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Mega project development: optimising current practices and strategies

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MEGA PROJECT DEVELOPMENT: OPTIMISING CURRENT PRACTICES AND STRATEGIES

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ABSTRACT: The forecast capital cost for the 295 Australian projects that are in the project development phase (Evaluation) is approximately A$245 billion. With average prices for projects increasing, the project development phases have never been more critical (Australian Government, Bureau of Resources and Energy Economics 2012). Project development in the Australian mining community is generally undertaken in four separate stage-gated study phases Resource Planning, Concept, Pre-feasibility and Feasibility. Each phase further defines the level of maturity required for investment, risk and project portfolio evaluation purposes. However, even with this mature project development approach, the vast majority of mining mega projects has experienced cost and schedule overruns. Current industry practices are outlined, which suggests a vertically integrated framework for the four study phases through project development. This approach is focused on increasing the links between project development and program and project portfolio management and presents a new vertically integrated model in an optimised project development life cycle, adapted from current standard linear.

INTRODUCTION

In 2012, the Australian Government Bureau of Resources and Energy Economics (AGBREE) noted that there are 393 listed projects within Australia of which 98 are in the advanced (Implementation) category and 295 are in the less advanced (Project Development Phase) category. The total value of the proposed capital expenditure for the advanced projects is over $260 billion which is a 34 per cent increase from April 2011.The forecast capital cost for the less advanced projects currently under evaluation is approximately $245 billion. The Australian mining sector was spending at record levels in 2010-2011; mineral exploration expenditures were double the average expenditure during the previous 30 years (AGBREE, 2012).With the current market fluctuations and uncertainty, mega projects have to deal with competing projects, frequently changing context, purposes, cost constraints and ambitions (Giezen, 2012). Average prices for projects are increasing and the project development phases have never been more critical. These key study phases ensure that proposed projects align with current business strategies as well as provide confidence in long term asset viability during international downturns (Smith, 2006; AGBREE, 2012).

The Project Management institute (2008) describes a "project" as a temporary endeavour undertaken to create a unique product, service or result. Development, on the other hand is defined in the Oxford Dictionary (2012) as a specified state of growth or advancement. In this paper, the term "project development" refers to a staged approach which increases the maturity and definition of a proposed mine as a temporary endeavour. Project development in the Australian mining and metals industry generally comprises four separate stage gated study phases Resource Planning, Concept, Pre-feasibility and Feasibility (Anglo American, 2009). Each phase(see Figure 1) further defines the level of maturity required for engineering and construction, investment, risk and project portfolio evaluation purposes at relevant stages of the project development(Yescombe, 2002; Nethery, 2003; Madic, 2011). The study phases are generally depicted as a linear approach moving from one phase to the next via stage gate approval processes. In each phase, the owner develops a detailed definition of the scope and engineering requirements for a capital project to meet business objectives (Independent Project Analysis, 2004). The level of maturity and cost of the project scope is further refined as it progresses from one phase to the next through the development of standard deliverables and the estimating process.

The maximum ability to influence value for the project occurs in the Concept and the first half of Pre-feasibility study phases of the project development cycle. As the project progresses through the subsequent project development phases, the implementation of change has a disproportionate effect on cost (Van Der Weijde, 2008).

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Figure 1 - Linear project development cycle (Anglo American, 2009)

THE STAGE-GATE PROCESS

The stage-gate process is a review of the project based on the developed deliverables in each project development phase. This review is generally provided by specialists who assess the project against its objectives and measure the project's potential to provide continuing value in the next phase of development (Cooper, *et al.*, 2002). If the project does not align with the expected benefits or strategic objectives, or it does not provide business confidence at any stage of the project review cycle, the study may return to the start of the phase, or be returned to the key value-adding phases of Concept and Pre-feasibility (Mackenzie and Cusworth, 2007). The objective of the stage-gate process is to validate the project maturity and benefit alignment, as well as identify implementation issues in a later phase (Magnussen and Samset, 2005). The stage-gate process also allows program and project portfolio input into the long term project strategy. As a point to note, according to Anglo American (2009), approximately 12.5% of mega projects in the minerals industry actually deliver on the benefits that were originally anticipated.

PROGRAMS AND PROJECT PORTFOLIOS

Organisations are increasingly using projects as a means to achieve their business objectives economically which increases the number of projects and therefore creates the need for program and portfolio management (Blomquist and Muller, 2006). According to Ataya (2007), programs are a structured group of interdependent projects that are both necessary and sufficient to achieve the desired business outcome and deliver value. A project portfolio is a grouping of programs, projects, services or assets which are selected, managed and monitored to optimise value (Ataya, 2007). Similarly, Koh (2010) has described portfolio management as a tool for optimising the organisational returns from project investments by improving the alignment of projects with strategy and ensuring resource efficiency. The key differentiator is that, unlike projects or programs, portfolios do not have a finite life. Portfolio management is a continuous process and requires regular tending to ensure the portfolio remains in balance and consistent with the organisation's strategic objectives (AIPM, 2011).

RESOURCE PLANNING PHASE

The purpose of the Resource Planning Phase is to identify deficiencies and gain confidence in the geological data from existing assets as a basis for the project pipeline development (Anglo American, 2008). This phase also identifies all value adding business alternatives and outlines a preferred approach to develop a potentially viable asset (Anglo American, 2009).At this initial stage of the project development cycle, uncertainty about the future is high and tolerance of project uncertainty is required (Atkinson, *et al.*, 2006).

The project pipeline developed in the resource planning phase provides internal competiveness between projects and strategies which ensure the focus remains on higher value projects (Anglo American, 2009). This focus on delivering corporate strategy is a key component of organisational success and long term growth (Aitken and Crawford, 2012).This body of work is generally a high level assessment based on current resource assets overlayed with project costs based on benchmarking data or factored project pipeline costs from recently estimated or executed projects (Golding, 2009). If the resource planning opportunity gains approval through the stage-gate process, it will then proceed to the Concept Study Phase. If not, the opportunity will be re-assessed in the resource planning phase and recycled as required.

CONCEPT STUDY PHASE

The purpose of a concept study is to define the future potential of a project, reduce sub optimal alternatives and determine if there is sufficient justification to continue to the next phase of development

(Noort and C, 2006).This work involves understanding and leveraging off the optionality generated in the Resource Planning Phase.

The concept study report should outline clear objectives, identify how the project fits into the program and project portfolio and is portrayed in a business perspective (Anglo American, 2009). It also outlines the project risk profile and its potential impact on development. Generally the concept study is a mix of benchmark, production or capacity factored top down cost estimates based on typical industry processing technology (Golding, 2009).At the relevant time the concept study is reviewed through a stage-gate process. It is assessed against the maturity of optionality, alignment with the business strategy and risk profile. If the project can demonstrate it has the capacity to deliver strategic objectives and has an acceptable risk profile, it will generally progress to the pre-feasibility study phase. If the project does not gain support through the stage-gate process it can be recycled back to the resource planning phase or return to the start of the concept phase (Mackenzie and Cusworth, 2007).

PRE-FEASIBILITY PHASE

The pre-feasibility study phase has two stages. The initial stage is primarily focused on assessing all valid options and identifying the best value case. The valid options are generally permutations of those developed in the concept study phase. The permutations are developed through an opportunity framing process in which operational and business unit stakeholders identify the potential development options in a workshop environment (Da, *et al.*, 2012). The valid options are scoped, estimated (capital and operating costs), risk assessed and financially modelled to ensure the best long term value option is selected. This process also identifies the key drivers and risks associated with each option and the organisation's risk appetite for the development of the preferred option.

At this stage of the project development market conditions and short to mid-term supply forecasts have emergent strategy impacts and may introduce additional or reduced optionality into the assessment process which was not identified or taken forward from the Concept study (Mintzberg, 1987). This is primarily due to the time duration of the studies to get to this stage. The preferred option is subjected to a mid-point stage gating process where the optionality is assessed against the business strategy and objectives.

The second stage of the pre-feasibility study involves validating that the selected case will retain value as the project maturity increases and the level of contingency decreases. At this point the majority of the deliverables change from a factored or top down methodology to a more quantifiable bottom up basis. This change from a top down factored estimate to a bottom up basis has a considerable impact on the resource project workload. At the end of the options assessment, the best value case is audited via the stage gate process to ensure it has the potential to deliver the benefits identified in the first stage of the Pre-feasibility Study Phase. If the project submission is not successful in the stage gate review, it may be recycled to the initial optionality framing stage of the Pre-feasibility Phase or even recycled to the start of the Concept Phase. Overall this is the most complex of the four study phases because of the dynamic nature of optionality refinement, assessment and selection (Collyer and Warren, 2009).This complexity is compounded by the integration alignment of key stakeholders from business, project, program and portfolio management. This alignment and agreement to project success then transfers into corporate success (Cook-Davies, 2002).

FEASIBILITY PHASE

The main objective of the feasibility study phase is to validate all previous design, economic assumptions as well as ensure the project aligns with both internal and external benefits (Bruzelius, *et al.*, 2002). This is the longest and most detailed of the four phases. The feasibility study provides a complete analysis of the project and its risk profile, justifies the project implementation, provides investment or funding basis for the project and supplies a detailed framework for monitoring cost control (Anglo American, 2008). This phase includes considerable value improvement processes which, according to Independent Project Analysis (2004), are out-of-the-ordinary practices used to improve cost, schedule, and/or reliability of capital projects. At the end of this phase, the study is subjected to the final stage-gate process in the project development cycle. If the project is successful in showing it can deliver the benefits and long term value originally forecasted, and provide confidence to the portfolio management team, it will progress to the execution phase. However there may be approval challenges even if the benefits cannot be realised. These challenges may result from higher performing projects receiving funding preference or changes in the strategic direction of the organisation, as seen in the mining and metals industry in the recent past.

AN INTEGRATED LIFECYCLE APPROACH

In the optimised approach, each study phase is not only linearly integrated with subsequent study phases in the project development lifecycle but has the added dimension of vertical integration with business strategy, program and portfolio management. This increases the project's exposure to major decisions which link deliberate and corporate strategy earlier in the study phase cycle (Mintzberg, 1987; Bowman, 2001).

The resource planning phase is primarily supported by data developed from concept, pre feasibility and feasibility studies for projects currently in execution within the organisation. Linking the start of the resource planning and the end of the typical linear feasibility study ensures the Resource Planning Phase has access to current project estimates and data. The cost benefit of this is seen immediately if the pipeline projects are similar to those being studied or executed as the estimates are considerably more mature than would be expected at this early stage of the development (Van Der Weijde, 2008). Resource planning is developed directly from the business strategy which becomes the core of the radial project development lifecycle. (Refer to Figure 6.) In this case, business strategy is primarily focused on how the business competes in a particular industry or market (Bowman and Helfat, 2001). As the business strategy area is encapsulated by the four phases of the project development cycle it creates axis point for vertical integration through each study phase.

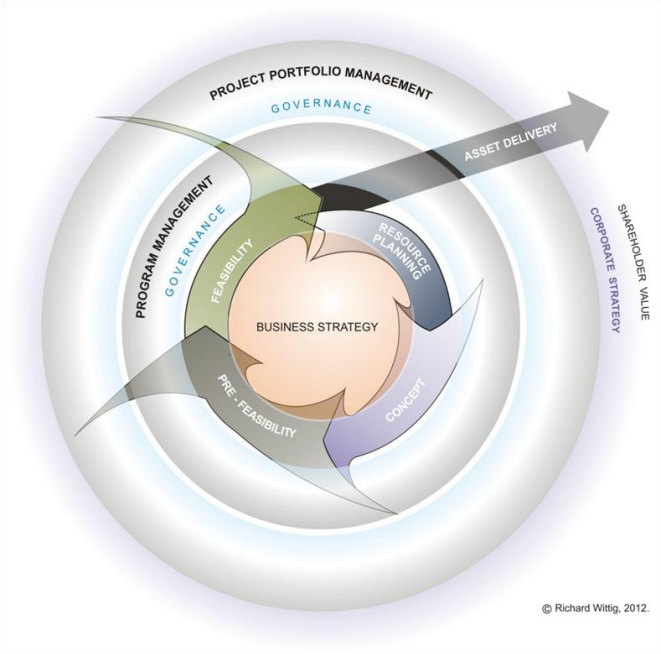

Figure 2 - Radial project development lifecycle

As Ataya (2007) has described, program management is a structured group of interdependent projects that are both necessary and sufficient to achieve the desired business outcome and deliver value. With that in mind, a program management and governance layer was added to the radial project development lifecycle.

As outlined earlier project portfolio is a grouping of programs, projects or assets, selected, managed and monitored to optimise value (Ataya, 2007). Considering the value management requirement of programs, project portfolio management and governance was added to the radial project development lifecycle. This provides the tool for optimising the business organisational returns from project investments by improving the alignment of project portfolios with corporate strategy (Koh, 2010; Bowman, 2001). The radial project development lifecycle includes a time aspect. This is in a clockwise motion based on the development timeframes associated with each study phase. The stage gate recycling process (non-approval) is in the form of anticlockwise movement. The project lifecycle phase can be reset so that the time impact can be clearly seen and further approval process understood. Once the project is approved at the end of the Feasibility phase it then moves into the asset delivery lifecycle. This asset delivery section outlines the transformation from project development cycle to execution phase and shows the value increase to the asset over time.

From a phased project approach, the utilisation of the radial lifecycle appears to offer the following vertical integration benefits:

- Resource Planning
  - A clear link with business strategy during initial idea generation
- Concept Phase
  - Ongoing integration with business strategy and project pipeline optionality
  - Project optionality supported by business strategy area
  - Early integration to program management and governance requirements
  - Early project exposure to program management approvals
- Pre-Feasibility Phase
  - Embedded business strategy and practices within the project
  - Project optionality supported by program management and governance and business strategy areas
  - Embedded program management approvals and governance requirements
  - Early integration with project portfolio governance requirements
  - Early exposure to project portfolio management approvals
- Feasibility Phase
  - Project "option" supported by program, project portfolio and business strategy areas
  - Embedded program, portfolio management and governance practices within the project
  - Integrated with board level approvals and governance requirements
  - Provides ongoing integration with business strategy and project pipeline optionality via supply of real time pricing for resource planning optionality planning.

As can be seen in Figure 2, project, program and project portfolio management can be linked to the business strategy axis point at any stage of the project. This also defines the current level of integration and forecasts the level of engagement required to ensure all stakeholders are aligned with the project requirements. This strategic alignment is critical to enable optimum resource utilisation whilst working inside the mandated strategic boundaries and identified constraints (Smith, *et al.*, 2006)

CONCLUSIONS

The success of any mining company is primarily due to its ability to effectively manage its capital investment in a strategic context to ensure acceptable stakeholder returns (Smith, *et al.*, 2006). The objective of the resource planning study phase is to provide a pipeline of projects to be evaluated to ensure growth from business strategy and existing assets. The concept study focus is to validate the business opportunity and identify the scope alternatives that will be the subject of a trade-off evaluation in the next phase (Anglo American, 2009). The objective of the Pre feasibility study is to assess all valid options, narrow the project to one scope and confirm project economics and the role of the fourth study phase, feasibility, is to validate all previous design and economic assumptions and ensure the project aligns with both internal and external benefits(Mackenzie, 2007; Bruzelius, *et al*., 2002).

By utilising the vertically integrated optimised model, each study phase is linearly integrated with the added value of vertical integration within the project development lifecycle. This vertical integration with business strategy, program and portfolio management increases the project's exposure to governance which links deliberate and corporate strategy earlier in the study phase lifecycle, thereby increasing the chance of project success (Mintzberg, 1987; Bowman, 2001).

A summary of benefits, as outcomes from the project development phases, is, improved cost predictability, enhanced cost effectiveness, better schedule predictability, faster project delivery (schedule effectiveness), optimised scope, and better operability and safety performance (Van Der Weijde, 2008).
The realisation of the project development phases is easily quantified once the project becomes operational. The focus then turns from project development to operational efficiency and long term optimisation where the long term value is extracted from the asset (Mackenzie and Cusworth, 2007).

In summary, project development plays a crucial role in corporate strategy via the delivery of benefits through portfolio, program and project management to enable long term business growth delivered through the operating facilities we extract value from today (Aitken and Crawford, 2012).

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