INDUSTRIAL MINERALS – EVALUATION AND PROFITABILITY

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SUMMARY

The scope and principal objectives of this paper are to improve our understanding of the industrial minerals sector, especially regarding project evaluation and business profit drivers. Information and discussion is aimed to stimulate debate and hopefully assist towards a more professional approach in development of industrial mineral projects.

Industrial minerals are often misperceived by the community, education and research organisations, industry professionals and Governments. They are best defined as mineral products used and consumed in industrial, manufacturing and agricultural applications. Production of industrial minerals may enhance or up-grade their chemical and physical properties, though the mineral remains largely unchanged by chemical processing. Examples include iron ore, potash, borates, ilmenite, silica sand, gypsum and kaolin.

Industrial minerals are commonly underrated as the poor cousin to precious metals, base metals, light metals and energy minerals. To the contrary, many small and large industrial mineral companies are highly profitable with long-term 15-30% EBIT / Sales margins and strong returns on capital employed.

Successful evaluation and development of industrial minerals must recognise the principles of "Value in Use". This involves a dynamic interplay between technical, market and commercial factors, including resource characterisation, geo-metallurgy, application tests, process optimisation, customer trials and primary market surveys. Industrial mineral products require consistency of physical and chemical properties, leading to performance in the customers' application.

Keys to profitability include technical understanding, market knowledge, QA / QC discipline, and customer relationships. Success is rarely about having the biggest or cheapest operation, it's more about consistency, rarity, functionality, market structures, barriers to entry and, ultimately, price leverage.

"New Age" raw materials to supply the electronic, battery and sustainable energy industries are considered, including lithium, cobalt, graphite, indium, manganese, scandium, and high-purity quartz.

Principal conclusions from this paper are that industrial minerals can be very profitable businesses if managed professionally with an understanding of industry drivers, opportunities and risks.

Key words: industrial minerals, evaluation, profitability, quality control.

INTRODUCTION

This paper contains insights to the diverse world of industrial minerals. Information and opinion is based on public domain reports, industry research and analysis, and many real-life experiences over ~30 years. As such, it is an attempt to provide a template for effective project and business evaluation in the industrial minerals industry, to qualify risks and opportunities, and result in identifying keys to profitable business development.

WHAT ARE INDUSTRIAL MINERALS?

My working definition of industrial minerals is "mineral products used and consumed in industrial, manufacturing and agricultural applications, where their production may enhance or up-grade chemical and physical properties, though the mineral remains largely unchanged by chemical processing". This definition merges with industrial chemicals upon significant purification or refining.

Industrial minerals are often misperceived or misunderstood by the community, education and research organisations, industry professionals and Governments. Most people consider the production of industrial minerals to involve simple quarrying and processing operations, as these are the most visible to our main populations of coastal city dwellers. People rarely understand or underestimate the myriad uses and requirements of domestic and export markets for industrial minerals, where quality control of production (QC), product consistency, and customer relationships are paramount to ensure sustainable, profitable business. Alternatively, some people may only see the "big business" side of the iron ore industry and rarely consider this as Australia's premier industrial mineral business. There are several reasons for these misperceptions, including our relatively small island nation economy, where the domestic industrial mineral markets are relatively small and diverse eg. steel industry, with large mining operations and related infrastructure often in remote locations eg. Pilbara. As Australia's end-use markets are relatively small, it may be cost-effective for consumers to import small volumes of processed and packaged industrial minerals, rather than develop mining and mineral processing operations due to poor economies of scale. To the contrary, where a domestic industrial mineral business meets the needs of local industry customers, then small volumes and the high cost of international shipments and inventories, may reflect in relatively high prices and support for niche, profitable domestic industrial mineral businesses.

Industrial minerals are commonly underrated and undervalued as the poor cousin to precious metals, base metals, light metals and energy minerals. To the contrary, many small and large industrial mineral companies are highly profitable businesses with long-term 15-30% EBIT / Sales margins and strong returns on capital employed (refer Table 1)

Mineral Industry By Size & Growth / ~30 years (US$B)*	Average Profitability EBIT/Sales %			Comments
	1990's	2000's	2010's	
Phosphate Rock ($5- 18B)	20	25	30	Fertilizer demand growth, especially oil palm (Asia) & canola (global). Robust price support
Potash ($3.3 - 15B)	28	35	40	
Sulphur ($2.8 - 7B)	12	10	15	Shortage 2010-17
Salt ($3.3 – 7B)	20	21	23	High PVC demand
Gypsum ($2.1 – 5.4B)	18	18	18	By-product use
Borates ($1.0 – 3.0B)	32	33	35	Limited sources
Soda Ash[1] ($1.1 – 2.1B)	25	22	28	Synthetic oversupply
Silica Sand ($2.2 – 3.8B)	15	15	18	Glass demand Asia
Kaolin ($2.8 – 5.2B)	16	18	20	Paper demand
Iron Ore ($19 – 200B)	26	32	>40	China steel demand & supply lag
Manganese ($2-10B)	23	30	33	Limited sources
Coking Coal ($20-165B)	18	25	30	China steel demand
Bauxite[2] ($3-10B)	23	25	25	Flat Al price, vertical integration
Ti Minerals[3] ($1.0-1.8B)	25	23	28	Oversupply & flat prices 2000's,
Source: Company reports, industry analysis, primary research (Turvey 2004, 2005) & personal estimates				
Gold ($5 – 10B) (cf. ~$120B metal)	4-7	5-10	12-20	Increased 25-40% +2015
Copper ($5 – 10B)	3-6	6-9	10-15	Oversupply + price lag
Zinc ($2 – 4B)	3-6	5-8	8-10	Shortage +2016

Notes:
* Ore Production Mtpy @ US$/mtu fob. for estimated ore value ex mine &/or beneficiation plant
Market size US$B strongly reflects price trends & price growth due to increased demand &/or restricted supply
1 Natural soda ash producers
2 Includes transfer pricing from integrated alumina & aluminium producers.
3 Ti slag & syn-rutile are not included or discounted

Table 1: Long-Term Profitability of Industrial Mineral Industries compared to Metal Industries

Reasons for the relative high-profitability and consistent, robust returns in industrial mineral businesses include:

a) Limited number of large, long-term producers ie. oligopoly supply, based on limited high-quality resources.
b) Long term production (>30 years) with incremental or staged capital and flexible capacity.
c) Direct customer relationships with aligned supply contracts and "tailored" product specifications.
d) Price elasticity and leverage based on "value in use" for the customer.
e) Location and logistics for "just in time delivery".
f) Market barrier to entry for new producers due to unproven product availability and performance (feedback to a)).

In comparison, reasons for the poor profitability in the metal industries include:

a) Large number of competitors and producers with chronic production over-capacity and market over-supply
b) Rapid supply response to demand and price increases, especially from small mines due to widespread distribution of resources
c) Relatively high capital cost entry for short-term production assets (~10 years) and inflexibility in capacity expansion.
d) Cost-driven profit with limited ability for cost mitigation in boom cycles.
e) Commodity industries with limited to no price leverage due to benchmark pricing and financial instruments based on exchange indices, warehousing, forward contracts etc.

In general, highly profitable industrial mineral and metal businesses are based on premier mineral deposits (high-grade, simple processing) with low production costs, mineral or metal rarity, unique or desirable properties, and supply responses. Also important are good logistics and infrastructure, competitive cost structures (power, labour) and supportive, stable investment policy.

THE CONCEPT of "VALUE IN USE"

Successful evaluation and profitable development of industrial minerals must recognise the concept and principles of "Value in Use" (VIU). The concept of Value in Use is that the price of an industrial mineral product is a direct function of the performance and value provided to the customer's end-use application. The principle and practice of Value in Use involves a dynamic interplay between technical, market and commercial factors as critical inputs to financial evaluation of an industrial mineral project or business.

Technical factors include exploration and resource characterisation, geo-metallurgy, logistics, and production studies (mining, processing) in order to establish product specifications and determine optimal project scale, methods and practices. Market factors include desktop studies, primary research via customer visits to relevant industry sectors, and customer application trials in order to define key target customers and a viable market entry strategy. Importantly, any evaluation should not rely on open-file or secondary market and price data as it is commonly quite misleading or wrong, rather than obtaining and vetting of current, primary market information direct from potential customers or independent industry sources.

Financial evaluation commonly involves a staged and contingent approach with an initial scoping study, followed by a pre-feasibility study and feasibility study to determine financial viability, opportunity and risk. A scoping study should establish all technical, market and logistics factors as inputs to a base-case financial model, while also providing an important "reality check" on project or business viability. Subsequent pre-feasibility and/or feasibility studies should update and optimise input information to an improved levels of confidence or certainty as the basis for a revised financial model/s, including sensitivity analysis. Importantly at all stages, evaluation studies should include risk and opportunity analysis to determine a successful market entry strategy, especially if a new-comer to the industry. Evaluation studies may be conducted in a contingent series (one after the other) or compressed and combined depending on the relative level of understanding, knowledge, certainty and risk profile.

The main aims of Value in Use are to determine price elasticity and competitive advantages. Price elasticity is a powerful strategic tool in understanding the customer and the industry, to possibly share that value with the customer, and recognise competitive threats and potential substitution. Ultimately, the outcome of Value in Use is to ensure product consistency and performance to the customer, thereby providing a price point for optimized profit margins to the producer or supplier and providing a competitive barrier to entry.

Based on Value in Use, the validity and accuracy of evaluation studies significantly supports project development and business funding. The result of evaluation studies are only as good as the input information and the intrinsic merits or risks of the project or business ie. garbage in = garbage out. A commercially viable project that is based on sound, professional evaluation studies is readily understood, believed and funded.

The practice of Value in Use is a critical component of valuation methodology for an industrial mineral project and business (refer Table 2)

TECHNICAL	MARKET	COMMERCIAL	DEVELOPMENT
Resources Exploration Characterisation Domaining	**Studies** Desktop Sectors Indicative Specs	**Scoping** Study inputs Value in Use Financial model	**Approvals** Government Community Environmental
GeoMet Metallurgy tests Product Specs Bulk Samples	**Research** Customer visits Price drivers Application Trial	**Pre-Feas.** Revised inputs Value in Use Revised $ model	**Production** Construction Commissioning Stage 1 + QA/QC Expand Stage 2
Production Mining Processing Optimised + QC	**Customers** Relationships Key targets Trial parcels	**FS / BFS** Final inputs Value in Use Base $ Model	**Marketing & Sales**
Logistics Options Contracts Integration	**Strategy** NDA, LOI/MoU Market Entry Risk Analysis	**$ Funding** Debt / Equity Offtake Contracts	**Replacement or Closure**

Table 2: "VALUE IN USE" – Industrial Minerals Project and Business Evaluation Matrix

EVALUATION METHODS - TECHNICAL

Technical evaluation studies of an industrial mineral deposit, project or business should include:

a) geology & exploration – systematic mapping, drilling and/or representative sampling to establish resources,
b) material characterisation – multi-element chemical assay and preliminary physical properties of representative samples,
c) resource domaining and/or reserve estimates – assay deportment and correlations, definition of ore types, JORC estimates,
d) geo-metallurgy – detailed chemical and physical properties including key impurities, establish indicative product specifications, provide bulk product samples for customer application trials,
e) logistics and infrastructure – options and costs for power, water, equipment, transport, labour, integration v's contract,
f) production – mining methods and options, processing flowsheet and optimization studies, QA/QC systems

The aim of technical evaluation studies is to establish product specifications and determine optimal project scale, methods and practices. Further, to provide interactive input to market evaluation studies and determine "Value in Use" of the industrial mineral product/s. Importantly, technical evaluation is the fundamental basis for commercial evaluation and business development ie. profit is derived from the rocks and how you realise it. The ultimate aim is to supply product consistency and performance to customers.

Technical evaluation should not rely on open-file or historic data on services or cost structures as they are commonly outdated or wrong, rather than obtaining and vetting current information directly from service providers or independent industry sources.

EVALUATION METHODS - MARKETS

Market evaluation studies of an industrial mineral deposit, project or business should include:

a) desktop studies – open-file information & data, "off the shelf" market studies eg. Roskill or CRU or IM Research etc,
b) industry contacts – provide introductory project summary and/or indicative product specifications to potential customers in relevant industry sectors, establish dialogue and credible identity, obtain industry feedback,
c) primary research – conduct customer & plant visits to selected industry sectors and potential customers, provide updated project information, confirm product specifications and/or provide samples for application trials, obtain customer information and product requirements
d) customer relationships – (under mutual confidentiality agreement) develop working relationships with key target customers, provide trial bulk parcels and/or resource information and product characterisation / metallurgy results, obtain feedback of trial results, provide indicative production flowsheet and QA/QC system information,
e) market entry strategy – define industry and market structures, determine supply chain relationships, conduct risk & opportunity analysis, identify barriers to entry.

The aim of market evaluation studies is to determine "Value in Use", price drivers and price elasticity of the industrial mineral product/s, and to identify potential competitive advantages and barriers to entry. Further, to establish a credible industry profile as a new producer and provide interactive input to commercial studies. Importantly, to recognise that market evaluation and knowledge are critical factors for commercial evaluation and business development ie. ultimately, profit margin is a function of sales price.

Market evaluation should not rely on open-file or secondary market and price data as it is commonly quite misleading or wrong, rather than obtaining and vetting of current, primary market information direct from potential customers or independent industry sources.

EVALUATION METHODS – ELECTRONIC RAW MATERIALS (EIMs) & SPECIALTY METALS (SIMs)

Electronic raw materials eg. Li, Co, graphite, natural manganese dioxide, high-purity quartz etc and specialty metals eg. Cs, In, Sc, REE etc, that are used in advanced technologies and energy applications, are all the market rage and "flavor of the month". Effective evaluation of industrial mineral projects and business for EIM's & SIM's should follow the previously outlined "Value in Use" methodology ie. determine the value of the mineral product and understand industry structures to obtain a position of competitive knowledge and sustainable, high-margin profit.
Sounds simple doesn't it?

Rather than provide detailed case studies and examples of evaluation methods, I'll pose some questions and provide opinions to hopefully progress understanding and promote reasoned debate.

1. Is Demand Growth Real or Biblical? (one day of greatness followed by seven days in the wilderness)
   I support the Yes Vote for the former position based on:
   a) Increased intensity of use (IOU) and demand growth for consistent, high-quality industrial minerals due to population growth, emerging middle class consumer demands, technology and environmental trends, need for efficient agriculture.
   b) Transition from the Iron Age and the Coal Age.
   c) Light, powerful, reactive, efficient, useful and fun are key future drivers.
   d) Nano-materials and technologies will revolutionise the way we live.

2. Lithium
   What is the better business – hard rock or brine extraction?
   I support both, though would much prefer a good hard-rock project due to commercial flexibility.
   a) Lithium deposits are not rare, good ones are more so with "devils & saints" in the mineral / element assemblage.
   b) Capital and operating cost structures, development lead times, capacity expansion and payback are quite different.
   c) RIO's Jadarite effect and future influence is real (perhaps due to its kryptonite chemistry).

3. Graphite
   Is graphite production a long-term, high profit margin business?
   I support the No Vote and maybe it's time for a reality check (though I don't mind being wrong, you learn something).
   a) Graphite deposits are very common.
   b) Graphite markets are quite small, diverse and well supplied, whereas high-tech graphite markets are tiny and require high specification products.
   c) Processing graphite using patent technology is the key, though "value-added" processing is currently tightly controlled and somewhat secretive (otherwise it's R&D).

4. Cobalt
   Is there a looming cobalt shortage and will prices reach new highs and remain high?
   I support the No Vote.
   a) Cobalt is a by-product of large copper operations in the Congo and nickel operations in Canada & Australia. These operations are based on large resources, where cobalt-rich tailings and residues could readily be processed.
   b) High-grade cobalt deposits located in Canada, Morocco and Australia could readily fill demand increases.

5. Is there supply risk and a pending critical shortage of strategic materials due to significantly increased demand? (remember the wildly erroneous forecasts of The Club of Rome “think tank” in the early’70’s)
I support the No Vote in the medium to long-term (5 years to >50 years)
   a) Deposits are not rare but under-explored, where economic grade will be a function of product price and use options. Good recent examples of price sensitivity are lithium direct shipping ores (DSO >800,000t @ ~1.2% Li_2O from the Pilbara during 2017) and tens of millions of tonnes of lateritic nickel ores @ ~1.8% Ni during 2010’s for nickel pig iron.
   b) Real and forecast increased demand will drive prices in the short-term, though will also support funding for exploration and development (evidenced by recent IPO’s and fundraising by >50 public companies).
   c) Lead & lag times for exploration, evaluation and production will cause short-term price fluctuations.
   d) Financial games will be played with Boom & Bust effect, though good deposits will be discovered and exploited to ultimately balance supply & demand – remembering that economic deposits are not rare.

A wise man once said (he wasn’t an economist) that “grade is king”, “metallurgy is queen” and politics is the joker” (political risk is real, just look at what the Tanzanian Government has just done to much needed foreign investment in Africa).
Another wise man once said (it was either my father-in-law or Confucius) that “small fish are sweet to eat (read profitable), though big ones are great fun to catch”.

CONCLUSIONS

Evaluation methods and successful development of industrial minerals must recognise the principles of “Value in Use” in order to achieve optimal profitability and sustainable business.

Keys to business profitability include:

a) Knowledge – technical, market, logistics (not just data, information and surficial understanding).
b) Value in Use – where a product price is determined by function and performance.
c) Production QA / QC – because product consistency is essential and drives acceptance.
d) Customer Relationships – formed on credibility, reliability and mutual support.
e) Competitive Advantages – from price elasticity and leverage.
f) Barriers to Entry – based on industry knowledge and position.

Regarding the media hype and biblical markets for electronic & specialty raw materials, I see it more as real demand and growth trends with greater acceptance for **LGBTI++** (ie. **L**ithium, **G**raphite, **B**oron, **T**horium, **I**ndium etc).

The “Bottom Line” is that industrial minerals can be very profitable businesses if evaluated, developed and managed professionally with an understanding of industry drivers, opportunities and risks.

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