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.

Productivity Comparisons

The productivity data for the conventional and mechanized operations are shown in Table 1.

Productivity of present conventional warehouse operations was developed from a composite of data obtained from National-American Wholesale Grocers' Association, National Association of Food Chains, Super Market Institute, U.S. Department of Agriculture, and A.T. Kearney and Company warehousing studies. The data reflect an average of productivity in large warehouses that use improved methods.

System 1 -- Mechanized Case Take-Away: In this system individual cases were manually placed on conveyors that transferred them into delivery vehicles. The grocery warehouse using this system used batch picking (three stores per batch) and mechanized sortation and was more productive than warehouse operation not using batch picking or mechanized sortation.

Approximately $1,000,000 would be required to finance all of the materials handling equipment for this system. Sortation equipment alone would cost $250,000, with $350,000 needed for conveyors, controls, installations, and related mechanized equipment. Annual maintenance cost, including salary for two men, was estimated at $50-65,000.

System 2 -- Mechanized Selector Transfer: In this system a selector batch picks cases for eight stores from both sides of an aisle as he is mechanically transferred from slot to slot. The selector manually places the cases on a table where a label is attached and the case mechanically shoved onto an elevator conveyor that lifts the case to an overhead conveyor. The overhead conveyor transfers the cases by an optical scanner and sorter. The sorted cases are sent down roller conveyors to palletizing stations where they are palletized and the pallet loads transferred by forklift to the appropriate delivery truck.

An investment in the mechanized equipment for this system was approximately $600,000. Racks and other materials handling equipment are not included in this investment merely because these are standard equipment in conventional warehouses also. Maintenance for this operation amounts to $60,000 per year.

System 3 -- Storage Retrieval Machines: Two of the three warehouse operations which used storage-retrieval machines were in industries other than groceries and one was handling frozen foods.

In the three firms studied, storage-retrieval machines were used to move products that are loaded on captive pallets from the receiving dock and to place them in storage. One of the nongrocery firms that shipped products in unit loads used the storage-retrieval machine to remove products from storage and place them on staging racks where forklifts removed the unit loads. In the other nongrocery firm, storage-retrieval machines removed unit loads from storage and transferred them to a roller conveyor. The roller conveyor moved the unit loads to the console (control point) where they were cycled through a manual selection section where order selectors obtained the required number of cases and the unused products were returned to storage. In the frozen food warehouse, the storage-retrieval machine was used to replenish the selection area.

The average investment in mechanized equipment, racks, and captive pallets in the three warehouses was $131 per storage cell with a range of from $75 to $169 per cell.

System 4 -- Mechanized Selection: The firm that used mechanized selection is in the grocery handling industry and is receiving a lot of attention in the trade press. The mechanized selection system consists of ten levels of inclined chutes. Cases of products are held in the chutes by trip mechanisms which are computer controlled. When a case of product is to be selected, the trip mechanism is activated and one

TABLE 1: Productivity With Mechanized Systems Compared With Conventional Warehousing

Warehousing operation - Function -	Productivity				
	Conventional	System 1	System 2	System 3	System 4
Receiving:					
Rail unloading (TPMH)	4.24	4.24	4.24	4.24	4.24
Truck unloading (TPMH)	6.53	6.53	6.53	6.53	6.53
Put away and replenish (TPMH)	3.00	3.00	3.00	6.70	3.00
Shipping:					
Order selection (CPMH)	154	455[1/]	500[2/]	154	635
Truck loading (CPMH)	481	490	1,250	481	750

1/ 240 cases per man-hour when manual assisted operations, control station operation, and pallet load.

2/ Excludes palletizing.

System 1 -- Mechanized case take-away.
System 2 -- Mechanized selector transfer.
System 3 -- Storage-retrieval machines.
System 4 -- Mechanized selection.

case drops out of the chute onto a conveyor that moves it to the appropriate trailer where it is loaded by either palletizing or floor stacking.

The investment in mechanized equipment in this warehouse amounted to $1.5 million. This system is not capable of handling brooms and mops, bagged items, repack items and has difficulty with shrink-packed items. However, the manufacturer is working on the shrink-pack problem.

Summary

The storage retrieval system (system 3) provided increased productivity over conventional methods in putting away merchandise and replenishing selection slots. All of the mechanized systems provided increased productivity in order selection and truck loading when compared with conventional systems. In all instances, the increased productivity must be balanced against present and anticipated wage rates and the capital investment for the equipment.

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