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Mining Innovation State of Play 2013

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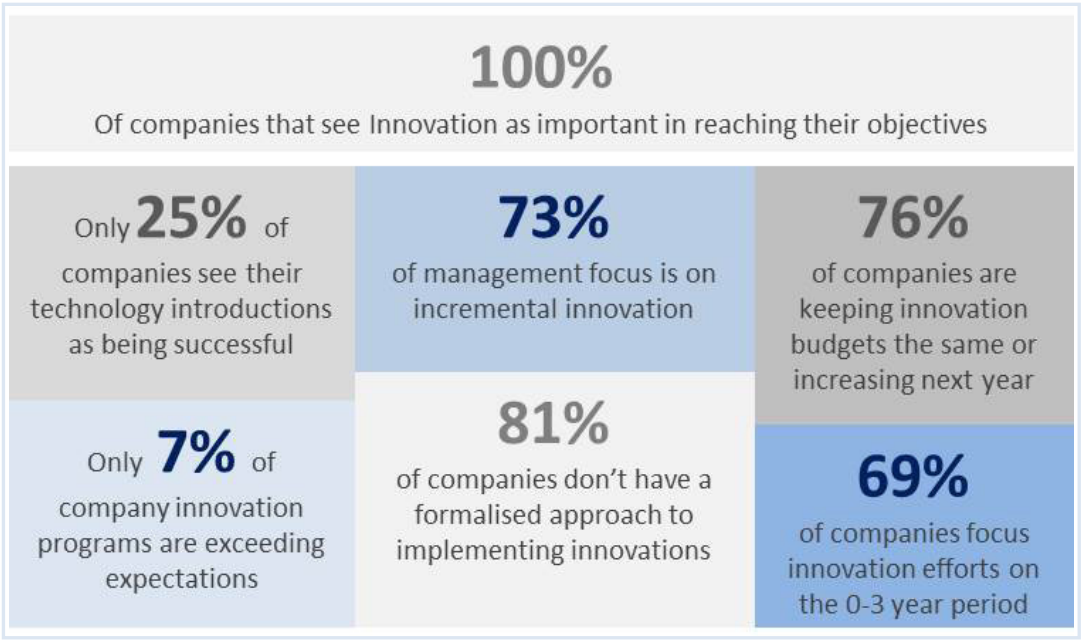
About this report from VCI

There have been a large number of reports on innovation across all geographies and industries however the mining industry has been largely overlooked. There has been limited focus on understanding the innovation strategies that global mining companies are deploying, and the performance that they are achieving as a result of these programs. VCI's Mining Innovation State of Play survey aims to contribute to bridging this gap, by canvasing the views of senior decision makers across 20 of the largest global mining companies.

'Business has only two functions; marketing and innovation' Milan Kundera

The survey reflects the broadly held view that innovation is a very important determinant of future success, however, the level of action taken on innovation does not correlate with this view of importance. The purpose of this report is to understand the constraints the industry faces in using innovation to underpin the achievement of their business strategy and based on these insights, offer three key recommendations to achieve greater impact from their innovation efforts.



1. What is innovation?

Innovation is a widely, and often loosely used term. It is unusual to see an executive presentation discussing strategy or operations without innovation being referenced. So what is “innovation”?

When we asked respondents to define innovation three consistent themes emerged:

- Doing new things (changing)
- Utilising technology
- Increasing business value

Utilising these themes the definition we have adopted is ‘innovation is an endeavour to meet an existing or emerging challenge in a new way that increases business value.’

The industry appears to view innovation as being biased towards changes in technology. Whilst technology plays a central role in innovation we believe it is important that innovation is viewed from a broader perspective. At its highest level innovation begins with the business model and all of its commercial, organisational and technological components. Innovation helps businesses overcome the challenges that stand in the way of them achieving their stretch aspiration and strategy.

> *“Innovation is an endeavour to meet an exisiting or emerging challenge in a new way that increases business”*

The ultimate measure of innovation success is the creation of business value and competitive advantage. One of the survey respondents elegantly captured the essence of innovation success, noting that “You know you have achieved innovation success when people on the periphery (of the innovation effort) begin to claim involvement!”

The perceived importance of innovation

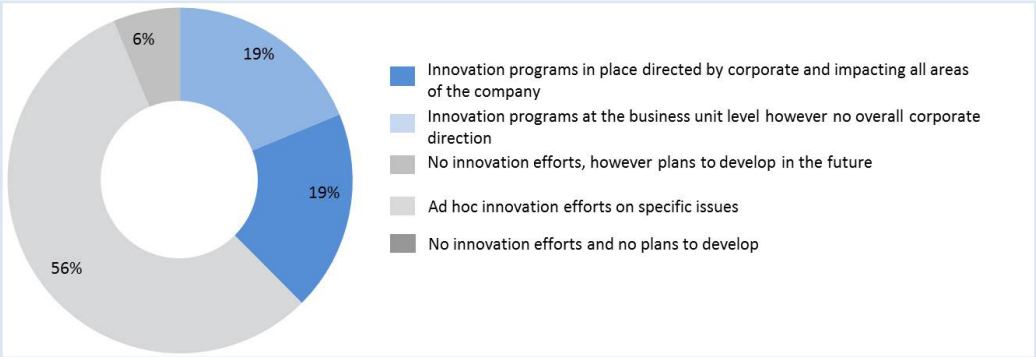
As noted earlier, the mining industry sees innovation as being very important for its future success; however actions do not seem to reflect this sentiment.

Roughly 75% of participants said they won't reach their committed targets without the use of innovation [Figure 1]. Given the challenging industry environment, deterioration in productivity over the last decade and reducing margins, it is no surprise that respondents feel that new things need to be done.

Figure 1: Importance of Innovation in achieving your long term business strategy

This stated level of importance contrasts with the respondents current actions - 62% of the companies classify their innovation efforts as "ad hoc" or "non-existent" [See Figure 2]. Further to this, when asked about the level of structure in implementing new innovations, 81% of companies were either "not very structured" or "completely ad hoc."

Figure 2: Breakdown of Innovation project efforts



Perhaps this lack of a structured approach to innovation reflects that for most mining companies' innovation is seen as adding value, but is not yet seen as essential for survival or growth.

"Innovation is generally not seen as essential for survival or growth"

To some extent the perception of the need for innovation in the mining industry can be explained by the structure of industry competition. Barriers to entry can be very high due to large capital and infrastructure requirements, and for those companies with access to long life, low cost ore bodies there is no survival imperative to innovate. For companies with operations that are marginal over the long term, innovation is an imperative.

These businesses however are often caught in a “boom-bust” cyclical trap where either: margins are very high and innovation falls off the agenda; or the business is focussing on short term survival and investment in innovation gets shelved as part of cost cutting exercises.

The perception of the need for innovation in mining should logically be shifting as gaining exclusive access to long life, low cost assets with existing development methodologies is diminishing, whilst at the same time commodity prices are softening.

Our results indicate that when innovation is seen as critical to success, the approach to innovation changes. These companies typically described their biggest challenges as developing new ore bodies that are un-exploitable (unsafe or too expensive to mine) using traditional methods and therefore have a distinct need for innovation to grow. They were inevitably more focussed, structured and took a longer term perspective of innovation.

Further to this, of the small sample of mining service companies surveyed, 75% of them indicated that innovation was critical to their success compared to only 19% of mining companies. This is not surprising given innovation in their offering is critical to survival, and is akin to the exploration imperative for an integrated mining business.

If current business conditions continue, and relatively straight forward cost cutting opportunities are exhausted, we would expect to see innovation increasingly seen as critical for survival and growth, not just an important option.

2. Where we innovate

The mining industry’s innovation focus is heavily oriented towards process and operational improvement. When asked where their innovation efforts were focussed, the majority of responses were aimed at processing, while the top three drivers for innovation were operational in nature:

- increasing productivity
- reducing operating costs
- reducing capital expenditure

Although technical and operational improvement through innovation is critical, innovation has a far broader potential application in helping businesses achieve their strategy. Business and operating model, organisation, marketing and sustainability are also key areas that the innovation process can help create new ways of realising value [Figure 3 overleaf]

Mining companies mostly focus on short-term, incremental innovation

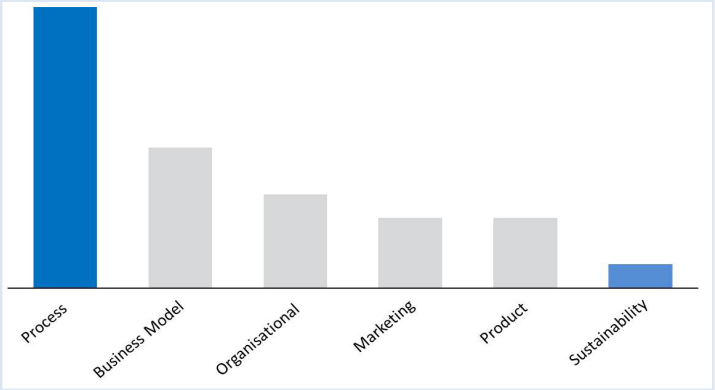
Despite the industry typically adopting ‘growth at all costs’ strategies over most of the past decade, the innovation focus within the industry has remained directed towards short term operational objectives.

The majority of respondents focused their efforts over the 0-3 year time horizon [Figure 4 overleaf]. In fact, mining companies allocated on average about 73% of their innovation budget targeting incremental operational improvements. While there are certainly large benefits to be realised by optimising within this time frame, the lack of spread across the longer time frames was surprising given the length of life of the average asset [many ~ 20

years or more].

The observed approach is consistent with the widely adopted fast follower model for integrating new concepts and technologies into mining businesses. This model is largely driven by the lack of competitive need to be first, coupled with the assumed risk associated with developing and implementing new approaches.

Figure 3: Focus area of Innovation efforts



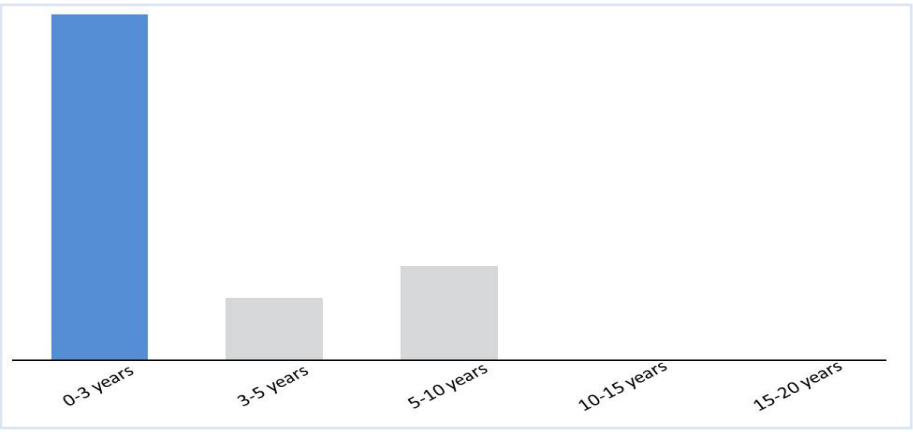
Given the relatively narrow innovation focus, and incremental time frame, the obvious question emerges as to where longer term, step change innovation will come from within the mining industry. One major source will likely be via the network of suppliers and service companies that support miners. Large service companies can have R&D budgets up to 10 times those of mining companies (% of revenue basis). Added to this is the reality that services companies compete for survival based on the quality and value of their offerings, which is ultimately driven by their ability to innovate.

This drives two major questions for mining companies:

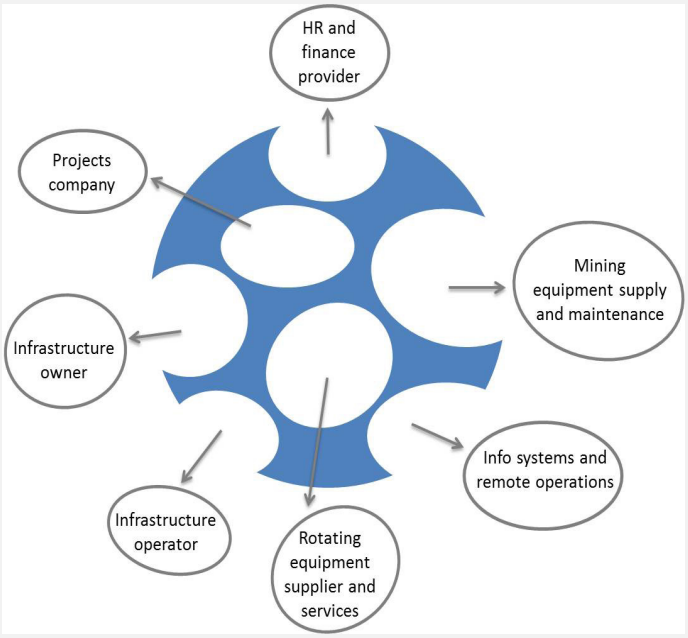
- Where should they take the lead in longer term innovation?
- How can they shape the contribution of suppliers to achieve their objectives?

The question for mining companies therefore still remains as to where they themselves should take the lead in longer term innovation, and how they can shape the contribution of suppliers to achieve their objectives. In part this question has underpinned the recently observed trend away from a simply transactional relationship between mining company and supplier and towards increasing alignment and the formation of development partnerships. We expect this to continue into the future, albeit with some temporal pressure as industry margins are reduced.

Figure 4: Time frame for the primary innovation focus



Service companies and the changing face of mining...



19% of mining companies saw innovation as critical to their success however 75% of mining services businesses saw it as critical when we asked the same question.

As global competition increases, and services business continue to innovate and become more advanced (particularly technologically), their offerings to the mining industry will become greater in breadth, more embedded and higher in value. What could also occur is an accompanying increase in both value created and captured by services companies, as well as an increased dependence by mining companies on the technological capability of service companies. This trend is well advanced in other industries and "fast forwarding" to the end game in mining, one could see mining companies primarily focussed on accessing and securing access to mineral resources, deployment of capital and protectors of industry brand.

Why is this important? Simply put, mining companies can either benefit or lose from this trend depending on how they react and shape the business network to their advantage.

The focus on health and safety, social and economic development and sustainability is surprisingly low

A surprising outcome of the survey was the relatively low current and future focus on innovation in health and safety, social and economic development and sustainability. We expected higher results, given the highly public statements made by mining executives and the importance of addressing challenges in these areas to long term value creation.

Social and economic development and sustainability

Despite being essential to accessing and developing new ore bodies, improving social and economic development and reducing environmental impact rated in only the third and fourth quartile of responses.

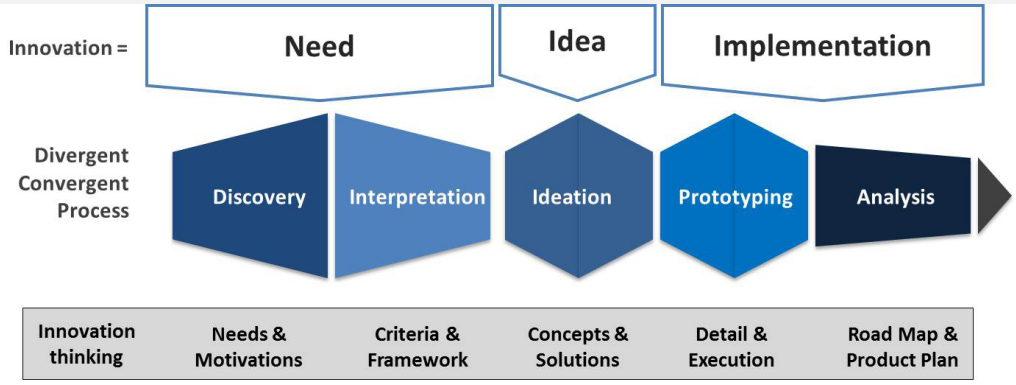
Prospective new ore body opportunities are increasingly located in emerging economies, where the associated social, political and economic development complexity is significant. Furthermore, the situation is highly dynamic with local communities and governments becoming more sophisticated and expectant in terms of the positive social and economic dividends that mining developments should bring, and also in the absolute level of "rent" that the community should extract.

Figure 5: Strategic imperitives for utilising Innovation

Given the increasing strategic need to find new models for developing communities and economies, why then does innovation in this area not rank more highly in articulated priorities? When this question was specifically asked in follow up interviews, two potential reasons emerged. Firstly, because of the experience profile of people in the industry, innovation is seen as an operational and technical issue and is mostly not equated with the challenges of community and economic development. Secondly there is an underlying view that the community and government appetite for support is ultimately insatiable, so businesses tend to restrain their interactions, rather than pro-actively contribute to innovation in this arena.

Either of these explanations suggests a change in approach is required. Given that sustainable access to new ore-bodies is a core value driver for any mining company, utilising innovation to design new methods to secure these ore bodies that meet the needs of the communities, governments and other stakeholders should be a high priority.

VCI's Innovation Process



The innovation process is a replicable tool that can be used to develop an optimum solution for complex problems. The process is driven by gaining a deep and abstracted understanding of the challenge that is being solved and, starting with "what can be" approach, overcoming constraints through ideation and prototyping. This differs from regular problem solving processes that starts with the constraints and then developing a solution that fits within them.

Innovation and the focus on Safety

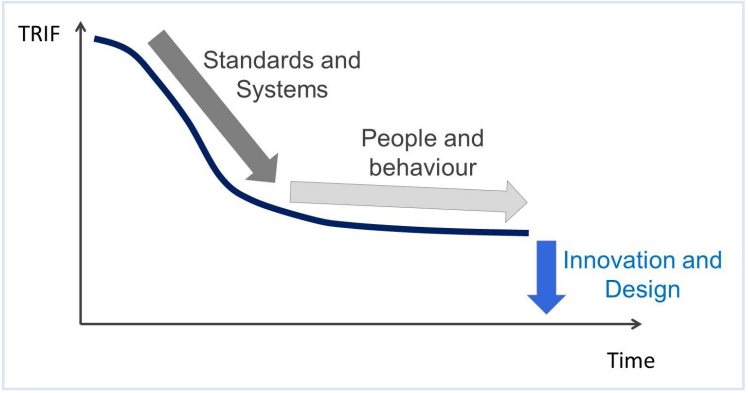
Safety was the sixth ranked response in terms of innovation focus, which is seemingly at odds with the primary importance of this topic to mining companies.

Follow up interviews suggested that this apparent disconnect is potentially due to two factors. Firstly, there is an intuitive belief that operational innovations such as automation and remote operations, will also inherently achieve the aims of improved safety. Secondly, and more significantly, safety challenges are seen as more of a behavioural and relationship management issue than something that can be addressed through an innovation challenge or innovative re-design of assets.

While behaviour is unarguably critically important in safety performance, innovation and design will become increasingly important. Figure 6 [see overleaf] underlines this point that improvement in safety is beginning to plateau in many companies and that innovation and design will become relatively more important to change this.

We are already experiencing an increasing application of innovative clean sheet redesign in an effort to separate people from sources of high energy and also the application of human factors research to find new ways of improving safety. We believe these trends will continue and probably accelerate.

Figure 6: Improvement in safety over time

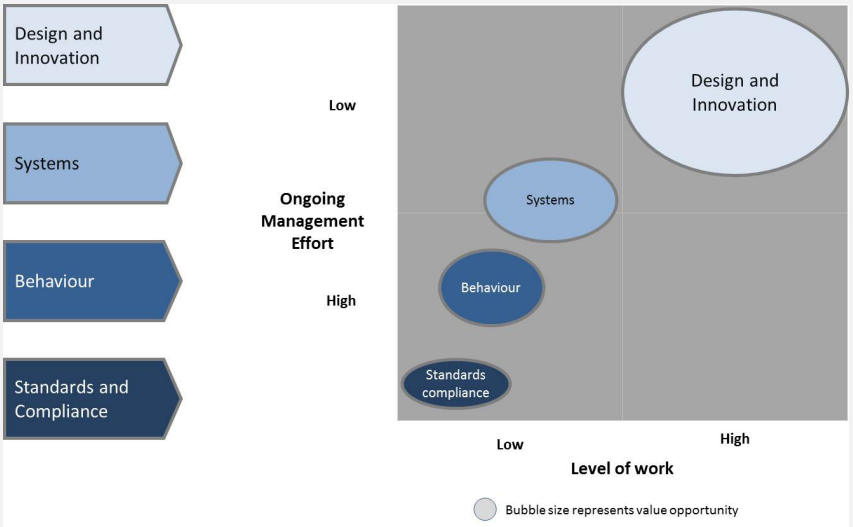


Use of Design and Innovation for step change safety improvement

Figure 6 shows the plateau in improvement in TRIF. It is clear that to reach the next step in improvement a new approach is required.

Fundamentally, injuries are caused by people being located near high energy sources (kinetic / mechanical / thermal). Past efforts to improve have been based on altering human behaviour requiring extensive ongoing management. The opportunity is to utilise the innovation process to find new solutions to separate humans from the high energy sources. Once separated, the ongoing management efforts will also decrease.

This is essentially a high level design challenge that requires a step change [future mine] vision, and structured roadmap for inclusion of this vision in both growth projects and existing operations.



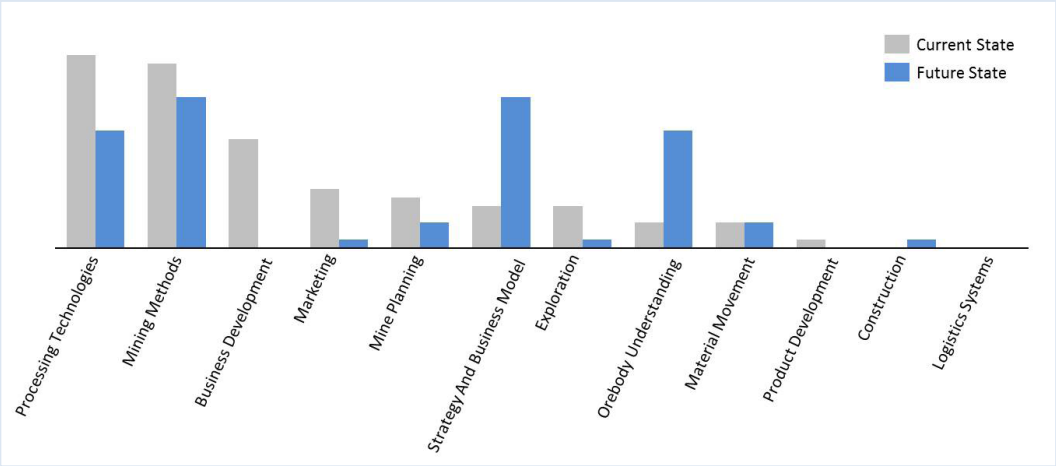
The outlook for innovation is more strategic than today's focus of processing and mining

When asked where innovation will create the greatest value, now and in 10 years there was a significant shift. Over the next 10 years companies suggested that they are intending to re-orientate innovation efforts more towards long term objectives such as strategy, business model and ore body understanding [Figure 7 overleaf].

Major value creation potential exists today by improving operational methods and processes, as we sit on the cusp of step changes in automation, continuous mining, processing technologies and accompanying new organisational models. We expect this trend to accelerate over the next 10 years. It is also clear that in the future, increased understanding of ore bodies will provide a strong advantage given the increasing difficulty in finding, securing and developing them. We are already seeing evidence of increased development efforts in this area.

While the rationale for focusing on process and ore body is readily apparent, the question remains as to what will catalyse the shift from the current paradigm of innovation being an operational challenge, to one which is more inclusive of strategy and business model design as suggested in Figure 7.

Figure 7: Where Innovation Will Create The Greatest Value (Current And 10+ Years)



One potential catalyst may be shareholder demands: Value strategies have typically been driven by M&A and green-field development projects with the benefits being locked in by operational improvements. Given the recent high-profile failure rate of megaprojects and M&A transactions, as well as decreases in industry productivity, we are seeing pressure from investors demanding a more prudent approach to capital deployment.

Possibly the most potent catalyst will be the natural cycle of industry competition. That is, as strategies become indistinguishable, the inevitable consequence is decreasing margins, with the only remedy ultimately being business model and strategic innovation. It may well be that the originators of new business models will come from outside the traditional mining companies.

The potential for this catalytic change is not theoretical, as at least one respondent highlighted that "the industry mostly sees innovation as operational and technical, but the real value is in the business model this is where we are innovating."

3. How we Innovate

By the very nature of the challenges historically faced and the types of people attracted to these challenges, the mining industry has very sound foundations on which to build a highly successful and innovative industry. However this great foundation has not yet reached its full potential, the reasons for which respondents mostly attribute to leadership and structures associated with innovation.

The mining workforce has the right culture, capability and intent to harness innovation

Today's miners are a highly resourceful, collegiate and creative group – the ideal ingredients for a successful and lasting culture of innovation. Given mining executives universally rated innovation as being key to achieving stated business objectives, it is clear the industry is

strongly positioned to aim for step change performance.

When asked to describe how they rate their company in the foundational elements for innovation success, mining executives identified two critical areas where mining is strong:

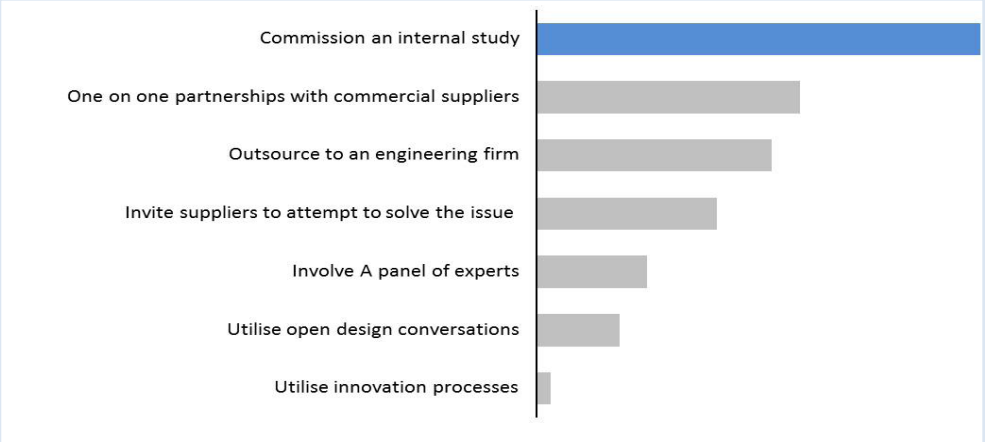
- We use diverse multi-disciplinary teams
- We have a culture of questioning assumptions

These provide a strong foundation upon which to build an innovative company and culture. Significantly, executives also said that, despite tightening margins, funding for innovation will largely be kept intact given its role in addressing important challenges – particularly productivity. This further underpins intent, providing recognition of the importance of innovation in meeting business objectives.

The mining industry underutilises the range of innovation methods

The survey results showed that when mining companies are faced with a large and difficult technical or operational problem their first instincts are to commission an internal study, rather than adopt innovation approaches.

Figure 8: Common methods utilised for solving complex challenging problems



This response is possibly driven by an underlying view that innovation methods are risky and impractical, or because of a natural competitive tendency to keep issues in-house.

> *'We look mostly at R&D and off the shelf – we should be much more deliberate across the value chain by applying the most appropriate innovation methodology'*

In reality, success in solving these difficult problems requires a contrary approach. Firstly, when faced with a difficult technical issue, it is generally a truism that there are always more potential solutions and capable people outside the business than within it.
Secondly, in mining as in most other industries, the breadth of the competitive landscape is often overstated. Mining companies mostly compete for access to ore-bodies, so the competitive rational for turning inwards to solve many process and operationally related problems is limited. Finally, well architected innovation processes need not involve unacceptable risk if the process and pilots are structured effectively.

One manifestation of the reluctance to embrace innovation processes is that problems are only temporarily mitigated and fundamental issues become embedded. The mining industry is at risk of, as one interviewee said "continually building the newest – old mine" which given the life of assets, is sub-optimal long term.

Recently, in response to the increasing complexity and magnitude of challenges, we have seen a shift towards more open innovation approaches that 'bring the outside in' through cross pollination with other industries, consortia and partnerships. This follows the well-developed path taken by other industries such as pharmaceuticals and fast moving consumer goods, which provides a useful roadmap for innovation methods and processes. We expect this to become more common as the industry sees the results of some of the early adopters of these approaches.

4. Three recommendations for innovation success

Perhaps the most telling insight into the state of innovation in mining was the outcome that less than half of the respondents felt innovation programs in their businesses were meeting expectations. That is, it can be said that a majority of executives were dissatisfied with their innovation programme results.

Figure 9: Improvements to increase success of innovation programs

Some of this performance can be explained by the fact that structures and processes guiding innovation are not, in general, sufficiently developed in mining. For example, only 1 in 5 companies have a company-wide innovation program in place, and even if they do, approximately 80% have not developed clear structures for capturing, developing and implementing initiatives.

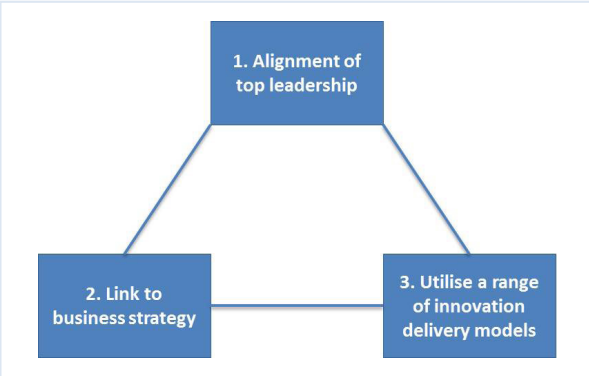
Industry executives also identified fundamental issues impeding innovation performance [Figure 9], with key priorities including the need for: a more direct link with strategy; greater leadership alignment and advocacy; greater clarity in the guiding "future mine" vision and its tangible implications; and articulation of the innovation need through identification of a compelling burning platform.

Drawing from our experience in guiding step change strategy and innovation processes, combined with the insights drawn from this survey, we have identified three foundation principles for mining companies seeking greater impact from their innovation.

They are:

1. Align top leadership on the need for change, with the CEO assuming the role as "visible champion"
2. Link innovation directly to business strategy, and connect with a guiding "future mine" vision
3. Utilise a range of innovation delivery models and bring "the outside in"

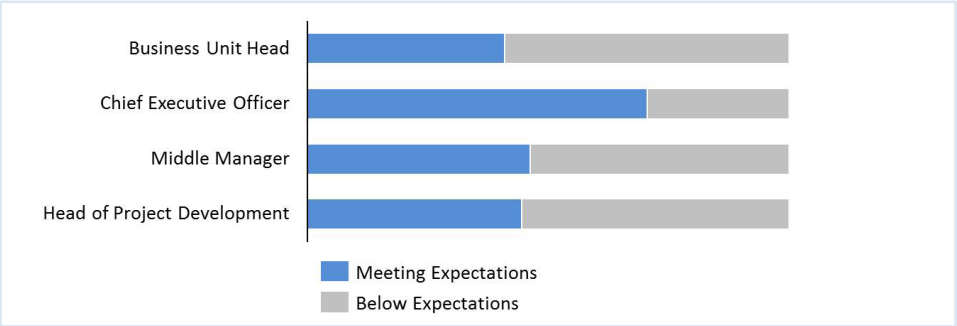
Figure 10: Recommendations for innovation performance



1. Align top leadership, with the CEO as "visible champion"

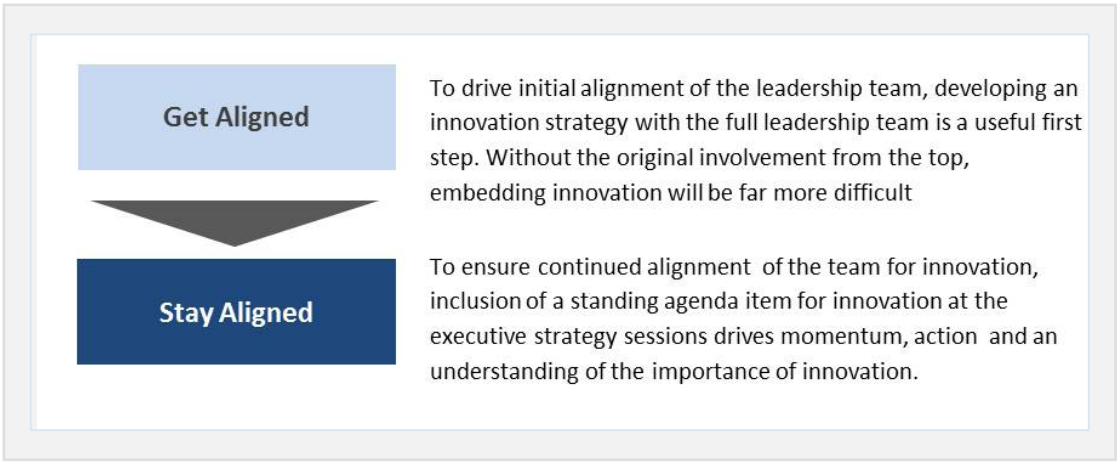
By definition, real innovation requires substantial change, and a fundamental starting point for any successful change process is aligned leadership. Respondents identified this factor as a high priority, along with visible CEO leadership. The point is underlined by the data in Figure 11 which demonstrates that when the CEO takes a visible leadership position, innovation programs meet expectations more than 70% of the time. When others assumed the primary leadership role, success rates dropped to well below 50%.

Figure 11: Driver of Innovation vs. Performance of Innovation



There are three overarching reasons why executive leadership alignment is critical. Firstly, it creates the top cover necessary for innovation work to proceed, which by its nature is counter cultural and potentially threatening to the status quo. Secondly, innovation work must be closely aligned with strategy, and this can only occur through the work of the top leadership team. Finally, CEO led programs are more likely to survive business cycles.

While the push of the CEO will drive alignment of the executive team, it is crucial that the executive team effectively cascades the vision and process further into the organization. Without this deeper engagement, many innovation processes have failed in the early stages of implementation.



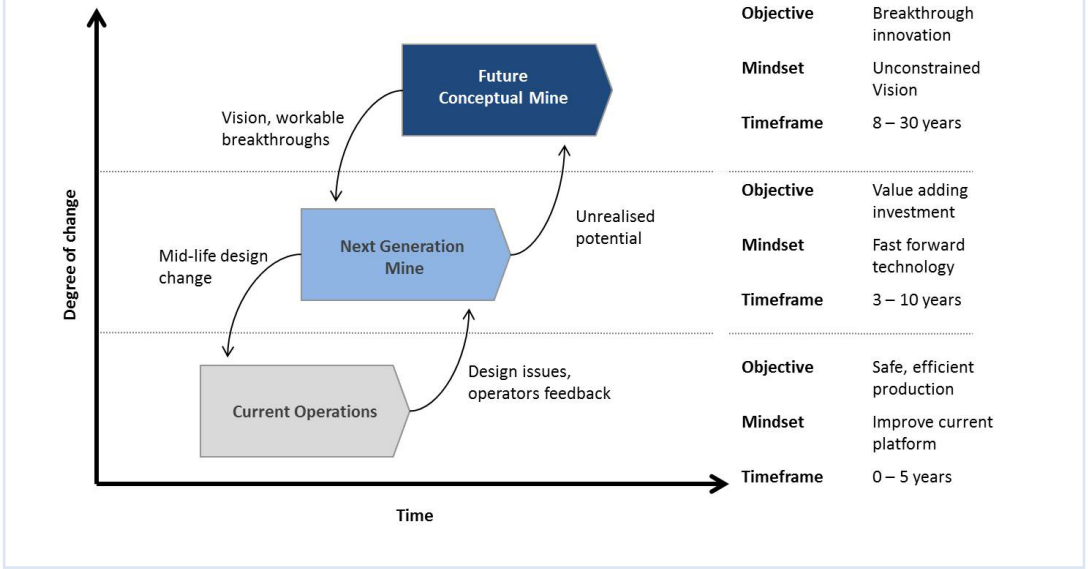
2. Link innovation directly to business strategy, and connect with "future mine" vision

Linking innovation to strategy was the most important factor identified by respondents when asked how they could improve their innovation programs. One of the most effective methods of achieving this is to develop a "future mine" vision that will deliver the business aspiration and enable its strategic objectives, and then utilise this structure to manage the innovation program.

The value of a unifying vision has been demonstrated through the leading innovation programs at major mining houses such as Rio Tinto – with its highly successful Mine Of The Future™ program – and at AngloGold Ashanti with their Technology Innovation Consortium. Each of these visions provide technology, systems, people and change roadmaps that transcend short term, cyclical imperatives.

When structured in this manner, the vision creates 3 distinct tiers [similar to that used in the automotive industry] allowing the business to separate the distinct layers and work style of the conceptual future mine from the next generation flagship greenfield mine, and from improvements in the current operations.

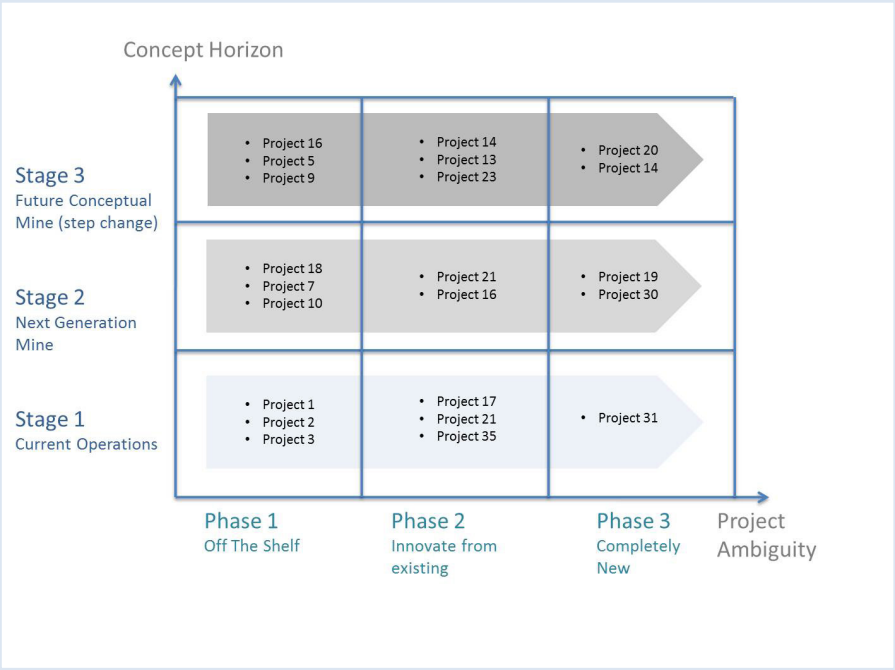
Figure 12: Tiered future mine structure



The key element is to have insights and implementable innovations cascading down into the lower tiers. Simutaneously key learnings and challenges from below are reflected in the upper tiersas innovation challenges.

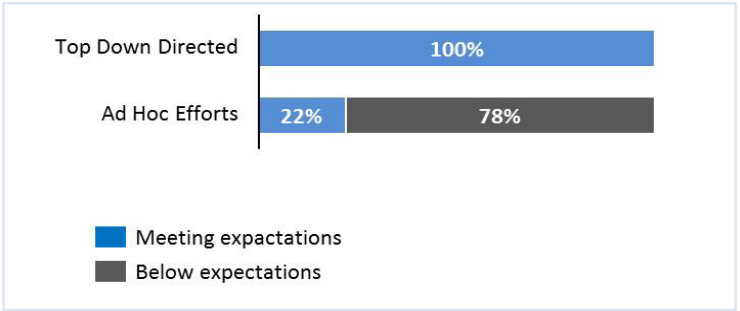
Once a future mine vision is in place, this can readily be translated into a staged and phased roadmap of “innovation projects” across the business. This roadmap is critical for successful management and implementation of innovation programs as it provides a “master plan” or systemic view of projects critical to delivering on the strategy. It also allows better financial management of innovation as spending is deliberate and targeted.

Figure 13: Staged and phased roadmap



The effectiveness of a structured innovation program was reflected in our survey, as those companies that had top down directed innovation programs were considered far more successful than those that innovated on an ad hoc basis [Figure 14]. Without an overarching vision and structure to guide innovation efforts, it is practically inevitable that the existing system will reject change efforts.

Figure 14: Innovation program structure vs. Program performance



3. Utilise a range of innovationdelivery models and bring “the outside in”

When faced with complex challenges, companies can benefit greatly by looking more broadly than the models historically favoured within the industry. In particular, adopting the base response of looking outside first, rather than as a final resort is important.

Figure 15: Range of innovation models

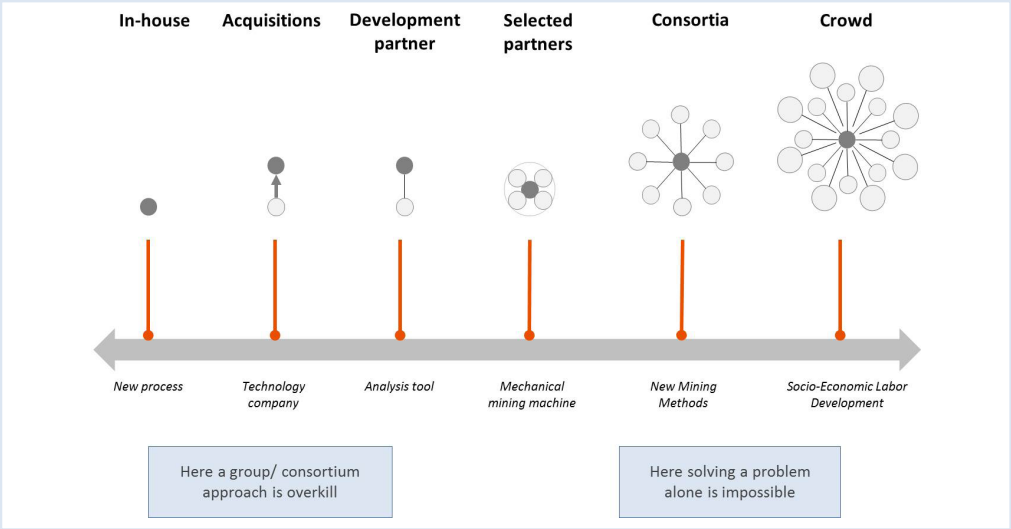


Figure 15 shows a representation of different innovation models that can be utilised. Models vary by the complexity of the challenge and the level of involvement of external parties. Some challenges are simple in nature and can be addressed through utilising an innovation process internally or with a single development partner. Other challenges however are too complex to solve individually and require bringing together the collective experience, ideas and perspectives of different parties to enable a solution.

The more parties involved in the solution the greater the management effort required and so there are times where consortia and open approaches may not be required. With this in mind, the key is to understand deeply the nature and complexity of the challenge and match the optimum innovation model that provides the greatest chance of success. It is always necessary to bear in mind when choosing the appropriate innovation approach that framing the problem at the appropriate level is sometimes the most challenging of all tasks – this is why connectivity with strategy, and aligned leadership are such critical activities.

Conclusion

When viewed from the perspective of technology change cycle times, and capital intensity, innovation in mining is very different to other, faster moving, less capital intensive, innovation benchmark industries such as information technology and pharmaceuticals. Ultimately though, the fundamental premise of innovation (and the challenges underlying success criteria) remains similar across industries, and that is to utilise processes that help solve challenges in new and different ways.

While this survey shows that the mining industry has significant room for improvement in its approach to innovation from the perspective of both its breadth of application, and its effectiveness, it is in a very fortunate position from two perspectives. Firstly, there is an underlying culture of team work and a tendency to challenge the status quo and secondly, mining executives are very aware of the key change levers that are required for innovation success.

Interesting questions remain as to what will catalyse the compelling need for innovation, which companies will embrace it proactively to drive competitive advantage as we enter a new phase in the industry cycle, and for which companies' will innovation remain an important but discretionary investment.

We look forward to revisiting these questions next year as we seek to create an on-going analysis of innovation within this industry.

For a full breakdown of the results of this study or to understand more about how your company calibrates with the industry, please contact us.

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Methodology

VCI surveyed more than 60 mining executives from 25 companies, representing approximately AU$452 billion in revenue for the year 2012.

We focused on five categories: Defining Innovation, InnovationToday, How We Innovate, Where We Innovate and Innovation Tomorrow. The purpose of these categories was to not only help us provide a snapshot of the key innovation challenges today but also provide a longitudinal perspective on how innovation is changing in the long run.

To enable meaningful comparisons across the industry and avoid bias, we applied a weighted average to companies with multiple responses to reflect the view of a single company and then applied a variety of statistical methods for analysis. Follow-up interviews with a selected sample of executives covering strategy, technology and operational disciplines provided additionalinput to our analysis.

We also surveyed a subset of mining suppliers and leading industry bodies to gain an external perspective. These results were not included in the statistics (unless specifically stated).

Company names and responses have been kept confidential.