Connected Mining

Agenda

- Opening remarks: Anthony Finch (Hitachi Consulting)
- Speaker 1: Dr .Glen Callow (Rio Tinto) followed by Q&A
- Speaker 2: Yoshinori Furuno (HCM) Followed by Q&A
- Speaker 3: Alex Atkins (Deloitte) Followed by Q&A
- General Q&A
- Concluding Remarks

The recent mining downturn has highlighted how vulnerable the sector is to changes in operating conditions.
The downturn in Australia was/is specifically severe because it was a combination of factors that affected profitability.

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Remote sensing
Drill strata recognition
Data Analytics and modelling

OEM performance data
Commodity price analytics
Beneficiation analytics
Plan optimisation (MILP)
Simulation
Capital allocation/performance

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IT/OT Convergence – OEM to Insight (FMS)
Autonomy
Predictive maintenance, remote maintenance
Supply chain optimisation
Energy optimisation
Tactical and control simulation (FMS)
Performance analytics and prediction
Beneficiation/Mining analytics and optimisation

Supply chain optimisation
Remote sensing and control
Autonomy
Energy management

Supply/Demand Analytics
Connect the market back to the mineral resource
Future exploration effort
Cash Management

Mineral Resources

Mine/Project planning

Execution

Product Transport

Sales Marketing

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Pressures

Specifically a drop in commodity prices in the face of a skills shortage, over capitalisation, along with an increase in the costs of consumables and other factors of production.

With the benefit of 20/20 hindsight the downturn was quite predictable and almost inevitable, and the players did little to avert it.

The predictability comes from basic economics and the way miners sit in terms of the industry economics. Fundamental economic theory of the firm asserts that there is a supply and a demand curve for the industry and the individual supplier within that industry

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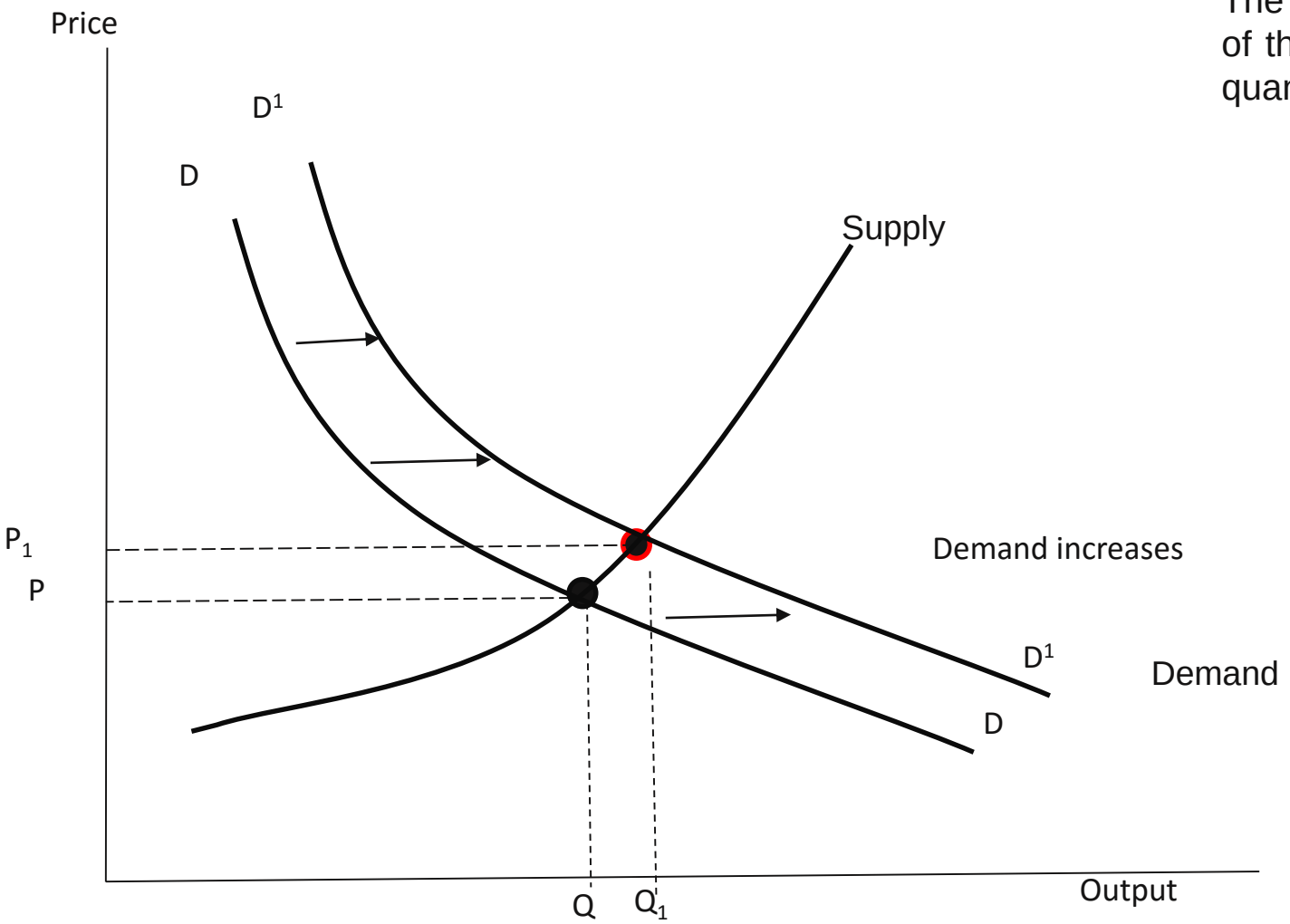
Theory of the Firm



The slope of the supply curve reflects the elasticity of the suppliers – that is their ability to change the quantity supplied for various changes in demand.

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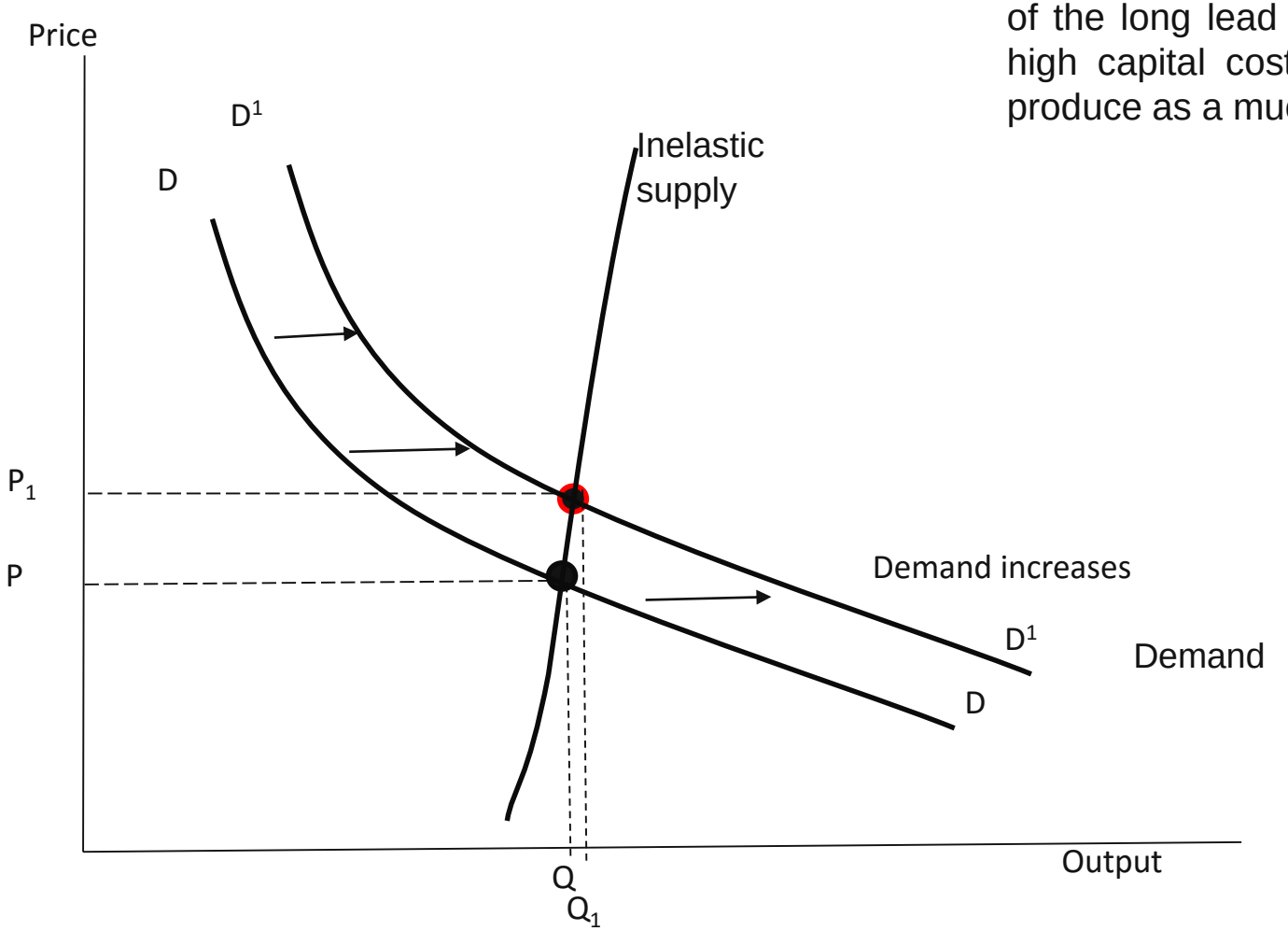
Inelasticity of supply



Traditionally miners have very low elasticity of supply mainly because of the long lead time required to create productive capacity and the high capital cost of that capacity and because of the mandate to produce as a much as possible (fully utilise the capital).

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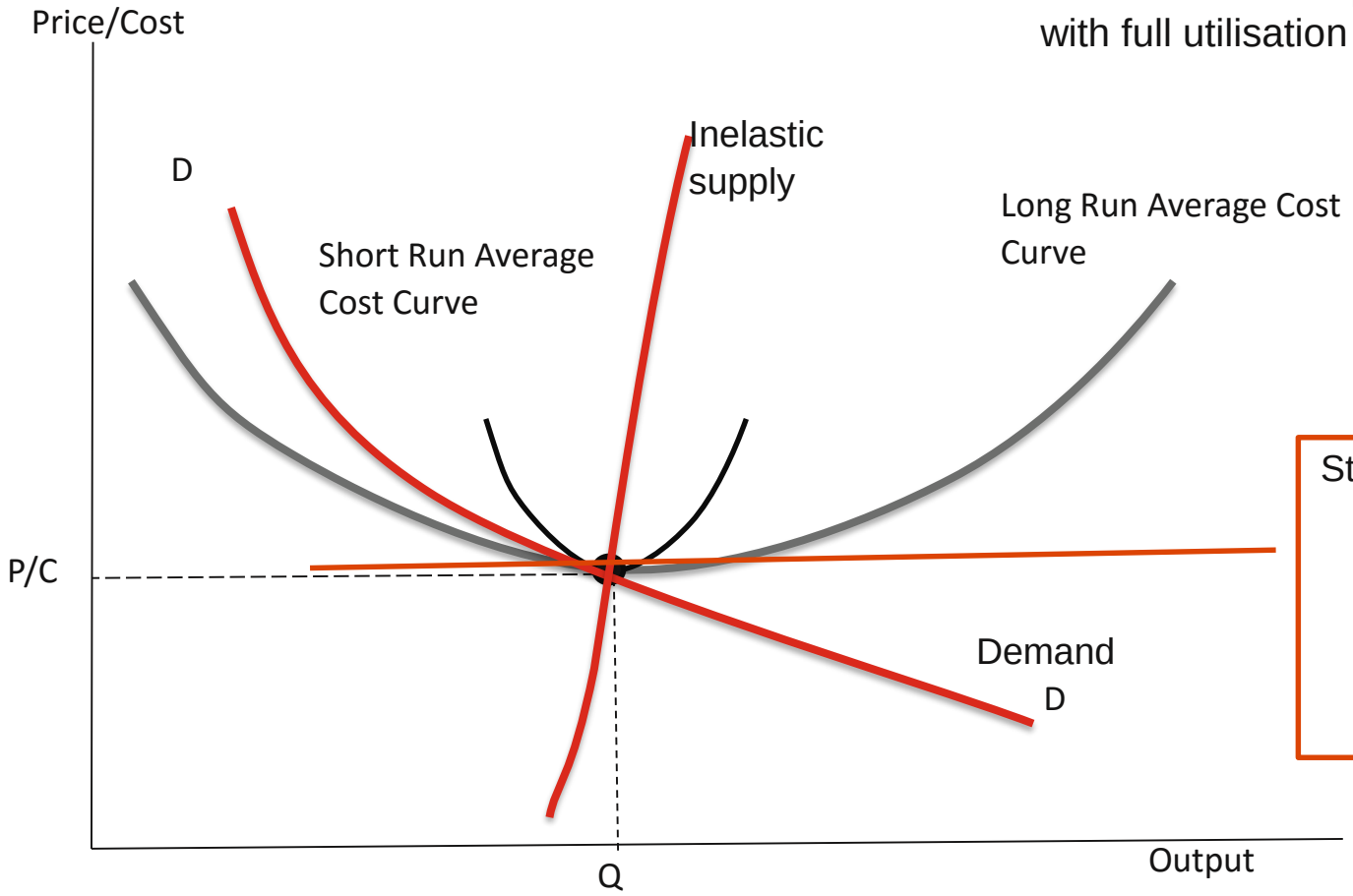
Steady state – optimum profits

This is not generally considered a bad thing as the theory of the firm also asserts that both short run and long run average cost of production can be minimised for a specific cost/quantity set point. This is normally associated with full utilisation of capital and maximum shareholder return



Steady state both short run and long run average costs are minimised, profit maximised

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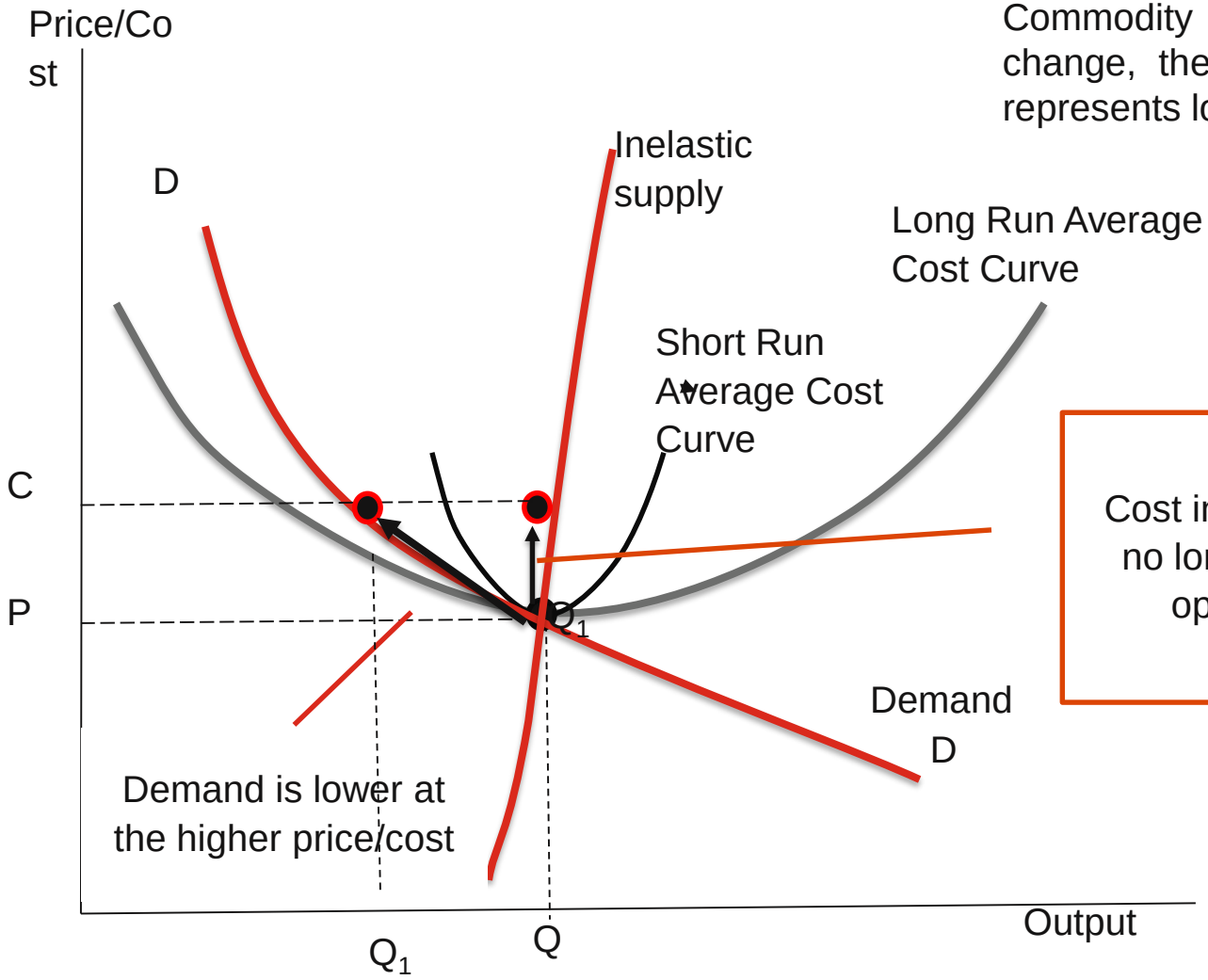
Changing conditions

What happens however when the operating conditions change? Costs of consumables changes? Skills availability changes? Transport costs? Commodity prices? When any one or several of those things change, the miner is no longer operating and the minimum cost, this represents lost opportunity, lost profits, and lost shareholder value.



Cost increases - the mine is no longer operating at the optimum profit point

The inability for the miner change either the short run costs or the long run costs in any meaningful way quickly represents collapse of the market. With modern technology, connected mining, and the Internet of things this consequence can be radically changed. By connecting the work at the face (and even exploration) to the market and the operating environment along with all the components in between the industry can capitalise on the opportunities created by the changing operating conditions.

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The Model T Ford

I normally don't like analogies drawn from manufacturing applied to mining. Mining is different from producing widgets, however us miners have become adept at using manufacturing paradigms to benefit our operations. So I have an manufacturing analogy my apologies in advance.

The model T ford started production in 1908 finished in 1927. This car represented a revolution in manufacturing as it was mass produced on a production line. This resulted in drastically reduced costs of production and it meant that cars were affordable to the middle class. So this car created 2 revolutions. The systemisation of manufacturing – the production line, and the automotive industry. The production line technology introduced by ford revolutionised the world, not just the motor industry. However if you wanted a model T it had to be black, it had 4 seats, 2 doors, in fact everything was standardised to the point where all model T's were the same. This standardisation underpinned the production line. It would not have been possible without it.

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Modern manufacturing

One hundred years later it takes Nissan 18 hours to produce a car. But each car is pretty unique. It can be one of several colours, it can have special lights, gears, transmission, motor, wheels, fuel, seating, etc.

The intense competition in the automotive industry has led it to meet the market in order to create competitive advantage for shareholders. There has been certain enabling technologies that have facilitated this transformation. Basically instrumentation (the internet of things) and automation.

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Digital Mining

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These technologies are now real and reliable in the mining industry. We are becoming automated, we are becoming instrumented across our supply chain. However many of us are **not** becoming more flexible. We are not meeting our market conditions with the vigour and relish that we should.

Wenco

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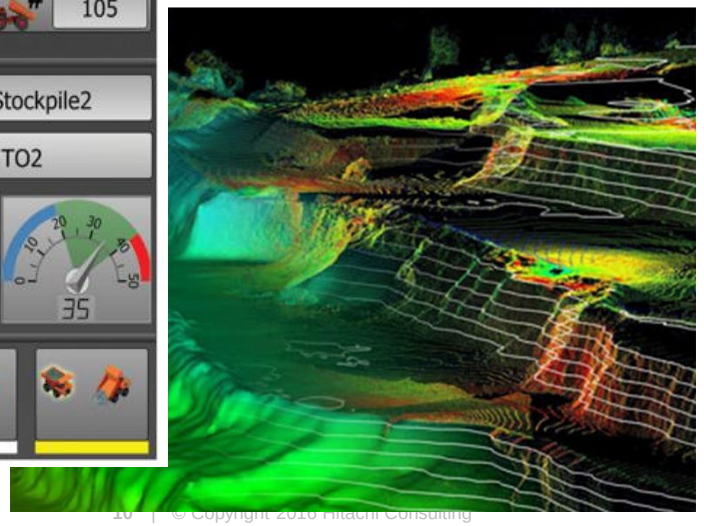
Hitachi Construction Machinery (Australia) Pty Ltd

April 2015 - HCA take Distributorship of Wenco, FMS Products & Support.
HCM – HCA and Wenco for the Development of AHS in Australia.

This is not easy. It takes at least 5 years to develop a mine, mines are very capital intensive and we are motivated to make the most of the capital. This means we have difficulty adapting mine plans and plant to changing underlying operating conditions. I am sure this is exactly what Ford would have said if he was asked for a different model T, he would have to re-tool, retrain, etc.



Today it takes billions to build a car manufacturing facility, it still takes 5 years to get a car from concept to production. The difference today is that in car manufacturing, the flexibility is built in, they build in the assumption that they will be meeting the market when it comes to production of that model.

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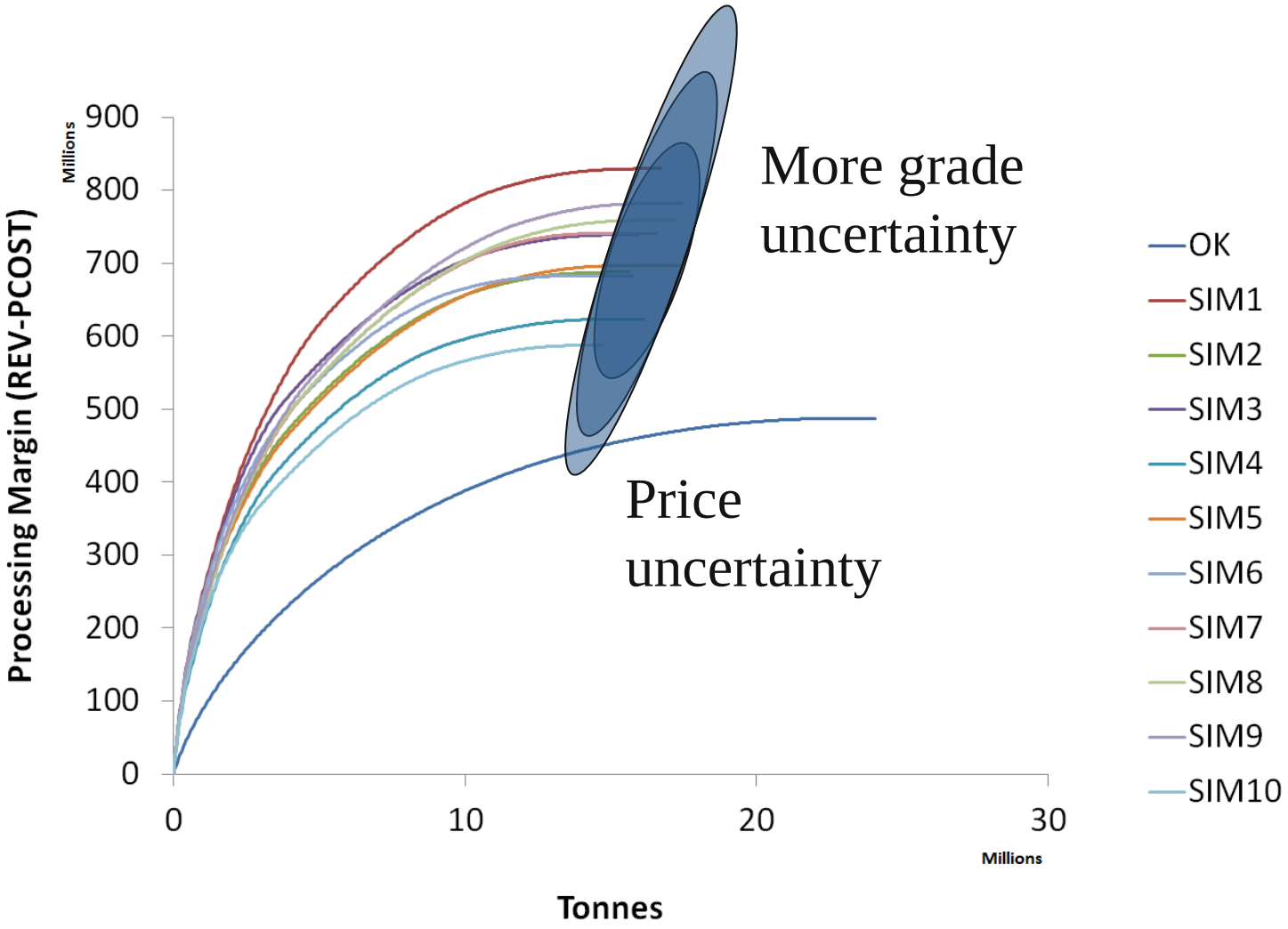
Planning for uncertainty



In mining, this kind of thinking has been around for a while in the feasibility study world. During my time as a mine planning consultant we were starting to introduce stochastic modelling to our studies so that we could assess the resilience of the study to random changes in operating conditions, the goal being to choose the study option with the highest resilience (lowest risk) rather than the study option with the highest NPV.

Not many developers chose this option, they normally chose the highest NPV. This option is typically the least resilient, the least flexible, and of course, when developed, leads the industry to inelastic supply and eventual market collapse.

In my view a truly competitive global miner takes broader take of markets and supply. That miner seeks out technologies that connect the market to the face, and options that include resilience.

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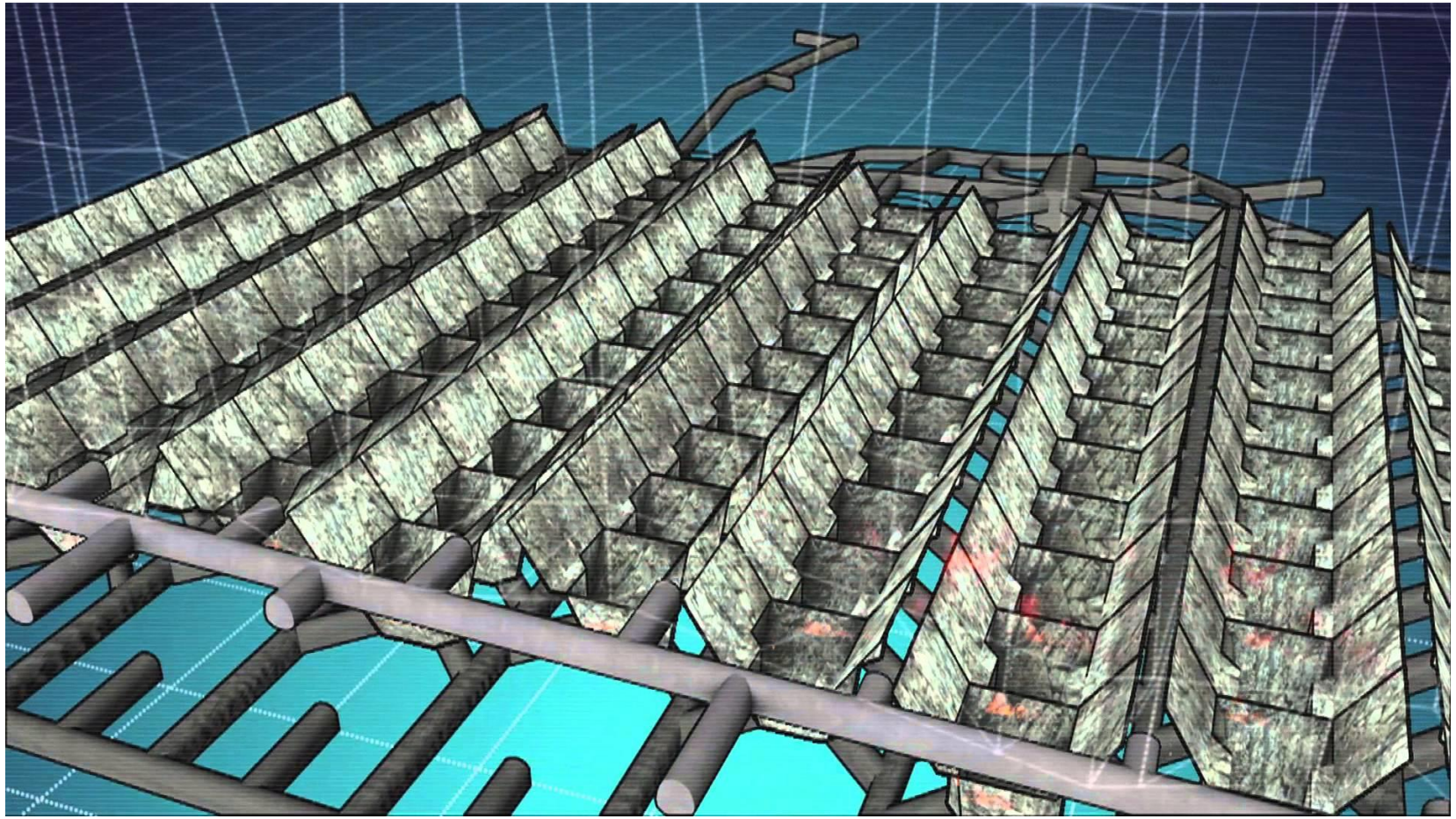
Copper Block Cave



Imagine a block cave Cu mine that sells a shipment of concentrate with specific properties because of knowledge of both the market and the ore available at all the draw points.

After selling the concentrate the mine then produces the ore from the cave using autonomous loaders and blending technology, crushes, and hoists it, concentrates it (with full knowledge of material properties required of both the ore and the market), produces the concentrate shipment, and dispatches it to the customer, all within a matter of days. This kind of thinking is happening now.

Connected Mine
Coal

Image a coal marketing department that identifies an opportunity to fill a ship with niche coal specification that they happen to know the mine can fulfil because they are appropriately connected to the mine operations.

Marketing will sell that ship load on the basis of its availability. The mine fulfils the order on time and on budget without undue disruption to operations. The company achieves extraordinary profits consequently.

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With current advances in high precisions mining, fleet management systems, plant controls systems, and overarching cost and supply chain modelling systems these scenarios are not only possible, they are inevitable and are happening now on a limited basis.

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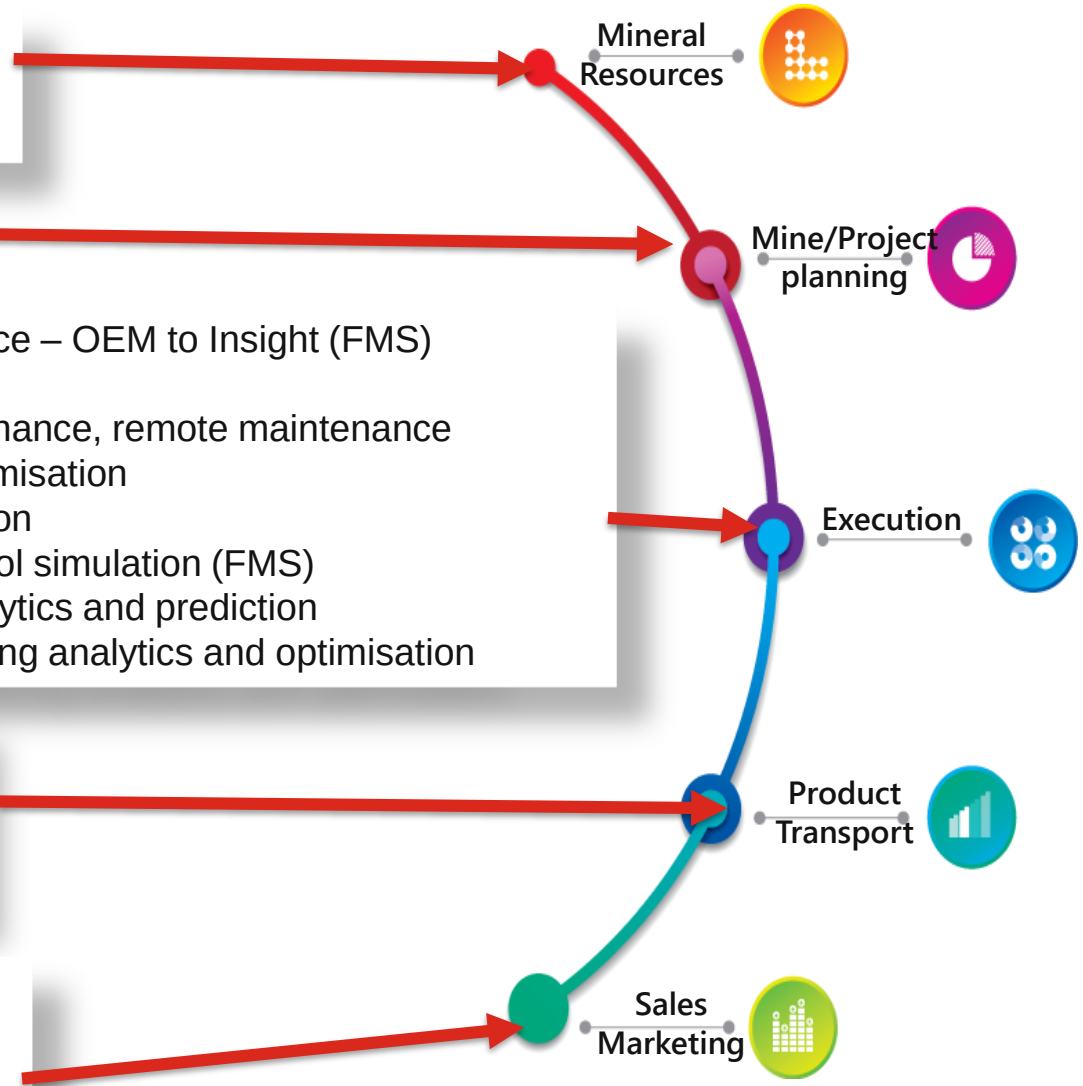

The mining industry should get used to the idea of producing new detailed life of mine plans and budgets in hours not weeks based on ever changing assumptions, the industry should be able to reconfigure the mobile and fixed plant fleet on the fly to meet the demands of the market.

When we have end-end integration in our mining enterprises along with automation and control (just like in car manufacturing) the connected mining operator is positioned to enjoy a new level of sustained profitability.

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