

ALTA 2015 Free Paper

PROCEEDINGS

Nickel-Cobalt-Copper Conference

Sponsored by



4th Annual Nickel-Cobalt-Copper Event

A faint, light-colored world map is visible in the background of the lower half of the page, centered behind the event details.

ALTA 2013

25 May - 1 June

Perth, Western Australia

Melbourne, Australia

www.altamet.com.au

PROCEEDINGS OF ALTA 2013 NICKEL-COBALT-COPPER SESSIONS

27-29 May 2013

Perth, Australia

ISBN: 978-0-9871262-6-9

ALTA Metallurgical Services Publications

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ALTA Metallurgical Services was established by metallurgical consultant Alan Taylor in Melbourne, Australia in 1985, to serve the worldwide mining, minerals and metallurgical industries.

Conferences: ALTA convenes international technical conferences, trade exhibitions and technical short-courses. The event is held annually in Perth, Australia. The event comprises three conferences over five days: Nickel-Cobalt-Copper, Uranium-REE and Gold. ALTA conferences and exhibitions have become established as major events on the international industry calendar.

Publications: Sales of proceedings and manuals from ALTA Conferences, Seminars and Short Courses.

Short Courses: Technical Short Courses are presented by Alan Taylor, Managing Director and Conference Convener.

Consulting: High level metallurgical and project development consulting, short courses & seminars.



Nickel-Cobalt-Copper Proceedings

ALTA 2013 Opening Address

INNOVATION IN MINERAL PROCESSING: WHERE ARE WE HEADED?

By

Jonathan Law
CSIRO Minerals Down Under Flagship

Presenter and Corresponding Author

Jonathan Law
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Acknowledgements: sources of referenced information...

1. Trends in the Mining and Minerals Industry, International Council on Mining and Metals, 2012. The report is available at www.icmm.com
2. Tracking the trends, Deloitte, 2012. The report is available at www.deloitte.com
3. Tracking the trends, Deloitte, 2013. The report is available at www.deloitte.com
4. Opportunity at risk, Port Jackson Partners, 2012. The report is available at www.minerals.org.au
5. Charts from Gold Fields Mineral Services (GFMS). These charts are available at www.gfms.co.uk
6. Critical materials summary, US Department of Energy, 2011. The report is available at www.energy.gov
7. Metal Recycling Rates, United Nations Environment Programme, 2011. The report is available at www.unep.org
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10. Quarterly Economic Brief, Minerals Council of Australia, 2013. The report is available at www.minerals.org.au

National Research Flagships



BIOSECURITY



CLIMATE ADAPTATION



DIGITAL PRODUCTIVITY
AND SERVICES



ENERGY TRANSFORMED



FOOD FUTURES



FUTURE MANUFACTURING



MINERALS DOWN UNDER



PREVENTATIVE HEALTH



SUSTAINABLE AGRICULTURE



WATER FOR A
HEALTHY COUNTRY



WEALTH FROM OCEANS

Ensuring the longevity of Australian industry

Global challenges require innovative solutions

CHALLENGES

Environmental performance

Declining discovery rates

Declining ore grades

Increasing production costs

Working in deeper mining environments

Global skills shortage

CREATING SOLUTIONS THROUGH

Collaborating with the best

Working globally

Creating links between research, industry
and the community

Our goals

Creating positive impact in three key areas



Growing Australia's
resource base



Increasing productivity



Reducing environmental
footprint

iron | copper | nickel | lead | zinc | uranium | gold | aluminium | magnesium

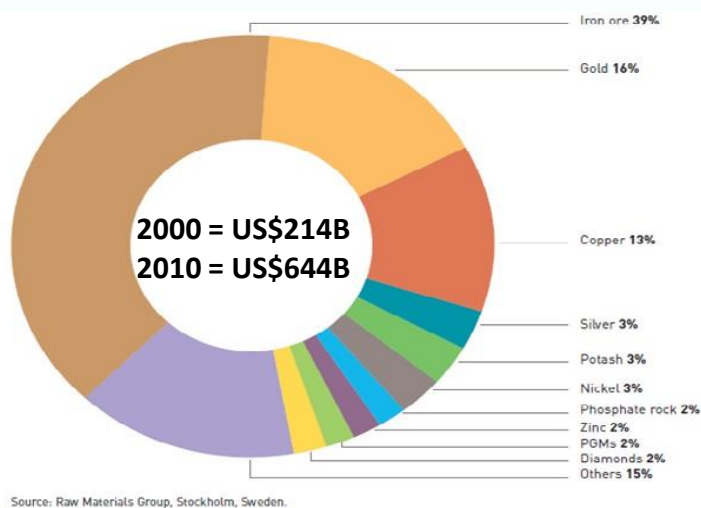
Innovation through partnership



Book available
from the author

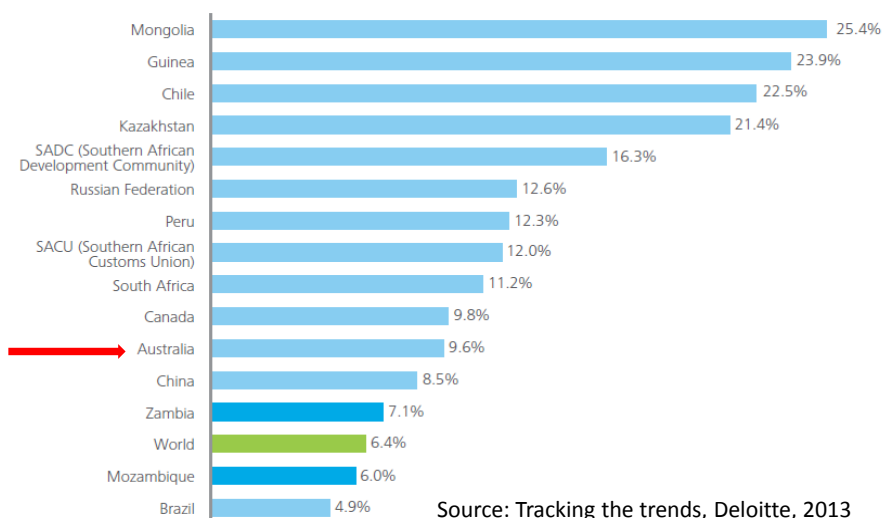
An industry perspective

Global metal production, 2011



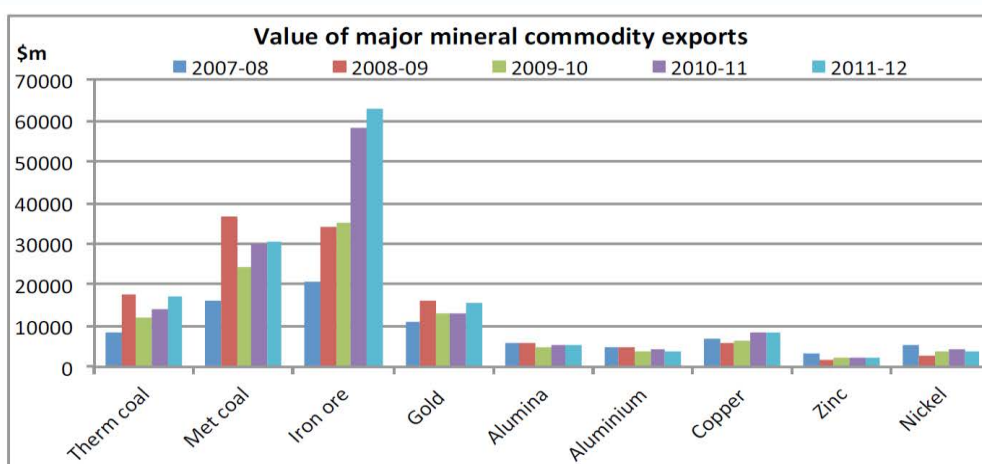
Source: Trends in the Mining and Metal Industry, ICMM, 2011

Mining contribution to National GDP



Source: Tracking the trends, Deloitte, 2013

Australia's 5 year evolution...



Source: BREE

Source: Quarterly Economic Brief, Minerals Council of Australia, 2013

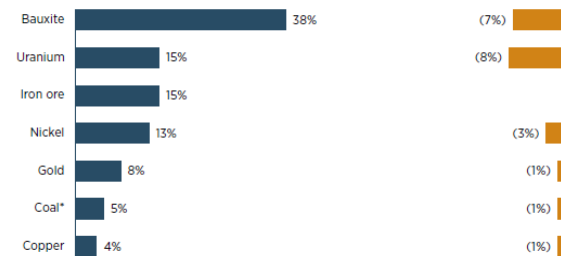
Australia's share of commodities

Australia's Market Share of Global Production

Change in market share, percent of world production

1960 to 2000 – substantial share gains

2000 to 2010 – share loss or stagnation



* Includes bituminous and anthracite, lignite and brown coal

Source: US Geological Survey Minerals Yearbook; British Geological Survey World Minerals Statistics; BP Statistical Review of World Energy; ABARE

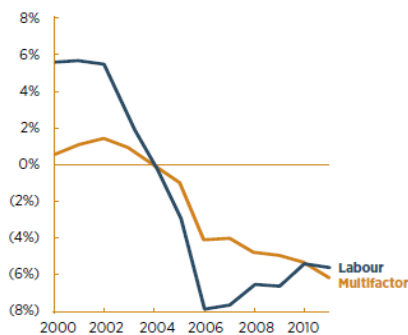
Source: Port Jackson Partners, 2012

Australian mining competitiveness

Australia's Mining Productivity

Productivity growth

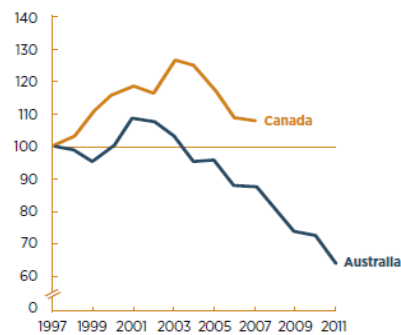
Percent, rolling five year CAGR



Source: ABS; CSLS

Multifactor productivity index

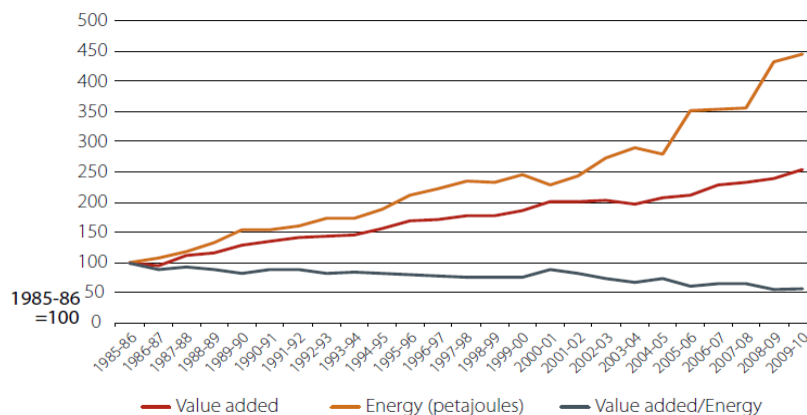
Index, 1997 = 100



Source: Port Jackson Partners, 2012

Mining value added for energy consumed declines

Figure 4-1: Index of mining value added, energy use, and energy productivity, 1986-2010



Source: ABS (cat 5204, 2012a) and BREE (AES, various years)

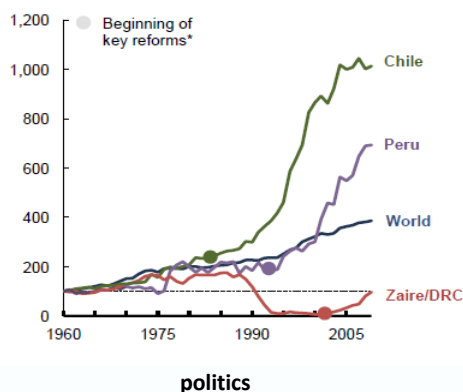
Source: Port Jackson Partners, 2012

International competition...

PROLIFERATION OF COMPETITORS

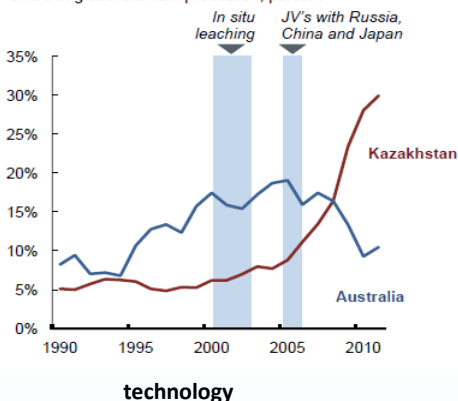
Improving investment attractiveness...

Copper production index, 1960 = 100



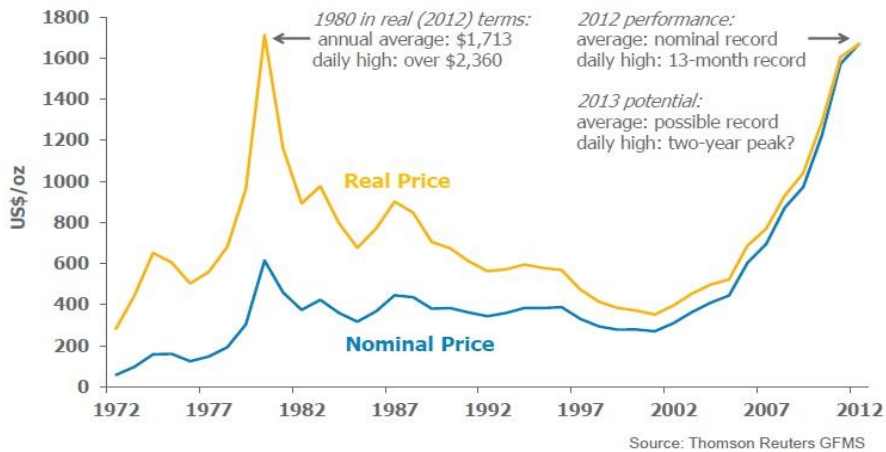
...is combining with new technologies and investors

Share of global uranium production, percent



Source: Port Jackson Partners, 2012

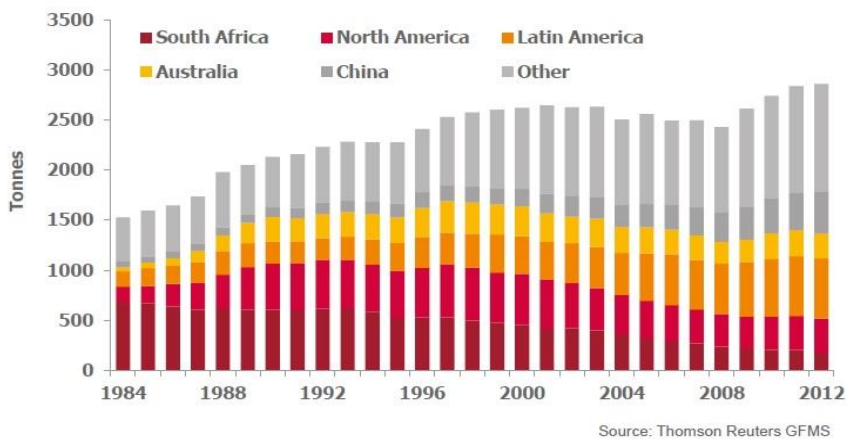
REAL AND NOMINAL GOLD PRICES (REAL US\$ PRICE IN CONSTANT 2012 TERMS)



GFMS

THOMSON REUTERS

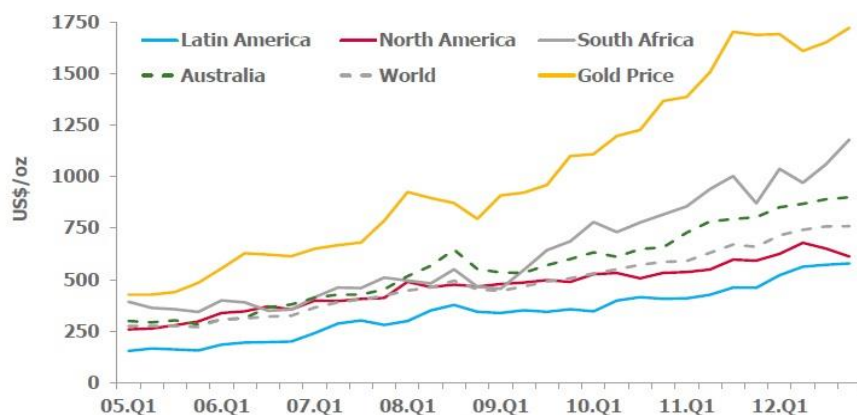
WORLD MINE PRODUCTION



GFMS

THOMSON REUTERS

COMPANY REPORTED QUARTERLY TOTAL CASH COSTS (IN MONEY-OF-THE-DAY TERMS)

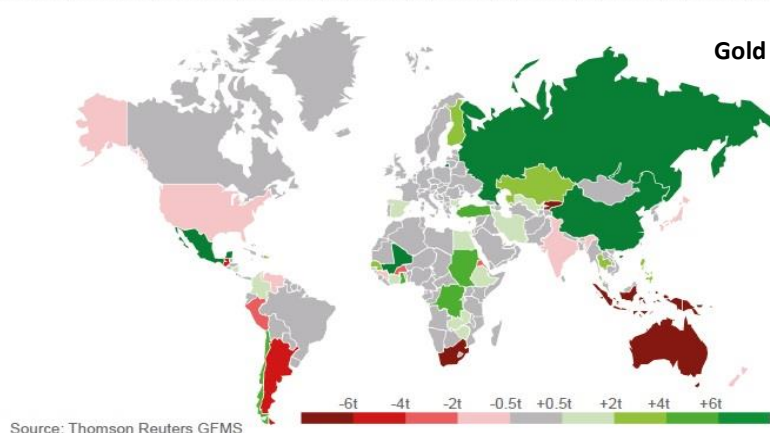


Source: Thomson Reuters GFMS

GFMS



MINE PRODUCTION: WINNERS AND LOSERS 2012 VERSUS 2011

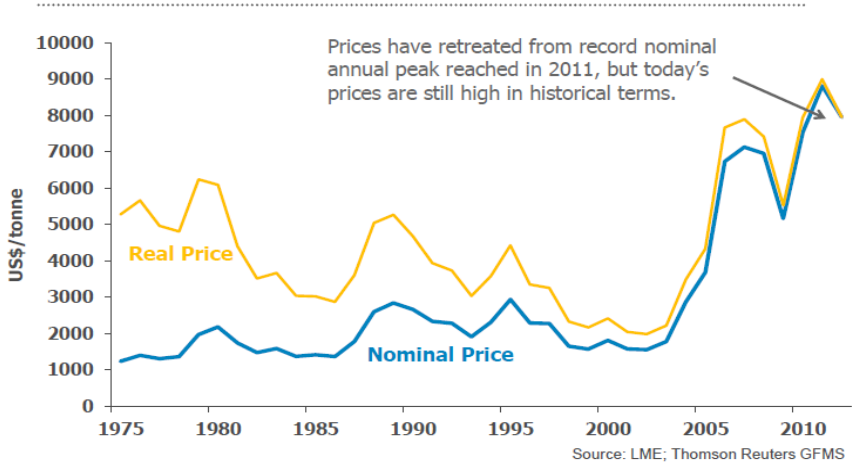


Source: Thomson Reuters GFMS

GFMS



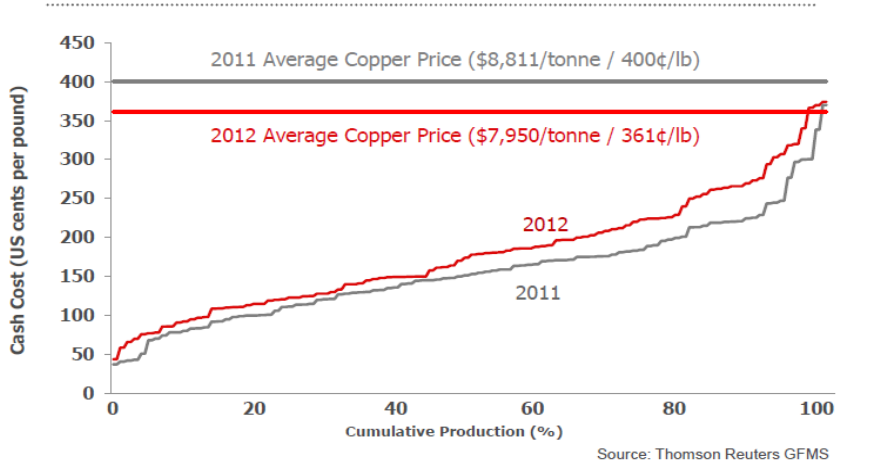
REAL AND NOMINAL COPPER PRICES (REAL US\$ PRICE IN CONSTANT 2012 TERMS)



GFMS



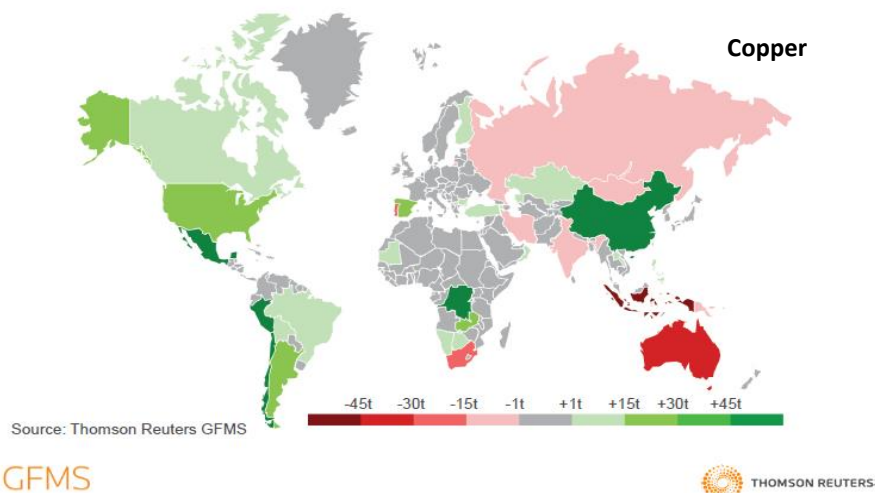
WORLD MINE PRODUCTION CASH COSTS



GFMS



MINE PRODUCTION: WINNERS AND LOSERS 2012 VERSUS 2011



It's not raining;
it's pouring

Deloitte.

It could be argued that the burning issues facing the mining industry tend to remain largely unchanged over time. While this may be factually correct, it fails to take into account the extent to which shifting social, economic and political trends affect the mining sector. Looked at in isolation, each challenge may seem familiar. Looked at through a macroeconomic and geopolitical lens, however, it becomes clear that the difficulties afflicting the industry are rapidly reaching an unprecedented level of extremity.

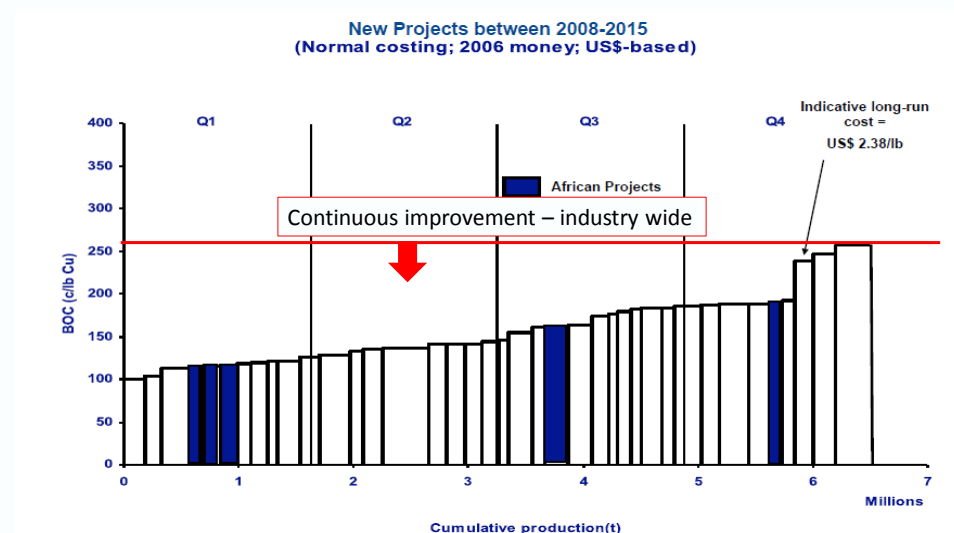
Source: Tracking the trends, Deloitte, 2012

2 Tracking the trends 2012

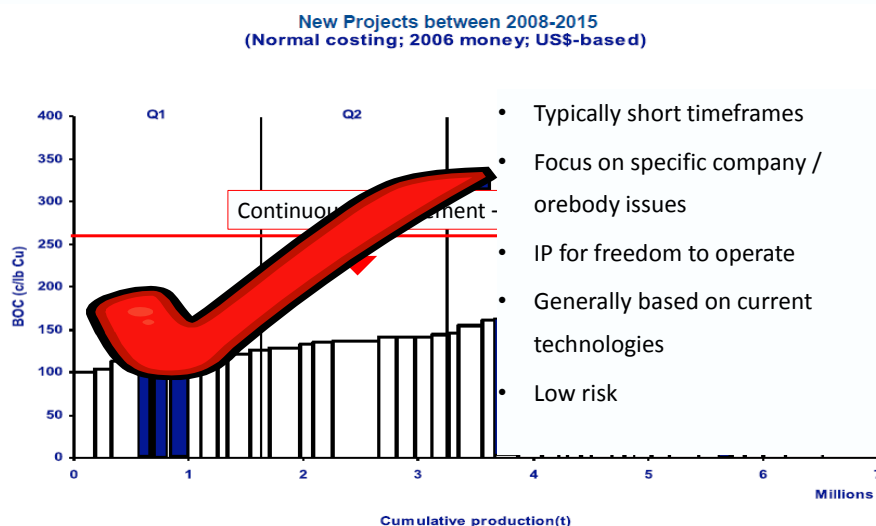
There are many pressures to innovate:

3 scenarios – a cost based approach

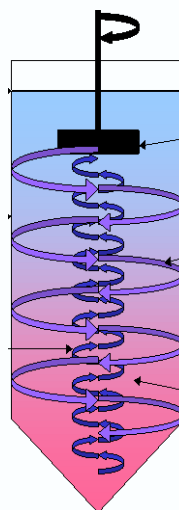
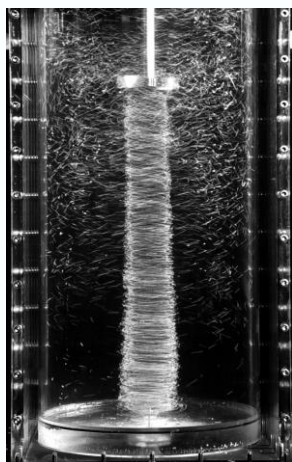
1. Continuous improvement: remove roadblocks



1. Continuous improvement: remove roadblocks

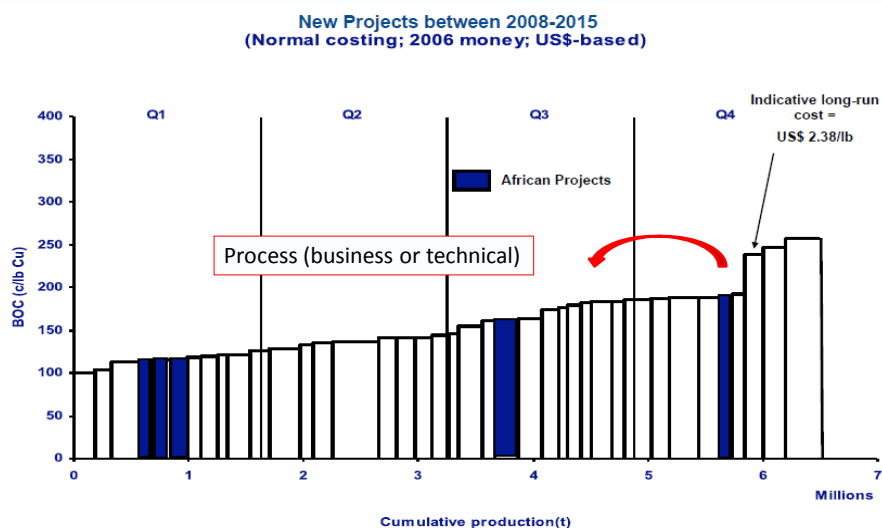


Swirl Flow Technology

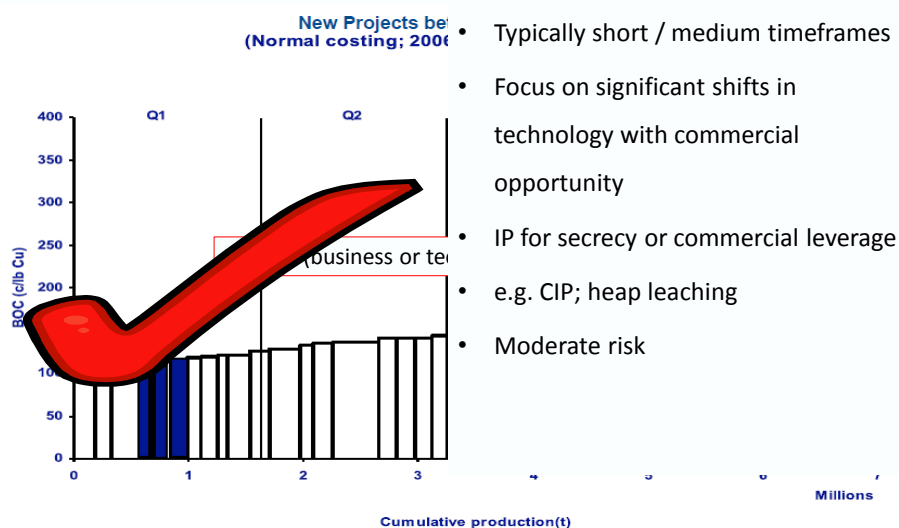


Developed jointly by CSIRO/Queensland Alumina Ltd

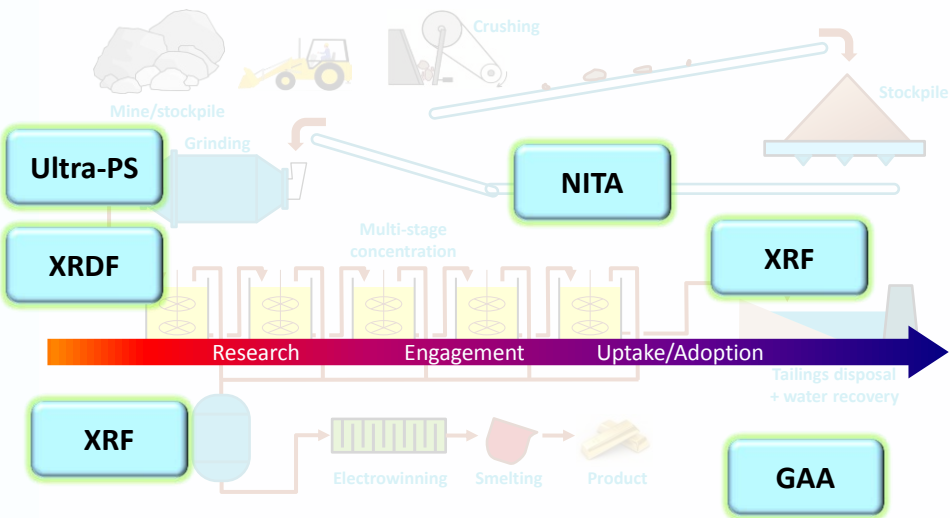
2. Process innovation: change what we do



2. Process innovation: change what we do

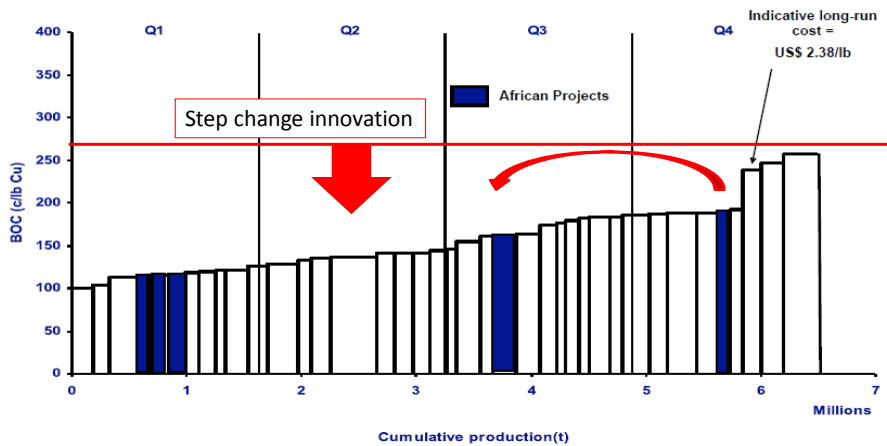


Technology platforms

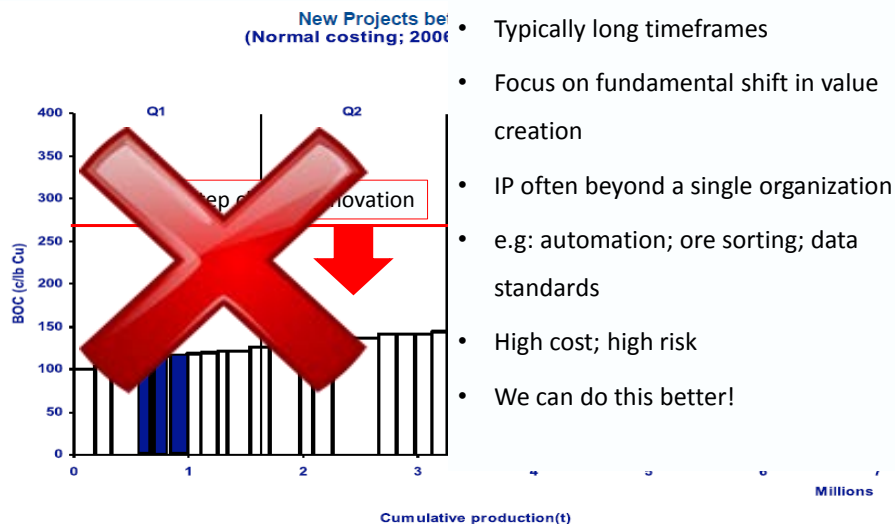


3. Step change innovation: transformational technologies

New Projects between 2008-2015
(Normal costing; 2006 money; US\$-based)



3. Step change innovation: transformational technologies



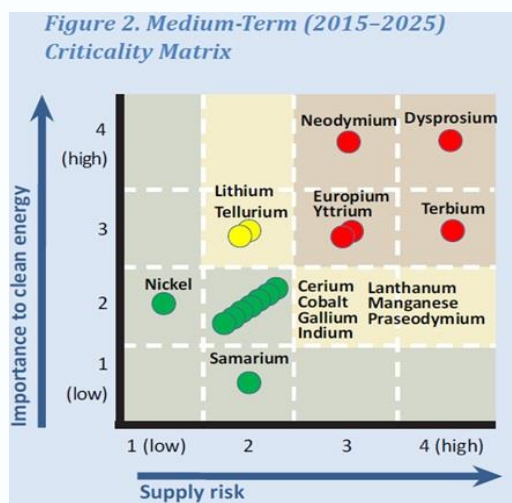
Nickel laterite processing without sulfuric acid

- Potential to make millions of tonnes of nickel laterites economically viable
- Uses nitric acid instead of sulfuric acid in processing
- Able to recycle 95% of nitric acid, reducing waste and avoiding costly neutralisation of acid
- Improved environmental performance
- More cost effective
- Collaboration with Direct Nickel



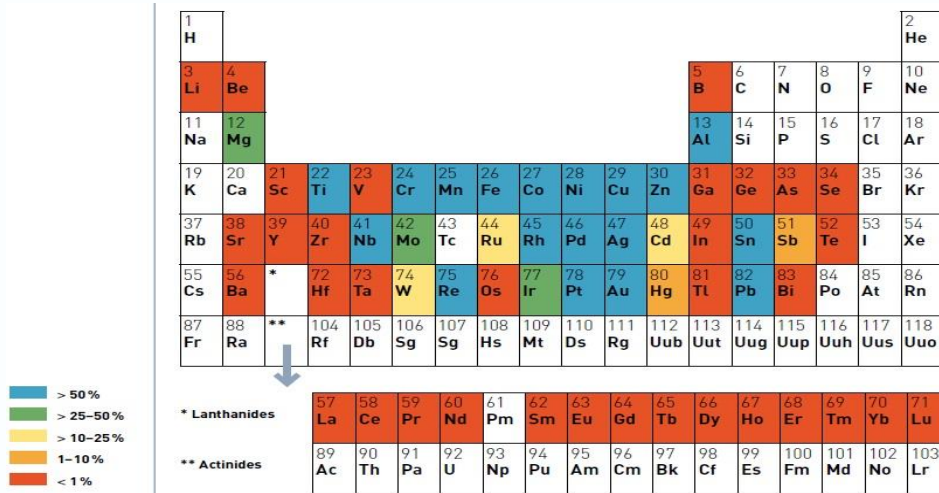
New emerging opportunities

Strategic metals – energy perspective...



Source: Critical materials summary (US Department of Energy, 2011)

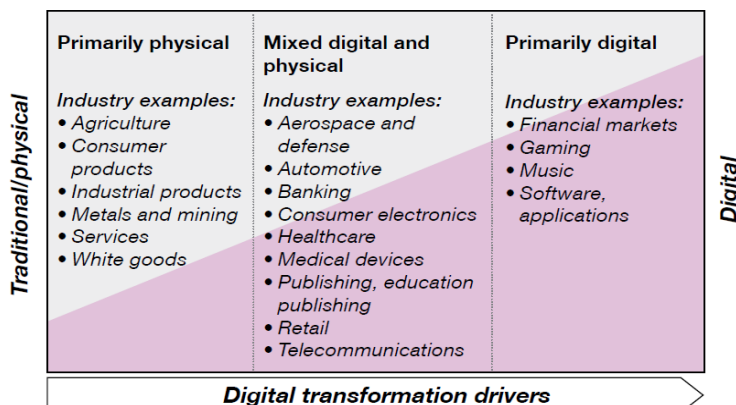
End of life functional recycling



Source: Metal Recycling Rates (UNEP, 2011)

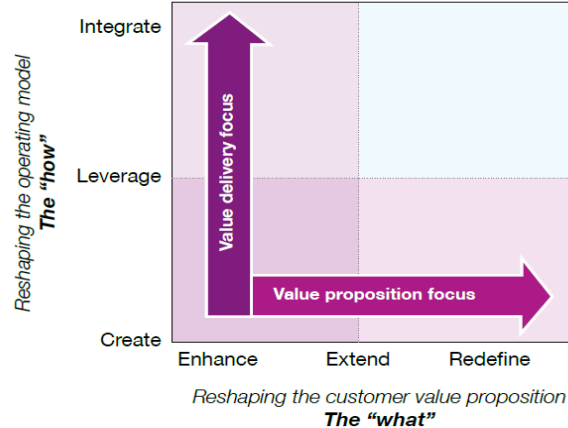
Real meets virtual!

Degree of product and service digitization



Source: IBM Institute for Business Value analysis.
Source: Digital transformation, IBM, 2011

Elements of digital transformation



Source: IBM Institute for Business Value analysis.
Source: Digital transformation, IBM, 2011

Skills and opportunities

Business model innovation	Building customer value as a core competency across industry, revenue and enterprise models
Customer and community collaboration	Driving customer centricity into each part of the enterprise and using social networking tools and capabilities to engage
Cross-channel integration	Integrating all customer touch-points across digital and physical channels
Insights from analytics	Integrating information across all sources (internal, external) and taking full advantage of the predictive power of advanced analytics
Digitally enabled supply chain	Optimizing all supply chain elements, effectively integrating cross enterprise
Networked workforce	Getting the right skills aligned around the right business opportunities

Source: IBM Institute for Business Value analysis.
Source: Digital transformation, IBM, 2011

Challenges for transformational innovation

Inertia...



A happy man is too satisfied with the present to dwell too much on the future.

Albert Einstein

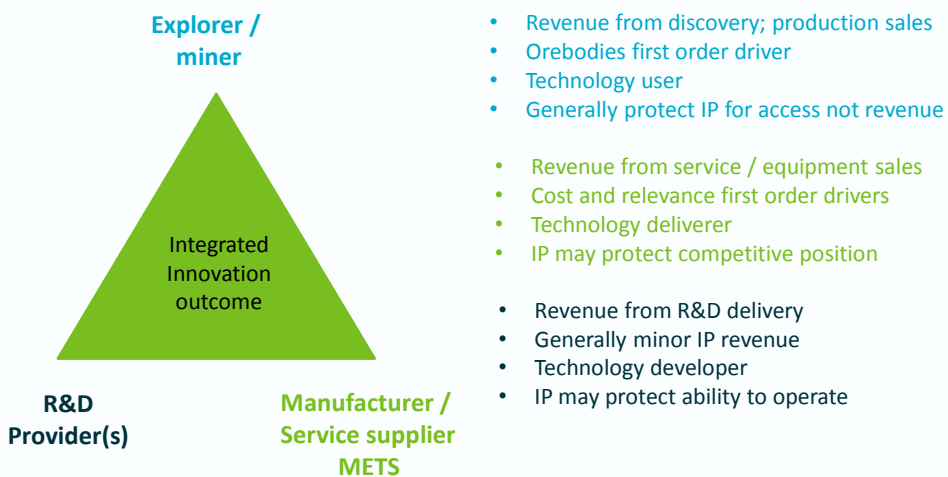
Photo: Wikipedia

Barriers to “step change” innovation

- Cohesive long term funding
- Complex nature of challenges
 - No common ‘sense of purpose’
- Fragmented IP position
- Complex leverage with ‘strings attached’
- Fragmented research, production and METS sectors

Role of collaboration

Collaborative innovation



But if we share, how do we compete?

- Inherent characteristics of resource base (#1 by far)
 - Company view
 - National view
- Competitive **application** of technology rather than competitive **protection** of technology
- Specialist products and services to an integrated system
- Those who participate (and share the risk) benefit first
- Global market freedom over time