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**STRATEGIC OUTSOURCING AND THE DEGREE TO WHICH IT MAY MAXIMIZE
PROJECT VALUE AND SUPPORT SUCCESSFUL AND SUSTAINABLE GROWTH,
THROUGH COLLABORATION BETWEEN MINING COMPANIES AND SERVICE
PROVIDERS**

**TESIS PARA OPTAR AL GRADO DE MAGISTER EN
GESTIÓN Y DIRECCIÓN DE EMPRESAS**

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Resumen Ejecutivo

En el competitivo entorno actual, y con restricciones de acceso a capital existentes, se requiere buscar constantemente soluciones nuevas y originales para lograr una ventaja competitiva. Leyes más bajas, minerales de mayor dureza, costos significativamente más altos, y precios de metales a la baja; son todos desafíos para las compañías mineras en su intento de encontrar maneras más eficientes y rentables de desarrollar proyectos, mantener y/o mejorar su participación de mercado, y maximizar los retornos de sus accionistas. La Externalización Estratégica y Colaborativa (EEC) – muy poco común en la industria minera de nuestros días – es una solución plausible que puede explotarse con el fin de maximizar el valor del proyecto. El objetivo de este documento es presentar una base teórica, que ha sido investigada en la práctica, para mostrar el valor que podría extraerse a partir de un modelo de EEC, para dar soporte a un crecimiento exitoso y sustentable. Pampa Norte (PN) (SGO) ha desarrollado un estudio económico para comparar las siguientes alternativas:

- i) Enfoque Tradicional: sin externalización (Caso Base)
- ii) Modelo de Externalización Convencional: el servicio se presta para atender las necesidades específicas de un cliente (cliente exclusivo)
- iii) Modelo de EEC: diseñado para atender las necesidades de múltiples clientes

El Caso Base asume un proyecto cuyo alcance es desarrollado en su totalidad directamente por el mandante. Es decir, incluyendo un proceso convencional de concentrador (100ktpd), flotación de cobre de baja ley con suministro de agua a través de desalinización de agua marina, depósito de relaves e infraestructura portuaria para exportación de concentrado. Los casos (ii) y (iii) suponen la externalización del manejo del agua, puerto, y transporte del concentrado. El caso (iii) limita el alcance de la EEC sólo al contrato para el suministro de agua. Sin embargo, éste asume la externalización tradicional del puerto y transporte de concentrado, al igual que en el caso (ii). El foco está en el suministro de agua, ya que representa la fracción principal del valor total. Para llevar a cabo la evaluación económica, se utilizaron una serie de estimaciones de ingeniería y cotizaciones presupuestarias enviadas por los proveedores de estos servicios. Los resultados indican que el Modelo de EEC maximiza, por una gran diferencia, el valor del proyecto (varios cientos de millones de Dólares en VAN diferencial).

- **Menor costo de capital:** costo de capital 30% más bajo que en el caso (i)
- **Mayor VAN:** Valor actual neto 40% superior al del caso (i) y 26% superior al del caso (ii)
- **Mayor Tasa Interna de Retorno:** 60% superior a la del caso (i) y 35% por sobre el caso (ii)

Conclusiones Principales

- La EEC tiene el potencial de maximizar el valor del proyecto.
- La externalización puede permitir una gestión con alternativas estratégicas y competitivas sumamente importantes en el entorno económico actual.
- Las prácticas actuales parecen restringir la maximización del valor del proyecto.
- Para el éxito del plan de externalización y la gestión de riesgos, es clave contar con las personas correctas en los roles correctos. “Si no eres el mejor del mundo haciendo algo, y lo haces tú, estás renunciando a la ventaja competitiva. Podrías externalizar esta tarea al mejor del mundo, mejorar el valor y disminuir el costo.”

Executive Summary

In today's highly competitive and capital restricted environment one has to constantly look for new and novel ways to do things to gain competitive edge. Between declining metal feed grades, harder ores, significantly increasing costs, and reducing metal prices, mining companies are challenged with finding more efficient and cost effective ways to develop new projects so as to maintain/enhance market share while maximising shareholder returns. Strategic and Collaborate Outsourcing, a strategy uncommon in the mining industry today, is one possible solution that may be exploited in the quest to maximise project value.

The objective of this paper is to provide a theoretical and practically researched foundation to show the potential incremental value that could be derived from a strategic and collaborative outsourcing model and the degree to which this may in maximise project value and support successful and sustainable growth. A comparative economic trade off study was undertaken to compare:

- i) The traditional approach: No-Outsourcing (Base Case)
- ii) Conventional Outsourcing (exclusive client), service is tailor made for one client
- iii) Collaborative Outsourcing Model (non-exclusive client), to suite multiple clients

The base case scenario (i) stems from a tangible project case consisting of a conventional concentrator process (100ktpd), low grade copper flotation with sea water desalination process water supply, tailings dam and concentrate export infrastructure (port facility), the full scope. The outsourced cases (ii & iii) consider outsourcing of water, port and concentrate transport. Case iii) limits the collaborative outsourcing scope to the water supply contract only and assumes conventional outsourcing of port and concentrate transport (same as in case ii). Focus has been placed specifically upon the water component as this represents the bulk value. A series of engineering estimates coupled with budgetary quotes from service providers were used to feed the economic evaluation.

Results have indicated that the strategic Collaborative Outsourcing model delivers maximum value by far (several hundreds of millions of US\$ in NPV benefit)

- **Lower Capital Cost:** 30% lower capital costs than case i)
- **Higher NPV:** 40% higher NPV than case i) and 26% higher than case ii)
- **Higher IRR:** 60% higher IRR than case i) and 35% higher than case ii)

Key conclusions:

- Collaborative Outsourcing has the potential to maximise project value
- Outsourcing provides management with highly important strategic and competitive alternatives in today's challenging business environment (need to think differently)
- Current practices appear to be restricting the attainment of maximum value
- Requires the right people in the right roles, crucial to the success of outsourcing plan and risk management (from strategic planning through to implementation)

- “If you are not best in the world in doing something and are doing it in-house, you are giving up competitive edge. You could outsource to the best in the world, up the value, and lower the cost.”

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1. INTRODUCTION

Between declining metal feed grades, harder ores, longer haul distances required to transport material, rising strip ratios and significantly increasing costs (capital and operating costs), mining companies are challenged with finding more efficient and cost effective ways to meet global demand and hence maintain/enhance their respective market shares. To this end, and in the context of the copper industry, the development of the low grade resource projects (typically in the range of 0.4 – 0.6% copper) becomes more important to execute in order to offset the supply gap. Whilst metal prices have risen steeply over the last few years, so too have the issues of exorbitant costs (capital and operating costs) come to the forefront resulting in marginal economics from the lower grade projects and in some cases, value destroying. Most of these projects are essentially shelved.

Clearly innovation and technology development are key and critical components of the process in the challenge to maximise project value by way of reducing unit costs and increasing productivity and competitiveness. Technology is one of the key enablers that industry should be aggressively pursuing thereby embracing more “out of the box” thinking so as to break down existing paradigms in pursuit of novel initiatives which will certainly result in newer, fresher and more efficient ways of doing things. These initiatives should be accelerated.

Having said this, the copper industry has not really seen any significant technology breakthroughs over the last decade or so nor has there been any significant changes to existing processing technologies (heap leaching and concentration of ores via milling and flotation), with the exception of scale. Clearly the sheer scale of the mining equipment being produced today has certainly increased significantly over the years (e.g. trucks, shovels, grinding mills, flotation cells etc.). Even from the perspective of sheer scale; most organisations are reluctant to be the first to implement these bigger machines and rather choose to adopt the general approach of “following” technology development/implementation executing only once technology has been proven by others. This approach tends to slow down the rate at which new(er) technologies are brought to the industry, even scaled up version of existing technologies for that matter. The billion dollar question is; will bigger machines be enough to drive down unit costs? Will these be sufficient turn around lower grade marginal projects into more attractive investments to companies and their shareholders?

The objective of this paper is to provide a theoretical and practically researched foundation endeavouring to show the potential incremental value that could be derived from strategic and collaborative outsourcing through business models/relationships. This paper takes the outsourcing model one step further and shows the incremental value from outsourcing should mining companies collaborate with each other (via third party service

providers), not very commonly applied in industry today, to maximise value of their businesses. To this end, these could be used to assist organisations in making informed decisions around Strategic Outsourcing and the degree to which this may support successful and sustainable growth to their respective businesses in quest to maximise underlying value (a common interest amongst all). One should strive to achieve the maximum results, as opposed to settling for a good result.

In some cases, this potential incremental value add, is what's required to sway key investment decisions turning great projects into super projects, good projects to great ones and even those average projects into more robust investments bringing them back on line against a decision to close them down. This will also assist organisations to:

- **Understand the full value potential of their investment opportunities** (collaborative outsourcing cannot be looked at in isolation and should be considered in conjunction with all other value adding initiatives within that investment opportunity to understand the full potential)
- **Be more efficient ranking of the investment alternatives** thereby promoting more informed decision making (use of optimal data to ensure a more robust ranking process)
- **Generate more competition for capital within the organisations themselves ensuring that the best projects are prioritised** (competition becomes even more rife in those organisations producing multiple commodities).

It is important to note that in the quest to achieve and remain in a competitive status in all business processes, outsourcing is only one possible solution in response to the challenge at hand. Strategic outsourcing should not be considered in isolation, but rather seen together with other initiatives (innovation, technology, value engineering etc.) aligned with the strategic fit of the organisation which ultimately endeavours to maximise value.

This paper does not focus on enhancing project value through the development of technology initiatives (as mentioned above). Having said this, technology and innovation should be at the forefront of all business development.

The following thesis explores the potential incremental value that could be added through collaborative relationships between mining companies (competitors) either directly or indirectly via third parties, working together to significantly reduce their respective costs via the sharing/joint development of ancillary infrastructure.

The aforementioned analysis (base case) has been centred around the development of a typical low grade greenfields project via the conventional milling and concentrator process (around 100ktpd), with supporting sea water desalination process water supply (pumping some 200km to approx. 2000masl), concentrate transport (pipeline) and concentrate export infrastructure (port facility).

2. ORGANIZATIONAL DESCRIPTION

BHP Billiton's Pampa Norte's Spence operation will be used as the basis for this evaluation in the context of developing its low grade Hypogene resource (greenfield expansion) that underlies the existing oxide and supergene ores currently being treated.

Spence is located about 140km from Antofagasta (refer to Figure 1), at an altitude of approximately 1700m above sea level, was commissioned in 2006 with a processing capacity of around 55-60ktpd and designed to produce around 200KT of copper per annum via the conventional heap leaching process. The process treats oxides ores via a chemical leaching treatment and secondary sulphide material through the conventional bio leaching process.

Figure 1: Location of BHP Billiton's Spence Operation



Source – BHP Billiton, Pampa Norte

Spence has been in the process of evaluating a greenfields expansion via the exploitation of the hypogene mineralisation (copper and molybdenum). The hypogene ore body underlies the existing oxide and supergene ores currently being treated by conventional heap leach practices, as described above.

The project scope is to process the hypogene ore by way of the conventional concentration/flotation process in the order of 100ktpd and includes the development of the following key infrastructure:

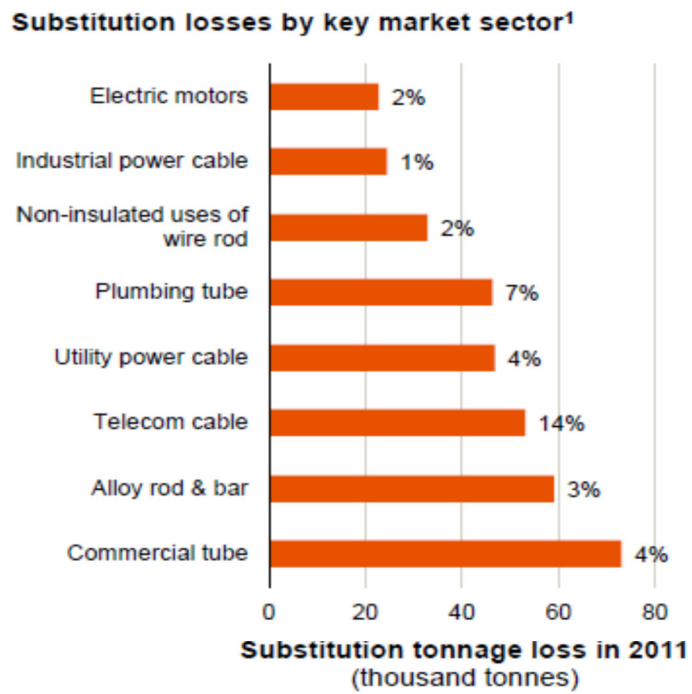
- Concentrator and concentrate pipeline
- Desalination plant and water pipeline
- Filter plant
- Tailings dam
- Port facilities

A more extensive and complete overview of the base scenario may be referenced in Section 9.3.

3. MARKET CONDITIONS

Copper remains a material of choice (energy efficient and carbon sensitive). The overall substitution remains fairly small (approximately 2-3% of the global market), even at a price ratio of 4:1, aluminium substitution has not significantly increased penetration. This may be evidenced in Figure 2. The industry has seen metal prices skyrocket over the past few years however today our industry appears to be changing again. The rebalancing of supply and demand has resulted in oversupply and lower prices. In the absence of the higher prices of the past, can we still deliver returns to our shareholders whilst at the same time successfully respond to the longer term supply challenge as grade decline constrains the supply response? Supply needs to grow fairly rapidly to offset the impact of declining ore grades.

Figure 2: Copper Substitution Losses by key market sector

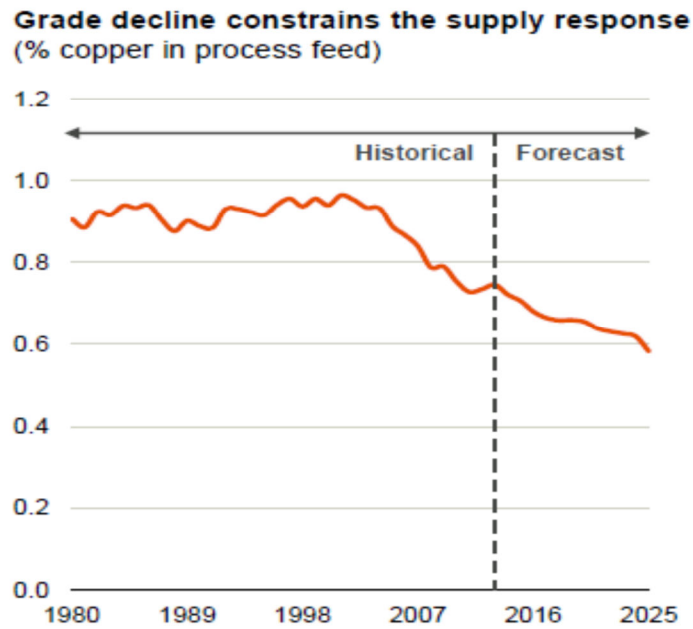


Source: ICA; CRU International.

1. Percentage shown represents share of product market lost in 2011.

Figure 3 illustrates the global average trend in copper feed grades.

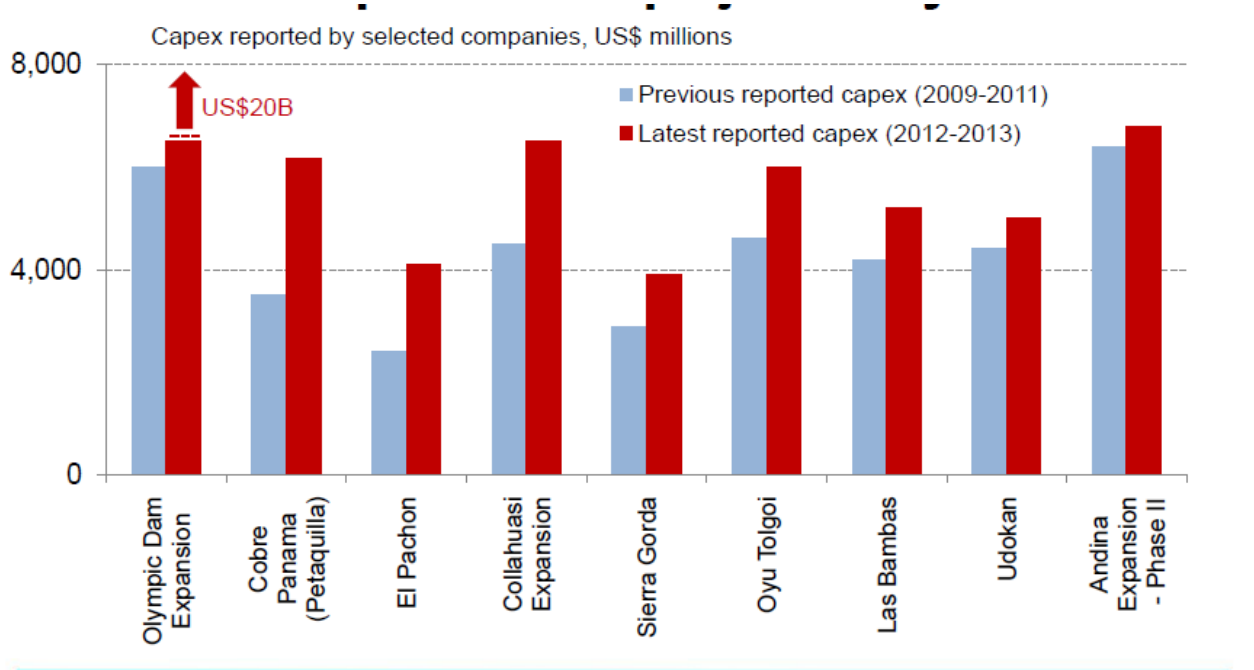
Figure 3: Global average Copper ore grades (%)



Source – Brook Hunt

On the other side of the lower metal process and declining ore grades is the issue steeply rising costs (capital costs and operational costs). Capex escalation is one of the major global issues today. Upward Capex revisions are increasingly responsible for project delays. Figure 4 shows the impact of increased Capex as reported by selected companies.

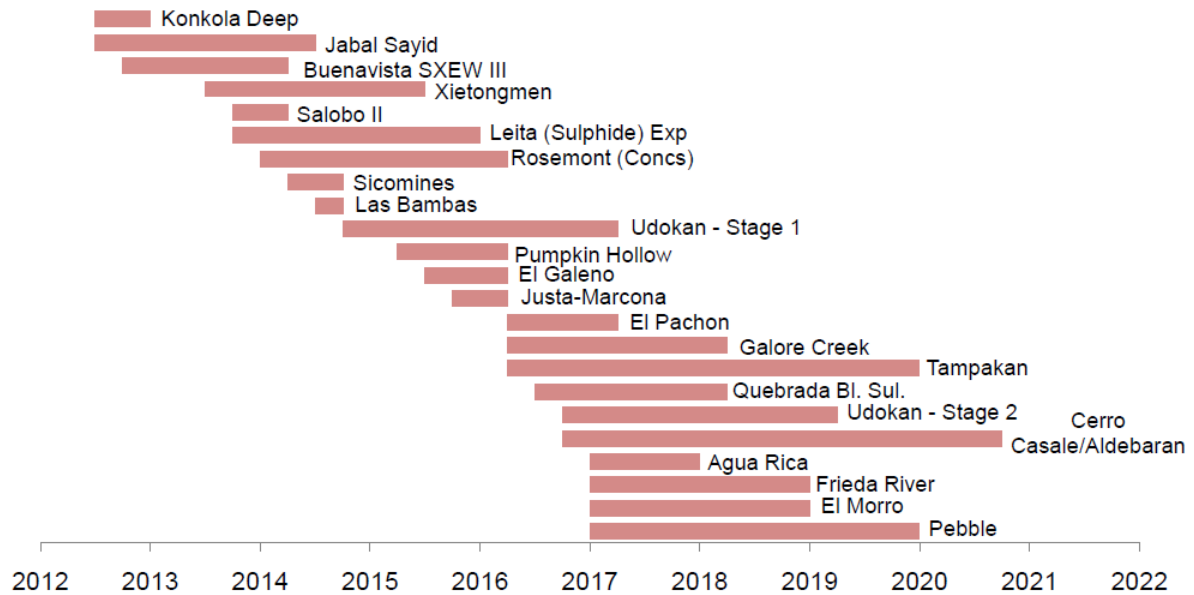
Figure 4: Increase in Capital Estimates reported



Source - 2013 CRU International Limited

Project delays can still be significant; Project value may be significantly eroded or even completely destroyed with delay. Figure 5 illustrates project delays by current commissioning dates versus those reported a year ago. Planned brownfields projects are said to only sustain production levels of current mines until 2020, world copper production critically depends on new resource (new mines or enhanced production from additional resource to reserve).

Figure 5: Delays in expected Commissioning



Source - 2013 CRU International Limited

There are various new projects expected to come on line within the next 5 years however these are subjected to supply uncertainty. Less than half of these projects are firm and most of these are greenfields projects.

The challenges of rising costs complemented by the slowdown in the market (hence reduced metal prices) will make it even more difficult for projects to stay the course through execution in what may be described as a very competitive and restricted capital environment.

4. DESCRIPTION OF TOPIC, OBJECTIVES AND KEY QUESTIONS

The basis for the evaluation is pre-feasibility level study considering the conventional concentrator process (grinding, flotation and tailings dam). Inclusive of supporting infrastructure: water - desalination plant, concentrate transport - via pipeline and shipping to one's own port facility.

This study looks into merits and disadvantages of jointly developing non-core infrastructure with neighbouring mines (via third parties) should here be synergies the respective project timing, in search of the lowest possible costs for maximum benefit.

The scenarios may be described as follows:

1. **Base Case:** No outsourcing (all infrastructure to be built and operated in house)
2. **Outsourcing (exclusive):** Water, port and concentrate transport services (exclusive 3rd party services)
3. **Collaborative Outsourcing:** Water, port and concentrate transport services via collaborative relationships with other mining houses and third parties (3rd parties collectively services of more than one mining company through this collaborative strategy)

Some of the key questions may be summarised as follows:

- Is there value that could be generated via outsourcing (versus having everything in house)?
- Is there any further value that could be generated via outsourcing from collaborative relationships between mining companies (competitors)?
- Are current practices inhibiting or restricting the attainment of maximum value?
- Can mining companies work together on non-core infrastructure/services?
- Will the additional value from costs savings (if any) be enough to turn around marginal projects into executable investments?
- Are there any additional social /cost factors or benefits?
- Can these potential savings be enough to shift marginal/average projects into feasible/great investments?

5. EXPECTED RESULTS

Provide a theoretical and practically researched foundation which may be used to assist similar project (or others) to looking for novel ways to maximise project value through the collaborative outsourced relationships between mining companies and service providers.

- Requested Budgetary quotations from service providers (port, water and concentrate transport) – key inputs' to trade off studies
- Qualify the responses of other mining houses with respect to their willingness to pursue commercial contracts of this nature,
- Show how current practices are inhibiting/restricting value (maximum potential not being captured)

- Indicative incremental value (NPV, IRR, Cash costs) that could be derived from outsourcing (exclusive outsourcing contracts)
- Indicative incremental value (NPV, IRR, Cash costs) that could be derived from outsourcing (non-exclusive outsourcing contracts)
- Provide detailed overview of Outsourcing inclusive of:
 - Advantages/Disadvantages,
 - Risks Analysis tools
 - Project Planning and Managing Outsource Risks
 - Key elements required for a successful Outsourcing
 - Key characteristics required by an outsourcing team
- Provide recommendations going forward (Future research topics)
 - Promote cluster projects in this direction (water should a priority)

6. CONCEPTUAL FRAMEWORK AND DEVELOPMENT CONTEXT

The issues of sharply rising costs come to the forefront as capital escalation is one of the major global challenges facing the copper industry (amongst others). Having said this, supply needs to grow fairly quickly to offset the impact of declining ore grades (as mentioned in the market outlook section) however on the other hand, upward capital revisions increasingly responsible for project delays and in some cases, project closure. This impact is amplified especially in the development of low grade projects. The challenge: Delivering the low risk, high return volume growth in highly volatile market/environment.

It is uncommon for mining companies to work together (either directly or via third parties) in the joint development/sharing of non-core infrastructure. In the context of rising costs there is an opportunity for the industry to foster more collaborative relationships with jointly seeking opportunities to significantly reduce by working together with neighbouring mining companies (should respective project timelines overlap or permit) as these relationships may result in significant cost savings.

The following study explores the value that could be derived by exploiting the concept of outsourcing and goes a step further looking to exploit additional value from collaborative relationships between mining companies (competitors), and endeavours to estimate the potential incremental value that could be added through working together in the quest to significantly reduce costs via the sharing/joint development of non-core infrastructure.

The aforementioned analysis (base case) will be centred around the development of a low grade greenfields project via the conventional milling and concentrator process, with supporting sea water desalination process water supply (pumping approximately 150 -

200km to approx. 2000 - 2500masl), concentrate transport (pipeline) and concentrate export infrastructure (port facility).

Can these strategic outsourcing decisions be exactly what companies should be looking for in order to maximise the value of their investments?

7. METHODOLOGY

A series of business cases have been generated so as to use comparative economics inclusive of risk assessment techniques to determine the potential value add from joint development against a back drop of the base case where all of the infrastructure is developed in-house. The following activities endeavour to talk to the methodology and process steps that were advanced in generating this study.

- **Identification of Alternatives** Opportunity framing scenario analysis– to identify the various options/opportunities to be evaluated in this study setting the scene for the project scope, specifically those strategic decisions.
 - **Alternative 1: The BASE CASE (No outsourcing)**
 - **Alternative 2: Outsourcing (exclusive client base)**
 - **Alternative 3: Collaborative Outsourcing (non-exclusive client base)**

Alternative 3 limits the collaborative outsourcing scope to the water supply contract only and assumes conventional outsourcing of port and concentrate transport (same as in case 2). Focus has been placed specifically upon the water component as this represents the bulk value.

In addition, water is seen as the biggest challenge of the three areas given that there is currently no infrastructure available today to respond to this water demand (800 – 1000l/s). Construction of desalination plants will be required to deliver on this demand.

On the other hand, current infrastructure exists for port and concentrate transport (rail and trucks) hence making these easier to advance. Shipping through different ports and trucking/railing of concentrate can mitigate impact of delays.

- Pre-feasibility level study was completed and inputs used to feed this study
- Trade off studies undertaken to quantify the order of magnitude of potential costs savings related to the sharing of specific infrastructure (base case versus alternative project cases assuming different business/commercial models)
 - Capital cost estimates
 - Operational costs

- Technical inputs to support business case (feed grades, metal recoveries)
 - Mine plans
 - Range analysis techniques to ensure adequate inputs
- Budgetary quotations were received from service providers (water, port services and concentrate transport)
 - This is a crucial step of the study as this provides the basic data to evaluate these options
- **Interviews with other mining houses, service providers and technical/commercial experts**
 - Ascertain their willingness/acceptance to a collaborative model,
 - Gauge the risk profile of the mining company
 - Investigate if any preferences to specific commercial models
- **Benchmarking,**
- Legal advice, implications and considerations (aligned with internal Anti-Trust, Anti-Corruption and Competition clauses), internal approvals and guidance from the BHP Billiton Legal team was required to advance discussions with competitors and other service providers, inclusive specific.
- **Generation of Inputs into the Business Cases** – The consolidation of the various packages of information was used to generate key inputs required to develop the respective business cases. These are made up both technical inputs (price models, metal recoveries, capital costs, operating costs, mine planning/production profiles (base case)) as well as commercial inputs for those scenarios which assume shared infrastructure with other mining companies and/or with other service providers (various commercial strategies and models come into play).
- **Risk Assessment and Range Analyses** – Like any other project development work plan, risk assessments and range analyses are extremely important parts of the project evaluation cycle and hence are featured very highly on the list of priorities. These analyses will assist in the ranking, and hence de-selection, of the various alternatives as they will provide more confidence in the selected option (end product). A lack of ranging inputs in projects is one of the key errors which projects make resulting in over aggressive inputs, which yield outputs that are eventually difficult or impossible to achieve.
- **Economic evaluation (Discount Cash Flow (DCF) methodology)** – The final step of the valuation process which generates the projects economic outputs (NPV, IRR, etc.) against a backdrop of the base case. This, together with a series of

complementary information (risk profiles etc), will then prompt the key decision makers to pursue key strategic investment decisions.

Disclaimer: Owing to the sensitive nature of the results from the Spence Hypogene Pre-Feasibility Study, no details (costs, commodity prices, production volumes, Capex, Opex , economics) have been quoted in this study. The results herein have been presented on an incremental basis relative to the base case. .

8. OUTSOURCING

8.1 What is Outsourcing really about?

“Outsourcing” is not anything new and has become part of everyday business terminology and has been applied to a multiplicity of relationships in the business arena. In the broadest terms, Outsourcing implies the transferring of a specific responsibility for an area of service, inclusive of its objectives and activities, from the owner to a third party.

Outsourcing started with companies outsourcing physical parts. Currently outsourcing scope has transcended to intellectually based service activities including research, product development, logistics, human relations, accounting, legal work, marketing, logistics, and market research. ***“If you are not best in world in doing something and are doing it in-house, you are giving up competitive edge. You could outsource to the best in the world, up the value, and lower the cost.”*** (James Brian Quinn, The Outsourcing Institute).

A clear example of an outsourced activity in the mining industry is that of drilling services (resource, exploration, geotechnical and hydrological drilling). The function is usually, contracted out to specialist contractors with the experience and expertise to handle such an activity safely and efficiently. These are also common for those non-core business activities which do not require ongoing requirements and therefore cannot justify in-house function (retention of the specialist personnel including costs of specialised equipment required). Another such example would be the transport of staff (usually transport companies are hired to expedite this function).

One of the most complete definitions of the outsourcing concept is given by J. Brian Heywood (author of *The Outsourcing Dilemma: The Search for Competitiveness*), ***“...The transferring of an internal business function or functions, plus any associated assets, to an external supplier or service provider who offers a defined service for a specified period of time, at an agreed but probably qualified price”***.

It is important to note that in this model the control of the function resides with the service provider who as a specialist in the field, should be positioned to add value (lower costs and enhanced productivity amongst others) not normally achievable in a non-core function retained in house. One can then conclude that it is not just the function that is passed on to the service provider, but also the associated risks and certain levels of involvement in

the strategic direction of the company. To this end, outsourcing becomes more than just a service contract in some areas, highly focused on value creation and not just cost saving. Although it is now widely acknowledged that outsourcing holds inherent risks, businesses often do not have a choice in that finances are limited and/or skilled personnel are difficult to source.

It is ironic that in the past, there was common belief that *“if you want something done right, then you do it yourself”*. Nowadays this mantra has changed to *“if you want something done right, then give it to an expert”*.

Table shows the difference between a traditional organisation and a network organisation. The latter is far more conducive to a strategic and integrated relationship in the interest of the collaborative outsourcing model.

Table 1: Traditional Organisation versus the Network Organisation

TRADITIONAL ORGANISATION	NETWORK ORGANISATION
Everything is done in-house and focus is on “How to do Things”	Do what has to be done and the focus is on “What to do” and ensuring that these are right things to do.
Focus is largely on cost	Focus is on value creation as perceived by the market place
Resources are of paramount importance (acquisition and allocation of resources)	There is an obsessive focus on results

8.2 Fundamental reasons for Outsourcing

In line with the different literature appraised and interviews held, there appears to be fairly similar findings as to the rationale and key reasons for outsourcing. These may be summarised as follows:

- Conserve capital,
- Reduce operating costs,
- Inclusive of increased productivity (“leave it to the experts”),
- To concentrate core competencies/core business activities,
- To improve the service or the result of the endeavour (improved quality),
- Speed to market,
- Grow revenue,
- Foster technology and innovation.

The concept of core competencies is an important one, it is those activities and/or resources possessed and utilised by an organisation to establish a competitive advantage. This represents the foundations on which any decision to outsource is based.

In order for core competence to be value adding, it is imperative that the competency is clearly defined and understood by the organisation so as to maximise its advantage/value. These competencies are also associated with people's attitudes and behaviours within the company, its products and quality. These must be lined to the end product of the organisation (core products) and are essentially made of those elements actually contributing to the value of the end product. To this end, the control over the core products enables an organisation to dictate or mould the end products whilst at the same time, outsourcing of the non-core business items would alleviate the organisation to focus on the key value drivers within the core business activities.

8.3 Advantages & Disadvantages of Outsourcing

This section talks to the advantages and disadvantages of outsourcing.

8.3.1 Advantages

Financial

- Cost savings
 - Reduced capital costs (favourable especially in capital restricted environments)
 - Reduced overheads
 - Direct outsourcing (exclusive outsourced contract with third party)
 - The cost effectiveness of multi-client shared services platform (collaborative outsourcing) makes it more affordable for the smaller clients and more profitable for the larger ones. The main platform is usually responsible for up to 80% of the costs (customisation accounts only 20%) which is now shared between the various clients and hence reduced total unit cost per client
 - Following on from the previous point, alternatively, a higher quality service may be delivered to the client at the same cost
- Cash-flow relief (currently a global issue)
- Predictable costs either through fixed or usage based price agreements.

Flexibility:

- Shifting of expenditure from the capital to the operating budget, this is usually less rigid (especially in highly capital restrictive environments)
- Catalyst for organisational change (behaviour, restructuring, rationalisation)
- Shorter lead time to take advantage of new technology and ideas
- Remove inflexible work practice mandated by legislation and unions
- Access to leading edge, specialised skills (this should yield higher productivities)
- Access to technology without capital investment (linked to various of the abovementioned elements, optimised costs and possible competitive advantages)

Efficiency and effectiveness (enhanced productivity factors)

- Enables technology catching up or leapfrogging. Having experts in their field will optimise process and increase productivity
- Predetermined service levels – parties are forced to define and/or agree to what is Expected (room for flexibility and optimisation should be considered in the contracts)
- With pay for performance, service providers are more responsive to performance complaints as it affects profitability
- Centralised support with one point of call (the service provider)
- Efficiency motivation by converting internal cost centre to a service provider profit Centre
- Release Scarce Resources for Other Areas of Business - Often in a world of increasing competition, diversifying markets and constantly changing technology, Management spends an inordinate amount of time focused on issues unrelated to the achievement of their goals. The constructive outsourcing of such tasks should free much of management's time for more creative work

Benefits to Communities/Local Service Providers

- Create local job opportunities during construction and even operation of the service facility (development and training to develop the required skills)
- Communities could benefit from services e.g. the construction of a desalination plant to service a specific client (exclusive customer), or perhaps multiple clients (the collaborative relationships), could extend scope to providing water to local communities (costs to be shared amongst all players), win-win for all.
- Collaborative Outsourcing model brings with it a more cost effective solution through a multi-client shared services platform (reduced unit costs). This makes it more affordable for the smaller clients who otherwise, would not necessarily have opted for the service. Enhanced profit margins will make smaller businesses and even the larger ones more sustainable hence the local workforce and communities benefits from these.
- Developing local service providers (Cluster program currently being dominated by BHP Billiton & Codelco), to provide support to the efficient operation and maintenance of the service facility. This will drive the development of the local skills sets endeavouring to bring these up to world class standards.
- An opportunity exists to extend the cluster scope (usually focussed on short term optimisation of existing unit operations) to be involved early on from the design phases (an area that has not yet been pursued by Cluster, hence the opportunity). This will start to exponentially develop local expertise in the design space through exposure to international industry experts (amongst others) and consequently build up a highly developed technical skills set. An analogy to China, aspiring to extend beyond the realms of just a low cost mass producer ("Made In China") to that of more sophisticated innovation and design (Designed and built in China)
- This can be driven through the collaborative relationships between mining houses, service providers and clearly governmental support.

8.3.2 Disadvantages

- Could result in unexpected costs, specifically for those elements that are not explicitly in the scope of the agreement
- Project financing and start up delays could materially impact projects economics
- Higher unit costs if usage projections are above or below the agreed rates
- Cost of additional skills and resources required to manage the relationship
- Leakage of confidential information/IP (Intellectual Property issues) resulting in competitive disadvantage and/or eventual legal issues
- High exit barriers and irreversibility, reduced cost-effective options if arrangement fails
- High end service providers (world experts in their fields) may not necessarily have location local affiliations. This is sometimes viewed as a disadvantages of not having country specific operating experience
- Service provider's inflexibility to economically meet changing requirements on a timely basis
- Exposure to service provider's financial strength and profit motive
- Supply restrictions (into a single supply source)
- Exposure to service provider's lack of commitment, they may focus their attention on larger or more strategic customers.

8.4 The Risks of Outsourcing

8.4.1 Managing the Risks

Competitive activity, technology and legislation can all but change overnight. Whilst the outsourcing strategy has proved to be effective, it certainly brings with it substantial risks that must be identified, reduced/mitigated and managed. In outsourcing, a company is relying on a third party to run and deliver on certain business functions and if not properly managed, companies will adversely impact their operations, customers and clearly the bottom line. ***The product or service can be outsourced, but not the risk.***

The Outsourcing service provider is subject to the same risk but this can be significantly reduced when the investment is made for and spread over the work carried out for a range of clients (Collaborative Outsourcing).

Effective Risk Analyses accompanied by optimal and ongoing Risk Management is required to successfully mitigate outsourcing risks.

Aligned with the disadvantages of outsourcing mentioned in the previous section, the following undesirable outcomes could be possible if not managed optimally:

- The lack of a rigorous strategic sourcing methodology and complete market and risk analysis to produce a robust and effective outsourcing strategy, presents significant risks to an organisation
- Not having the right people in the right roles will certainly result in sub optimal results, no matter how robust the plan is. The outsourcing team is crucial to the success – from strategic planning through to implementation)
- Product or service quality may also suffer in outsourcing, affecting customer satisfaction. It is crucial for companies to carefully select, qualify, contract with, and manage their outsourcing partners to ensure that quality does not deteriorate. This often requires adequate transition periods. Effective cross-training between companies is also required to mitigate this. These aspects are often neglected or overlooked as a result of cost saving efforts
- Implementation failure if schedules and budgets are not achieved because of insufficient planning and/or resources. An outsourcing project must be run with the same discipline and planning as a well-run large-scale systems/project implementation. Clearly the impact on the bottom line would be significant herein as outsourcing is a replacement of production or service functions which have a direct bearing on the company's ability to meet its commitments to customers and shareholders.
- One of the key risks is related to the financial viability of the service providers. This could result in delays in project start up should service providers not be able to receive project financing on time (for execution phase). Delays in project start up could have significant financial ramifications on the companies hiring the services (e.g. mining house contracts a service provider to build, install and supply water. Delays in getting water to the site will impact on the start-up of the project and hence the revenue losses resulting from delays). This could also be an issue post execution phase, suppliers could run into financial difficulties during the delivery/operation phase (after having successfully built the facility) hence exposing the company to supply interruption risks because of the suppliers lack of financial resources
- On-time delivery performance and end customer satisfaction levels may decline because of delays at third parties. These delays could be attributed to factors both inside and outside of the span of control of the third party (port/customs delays, labour disputes, weather, and political unrest)

How can these issues be mitigated? The following Section talks to the Risk analysis process.

8.4.2 The Risk Analysis Process

The risk analysis process is usually undertaken prior to selection of the preferred supplier and is also a very used to continuously assess the risk profile of that supplier. Whilst companies may have their own risk analysis processes,

Figure_6 illustrates the typical risk analysis process whereby potential suppliers are compared to a set of risk criteria as defined by the company hiring the service. It is critical that the selection criteria be adequately set, robust and optimally weighted in ensuring that the best supplier is chosen (the selected option is often not the cheapest supplier). To this end, a risk ranking of the suppliers is developed as a result. Organisations often undertake independent Commercial Reviews/Audits for the major contracts to ensure that the optimum supplier has been selected.

Figure 6: Risk Analysis Process

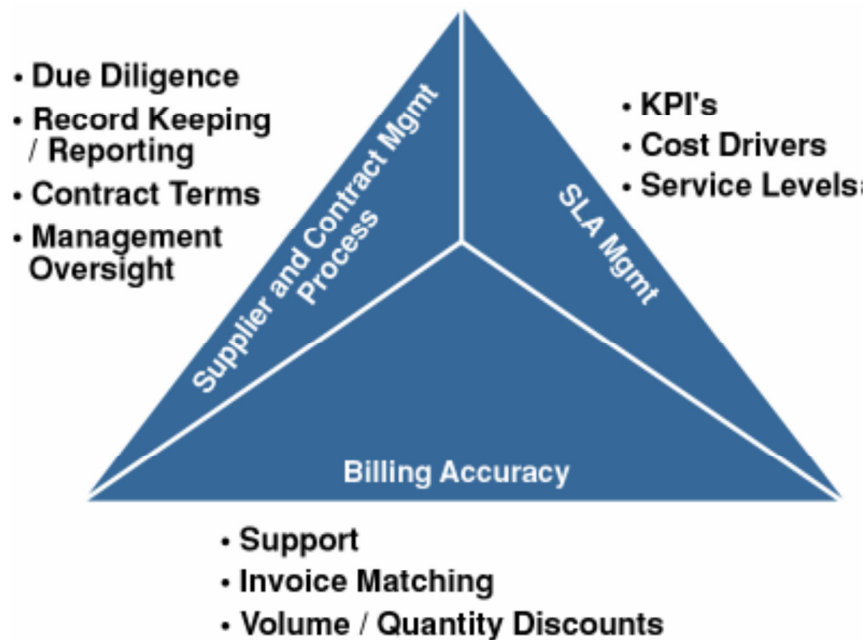


With a clear understanding of the service providers risk profile, adequate control measures may be determined inclusive of robust risk management processes for inclusion into the contract terms. The desired supplier relationship would also be defined during the supply risk/impact analysis phase.

8.4.3 The Risk Management Process

The ongoing Risk Management process is key and critical, not just to outsourcing, but to the business as a whole. With respect to the outsourcing context, there are essentially three key elements to Risk Management as can be evidenced in Figure 7.

Figure 7: Elements of Risk Management



1. *Supplier & contract management process:*

- Keeps track of the statistics and historical performance of the outsourcing relationship over time,
- These are continually leveraged to improve the performance of the relationship for both the outsourcer and the outsource provider
- Used for benchmarking performance and productivity levels

2. *Service Level Agreement (SLA):*

- The agreements are the link between the specifications laid down in the contract and the delivery of the service
- Provides the basis of the legal framework under which the performance of the service provider is measured

- Service performance measurements – important for each activity in the SLA has its own targets and that all quality assessments and performance targets can be measured (could be based on quality, quantity, time elapsed, availability, utilisation or any other measure jointly agreed by both parties)
- Serious consideration is given to penalties if targets are not met
- It is imperative that performance indicators be defined as clearly as possible to avoid confusion and ambiguous interpretation
- Independent quality assessments may also form part of the agreement whereby a 3rd party consultant would be brought in at agreed intervals to undertake benchmarking studies
- The SLA establishes what statistics will be kept and states the requirements of the parties,
- The SLA should be reviewed and updated periodically as determined by the contract terms
- Of equal importance is to agree upon the service performance indicators and the establishment of an environment conducive to continuous improvement programs. Short term will focus on improvement in reliability, speed and quality perhaps whilst longer term opportunities like cost reduction must be investigated and captured
- Many successful outsourcing relationships can be attributed to the implementation of the continuous improvement programmes created sometime after the contract got under way, due to the right risk/reward sharing environment for the service provider to work in.

3. *Billing accuracy:*

- Billing accuracy has been placed as an area on its own as this is an area in which so many issues with outsourcing revolve around
- The outsourcing party must continually review billing to ensure compliance with the contract terms and conditions

8.4.4 Contract Risk Management

Companies usually rank and identify those critical contracts that have the highest risk and importance to them. These are consequently segmented into categories as a function of risk (high, medium and low risk) and can hence be managed that way.

- High risk contracts – more continuous review cycles at business levels as they provide mission critical product or services and typically have high dollar transaction volumes,
- Medium risk contracts - actively monitored and reviewed at business level on a frequent but not continuous basis (perhaps quarterly),
- Low risk contracts – may not be actively monitored at the Asset/Business level (but clearly at the operational level)

8.4.5 Project Planning & Project Management Risks

Project planning and management are critical disciplines to enable successful outsourcing initiatives. The planning and management referred to herein go beyond Gantt charts and critical path analysis (even though these are fundamentally important disciplines and tools). It is fundamental to the success of the outsourcing strategy planning and implementation, the effective use of the people who possess the appropriate project management and risk management skills and experience and the ability to use the right tools and programs to get the work done.

Members of outsourcing teams need to also bring with them specific knowledge regarding the outsourced product or function, business and stakeholder objectives, and the knowledge of the market and the skills to analyse the potential supply market and associated risks for the product or service to be outsourced. Team members must also be able to think critically about and assess what could go wrong and put sourcing and risk mitigation/contingency strategies and plans in place to handle those scenarios. Team members should also step up to the challenge of breaking intercompany/industry/country paradigms and implementing new and innovative thinking into the ways we do things.

When firming an outsourcing team, there are several characteristics that one should look for:

- Diversity of skills and opinion. The team must be cross-functional and members should have multi-disciplined backgrounds
- The team should be made up of people who will challenge themselves and others
- The teams should contain the skills required to plan, analyse the supply market and risks, source and select suppliers, negotiate and to plan negotiations effectively, and design and execute comprehensive and effective contracts and supplier relationships and controls
- They should be self-directed and should not easily accept the status quo (break paradigms, get people to think differently)
- Supplier, product, and process-specific knowledge must be represented on the team. They must be able to work with people at all levels of an organization, internally and externally

8.4.6 Assessing and Managing Outsourcing Project Risks

Figure 8 displays a generic risk management model, which applies equally to outsourcing as well as to systems integration/systems project risk management. These models are used by outsourcing organisations to help develop strategies and tactics for assessing and managing project risk.

As can be evidenced in the aforementioned Figure, the basic indication is that the project is constantly being evaluated (loop) in relation to the goals and objectives that were originally set out:

- Identify those items/activities that could prevent the objectives from being achieved
- Risk management strategies are put in place and are followed by control mechanisms to ensure that these strategies and actions are adequately applied
- Controls are actively monitored
- Feedback from monitoring assists in identifying opportunities to improve performance and risk management capability
- Proactive and effective project risk management can help to predict and then prevent major implementation problems

Figure 8: Generic Risk Management Model



8.5 Key Elements for Successful Outsourcing

- Need to have the right people in the right roles will certainly result in sub optimal results, no matter how robust the plan is
- Strategic sourcing methodology and complete market and risk analysis to produce a robust and effective outsourcing strategy
- Thorough understanding of the total cost structure, value improvements, or savings and /or avoidance – If cost is factor in the decision to outsource (which is usually the case), all parties must clearly understand the financial goals of the outsourced function. The goals should not just be stated, clear monitoring plans to be described therein
- Rigorous and robust technical evaluation
- Identifying the best service providers/services. The following factors should be used as a guide:
 - **Credibility** - how much experience does the service provider have i.e. how many existing clients?
 - **Reliability** – does the provider satisfy its client’s needs?
 - **Flexibility** – is the provider flexible enough to match the organisation’s needs in the short term and be able to adjust in future if the business grows substantially or declines?
 - **Skills Base** – possible demands? does the provider have the skills for now and future
 - **Potential savings** – will this provider be able to offer greater or lesser savings than others?
 - **Service** – how will this provider’s service compare with what the organisation currently enjoys or what others may provide
 - **Management skills** – if the organisation’s business grows or shrinks does the provider have the management time, skills and desire to support the newly established needs?
 - **Personnel policy** - what is the provider’s personnel policy and how will this affect the organisation’s employees?
- Effective contract management strategy in place

8.6 The Risk Management Framework

Figure 9 portrays the Risk Management framework which talks to the types of risk management activities that should be considered throughout the outsourcing life cycle.

- Project management activities centre on the sourcing strategy, both prior to and during the actual outsourcing effort, these clearly being tied to the overall company strategy,

- The outsourcing team should be cross-functional and composed of personnel with the proper technical (product/service), process, and analytical skills. The sourcing strategy should drive the supplier selection and relationship.
- To minimize the risk of project failure proven outsourcing and risk management methodologies is recommended

Contract management risks may be mitigated by the development of robust contract and a negotiation plans (proactive planning) and documenting all aspects of the agreements (SLAs, escalation procedures product specifications, transitional requirements, change management documentation, roles and responsibilities, and exceptions).

The key to managing and controlling performance risk is built during contract planning, negotiation, and post-award management of the contract and supplier phases. The primary tool herein is the development and negotiation of a comprehensive contract inclusive of:

- Effective performance feedback mechanism that should be supplemented by performance monitoring and periodic contract and invoice audits as well as other measurements and controls.
- Clarity of roles and responsibilities in this stage will be critical to the management of the contract and will also support the achievement of supplier and contract management process efficiency and control objectives.

Figure 9: Risk Management Framework for Outsourcing



To this end, outsourcing provides management with highly important strategic and competitive alternatives especially in today's challenging business environment. But outsourcing is often a high risk and/or high impact proposition for organizations. These risks may be adequately identified and managed through the processes discussed above.

The more successful organizations pursue extensive project planning and decision making approaches; they have employed rigorous tools, frameworks, and methodologies; have demanded cross-functional and cross-company teamwork; and have implemented highly effective risk management, performance management, compliance and control techniques, and disciplines.

In the context of multiple outsource clients, the risks and control measures are expected to be similar. E.g. If a water supplier provides water to more than one mining house (contractual agreements clearly undertaken directly with the supplier, and not with the competition), Outsourcing through collaborated relationships with other mining houses will provide added cost benefits (economies of scale) but should not change the aforementioned risk analysis and risk management approach discussed above. The issue is that historically, mining houses have been reluctant to outsource in the first place and if they do, they sought exclusivity from the service provider. Willingness to be part of a clientele with the competition was not very well received in the past (e.g. the same service provider could supply water to neighbouring mining operations (competitors) for significantly reduced costs).

This trend appears to be changing today. During the development of this study, a series of conversations and interviews were held with service providers, competitors and others. It became apparent from these conversations that the competition are more willing to be part of integrated solutions which offer benefits to their bottom lines, and working together with competition to drive this. In some cases, some have been willing to work directly with the competition (no third party supplier) to build joint infrastructure to support both operations. This is clearly a shift change in the thinking now (vs traditional approaches).

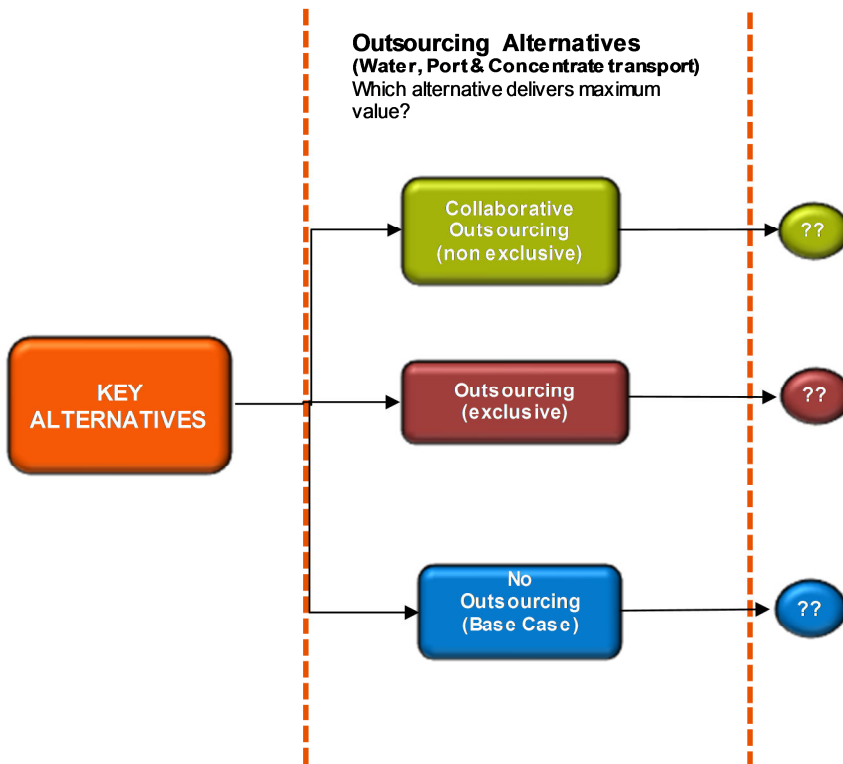
9. RESULTS

Disclaimer: Owing to the sensitive nature of the results from the Spence Hypogene Pre-Feasibility Study, no details (costs, commodity prices, production volumes, Capex, Opex , economics) have been quoted in this study. The results herein have been presented on an incremental basis relative to the base case.

9.1 Identification of the Investment Alternatives

An opportunity framing analysis was undertaken to define the various alternatives to be evaluated as part of this study. Subsequently, a decision tree methodology/scenario analysis was expedited to screen out the various alternatives in the attainment of the final scope. A series of three alternatives were defined for evaluation, these are shown in Figure 10 below.

Figure 10: Investment Alternatives Evaluated



9.2 Description of Alternatives:

- **Alternative 1: The BASE CASE (No outsourcing)** - assumes in house design, construction and operation of water (desalination plant + pipeline), port and concentrate transport (pipeline) i.e. the higher capital option
- **Alternative 2: Outsourcing option (exclusive client base)** – This alternative appears to be a more traditional outsourcing strategy (once a decision has been made to outsource in the first place). Service providers are requested to provide exclusive services to suit the specific requirement of that particular client. In this model, clients are not willing to share infrastructure with others mostly because this has not is not aligned with the way things have been done to date.

This alternative assumes that the water (desalination plant + pipeline), port and concentrate transport services (by train) will be outsourced to third parties. Third parties will construct exclusive water infrastructure (desalination plant) to the size required to service this specific requirement. In addition, modifications to existing port facilities/concentrate transport infrastructure to service the requirements of this project.

Several meetings were held with the service providers (water, port and concentrate transport) and discussions were held around the nature of modifications that would be required to service this demand and the associated costs. Some engineering was undertaken and budgetary quotations were received which were used to feed the comparative economic evaluation.

- **Alternative 3: Collaborative Outsourcing (non-exclusive client base)** – this scenario has been designed to look at the potential benefits through “collaborative outsourcing” models, somewhat different to that discussed in Alternative2. In this collaborative model, the scope is opened up where mining companies actually work together (either direct or even indirect mechanisms could apply) via a third party service provider. In this scenario the service provider would have a multi-client base hence the construction of infrastructure (shared costs) to service the requirements both customers (not limited to 2 customers however this study has been evaluated on the basis of 2 clients). Mining companies thereby reduce costs to maximise value from economies of scale, amongst others, thereby providing more cost effective solutions to market. This is envisaged as a win-win scenario for all three parties. **The question is, does this type of collaborative model ADD VALUE?**

For this to be successful, out of the box thinking is required in industry and even at government levels to be able to materialise these. Clearly this is not a common practice in industry and contrary to the current way in which we do business. The market has changed; the challenges have become more difficult hence the industry needs to change the approach to doing business promoting different ways to grow the business. If we continue to operate in the same way as we have been, fewer development opportunities will be achievable as these will become too expensive for even the major players to develop. The supply gap will not be fulfilled.

Whilst this strategy may be extended to the port and concentrate transport services, these have been excluded from the scope of Alternative 3. Focus has been placed specifically upon the water component as this represents the bulk of the capital savings from infrastructure costs (savings for not having to build a desalination plant/pipeline) and also because water is seen as the biggest challenge of the three areas given that there is currently no existing infrastructure with available capacity to service the requirements of these mega projects. On the other hand, current infrastructure exists for port and concentrate transport (rail and trucks) hence making these easier to advance. To this end, the economic benefits from collaboration outsourcing of port and concentrate transport have not been captured in this evaluation and is subject to future optimisation work. Budgetary quotes were received for the collaborative water supply alternative. Port and concentrate transport cost inputs will remain the same between alternatives 2 and 3 (an opportunity to be explored in further research work).

In addition to the budgetary quotations received feed Alternative 3, a series of conversations were held with key Executives from other mining companies. The fundamental objective of these initial discussions from the onset was to get a feel for whether these companies are willing to work together (either directly or indirectly) within the context of a collaborative outsourcing model. Each of the executives in question was keen and very open to this type of collaboration which is clearly pointed to the best interest of the respective business. Further work is required to consolidate this and make this a reality; however, there appears to be little resistance to make this happen.

9.3 Basis of Evaluation

A general overview of the base case (Alternative 1) for this study was provided in section 2.2 however for additional context to the evaluation; a more detailed description is contained herein.

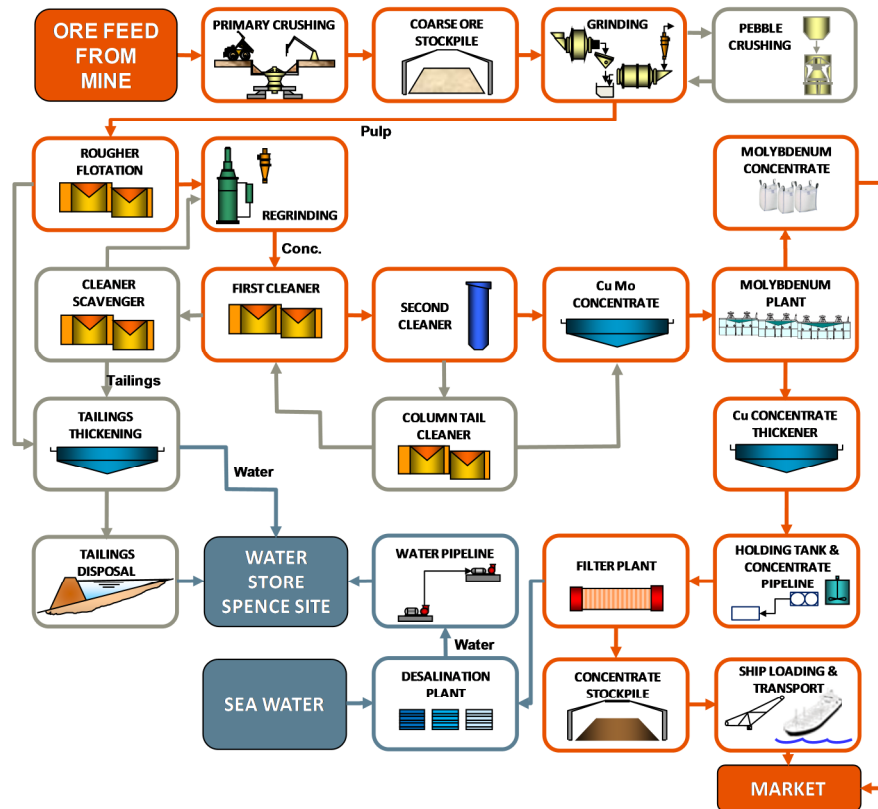
The base scenario consists of a conventional milling and concentrator process (low grade copper and molybdenum flotation) with supporting sea water desalination process water supply, tailings dam and concentrate export infrastructure (port facility).

The main process facilities (common to conventional concentrator/flotation processes):

- Primary Crushing and Ore Distribution
- Grinding Circuit (SAG + Ball milling)
- Copper Flotation Plant
- Molybdenum Flotation Plant
- Molybdenum Concentrate
- Tailings Disposal and Water Recovery
- Copper Concentrate Thickening and Transport
- Filter Plant
- Concentrate Stockpile, Reclaim & Shiploader
- Sea Water Desalination Plant (800 – 1000L/s)
- Water Supply, Recovery and Distribution systems
- Power supply and distribution

Figure 11 displays a schematic of the process flow sheet (a typical conventional concentrator/flotation process). The basis of analysis, results and conclusions from this thesis has been based upon pre-feasibility level inputs from the project.

Figure 11: Schematic Project Flow sheet (Mine to Port)



It is important to note that the aforementioned case had been developed to a fully-fledged Pre-Feasibility Study and has been a fundamental input into this study particularly around the base case.

Like any other project development work plan, risk assessments and range analyses are extremely important parts of the project evaluation cycle and have also been incorporated into the inputs used as the basis. These analyses will assist in the ranking, and hence de-selection, of the various alternatives as they will provide more confidence in the selected option (end product). A lack of ranging inputs to the key value drivers (Capex, Opex, metal recoveries, schedule, price) in projects is one of the fatal flaws which projects make resulting in over aggressive inputs, which yield outputs that are eventually difficult or impossible to achieve.

9.4 Investment Evaluation

Disclaimer: Owing to the sensitive nature of the results from the Spence Hypogene Pre-Feasibility Study, no details (costs, commodity prices, production volumes, Capital Costs, Operational costs, economics) have been quoted in this study. The results herein have been presented on an incremental basis relative to the base case.

9.4.1 Overview and Context - Selection of Maximum Value Adding Alternative

Trade off studies were undertaken to evaluate each of the alternatives. The standard Discount Cash Flow (DCF) economic evaluation methodology was used to evaluate each of the scenarios presented in this study. Each of the alternatives evaluated herein have been assessed against the base case (Alternative 1). The specifics around Alternative 1 may be referenced on the previous section where it has been discussed in extensive detail.

The comparative economics for both the “Outsourced option” (Alternative 2) and the “Collaborative Outsourced” model (Alternative 3), are shown as incremental values against a backdrop of the “non-outsourced” scenario (Alternative 1).

To this end, these results have been presented as % increments (Y Axis) to the respective Base Case units under comparison. The results from these comparative economic analyses have been centred on the following:

- Capital Cost (Capex) – refers to the capital costs associated with the Owners project scope (Concentrator, flotation plant, tailings dam amongst others - as outlined in Section 9.3). The capital savings refer to the capital costs differential between construction of own facilities (desalination plant, water pipeline, port and concentrate pipeline) versus the outsourced model
- NPV,
- IRR.

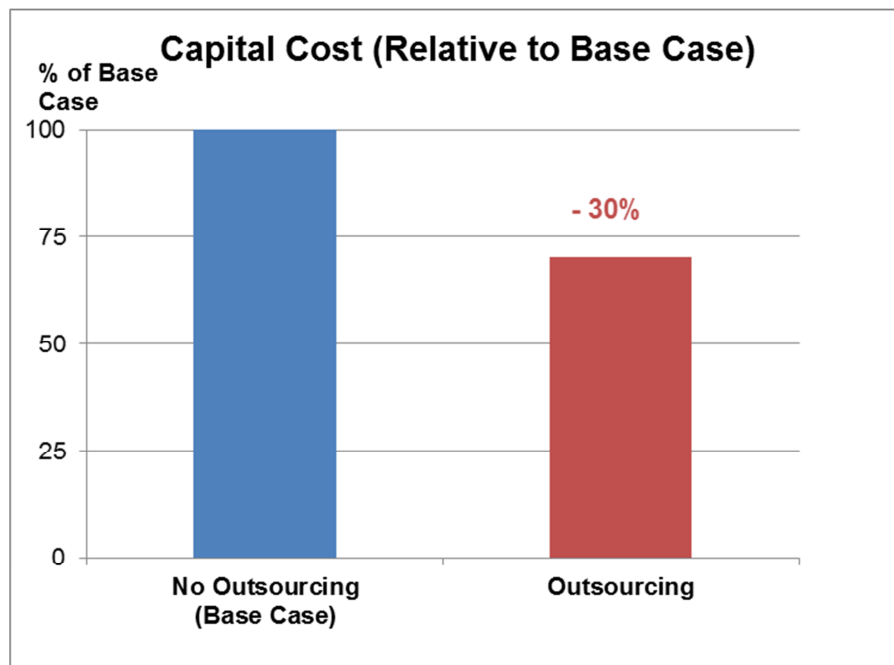
9.4.2 The VALUE ADD from OUTSOURCING (exclusive client base)

OUTSOURCING (exclusive client base) Versus NO OUTSOURCING

As per the discussion in Section 8.3, one of the advantages of moving to an outsourced model is related to the immediate benefits of capital costs savings, especially in highly constrained capital environments, like the current one.

It is important to note that the Capital costs typically required to build concentrator plant (of the size/characteristics/standards mentioned in section 9.2 above) runs into billions of dollars (US\$). Figure 12 is indicative of the significant capital savings owing to a reduction of scope (water, port and concentrate transport). Approximately 30% in total capital savings, by not having to construct the water plant and associated infrastructure, was achieved (30% of a very large number, is a significant number).

Figure 12: Capital Cost Savings



Similarly, Figure 13 shows the NPV benefits of the outsourcing Vs non-outsourced package. As can be seen in the aforementioned Figure, an NPV benefit in the order of around 15% in comparison to the non-outsourced alternative) is achieved (usually in the order of several hundreds of millions of dollars). This benefit is largely attributed to the

enhanced productivity returns, “letting the experts build, construct and operate” what they know best to do (another advantage to outsource). Without the productivity benefits, these business cases generally tend to be more or less NPV neutral. It becomes important for mining companies to keep challenging the service providers to deliver on these benefits. In fact, incentives should be put in to further increase productivity without impacting the quality of the service.

Figure 13: NPV (Relative to Base Case)

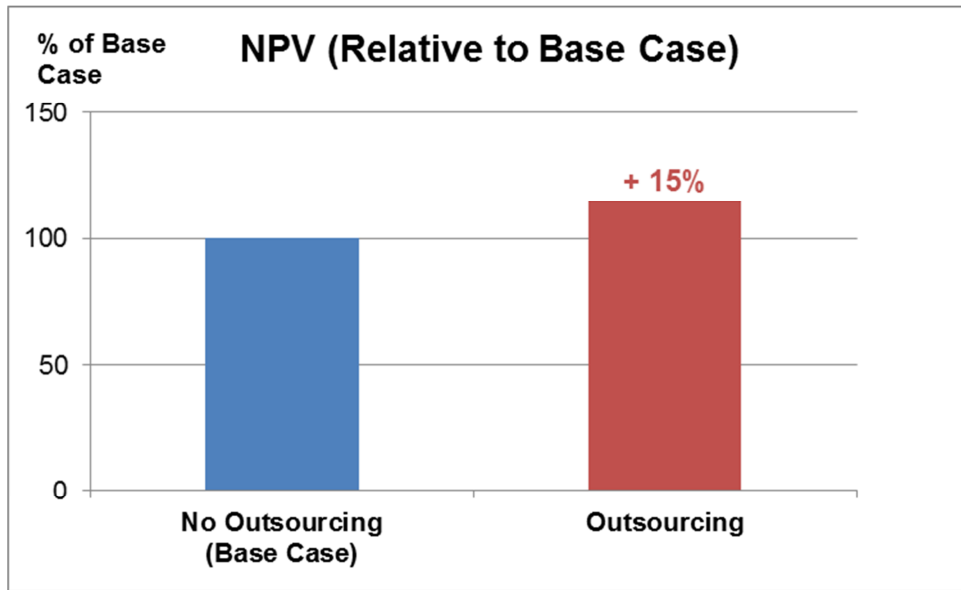
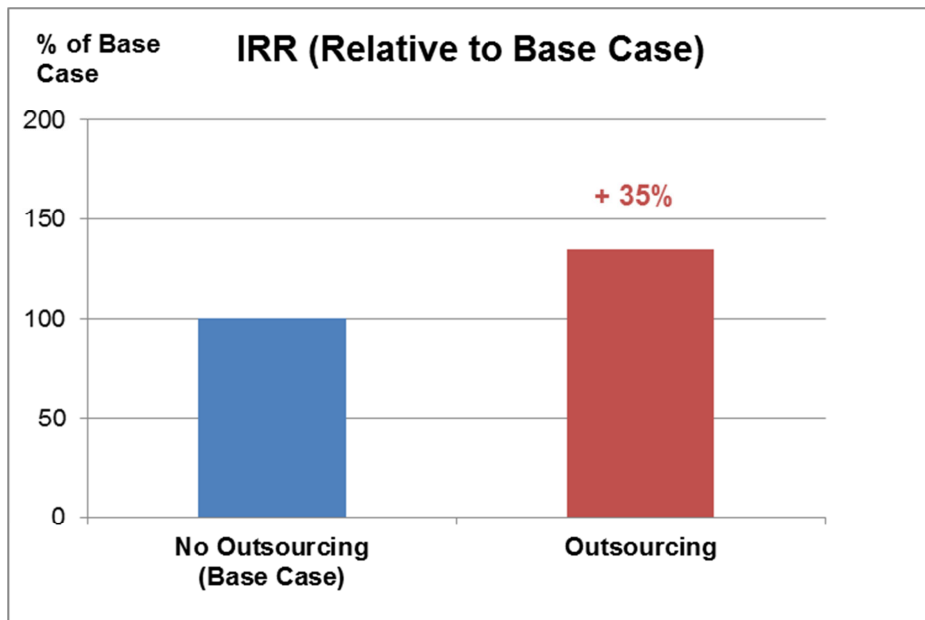


Figure 14 displays the significant IRR increment (approx. 35%) when moving to an outsourcing model. The step change is expected given the significant amount of capital savings resulting from outsourcing (approx. 30% as was shown in Figure 12 above).

The Internal Rate of Return (IRR) of projects has become an increasingly important factor as it appears to carry more weight in the ranking of projects and hence in the decision making process. Organisations are only willing to consider those projects that meet their minimum target IRRs as inputs to their capital planning processes which ultimately delivers the optimum capital portfolio. What is this threshold value? What is this magic number? This threshold value will vary across organisation however most financial analysts believe this to be the order of 15 % (nominal terms). This process becomes even more difficult for projects competing within a multi commodity producing organisation (only the best will stay the course).

Hence there is an urgency to implement new ways of doing things, instilling these strategic concepts early on in search of that competitive advantage which will ultimately set you apart from the competition. These practices are put in place to make sure that the right projects get done at the right time.

Figure 14: IRR (Relative to Base Case)



How does outsourcing scenario impact the cash cost factor (ultimately reducing Capital costs for higher operational costs)? The cash cost is expected to be increased by approximately 20% as a result of the outsourced model. Having said this, the overall value from the outsourced scenario delivers significantly more value as was shown in the previous Figures (NPV, IRR, Capex) hence this incremental cash cost does not offset the decision which favours outsourcing as the preferred alternative.

Clearly there are different drivers which influence business decisions one way or the other however, in a highly restricted capital environment, one would clearly want to minimise capital through the strategic outsourcing. Organisations therefore make decisions favour of capital reduction and are willing to operate at slightly higher operating costs. The key risks associated with outsourcings were discussed in detail in Section 8, and robust mitigation processes, tools and strategies were put forward to mitigate/reduce these.

Therefore, it may be concluded that the OUTSOURCING OPTION is certainly VALUE ADDING.

9.4.2 The Enhanced VALUE ADD from Strategic COLLABORATIVE OUTSOURCING

COLLABORATIVE OUTSOURCING (non-exclusive client base) Versus OUTSOURCING (exclusive client base) Versus NO OUTSOURCING

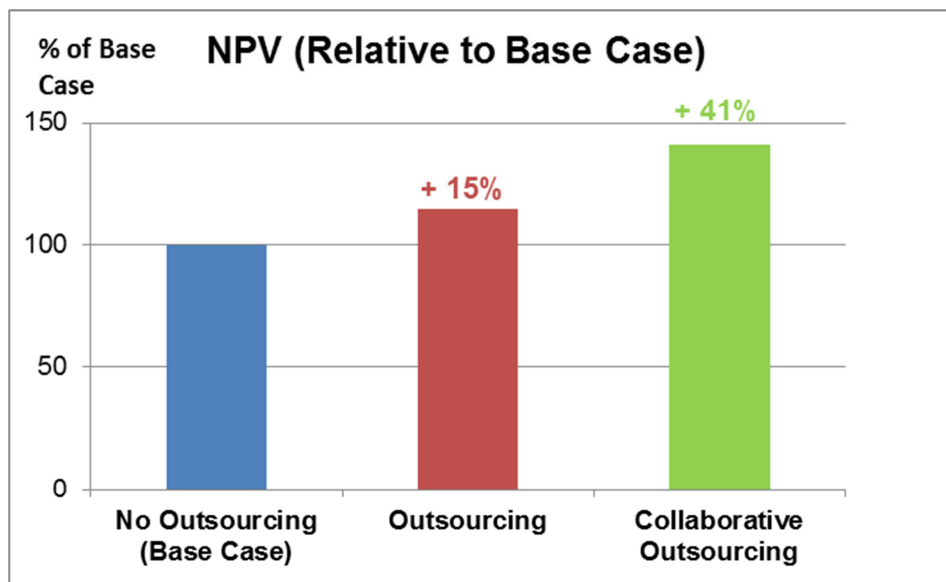
Results from the trade off study are shown below. These are presented against a backdrop of the results from Base Case (NO OUTSOURCING – Alternative 1) and that of the OUTSOURCED OPTION (exclusive) - Alternative 2).

The underlying question is: What is the potential value that may be derived from “Collaborative outsourcing”?

The answer to his question becomes glaringly obvious from Figure 15, displays this VALUE ADD very clearly.

The collaborative outsourcing model fetches an NPV of around of 40% higher than the base case (non-outsourcing model) and in the order of 26% higher than the exclusive outsourcing alternative. An extra 26% in NPV is essentially the value derived from “Collaborative outsourcing” versus the exclusive outsourcing strategy. Collaborative outsourcing adds significant value as these increments related to several hundreds of millions of dollars.

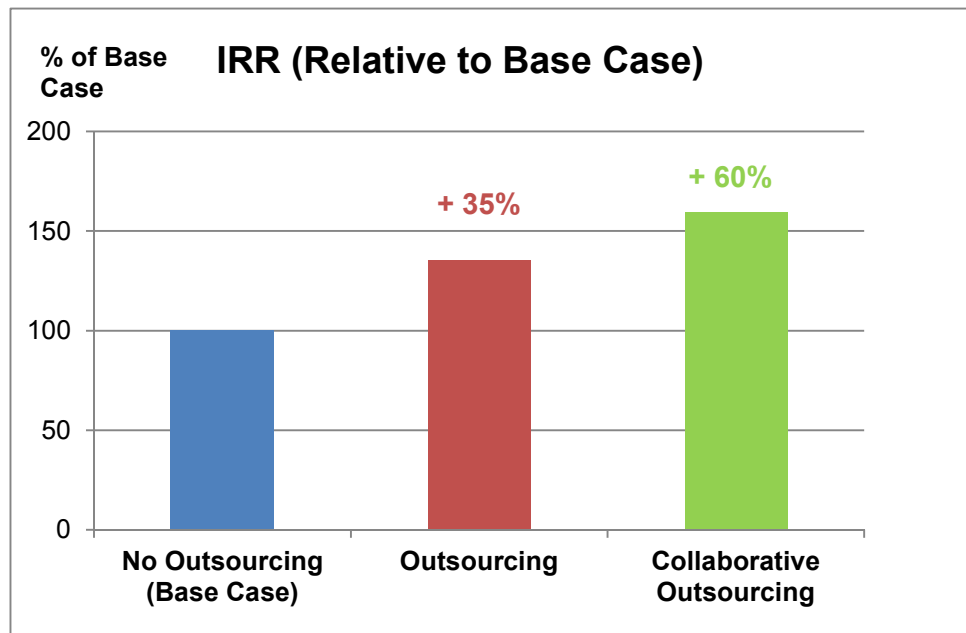
Figure 15: Incremental NPV Comparisons



To complement the value that could be derived from collaborative outsourcing,

Figure 16 shows the IRR trends for the three alternatives. A significant increase in IRR can be seen therein, collaborative outsourcing fetching a 60% increment against the non-outsourced case and also boasts an additional 25% in IRR over and above the exclusive outsourcing scenario (Alternative 1).

Figure 16: IRR Relative to the Base Case



Where does this value come from?

The cost effectiveness of multi-client shared services platform (collaborative outsourcing) makes it more affordable for the smaller clients and more profitable for the larger ones. The main platform is usually responsible for up to 80% of the costs (customisation accounts for only 20%) which is now shared between the various clients and hence reduced total unit cost per client. Alternatively, a higher quality service may be delivered to the client at the same cost; this alternative could be preferred by some clients as these depend upon the strategic and key value drivers of each business (could vary between clients).

This study focussed on quantifying the financial benefits from a Collaborative Outsourcing model (multi-client) with the clear target of minimising/optimising costs and hence has been evaluated as such.

Budgetary quotations received for this alternative and subsequent discussions with the water suppliers suggested that the water tariff may be reduced by 30% if shared

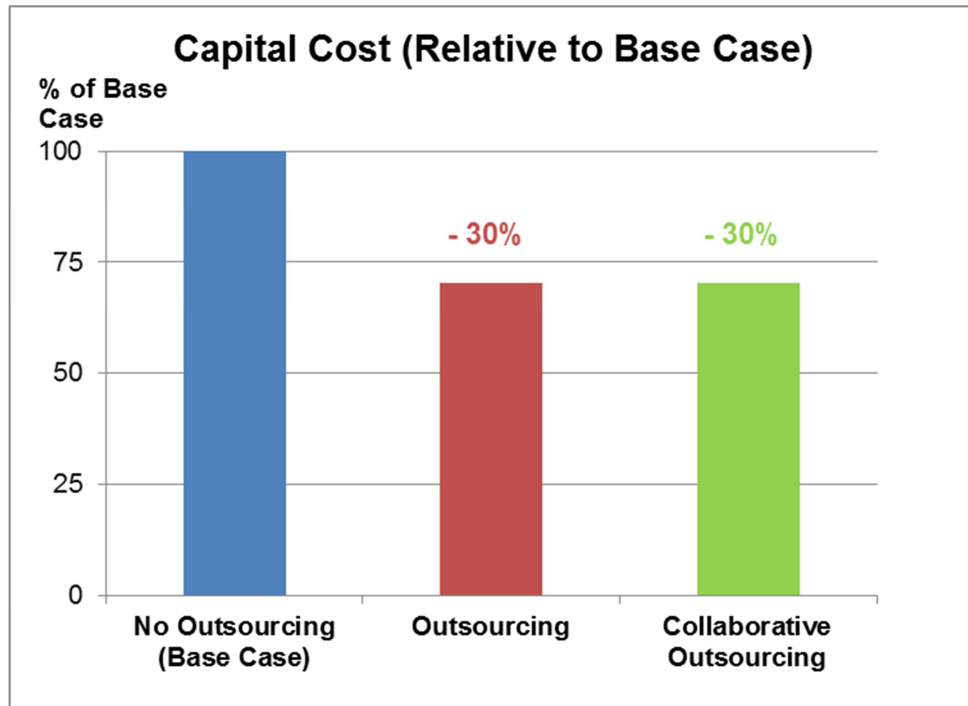
infrastructure is built (versus an exclusive facility – Alternative 2). This brings with it significant cost benefits from both a capital cost perspective (Engineering, Procurement and Contractor Management savings included). The Capex will be essentially be shared/distributed proportionately between the two end users and charges worked back into the tariff as an operational cost. Sustaining capital costs are also expected to be lower for each end user in a collaborative outsourcing model versus having to sustain an exclusive facility.

In addition, there will be operational cost benefits inclusive of maintenance costs that will be shared between the end users thereby reducing the overall unit rates (compared to having an exclusive facility). Further productivity related benefits should be banked as an upside to the aforementioned. Enables technology catching up or leapfrogging, with experts in their fields, promotes optimal process and increased productivities (from design, construction through to operation). These benefits should be managed add controlled, just like everything else in the business, but can certainly be banked.

There is huge opportunity to unlock substantial value though the strategic and collaborative outsourcing plan. This shows that current practices are significantly inhibiting maximum value creation

Figure 17 shows the Capital Costs savings for the various alternatives. The Collaborative outsourcing option presents a 30% decrease in capital costs in comparison to the bas case. Both exclusive outsourcing options and the Collaborative alternative have the same capital cost for the process plant and ancillary infrastructure as they share the same scope (removing scope of water, port and concentrate transport).

Figure 17: Capital Cost Savings



The cash cost is expected to be increased by merely 10%, half of the increment expected for the exclusive outsourced option which increases the base case to 20%. Further opportunities exist to optimise the Opex so as to offset this increment.

The Collaborative Outsourcing alternative is the maximum value adding alternative.

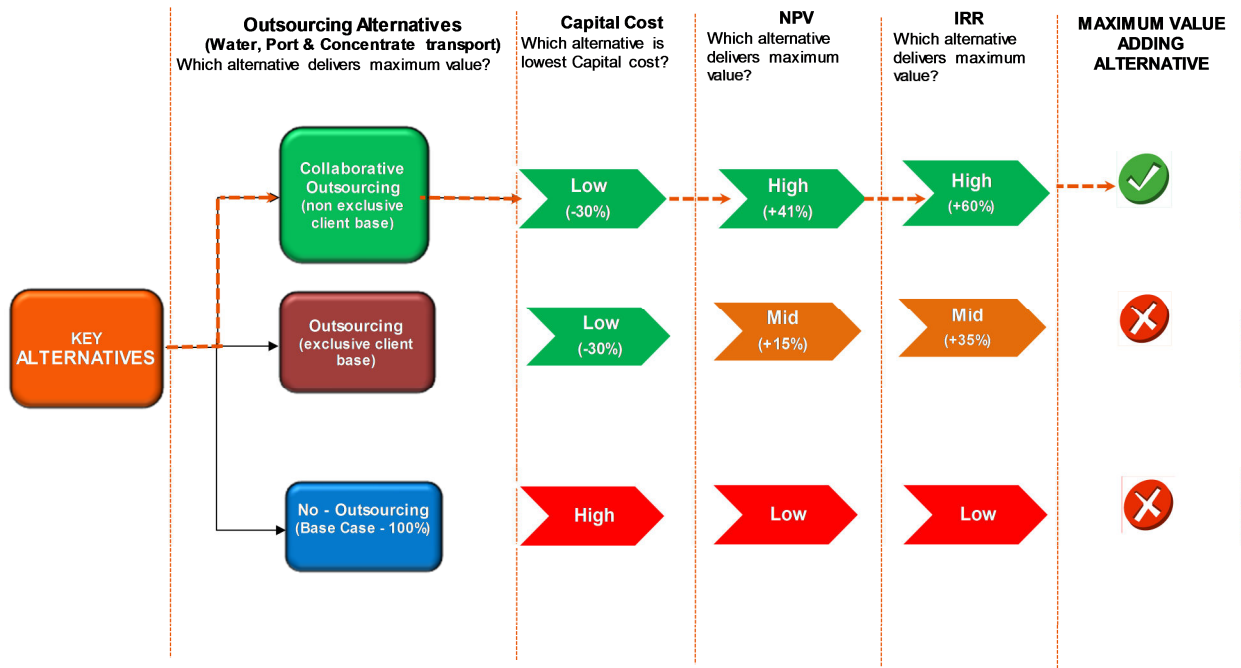
9.4.3 Summary of Results

Figure 18 shows the overall results in a decision tree format. The colour coding has been designed on the basis of value generation, highlighting the route to maximum value.



The path represented by the green blocks represents the highest value in the respective categories. As indicated in the previous sections, the percent increments have been calculated relative to the base case.

Figure 18 : Summary of Comparative Economics



Collaborative outsourcing is clearly mechanism through which value could be maximised though collaborative relationships with service providers and other mining companies. As can be evidenced in the aforementioned Figure,

NPV could be increased by 40% and IRR by 60% as opposed to the non-outsourced strategy which appears to be the most common approach in the business today. Mining companies should be more proactive in finding collaborate solutions to these complex issues which ultimately is aimed towards maximising their respective shareholder returns.

In the selection of the Maximum Value Adding Alternative, it may be concluded that the **COLLABORATIVE OUTSOURCING OPTION** is the **MAXIMUM VALUE ADDING** alternative far more attractive than both the non-outsourced and even the conventional outsourced alternatives (exclusive client base).

10. Main Conclusions

1. Strategic Outsourcing (if implemented judiciously) has the potential to maximise project value through collaborative relationships between mining companies and service providers.

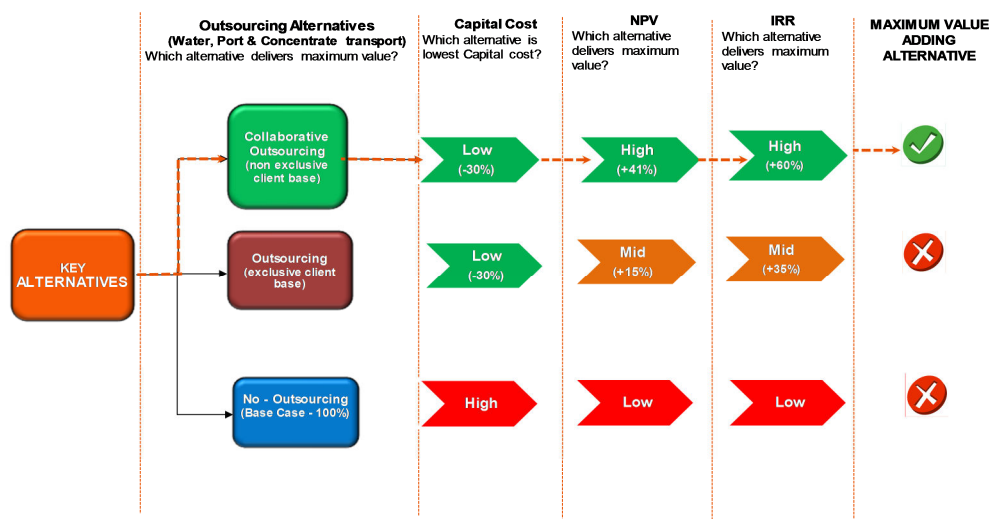
In today's highly competitive and capital restricted environment one has to constantly look for new and novel ways to do things to gain competitive advantage. Strategic and Collaborate Outsourcing, a strategy uncommon in the mining industry today, is one possible solution that may be exploited in the quest to maximise project value. In order to maximise value, Outsourcing cannot be considered in isolation. It has to be seen together with other management techniques developed to improve performance/maximise value such as value engineering, project value analysis, best practice, optimised execution strategies and total quality management. Collectively, project value will be maximised.

If you are not best in the world in doing something and are doing it in-house, you are giving up competitive edge. You could outsource to the best in the world, up the value, and lower the cost.

2. Significant Value could be generated through the collaborative outsourcing

In the context of the case studies evaluated in this study:

- **Lower Capital Cost:** 30% lower capital costs versus non-outsourced option (same capital savings achieved for the conventional outsourcing alternative owing to common scope) (30% of a large number is a big number – capital costs for process plants of this nature are usually in the order of several Billion US\$)
- **Higher NPV:** 40% higher NPV than the non-outsourcing model and 26% higher than the exclusive outsourcing alternative (several hundreds of millions of US\$)
- **Higher IRR:** 60% higher IRR than the non-outsourcing model and 35% higher than the exclusive outsourcing alternative



This incremental value add is significant and may be exactly what's required to sway key investment decisions turning great projects into super projects, good projects to great ones and even those average/marginal projects into more robust and value adding investments changing the minds of the decision makers and bringing them back on line against a decision to close them down.

3. Current practices appear to be restricting the path to maximum value

The collaborative outsourcing model is not commonly used in the industry today. If this type of strategic thinking is brought into the project scope early on, significant value could be added to the underlying project value resulting in win – win outcomes for all (service providers and mining companies will benefit).

It is important to note that most of the mega projects executed in Chile in recent times inclusive of those in their respective study phases have predominantly opted for the conventional concentrator/flotation process. Other than ore feed grade, processing capacity (driven by the characteristics of their respective ore bodies), differences in equipment specifications/sizing and geographical location amongst others, these projects ALL HAVE SIMILAR INFRASTRUCTURE REQUIREMENTS. They all need:

- **Water** for processing,
- **Concentrate transport** mechanisms to move product to port
- **Port facilities** to export product to market.

As was evidenced in this study, the infrastructure costs required to build one facilities has exponentially increased over the years making it more difficult for mining companies to build their own infrastructure each time. This is further complicated by declining metal feed grades, harder ores, longer haul distances required to transport material, rising strip ratios and significantly increasing costs (capital and operating costs), mining companies are challenged with finding more efficient and cost effective ways to meet global demand.

Collaborative Outsourcing is one possible solution hence if mining companies take on a more collective approach with each other and service providers, significant incremental value is to be generated.

4. Outsourcing provides management with highly important strategic and competitive alternatives in today's challenging business environment however this is often seen as a high risk and/or high impact proposition for organizations

This is one of the key reasons as to why organisations are reluctant to go the outsourcing route as the risks are perceived to be very high. The lack of a rigorous strategic sourcing methodology and complete market and risk analysis to produce a robust and effective outsourcing strategy is often lacking and hence presents significant risks to an organisation.

Having said this, the more successful organizations have developed:

- Comprehensive approaches to project planning and decision making;
- Employed rigorous tools, frameworks, and methodologies;
- Demanded excellent cross-functional and cross-company teamwork; and
- Implemented highly effective risk management, performance management, compliance and control techniques, and disciplines

These have been discussed in detail in Section 8 (principally section 8.4 and 8.6) of this report which talks to the various processes and methods to identify risks, implement actions/controls to mitigate these risks and a solid risks management process to control and monitor these risks. Clearly these are not the only methods and process available however they do provide a solid basis from which to work and may be customised to suite each of the respective business interests aligned with the strategic fit of the companies. In addition, the outsourcing service provider is subject to the same risk but this can be significantly reduced in the Collaborative Outsourced model when the investment is made for and spread over for a range of clients (non-exclusive client base)

5. The re-evaluation by Organisations of their Core Competencies, Core and Non-Core Business functions is of utmost importance. These are dynamic and change over time hence the need for constant updating.

The concept of core competencies is an important one, it is those activities and/or resources possessed and utilised by an organisation to establish a competitive advantage. This represents the foundations on which any decision to outsource is based. Given that these are dynamic and change over time, it is critical for organisation to re-evaluate these so as to ensure that there is alignment between the market conditions and the strategic fit of the organisation (doing the same things in the same way will not detrimental to the success of the organisation, especially if these are out of date).

In order for core competence to be value adding, it is imperative that the competency is clearly defined and understood by the organisation so as to maximise its advantage/value. These competencies are also associated with people's attitudes and behaviours within the company, its products and quality. These must be lined to the end product of the organisation (core products) and are essentially made of those elements actually contributing to the value of the end product. To this end, the control over the core products enables an organisation to dictate or mould the end products whilst at the same time, outsourcing of the non-core business items would alleviate the organisation to focus on the key value drivers within the core business activities. By understanding where the value will come from, companies can make better strategic decisions about whether outsourcing is a necessary or even appropriate way forward.

6. Not having the right people in the right roles will certainly result in sub optimal results, no matter how robust the plan is. The outsourcing team is crucial to the success – from strategic planning through to implementation.

Project planning and management are critical disciplines to enable successful outsourcing initiatives. The planning and management referred to herein go beyond Gantt charts and critical path analysis (even though these are fundamentally important disciplines and tools). It is fundamental to the success of the outsourcing strategy planning and implementation, the effective use of the people who possess the appropriate project management and risk management skills and experience and the ability to use the right tools and programs to get the work done. The step up culture concept is also a key and critical one, which shapes the types of people you need to be able to share the vision and most importantly take this to fruition. Without the right people, good ideas will remain as just ideas. The right people, in the right roles are required to turn these concepts to profitable business solutions. **These require high level strategic thinkers to be able to drive these ideas and develop them into tangible value adding outcomes.**

Members of outsourcing teams need to also bring with them specific knowledge regarding the outsourced product or function, business and stakeholder objectives, and the knowledge of the market and the skills to analyse the potential supply market and associated risks for the product or service to be outsourced. Team members must also be able to think critically about and assess what could go wrong and put sourcing and risk mitigation/contingency strategies and plans in place to handle those scenarios. Team members should also step up to the challenge of breaking intercompany/industry/country paradigms and implementing new and innovative thinking into the ways we do things.

When firming an outsourcing team, there are several key characteristics that one should look for:

- Diversity of skills and opinion. The team must be cross-functional and members should have multi-disciplined backgrounds
- The team should be made up of people who will challenge themselves and others
- The teams should contain the skills required to plan, analyse the supply market and risks, source and select suppliers, negotiate and to plan negotiations effectively, and design and execute comprehensive and effective contracts and supplier relationships and controls
- They should be self-directed and should not easily accept the status quo (break paradigms, get people to think differently)
- Supplier, product, and process-specific knowledge must be represented on the team. They must be able to work with people at all levels of an organization, internally and externally

“If you are not best in world in doing something and are doing it in-house, you are giving up competitive edge. You could outsource to the best in the world, up the value, and lower the cost.” (James Brian Quinn, The Outsourcing Institute).

7. Mining Companies can work together with service providers in a collaborative outsourcing model

A series of conversations were held with key Executives from other mining companies. The fundamental objective of these initial discussions from the onset was to get a feel for whether these companies are willing to work together (either directly or indirectly) within the context of a collaborative outsourcing model. Each of the executives in question was keen and very open to this type of collaboration which is clearly pointed to the best interest of the respective business. Further work is required to consolidate this and make this a reality; however, there appears to be little resistance to make this happen. Clearly the issue of timing of projects will be important for these to flourish however if the need and urgency for developing these has been created, the timing would work itself out.

In fact, mining industry has demonstrated that it can collaborate with each other. Technology research projects is a case in point e.g. AMIRA International Ltd, an organisation which develops, brokers and facilitates collaborative research projects. It is a member based organisation of various mineral companies and even suppliers which may jointly fund research initiatives and share the benefits from these. Access to the world's leading researchers and suppliers are made possible through this collaboration.

Another example of collaboration (closer to home) is the CLUSTER PROGRAM largely driven and lead by BHPB Billiton and Coldeco which endeavours to developing local suppliers and service providers to world class level.

Why can't mining companies come together in the context of collaborative outsourcing?

8. Technology and Innovation continue to play a key and critical role in the quest to maximise value

As had been mentioned on several occasion on this sturdy that Innovation and Technology development are key and critical components of the process in the strive to maximise value by way of reducing unit costs and increasing productivity and competitiveness. In light of the challenges facing the mining industry, there is a greater sense of urgency to see things initiatives brought to the field.

The optimum technology mix couples with the strategic outsourcing model, is envisages as the right recipe in the attainment to maximum value.

Industry should be aggressively pursuing/promoting more “out of the box” type thinking so as to break down existing paradigms in pursuit of novel initiatives which will certainly result in newer, fresher and more efficient ways of doing things. These initiatives should be uncovered sooner rather than later. There is sense of urgency, THE FUTURE IS NOW.

9. Collaborative Outsourcing brings with it potential benefits to Communities/Local Service Providers

- Could create local job opportunities during construction and even operation of the service facility (development and training to develop the required skills)
- Communities could benefit from services e.g. the construction of a desalination plant to service multiple clients (the collaborative relationships), could be extend to provide marginal intake of water to local communities (shared/joint community projects could be promoted via a shared cost base structure)
- Collaborative Outsourcing model brings with it a more cost effective solution through a multi-client shared services platform (reduced unit costs). This makes it more affordable for the smaller clients who otherwise, would not necessarily have opted for the service. Enhanced profit margins will make smaller businesses and even the larger ones more sustainable hence the local workforce and communities benefits from these
- Incentive the industry, service providers and even government institutions to start to think of novel ways to add value collectively via collaborative e.g. local taxi services may decide to join forces and create a common an integrated service to transport mine works to and from the airport (e.g. Calama or others) as opposed to having multiple smaller services. This will promote enhanced quality at optimised costs to the clients and also give smaller service providers a chance to enter the market (to meet the high demand).

10. Opportunities for Further Investigation/Research

The concept of collaborate outsourcing may be extended to a series of areas looking to maximise the underlying value of the business.

- Exploit opportunities to optimise the costs associated with concentrate transport and port services. These have not been investigated herein; however opportunities exist to optimise these
 - Port – costs (study and EPCM) associated with either modifying or expanding existing infrastructure should be shared approached via collaborative approach with multi-client base in mind (lower unit costs)
 - Concentrate transport – identify synergies with existing services (e.g. round trip concepts where trains/trucks bring in acid (or other consumables) to mine and return to port with concentrate)
- Extend the Cluster program to beyond that of just BHP Billiton and Codelco. Engagement of other mining companies and even government institutions to

continue to developing local service providers to provide support to the efficient operation and maintenance of the service facility. This will promote a more rapid development of the local skills endeavouring to bring these up to world class standards sooner

- An opportunity exists to extend the cluster scope (usually focussed on short term optimisation of existing unit operations) to be involved early on from the design phases (an area that has not yet been pursued by Cluster, hence the opportunity). This will start to exponentially develop local expertise in the design space through exposure to international industry experts (amongst others) and consequently build up a highly developed technical skills set. An analogy to China, aspiring to extend beyond the realms of just a low cost mass producer (“Made In China”) to that of more sophisticated innovation and design (Designed and built in China)
- Undertake more benchmarking analyses - The industry in general does not benchmark enough. This is a fundamental tool to be able to identify best in work, compare one’s own position to that marker and subsequently implement actions to pursuit of best in work results
- At the risk of not being a specialist in the Environmental Impact Studies, there appears to be opportunities to collaborate more with mining companies and government institutions to look for more effective ways to generate the environmental impact study analyses. Clearly the overall EIA is unique to each mine/operation and should be evaluated as such however there is significant amount of scope that is common. Recognising that this is time sensitive task, it is often the case that mining operations undertake these in similar timeframes, and cover large areas common to both (communities, pipeline routes etc), in the acquisition of data required to feed their respective studies. This activity is often seasonal and hence takes a period of 9-12 months. A more efficient approach, without compromising the equality of the information required, could be explored though a more collaborate approach between mining companies and the t respective governmental institutions which could act as the governing/regulatory body.

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Disclaimer: Owing to the sensitive nature of the information inclusive of Intellectual Property, no further detail to these references could be made available herein

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 - Project Development Manual,
 - Major Capital Projects (Minerals)
 - Schedule Classification
 - Capital Cost Estimate Classification
 - Legal council
 - Anti-trust and Anti-Corruption
 - Anti-Competition
- BHP Billiton, Santiago Hub Study reports
 - Escondida Projects (OGP1, EWS)
 - Spence Hypogene (SHP)
- ICA; CRU International, Brook Hunt (websites & publications)
- Interviews with BHP Billiton Copper staff:
 - Osvaldo Urzua, Institutional and Government Relations Manager. Osvaldo has lead the BHP Billiton Cluster initiatives
 - Cleve Lightfoot, Global Technology Manager
 - Sebastian Greco, Supply Manager, Pampa Norte Asset
- Interviews with Mining Companies (3 x companies with operations based in Chile)
- Interviews/meetings with service providers
 - Water: (6 x water companies and 2 power companies)
 - Port: (4 x companies)
 - Concentrate transport (1xtrain and 2 x trucks)
 - Budgetary quotations from services providers