Business Week

NUMBER 2243 August 26, 1972

A computer model to upgrade zinc profits

Cerro de Pasco is planning similar models for its lead and copper operations

From its executive suite on Manhattan's Park Avenue to its mines and smelters in the Peruvian Andes, the buzzword these days among managers and operations men at Cerro de Pasco Corp. is "optimization." With the aid of a complex mathematical management science technique called linear programming (LP), and a farsighted young management consultant, the subsidiary of Cerro Corp. has come up with a computerized working "optimization" model of its entire zinc business. Results in just six months indicate that the model may yield a big payoff in profitability.

In the volatile mining and metals business, with its wide price swings and its political vulnerability, Cerro can use all the help it can get to boost earnings. Cerro Corp.'s mining group, of which Cerro de Pasco is the major part, accounted for 43% total corporate sales of $425-million last year. But while the group has usually accounted for at least 50% of corporate "contribution" income—earnings before unallocated corporate expenses, interest, taxes, and extraordinary items, it chalked up a negative contribution last year of an estimated $5- to $6-million.

The "optimization" model, as its name suggests, is geared to show Cerro de Pasco how to wring more profits from its zinc operation, a key segment of its total business. And, indeed, the zinc operation model is believed to be one of the most comprehensive LP models in operation.

Plain speaking. First, the computer is fed a host of "variables" that have a direct bearing on profits: metals prices, labor and transportation costs, capital and raw material costs. Also fed in are various limiting factors, or constraints, including the amounts of ore or metal concentrates available, and the rates at which C de P plants can turn out relatively crude zinc concentrates or refined products such as metallic zinc, cadmium, and sulfuric acid.

The intricate relationships between all the variables and constraints are expressed in a set of algebraic equations, which make up the actual LP model for the computer. The model of Cerro de Pasco's zinc operations, which the company calls its zinc circuit, contains some 370 variables and more than 150 equations. What comes out of the computer is a simplified printout in language that tells management, at a glance, how much of the company's wide variety of zinc concentrates it should ship overseas and what it should refine further in its own plants for optimum profits.

The zinc model, like other LP optimizing models, is valuable in other ways. If conditions suddenly change—if, for instance, metals prices fall by 2¢, or if there is a wildcat strike or a 10% jump in transportation costs—Cerro de Pasco can immediately determine the best strategy for adjusting its zinc operations at a minimum cost. In minutes, the computer can grind out a new optimal plan to improve or double-check a seat-of-the pants decision.

Converts. After only six months, the tangible and intangible results from the zinc circuit model have been so promising that the company intends to develop similar models for its lead and copper circuits. "We're really going to find out what the model can do," says John W. Hanley, director of metallurgy for parent Cerro Corp. "It's looking pretty good, and I'm a believer."

Cerro de Pasco started to think about building an LP model last year after Bernard A. Lietaer, senior associate at big Manhattan-based management consulting firm of Cresap, McCormick & Paget, Inc., went to Peru as part of a team that was set up to help C de P and Cerro Corp. develop a new flexible budget system. Lietaer, 30, had long been intrigued by the use of models for short-term planning. While studying at MIT's Sloan School of Management, he had developed a computer model that multinational corporations could use to minimize their risks from exchange rate fluctuations and from inflation.

'You don't need an OR guy around. The model practically runs itself'

After a few months of working closely with Cerro de Pasco's operating and financial managers in Peru, Lietaer decided that at least part of the company's complex mining, metal producing, and marketing operations could be coordinated by using linear programming techniques. C de P gave him the go-ahead to develop an experimental LP optimization model for the zinc circuit, which was ready for use early this year. Since then, the model has been run some 200 times—for regular monthly updates, for special planning purposes, or when variables suddenly change.

Basic applications. Linear programming has been used most frequently to solve basic kinds of production and distribution problems, because the relationships among major variables in these areas usually are known and can be rather easily quantified and controlled. Marketing and financial applications have been less frequent, because many of the factors in those areas defy expression in numerical terms and their interrelationships often are unclear.

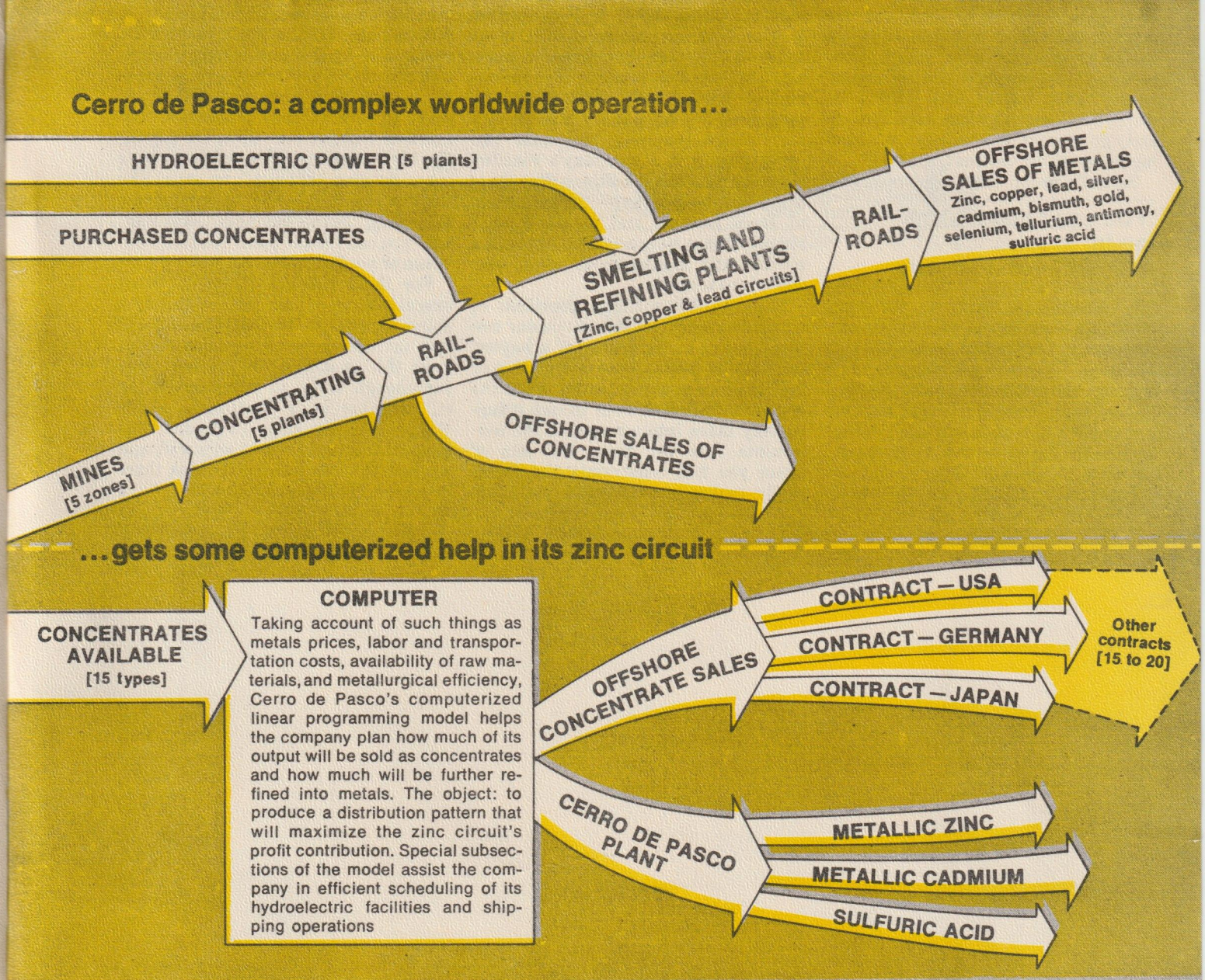
To take an example in production: A small parts-finishing company makes three products and knows its exact profit per unit. It has two basic departments, grinding and plating, each of which can handle a limited number of units of each product per day. By using an LP model, the company can determine how many units of each product it should make to gain maximum profits.

A textile company with three factories might use LP to determine how much of its production it should ship to each of its five warehouses in outlying locations to minimize total transportation costs. Or an oil company might use linear programing to hit on the most profitable product mix from its refinery.

But there is a danger in using LP techniques on such a limited basis. Profits from one small segment of a company might be enhanced at the expense of its total operation and profitability. The textile manufacturer might cut transportation costs by shipping more skirts to, say, Atlanta than Chicago. But an increase in demand in the Midwest might catch the company with its skirts in the wrong place, cutting over-all profits.

Safeguards. Cerro de Pasco has guarded against this peril by giving its model virtually all of the significant factors that affect its zinc operations—from the ores it mines and the concentrates it produces or buys to the refined metal products or raw concentrates it sells abroad. Without some way of looking at the total operation, explains Lietaer, problems are sure to crop up. "A marketing man can tell you what a particular sale or contract means for his operation," he contends, "but not what it will do in terms of manufacturing—and vice versa."

"Having this model has focused attention on all parts of the system," says David A. Bancel, a vice-president of Cerro Sales Corp., the Cerro Corp.



subsidiary that markets most of the metals and concentrates produced by C de P. And Hanley believes that it has helped managers to perform more competitively at all times. "It makes them more conscious of the whole process," he says. "The model is a sophisticated calculation, but it does throw it all right there in front of you."

Hanley concedes that some managers may have been a bit apprehensive when the model was being developed. But now that the model is in place, Hanley and Bancel insist it has given managers a new sense of confidence. "We found out through the model that we were doing a pretty good job," Bancel says.

Lietaer believes that the model was so readily accepted primarily because it presented internal results in familiar managerial language, not computer jargon. "That's what sold it," he says. "You don't need an operations research guy around. It practically runs itself."

Another reason for the acceptance can be traced to brainstorming sessions between Lietaer and Cerro de Pasco operating managers in Lima early in the development stage. Together, they sat down around a table and computer console to explore what the new model could do. Today, each manager has easy access to the model for help with operating plans and problems.

Other uses. An LP model is particularly suitable for pinpointing bottlenecks in a system. For example, a manager in Peru requested $60,000 for a new grinder in a previous capital budget. It was turned down, because it was decided that the payback period was too long by conventional measures and that the grinder would only slightly improve the grade of zinc concentrates.

But the model showed that the grinding operation was a bottleneck in the zinc circuit. With a new grinder, the upgrading of the concentrates could result in more profitable substitutions in a number of overseas contracts—to the tune of $300,000 annually, estimates Lietaer.

Cerro de Pasco also has found the model useful in contingency planning, which is known as playing the "what if" game. If a roaster breaks down, for instance, should the company stick to its usual repair schedule and have the facility out of operation for a week—or should it put on an extra man to get the job done in three days? By figuring the cost of the slowdown to the company's worldwide operations, the computer is likely to advise it to hire the extra man if he does not cost more than $5,000.

The "what if" game can show the company how vulnerable it is to swings in metals prices. On its regular monthly model runs, C de P also does a "sensitivity analysis" of what would happen to its distribution patterns if metals prices rose or fell by 2¢, and can come up with contingency plans.

Human factor. Cerro Sales employs the model to coordinate shipping. "This is where we've used it most and the most effectively," Bancel says. If a grade of concentrate becomes unavailable just

as a ship is ready to load, the dispatcher can tell at a glance from the computer printout what substitutions to make at a minimum loss to the company– what Bancel calls "the least worst solution." Then he can immediately go to work on a new optimal loading program for the next vessel.

Bancel's group has found optimization information, such as the most profitable distribution pattern by concentrate grade, useful in negotiating contracts. "You can get the guy who's making the contracts more aware," Bancel says. "In a particular instance you might tell him: 'Look, can't you go back to the Japanese and see if you can get them to take something else?' "

'You can't make plans too far in advance— or you'll be damn sorry'

Potentially valuable as the model may be, Cerro and C de P executives are quick to emphasize that it is no automatic system, but rather a management tool that must be used in connection with a hefty dose of human judgment. The LP model is essentially a short-range planning tool that can greatly shorten a company's reaction time to changing conditions. But there are other, longer-range factors, many of them political and economic, that simply cannot be quantified into such a model. And management must take these into account.

Says W. Willis Higgs, president of Cerro de Pasco: "At this particular moment, we're at the mercy of a buyers' market for this type of material, and you can't necessarily utilize what the computer indicates, even though it supposedly takes into account all the constraints that you have. But lots of times you find constraints you didn't really realize existed until you start working up programs of this kind."

Wait and see. With a world market for metals and concentrates subject to sudden disruptive price fluctuations, Bancel asserts that you may not aways want to ship all your products to the markets that, at that time, are paying the highest prices. "You've got to have some floating tonnage," he says. The same caveat may apply to buying raw materials. "In this business," says Bancel, "you can't make plans too far in advance or you'll be damn sorry."

For those reasons, Cerro de Pasco executives, to a man, refuse to put a dollar amount on the potential annual cost savings the company may realize from the LP model. "We've not come far enough along to put numbers on it," Hanley says cautiously. Adds Higgs: "I'm not going to predict. The general feeling is one of let's wait and see how it turns out. But I think there are some great possibilities here." ■

as a ship is ready to load, the dispatcher can tell at a glance from the computer printout what substitutions to make at a minimum loss to the company— what Bancel calls "the least worst solution." Then he can immediately go to work on a new optimal loading program for the next vessel.

Bancel's group has found optimization information, such as the most profitable distribution pattern by com-

> 'You can't make plans too far in advance— or you'll be damn sorry'

may be, Cerro and C de P executives are quick to emphasize that it is no automatic system, but rather a management tool that must be used in connection with a hefty dose of human judgment. The LP model is essentially a short-range planning tool that can greatly shorten a company's reaction time to changing conditions. But there are other, longer-range factors, many of them political and economic, that simply cannot be quantified into such a model. And management must take *these into account.*

Says W. Willis Higgs, president of Cerro de Pasco: "At this particular moment we're at the mercy of a bureau-

working up programs of this kind."

Wait and see. With a world market for metals and concentrates subject to sudden disruptive price fluctuations, Bancel asserts that you may not aways want to ship all your products to the markets that, at that time, are paying the highest prices. "You've got to have some floating tonnage," he says. The same caveat may apply to buying raw materials. "In this business," says Bancel, "you can't make plans too far in advance or you'll be damn sorry."

For those reasons, Cerro de Pasco executives, to a man, refuse to put a dollar amount on the potential annual