Team Research in Fertilizer Economics

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Complexity of today's fertilizer industry requires group of experts to gather and analyze the accurate and up-to-date data that management needs to make intelligent decisions

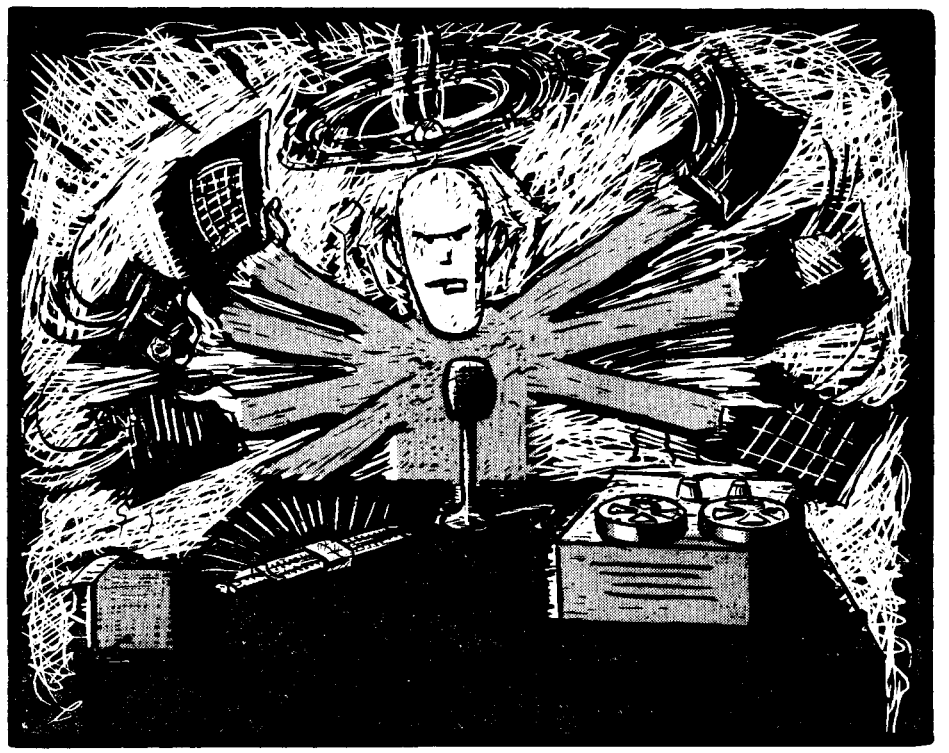
IN RECENT YEARS manufacture and distribution of fertilizer in the United States has become an increasingly complex and competitive industry. Not only has consumption of fertilizer risen sharply in the past 15 years, but there have also been major technological changes—which are still going on—that have added significantly to problems faced by management in the fertilizer industry. New types of raw materials have been developed and are now in common use, new products have been successfully marketed and are widely accepted by the American farmer, and new processes have created major problems in the fields of quality control, pollution control, and by-product disposal. With it all, as more and more companies have come into the fertilizer industry, competition has become increasingly severe.

In this situation, management's need for accurate and up-to-date technological and economic information is greater than ever. Without such information, intelligent decisions—both in day-to-day operations and in long-range planning—become difficult or impossible to make, and a company runs the risk of falling behind in the competitive race. The alert fertilizer company, however, recognizes this need for information and makes adequate provision for it through a well-planned, continuing program of research. When an important decision must be reached in such a company, a sound basis for that decision is already at hand.

Problems Faced by Management

The types of problems faced and the questions that must be answered will necessarily vary with the individual company, depending upon its size and the nature of its operations. On the one hand, a company may be involved only in the production and sale of a basic fertilizer ingredient to other manufacturers. Or the company concerned may produce intermediate materials that it sells either directly to the farmer or to still a third type of company—the manufac-

Three ways to explore a field . . . Find one man who can understand all the facets . . . Research one facet ar



turer of finished mixed fertilizers. Perhaps even more common are companies whose operations overlap into more than one of these categories, including fully integrated manufacturers that deal with all three classes of products—basic ingredients, intermediate materials, and finished fertilizers.

Whatever the position of the company in the industry, its management must cope with at least some facets of the over-all problem of fertilizer manufacture and distribution. Management must choose the products that it is to make and must have a reasonably accurate knowledge of the potential market for those products, giving full consideration to both geographic variations and seasonal fluctuations in demand. It must select the raw materials to be used, and be familiar with the latest manufacturing methods and the costs involved in processing those materials. Management must fit its operations to take advantage of the most economic methods of transportation and must develop a sales and distribution organization that will contribute to the growth and prosperity of the company. And finally it must be aware of what its competitors are doing and of existing or contemplated Government farm programs that may have significant effects on fertilizer use patterns.

Alternative Research Methods

The question of how a company can best secure the information it needs to reach sound conclusions on the problems it faces is an important one. At least three alternatives suggest themselves. As a first possibility, management may choose to explore only one facet of the total problem—let us say manufacturing methods and costs—and ignore or guess at the answers to the remaining questions. Unfortunately, the number of situations in which this approach will prove adequate is exceedingly rare. A second choice would be the assignment of a single individual to investigate and report on all the diverse problems that may underlie a particular decision. Unfortunately again, if the total problem is at all complex, the chances of finding any one man who is capable of understanding, investigating, and interpreting all the pertinent aspects of that problem are very slight.

If one concedes that neither of these two approaches would be suitable, there is still a third alternative that holds more promise—and that is the team approach to fertilizer economics research. At Battelle, where team research is the accepted and proved method for conducting all research, the team approach is also considered the best method for tackling problems in the fertilizer industry. Experience has shown that it provides the most effective mechanism for bringing to bear on a given problem the combined talents of chemists, chemical engineers, mineral engineers and economists, market specialists, agricultural and transportation economists, soil scientists, and any others needed to find the right answers. Each of these men has the necessary experience in his chosen field to know where and how to gather needed information most efficiently. Together, they form a team that can accurately evaluate the relative importance of the various aspects of the problem and arrive at sound conclusions that will serve as a useful guide to management. Furthermore, there is no particular limitation to the variety of problems that can be successfully attacked using this team approach.

Such a team may, of course, be drawn from a company's own staff; or outside help may be enlisted to work on the problem. In the latter instance, whether a company employee is an active member of the team or not, there must be very close cooperation between the company and the outside research agency to minimize the risk of misunderstanding company objectives or financial limitations.

Case Histories of The Team Approach

The case in favor of team research on fertilizer economics problems can be effectively supported by citing several actual fertilizer research programs. The three case histories which follow illustrate how the team approach has been effectively used at Battelle to gather fertilizer economics information for companies having three distinct positions in the fertilizer industry. Undoubtedly numerous similar examples could be cited by fertilizer companies themselves or by

nore all the others...

Or assign it to a team of experts

other independent research organizations. The emphasis in this discussion is on objectives and techniques, rather than results, since the latter are necessarily confidential.

Exploring the Market for Apatite

Our first illustration relates to a mining company that is potentially a supplier of a basic fertilizer ingredient —apatite or phosphate rock. This past winter, Multi-Minerals Limited of Toronto came to Battelle for assistance on both technical and economic problems that had arisen in connection with its plans to develop an ore body in Ontario. Previous investigations had shown Multi-Minerals that it owned a deposit rich in magnetite and apatite which represented a potentially profitable operation provided that the ore could be mined and processed economically and that adequate markets could be found for the products.

Over a six-month period, several different divisions at Battelle, working together, carried out a series of studies aimed at finding an answer to these questions. Using samples of the ore, the minerals beneficiation group conducted numerous experiments to determine the most economic methods for processing the ore and the products that would result from the application of alternative processing techniques.

Concurrently, this same division and the industrial economics division set up and carried out a twofold market survey to explore the potential markets for the magnetite and apatite, primarily in the Great Lakes region. Steel companies in the area were visited to determine their interest in and their possible purchases of the magnetite. Simultaneously, representatives of fertilizer manufacturers having plants in the Great Lakes Region were interviewed to ascertain the likelihood of their becoming purchasers of the apatite. Supplementary data were also gathered on fertilizer consumption trends and transportation methods and costs in the region, and a preliminary survey of processing techniques and costs was conducted by the chemical engineering research division.

At the conclusion of the series of studies, the management of Multi-Minerals Ltd. had received a group of related reports that spelled out objectively and in detail the prospects, from both a technical and economic standpoint, for developing its ore deposit.

Prospects for a Proposed Ammonia Plant

The second study selected as an illustration was sponsored by a company that is now a manufacturer and seller of both intermediate and finished fertilizer products. Late in 1953 Standard Oil Company of Ohio was seriously considering entry into the petrochemical business and called on Battelle to make a preliminary survey of the market potential for a variety of petrochemicals in the midwestern area served by the company.

On the basis of conclusions drawn in the report covering this initial survey, as well as information gathered by its own staff, Sohio tentatively decided to go into the production of anhydrous ammonia and other nitrogen products, and returned to Battelle in the spring of 1954 for a more comprehensive and intensive study of prospects in this particular petrochemical operation. Battelle was engaged to make a detailed analysis of:

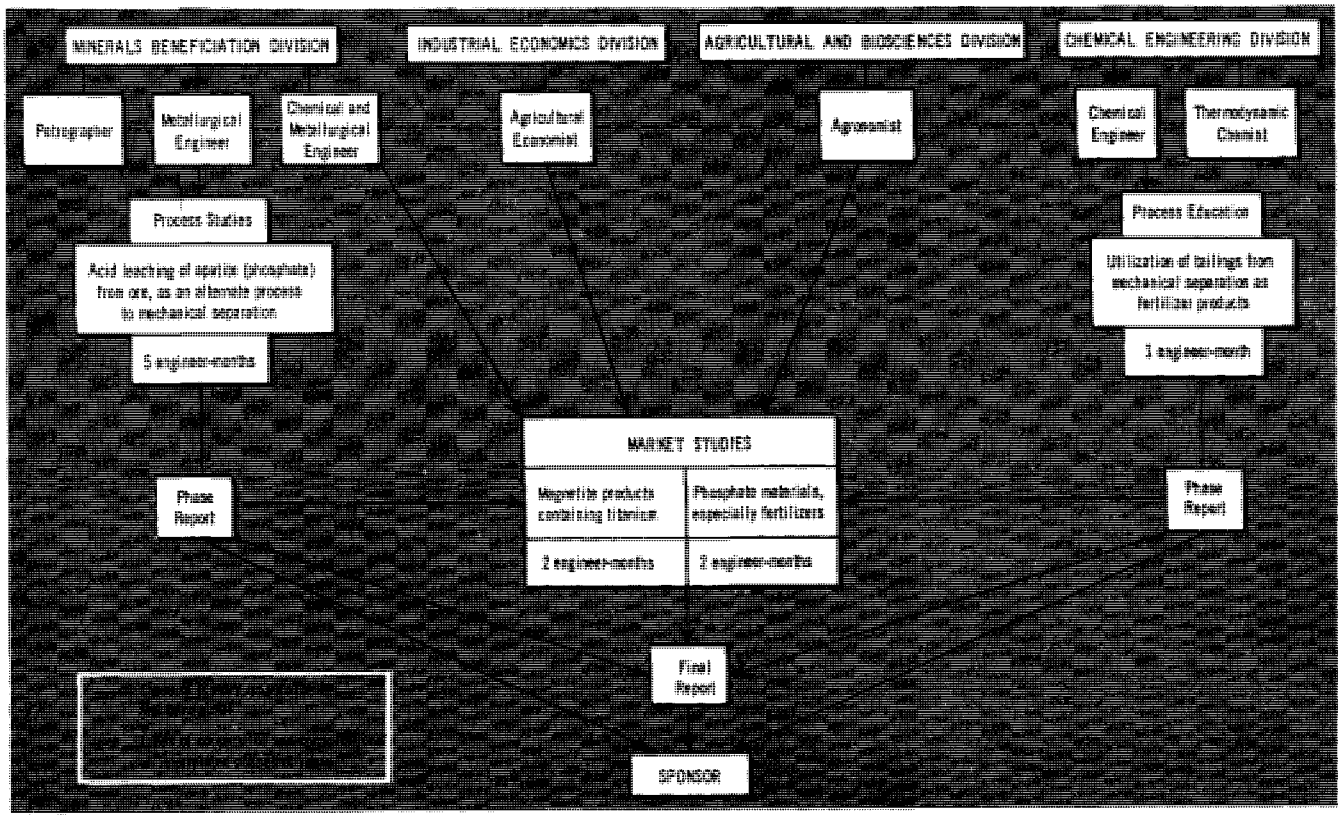
Present and future markets,
Sales and distribution methods,
Existing and probable future competition.

On the basis of this analysis Battelle was to make recommendations on:

Size of plant,
Products to be made and quantities of each,
Approximate sales organization and methods.

A study of such scope obviously required the services of a group of researchers with a wide variety of training and experience. Furthermore, in view of the rapid expansion then in progress in the nitrogen chemical industry, speed was essential in the conduct of the study so that Sohio executives could reach an early decision and take action on that decision without undue delay.

The time and talents of Battelle personnel as they were organized to find the answers for Multi-Minerals, Ltd.



Having clearly established the objectives and scope of the study, Battelle immediately formed a research team of chemical economists, chemical engineers, agronomists, and agricultural and transportation economists, and tackled the job of gathering and interpreting the mass of information necessary to the fulfillment of the study's objectives. Trends in fertilizer consumption and distribution in the Midwest, with particular reference to nitrogen materials, were checked by means of personal interviews with more than 150 fertilizer manufacturers, anhydrous ammonia distributors, county agricultural agents, and state college agronomists throughout a six-state area. Additional contacts were made with representatives of trade associations, trade magazines, railroads, and the U. S. Department of Agriculture. Some 75 more interviews took place with other companies to determine the industrial market potential for the likely products and by-products of the proposed plant. Throughout the study, a close, cooperative relationship was maintained between the Battelle team and the Sohio representatives concerned with the problem.

The information contained in the report on the study served to firm up Sohio's previous tentative decision to construct an ammonia plant. A new corporation, Sohio Chemical Co., was formed and its plant, located at Lima, Ohio, is now in full operation, selling a variety of nitrogen chemicals to the midwestern fertilizer industry.

Evaluating Indiana's Fertilizer Industry

Battelle's chemical engineering research group played the leading role in the third study selected as a typical example. The primary goal in this study, sponsored by the Indiana Farm Bureau Cooperative Association, Inc., was a thorough analysis and comparison of both well-established and relatively untried fertilizer processing techniques, together with a survey of probable future trends in fertilizer consumption and distribution in the state of Indiana. The association's objective in undertaking this research program was to obtain the information necessary for sound long-range planning to ensure continued good service to farmers throughout the state.

In the chemical engineering phase of this study, data on a wide variety of processing methods—covering raw materials, equipment, nature and quality of products, and operating costs—were gathered, both by personal visits to plants employing these processes and through a careful search of pertinent technical literature. These data were then correlated and analyzed, and the relative advantages of the various processes were presented to the association in report form.

Technology Studies

The fertilizer processes studied included all known technologically feasible processes that indicated any possibility of being competitive in the current fertilizer market. Nitric phosphate, ammonium phosphate, and calcium metaphosphate processes were studied for central plants with capacities ranging from 50,000 to 130,000 tons per year, as were granulation and conventional mixing processes. Possible captive production of such raw materials as ammonia, nitric acid, phosphoric acid, and sulfuric acid was also included in the economic analysis. The use of fertilizer materials from local plants with capacities in the range of 3,000 to 10,000 tons per year was compared with the distribution and application of fertilizers produced in central plants. The operations studied for local plants included bulk storage, custom-blending, and liquid fertilizer production. Attention was also given to fertilizer transportation and application costs.

Information on future fertilizer use trends in Indiana was obtained not only by personal interviews with individuals familiar with the midwestern fertilizer industry but also by means of a questionnaire mailed to a large group of Indiana farmers constituting an organized farm panel.

The main objective of this questionnaire, which was sent to approximately 1000 farmers, was to determine present fertilizer use patterns and probable changes in those patterns that might be anticipated in the near future. Each farmer was asked to reply, in terms of both present and probable future practice, to a series of questions covering such fertilizer trends as bulk application, custom-spreading, use of mixed goods as against straight fertilizer materials, granulation, and liquid mixed fertilizers.

Information on Punch Cards

The information received from the 883 farmers who responded was coded, transferred to punch cards, and analyzed with the aid of computational machines. This analysis served to confirm, at the "grass-roots" level, opinions previously gathered from agronomists and fertilizer experts in other areas. It showed that there is a definite trend in the Middle West toward bulk fertilization and the use

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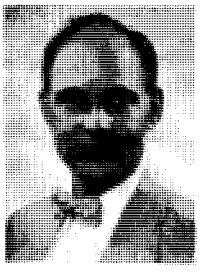

LAWRENCE L. LORTSCHER, a chemical engineering graduate of Massachusetts Institute of Technology, has been engaged in fertilizer research for the past several years. He has been especially concerned with the evaluation of new fertilizer technology, fertilizer process costs, and fertilizer industry economics. His previous experience includes the application of statistical procedures to the solution of product and test development programs in addition to specific research on problems for the steel, asphalt, and glass industries.

GEORGE F. SACHSEL, chemical engineer, joined Battelle in 1947, and is at present a consultant in the fields of process development and plant design. He received undergraduate and graduate degrees in chemical engineering from Columbia University. Included in his research experience are a variety of process and plant studies in the fields of inorganic and organic technology and studies on the performance and synthesis of liquid rocket propellants. He is intimately acquainted with many of the process industries serving agriculture and has conducted many studies involving cost estimates and engineering evaluation of processes and plants.

of granulated fertilizers. On the other hand, no evidence was found to suggest a significant lessening of the popularity of mixed fertilizers; and increases in the use of custom-spreading for dry fertilizers or the use of liquid mixed fertilizers seem likely to be slow in developing.

Conclusions

These are but three examples of the types of fertilizer economics problems that have been and can be successfully attacked by the team research approach. Team research admittedly presents some problems that are not encountered in the individual research method. Chief among these are the achievement of a unified and well-coordinated research effort among the team members in the execution of the study, and a coherent presentation of the results of the various aspects of the study.

The attainment of a unified effort in carrying out a study involving a diversity of problems requires the services of a competent coordinator or project leader. He must be thoroughly familiar with the over-all objectives of the study, must have a working knowledge of the present technology and economic status of at least one of the major facets of the total research problem, and must have a general understanding of the problems involved in all the aspects of the study. Under the guidance of such a coordinator, the individual segments of the study can be effectively carried forward by experts in those particular fields and such other personnel as may be drawn into the study to assist them with necessary "legwork."

Coordinator Makes Final Report

This same coordinator must carry the major responsibility for the preparation of a coherent final report on the project. The analysis and writing up of results in the several segments of the study may be done by different individuals responsible for those segments. However, the job of pulling together the various sections of the report, of arranging them in a logical sequence and providing a smooth transition between them, and finally of preparing the over-all summary and conclusions rests squarely on the coordinator. Once this job is accomplished, the administrative or supervisory personnel responsible for the technical quality of the research project and the report provide a valuable check on the success of this coordination effort.

These problems of achieving a unified research effort and a coherent report can be minimized through careful planning and selection of personnel, and it is our firm conviction that the team approach will continue to be the most effective research method for solving the complex problems of the fertilizer industry.

Acknowledgment

The authors wish to express their appreciation to officials of Multi-Minerals Ltd., Sohio Chemical Co., and Indiana Farm Bureau Cooperative Association, Inc., for granting permission to cite as examples the research studies conducted at Battelle for these companies.

Based on a paper presented at the meeting of the ACS Division of Fertilizer and Soil Chemistry in Atlantic City, Sept. 19, 1956.

A section of Sohio's ammonia plant, the result of a team approach to fertilizer economics research