

(5) Less Maintenance

- These factors are offset slightly by the higher operating costs.
- (6) Lower spare parts inventory
- (7) Lower capital costs

A SIMULATION APPROACH TO ANALYZING ALTERNATIVE DISTRIBUTION SYSTEMS FOR SMALL FOOD STORES

by
James L. Cline
Agricultural Research Service
U.S. Department of Agriculture

Distribution costs continue to be a major factor in the price of food at the retail level. The impact is especially critical in small food stores, where the distribution is often characterized by many short-haul deliveries that begin with a partial load and many routes that are duplicated by various distributors. Because of ever increasing labor, fuel, and equipment costs, distributors of all sizes must continually reappraise the economics of their operations. The purpose of this research was to develop an effective means by which management can predict the cost benefits of alternative food distribution systems. Studies of delivery systems serving small food stores were conducted in western Pennsylvania under a cooperative agreement between the Agricultural Research Service and the Pennsylvania State University.

The result of initial studies was the development of a simulation model, CONSOL, which utilizes the Fortran IV language. The program has been refined to include an abundance of comment statements to aid the user and simplified programming instructions which include a complete glossary of terms.

CONSOL was validated in three experiments. In the first experiment the study team compared separate daytime deliveries of dry groceries and bakery items to 19 convenience stores with consolidated night time deliveries of the two commodity categories to the same 19 stores. Actual operating data were collected primarily from company records and time studies and used in the simulation program. Simulation results indicated that consolidation could produce a 48 percent reduction in total annual costs of distribution of

these two commodity categories to the 19 stores. This equates to a saving of slightly more than \$700 per week and compared favorably with actual results achieved by the firm handling and consolidated deliveries, the dry grocery wholesaler.

In the second experiment, an analysis was made of the effect of varying daytime traffic congestion and distribution costs of separate bakery deliveries. The comparison was made between these costs and consolidated delivery costs developed for dry grocery and bakery items in the first experiment. The simulation results indicated a range of potential savings, through consolidation, from \$200 per week to \$724 per week.

The third experiment compared a combined delivery of meat and produce and a separate delivery of milk with a combined delivery of meat, produce, and milk. Simulation results indicated that an annual saving of \$5,000 could be realized through this effort of further consolidation.

Productivity improvements noted in the three experiments were a direct result of improved utilization of equipment and labor. Where extensive capital expenditures are required to effect consolidation, the savings might possibly be less dramatic.

We believe the results of this study can contribute to a greater appreciation of the potential benefits of consolidated deliveries. More importantly, this research has produced an effective tool which can supplement managerial judgment and improve the decision making process. With CONSOL, a firm can analyze its own particular situation and predict the advantages or disadvantages of consolidation without making physical changes in the operation.

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