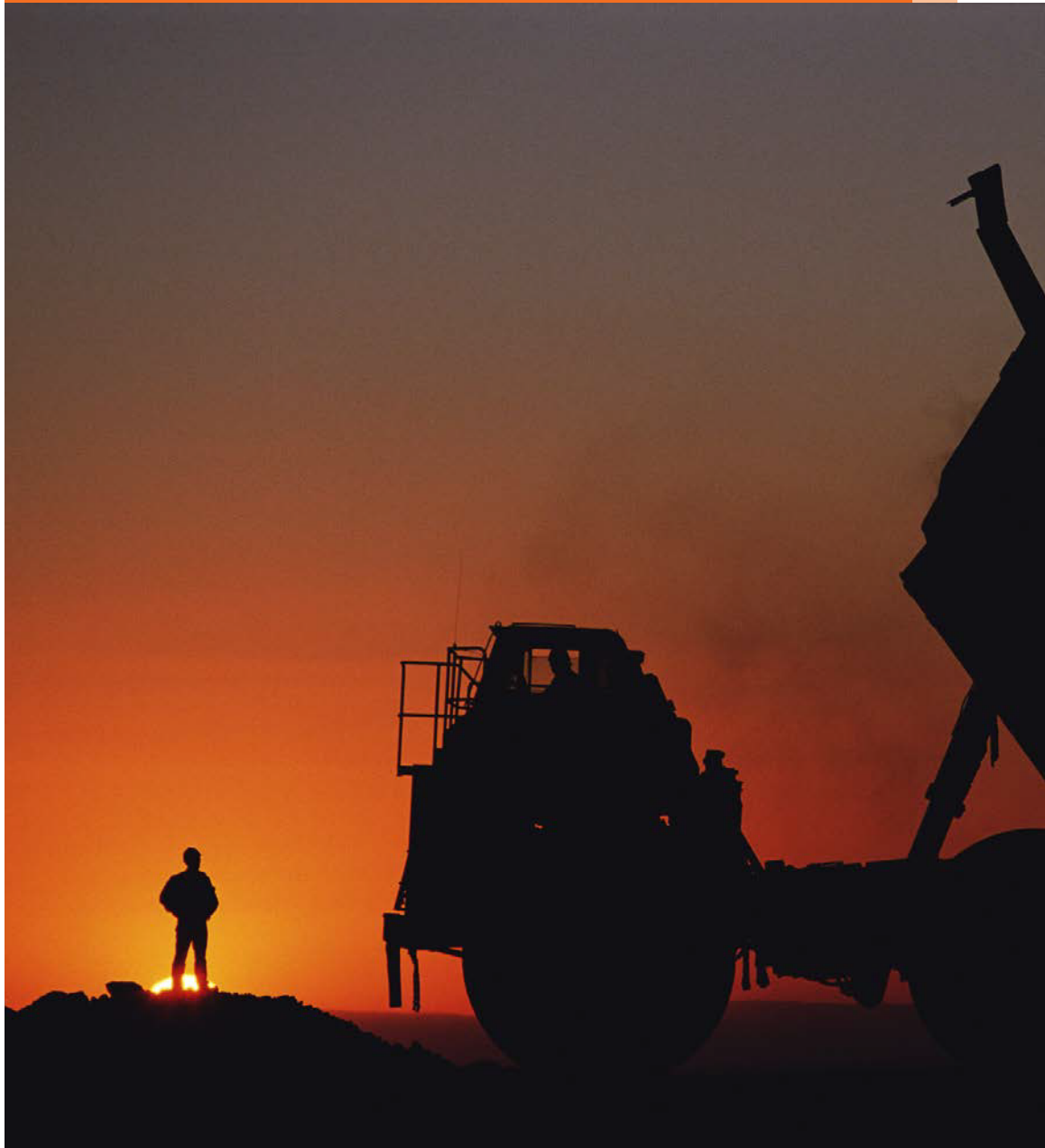


# *Investment appraisal of mining capital projects*

*Pedro Bueno Da Silva  
Brian Gillespie  
Fabio Buckeridge*

*July 2012*



# Contents

<i>Introduction</i>	01
<i>The case for global portfolio optimisation</i>	02
<i>Linking growth plans to strategy</i>	03
<i>Phased project planning</i>	04
<i>Identifying investment alternatives</i>	05
<i>Selecting the investment alternatives</i>	06
<i>Bringing it all together</i>	07
<i>Integrating risk and uncertainty</i>	09
<i>Maintaining the rigour in boom times</i>	10
<i>Conclusion</i>	11
<i>Mining Excellence@PwC</i>	12

---

# Introduction

The level of growth in the mining industry correlates strongly with the growth of the broader global economy although with a noticeable lag in time. The globalisation of commodity markets now drives the approach to investment appraisal of major capital projects.

Advancements in trade agreements, information systems, mining technology and human capital exchange are assisting mining companies of all sizes to diversify into an increasing range of countries and territories.

Operating a global asset portfolio requires continual effort to be expended on portfolio optimisation. This is at its most complicated when considering major capital projects situated across both developed and developing nations.



# The case for global portfolio optimisation



It is likely that the highest proportion of capital investments over the next two decades will be in rapidly developing territories such as Latin America, Western and Central Africa, China and countries that were formerly part of the Soviet Union. Many companies will enter into unfamiliar areas of the world resulting in increasingly diverse asset portfolios.

Sovereign risk metrics are now a common input to financial models alongside currency hedges and infrastructure costs. In theory, this should allow a potential project in Mozambique to be easily compared to another in Australia and yet another in Brazil. In practice, such comparisons are often made using a number of qualitative assessments.

The aim of the top tier global resource sector companies is to manage a robust portfolio focused on the long term growth plan but can also deal with the changes in local operating conditions and global market movements. In this way an organisation should hope to have a portfolio with strong alignment to both their long term growth plan and shorter term financial and operational objectives.

At the highest level, asset portfolios should maintain an A grade credit rating and deliver a steady dividend stream to shareholders.

However many organisations can compromise their long term growth plans by adopting a singular appraisal approach to each project under consideration.

A singular approach, no matter how robust, has the potential to knock out high potential value at many stages in the investment review lifecycle. In the current environment, it is common that shortages of qualified labour, long lead times for specialist equipment delivery and high sovereign risk factors can all sink a project with an otherwise attractive value. This is particularly sub optimal when an organisation seeks to maintain as much flexibility as possible across its growth portfolio while understanding and managing the aggregate demands on working capital.

Many organisations remain at a modest stage of maturity in terms of how they evaluate investment alternatives, prioritise their capital allocation and measure the overall position of their portfolios.

There are many potential consequences of poor portfolio optimisation:

- Misalignment of stakeholders' expectations of risk profile
- Misalignment of shareholders' expected return on equity investment
- Poor long term working capital forecasts leading to credit downgrades or lumpy dividend streams.

The principle reason why some companies are consistently successful in portfolio management of capital projects is due to their strict adherence to a standard appraisal methodology.

# Linking growth plans to strategy



Establishing the link between the strategic objectives of a company and the portfolio growth plan provides the shareholders and the market with a fuller explanation of the direction of that organisation. Most top tier mining companies have clearly stated strategic objectives. In BHP Billiton's case; two key goals are to own a portfolio of assets that have diversity across markets, commodities and geography and that are long life, large, low cost, expandable and upstream. These are the strategic objectives that shape the growth plan of new capital projects.

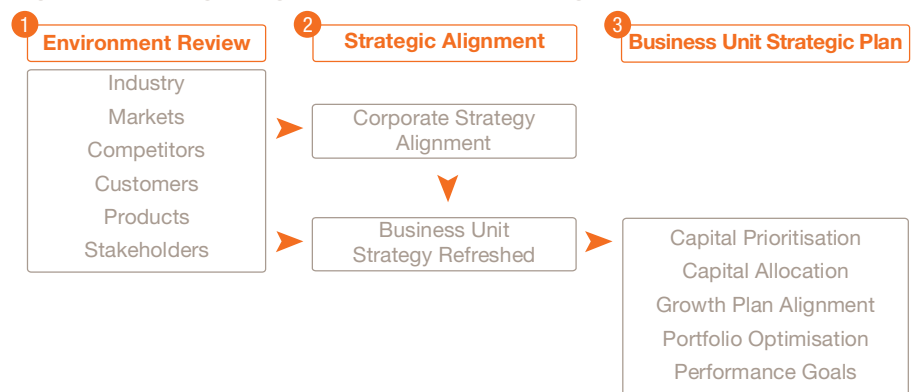
Rio Tinto has also demonstrated a strategic focus on transforming their capital portfolio of projects through a disciplined portfolio management approach with a focus on high return production creep and modernisation projects while delivering cost and productivity improvements.

This focused strategy aims to reshape the portfolio of projects resulting in efficient operations, reduced carbon footprint, and modern, large scale, long life assets in the first and second quartile on the industry cost curve

For a large global company operating without a clearly articulated growth plan, there is considerable opportunity for wasted effort as individual business units pursue potential projects that are not consistent with the growth plan. Seemingly attractive projects at the business unit level can waste tens of millions of investment dollars in feasibility studies due to a lack of visibility or clarity of the corporate growth plan.

Alignment can also provide subsidiaries with a unified corporate objective and focus. The integration between head office strategy and subsidiaries' strategies is critical to align portfolio development with long term expectations of shareholders. This is a common point highlighted by CFOs of global mining companies.

Figure 1: Strategic alignment of business unit growth plans



# Phased project planning



Mining companies must have strong frameworks in place for the evaluation and prioritisation of their portfolio investment alternatives.

A structured approach to assessing individual projects is the first step to ensure rigorous evaluation with investment decisions made on sound financial, social, environmental and sustainable development analysis.

In Rio Tinto's case, the focus is on the highest quality options through a disciplined capital phased approval process while allocating cash for investment through each investment cycle.

A 'stage gate' or 'toll gate' is the entry or approval point for the next project evaluation stage. Varying degrees of rigour are required depending on the level of capital under consideration. For most major mining companies, formal toll gating is required for all major capital projects although the definition of a major capital project itself does vary. Typically though, any project requiring upwards of \$500million investment would be considered a major capital project by all top tier mining companies.

A key component of stage gating is to clearly assign accountabilities at each stage. It is a formal process that ensures all stakeholders clearly understand the impact of approving funds and resources to the next evaluation stage, and ultimately, the project.

Figure 2: Stage gating terminology used by major mining companies

Anglo Coal Xstrata Coal Vale	Concept	Pre-feasibility	Feasibility	Implementation
Rio Tinto	Order of magnitude	Pre-feasibility	Detailed feasibility	Implementation
Peabody	Concept	Front End Engineering	Detailed Design	Construction
BHP Billiton	Identification	Selection	Definition	Implementation

## Methodical and phased approach:

- Establish a formal approach to portfolio optimisation based on consistency and a strong structure
- Identify and assess the key portfolio risks as part of the stage gate process
- Communicate the strategic objective of each stage to all individuals involved
- Assign clear accountabilities to key stakeholders.

# Identifying investment alternatives



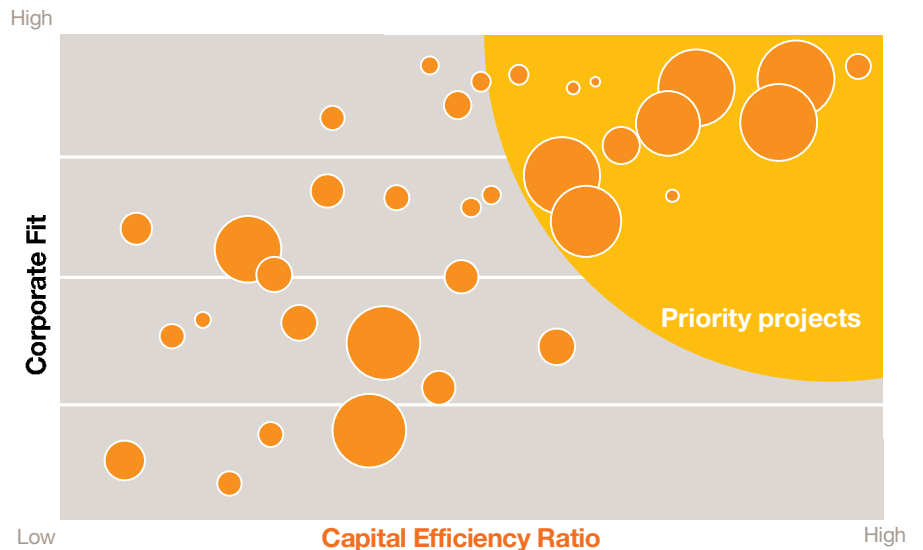
Prior to any portfolio consideration, potential projects should be considered for basic financial feasibility.

A portfolio approach at a minimum should rank projects on such metrics as NPV, IRR and Capital Efficiency Ratio. Good methodologies will also include key indicators such as cost curve percentile, margin curve percentile, future option value and a metric representing some internal measure of strategic fit. The best methodologies will also identify and quantify key enablers or the drivers of cost and margin.

Most major organisations will at this point also evaluate the likely project position on relevant industry cost and margin curves. Best practice organisations will go one step further and evaluate project risk, strategic fit and any major dependencies such as enabling infrastructure. As an example, BHP which has the biggest global pipeline of capital projects, considers all these factors when undertaking initial project evaluation.

This initial project evaluation should give a strong picture of the robustness of the project as a stand-alone proposition with the only portfolio assumptions at this stage being the delivery of any other major projects deemed as critical enablers.

Figure 3: Ranking and prioritising future growth options for further study based on strategy, value and dependencies



# Selecting the investment alternatives



Major mining companies use a variety of decision rules such as benchmarking and option analysis when analysing capital investment. Best practice requires the early development of a comprehensive study with option analysis that can be carried through to the execution stage with modification as required.

Interactive workshops with operational and business unit stakeholders at the early stages of options development is a practical starting point to develop a realistic set of opportunities and choices for any particular investment.

Framing investment alternatives at an early stage is designed to highlight the following :

- How might the alternatives affect the portfolio?
- Which alternatives do we really need to approve?

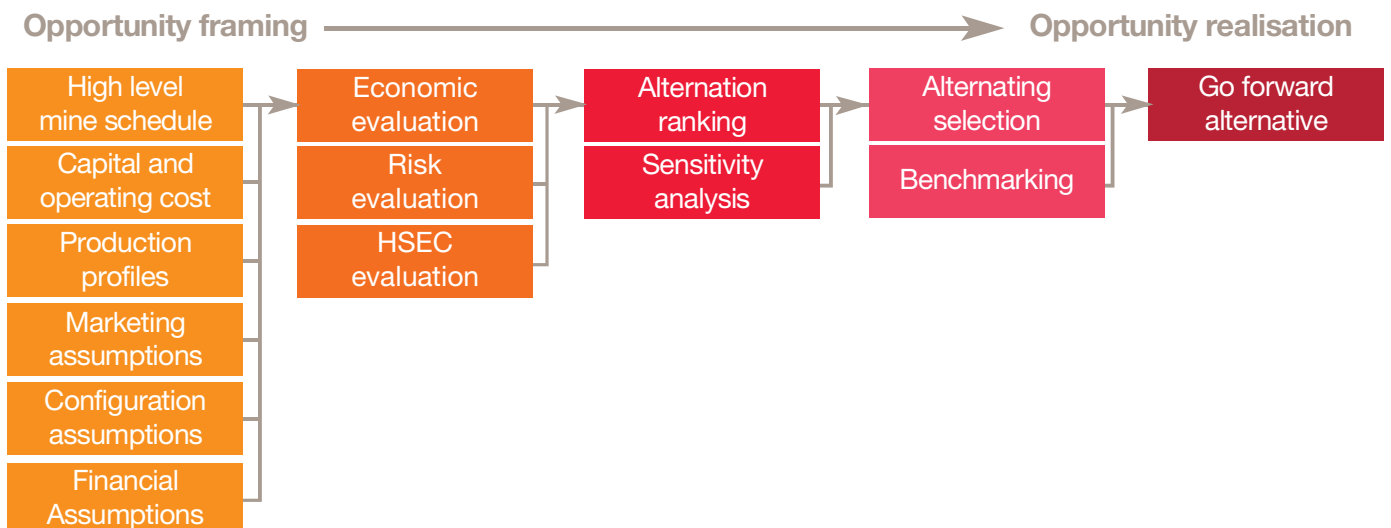
- What are the capital requirements?
- What is the impact on logistics, such as rail and port capacities?
- What is the potential incremental value?
- What major site infrastructure will be required?
- What type of workforce will be required?

This evaluation process should become a structured approach to deducing and quantifying the most noteworthy matters related to the investment case and should provide a logical path to arriving at the most attractive options. It should also enable the full array of possible risks and constraints to be identified, from localised operational matters to changes in the global market environment.

A key tenet in this analytical progression is that investment alternatives are aligned with the growth plan and the strategic goals of the company.

This process ensures a robust consensus of the alternatives reducing the likelihood of costly and time-consuming rework.

Figure 4: Framing the opportunity encourages creative thinking to capture all strategic drivers and objectives to select a preferred option





# Bringing it all together

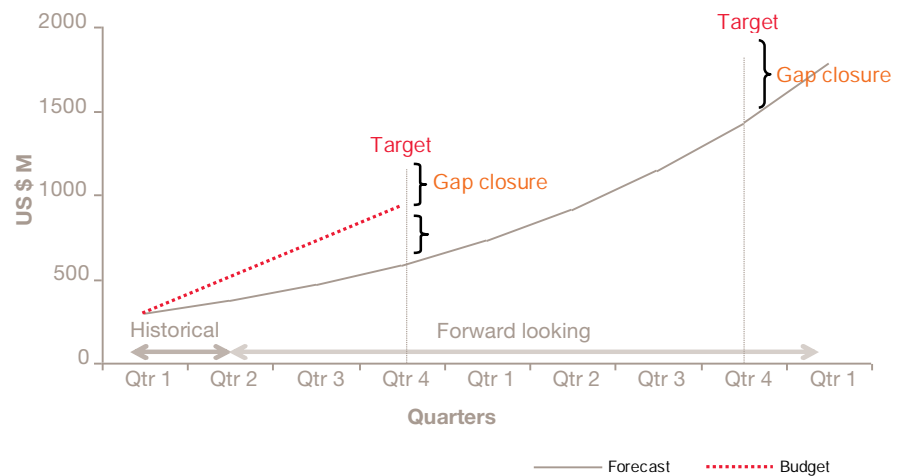


Optimising a portfolio requires an organisation to maintain alignment to business objectives and ensure projects are still integrated with the growth plan.

Strong portfolios tend to have regular independent reviews across the portfolio. It is critical that key stakeholders are well informed on the progress of all projects at all times.

Project sponsors must be able to effectively report any deviations or changes to project scope to senior stakeholders. In the event of adjustments arising in the execution phases, there should be a defined process to rigorously manage these changes. This process should incorporate analysis of both direct and indirect impacts on the outcome of the project and on the optimisation of the portfolio.

Figure 5: Portfolio management focuses attention on closing the gap between anticipated performance and strategic goals



In 2010, the PwC global review of mining trends found that over the past decade, only 2.5% of major capital projects in the mining sector were successfully achieved across the critical dimensions of schedule, cost, scope, and business benefits.

A portfolio model ought to be able to integrate all pre-selected investment alternatives and future value options.

It is therefore critical that all stakeholders understand the intricacies of portfolio optimisation. The best way to speed up an investment is to front end load as much of the feasibility study as possible and effectively plan the concept and feasibility phases. This makes it easier to ensure that the project will fit with the portfolio, particularly from a timing perspective around capex requirements.

Once a robust identification process has been put in place and the investment alternatives are narrowed, stakeholders must then measure and rank all reasonable value creating options.

This process should be followed by a ranking procedure, evaluating projects based on the pre-established KPIs that are aligned to corporate strategy such as NPV, IRR, Capital Efficiency Ratio, operational drivers, cost curve percentile, margin curve percentile and strategic fit.

A portfolio model should integrate all pre-selected investment alternatives and future value options, ranking projects by their respective return rates. Amalgamated dashboards can be used to summarise the entire value of the portfolio and highlight further constraints.

Figure 6: New approaches to portfolio management are essential if returns are to be maintained

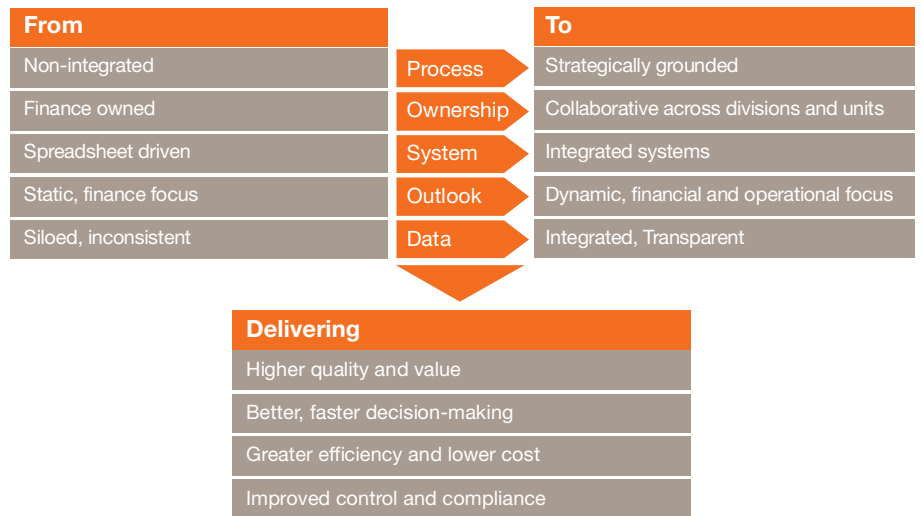
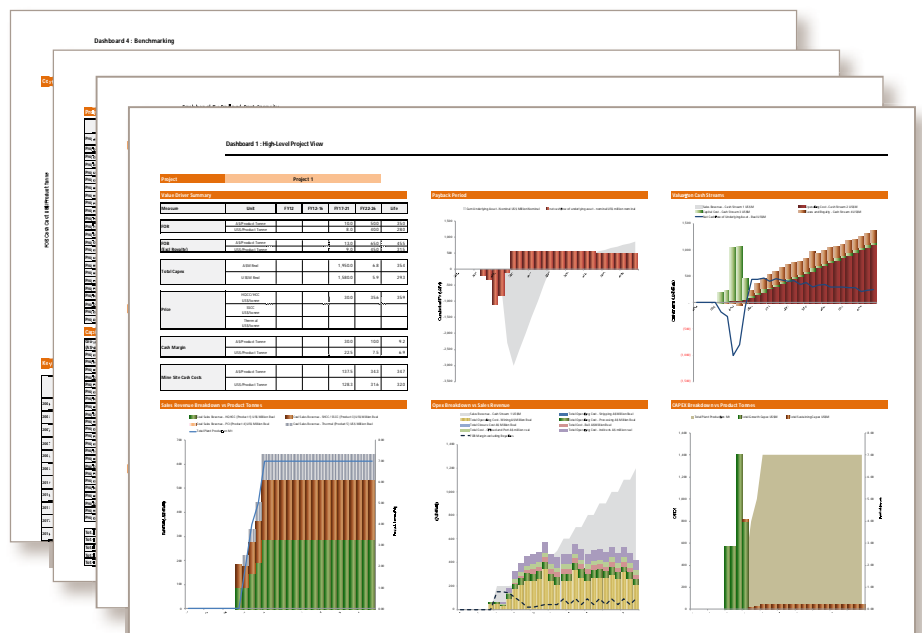


Figure 7: A holistic portfolio model enables project ranking, prioritisation, internal and external benchmarking and links to potential infrastructure bottlenecks



# Integrating risk and uncertainty

A number of risk management activities should occur at each stage of project evaluation:

- Enhancing the consideration and quantification of risk into standard commercial project evaluation methodologies (NPV, IRR, etc.)
- Identifying project options and impact on project design and value
- Reviewing uncertainty around project delivery parameters
- Review of OH&S compliance parameters and KPIs
- Sovereign risk from changes to tax, royalties or environmental law.

As projects become comparable on a time and value basis, the risk component must also be incorporated into the ranking process. At this stage, analysts should undertake detailed reviews of any portfolio risks.

Key risks for mining capital projects:

- Change in project scope
- Poor project cost estimations
- Undisciplined project management approaches
- Unrealistic availability estimates for labour, equipment and materials
- Poor understanding of projects, and interdependencies
- Lack of independent review, assessment and reporting.

It is important that all stakeholders understand the possible challenges, risks and potential returns across the selection of investments.

Key benefits of early formal risk management are:

- Established contingency and mitigation strategy
- Established risk distribution modelling
- Increased stakeholder awareness of “unknowns”.

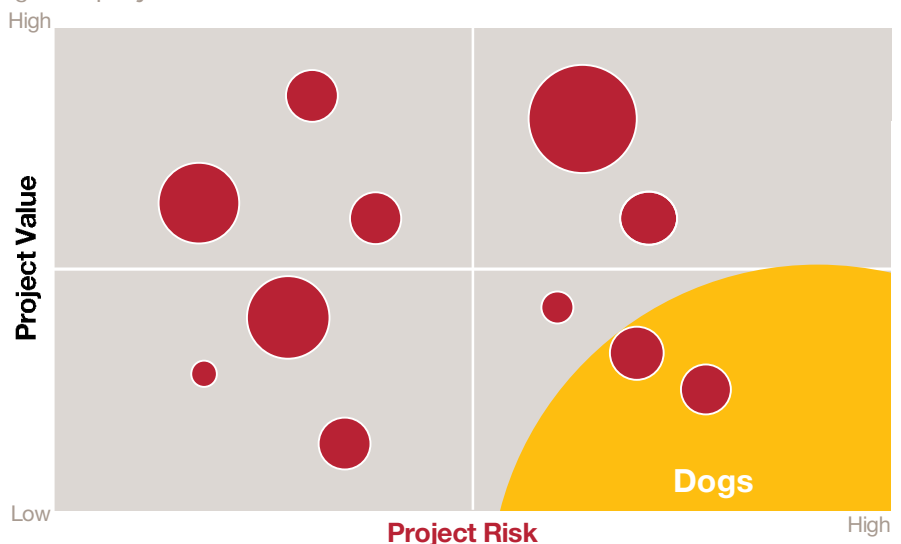
Risk workshops should also be undertaken to challenge and discuss the magnitude or materiality of the impact of the identified risks to the portfolio. These workshops should be attended by both project members and independent assessors. An integrated risk register must be maintained and updated with mitigating actions across the portfolio.

At both BHP Billiton and Anglo American, risk and project evaluation practitioners work closely together using a number of problem-framing techniques, including workshops and strategy table discussions.

***“Once projects have undertaken a rigorous process of analysis and review, it is vital for a portfolio to highlight the connection between risk and return on investment”***

Mike Allen, General Manager Infrastructure Strategy, Anglo American

**Figure 8: An ongoing process of identification and mitigation of risks against project value**



# Maintaining the rigour in boom times



During commodity price booms or at times of optimism around global growth, it is tempting for even the most stringent of companies to loosen their approach to the approval of major capital investment projects. Even if the basic rationale for the investment is economically sound, accelerated investment approval without robust analysis methods can result in significant delays and cost blowouts due to practical problems around scheduling and procurement.

For a company like BHP with an extensive number of major capital projects in selection, definition and execution, maintaining that rigour across all commodity cycles is vital.

In Rio Tinto's case the Project Development and Implementation (PDI) centralised group is responsible for partnering with Rio Tinto's product groups and business units to achieve repeatable success in delivering major capital projects. PDI consists of a Project Management Office (PMO) and Project Delivery Hubs. The PMO is responsible for developing, delivering, promoting and governing the standards and tools for projects. The Project Delivery Hubs are responsible for managing and delivering sustainable new business and assets for Rio Tinto. PDI manages capital projects on behalf of the business units.

Past experience has proven that the integration of the operating plan with the growth profile and execution of these large scale projects can be very complex when coordinating an investment with the portfolio of projects.

---

# Conclusion

The top tier global companies in the mining sector are all reasonably sophisticated around the investment evaluation and comparison of capital investment opportunities.

For many emerging companies venturing into new geographies, implementing a robust approach to investment analysis is vital to maintain a healthy growth portfolio of projects. Implementation and adherence of standard phased approach will help ensure continuous alignment with growth plans and allow easier comparison of significantly differing projects competing for the same capital.

This approach is most valuable when projects become comparable on a time and value basis and the many components of risk become the deciding factor when allocating capital.

It is most important during boom commodity cycles, when robust approaches to project appraisal capital allocation are often circumvented. Accelerated investment approval in such circumstances can lead to widely unbalanced portfolios even when each singular investment is sound.



---

## Acknowledgements

This paper has been developed following insights gained by PwC while working on major feasibility studies and operational improvement projects with Anglo American, BHP Billiton, Peabody, Xstrata Coal and Xstrata Copper.

Jason Economidis of BHP Billiton Mitsubishi Alliance, Mike Allen of Anglo American Metallurgical Coal and John Searls of Rio Tinto all took the time to provide us with the valuable insights to the realities of managing a portfolio of large capital projects. Our special thanks to BHP Billiton Mitsubishi Alliance and Anglo American, who have engaged us to assist in the ongoing evaluation and strategic development of major mining and infrastructure projects for their extended coal operations in Australia.

Thanks also to our PwC colleagues; Chris Sullivan, Edina Ente, and Gui Capper who worked with Pedro Bueno on the development of this publication and also contributed with many ideas contained in this paper.

## References

- PricewaterhouseCoopers, 2010. "Mine: Back to the Boom Review of global trends in the mining industry" Global Energy, Utilities and Mining.
- Fabio Buckeridge, Brian Gillespie and Stephen Loadsman, 2010. "Optimising Extended Mining Operations Through Value Driver Modelling".
- Anjuli Steffen, Jane Couchman and Brian Gillespie, 2008. "Avoiding cost blow-outs and lost time on mining capital projects through effective project stage gating".
- Krogh, G. and Cusumano, M. 2001. "Three Strategies for Managing Fast Growth" MIT Sloan Management Review.
- Khanna, T. 2010 "Vale: Global Expansion in the Challenging World of Mining". Harvard Business Review.
- Kloppers, M. 2012 "Presentation to Global Metals, Mining and Steel Conference, Miami, 15 May"
- Borensztein, E. and C.M. Reinhart, 1994. "The Macroeconomic Determinants of Commodity Prices," IMF Working Paper 94/9.
- Garnaut, R. and L. Song, 2006. "China's Resources Demand at the Turning Point." The Turning Point in China's Economic development, Australian National University Press.
- Pain, N., I. Koske, and M. Sollie, 2006. "Globalisation and Inflation in the OECD Economies." OECD WP1(2006)14 on Macroeconomic and Structural Policy Analysis.



# Mining Excellence@PwC

While issues faced by miners across the industry may be similar, we understand that 'value' means different things to different people. That's why at PwC it's not just about providing the 'right' answers. Our team of mining specialists remain focused on relationships to help our clients navigate the complex mining world and deliver on objectives. We are passionate about mining and have a team of highly skilled professionals exclusively focused on improving efficiency and adding value across the industry.

Mining Excellence@PwC delivers a team of industry experts exclusively focused on the mining sector

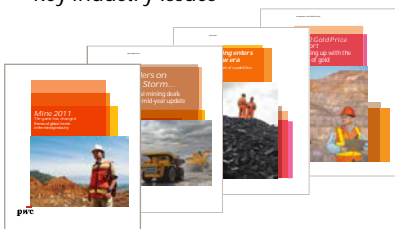
Mining Excellence@PwC provides our clients:

## leading edge knowledge and insight

We have made considerable investments to ensure our people are not only technically strong, but also have strong industry experience and expertise. Our Thought Leadership program is focused on providing in depth commentary on the key issues being faced by miners in today's complex operating arena.

Mining Excellence@PwC includes:

- a comprehensive industry insight program. This includes:
  - flagship publications such as *Mine* and *Mining Deals*
  - web casts available at pwc.com
  - insight publications focused on key industry issues



- an extensive industry development program, including on-site and in-class learning opportunities for our people and clients.

## connections to our vast network of mining experts and global client portfolio

We have the widest network of mining experts who work out of strategic hubs across the globe to help better connect you to vital mining markets.

Our connections provide:

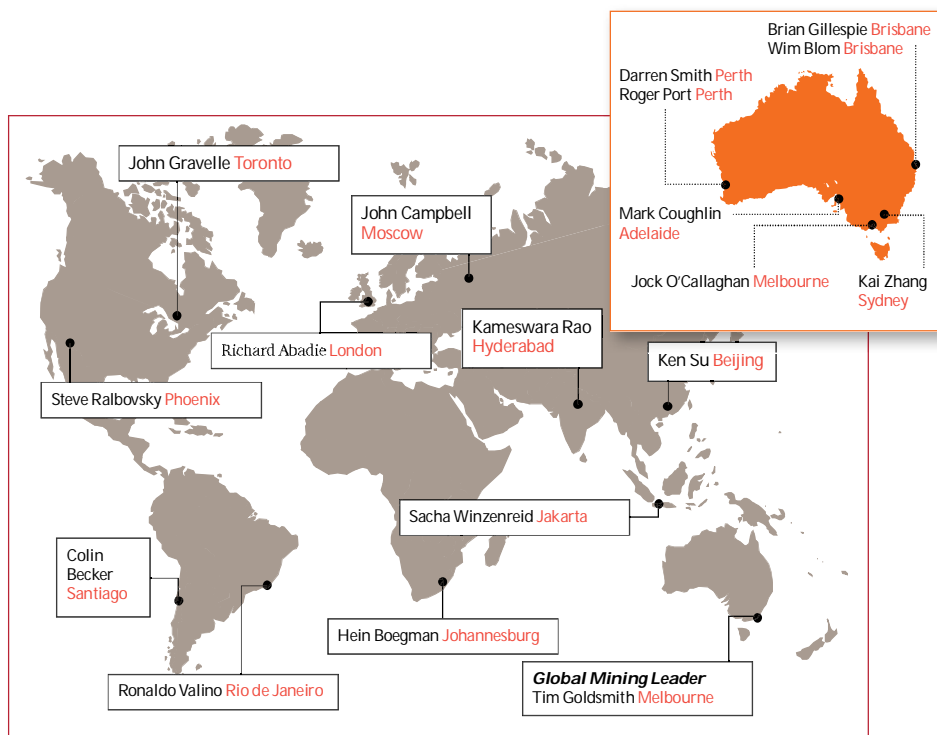
- collaborative cross-border account management, which ensures seamless client service
- a global community of mining leaders, allowing our clients to connect with key players in all markets to maximise deal potential
- a well-connected and mobile workforce.

## the delivery of an experience that meets our clients' definition of 'value'

With mining experts working in each key Australian state, our award winning teams are helping clients deliver on specific projects and organisational growth aspirations. We offer Advisory, Tax and Audit services to global corporations and locally listed companies.

Mining Excellence@PwC complements this with:

- a suite of niche mining consulting capabilities focused on optimising value across mining operations and effectively managing risk
- a comprehensive Client Feedback program to ensure we are consistently delivering on individual client needs.



# Authors

“



## Pedro Bueno Da Silva

Pedro is a Senior Manager in the PwC Consulting practice in Australia where he focuses on the Mining sector specialising in major capital projects, sustainable cost management and corporate performance management.

Pedro has several years of international experience in both the mining and finance sectors. Most recently, Pedro spent two years working on evaluation of major capital projects for BHP Billiton Mitsubishi Alliance, the largest coal miner in Australia. Before that Pedro worked on the redesign and implementation of Anglo American's global planning and corporate performance framework and operational improvement projects across Xstrata's Coal operations in Queensland.

Pedro holds a Bachelor of Commerce with Finance and Accounting majors from the University of Queensland, a Masters of Applied Finance and he is a Certified Practising Accountant, with CPA Australia.

**Pedro Bueno Da Silva**  
Senior Manager, Consulting  
Brisbane, Australia  
T: +61 7 3257 8489  
E: pedro.bueno@au.pwc.com



## Brian Gillespie

Brian is the Lead Partner for Capital Projects and Infrastructure in Australia. In recent years, Brian has led large projects both in Australia and globally with organisations such as Anglo American, BHP Billiton, Peabody, Rio Tinto, Xstrata, Queensland Rail Coal Division and Dalrymple Bay Coal Terminal.

Brian has published a number of publications dealing with the specific challenges of the mining, oil and gas sectors, including papers on mine site operational improvement, global credit risk management, major capital project stage-gating and safety classification.

Brian holds the degrees of BSc (Hons) and MBA from the University of Queensland and is a Chartered Engineer with the Institute of Technology and Engineering in the UK.

**Brian Gillespie**  
Partner, Capital Projects  
and Infrastructure  
Brisbane, Australia  
T: +61 7 3257 5656  
E: brian.gillespie@au.pwc.com



## Fabio Buckeridge

Fabio is a Senior Manager in the PwC Consulting practice in Australia. Fabio has eight years of international Resources sector experience and has knowledge of electrical engineering, logistics, mining, accounting and finance. He has worked on projects in South America, USA, UK and Australia.

In recent years Fabio has managed large operational improvement projects for Anglo American, BHP Billiton and Xstrata. Fabio has experience across several commodities and has recently managed the development of operational improvement models across all Xstrata Coal mine sites in Australia.

Fabio holds a Bachelor of Finance and Accounting (first class distinction) from the Queensland University of Technology and is a Chartered Accountant, with the Institute of Chartered Accountants of Australia. Fabio is currently undertaking his MBA at the London Business School.

**Fabio Buckeridge**  
Senior Manager, Consulting  
Brisbane, Australia  
T: +61 7 3257 8354  
E: fabio.buckeridge@au.pwc.com

”

## Contacts

### Global Mining Leader

Tim Goldsmith  
Melbourne  
T: +61 3 8603 2016  
E: tim.goldsmith@au.pwc.com

### Australia

Brian Gillespie  
Brisbane  
T: +61 (7) 3257 5656  
E: brian.gillespie@au.pwc.com

### South Africa

Hein Boegman  
Johannesburg  
T: +27 11 797 4335  
E: hein.boegman@za.pwc.com

### Latin America

Ronaldo Valino  
Rio de Janeiro  
T: +55 21 3232 6139  
E: ronaldo.valino@br.pwc.com

### Canada

John Gravelle  
Toronto  
T: +1 (416) 869 8727  
E: john.gravelle@ca.pwc.com

### Global Capital Projects and Infrastructure Leader

Richard Abadie  
London  
T: +44 20 7213 3225  
E: richard.abadie@uk.pwc.com

### China

Ken Su  
Beijing  
T: +86 (10) 6533 7290  
E: ken.x.su@cn.pwc.com

### India

Kameswara Rao  
Hyderabad  
T: +91 40 6624 6688  
E: kameswara.rao@in.pwc.com

### Russia and Central & Eastern Europe Moscow

John Campbell  
T: +7 (495) 967 6279  
E: john.c.campbell@ru.pwc.com

### United States

Steve Ralbovsky  
Phoenix  
T: +1 (602) 364 8193  
E: steve.ralbovsky@us.pwc.com