THE EFFECTS OF CONSOLIDATED DELIVERIES ON CONVENIENCE STORE SUPPLY: A SIMULATION STUDY

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The failure or partial usage of small shipment consolidation contributes to unnecessary logistical costs and city congestion. Consolidation of food products for delivery in one truck trip would appear to offer a potential for improving the productivity of small store supply operations benefiting both industry participants and consumers. If consolidated deliveries could be made at night there would be the additional advantages of reduced travel time, parking lot congestion, and interference with store activities. Any reduced vehicle usage or shift to off-peak hours would improve environmental conditions in metropolitan areas.

On the other hand, provision must be made for a facility to accomplish consolidation, and an information system to accommodate the timely coordination between stores, suppliers and the consolidating service agency.

In 1972, a USDA sponsored research project was conducted to compare the operating costs and benefits of small store supply systems before and after the consolidation of deliveries. The objectives were to reduce the total resources required to accomplish physical distribution. My report describes the analytical approach that was used and a summary of the findings. I have several copies of a Transportation Research Forum paper on this topic. The details and computer program are in a Ph.D. dissertation by Francis A. Sailer entitled "A Simulation Study of the Effects of Consolidated Deliveries on the Economic Cost of Convenience Store Physical Distribution Systems," 1973, PSU.

Computer simulation was used to replicate the real-life physical distribution system of a cooperating Pennsylvania convenience chain. The company operated a limited consolidation delevery system from a distribution center to 19 urban and suburban retail outlets. Some dry grocery items and a brand of bakery products were included in the consolidation program.

The conventional bakery supply system (System I) consisted of the daytime delevery of bakery orders by a processor making store-door deliveries five days a week, to the 19 retail stores, and the conventional delivery of dry grocery orders from a wholesale warehouse two days a week. System II refers to the partial consolidated delivery of bakery and dry grocery orders.

System II represents a considerable simplification over System I in the number of firms and truck trips directly involved in supplying each of the stores. On the days specified for consolidated grocery and bakery deliveries, the dry grocery order was selected and staged at the truck loading dock. The quantity of bakery goods required to fill all store orders was moved by tractor trailer from the bakery to the distribution center. Individual store orders for bakery products were then selected and placed in unitized

containers.

The bakery and dry grocery orders were next loaded in planned store delivery sequence. Deliveries were made between 10:00 p.m. and 6:00 a.m. For those deliveries made after 11:00 p.m., the hour of store closing, the driver and helper gained access with their own set of keys and placed the store order near the appropriate display area. Stale bakery items were loaded and returned for disposition at the warehouse.

The distribution system network was structured by arranging the most important operating elements into three subsystems: (1) Convenience Stores (CS), the demand point; (2) Administrative Service (AS), the order processing elements; and (3) Distribution (D), the physical performance operations.

The relationships and resources associated with each subsystem were then classified as variable or fixed attributes. That is, the total costs incurred are a function of order size, equipment, travel distance and speed, stale returns, total time utilized for order processing, pricing, and shelving, and total time utilized in selecting, loading and unloading delivery vehicles.

Data on the specific performance values for Systems I and II were gathered through time studies, company records, and personal discussions with executives of the firm. The purpose of the empirical data was to provide realistic numbers for the simulation analysis. Specific performance information for dry grocery and bakery products included order size, times for selecting, loading and unloading, driving time, shelving and pricing time, order processing time, and order preparation time. Each activity was analyzed to determine whether it was of a deterministic or stochastic nature. In the case of those activities functioning stochastically, parameters were estimated and tested for significance by means of statistical techniques.

Appropriate costs were then applied to these values. Equations were developed to describe the relationships existing within the subsystems and the system as a whole. Current rates for labor and equipment in this company were used. In order to provide an observation period of sufficient length, the operations of Systems I and II were simulated over a time frame of one year.

Results

The Administrative Service subsystem costs for System II exceeded those of System I by $21.19 per week. This is attributable to the bakery order-processing by convenience store personnel that was performed by the bakery driver-salesmen in System I.

The Convenience Store subsystem also sustains a net cost increase for System II deliveries. As was the case with the Administrative Service subsystem, this increase is solely due to the assumption of responsibility for bakery deliveries, since the administrative procedure for dry groceries has not been altered. The basis for the increase in this instance is due to two factors. First, the convenience store manager must now calculate and prepare his own bakery orders. Second, convenience store personnel are now responsible for shelving their own bakery orders from the previous night's delivery. For example, each convenience store manager now spends 75 minutes per week on ordering, and the convenience store clerk spends 60 minutes per week on shelving. The total cost increase resulting from these added functions amounts to approximately $114 per week, or $5,928 per year.

The Distribution subsystem provides the substantial cost saving shown for System II. The cost of this subsystem is reduced from $1508.12 to $498.95 per week for a net savings of $1009.17. Thus it completely overshadows the relatively minor cost increase sustained by the other two subsystems.

System Cost Comparison for a Simulated One Week Period

Subsystem	System I	System II	System II Savings (loss)
Administrative Service	$ 1.63	$ 22.82	$ (21.19)
Distribution	1508.12	498.95	1009.17
Convenience Store	17.88	132.35	(114.47)
		Total for one week	$ 873.51

Conclusions

The costs derived from the simulation of consolidated and unconsolidated deliveries indicate that it would not only be preferable to consolidate the deliveries of bread and dry groceries to the nineteen convenience stores under study, but to conduct the operations as night deliveries as well. The $45,422 annual savings in cost and the reduction in the number of truck trips would have been far greater if all of the brands of bakery products that are carried in the stores had been included in the consolidation program.

Finally, the major contributions of this study are considered to be the development of a conceptual framework and the application of simulation techniques to the analysis of alternate physical distribution systems. Although a single convenience store distribution system was examined, the approach may be generalized to small food store supply systems. It is also conceivable that the model could be modified to analyze other retail industries.

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EVALUATION OF MECHANIZED WAREHOUSE OPERATIONS

by
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About two years ago, USDA let a research contract with A.T. Kearney and Company to evaluate mechanized warehouse operations and to develop a model of the mechanized grocery warehouse of 1980. Although the model for the 1980 warehouse is not completed, we think you will be interested in the bench mark data and preliminary findings relative to mechanizaiton in existing warehouse operations.