Project management in mining: application of mining phase-gates

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Introduction

Project management, initially developed by the defence and construction industries, has been taken up by many other industries including mining. It focuses on results and the project processes which facilitate these results. Mining requires considerable initial expenditure before the mining venture delivers revenue. During this period there is both interest being paid on the investment, as well as zero return. Therefore there is significant benefit in earlier completion of the development process in order to gain revenue as soon as possible.

The essential model of project management — initial exhaustive planning before beginning work on site — is a relatively cheap and high value adding activity. This is followed by monitoring and control during the costly implementation phase (PMI 2004). Project management can reduce the period between commencement of major expenditure and revenue collection, significantly improving project returns.

The importance of up-front planning, rather than planning as the project progresses, is driven by the extremely low cost of planning in this early phase of the project, as a percentage of the whole-of-life cost, and the large cost incurred to correct any wrong decisions made. Planning costs are likely to be no more than 5–8% of the capital costs and only 1–2% of the whole-of-life costs. Correcting errors late in the life of the project can cost up to a million times the initial cost of correcting these ‘errors’ during the planning phase.

The potential reduction of construction time (the period during which large funds are expended with no return on the investment), justifies significant planning resources being spent during the relatively cheap planning period before major work occurs on site. For projects worth over $1b in which large revenues are possible, it is not unusual to spend more than 50 person years on constructability analysis (the comparison of alternative ways of delivering based on minimising time of delivery, Ireland 1983). Significant expenditure is justified by gaining the revenues much sooner due to the reduction in construction time of the more thoroughly planned activities.

McKillop and Brown (1999) studied the failings of the Ok Tedi Mine in Papua New Guinea and the Century mining project in Northern Queensland. They concluded that the problems at Ok Tedi were caused by aspects of the development proceeding in parallel, and decisions to proceed being taken without critical environmental aspects being considered. In the case of the Century mining project, market for half of the zinc produced was secured before the project was approved and the final environmental impact statement approved before the social environment was assessed, which caused significant distress to the local community. It is my experience, having been involved in case studies on hundreds of construction projects, that this constructability analysis is usually done inadequately (Ireland 1991).

A possible series of business decisions required to develop a mine through a project management phase-gate process are outlined below. Use of phase-gates, which stipulate what must be satisfied before the project proceeds, will provide a greater certainty of project success.

Phase-gate process

Rocque and Viali (2004) describe a structured approach for controlling a developing project through the use of phase gates. They recommend that at all gates we should ask the questions: what is the status compared to plan; who are the stakeholders; and what are the objectives/scope, technical considerations, cost/value/risk, quality, schedule, and resource requirements? A project phase is described as ‘A collection of logically related project activities, usually culminating in the completion of a major deliverable. Project phases are mainly completed sequentially but can overlap in some project situations’ (PMI 2004).

Cooper (2008) created the Stage-Gate® process for use in the development of new products, which is described as a set of information gathering stages followed by a go/kill decision gate. Steps in Cooper’s Stage-Gate® process are shown in Figure 1 and stages in Table 1.

Table 1 Example Stage-Gate® process (Cooper 2008, table 3)

<table>
<thead>
<tr>
<th>Discovery</th>
<th>Idea screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Scoping</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Build business case</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Development</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Testing and verification</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Launch</td>
</tr>
</tbody>
</table>

Figure 1 Stage-Gate® process (after Cooper 2008).
It is my view that the Stage-Gate® process is suitable for assessment of mining developments and in this article the term mining phase-gate will be used as a substitute for Cooper’s term in the mining process.

Key points of the Stage-Gate® process outlined by Cooper are:

- The process is not linear, although it is represented as such. Inside each stage there is 'looping, iterations and back-and-forth play; as the project proceeds some activities are undertaken sequentially, others in parallel, and others overlapping. Even the stages are allowed to overlap (beginning one stage before the previous one is completed), while often the project must iterate back to a previous stage.
- The first three stages — scoping, building a business case, and development — are perhaps the most critical.
- Stage-Gate® is not a substitute for sound project management; project management is a micro-process whereas Stage-Gate® is a macro-process.
- Approval of projects needs to be provisional until the next gate is reached; it is possible to abandon the project up until the construction phase because only limited funds would have been expended.
- Stage-Gate® is designed to enable project teams and team leaders to secure resources for their projects and then to speed them to market using the best possible methods to ensure success.
- Gate keepers should be nominated who have the power to kill a project.
- All projects must pass through the gates with the decision being based on scoring criteria.

Use of a phase-gate approach in mining can assist with the management of uncertainties and hence risk. Cooper’s basic relationships are shown in Figure 2. As uncertainty decreases the risk should also decrease.

**Mining phase-gate process**

The effective use of phase-gates in mining has always occurred on well-run mining projects, even if the process has not been called a phase-gate approach. Decisions to kill a potential development have been made for reasons such as the ore body not being as good as initially thought, and changed business conditions meaning the hurdle rate of return has not been reached due to reduced demand or increased interest charges.

The benefit of the mining phase-gates process is to provide:

- discipline in the development decision-making process
- quality of execution
- risk understanding and management
- decision-making based on facts
- structure for ideas generation
- scope for end user involvement in the earlier process phases
- transparency for users.

The mining phase-gate process can be used to gradually build-up information in a systematic manner, developing more detailed information as the business opportunity appears increasingly likely to be attractive. Going through a systematic set of phase-gates keeps the project under control, minimising the risk of failure or the loss due to abandoning the project.

Examples of the mining phase-gate process applicable to South Australian mining regulation are shown in Table 2.

**In summary**

The use of a commitment to up-front planning, the use of requirements, scenarios and work breakdown structure, managed through a mining phase-gate approach, provides sound support for project management.

**References**


PMI — see Project Management Institute.


For further information on the application of mining phase-gates or for information on the University of Adelaide’s new Master of Applied Project Management in Mining (see ad next page) contact Vernon Ireland, phone +61 2 9209 4113, email <vernon.ireland@adelaide.edu.au>.
### Table 2: Examples of the mining phase-gate process applicable to South Australian mining regulation

<table>
<thead>
<tr>
<th>Stage*</th>
<th>Mining phase-gate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preliminary investigation Does the area merit exploration funding?</td>
</tr>
<tr>
<td>2</td>
<td>Exploration licence application Tenement grant or refusal.</td>
</tr>
<tr>
<td>3</td>
<td>Exploration Discovery — yes or no.</td>
</tr>
<tr>
<td>4</td>
<td>Feasibility study including assessment of mineral reserves Does the proposal stack-up as a business venture?</td>
</tr>
</tbody>
</table>
| 5      | Mining lease proposal prepared to support a mining lease application. Process involves:  
  - community consultation  
  - description of environment  
  - description of mining operations  
  - aspect and impact event identification and initial risk assessment, including stakeholder concerns  
  - development of control measures  
  - residual risk assessment  
  - outcomes to be achieved (including closure)  
  Does the proposal deliver a net public benefit?  
  Tenement grant or refusal. |
| 6      | Project control group established, including operational people, and other key human resources engaged.  
  Business plan developed and finance sought. Going bankable. |
| 7      | Mining and rehabilitation program (MARP) prepared.  
  Involves the same conceptual assessment processes as for a mining lease proposal as well as:  
  - criteria to measure outcomes  
  - measurement capability.  
  Does the operator have a suitable management system?  
  MARP grant or refusal. |
| 8      | Detailed engineering and procurement                                              |
| 9      | Construction                                                                      |
| 10     | Business structure and processes for mine operation created Further development.   |
| 11     | Mine operation                                                                     |
| 12     | Mine closure and rehabilitation Have the closure criteria been satisfied, i.e. are there any legacy risks to government? |
| 13     | Lease surrender                                                                    |

* PIRSA is responsible for the administration and management of South Australia’s mineral resources and the regulation of the exploration and mining sectors. Refer to PIRSA’s website <www.minerals.pir.sa.gov.au> for further information.

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