

The Whittle Story

A Live Book

An algorithm for the ages – how one paper in the CIM Bulletin launched a discipline

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After 120 years of publishing, the CIM archives are vast. Inside them authors have laid the foundations for entire new schools of thought and methods for generating value from mineral resources.

That is what Helmut Lerchs and Ingo Grossman, a pair of mathematical whizzes-turned-operations-researchers at IBM, did in the January 1965 edition of the *CIM Bulletin*. “The model proposed in this paper,” the authors wrote, “will serve to explore alternatives in pit design, given a real or a hypothetical economical environment (market situation, plant configuration, etc.). ... The objective then is to design the contour of a pit so as to maximize the difference between the total mine value of ore extracted and the total extraction cost of ore and waste.”

Today the names Lerchs and Grossman are synonymous with open pit mine design, but when they published their eight-page paper, the technology required to execute their method did not yet exist, and would not for many years.

Jeff Whittle was contracting with Newmont in Australia when he came across the Lerchs-Grossman paper. “I also read an article somewhere that said that the mining industry would love to use Lerchs-Grossman but it was ‘too hard to program’,” Whittle wrote to *CIM Magazine* recently.

“In the early ‘70s Placer Dome had managed to get it working, but it was well known in the industry that they had had great difficulty and it had cost them a lot of money – I think the figure quoted was a quarter of a million dollars. That was indeed a lot of money in the early ‘70s. Of course, Placer Dome didn’t allow anyone else to use it.

“By 1980, I had had 18 years of technical programming experience, and I regarded ‘too hard to program’ as a personal challenge!” Whittle wrote.

The paper included a 2D and a 3D optimization algorithm based on graph theory, a realm of mathematics used to represent a collection of connected objects.

“The 3D algorithm was quite brilliant and logically very complex. Also the description was somewhat terse! Nevertheless, I figured out a way to program it and offered to write it for Newmont,” Whittle recalled. The company, however, was not prepared to take on the risk, so the Whittle family did. The program was written over a couple months using Fortran. His wife, Ruth, wrote the manual and took on the marketing. “The first run with real data at Newmont took 160 hours on a VAX mini-computer.”

It was another 12 months before they made their first sale. Then Whittle said, sales began to gather momentum and he was back at work with the next iteration of the software. Eventually there was not a bank in Australia that would finance a miner who had not used the optimization software to create a mine plan, according to Roussos Dimitrakopolous, a mining engineering professor at McGill University who specializes in mine optimization.

In 2014 Lerchs, Grossman and Whittle were inducted into the International Mining Technology Hall of Fame for their pioneering work, which ultimately established the discipline of strategic mine planning. Earlier this year, Whittle was also named an officer of the Order of Australia.

Grossman died in 1995. Whittle met Lerchs, who passed away last summer, at a CIM conference in the 1990s. “He had recently become aware that the algorithm was being used in mining,” said Whittle. “Apparently he had happened to sit next to a miner on a flight, and the guy had asked if he was the Lerchs of pit optimization fame.”

Whittle, who at 88 still programs “from time to time,” made a point of sharing the credit for his achievements with the people who have struggled with the optimization challenge over the last

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few decades and for those who first committed it to print. “There is no way I could have thought up the Lerchs-Grossman algorithm,” Whittle said. “It involved mathematics that were way beyond me.”

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