

RioTinto

Mine of the Future™

Transitioning to Autonomy Workshop: Changes in the Role of the Human in the National Airspace System

NASA Ames

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About this presentation



I will address three points during our time together:

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- 1** Rio Tinto – an owner operator view of introducing technology

 - 2** Our automation journey

 - 3** Lessons learned

Rio Tinto – a world leader in mining

Aluminium

Leading position in:

- bauxite
- alumina
- aluminium



Copper & coal

Leading position in:

- copper
- Molybdenum
- uranium
- export coking and thermal coal



Diamonds & Minerals

Leading position in:

- titanium dioxide & zircon
- borates, diamonds, salt



Iron Ore

Leading position in:

- seaborne iron ore



Mining is physical, it is connected to “places”

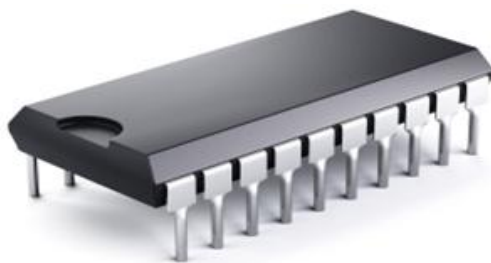


Mining is a physical activity, the ore bodies cannot be moved. This drives a locally focused self-sustaining management culture that has been very successful over time.

Large mines trigger significant parallel development through towns, schools, hospitals, roads etc. This further drives the concept of self-sufficiency.

Technology enablers reduce geographic boundaries

Power & cost of computer chips



Cost & capacity of data storage



Interconnectivity & cloud systems



Proliferation of sensors



Stepping out – our location experiences

2009 – regional

Western Australia, the world's first and largest integrated Iron Ore operations centre



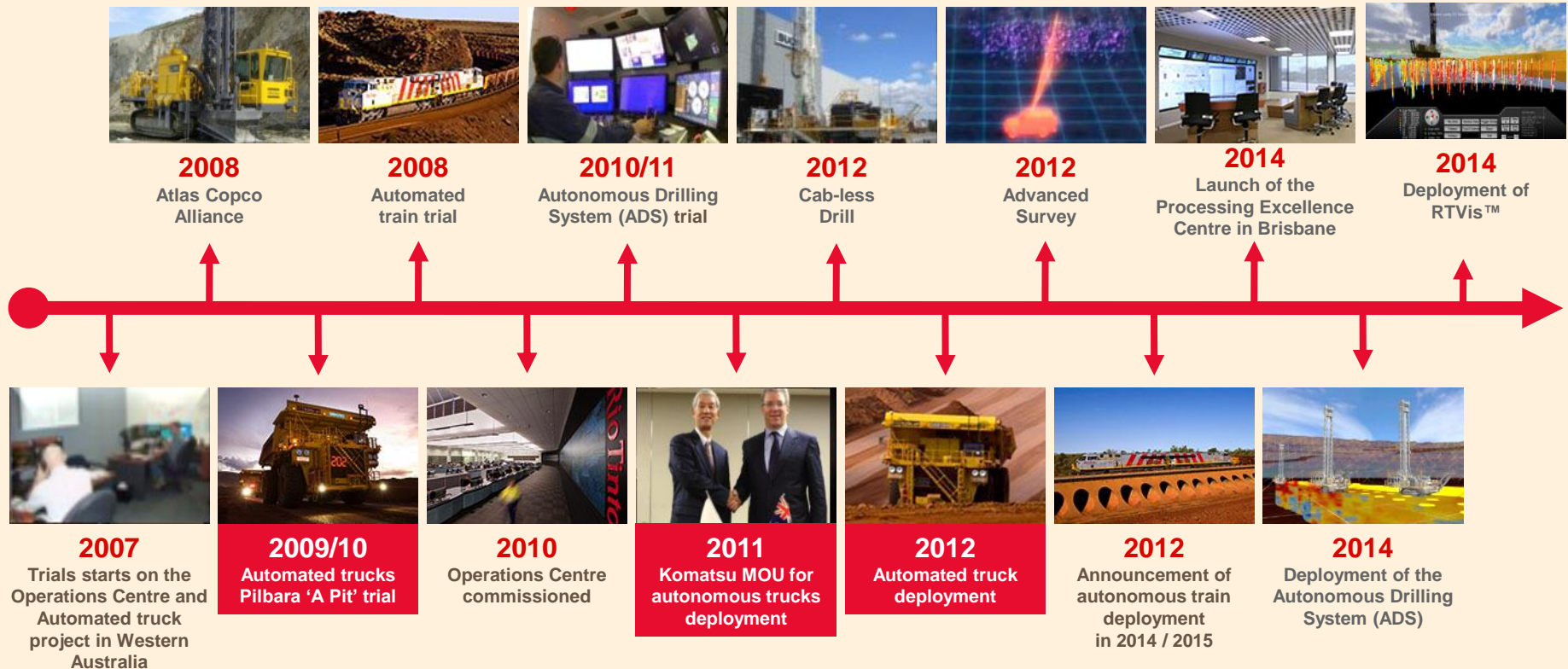
Collaboration
 Skills leverage
 Productivity
 Value add
 Exploit Big Data
 Distance irrelevant
 Human systems
 Advanced models
 Intelligent analytics
 Network partners

2014 - global

Integrated global multi commodity Processing Excellence Centre

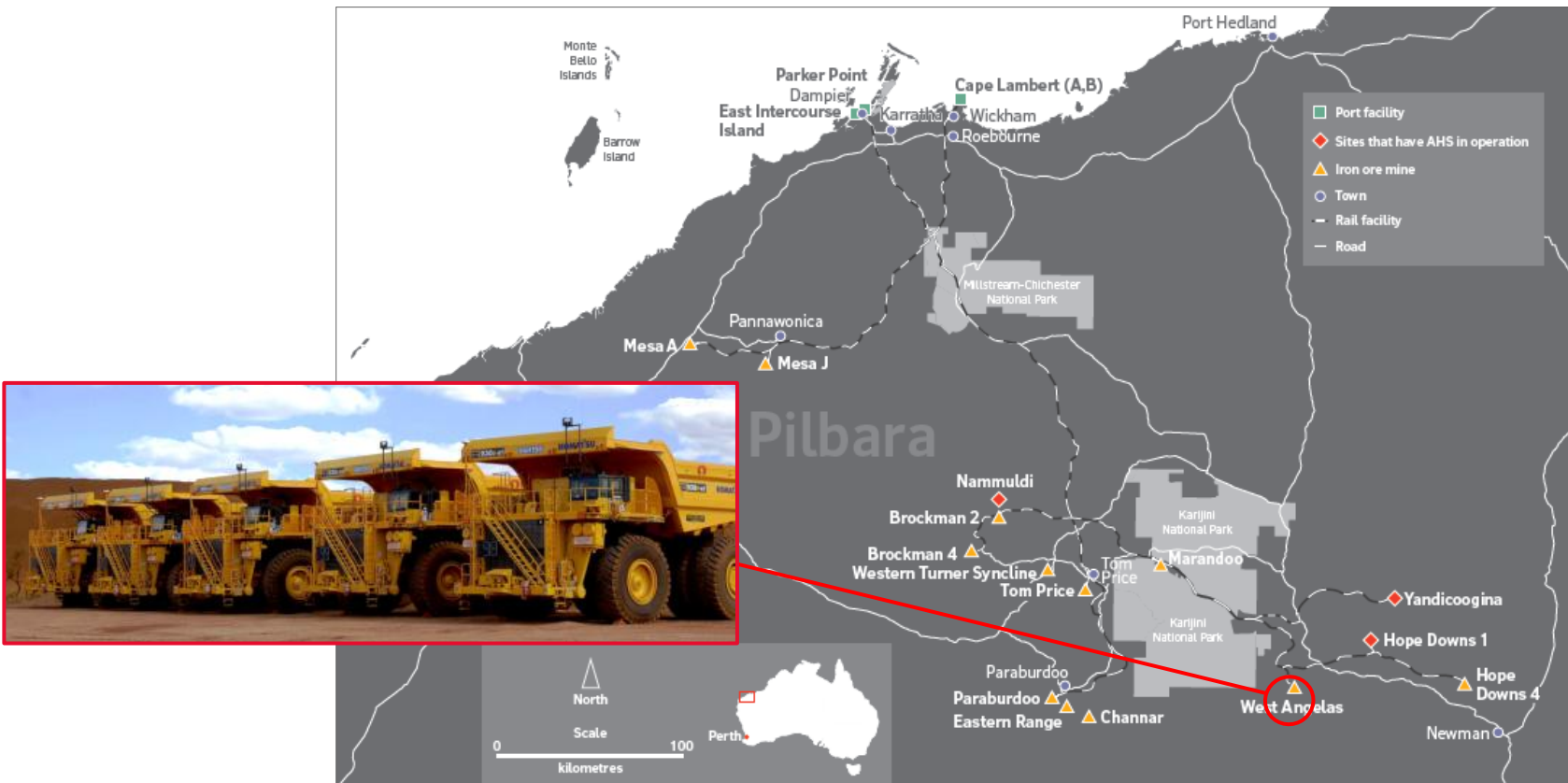


Busy with Innovation in Australia



'A Pit' Trial Site Location

In 2007 we committed an investment of \$50M – \$100M to the trial of owner-operated Komatsu Autonomous Haulage System (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?



The answer - Autonomous Haulage System (AHS) is a complex challenge

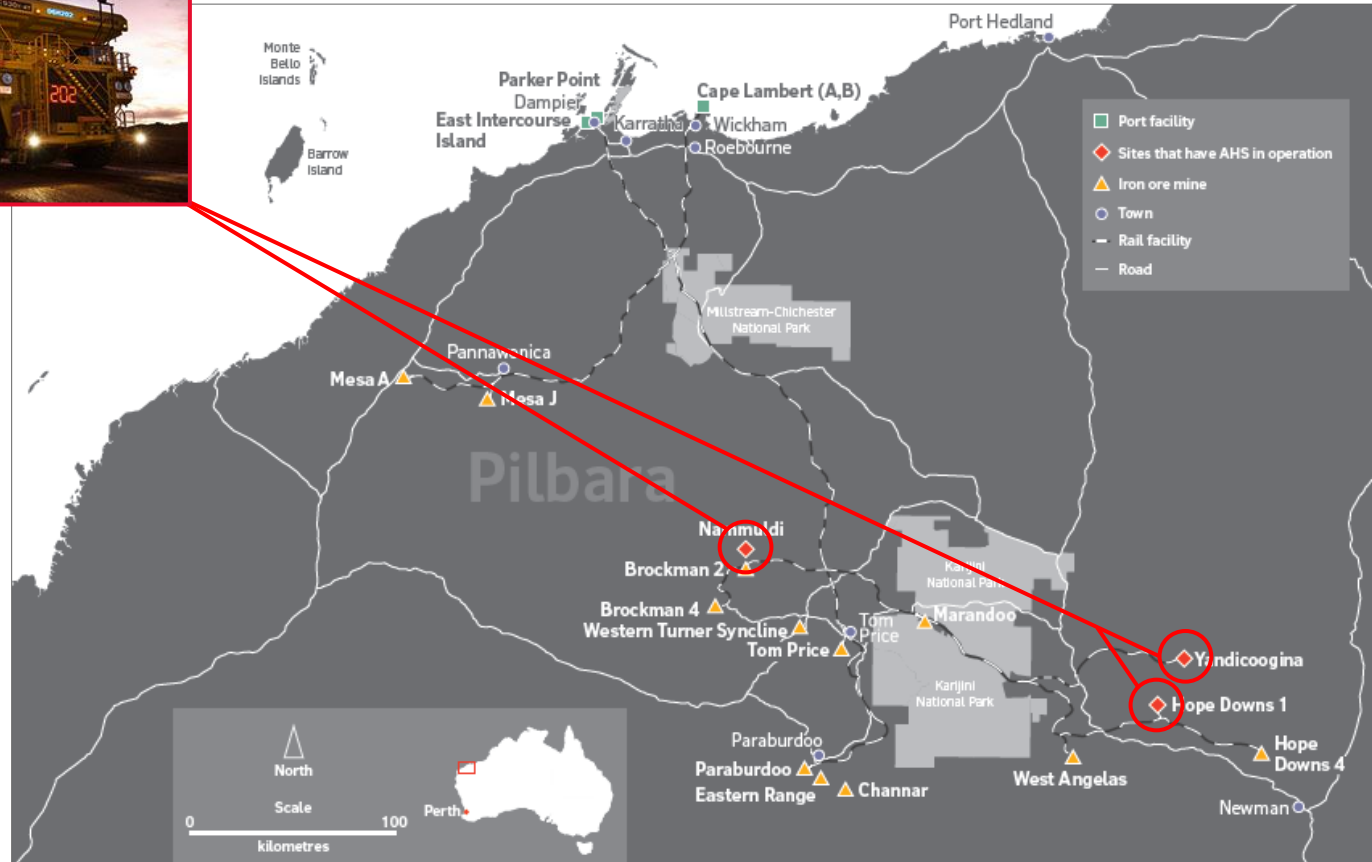
- Must introduce the change safely into a traditional industry
 - Interacting with manned machinery
 - Working under computer dispatch
 - Human supervision but not human operation
- New operating paradigm for mining operations
 - Haulage systems under autonomous control
 - Multiple machines in close 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



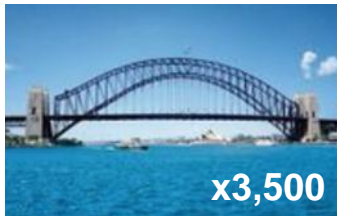
Rio Tinto and Autonomous Haulage (today*)



We own and operate the worlds largest autonomous haulage fleet operating in full production mode on three mine sites



Our autonomous fleets have covered ~3.9 million km hauling material in our operations (x 5 trips to moon and back)



We have moved >200 million 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*

Some reflections & lessons learnt

- Introducing any high technology into operations is challenging
- Underpinning the technology lies the critical role of the human
- Some things to think about very (very) carefully
 1. Safety, safety, safety then safety (listen to the operators)
 2. The bottom line – is there a compelling business driver for the change?
 3. What performance measures will demonstrate you are going well?
 4. Human systems interaction
 5. Cultural/social acceptance of the change
- Any one of the above can unhinge you
- So don't rush, be extremely methodical

Lessons learned - performance

While autonomy can help with consistency and removing people from hazardous situations, it requires continual supervision to get the best performance.

Putting in place systems, tools and processes to monitor the system and to quickly act on changes or events is key to maximising performance.



Lessons learned – cultural change

Introducing autonomous technology into manned operations can be perceived as disrupting and a threat by the existing workforce.

These people are key to making the system work at its maximum potential.

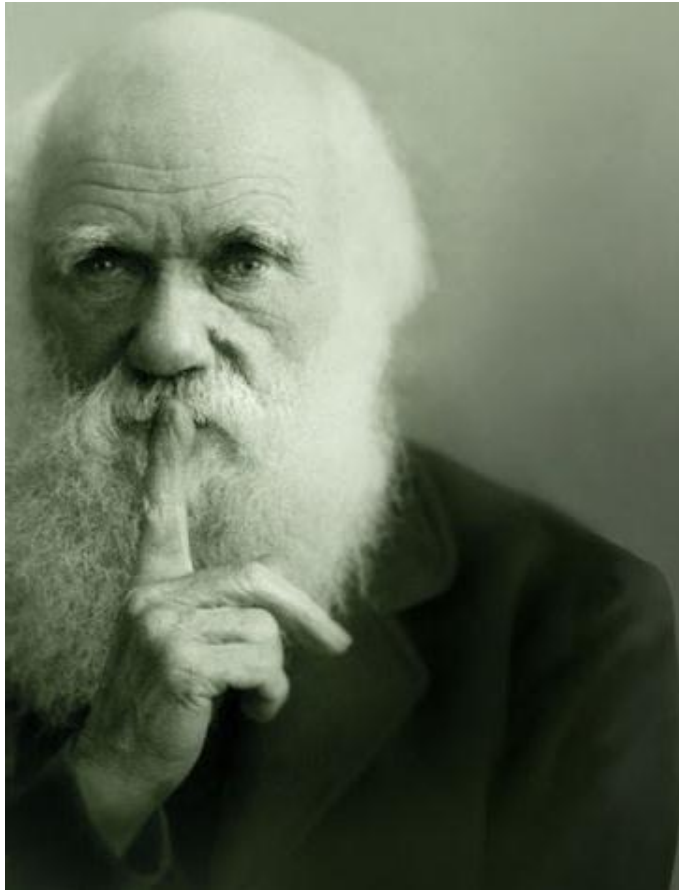
Having a well defined plan for managing organisational change, as well as the questions and concerns of the existing workforce, is crucial.



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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