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he said. The void space inside the shell around the disc is filled with the grinding media, while the discs operate at tip speeds of 21 to 23 metres per second, resulting in high energy input intensities of up to 300 kilowatt/m<sup>3</sup>, significantly higher than any other commercially available grinding equipment.

“As the shaft rotates inside the mill, the space between each disc acts as a discrete grinding element, acting in series with the disc before and after it. Feed is pumped into the feed end of the mill, and the particles pass towards the discharge end of the mill through the rotating media. The rotation of the disc radially accelerates the media and particles towards the shell,” explained Burford.

“Between the discs however, the media is not subject to the high outwards acceleration forces as at the disc face, and the media is forced back in towards the shaft – creating a circulation of media and particles between each set of discs. Minerals are ground as a result of the agitated media, the predominant mechanism being attrition grinding. As a result of having a number of grinding chambers in series, short circuiting of mill feed to the discharge is virtually impossible.

“The energy intensive environment within the mill can use media as fine as 1mm to obtain grind sizes down to 7µm. Grinding media is retained in the mill without the need for screens, by a patented product separator consisting of a rotor and displacement body at the end of the grinding chamber (driven by the same shaft as the disc).

“The design and position of the separator with relation to the last disc, enables the separator to centrifuge media to the outside of the mill before pumping it back towards the feed end thereby retaining the media in the mill. The balance of the product, essentially the

*MIM did not turn to the mineral processing industry for a solution. Instead the company looked at pigment grinding for cosmetics, paint and paper.*

ground product, exits the mill through the displacement body. This unique mechanism means that screens or cyclones are not required, simplifying the circuit and enabling it to operate in open circuit, while over grinding is minimised, creating a very sharp product distribution.”

MIM was now ready to commercialise its product, but it did not hit the markets with its new technology. Burford said that between 1999 and 2003, marketing was limited. The mill was “only installed in a small number of operations that were outside the lead/zinc industry that posed no perceived competition to the existing MIM lead/zinc business.”

In 2003, a combined effort from MIM, Netzsch and Anglo Platinum brought the M10,000 into the world. It offered the same benefits as the smaller M3000, but with a

10,000 litre capacity and a 2.6 megawatt motor.

In 2003, too, Xstrata took over MIM, for the bargain basement price of \$2.9bn. The acquisition included MIM’s Process Technology business which had been established to develop the IsaMill. Thus, Xstrata Tech was born.

The technology has continued to develop and spread across the world. “From the initial development of the first model to the latest project, technology has continuously progressed and trialled through research and design programs on small scale as well as full scale units,” Burford said.

The M50,000, with an eight megawatt motor and 50,000 litre capacity, has been produced and a new media charging system, known as the IsaCharger, is in production. “It was trialled in late 2009, and is now included on all installations. It was a big improvement from screening and auguring systems that had been developed, and eliminates all moving parts,” Burford said.

There are over 90 IsaMills, of varying size, installed worldwide – in Canada, the U.S., Peru, Ecuador, Mexico, China, Kyrgyzstan and Germany, among others.

Burford said “Magnetite projects are assessing the use of IsaMills in this new industry, in Australia and overseas. The first IsaMill treating magnetite is due to be installed at Ernest Henry in 2011. The need to grind large tonnages down to sizes of 40µm or less for some deposits, makes it an ideal candidate to provide an energy efficient solution for these isolated mining operations.” □

Contact: [www.isamill.com](http://www.isamill.com)

## Whittle’s transition from software to consultancy

The Whittle family took a bold gambit in 2001, offloading its programming business – on which it had made its name – and re-focussing as a more financially-oriented consultancy. Whittle managing director Gerald Whittle spoke to Mike Foley.

**WHITTLE CONSULTING** was born when Jeff Whittle sold the family’s pioneering software business to Gemcom Software International in 2001. Jeff’s son Gerald, who had a background in finance, joined the business in 1999 and was instrumental in changing the focus to enterprise optimisation consultancy.

Gerald Whittle related the story of how his father Jeff started the business, and took it to the point where it was sold to Gemcom.

“Whittle Programming was started in 1984 by my father Jeff Whittle. He was the first person to write a commercially available software package that applied the Lerchs Grossman algorithm, which was a pit optimisation technique that was actually designed in the 1980’s, but wasn’t able to be computed on a practical basis until 1984.”



Gerald Whittle.

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Gerald said that this algorithm is now “pretty much industry standard.”

Despite Jeff’s breakthrough, “it took 12 months until he sold the first software package. Now, the software is an industry standard. It is an obvious thing 27 years later, but at the time, like any new idea, people were cautious.

“It is based on assumptions of the value of the blocks – which is the price multiplied by the mean content multiplied by the recovery minus the selling and mining costs and the pit flows and other costs. It is a detailed model to optimise the shape of the pit. That was a product called Whittle Three-D.

“About a year later he made Whittle Four-D. It was very good on sensitivity analysis and how the pit would change with different metal prices, but also as a good technique for designing early pit phases and pushbacks within the ultimate pit.

“Then in the early 90s Jeff developed Opticut, a cut-off grade optimiser inspired by Ken Lane’s (of Rio Tinto) book: *The Economic Definition of Ore* in 1988. That is the definitive book on cut-off grade of ore. That is what inspired Jeff to write Opticut, a software tool to help do those complicated calculations.”

By that stage, Gerald said his parents Jeff and Ruth (who was in charge of marketing), had developed a very good business that had sold 400 licenses in over 50 countries.

Nevertheless, in 2001 Whittle Programming was sold to Gemcom. “It was clear that to take



Jeff Whittle.

this product through the consulting business and not sell it as a software product, as it is too powerful for many companies’ computer systems and too complex for clients to effectively utilise. “It is not the sort of thing you can run after a three day training course and leave in the hands of the user.

“I have a bank of 64 bit computers here that we run that thing on.” Gerald explained that the value Whittle Consulting offers its customers in terms of enterprise optimisation comes “on top of Prober.”

“Mining engineers are looking for constant mining rates. It seems to be attractive for some reason. And I can demonstrate that can’t be optimal.

“Then you get to cut off grades: Ken Lane wrote his book in 1988, but I estimate that 20% of the mines in the world actually apply that technique. But it is not for lack of software, the software has been around since the mid-90’s. It is a mindset.

“People feel bad about throwing away low grade material, which means you can process more high grade material and make more money.

“This seems to be lost on mining engineers and geologists. They tend to focus on the rocks and the tonnes and the ounces and the pounds.”

Gerald uses training courses to market Whittle Consulting, in a concerted effort to expand its market beyond its base in Australia and Indonesia. “During the last 18 months, I have delivered a training course called *Money Mining*. It talks about our concepts and methods and I hardly talk about software at all,” Gerald said – adding that over 600 people have attended.

This initiative has been fruitful for Whittle Consulting. “We get one or two from each training session that say ‘this is the right way to progress’, which has been the source of our rapid growth over the last 18 months... it has been an absolute whirlwind, we have quadrupled our business.”

Whittle formed an alliance agreement with engineering firm Ausenco to facilitate its push into the wider international market. Gerald said “12 months ago, we opened our own office in South Africa, and through Ausenco we have been offering our services in North and South America.”

In its home markets of Australasia and Indonesia, Whittle Consulting provides services for Chalco, PT Inco, Xstrata, Lihir and Goro Nickel, among others. Other customers include Vale, Rio Tinto, Gold Fields, Compania Minera Casale, Kinross, Anglo Gold, Anglo Platinum and Paladin. Gerald said Whittle Consulting plans to focus equally on all regions in the future, despite some proving easier to crack than others.

“In North and South America there are some more old fashioned, stubborn, less innovative companies... Africa has been refreshingly open minded to new ideas. I have been delighted with their response.” □

[www.whittleconsulting.com.au](http://www.whittleconsulting.com.au)

*Mining engineers are looking for constant mining rates. It seems to be attractive for some reason. And I can demonstrate that can't be optimal.*

the business to the next level it had to go to a much larger group with a bigger network and the outcome of discussions around that time was to sell it to Gemcom.”

Prior to the sale, in 1999, Whittle Programming had begun work on multi-pit blending scheduler software, known as Prober, which was not included in the sale to Gemcom. It remained with the family and now underpins its consulting capabilities.

It was designed for complex simultaneous optimisation modelling of cut off and stockpiling. Gerald said it made sense to market

“The [Prober] software is important, but the methodologies we apply are most significant,” he said. “We have some very comprehensive operational modelling activity, based on the theory of constraints.

“There are three layers. You have got software at the bottom, you have methodology on top and sitting above both you have a philosophy.” Gerald said it is challenging, trying to sell his philosophy. “You do encounter some resistance when you tell someone the way they have been running their business for 20 years is wrong.