change

• Any one of the above can unhinge you

• So don’t rush, be extremely methodical
Autonomy - part of an integrated strategy

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Automation and autonomy

Big data and analysis

Smart people, smart operations
An integrated strategy – data is the glue

• Rio Tinto Mine Automation System (MAS)
  – A seven year programme, partnership with University of Sydney
  – Embed many learnings and technologies from the defence sector

• One version of the “truth” in mining
  – Autonomy is one component in the mine
  – One part of our Sense/Think/Act strategy

Stitching it all together
Autonomous vehicles are one component in the wider complex mine landscape. Rio Tinto believes we have to integrate many mining systems to capture most value
Adaptability & Change in the 21st century

• Technology is all around us, new technologies emerge every day
  – The pace of technological change is accelerating
  – Successfully utilising the new technology generates value
  – Change management is a key to unlocking this value

• Adapting to the pace of change delivers competitive advantage

…. someone famous once commented on change and adaptability!
Adaptability & Change - not a new lesson

“It is not the strongest of the species that survives, nor, the most intelligent that survives. It is the one that is the most adaptable to change”

Charles Darwin FRS
12 February 1809 – 19 April 1882
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Questions