Avoiding cost blow-outs and lost time on mining capital projects through effective project stage gating

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Delivering major capital projects on schedule and to budget is an increasingly difficult challenge for many mining companies. In 2005, PricewaterhouseCoopers’ global review of major capital projects in the mining industry found that only 2.5 percent of projects could be defined as successful when assessed across the four critical dimensions of: scope, cost, schedule and business benefits.

However, several of Australia’s coal mining companies have robust capital project management processes in place and some of these organisations have moved further to the forefront of world’s best practice over the past few years as they look to manage larger project portfolios in a time of volatile market conditions.

This paper highlights Australian coal mining industry best practice in the following areas of major capital project management:

A. Phased project planning
B. Project portfolio management
C. Front end loading
D. Contracting strategy and management
E. Incorporating lessons learnt
A. Phased project planning

Mining companies must have strong frameworks in place for the evaluation and prioritisation of their projects. A structured approach to assessing projects ensures rigorous evaluation with investment decisions made on sound financial, social, environmental and sustainable development analysis.

By their nature, capital projects are not part of day-to-day operations. Whether related to infrastructure, construction of a new plant, buildings or systems, capital projects require separate financing, management, governance and assurance. Mining companies undertaking regular capital projects also need to ensure that their capital management processes are kept current to continue to support the delivery of the capital project portfolio.

The recent environment of opportunity in the global mining sector has resulted in a burgeoning number of capital projects. In Australia, many of the major mining companies have a growing portfolio of major capital projects which puts pressure on those organisations without robust capital project management processes in place.

To ensure more effective planning and evaluation of projects, a number of Australian coal mining companies have introduced a phased development process which is commonly described as a ‘stage gate’ or ‘toll gate’ process. This step-by-step approach enables companies to move their projects through the development pipeline and achieve a standardised way of evaluating project risks and opportunities.

Stage gating

A ‘stage gate’ or ‘toll gate’ is the entry or approval point for the next project evaluation stage. A key component of stage gating is to clearly assign accountabilities at each stage. At the end of each stage an acceptance or approval process, such as a stage gate meeting, should be held where key stakeholders or ‘gatekeepers’ sign off on their respective study areas, enabling the project to move forward into the next stage of evaluation. 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.

Terminology

Terminology varies across organisations. Most of the major mining companies use the following terms to describe the study stages: Concept, Pre-feasibility, Feasibility and Implementation. BHP Billiton uses similar stages but slightly different terminology for each stage of evaluation:

![Figure 1: Stage gating terminology used by major mining companies in Australia](image)

BHP Billiton’s recently introduced terminology is intended to clarify the end goal of each stage.

Influencing project success

The ability to influence project success and enhance value is greatest at the start of project evaluation and rapidly declines as a project advances towards implementation. In the same instance, the cost of change dramatically increases throughout each project evaluation stage. This suggests that the quality of decision making in the early stages of project evaluation is critical to an optimal project outcome.

Risk management

Mick Spencer, Development Manager at BHP Billiton Mitsubishi Alliance (BMA), manages the development of both growth and sustaining projects. He explains the key to understanding project evaluation methodologies, “Project evaluation in its first instance is a risk management process. When people understand this, they understand the processes”. At BMA, risk practitioners and project evaluation practitioners work closely together using a number of problem-framing techniques, including workshops and strategy table discussions.
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

Effective capital management

Large capital projects have the potential to create or destroy substantial shareholder value. Effective capital management is one of the largest levers that asset intensive companies can pull to extract enhanced shareholder value. Similarly, reducing the capital required to deliver a solution to an identified business requirement has an enormous potential impact on the return that the solution can generate. At each stage of project evaluation there are a number of key questions that should be asked to ensure effective assessment and capital management:

**Phased project planning:**

- Establish a formal approach to project evaluation that provides a strong structure and consistency
- Identify and assess the key project 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

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**Figure 2: Capital effectiveness over the project lifespan**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Pre-feasibility</th>
<th>Feasibility</th>
<th>Implementation</th>
<th>Post Implementation Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define need</td>
<td>Specify scope</td>
<td>Selection framework</td>
<td>Selection justification</td>
<td>Project evaluation</td>
</tr>
</tbody>
</table>

**Manage the demand for capital**

- Propose and screen projects
- Define problem and minimum scope
- Compare options using a standard framework
- Assess projects using a standardised rigorous financial justification
- Ensure approval processes are rigorous and challenging

**Reduce capital costs for capital projects**

- Ensure multiple options are floated and considered
- Source external views for 'out-of-the box' options
- Ensure projects meet or exceed technical and business requirements
- Ensure the costs of risks are properly understood
- Compare estimates and ensure these are standardised
- Use a standardised process for justifying and approving scope changes
- Review project at each construction phase

**Improve execution of capital projects**

- Involve all relevant stakeholders in design reviews
- Compress construction timelines
- Hold monthly reviews
- Assess the project financial justification
- Conduct a post-implementation review
- Make recommendations for improvement of future projects
B. Project portfolio management

All too often, projects can be approved on the basis of project sponsorship by a stakeholder with the most sway or the largest budget. Project portfolio management (PPM) provides a structured method of decision making that enables a company to select and run an optimal set of projects. A standardised approach to investment evaluation enables projects to be compared on an equal basis and assigned a priority based on strategic fit and risk appetite of a company.

A further level of complexity in PPM is that, once approved, changes in the internal and external environment can negatively impact or even invalidate projects. Senior management therefore requires consistent information on which to assess the impact of such changes. A mature PPM approach is critical to project success. A recent PricewaterhouseCoopers’ global study indicated that 75 percent of projects using a mature process delivered superior project outcomes.

Key benefits of PPM:
- The right projects are selected to achieve strategic outcomes and priorities
- Resources are deployed where they are required most
- Projects are monitored against key outcomes
- Projects are consistently delivered and successful

Similar to project evaluation, PPM is an exercise in risk management. To compare projects effectively, the risks involved with each project need to be compared at a number of different stages:

1. Defining strategic objectives, strategic risks and risk appetite
   - Identify and align projects with corporate strategy.
   - Enhance the corporate articulation of strategic objectives and define projects against these, including:
     - Growth-earnings
     - Diversification (geography, commodity, industry, etc)
     - Regulatory compliance
     - OH&S
     - Sustainability

2. Defining corporate risk appetite and risk acceptance criteria. Match the profile of project & portfolio risks against risk appetite

3. Stand alone project evaluation
   - Improve project risk consideration in valuation and ranking of projects based on financial and/or non-financial criteria
   - Enhance the explicit consideration of optionality in project formulation and design

4. Project portfolio modelling and optimisation
   - Evaluate and prioritise an optimal portfolio of projects
   - Consider portfolio delivery capability and associated portfolio constraints

5. Project delivery
   - Delivering approved projects on time, on budget and proactively managing ongoing risks
   - Ensuring ongoing conformance with project governance and delivery
   - Ensuring ongoing project performance against articulated financial and other strategic value objectives

Figure 3: Advanced risk management in investment / project evaluation and delivery

Key: Projects


### Project portfolio management:

- Establish a clear approach to project portfolio management to allow projects to be compared on an equal basis
- Ensure projects are aligned with the strategy and risk appetite of a company
- Conduct regular risk assessments

### Stages:

#### Stage 1

- **Define strategic objectives, strategic risks and risk appetite**
  - Articulate corporate strategy into a clearly defined objectives hierarchy
  - Define key strategic risks that should be considered in project formulation
  - Articulate and define risk appetite, risk acceptance and its impact on proposed strategy and projects
  - Consider corporate risk culture and possible impact on project success

#### Stage 2

- **Stand alone project evaluation**
  - Enhance the consideration and quantification of risk into standard commercial project evaluation methodologies (NPV, IRR etc.)
  - Identify project optionality and impact on project design and value
  - Review uncertainty around project delivery parameters
  - Conduct project insurance programme design
  - Review OH&S compliance parameters and KPIs

#### Stage 3

- **Project portfolio modelling and optimisation**
  - Model cash flow at risk and assess project impact under probabilistic scenarios
  - Consider risks versus return tradeoffs
  - Model the portfolio diversification benefits
  - Assess portfolio delivery capability and constraints – e.g. financial, skilled labour, management time, 3rd party contracts
  - Assess financial risk – hedging FX, commodities and fuel policy and strategy

#### Stage 4

- **Project delivery**
  - Validate project on an on-going basis against financial and other strategic objectives
  - Communicate project progress and risks
  - Ensure project governance and assurance
  - Select third parties and review regimes
  - Ongoing project risk management
C. Front end loading

To increase the likelihood of meeting a project’s end goals, the variance of cost, schedule and operating methods have to be reduced to a minimum. This is a challenging task and requires a strategic approach to project evaluation from the very start of a project. Front End Loading (FEL) is a methodology that takes a deliberate approach to major capital project planning and can have significant impact on the outcome of a project.

An independent project analysis group which benchmarks projects, both large and small in mining and utilities, found evidence that FEL contributed significantly to:

- lower total investment costs,
- faster project cycle times, and
- enhancements in system/installation operability.

(Jones, 2004)

All of which resulted in enhanced safety and a larger Internal Rate of Return (IRR).

How FEL is making a difference in project evaluation

FEL is a structured process that covers the tasks, activities and deliverables of the first three project phases to maximise the opportunity for project success. FEL consists of the following components:

Figure 4: Front-end loading project phases

<table>
<thead>
<tr>
<th>Front end loading phases</th>
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</thead>
<tbody>
<tr>
<td>Pre-concept</td>
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<tr>
<td>Concept</td>
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<tr>
<td>Pre-feasibility</td>
</tr>
<tr>
<td>Feasibility</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>Operation and post-implementation review</td>
</tr>
</tbody>
</table>

- Plan for resources
- Define roles
- Define success criteria
- Define models and scope
- Identify opportunities and scenarios
- Classify risks
- Align objectives
- Identify quick wins
- Quantify economics
- Define options and portfolio
- Rank by value, risk and effort required
- Basic engineering
- Operations plan
- Risk plan
- Contracting
- Sanctioning
- Detailed design
- Plan and logistics
- Risk management
- Execution
- Supervision
- Measurement
- Track plan vs. real measurement
- KPI monitoring
- Plan correction

Identify and evaluate options
Design and materialise options
The FEL approach requires extensive identification, evaluation and optimisation of probable development scenarios. The benefits of detailed pre-project planning are fewer changes and surprises at later project stages, which directly translates into lower costs and less schedule variance.

The result is a comprehensive plan that accurately accounts for uncertainties through all stages of development to maximise production and returns. The FEL process ensures that key stakeholders have the opportunity to contribute to the plan from concept to project implementation. Some companies, particularly in the oil and gas industry prefer using the term FEED (Front End Engineering & Design). It is similar to FEL but as the initial cost estimates are dependent on the plant or infrastructure design, it is eminently important to focus on the design elements.

The pre-concept stage is increasingly critical in mining

The projects division of BHP Billiton has implemented the fundamental principles of FEL. BHP Billiton believes that project success is contingent on the quality of the information and strategic decisions made at the very start of the project evaluation process. With BHP Billiton, responsibility for this initial step involves scenario and strategy planning within its resource development and planning team.

BHP Billiton attributes its recent project success to the simple premise: all other parts of the project evaluation process will proceed smoothly if a solid resource development plan, aligned to the business’ strategy, is followed.

Front end loading:

- Front end loading key elements of project evaluation should reduce risk and decrease cost blow-outs at later stages
- Base all FEL initiatives and project evaluation on quality resource definition and planning
- Earlier identification and evaluation of options leads to streamlined design and decisions
D. Contracting strategy and management

In an increasingly competitive business environment, a key part of the initial planning for capital investment is the formulation of an effective procurement strategy. While changing market conditions can influence the procurement approach, risk allocation and a number of factors including: project complexity, degree of scope clarity, owner and contractor capability and willingness to share risks and rewards, largely determine the chosen project delivery method.

Incorporating contract management into stage gating

One effective way to manage the complex contracting environment is to integrate an extensive contract management framework into the stage gate process. Enough time should be spent in the initial stages, fully assessing the risks of the legal and commercial aspects of the project delivery method and identifying the best time to go to market with a clear, concise and complete tender document.

The tender phases of major construction projects usually takes between four and six months. This time pressure forces companies to follow a rigorous sequence of well-defined sub-phases, and carefully monitor progress on each of these, to ensure a complete, competitive and reliable offer can be submitted at the tender date. Peter Breuninger, Controls Manager at Bilfinger Berger AG, a leading provider of construction services to mining companies explains that “A thorough risk assessment and evaluation process carried out in parallel to pre-design, planning and cost estimating activities minimises the errors made in the short time available”.

Current issues in project delivery

Long-term practices and unprecedented levels of demand for design, construction and project management services have put pressure on projects’ procurement strategies. Shortages of skilled professional and trade resources, and difficulties in retaining staff has meant that many organisations in Australia’s mining industry turn to contractors to relieve the shortage.

Figure 5: Project stage gates and contractor involvement by project delivery methods

<table>
<thead>
<tr>
<th>Key:</th>
<th>Owner activities</th>
<th>Submission phases</th>
<th>Contract design &amp; construction phases</th>
<th>Tender, negotiation and award</th>
</tr>
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<tbody>
<tr>
<td>Feasibility</td>
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<td>Project design</td>
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<td>Implementation initiation</td>
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<td>Design development</td>
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<td>Procurement</td>
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<td>Operations</td>
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</tbody>
</table>

- **BOOT alliancing**
  - Owner activities
  - Tender, negotiation and award
- **Project management**
  - Owner activities
  - Tender, negotiation and award
- **Design & construction**
  - Owner activities
  - Tender, negotiation and award
- **Document & construction**
  - Owner activities
  - Tender, negotiation and award
- **Construction management**
  - Owner activities
  - Tender, negotiation and award
- **Traditional contract**
  - Owner activities
  - Tender, negotiation and award
High levels of dispute have been a significant issue in recent years. Inappropriate risk allocation has been a major contributor to this trend. Project owners in Australia have transferred whatever risks they can to contractors, who in the past have accepted them and often passed them on to subcontractors. This practice passes risk down the supply chain to parties that are not equipped to manage this level of risk and when events do occur entire projects can be put in jeopardy.

Another common issue is that some organisations select contracting strategies that are inappropriate for the project concerned. Past experience is often relied upon with the same contracting strategies used as in previous projects, with little or no regard to project risks, scope or commercial relationship.

Selecting an appropriate procurement strategy

Recognising that the formulation of the procurement strategy is a key business function is the starting point for an effective procurement strategy. Underpinning any analysis of procurement and delivery options for a specific project should be the development of a sound understanding of the project risks and opportunities. This assessment must take into account which party can best manage these risks and realise potential opportunities, whether or not the risks are:
- retained by the organisation itself,
- transferred to another party (designer or contractor), or
- defined by a risk-sharing agreement.

The procurement approach employed determines the way in which risk is managed. However, every project has its own particular set of needs and priorities around scope, scale and technical complexity. A well defined, low risk project will suit traditional tendering and contracting approaches where transferred risk can be readily quantified and competitively priced by the market. At the other end of the spectrum, relationship contracts suit projects of higher risk and complexity that require collaboration under risk reward sharing arrangements.
E. Incorporating lessons learnt

A focus on continuous quality improvement sets the stage for incorporating lessons learnt into standard practices. Learning from successes and mistakes, and ensuring these are documented and considered in future project is key to ensuring mistakes are not repeated, and capital is effectively used for value-adding activities. Every company has a level of cumulative intellectual capital and experience, often held either in employees’ minds or ideally in organisational repositories. Frequently, however, these pools of knowledge are not properly utilised for continuous process improvement.

Gathering the lessons learnt can be a difficult task with the following common pitfalls:

- Not all projects collect end-of-phase and/or end-of post implementation lessons learnt
- Collected lessons learnt lack appropriate categorisation, context, problem definition and/or solution
- Repositories lack easy access, good navigation, and/or sophisticated search and retrieve capability
- Over time, the repositories grow to be too large, resulting in stale information, slow searches, and even irrelevant results

Capturing and institutionalising lessons learnt

To ensure lessons learnt are effectively passed on to future projects, leading organisations introduce a lessons learnt process that is clearly defined and integrated into the stage gate approach. For example under the guidance of Anglo Coal’s Control Manager, the organisation now undertakes a review of the effectiveness of each stage and the suitability of the organisational processes and documents during that stage. This should occur at the end of each stage of the project evaluation process. Feedback is sought from a number of sources including employees, contractors and any other parties involved in the project stage. This is conducted through functional workshops and one-on-one interviews. The lessons are then compiled, assessed and where appropriate, formally incorporated into the stage gate process for use in future projects.

Figure 6: Lessons learnt process followed at Anglo Coal Australia

Incorporating lessons learnt:

- Promote continuous improvement and ensure it is a focus for senior management
- Effectively capture and institutionalise lessons learnt
- Ensure procedures and policies are continuously updated to reflect improvement opportunities identified
Conclusion

Delivering major capital projects on time, to specifications and on budget is proving to be increasingly difficult for many mining companies in today’s volatile environment. This paper has sought to highlight five areas of focus to improve the likelihood of project success:

A. **Implementing a phased project evaluation process** ensures investment decisions are made based on sound financial, social, environmental and sustainable development analysis

B. **Effectively managing project portfolios** enables a company to compare projects and ensure priority is based on strategic fit and risk considerations

C. **Front end loading** key elements of project evaluation reduces risk and decreases cost blow-outs at later stages

D. **Determining a contracting strategy** early in the project evaluation process, which incorporates a sound risk management approach, increases the likelihood of a successful outcome

E. **Learning from successes and mistakes** and ensuring these are documented and considered in future projects is key to continuous improvement

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Further to this, Jane has also coordinated the development of processes surrounding the capture, dissemination and embedding of lessons learnt into Anglo Coal’s new mine projects.

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