Risk Management

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Risk Identification & Analysis for Engineering Projects

CASE STUDY

A Remote Mining Site

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Mining Case Study Risk Analysis

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You are a transport infrastructure Engineer in the design team for remote mine site and you have been asked to prepare a risk analysis to guide the development of the functional design for all transport features needed for the project.

Mining Case Study Scope

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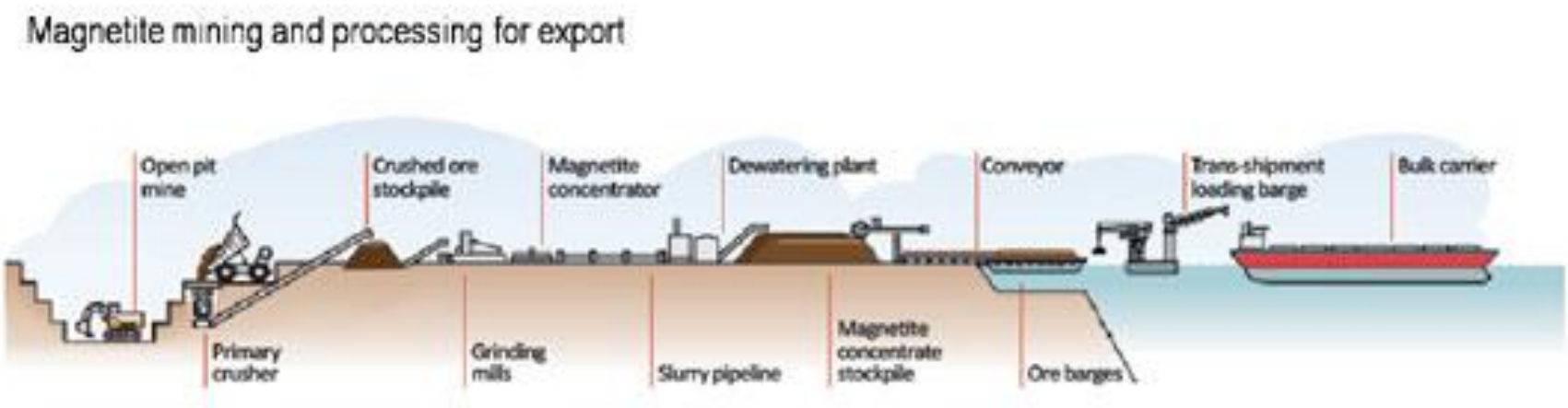
Mine site loading system

Mine to Port transfer system

Land-side port facilities

Marine-side port facilities



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Mining Case Study Scope

Transport infrastructure includes:

Access roads

Railway

Conveyors

Port

Airport.

Ship loader & ship

Mining Case Study Context

Typical performance requirements:

- **100,000 tonnes of ore must leave the port each day, for 365 days/year;**
- **The cost per tonne delivered, must remain within budget** (Fixed for 5 years) **;**

Mining Case Study Context

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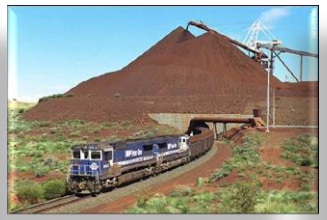
Risk Profile:

Hazards	Risks
Remote location distant from labour market	????
Remote living conditions not “family friendly”	????
Aggressive environment for operating equipment	????
Extended transport time to receive consumables, spares & new equipment	?????
Many different technical systems involved to transport product from mine to ship on a linear path.	?????


Mining Case Study Context

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Risk Profile:

Hazards	Risks
Extreme weather events occur each year	????
Price for product influenced by international issues such as currency exchange and 5 year price cycle.	????
High dependence on remote control systems	????
Small change in cost per unit of work multiplies to a large project cost because of the large volume throughput	????
Stringent environmental controls apply to the project.	????





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Procurement of skilled labour for a remote location:

1. *Labour skills analysis;*
2. *Labour demand analysis;*
3. *Labour availability analysis;*
4. *Employment from indigenous population;*
5. *Training requirements analysis;*
6. *Labour accommodation and travel options analysis;*
7. *Life of mine labour requirements;*
8. *Social infrastructure requirements;*

For each category of labour!

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Procurement of managers for a remote location:

1. *Staff demand analysis;*
2. *Staff availability analysis;*
3. *Training requirements analysis;*
4. *Staff accommodation and travel options analysis;*
5. *Life of mine staff requirements;*
6. *Social infrastructure requirements;*

For all levels of professional and management staff!

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Procurement of specialist equipment in a remote location:

1. *Operational risk analysis;*
2. *Life expectancy risk analysis;*
3. *Maintenance risk analysis;*
4. *Parts availability risk analysis;*
5. *Supply chain risk analysis;*
6. *Procurement (purchase) risk analysis;*

For each item of plant & equipment!

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Procurement of specialist equipment in a remote location:

1. *Operational risk analysis;*
2. *Life expectancy risk analysis;*
3. *Maintenance risk analysis;*
4. *Parts availability risk analysis;*
5. *Supply chain risk analysis;*
6. *Procurement (purchase) risk analysis;*

For each item making up the equipment!

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Procurement of specialist equipment in a remote location:

1. *Operational risk analysis individual &*
2. *as a component in an interlinked system;*
3. *Life expectancy risk analysis;*
4. *Maintenance risk analysis;*
5. *Parts availability risk analysis;*
6. *Supply chain risk analysis;*
7. *Procurement (purchase) risk analysis;*

Taking account of interlinked equipment in a system!

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Aviation for high value transport requirements:

1. *Load analysis (type, weight, frequency) including risk analysis;*
2. *Aircraft procurement/lease analysis;*
3. *Service reliability risk taking account of environmental conditions;*
4. *Airport requirements to match demand;*
5. *Analyse capex & opex for airport;*
6. *Risks of airport not being available;*
7. *Downside risks if service not available;*
8. *Cost/benefit analysis for business case;*

Transport for labour, perishables & spare parts!

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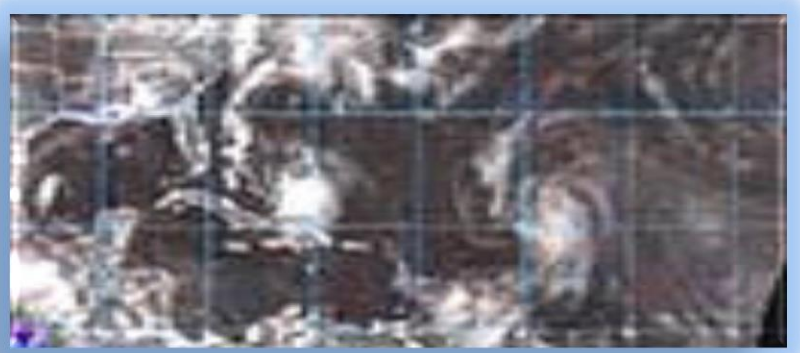
Analysis to take account of extreme weather events:

1. *Analysis of weather data to asses frequency & severity of extreme weather events (rain, wind, dust, tides, sea swell, high temperature);*
2. *Each set of data has inherent risks which determine it's accuracy and compatibility with other data;*
3. *Analysis of the risks of extreme weather events affecting critical mining infrastructure and/or operations;*



Local weather patterns

Regional weather patterns

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Mobile plant & equipment risks:

1. *Impact of materials to be handled;*
2. *Access road standards;*
3. *Operator skill levels;*
4. *Quality of routine maintenance;*
5. *Service reliability risk analysed taking account of environmental conditions;*
6. *Risk analysis of accidental damage;*
7. *Parts availability risk analysis;*
8. *Supply chain risk analysis;*
9. *Procurement (purchase) risk analysis;*
10. *Stand-by plant as a mitigation measure;*

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Establishment of high reliability infrastructure:

1. *Define level of service required (outage frequency & severity)*
2. *Define power demand normal peak & emergency conditions;*
3. *Adopt risk analysis used for specialist plant & equipment;*
4. *Foundations & flood risk analysis;*
5. *Risk of damage from wild life;*
6. *Access for maintenance and future upgrades;*
7. *Provision for future expansion (baseline now);*
8. *Stand-by plant for maintenance outages and for emergency conditions;*

Central electricity generators for the mine & railway.

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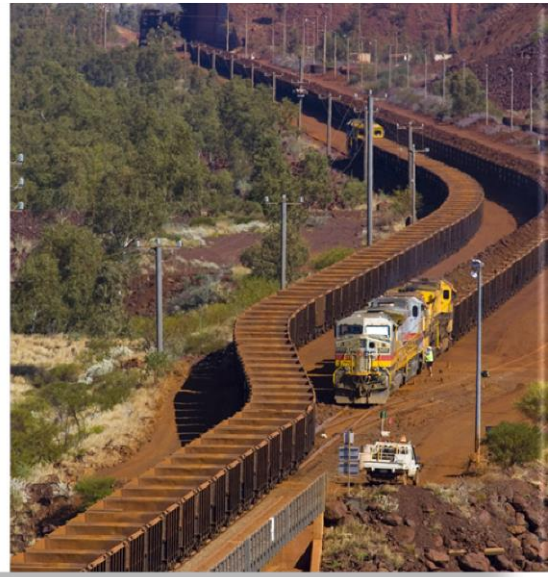
Heavy haul rail rolling stock:

1. *Critical linear transport link;*
2. *Single track must be available continuously;*
3. *Service reliability risk analysed taking account of environmental conditions;*
4. *Approaching edge of current rail technology;*
5. *High capex & opex equipment, therefore redundancy not favoured for risk mitigation;*
6. *Monitoring critical parts is core to risk mitigation measures (aviation industry);*
7. *Maintenance whilst trains are in service has been a priority;*
8. *Preventative maintenance risk analysis used;*



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Heavy haul rail track infrastructure:

1. *Critical linear transport link;*
2. *Single track must be available continuously;*
3. *Track & track bed protected from floods , land slips & subsidence based on a risk-based conditions assessment;*
4. *Protection from track obstructions like straying animals provided;*
5. *Train control system based on fail-safe communications network;*
6. *Track maintenance whilst trains are in service is a priority;*

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Marine-side port facilities

1. *Tide risk analysis;*
2. *Storm risk analysis;*
3. *Dredging maintenance risk analysis;*
4. *Dredging versus longer jetty comparison;*
5. *Material corrosion risk analysis;*
6. *Access for equipment maintenance analysis;*
7. *Ship impact risk analysis;*
8. *Future jetty and pontoon expansion risk analysis;*
9. *Operational OH&S risk analysis*

Jetty and mooring for all outgoing product.

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Marine-side port facilities

1. *Tide & storm risk analysis;*
2. *Service reliability risk analysed taking account of environmental conditions;*
3. *Monitoring critical parts is core to risk mitigation measures combined with preventative maintenance risk analysis;*
4. *Access for equipment maintenance (frequency & severity analysis);*
5. *Ship impact risk analysis;*
6. *Operational OH&S risk analysis*

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Land-side port facilities – Specialist stacker/reclaimer

1. *This is a risk transfer candidate;*
2. *Subcontract supply, operate and maintain the equipment for a specified level of service;*
3. *Include requirements for risks associated with integration with linked equipment & with supporting infrastructure managed by the Mine;*
4. *Cover risks arising from power supply, access roads, personnel facilities, communications, labour relations, priority for incoming freight transport.*
5. *Provision of buffer storage to absorb delay risks;*

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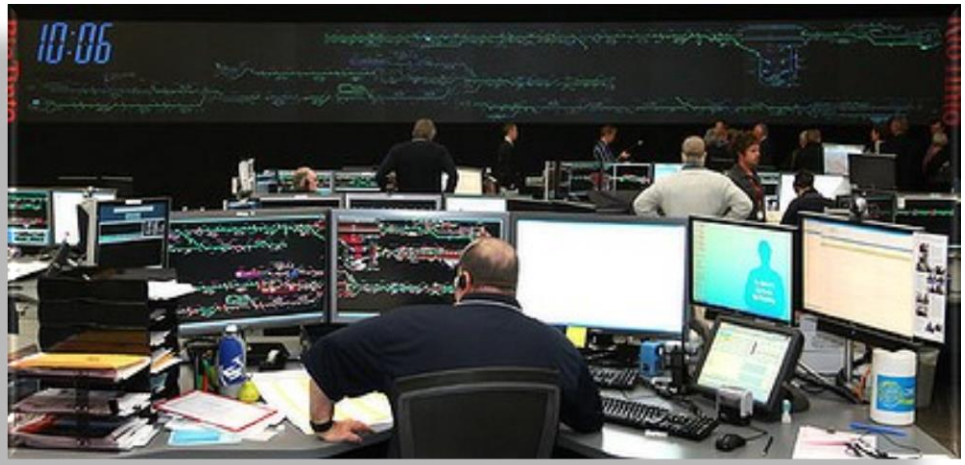
The future for risk management of isolated mine operations

Remote control using real time data analysis & artificial intelligence.



The new Rio Tinto operations centre at Perth Airport

The country's biggest iron ore producer can co-ordinate its mining, rail and port operations 1500 kilometres away in the Pilbara from the new centre. (*Picture by Mogens Johansen, The West Australian*)

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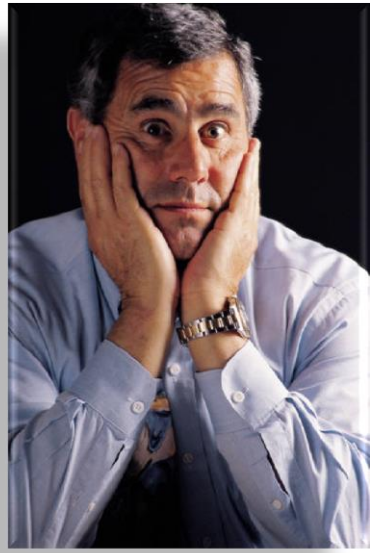
Qualitative risk analysis:

Risk analysis requires an assessment of the risk that the data may be inaccurate, the probability that critical location events may occur concurrently and the risk of long term environmental trends exacerbating critical events.

A numerical analysis is needed with risks assessed by sensitivity checks using combinations of data.



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CONCLUSION