

How secure is your supply?

A guide to effective supply risk
management in the mining industry



Executive summary

Emerging economies around the world are continuing to industrialize and grow. In turn this growth is driving unprecedented demand for mining commodities along with rising commodity prices. With the current global boom in mining commodities, mining companies are under pressure to meet production targets and deliver new capital projects on-schedule. Capital project investment for the world's top 40 mining companies doubled between 2010 and 2011¹, which has led to increased competition for scarce personnel, equipment, and materials.

In today's turbulent business climate, ever increasing supply risks threaten the ability of mining companies to meet market expectations consistently. Given rising commodity prices, the opportunity cost of lost production caused by supply issues is significant. Failure to meet production and capital project targets can significantly impact shareholder value, and can cause companies to lose the confidence of key partners, suppliers, and other critical stakeholders in the short term. In the long term, failure to meet production and capital targets can threaten the viability of a mining company.

Supply risk is also on the rise, driven by geopolitical and economic uncertainty, the increasingly globalized nature of supply chains, and imbalances between supply and demand. There are a number of supply risks that threaten a mining company's ability to obtain reliable and secure supplies of personnel, equipment, and materials. The nature of these risks can be classified into: financial; regulatory; operational; and geopolitical. Mining companies who fail to address these risks effectively face greater risk exposure and are more likely to be impacted by supply disruptions.

Mining companies today face challenges on several fronts when it comes to addressing supply risk effectively. There are people challenges, which include high turnover rates, a limited supply of skilled labour and service providers, and the logistics around getting personnel to mining sites in remote locations. There are process challenges throughout the mining supply chain that include: limited negotiating power in sourcing and procurement; coordination of complex global distribution networks across multiple regions and modes; a lack of upstream information necessary to perform adequate planning and forecasting; and ineffective processes to assess and quantify the magnitude of various risk types. Finally, there are technology challenges related to poor quality of data and a lack of effective analytical tools to support the modelling and evaluation of risk.

Leading practices in supply risk management address risk quantitatively and strategically, and take an integrated view of risk across the value chain and the enterprise. Strategic risks need to be segmented and separated from financial and operational risks in the current environment. Identifying the key drivers of change can help organizations prepare for changes across different time durations. Core supply chain and supply management capabilities must include an organization, with the appropriate skills and abilities, charged with managing and reducing overall supply risk. In addition, core supply chain processes in the areas of forecasting and planning, inventory management, strategic sourcing, contract management, and supplier relationship management are a basic first line of defence to combat supply risk.

¹ <http://www.cfoinnovation.com/content/supply-and-cost-management-key-challenges-mining-industry>

Those organizations who are more advanced in addressing supply risk deploy specialized risk management capabilities to address the more complex threats posed by regulatory and geopolitical shifts. These advanced capabilities include: focusing on market intelligence by partnering with strategic suppliers to share and evaluate data on market and economic conditions; enhancing internal systems to capture data that supports dynamic decision making; and intelligent risk modelling tools to conduct scenario analysis and optimize supply decisions.

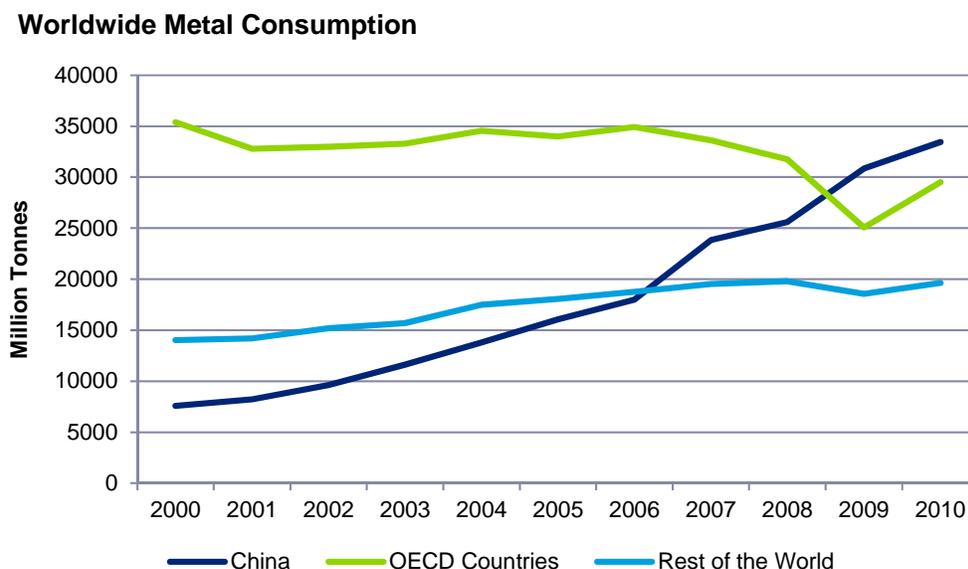
Overall, mining companies today are faced with pressure to meet rising demand for mining commodities in a climate where the cost of supply disruptions is greater than ever. Mining companies that effectively develop the capability to manage supply risk will be better positioned to meet market demand and exceed stakeholder expectations amid volatility and uncertainty.

As demand rises, delivering consistent throughput is key

Emerging economies in Brazil, Russia, India, China, and the rest of Asia are continuing to industrialize and grow rapidly. These regions continue to expand and invest in infrastructure, manufacturing and heavy construction to meet the demands of economic growth. With this growth comes increased demand for mining commodities. Projects in infrastructure, manufacturing and heavy construction tend to consume significant quantities of mining commodities. For example, China accounted for more than 40% of global metal consumption in 2010, and its consumption of key base mining commodities is growing at 16% yearly (see Figure 1).

Going forward, near-term prices for mining commodities are expected to rise until new capacity comes online to meet rising demand.² As an example, the World Steel Association (Worldsteel) released its October 2011 Short Range Outlook (SRO) for 2011 and 2012. Worldsteel forecasts that apparent steel use will increase by 6.5% to 1,398 mmt in 2011, following growth of 15.1% in 2010. In 2012, it is forecast that world steel demand will grow by a further 5.4%.³ Significant year-on-year growth in the demand for minerals raises the question of whether growth in demand will outpace growth in supply, causing further increases in the cost of minerals. Such increases are illustrated in the cost of metals over the past 10-years. Since 2008, volatility in the global economy has contributed to sporadic downward movements in mining commodities prices; however, these movements do not negate the overall upward trend.

Figure 1: China has seen a steady increase in its metal consumption for the past decade⁴



² <http://go.worldbank.org/3JBGUC58M0>

³ <http://www.worldsteel.org/media-centre/press-releases/2011/october-sro.html>

⁴ <http://go.worldbank.org/3JBGUC58M0>

Figure 2: Potash consumption has risen steadily in all major global markets⁵

Worldwide Potash Fertilizer Consumption

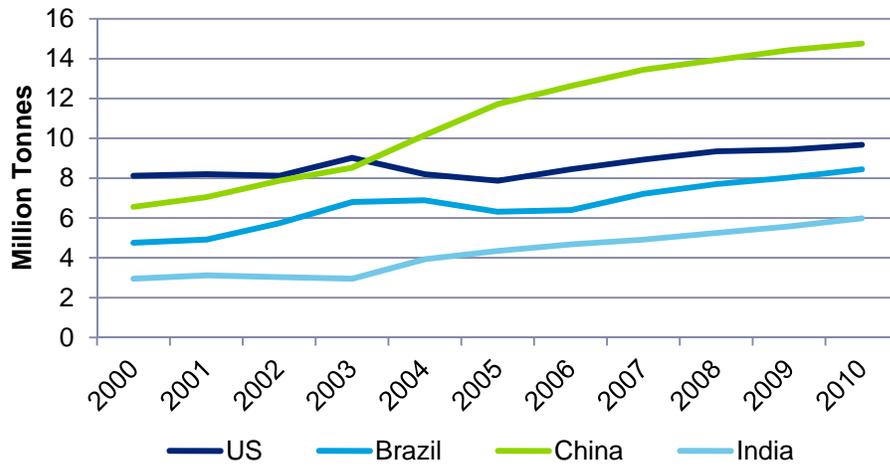
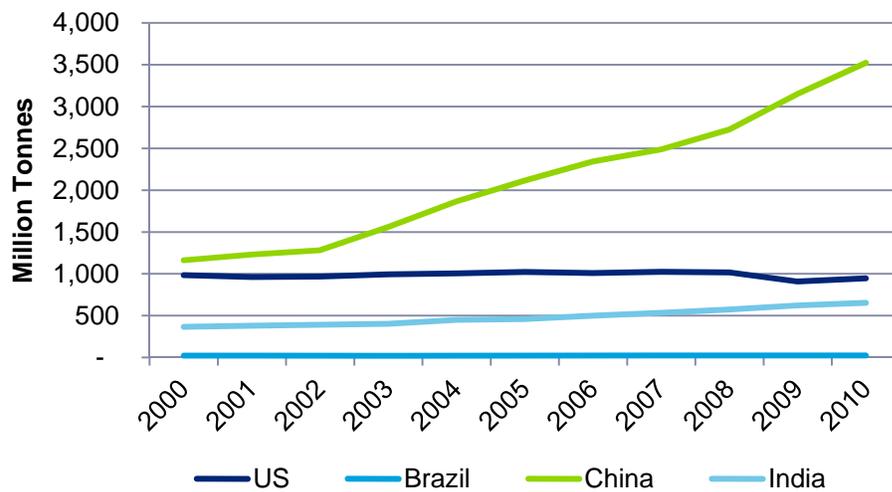


Figure 3: Growth in global coal consumption has been driven by China since 2000⁶

Worldwide Coal Consumption

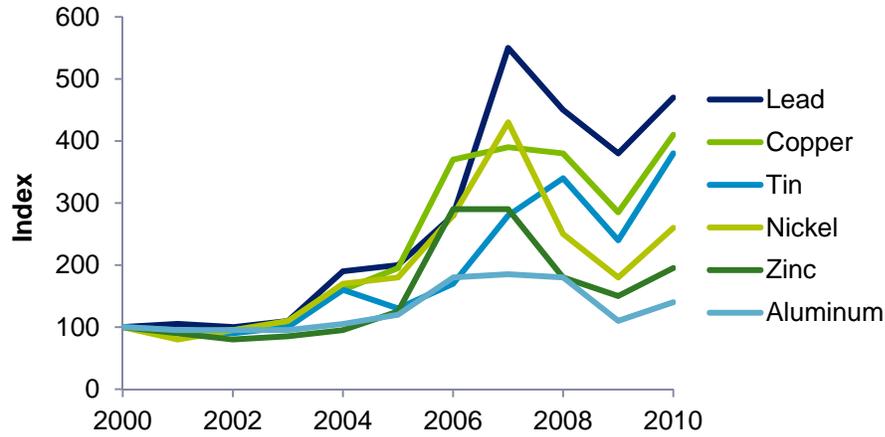


⁵ <http://www.napotash.com/aboutpotash/demand/>

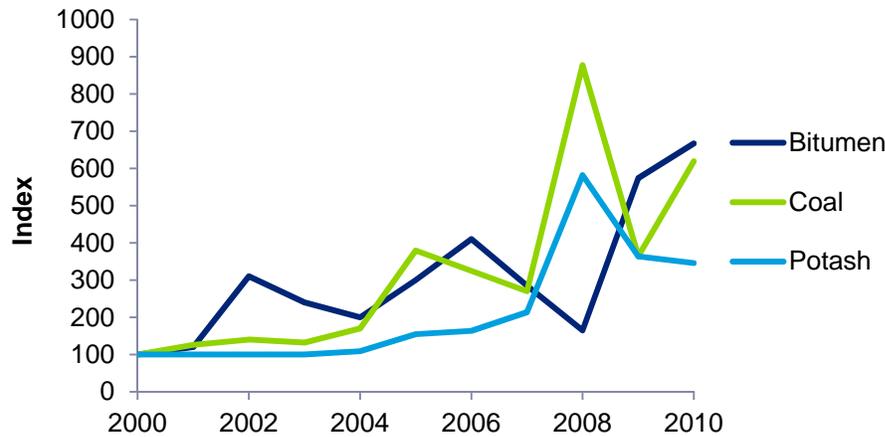
⁶ <http://www.indexmundi.com/energy.aspx?product=coal&graph=consumption>

Figure 4: Metal and non-metal prices have experienced volatile growth since 2000^{7,8}

**Price increase for select metals
(2000 as base year)**



**Price increase for select non-metals
(2000 as base year)**



⁷ <http://www.aomevents.com/media/files/ARCIC/Allan%20Trench.pdf>
⁸ http://www.andrewnikiforuk.com/Dirty_Oil_PDFs/BitumenPriceReview07.pdf (Page15);
http://www.ercb.ca/portal/server.pt/gateway/PTARGS_0_0_309_0_0_43/http%3B/ercbContent/publishedcontent/publish/ercb_home/industry_zone/alberta_s_energy_resources_and_statistics/oil_gas_and_oil_sands/st3.aspx;
<http://www.em.gov.bc.ca/Mining/MineralStatistics/Market/WeeklyMetalandCoalPrices/Pages/default.aspx>;
<http://www.magindustries.com/cmsdocs/Presentations/MagIndustries-on-Potash.pdf> (page 28);
<http://www.infomine.com/investment/historicalcharts/showcharts.asp?c=Potash>

Mining companies are facing ever-increasing challenges to supply the market demand. The world's top 40 mining companies saw revenue increases of 32% year-on-year in 2010, to USD\$435 billion, largely due to commodity price increases coupled with a 5% increase in output.⁹ Strong opportunities have arisen for new capital projects, including both new mining projects (greenfield), and the expansion of existing mining projects (brownfield). For example, the world's top 40 mines announced \$120 billion in capital expenditures for 2011, double the capital expenditure for 2010¹⁰. This has led to increased competition between mining companies for scarce resources, including qualified personnel, equipment, and materials.

For mining companies, the ability to meet this heightened demand is critical for two reasons. First, in the short term, any failure to meet quarterly earnings expectations and capital projects targets can trigger an adverse reaction from capital markets. Confidence among other stakeholders (suppliers, partners, customers) can also suffer as a result. Second, in the long-term, failure to meet demand could result in liquidity and solvency problems and threaten a mining company's viability.

Given the demand projections for the medium- to long-term, the opportunity cost of supply disruptions is significant. Supply disruptions will negatively impact throughput and will hinder companies' ability to take advantage of commodity price increases. In a market upswing, security of supply is the most important factor in maintaining and increasing throughput. For mining companies, this translates into delivering adequate supply of goods and services to meet throughput requirements and to support greenfield and brownfield capital projects.

The cost of supply disruptions:

- BHP Billiton posted record profits for the 6 months ended December 2010 as a result of high iron ore, copper and oil prices. Effectively, the company makes \$58 million in profit per day – this is the opportunity cost of one day's production loss for BHP¹¹
- Freeport McMoRan's copper mine in Indonesia halted production due to a labour strike. Output decreased by 230,000 tonnes of ore per day, equivalent to \$6.7 million in lost revenues per day¹²
- Northam Platinum's Zondereinde mine in South Africa was shut down while workers were on strike, leading to 9 million rand or \$1.3 million in revenue losses per day¹³ (this mine produces 300,000 oz of platinum group metals and gold annually.¹⁴

⁹ <http://www.cfoinnovation.com/content/supply-and-cost-management-key-challenges-mining-industry>

¹⁰ <http://www.cfoinnovation.com/content/supply-and-cost-management-key-challenges-mining-industry>

¹¹ <http://www.smh.com.au/business/bhp-makes-58m-profit-per-day-20110216-1avjt.html>

¹² <http://af.reuters.com/article/metalsNews/idAFL3E7KG0F720110916>

¹³ <http://af.reuters.com/article/investingNews/idAFJ0E68L0KS20100922>

¹⁴ http://www.northam.co.za/b/zon_i.asp

Increasing supply risks threaten the flow of critical materials and labour

For mining companies, “supply risk” can be defined as all potential disruptions to the timely inbound flow of quality resources (i.e., goods, services, and people) to the mine site. Supply risk is on the rise, driven by a number of strategic forces such as the increasingly globalized nature of mining supply chains, an increasingly turbulent geopolitical and economic climate, and increasing financial and operational capacity constraints relative to rapidly increasing demand. Mining companies that don’t address supply risk effectively are therefore exposed to potential production downtime and the resulting revenue losses.

Supply risk breaks down into four major areas:

1. Financial risk

The uncertainty and volatility surrounding the current global economic environment has not made life any easier when it comes to managing financial risk in the supply chain. The financial risks relevant to supply in mining can be viewed as three components:

- *Supplier financial risk* – Suppliers can encounter financial problems such as reduced cash flow, broken lending covenants, reduced access to credit and insolvency or bankruptcy. Customers without visibility to significant supplier financial issues are likely to be impacted themselves.
- *Input price volatility risk* – Mines need products and labour available on demand to meet production targets; however, the combination of their remote location, limited supply options for parts and labour, and limited negotiation leverage can result in significant cost premiums. These premiums can come in the form of supplier mark-ups, high wages and retention bonuses for labour, and switching costs between supplier products. Getting good long-term supply contracts in place and managing the performance of those supplier contracts remains a challenge in mining today.
- *Exchange rate and supply scarcity risk* – Variables such as exchange rates, competition (or lack thereof), and rising commodity prices all represent financial risks in contracting supply for mines. The cyclical nature of the mining business means those who can effectively manage contracts and their inherent financial risks in both upturn and downturn markets are more likely to succeed.

2. Regulatory risk

The mining industry is highly regulated and mines are increasingly operating in locations where local regulations and laws are continuously evolving (e.g., India, Mongolia, and Australia). The geographic placement of operating sites means they can be governed by a range of regulations related to the environment, health, and safety, all of which can impact supply decisions. In turn, these decisions can restrict and constrain the supply of goods and services to mining sites.

3. Operational risk

Obtaining secure and reliable sources of supply for a mining site is fraught with operational challenges throughout the supply chain. The most critical parts need to be on hand at all times as the opportunity cost of any downtime is high. In many cases, mines have limited supply choices for critical or proprietary parts. Among suppliers where there are wider alternatives, mines are increasingly forced to look at second or third choice vendors because their preferred supplier cannot meet current demand. Such sourcing decisions are accompanied by greater supply risk as these suppliers may be less viable, less reliable, and could potentially be lower performers. The ability to understand and evaluate a supplier’s

ability to meet customer needs across a range of dimensions (e.g., capacity, quality, safety, efficiency) is vital to detecting and mitigating supply risks before there is an actual impact. In the context of global demand, a strategic view is needed to balance the discussion of second and third supplier choices. Transportation across the mining supply chain can also be complex and contain risk. Transporting the supply of both products and labour to a mining site often involves several modes with many handoffs. Accordingly, there are several points of failure where delays can occur, caused by anything from logistical issues to environmental problems (e.g., weather conditions).

4. Geopolitical risk

Supply lines can often extend across a number of sovereign lines. As a result, actually getting supplies from the source to the mining site can require a journey that crosses multiple jurisdictions each with different regulations and approaches to doing business. These various political environments can in turn drive changes in regulatory conditions, potentially altering the level of supply risk to mine.

Regulatory risk in action:

Imperial Oil's strategy of importing large modules for their Kearl Oil Sands project in Ft McMurray, Alberta involved the modules being manufactured in South Korea and transported through the US and into Canada. The arrangement to transport through Idaho and Montana required construction work to modify roads, utility lines and traffic signals. Regulators denied transport permits for large modules and some had to be re-configured to smaller components to meet local regulatory demands. Additionally, legal challenges were launched in both states by protestors, saying the transport of these modules would hurt tourism, roadways and the environment¹⁵.

While the above risks are common to the industry, specific risks can be related to the environment and situation for each individual company. It is important for companies to realize and separately address Strategic Risk from Financial and Operational Risks. Strategic risk is something that only increases in time and requires a fundamentally different response to planning. Being sufficiently prepared for changes that may happen either too slow or too fast for the organization to adjust to is critical.

¹⁵ <http://www.calgaryherald.com/business/Imperial+moves+largest+Kearl+equipment+loads/5314646/story.html#ixzz1cbYMINX7>

Mining organizations face unique challenges in addressing supply risk effectively

People challenges

Across the mining industry the current shortage of qualified personnel is projected only to worsen as baby boomers increasingly exit the labour market. This shortage of resources is driven in part by a lack of interest in the sector¹⁶. Attrition is also an issue: some corporations report turnover rates surpassing 30%¹⁷. When key employees leave, they take process knowledge and key supplier relationships with them.¹⁸ Furthermore, a lack of resources trained specifically in supply risk analysis results in risk management being viewed as merely a subjective exercise.

With the recent boom in commodities markets and associated growth in new capital projects, strain has also been placed on service providers, who are now in short supply. Some mining companies have been forced to hire second- and third-tier service providers. As a result, quality may suffer, as suppliers are chosen based on cost and availability rather than quality or financial viability. In Western Canada, mining and energy companies are competing heavily for the same resources, and have begun importing skilled workers from Eastern Canada to meet demand; however, with the recent award of major ship-building contracts in the East, competition for this labour will increase and labour shortages will rise.

In addition to shortage of resources, cultural inertia also hinders the ability of mining companies to manage risk. The weight of existing practices often prevents changes from being implemented. For example, existing relationships between Procurement and suppliers can limit objective decision making around optimal sources of supply. Even when suppliers do not comply, companies have been observed not taking disciplinary actions in order to avoid upsetting the apple cart, in effect condoning negative behaviours.

Lastly, regional differences – including culture, language, local regulation and availability of skills and leadership – make collaboration and coordination among teams more difficult.

Process challenges

Due to geographical remoteness and the ensuing lack of negotiating leverage with certain suppliers, challenges associated with core supply chain and risk management processes are not easy to manage.

¹⁶ <http://www.mihir.ca/en/resourcesGeneral/MLMT-SUM-EN1.pdf>

¹⁷ Deloitte project experience.

¹⁸ <http://www.mihir.ca/en/resourcesGeneral/MLMT-SUM-EN1.pdf>

Sourcing and procurement

There are a limited number of suppliers willing and able to service remote sites, thereby creating delivery and project scheduling issues. Because of this, suppliers have greater leverage in negotiating and setting prices for goods and services. In general, it is not easy to change suppliers for remote mine sites as not every supplier is capable or willing to serve clients in particular geographies. Hence, a supplier presenting quality problems poses a real and likely risk of disruption.

Mining companies need to be aware of potential human rights/environmental performance of key suppliers in order to ensure responsible process for supply chain management. Additionally as mining companies develop community based programs, including sourcing local products and services; there is an increasing overlap between the processes of building effective relationships within the community and the supplier base.

Mining companies also need to think about their sourcing concentration risk: for example, the dependencies associated with remote regional suppliers should be considered. If visibility into supplier operations and activities is limited, downstream cascade effects might lead to responsiveness issues, delivery delays and price increases¹⁹. However, dependency on a singular or very limited source of supply creates risk. This situation exists for a number of materials and services in the mining industry and is forcing mining companies to think about more sophisticated supply management approaches to obtain reliable supply and prevent downstream impacts from occurring. Many companies currently grapple with squeezing supply chains for efficiency gains and, with increasing pressure to reduce costs, the focus on selecting suppliers can be short-sighted and too often targeted towards quick wins in pricing and immediate acquisition costs.

Case study 1 – Lack of supply options and availability in the mining industry²⁰

According to a recent article in Mining Weekly, Hwange Colliery Company (HCC) is only able to operate at 60% capacity due to shortages in supply of critical materials and services. The company installed coal production capacity of 500,000 t/m in Zimbabwe; however, it currently operates at only 300,000 t/m.

According to HCC Managing Director Fred Moyo, “There is a shortage of supply to industry, as HCC is not meeting the demand, owing to aging equipment. Most of the company’s equipment is over ten years old, with low efficiency.” Further, equipment suppliers are unable to service the equipment or supply spare parts.

To address this challenge, HCC has begun to manufacture some of its own spare parts. While this strategy may alleviate pressure in the short-run, in the long-run HCC will have to develop its relationships with core spare parts suppliers and review its asset lifecycle management processes.

Transportation and distribution

An important issue for miners is the economic exposure due to the global logistics networks required to service world-wide mining operations. This requires a global approach to supply risk management. Further complications arise from the communication and coordination required between the engineering, procurement, and construction (EPC) contractors; workforce managers; air and ground transportation contractors; and housing and camp providers. Hundreds of teams, with diverse skill sets in different shifts, must be assembled accurately after being transported efficiently to various job sites.

Labour supply disruptions are almost unavoidable due to the complexity of moving people to and from sites and the lack of appropriate skilled resources. Inadequately qualified labour leads to supply risks for remote projects because the skills to forecast demand and manage the supply chain and inventory levels are in short supply. These challenges are exacerbated by transportation and logistical bottlenecks, usually due to infrastructure issues.

¹⁹ Is your supply chain setup for success? Deloitte. October, 2011

²⁰ <http://www.miningweekly.com/article/zimbabwe-mining-sector-grows-but-uncertainty-and-challenges-remain-2011-10-14-1>

Planning and forecasting

The lack of availability of “upstream” information is a key challenge for mining companies. Very few mining companies have effectively implemented information visibility across their external environment in order to provide timely information flow across the supply chain. In some cases, these gaps result from a lack of skills or appropriate systems; in others, the cause is the complexity inherent in a global mining company’s operations. In general, the lack of standardized information combined with non-standard processes and technologies creates the largest barriers to the visibility that is vital to managing supply risk effectively.

Risk management

For many mining companies, risk management is currently a subjective exercise, and quantifying the magnitude of risk in many cases is thought to be impossible. Inevitably, this results in companies changing their supplier portfolio due to unforeseen micro- and macro-economic effects, without concrete evidence of cascading effects.

The frequency and impact of supply risks are best addressed by maximizing visibility across the global supply chain. For example, using technologies such as GPS tracking can provide quantitative data that yields practical insight into supply risk. Very few mining companies have formalized risk indicators in their performance monitoring process²¹. For example, one mining company piloted an initiative that integrated disparate parts of their transportation information systems to improve supply chain visibility²². More than half of all mining companies are incorporating risk strategies and mitigation policies into their supply chain strategy. Successful risk management requires coordinated information sharing between management and mine operations.

Technology challenges

Many mining companies lack appropriate data and analytical capabilities to conduct effective risk management.

Poor data quality

A key challenge faced by many mining companies is data integrity: they need the right data in a standard format to enable consolidation across the enterprise. At a minimum, that data will include inventory levels of critical materials, demand and supply plans to drive replenishment requirements, available supplier inventory and associated lead times, and total cost parameters to support decision modeling. There is also a need to develop proper tools to extract and monitor relevant data and to improve data quality. Additionally, companies need to ensure that data are available at more detailed levels to support development of Total Cost of Ownership (TCO) models. For example, many mining companies have difficulty breaking down cost data into component parts (e.g., cost to operate an evaporator, or one shovel, or one crusher), which is often caused by insufficient accounting practices and systems.

Many mining companies have not effectively implemented information visibility inside or outside their organizations, limiting the amount and quality of information required to evaluate risks and make decisions on appropriate mitigation strategies. As a result, these organizations cannot conduct impact assessments or optimization studies and are at a loss to measure and optimize business performance.

Case study 2 – Data quality issues in the mining industry²³

Poor data quality is an issue faced by many mining companies. As a result, companies have limited ability to make optimal decisions regarding their operations.

To address this, a number of software providers are developing solutions that help mining companies leverage data to better optimize their operations. Leading technologies are helping mining companies maximise proper use of equipment, development and production headings and personnel to increase efficiencies.

²¹ Deloitte project experience

²² Deloitte project experience

²³ <http://www.miningweekly.com/article/improved-production-and-control-management-increases-logistics-productivity-2011-03-08>

Insufficient risk modelling tools

Effective risk management requires quantification of risk and the use of statistical methods and tools to improve decision making. Currently, most mining organizations do not employ a quantitative and integrated view of risk; they therefore lack a “cause-effect” understanding of how different economic factors impact their sources of supply. More than that, sophisticated risk modelling software is not commonly used among most mining organizations.

Due to many of these challenges, supply risk management in mining lags other industries, manufacturing and retail in particular.

Case study 3 – Looking across industries for advanced approaches to managing supply risk²⁴

Cisco Systems is regarded in the high-tech industry as having a sophisticated supply risk management capability. Through its supply risk management practices, Cisco has been able to mitigate negative impacts from several recent crises and disruptions:

- **Chengdu earthquake (May 2008):** After the 7.8-magnitude earthquake hit central China on Sunday, Cisco immediately deployed its crisis management capabilities. By the end of the following day, the supplier mix had been re-optimized and orders rescheduled, minimizing downstream impact on key customers.
- **Financial crisis (late 2008 to mid-2010):** Amid the financial crisis, five of Cisco's key suppliers faced high risk of disruption. When this came through in Cisco's analytics, options such as "last-time buys" and second sourcing were instituted so that when all five suppliers actually filed for bankruptcy, Cisco's business was not impacted.
- **Product “derisking” (ongoing):** Cisco has tools and capabilities to derisk a product before introducing it into the market. This can save as much as \$1 million (the benchmark cost to derisk an established product).

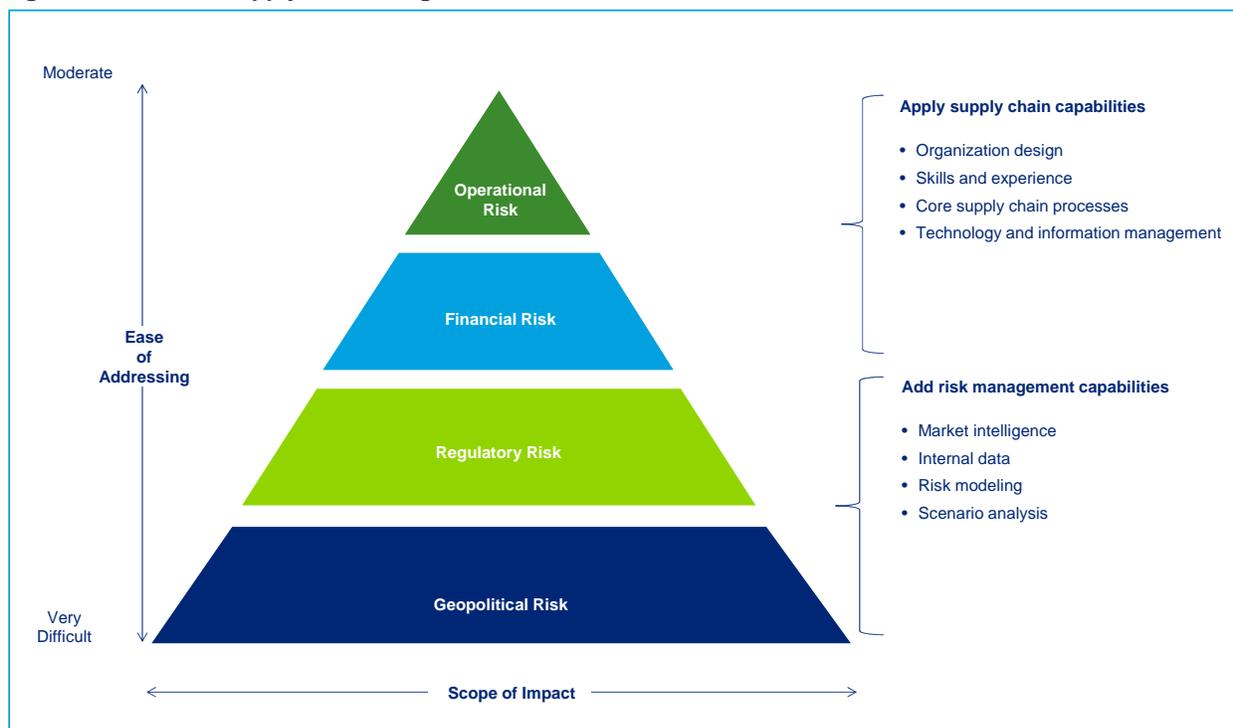
²⁴ http://www.cisco.com/web/strategy/docs/manufacturing/Cisco_Case_Study_AMR_10-0917.pdf

Leading practices involve an iterative, integrated and quantitative approach to risk management

Supply risk management framework

Leading practices in managing supply risk leverage a range of risk management and supply chain capabilities, allowing organizations to address supply risk issues in an objective and holistic manner. While traditional supply chain and supplier management approaches can be effective for managing some operational and financial risks, the more complex threats posed by strategic uncertainty around regulatory shifts and geopolitical disturbances require specialized risk management capabilities.

Figure 5: Deloitte's supply risk management framework



Supply Chain and Supplier Management Capabilities:

Organization design – Companies should establish a company-wide supply chain organization with the mandate to monitor and reduce overall supply risk. They should also build sufficient reporting lines between dispersed operational centres and the supply chain group to improve visibility to supply risk issues and develop appropriate supply chain key performance indicators (KPIs) to drive better coordination around risk management activities. A more effective organization design will enhance supply chain governance, processes, and the overall operating model.

Skills and experience – Recruitment and retention of essential technical supply chain skills and resources required to monitor supply risk and deploy mitigation strategies is critical. Where resource skills are lacking, companies should establish strategic partnerships with organizations that have deep expertise and capabilities in supply risk analytics and management to augment results. Lastly, investment in training programs can provide significant returns in the form of improved skills and greater retention.

Core supply chain processes – Core supply chain processes can be used as a first line of defense against imminent supply risks, especially risks of an operational and financial nature. However, more complex risks, especially those strategic in nature like regulatory and geopolitical risks, will require more advanced risk management capabilities (see next sub-section).

- **Forecasting and planning:** More accurate forecasts allow for more accurate procurement plans to ensure supply requirements are met; moreover, smaller forecast errors will allow companies to adopt more efficient inventory policies.
- **Inventory management:** Understanding when and where to store inventory, and when to shift inventory to suppliers, will help make certain that key materials are available within acceptable lead times.
- **Contract management:** Improved contracting will help secure supply of goods and services over longer periods, and can also help drive quality and service level improvements through effective service level agreements (SLAs).
- **Strategic sourcing:** Improved supplier selection techniques can lead to more reliable suppliers that are incented to continuously improve quality and service, not only price. Understanding the global supply base to develop a strategic portfolio of suppliers for categories can prevent supply disruptions when one or more qualified suppliers are unable to meet orders on-time.
- **Supplier relationship management:** Relationships with key strategic suppliers can be strengthened to clarify and help in proactively addressing supply risks and also implementing a responsible approach to community relationship management.

Technology and Management Information – Visibility into the entire chain affecting supply is important to understand current state and potential risk factors that could affect the security of supply. Companies must use technology to provide this clarity and timely information. Technology can be used to provide effective data and effective analytical tools to support the modeling and evaluation of risk, thereby providing access to data for effective decision making and risk response strategies.

Risk management capabilities:

Market intelligence – Application of forward-looking market intelligence approaches can significantly reduce supply risk in key expenditure categories. Knowing the entire supply value chain leads to increased understanding of category and supplier economics, including suppliers' strengths and weaknesses. Companies should look for opportunities to partner with strategic suppliers to share information on market outlook and key risk factors. Using leading market indicators to obtain insights toward the development of a predictive view of fluctuation in prices of goods and services is critical. As organizations develop more mature risk management capabilities, they can look to adopt advanced iterative approaches like game theory to proactively assess the preferences of market players and predict actions and sequence of actions to occur.

Internal data – Mining companies should also enhance internal systems to capture dynamic performance data and improve data integrity to augment decision-making capabilities. Improving data quality management practices will help drive more accurate data that is both comprehensive and timely.

Dynamic risk modeling – Dynamic and intelligent risk modeling process and tools can greatly improve the ability of mining companies to assess the riskiness of specific supply chain decisions. Dynamic risk models leverage predictive TCO models that accurately reflect the total supply chain. These models break the supply- and value chains into their core components and develop risk "quantifiers" for each. They then embed risk parameters into the TCO models to capture risk and facilitate scenario modeling. With dynamic risk models, mining companies can conduct scenario analysis (e.g., Monte Carlo analysis) as a standard method to optimize key supply decisions to meet demand (i.e., find the appropriate balance between risk and cost).

Scenario Analysis – Mining companies need to stress test their strategies and decisions against potential scenarios. Scenarios are created by a confluence of drivers assigned specified values (e.g., high economic growth + weak regulation) and much challenge the company’s current assessment of their future (i.e., current strategy). Building scenarios is different from contingency planning (what if a specific event occurs?) and sensitivity analysis (what if one variable in our forecasted future changes?). Companies need to build new scenarios, and appropriate response strategies to address risk as internal and external conditions evolve. This should be done as part of an iterative process.

Supply risk management methodology

Effective supply risk management is a cyclical process that uses internal and external data to drive the kinds of risk-based models that optimize key supply management decisions. The diagram below outlines the core steps that leading mining companies follow to effectively manage supply risk.

Key steps to managing supply risk

Step 1: Collect external and internal data

- Data should be gathered periodically
- Both market-facing data (i.e., commodity prices and forecasts, economic indicators, etc.) and internal data (i.e., historical spend, supplier distributions, etc.) should be leveraged

Step 2: Identify options and constraints

- Key supply management decisions, such as which suppliers to use or which countries to source from, should be modeled according to the discrete options and the relevant constraints for each feasible scenario

Step 3: Evaluate the cost and risk profile of each option, and optimize across the value chain

- Use modeling tools and techniques to understand the implications of each option on cost and risk
- Applying Monte Carlo techniques to a total cost model adjusted for risk can generate cost distributions for each scenario under study
- These distributions can be assessed in order to optimize the trade-off between reducing risk and increasing cost

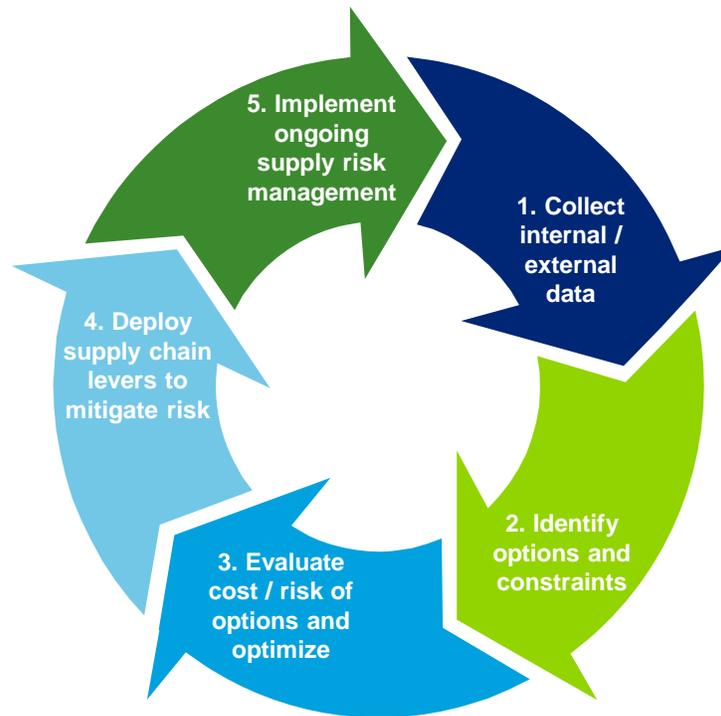
Step 4: Deploy supply chain management levers to mitigate risk

- Based on the outcomes of risk-modeling, key supply chain tactics should be applied
- For example, where competitive supply options exist, strategic sourcing should be implemented to select new sources of supply
- Where competitive supply options are limited, supplier relationships need to be strengthened to promote greater collaboration to solve increasingly complex supply chain challenges
- In cases where lead times are too long to meet material requirements consistently amidst volatile demand, inventory management techniques should be applied to optimize storage levels of key parts

Step 5: Implement ongoing supply risk management

- Develop a program to maintain a supply risk management capability and drive continuous improvements in managing supply risk via an iterative process across the entire portfolio of investments

Figure 6: Deloitte's 5-step methodology for effectively managing supply risk

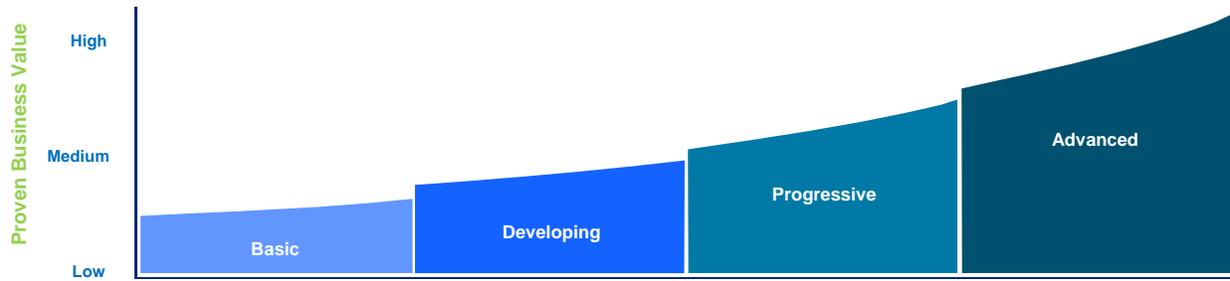


Keys to success for your organization

In the global mining industry, supply risk management capabilities vary from company to company. While the framework and methodology for addressing supply risk should not change based on internal factors, the method of deploying these approaches should. To implement and execute this process successfully and sustainably, mining companies first need to assess their organizational maturity with respect to risk management capabilities (see Fig. 7).

- Companies at “Basic” level:
 - Identify data gaps and determine workarounds to obtain necessary data
 - Develop partnerships with organizations that specialize in risk management approaches and tools to help collect and analyze data and to support decision-making
 - Leverage partners to provide ongoing risk mitigation support in key supply chain tactical areas
- Companies at “Developing” to “Progressive” level:
 - Enhance data systems to capture performance data and improve decision-making
 - Develop predictive total-cost models that capture risk and facilitate scenario modeling
 - Utilize scenario analysis to optimize key supply decisions (i.e., low cost/low risk) in order to meet demand
 - Develop capability to perform dynamic modeling and analysis in real-time
- Companies at “Advanced” level:
 - Develop more sophisticated internal capabilities to adopt and adapt an intelligent modeling approach to supply risk management
 - Develop formal supply risk function charged with monitoring and protection
 - For benchmarking purposes, look at organizations in more mature industries with respect to risk management

Figure 7: Deloitte's supply risk management maturity model²⁵

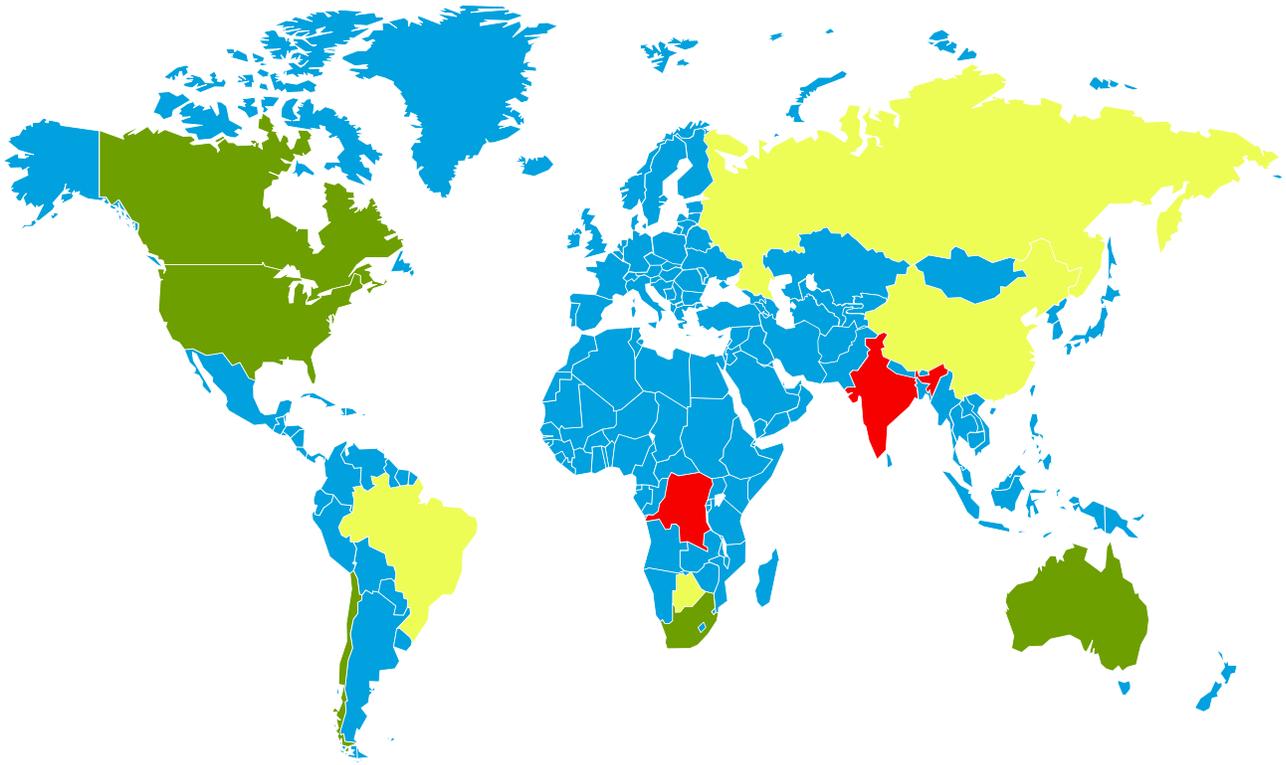


Stages of Supply Risk Management

	Illustrative Attributes			
People	<ul style="list-style-type: none"> No formalized risk management or responsibility framework Staff lacks skill sets to undertake monitoring or performance management 	<ul style="list-style-type: none"> Risk management and responsibility focused on point of outage or disruption – e.g., region or function Performance management staff is inexperienced, have limited access to leading suppliers 	<ul style="list-style-type: none"> Risk management and responsibility are carried by functional managers via localized strategies Performance management staff is well trained, have access to leading suppliers 	<ul style="list-style-type: none"> Risk management responsibility is shared across organizational business units to provide integrated view Formal supplier teams are in place to monitor and report on risks related to resources, capabilities, skills sets
Process	<ul style="list-style-type: none"> No process in place to measure, monitor, or report risk and disruption No planning and forecasting capability No contract or performance management processes 	<ul style="list-style-type: none"> Risk assessments are conducted on a reactive basis only, post disruption Low emphasis on planning and forecasting Reactive contract and performance management processes High level risk measures utilized to make decisions 	<ul style="list-style-type: none"> Risk assessments are conducted more routinely, at the onset of supplier or market changes Planning and forecasting is limited to the most critical suppliers and process is inconsistent Periodic contract and performance management collaboration with critical suppliers More developed process for measuring critical risk factors 	<ul style="list-style-type: none"> Risk assessments, integrated, strategies are iterative and aligned between functions and reported to executive level Comprehensive processes for collaborative planning and forecasting; benchmarks are utilized Consistent, collaborative approach to contract and performance management from a Total Cost of Ownership perspective Consistent and quantitative approach to risk metrics
Technology	<ul style="list-style-type: none"> No formalized supply plans across organization Rudimentary technology may be in place but is not used for performance monitoring 	<ul style="list-style-type: none"> Basic supply plans are in place, risk evaluation is qualitative only Rudimentary technology / methodology is used inconsistently to monitor performance 	<ul style="list-style-type: none"> Formalized planning, including demand and supply forecasting, is in place Mix of EDI, Web, and asynchronous communications is used to monitor supply and performance No use of services or systems to assess supplier and market Risks 	<ul style="list-style-type: none"> Planning and order management collaboration systems are utilized Supplier performance measurement systems and ERP systems enable dynamic modeling capabilities Leverage third-party information services for supplier risk and supply market Intelligence

²⁵ Deloitte project experience.

Figure 8: Our view of supply risk management maturity across global mining hubs²⁶



	Supply Risk Management Capabilities*	Supply Risk Management Areas of Focus
	Basic	<ul style="list-style-type: none"> Establish partnerships with organizations with high risk management capabilities
	Developing to Progressive	<ul style="list-style-type: none"> Enhance data systems and improved data integrity Utilize predictive total ownership models and scenario analysis to optimize key decisions
	Advanced	<ul style="list-style-type: none"> Create formal supply chain function to monitor and mitigate supply risk

Map represents countries where mining companies are headquartered

²⁶ Deloitte project experience

Summary

Mining companies today are challenged to meet unprecedented demand for mining commodities and to deliver results that exceed stakeholder expectations. With increasingly globalized supply chains and operations spreading into more remote regions, mining companies are exposed to the rising array of supply risks. In this climate, it is imperative to strengthen core supply risk management practices and capabilities. As a critical first step, mining companies should assess their current capabilities in order to identify and prioritize key areas to focus on for improvement. By doing so, mining companies will be better positioned to weather the storm of severe risk events and maintain a secure flow of supply.

Our Global Mining Team would be pleased to discuss our capabilities with you

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