United States
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Market Research
Report No. 1139

Productivity Measurements of Regional Farm Supply Cooperatives

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PRODUCTIVITY MEASUREMENTS OF REGIONAL FARM SUPPLY COOPERATIVES, by James R. Snitzler and James A. Caron; Office of Transportation, U.S. Department of Agriculture, Market Research Report No. 1139.

Abstract

The recent inflationary spiral of costs accompanied by a sharp downturn in the farm economy has adversely impacted the competitive position of the Nation's farm supply cooperatives. One means of minimizing these adverse effects, as suggested by cooperative distribution managers, is to develop an industry-wide program, stressing cost control and efficiency through the uniform application of productivity measurements and eventually productivity standards.

Implementation of the program was preceded by an indepth analysis and appraisal of the policies, as well as the physical and operating characteristics of selected farm supply cooperatives for the purpose of determining similarities and differences which might impact upon the productivity measurements. Information was obtained on measurements, both financial and physical, which were already in use by some of the cooperatives. An implementation phase was recommended in which a small number of the financial and physical productivity measures would be selected for further development.

Notes

This study was conducted in cooperation with the Cooperative Physical Distribution Committee of the National Council of Farmer Cooperatives, Washington, D.C.

Authority for the study is to be found in the Agricultural Marketing Act of 1946, Title 7-1621-27, P.L. 79-0733 and in the Cooperative Marketing Act of 1926, Title 7-0451-57, P.L. 69-0450.

References to companies or products within this study do not imply evaluation or endorsement by the U.S. Department of Agriculture.

Acknowledgments

The authors wish to express their appreciation to the management and personnel of the eight regional farm supply cooperatives for their cooperation and support in this study. Appreciation is also expressed to the management and personnel of the Agricultural Cooperative Service of USDA for their assistance in providing historical data on the cooperative industry. Special thanks are due Mrs. Constance Valentine for typing of the manuscript and performance of other secretarial duties related to this study.

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PREFACE

Sharply rising costs in recent years of capital, labor and energy are impacting heavily upon the physical distribution system by forcing similar cost increases. This development is of great concern to managers of the nation's major farm supply cooperatives, since it in turn may adversely impact upon farm production costs and thus the ability of farmer members to fully compete in domestic and overseas markets. In recognition of this fact, the Cooperative Physical Distribution Committee of the National Council of Farmer Cooperatives requested the Office of Transportation of the U.S. Department of Agriculture to undertake a study to show means of improving the physical distribution system for moving farm supplies to producers. Specifically the request was directed at the determination of existing and possible development of new productivity measurements which would provide the basis for a continuing program of improvement of the distribution system. Its primary purposes would be to increase efficiency and control costs within the individual farm supply cooperatives as well as for the industry as a whole.

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The Cooperative Farm Supply Industry

— Farmer cooperatives accounted for one-third of all farm supply sales in the United States in 1981.

-- Gross farm supply sales of the study cooperatives as a group totaled $6.57 billion, about 21.8 percent of total supply sales for all U.S. cooperatives in 1979.

— Petroleum products, feed, and fertilizer account for the greatest percentage (72.4 percent) of farm products sold.

-- Within the study group, 10.5 percent of all farm commodities sold passed through distribution centers enroute to retail outlets or to farmers in 1980 and 1981.

-- Farm supply sales of the study cooperatives continued to increase as a percentage of total cooperative business (which includes marketing and other services), while sales through distribution centers have decreased in relation to total sales in the last 3 years.

Physical Characteristics of Distribution Centers

Warehousing

— The eight regional farm supply cooperatives operate a total of 29 distribution centers with a total facility space (under roof and outside storage) of about 5 million square feet.

-- Actual storage space under roof for the 29 distribution centers range from a high of 429,000 square feet to a low of 25,000 square feet, while conventional ceiling heights range from 9 feet to 30 feet. Five of the distribution centers have special high-rise stacker crane areas with ceiling heights of 70 feet.

-- Truck unloading and loading facilities predominate at all of the distribution centers. Truck receiving bays total 227 for the 29 distribution centers while rail receiving bays number only 84. In the case of shipping, the contrast is even greater, with truck bays totaling 112, and rail bays totaling only 5.

Transport Equipment and Facilities

— With one exception, the eight study cooperatives owned at least some of the vehicles used to distribute farm supplies. Six cooperatives reported leasing rather than purchasing supply vehicles.

-- Each study cooperative reported operating at least one repair or maintenance facility for its vehicles.

-- Study cooperatives had difficulty segregating vehicles or vehicle repair and maintenance facilties used exclusively for farm supply operations as opposed to other cooperative operations because of pooling operations.

Operating Characteristics of Distribution Centers

Warehousing

-- Eleven major functions were identified as being performed in the operation of the warehouses. Among these were order taking, receiving, storage, order picking, staging, and order consolidation and shipping. All of the functions with the exception of replenishment, staging, and order consolidation and order taking were reported as being performed by all of the distribution centers. The latter three functions were not performed by a few distribution centers because of lack of space.

-- The number of line items stocked by the 29 distribution centers ranged from 27,500 to 200, while the number of personnel ranged from 99 to 6, with the weighted average about 30.

-- Only two of the eight regional farm supply cooperatives had unionized warehouse personnel. A comparison of hourly wage rates among the top six cooperatives with the highest wage rates (two union, four nonunion) showed the weighted average rate for the two unionized cooperatives to be 24 percent higher than the comparable nonunion wage rate.

-- A substantial variation was revealed in the degree of technology used among the material handling systems. The range was from a primarily forklift truck operation to highly mechanized operations utilizing such equipment as automatic storage retreival and man-aboards.

-- Computers are used in the distribution (warehouse) operations of all of the eight regional cooperatives. The degree of use ranged from one cooperative reporting all 21 of the identified distribution operations being performed, to four of the cooperatives performing from 9 to 11 of the functions.

Transportation

— Transportation operations are generally categorized as either inbound or outbound. Outbound transportation was said to be emphasized more than inbound because it was perceived to be identified more closely with member service.

— Cooperatives identified transportation operations as a cost center in six of the eight cases. The remainder were identified as profit centers.

--Responsibilities for inbound operations were often charged to traffic managers (in coordination with purchasing managers) while distribution center management was responsible for outbound operations.

-- In comparing vehicle driver force to farm supply sales through the distribution center, dollar sales per driver increased as sales volumes increased.

-- For-hire vehicles (common or contract carriers) delivered an average 51 percent of farm supplies to the distribution center, private carriers (cooperative and vendor vehicles) transported 42 percent and railroads 7 percent.

-- The cooperative vehicle fleet was used to transport inbound shipments 30 percent of the time. Peddle deliveries averaged 65 percent utilization with the remaining 5 percent vehicle use being attributed to other services.

-- Over 95 percent of all supply transfers to retail outlets occurred through peddle deliveries as opposed to "will call" transfers (5 percent).

-- Average backhauls achieved during distribution operations was 37 percent and ranged from 5 to 75 percent among study cooperatives. Most backhauls were interstate rather than intrastate movements.

Tradeoffs

— Although all cooperatives were aware of cost tradeoffs among the various distribution functions, no cooperative reported using a formal quantitative approach to that measurement.

Productivity Measures

Financial

— Productivity measurements of various types are being used by the eight regional farm supply cooperatives. Four of the eight cooperatives base their measurements upon both cost and physical data, three utilize cost data only, and one uses physical data only.

-- All but one of the cooperatives reported that they were not satisfied with their existing measurements.

-- Ten financial measures of productivity were identified and analyzed on the basis of input and output units, time periods covered, and reporting levels. The measures were primarily concerned with cost accounts as related to sales or throughput volume.

— The variation in the composition of input units (total expense, warehouse cost, total operating expense, net expense, net operating expense, gross margin and net margin), as well as output units (sales, throughput, and net patron purchases), will have to be reconciled to arrive at acceptable financial measurements.

Physical

— Pounds shipped and pounds received as a ratio of hours worked was the most common physical measure used in distribution center warehouse operations.

-- Weight alone was found inadequate to measure work performed. The number of items to be moved significantly impacts the amount of labor which must be involved in a particular task.

-- A combination of financial and physical data was compiled by all cooperatives to measure transportation performance as related to sales and to total miles driven.

— Physical measures of transportation activities were reported by only one cooperative. These measures were used to show the relationship of miles driven to tonnage hauled over time, and to evaluate the backhaul activity by facility location.

CONCLUSIONS

1. There is great interest on the part of the study cooperatives to improve productivity within their physical distribution operations.

2. There is a wide variety of approaches being used by the cooperatives to measure performance through financial and physical data.

3. Despite the variety of approaches, a number of industry-wide productivity measures are possible.

4. The use of productivity measures within a farm supply cooperative will enable it to evaluate its own performance over time.

5. Productivity measures will also permit the cooperatives to compare and evaluate their performance against that of other cooperatives who are participating in the productivity measurement program.

6. The process of actually comparing and evaluating performance has the potential for stimulating greater productivity among the involved cooperatives.

RECOMMENDATIONS

1. That cooperatives seek to establish financial and physical measures of productivity within their own operations.

2. That these productivity measures be so constructed as to permit comparisons with other industry cooperatives.

It is suggested that the following action be taken in order to implement the above recommendations:

a. For the purpose of carrying out the followup work, a productivity measurement committee be established by designating one person from each cooperative as the contact and working representative on the committee.

b. That the duties of the committee be as follows:

(1) To review the report's productivity measure critiques to determine which of these would be most useful to the study participants and for industrywide comparisons.

(2) To select measures which would then be forwarded to the committee chairman, along with a breakdown of the actual components used to construct the various productivity measurements.

(3) To meet and concur on which measures to adopt for comparison and evaluation purposes.

c. U.S. Department of Agriculture, Office of Transportation representatives would be available to analyze and evaluate the components for the purpose of implementing these initial productivity measurements.

INTRODUCTION

Background

The Office of Transportation (OT) of the U.S. Department of Agriculture received a written request in 1979 from the Cooperative Physical Distribution Council, a group of managers from 21 regional cooperative farm supply organizations, to undertake a study to explore means of improving the physical distribution system for moving supplies to producers.

The request reflected a growing concern among cooperatives as well as the entire agricultural industry over the rapidly spiraling costs in recent years of capital, labor, and energy. All of these cost ingredients are impacting heavily upon the physical distribution system and forcing similar cost increases.

The Distribution Council's request was directed specifically at the determination of existing and possible development of new productivity measurements. It was anticipated that the measurement would provide the basis for a continuing program of improvement of the distribution system so as to control costs within the individual farm supply cooperative as well as for the industry as a whole.

OT was unable to comply with the council's request at the time because of previous personnel commitments. Subsequently however, as these commitments were fullfilled OT personnel became available in 1981 to begin the study with the full endorsement and cooperation of the Cooperative Physical Distribution Committee (CPDC), successor to the Cooperative Physical Distribution Council. The CPDC consists of officials from approximately 81 cooperatives dispersed throughout the Nation who have responsibility for daily distribution activities within their respective organizations.

In a recent landmark study by A. T. Kearny, Inc., Management Consultants, Measuring Productivity in Physical Distribution 1/ the country's physical distribution bill was estimated at about $400 billion a year. At the same time, the consultants estimated the improvement opportunity for virtually every distribution activity in the country at a miminum of 10 percent, or about $40 billion annually nationwide. An updated estimate made by Kearny officials in June 1981 because of inflation and other causes indicated a potential annual improvement opportunity of $60 billion for the Nation's physical distribution activities.

Total cooperative business volume of farm supplies (excluding intercooperative business) for the United States was about

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1/ The National Council of Physical Distribution Management, 222 N. Adam Street, Chicago, Illinois 60606

$13.5 billion in 1979.1/ Data on actual distribution costs for the industry as a whole are not available, but discussions with cooperative distribution managers indicate that such costs for farm supplies moving through distribution centers range from 6 to 12 percent of total business volume (throughput) of the distribution centers. Since a large percentage of the bulk farm supplies (petroleum, feed, fertilizers, and similar products) move directly to the cooperative retail outlets or to the farm (thereby eliminating handling costs at the distribution center), overall distribution costs for the industry probably are in the 5-percent range.

This would give an estimated total distribution cost for cooperative farm supplies of about $675 million in 1979. Even if one assumes that distribution costs in 1980 and 1981 lagged somewhat behind the inflation rate, an annual rate of 10 percent would increase the distribution costs of farm supplies to about $800 million for 1981. If these costs could be reduced by a minimum of 10 percent, this would represent a very substantial benefit to the cooperatives and their farmer members.

It was in recognition of those potential cost savings and productivity improvements, through use of effective physical distribution productivity programs, that industry representatives contacted the Office of Transportation. While a few member cooperatives had limited historical information available for judging improvements, nowhere was their available industrywide cost and productivity standards. The Cooperative Physical Distribution Committee felt such information would be invaluable for improving service to their members and, as a result, turned to USDA, as an impartial third party, to administer and coordinate information gathering, analyzing, and dissemination. This procedure would ensure confidentality of sensitive data.

Objectives

The objectives of the study are as follows:

1. Determine the extent of productivity measurements being applied by study firms.

2. Determine type and use of such productivity measurements.

1/ U.S. Department of Agriculture, Farmer Cooperative, June 1981, p. 10.

3. Analyze and evaluate the comparisons and differences which exist among the study firm's physical distribution facilities, operations and policies, and their impact upon the productivity measurements.

4. Evaluate the applicability of productivity measurements among the study firms and for the industry as a whole.

5. Develop recommendations for suggested productivity improvements and their implementation which would have as their goals increased efficiency, lower costs, improvement of service and reduction in energy.

General Approach

The limited financial and human resources available for this study dictated that a case study approach be utilized in the analysis and evaluation. Consultation with knowledgeable industry officials resulted in the selection of eight regional farm supply cooperatives. The selection criteria reflected size of firm, geographic distribution, technological development, and willingness of the firm to fully cooperate.

The eight selected firms with locations of corporate headquarters are:

Agway, Inc., Syracuse, NY

Farmers Union Central Exchange, Inc. (CENEX), St. Paul, MN

Farmland Industries, Inc., Kansas City, MO

Goldkist, Inc., Atlanta, GA

Land O'Lakes, Inc., Fort Dodge, IA

MFC Services (AAL), Madison, MS

Midland Cooperatives, Inc., Columbia Heights, MN1/

Southern States, Inc., Richmond, VA

The above regional cooperatives operate a combined total of 29 distribution centers dispersed from New York State to Georgia and from Pennsylvania to Washington State. Service is provided to farmers by the regionals in 41 of the 48 States of the continental United States.

1/ Midland cooperatives is now merged with Land O'Lakes.

The procedure followed by OT personnel in conducting the study was as follows:

1. Made orientation trips to the corporate headquarters and distribution centers of four of the eight cooperatives participating in the study.

2. Attended the annual meeting of the Cooperative Physical Distribution Committee at Minneapolis, Minnesota, May 1981, and conducted a special session on the proposed productivity study, including discussion of a preliminary work plan and major items of concern.

3. Prepared a revised work plan and drafted an interview guide and data requirements form.

4. Conducted field tests on the guide and data requirements form.

5. Made revisions in the form and conducted field interviews with the cooperators during July and August of 1981.

6. Analyzed and evaluated the data gathered and followed up on data still outstanding.

7. Prepared draft report, including text and tables.

8. Submitted draft for review by cooperators.

9. Reviewed comments of cooperators and prepared final report.

Authority

The authority for this study is to be found in the Agricultural Marketing Act of 1946, Title 7-1621-27, Public Law 79-0733, in which Congress directed the Department of Agriculture to conduct "continuous research to improve the marketing, packaging, handling, storage, processing, transportation, and distribution of agricultural products," and authorized cooperation with other branches of the Government, State agencies, private research organizations, and industry in conducting the research.

Further authority is to be found in the Cooperative Marketing Act of 1926, Title 7-0451-57, Public Law 69-0450, in which the Secretary was directed to establish a Cooperative Marketing Division to conduct economic studies and make surveys and analyses of cooperative associations upon their request for information concerning marketing and distribution of farm products. The transportation functions of this act (a part of distribution) was assigned to the Office of Transportation by the Secretary of Agriculture's Memorandum No. 1966, dated December 12, 1978.

THE COOPERATIVE FARM SUPPLY INDUSTRY

Farm Inputs

The farmer depends heavily on two basic distribution systems: the physical movement of inputs (for example, seed, fertilizer, and equipment) to the farm, and the physical movement to market of what has been produced (for example, livestock, grains, and produce). While it seems greater emphasis has been placed on marketing distribution costs because of the more obvious impact it has on the price a farmer receives for commodities produced, of equal importance are the distribution costs of inputs. While these costs may not be as readily apparent, they also detract from the farmer's net margin or revenue.

The complexity of the input distribution system, bringing raw and finished products to the farmer, is compounded by the variety of inputs and the irregularity of demand for many of those inputs. Farmers require products ranging from fertilizers, which may arrive in bulk shipments directly from production areas, to small vials of animal vaccine, which often move through a more intricate distribution network and require special handling.

Because of a variety of factors, including population concentrations caused by industrialization and agricultural specialization in regions with high comparative advantages, many farmers are now operating far from large population and industrial centers. Although many privately owned firms are actively involved in providing supplies to these areas, farmers often find that because of their location, service is often costly and in some cases unobtainable.

In order to ameliorate this situation, some farmers have organized cooperatives--member-owned, member-controlled organizations--to purchase their inputs. The farmer cooperative not only assures a supply of necessary inputs but also may reduce costs by placing larger orders closer to points of production. Cooperative profits or savings are returned to the farmer or retained to improve a cooperative's operations. Many cooperatives supply building materials, containers, farm machinery and equipment, feed, fertilizer, meats, groceries, petroleum products, seed, pesticides, tires, and other products (including apparel and household goods) to the farmer.

Table 1 below lists five major farm input groups which accounted for 86.2 percent of cooperative farm supply sales in 1981.1/ Each supply group is compared with total sales to farmers by all U.S. farm supply firms.2/

Table 1 - Percentage of cooperative farm supply sales of total U.S. sales for five input groups, 1981

Group	Total U.S. sales	Cooperative sales	Cooperative share
	---Million dollars---		Percent
Feed Grain & Hay	17,147	3,531	20.6
Fertilizer	10,074	3,676	36.5
Petroleum Products	9,109	5,646	62.0
Seed	3,930	575	14.6
Farm Chemicals	3,569	1,275	35.7
Total	43,829	14,703	33.5

Note: Cooperative sales exclude inter-cooperative business.

The figures presented attest to the significant share (33.5 percent) farmer cooperatives have gained in this sector.

Farmer Cooperatives

In order to understand a cooperative's farm supply operation and how it serves the farmer, it is important to understand a few basic aspects of cooperatives in general and what distinguishes them from private business firms.

Farmer cooperatives, in addition to supplying inputs, assist farmer members in marketing and processing their products, obtaining credit, insurance, and providing other related services. Organized by farmers to perform these functions, the cooperative is also owned and controlled by its farmer members. Services are offered on a cost basis and any profits realized from the services are returned to farmers on an equitable basis. Cooperatives, like any business, must retain capital to operate and there are limits on the returns from invested capital a farmer may receive.

1/ Farmer Cooperative Statistics 1981, U.S. Department of Agriculture, Agricultural Cooperative Service, CIR 1 S27, March 1983, hereafter cited as "Cooperative Statistics, 1981".

2/ Income and Balance Sheet Statistics, Economic Indicators of the Farm Sector, U.S. Department of Agriculture, Economic Research Service (unpublished), August 1983, hereafter cited as "Economic Indicators, USDA".

To be a cooperative, as defined by the Agricultural Cooperative Service (ACS) of the U.S. Department of Agriculture, (1) farmers must hold the controlling interest of the cooperative, (2) no member is allowed more than one vote or the cooperative does not pay dividends of more than 8 percent on stock or membership capital, and (3) the cooperative does not market products, supply inputs, or provide other services to more nonmembers than members, based on value.1/ Important in the definitions is the philosophical orientation of a cooperative as a "service to members" business. The actual operation of the cooperative closely follows this philosophy. Briefly, members, boards of directors, and managers all interact in the operation of the cooperative. Directors are elected by members from the ranks of farmer members. They are responsible for operating policies (based on member input) and choosing and guiding the cooperative's management. The manager is responsible for directing the cooperative's operations.

Because members ultimately control the cooperative decision process, the cooperative firm's business attitude or philosophy differs somewhat from the strict profit motive commonly attributed to firms competing in the private farm sector. A farmer, because of his part ownership, expects, and often receives, services that are not available, for whatever reason, from private firms. Entitlement to those services is arguable from the position that the cooperative was formed to provide service at reasonable costs. On the other hand, the cooperative must be able to offer its marketing services or farm supply products at prices competitive with other private and cooperative firms or it may loose member patronage. The agrument is clearly an equity versus efficiency one, and is best decided by the individual cooperative through its policy decisionmaking process.

From the perspective of this study on farm supply distribution operations, the argument is particularly pertinent. In order for firm managers or directors to determine how efficiently services are being provided they must have access to the best possible information and data concerning the performance of those operations. As to the question of equity, while the cooperative boards of directors must decide equity policy, the decision may be more wisely made if the costs of the equity decisions are known and are factored into the decisionmaking process.

1/ Cooperative Statistics, 1981.

Farm Supply Cooperatives

The Agricultural Cooperative Service, responsible for much of the data publicly available on cooperatives, estimates that in 1981, cooperatives handled $17.1 billion in farm inputs, representing 23.8 percent of total cooperative business. While the majority of cooperatives' business (dollar) volume can be attributed to the marketing of products for members, farm supply business has increased (from 20.7 to 23.8 percent) as a percentage of total cooperative business since 1950. Of the total number of cooperatives in 1981, 37.9 percent were predominantly farm supply, up from 32.6 percent in 1950. Farm supply memberships also grew from 40.6 percent in 1950 to 53.5 percent of total cooperative memberships in 1981.1/

Strictly defined, a farm supply cooperative is a cooperative "whose farm supply business accounted for more than 50 percent of its total dollar volume". While the increasing number of farm supply cooperatives indicates the growing importance of this sector as a percentage of the total business of all cooperatives, the supply function is also important to cooperatives defined as marketing or service cooperatives.

Table 2 identifies business activity for 3 years by dollar volume for the eight cooperatives under study. Using 1980-81 figures in order to compare them with 1981 data compiled by the ACS 2/, gross business volume (marketing, farm supply, and other services) for the study cooperatives totaled $18.2 billion, 17.9 percent of all business conducted by cooperatives in 1981. Gross business volumes of the study cooperatives ranged from $487 million to $5.76 billion. Five cooperatives are defined as marketing cooperatives and three as farm supply cooperatives, based on the percentage (over 50 percent) of business volume attributable to those functions. As a group, the study cooperatives handled gross farm supply sales totaling $6.57 billion, 21.8 percent of total supply sales for all U.S. cooperatives. Farm supply sales as a percentage of total busines for each cooperative ranged from 4.2 percent to 100 percent and averaged 36.1 percent in 1981.

1/ Cooperative Statistics, 1981.

2/ The cooperative firms under study account business activity by fiscal years beginning at various times throughout the year. Because data were unavailable by month, no attempt was made to compute volumes using the same monthly periods that defined a fiscal year.

Table 2 - Business volume of selected regional farm supply cooperatives, 1978-79, 1979-80, and 1980-81 1/

	Regional Cooperative							
	I	II	III	IV	V	VI	VII	VIII
	1,000 Dollars							
Gross business volume (includes intercooperative business)								
1978-79	2,049,080	1,043,784	3,859,765	1,686,629	1,490,327	316,371	404,200	508,581
1979-80	2,658,610	1,209,784	4,744,606	1,960,000	2,442,681	473,259	518,000	625,950
1980-81	3,828,262	1,578,080	5,760,297	2,027,261	3,303,719	487,043	523,500	713,861
Gross farm supply volume 2/								
1978-79	142,200	1,043,784	2,269,560	205,690	569,000	103,472	402,100	84,718
1979-80	159,000	1,209,784	2,725,412	208,474	753,000	124,585	515,700	94,012
1980-81	162,600	1,578,080	3,100,000	260,732	703,000	139,636	519,100	103,320
Gross farm supply volume moving through distribution centers (DCs)								
1978-79	75,600	83,070	232,959	33,991	32,086	22,337	33,700	55,487
1979-80	85,300	94,203	225,725	27,324	41,657	18,065	38,400	60,664
1980-81	89,900	81,014	283,500	20,744	35,575	24,397	35,200	68,967
Gross farm supply volume moving direct to cooperative retail outlets, bypassing DCs.								
1978-79	66,000	960,714	2,036,601	171,699	537,700	81,135	368,400	29,231
1979-80	73,700	1,115,581	2,499,687	181,150	711,000	106,520	477,300	33,348
1980-81	72,700	1,497,066	2,816,500	239,988	667,000	115,239	483,900	34,359

1/ Data for cooperatives V and VII are for calendar year 1978, 1979, and 1980.
2/ Does not include intracooperative transfers of farm supplies which are less than one percent of gross farm supply volume.

In the 3-year period 1977 to 1980, U.S. sales of the five supply groups increased by 38.2 percent, not discounting inflation. By comparison, in the same period, sales of the study cooperatives amounted to 36.7 percent of all supplies sold. Table 3 lists the farm supplies normally sold by cooperatives, along with dollar volume and percentage of total sales.

Table 3 - Farm supplies sold by all U.S. cooperatives, by dollar volume and by percentage of total sales volume, 1981

Product group	Sales volume 1/	Share of total sales
	Million dollars	Percent
Petroleum products	5,646	32.2
Fertilizer	3,676	20.1
Feed	3,531	20.1
Other supplies	1,282	7.3
Farm chemicals	1,275	7.3
Seed	575	3.2
Building material	447	2.5
Farm machinery & equipment	378	2.1
Meats and groceries	163	0.1
Total	17,533	100.0

1/ Excludes intercooperative sales

Source: Farmer Cooperative Statistics, 1981, U.S. Department of Agriculture, Agricultural Cooperative Service, CIR1S27, March 1983.

Petroleum products, feed, and fertilizer clearly account for the majority (72.4 percent) of cooperative sales. These products, along with many items in the other product groups, may be handled in bulk (full truckload) which, in many instances, bypass a cooperative's distribution center. On the other hand, any one of these products may have to be processed through a distribution center enroute to the retail outlet. The movement of the latter group of products through the distribution centers, which vary greatly in size, weight, mass, form, composition, consistency, and fragility, is the focus of this study.

No national data are available revealing the total volume of farm supplies moving through cooperative distribution centers (DCs) as opposed to farm supplies that move directly to retail outlets. The study cooperatives reported (table 2) that 10.5 percent of all farm supply sales moved through DC's in

1980-81. Two years earlier 12.9 percent of sales passed through the DC's. The decrease in sales through the DC's over that period may be due to factors such as (1) actual decrease in physical volume through the DC's or (2) a greater price increase for direct versus DC's serviced goods, or a combination of both.

The Retail Outlet

The cooperative retail outlet provides the necessary link between the regional farm supply cooperative, with its one or more distribution centers, and the farmer. Numbering into the thousands in States with large agricultural industries, the retail outlet is placed convenient to farmers and other consumers (both members and nonmembers). The outlet may receive products through the cooperative regional distribution center or directly from manufacturers. These products are sometimes separated into smaller units and either priced and sold to customers or stored for later sale. Retail outlets often take special orders, provide credit, and will deliver directly to the farm in some cases.

The relationship between the regional supply cooperative and the retail outlet serviced varies. A regional cooperative may own and manage some or all of its retail outlets, and exercise a good deal of control over its distribution operations to the final consumer. In cases where the retail outlet is owned by a local cooperative, the regional cooperative may manage or provide management assistance to the outlet. Other retail outlets, sometimes called independents or affiliates, are locally owned and managed. These outlets may depend on one or more regional cooperatives and other private suppliers for farm inputs. Whether retail outlets serviced by a regional cooperative are owned, managed, or are independent, the regional's responsibility to provide acceptable service and quality products at competitive costs varies little. The final consumer, in most cases, has many supply options. Patronage at any particular retail outlet will depend on how well the member's needs are served.

Distribution of Retail Outlets

Regional farm supply cooperatives, which may serve several States, quite often begin as local operations. Growth and expansion of service area is accomplished by merging with other supply cooperatives and by successfully competing for new and existing business with other private and cooperative suppliers. The regional supplier must constantly monitor its methods of distribution to determine the optimum location for its distribution center(s) and the best routes to reach its customers. Decisions concerning the number of distribution centers (DC's) and their size will depend on factors such as:

1. The number and locations of retail outlets to be serviced, and

2. the frequency and volume of each delivery to the outlet.

The study cooperatives vary significantly in dollar sales, number of distribution centers and retail outlets serviced. Table 4 identifies these characteristics and their relationship to one another. Regional supply cooperatives studied were found to maintain from 1 to 9 distribution centers which supplied between 105 to 2,481 retail outlets. Each DC services an average of 261 retail outlets, although the range varies from 39 to 638. Figure 1 graphically portrays the location of cooperative distribution centers and lists retail outlets and their patronage by State.

Regional cooperatives account seperately those sales that pass through their distribution centers as opposed to sales that go directly to retail outlets. DC sales, divided by the number of DC's, are listed in table 4. DC sales per DC range from $6.9 million to $35.2 million and average $19.8 million. Four of the five firms that had higher than average DC sales per DC also had a higher than average number of retail outlets per center. This positive correlation is reasonable if one considers that a DC with above average outlets would tend to have above average sales.

Because all sales may not move through the distribution center, total farm supply sales of each regional are computed for each retail outlet. Average total sales to each outlet was $0.85 million with a range of $0.19 to $2.21 million. The farm supply sector, and in particular the study firms, are characterized by a marked degree of diversity in volume of sales, number of distribution centers and number of retail outlets serviced. The material presented does not reveal how well, given that diversity, each cooperative carries out its distribution operation. To approach that question, one must explore the firms' organization and its physical distribution policy, and attempt to define the physical, operating, and financial characteristics of the warehousing and transportation functions within each firm.

Organization and Control

Regional cooperatives because of their size and complexity, have found the need to departmentalize line and staff functions. To perform services with efficiency, clear lines of responsibility and control are required. Figure 2 portrays a simplified organizational flow chart of a regional cooperative which would commonly perform marketing and other member services (for example, product storage and drying, trucking, and insurance) as well as the merchandising of farm supplies. The organizational chart is not truly representative of any of the particular cooperatives studied but is rather a composite. In reviewing the organizational charts of the eight study cooperatives, considerable variation was found in the placement and centralization of many functions.

Discussed previously were the interrelationships between members, the board of directors, and the manager or president. The manager, in order to make informed decisions, maintain control, and monitor the performance of line functions, is

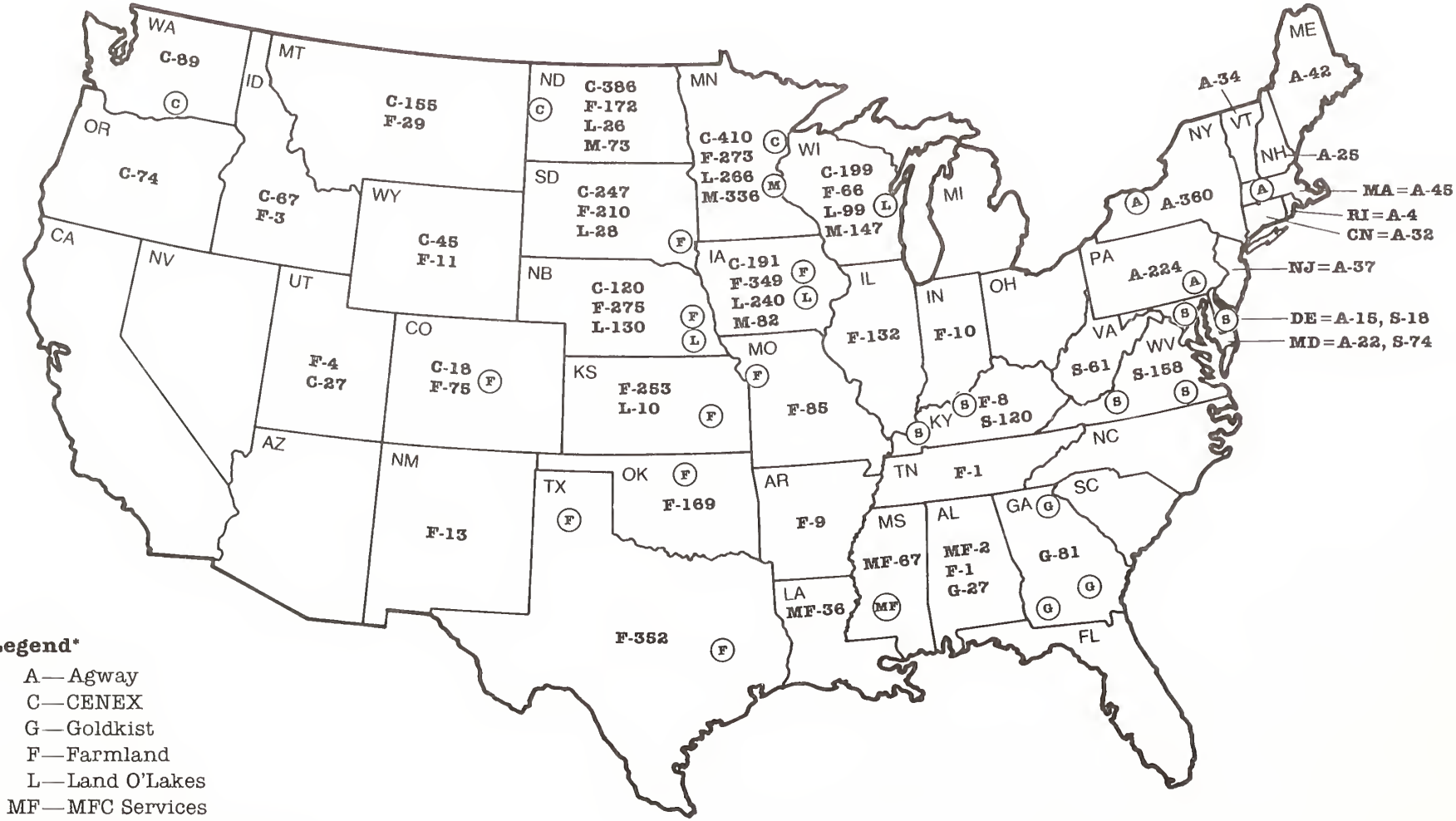
Table 4 — Number of retail outlets and distribution centers, and farm supply sales (1980-81) by regional farm supply cooperative.

Cooperative	Distribution centers (DC)	Retail outlets (RO)	Total farm supply sales	Farm supply sales through DC's	RO/ DC 1/	DC sales/ DC 1/	DC sales /RO	Total sales /RO
	Number	Number	—Million Dollars —		Number	— Million Dollars —		
III	9	2,481	3,100.0	283.5	276*	31.5*	.114*	1.25*
VIII	6	431	103.3	69.0	72	11.5	.160*	0.23
II	3	2,028	1,578.1	81.0	676*	27.0*	.040	.78
V	3	800	703.0	35.6	267*	11.8	.044	.88*
IV	3	118	260.7	20.7	39	6.9	.177*	2.21*
I	3	828	162.6	89.9	276*	29.9*	.108*	.19
VII	1	638	519.1	35.2	638*	35.2*	.055	.81
VI	1	105	139.6	24.4	105	24.4*	.054	1.33*
Average					261	19.8	.094	.85

1/ Astericks indicate ratios which were above the average for each category.

Figure 1

Locations of Regional Cooperative Distribution Centers and Retail Outlets by State



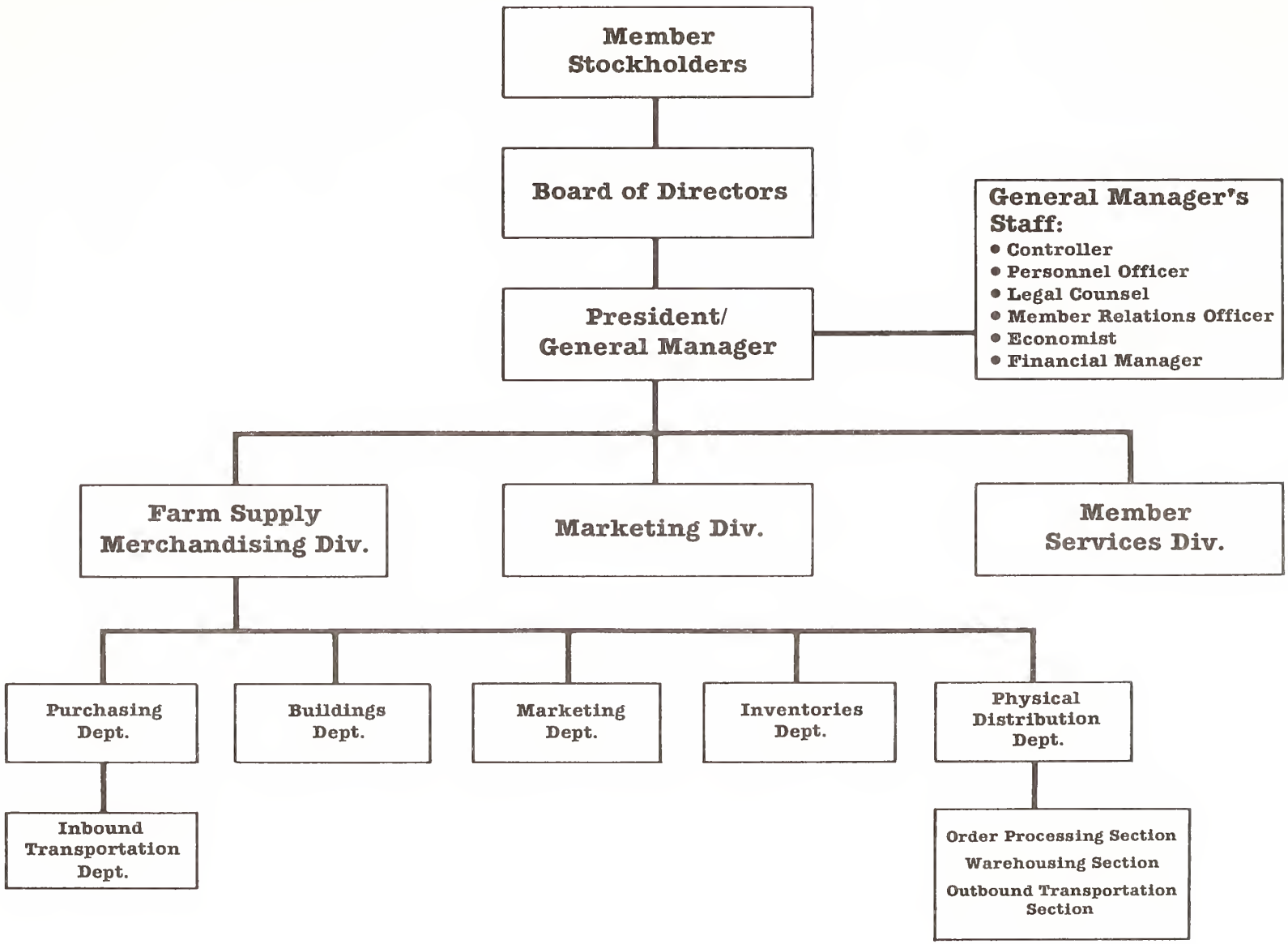
Legend*

A—Agway
C—CENEX
G—Goldkist
F—Farmland
L—Land O'Lakes
MF—MFC Services
M—Midland Cooperatives
S—Southern States

*Circled letters denote locations of cooperative distribution centers.

Figure 2

Organizational Structure of a Regional Cooperative



assisted by a staff of professionals. Controllers, personnel managers, legal counsel, member relations counselors, economists, and financial managers are commonly part of this staff.

Focusing on the merchandising or farm supply function, the areas of control are often divided into departments such as buildings, transportation, purchasing, marketing, inventory, and physical distribution. Although each department is managed and operated independently of the others, the operations of one department quite often affect other departments. The manager of the merchandising division is charged with coordinating the decisions of the various departments in order to maintain the most efficient service.

While the president and his staff may be consulted for proper direction, the merchandising division manager is often given considerable operating autonomy. Depending on the degree of autonomy and the extent of the merchandising function, a merchandising division manager (and the marketing and services division managers for that matter) could well use one or more staff positions attached to the president's staff on a full-time basis.

For instance, enough legal or financial issues could be raised by the operations of one division to require the employment of one or more professionals in those fields. A division staff, directed by its manager, would benefit from the proximity to the operation and direction from the division manager. The disadvantage lies in the lack of communication between division and top management staff experienced when those staff functions are segregated from one another. This argument, centralization versus decentralization, extends beyond staff responsibilities and may even create greater impediments to efficient operations among the line responsibilities.

Specifically within the merchandising division, one department's actions to improve the efficiency of its operations may stimulate greater costs in other departments and collectively might cause overall costs of the division to increase. Consider a purchasing manager's decision to purchase farm implements from a number of small suppliers to be delivered within a relatively short time period. The inbound transportation manager is faced with the increased costs of a number of small orders arriving by more expensive less-than-truckload (LTL) motorcarrier service. Transportation savings might have been achieved if a full truckload had been ordered from a single vendor. By coordinating the activity with that of the physical distribution manager, the purchases might have been brought in as a backhaul by one of the returning peddle delivery vehicles. If the purchase were timed to achieve a savings in price but not timed to the orders of retailers, the costs of inventory could increase. The receipt of purchases, when warehouse space is dear, could increase building cost (in leasing more space) and may disrupt orderly put-away and

picking operations for the warehousing section. Another example would be a marketing decision that does not allow enough lead time between retail outlet ordering deadlines and delivery. Such a policy could overload the capabilities of order processing, transportation, and the warehousing section.

Many examples of such cost tradeoffs among functions within an operation are apparent, and a good division manager is aware that they occur. Determining the extent of the occurrence and taking appropriate actions to minimize those occurrences is a challenge that has received considerable attention recently among firms whose budgets reflects significant physical distribution costs.

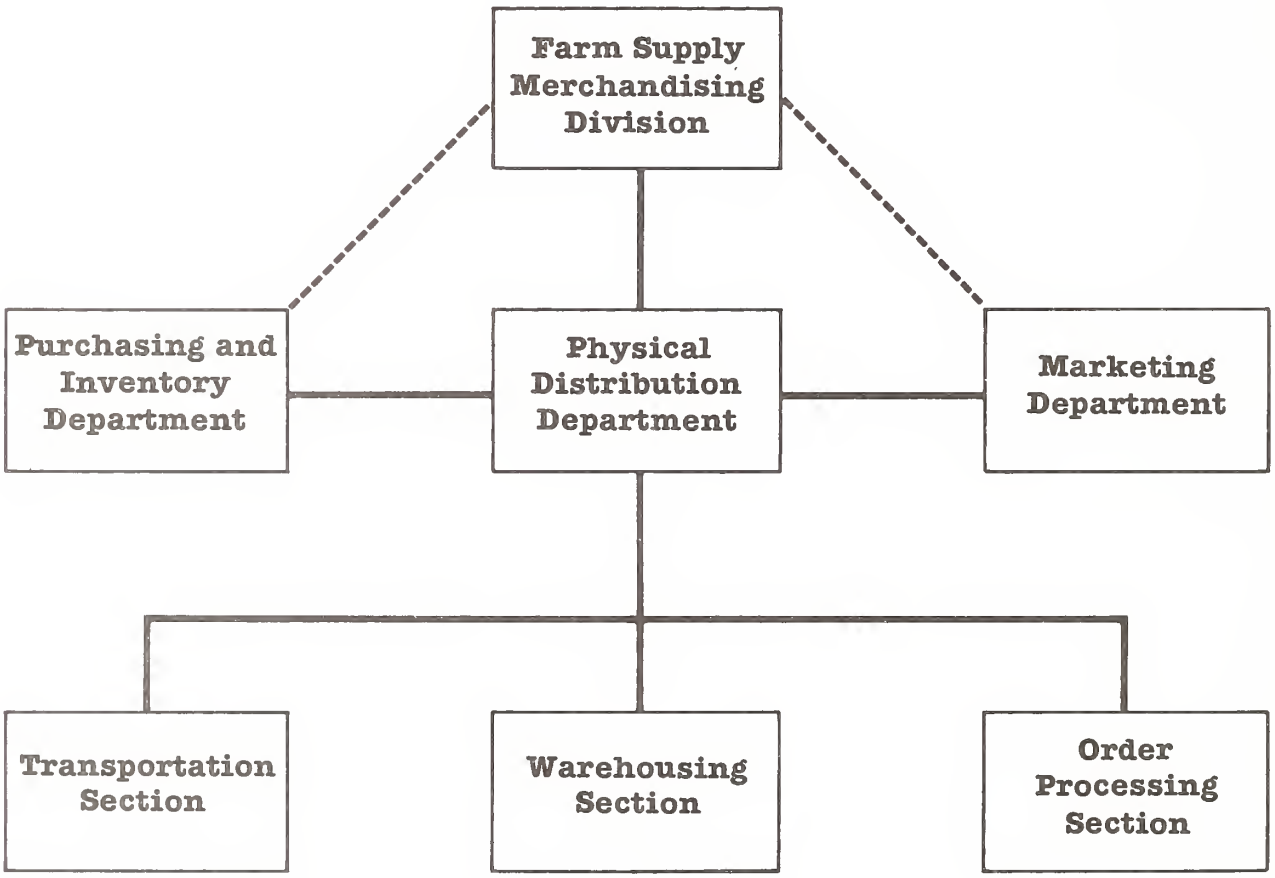
From an organizational standpoint, regional cooperatives commonly emphasize the importance of three departments within the merchandising division: purchasing, marketing, and physical distribution. Managers of those divisions are responsible for confronting problems seemingly internal and individual to their operations. Purchasing is encouraged to reduce the cost of obtaining farm supplies, marketing to create effective demand to lower inventories, and physical distribution to provide efficient customer service. Although each division must function somewhat independently, business professionals suggest a more positive approach in recognizing each function as a chamber temporarily directing a flow of products. The manager of the product flow from suppliers, into and out of warehouses and into the hands of the retail consumer, must be intimately aware of each division's problems and seek to correct deficiencies based on a firmwide view of objectives, usually net profit or savings. Such a manager would be termed a materials manager, logistics manager, planning manager, or physical distribution manager. The position "allows a company to take advantage of cost and inventory reduction and performance improvement opportunities unavailable if each function area focuses on its own limited area of concern."1/

Proponents of the material management approach would reassemble organizational charts to have all merchandising departments report to the material manager, who would in turn report directly to the merchandising division manager (figure 3). The emphasis would be to coordinate the flow of products to achieve the greatest efficiencies. Both inbound and outbound transportation functions would be combined. Because inventories are demand-responsive, control would rest within the purchasing department under marketing-selected guidelines that would assume varying levels of service for particular products.

1/ "Materials Managers -- Who Needs Them?", J. Miller and P. Gilmour, Harvard Business Review, July-August 1979.

Figure 3

Organizational Structure of the Merchandising Division with Emphasis on Material Handling



A less parochial approach might direct both purchasing and marketing departments to report directly to division management (dotted lines, figure 3) if product flow control were deemed less important than those functions. At least one of the regional cooperatives studied has moved to this middle-ground by encouraging emphasis on product flow while maintaining the autonomy of the purchasing and marketing departments.

The cooperative allows the purchasing department the discretion of product buying from its various vendors but assigns the responsibility of how and when the products arrive to the physical distribution department. Although more efficient flows are possible through such shifts of responsibility to the physical distribution manager, the structural change will undoubtedly require much more coordination among the three divisions to prove successful.

While organizational structure is important, the incentive of each department to interact, coordinate, inform, and assist other departments is not stimulated by managerial decree alone. Responsibility directives and organizational networks provide only the means to facilitate the desired ends. To provide the proper incentives, some of the study cooperatives are focusing on placing cost and profit reponsibility for product lines as close to individual functional units as possible.

As each product moves through the cooperative's merchandising network it accumulates cost, or in the parlance of marketing professionals, value added. In the process of acquiring title (purchasing), receiving (inbound transportation and material handling), storing (warehousing and inventory interest charges), selling (marketing) and dispersing (material handling and outbound transportation), each product will generate costs unique to its physical characteristic. Segregating and allocating those costs not only provides a more accurate base to distinguish each product's marginal profitability but also helps to flag high-cost activities unique to the particular product within the flow. While this approach will be treated in greater detail in the study, it is mentioned here because of its potential ability to temper the reliance on organizational structures to enforce greater efficiencies.

PHYSICAL CHARACTERISTICS OF DISTRIBUTION CENTERS

General

A determination of the physical characteristics of each of the distribution centers involved in this study is an essential ingredient to the entire process of evaluating the applicability of productivity measurements on an industrywide basis. Such measurements can only be applied against a background of knowledge which reveals not only the degree of comparability among the distribution centers but also the significant differences.

It is for this reason that the study contains substantial support information for evaluating the productivity measurements such as the physical charactertistics of the distribution centers, firm size, commodity mix, automation, and service areas. This background of support information should enable the cooperative distribution center management to more clearly determine the productivity position of their particular DC's and the firm itself within the context of this study.

Warehousing

Spatial Requirements

The 29 distribution centers in the study occupy approximately 408 acres, with the total facility space area under roof and outside storage totaling 5,014,000 square feet, about 105 acres, or 29 percent of the area (table 5). The remainder of the area is utilized for such purposes as fleet trucks, employee and visitor parking, truck maintenance facilities, and rail sidings, or is lying idle for future expansion or investment.

Actual storage under roof for all of the DC's is about 4,132,000 square feet. This latter figure includes space for necessary working aisles. Nonstorage space under roof of 316,700 square feet is taken up by offices, and in some instances by activities such as motor oil blending facilities, antifreeze manufacturing and packaging, seed packaging, farm gate assembly, and catalog packaging.

Actual storage space among the 29 DC's ranges from a high of 429,000 square feet to a low of 25,000 square feet. Grouping of DC's by actual storage space shows the following size distribution.

Table 5 - Physical size of cooperative distribution centers in study

Rank by actual storage	DC code	Total area occupied	Total facility space	Area under roof: Non-storage use	Area under roof: Storage use	Area under roof: Storage use	Outside storage
		(acres)		Square ft.		Cubic ft.	Square ft.
1	D	48.4	618,500	39,000	429,500	12,864,000 1/	150,000
2	W	25.0	500,000	50,000	400,000	5,236,000	50,000
3	J	4.2	295,000	22,200	272,800	5,592,400	-
4	K	13.4	247,800	18,400	229,400	4,583,000	-
5	AA	43.0	242,000	28,800	213,200	4,690,400	- 3/
6	B	5.1	221,600	4,400	189,200	5,086,300 1/	28,000
7	A	4.5	194,800	5,300	179,500	4,732,200 1/	10,000
8	C	4.5	194,800	5,900	178,900	4,845,400 1/	10,000
9	Y	12.0	191,000	9,500	176,500	3,265,000	5,000
10	F	48.4	270,000	4,500	165,500	5,777,700 1/	100,000
11	V	16.0	162,000	3,200	146,800	2,936,000	12,000
12	H	7.5	150,000	4,000	146,000	3,504,000	-
13	Z	7.0	151,000	6,000	139,000	2,780,000	6,000
14	BB	4.0	152,000	8,800	137,200	2,238,600	6,000
15	G	9.9	137,400	5,300	132,100	2,642,000	-
16	O	6.0	175,000	5,000	130,000	3,500,000	40,000
17	M	4.5	129,500	7,200	120,300	2,793,900	2,000
18	R	23.8	116,200	4,000	112,200	1,620,300	-
19	E	47.6	218,000	6,500	111,500	2,676,400 2/	100,000
20	Q	10.0	136,000	8,800	107,200	2,208,000	20,000
21	X	13.0	86,000	13,600	72,400	1,230,800	-
22	L	5.0	71,000	2,000	59,000	1,010,000	10,000
23	N	8.5	54,600	3,000	51,600	1,083,600	-
24	I	4.0	54,500	4,000	48,000	768,000	2,500
25	CC	3.0	45,000	3,000	42,000	672,000	3/
26	S	10.0	50,500	10,000	40,000	720,000	500
27	T	10.0	50,500	10,000	40,000	720,000	500
28	P	3.5	58,900	9,300	37,600	562,100	12,000
29	U	15.0	40,500	15,000	25,000	400,000	500
Total		407.8	5,014,100	316,700	4,132,400	90,677,800	565,000

1/ Includes high-rise storage areas as follows: No. 1 - 2,058,000 cubic feet No. 6 - 1,470,000 cubic feet.

2/ Includes area under roof and outside storage.

3/ Outside storage available, but not used.

of DC's by actual storage space shows the following size distribution.

Number of distribution centers	Actual storage space under roof (Square feet)
2	400,000 and over
3	200,000 - 399,000
15	100,000 - 199,000
9	Under 100,000

Actual storage use averages about 93 percent of the total area under roof, while nonstorage averages 7 percent for the 29 DC's (table 6). The range among the DC's is from 62.5 percent to 97.9 percent for storage use with the residual percentage for nonstorage use ranging from 2.1 percent up to 37.5 percent.

Ceiling heights are a major component in comparisons of storage space among distribution centers They add a third dimension (cubic feet) to the conventional length and width square feet measures, and thus allow calculations to be made of volume measures, depending upon the variations in warehouse ceiling heights. Present warehouse materials handling equipment will allow stacking in racks of palletized merchandise three pallet loads high for ceiling working heights of from 15-16 feet, and four pallets for 20 foot ceilings. These stacking allowances are based upon the usual height of 54 inches (4.5 feet) for a pallet load. Some distribution centers may on occasion add an additional pallet by reducing the stacking height of the top pallet. It is also possible to stack up to six pallets high with special fork truck adaption for counterbalance and extension and a working height ceiling of at least 30 feet. In addition, high-rise stacker cranes used in automated storage retrieval systems achieve heights much greater than 30 feet. For example, two of the study participants utilize stacker cranes in their distribution centers. One has a total of 57,000 square feet in its three DC's, with working ceiling heights of 70 feet serviced by stacker cranes (one for each DC). The other has a high-rise stacker crane area totaling 63,400 square feet for two of its three DC's which have such facilities. The ceiling heights are the same as those of 70 feet.

Conventional ceiling heights of the storage areas for the 29 DC's ranged from 9 feet to 30 feet. But nearly three quarters of the total potential storage areas, as measured in square

Table 6 - Percentage of actual storage to nonstorage use of roofed area at cooperative distribution centers

Ranked number by actual storage	DC code	Total	Actual storage use	Nonstorage use
		Percent		
1	D	100.0	91.7	8.3
2	W	100.0	88.9	11.1
3	J	100.0	92.5	7.5
4	K	100.0	92.6	7.4
5	AA	100.0	88.1	11.9
6	B	100.0	97.7	2.3
7	A	100.0	97.1	2.9
8	C	100.0	96.8	3.2
9	Y	100.0	94.9	5.1
10	F	100.0	97.4	2.6
11	V	100.0	97.9	2.1
12	H	100.0	97.3	2.7
13	Z	100.0	95.9	4.1
14	BB	100.0	94.0	6.0
15	G	100.0	96.1	3.9
16	O	100.0	96.3	3.7
17	M	100.0	94.4	5.6
18	R	100.0	96.6	3.4
19	E	100.0	94.5	5.5
20	Q	100.0	92.4	7.6
21	X	100.0	84.2	15.8
22	L	100.0	96.7	3.3
23	N	100.0	94.5	5.5
24	I	100.0	92.3	7.7
25	CC	100.0	93.3	6.7
26	S	100.0	80.0	20.0
27	T	100.0	80.0	20.0
28	P	100.0	80.2	19.8
29	U	100.0	62.5	37.5
Averaged		100.0	92.9	7.1

feet, had ceiling heights ranging from 15 to 22 feet, as shown in the tabulation below:

Ceiling heights Feet	Percentage of total potential storage Percent
Less than 15	16.5
15-22	73.4
23-30	10.1
Total	100.0

Outside storage areas within the spatial limits of the DC's were reported as being utilized by 20 of the 29 DC's; two reported having such areas but not utilizing them, while 7 had no outside storage.

The combined outside storage area totaled 565,000 square feet, while the average for the DC's having such areas was 28,250 square feet (table 5). A large variation was found in the size of outside storage areas with the range from 150,000 square feet down to 500 square feet.

Among the major items reported as being stored in these outside areas were empty pallets, wire, fencing, plastic pipe, garden mulch, stock tanks, fertilizer tanks, propane tanks, hog feeders, grain bins, farm trailers, and building materials.

Although most of the DC's use outside storage, only a few advantages were enumerated. They were: allows flexibility during peak inventory periods when storage is at a premium; good for large, bulky items that are weather resistant; cheap, since there are no building costs; and is less restrictive in terms of size or shape.

By contrast, numerous disadvantages of outside storage were listed by the DC managers. Among these, weathering and deterioration were mentioned most, followed by such other disadvantages as theft, no coordination with the DC, high pick costs, not readily available, damage to equipment, and lack of proper ground surface. As a result of the weather, rust and aluminum oxidation were mentioned as problems, with the result that at times the merchandise might have to be sold at a discount or at any price. Allied with the weather was the hardship of battling the elements, especially in the winter, in attempting to service or to minimize the damage to items stored outside. Unless the DC is located in an area of relatively mild winters, the disadvantages of outside storage may greatly outweigh the advantages.

Lease or Rental of Warehouse Space

Five of the eight regional farm supply cooperatives reported that they leased or rented warehouse space to supplement that of the distribution centers for storage of farm supplies. The practice was not applied, however, by all distribution centers of the five regional cooperatives. Of the 17 distribution centers operated by the 5 regional cooperatives, 10 reported that they either leased or rented storage space to supplement that of their own distribution centers.

Total warehouse space leased or rented by the 10 distribution centers is about 313,000 square feet, with a range among the DC's from 8,700 to 50,000 square feet. This supplementary warehouse space represents about 7 percent of the total warehouse space under roof operated by the 10 distribution centers.

Five of the DC's reported they leased or rented the warehouse space throughout the year, while the other five reported seasonal use only.

Specific commodity use of the space was reported by all but two of the users, with agricultural chemicals being the major commodity group. Other commodities reported were tires, antifreeze, stock tanks, appliances, heating equipment, fertilizers, and general surplus stock, especially of the large and bulky variety.

Most of the rented or leased warehouse space was located within 5 miles of the particular distribution center, although some was scattered throughout the marketing area.

Cost information received from 7 of the 10 DC's showed the cost per square foot on an annual basis ranged from $0.33 to $2.50. Eight of the 10 DC's reported that these lease or rental costs were lower than owned space, while one estimated the costs were the same, and another stated the costs were higher.

Three of the 29 distribution centers reported that they also leased some of their own warehouse space on a seasonal basis. These arrangements were on a lease-back basis to agricultural chemical suppliers who would pay to have their chemicals stored during the off-season. Generally, the lease-back would apply to return merchandise which could be held in the warehouse and be subject to sale.

Unloading and Loading Facilities

Trucks are the predominate mode in unloading and loading facilities at all of the distribution centers in the study. This is illustrated by table 7, which shows that the 29 DC's have a total of 227 truck receiving bays, by contrast with 84 rail-receiving bays. In the case of shipping facilities, the contrast is much greater, with 112 truck bays and only 5 rail bays. The fact that there are almost no rail shipping bays is

Table 7 - Number of bays for unloading and loading trucks and railcars at distribution centers

DC rank number by total bays - trucks	DC code	No. of bay facilities: receiving: truck	receiving: rail	shipping: truck	shipping: rail	Total bay facilities: receiving and shipping: truck	receiving and shipping: rail
1	C	23	3	8	0	31	3
2	W	21	5	10	0	31	5
3	B	20	3	8	0	28	3
4	A	19	5	9	0	28	5
5	D	6	5	17	5	23	10
6	K	18	4	(18) 1/	0	18	4
7	AA	7	4	7	0	14	4
8	M	6	3	6	0	12	3
9	Q	12	0	(12) 1/	0	12	0
10	F	5	3	7	0	12	3
11	Z	6	2	6	0	12	2
12	Y	6	2	6	0	12	2
13	V	5	2	6	0	11	2
14	BB	5	3	5	0	10	3
15	E	4	2	5	0	9	2
16	O	8	3	(8)	0	8	3
17	X	4	2	4	0	8	2
18	CC	4	2	4	0	8	2
19	L	7	5	(7) 1/	0	7	5
20	H	3	5	4	0	7	5
21	G	6	3	(6)	0	6	3
22	J	5	6	(5)	0	5	6
23	N	5	4	(5)	0	5	4
24	P	4	2	(4)	0	4	2
25	R	4	2	(4)	0	4	2
26	S	4	0	(4) 1/	0	4	0
27	T	4	1	(4) 1/	0	4	1
28	I	4	1	(4)	0	4	1
29	U	2	2	(2) 1/	0	2	2
Total		227	84	112	5	339	89

1/ Receiving and shipping bays are used interchangeably.

indicative of the peddle-type deliveries typical of the shipping operations of all the cooperative supply distribution centers in the study. This type of operation cannot be handled by railroads in competition with trucks because of the frequent dropoff shipments; relatively short hauls between dropoffs; customer services performed by the driver; and the flexiblity of the truck to adapt to changing backhaul conditions.

The number of truck receiving bays by distribution center ranged from 23 down to 2, while the range of truck shipping bays was from a high of 17 down to a low of 4.

Eight of the distribution centers reported using the truck receiving and shipping bays interchangeably. (See table 7.)

Transport Equipment and Facilities

Regional cooperatives under study were asked (1) to list the number of tractors and trailers used to distribute products into and out of their distribution centers; (2) if they owned or leased these vehicles; (3) if they leased railcars for distribution purposes; and (4) to give the physical characteristics of their repair facilities, the nature of the repairs performed, and the cost of operating the facilities.

Information of this nature was obtained to provide a general picture of a cooperative's physical transportation features which, in turn, will provide background for the later section on transportation operating characteristics. Data sought is introductory to the analysis of equipment lease versus ownership and contract maintenance and repair of equipment. But while those questions may be very important in determining transport efficiency, it is not within the scope of this examination to develop those analyses.

Of the seven cooperatives responding, four indicated their fleet consisted of both owned and leased tractors and trailers, two reported wholly owning their fleet and one leased all equipment.

Although cooperatives attempted to enumerate the number of vehicles involved in the distribution operations, the procedure could not be completed satisfactorily by all cooperatives for several reasons. A regional cooperative, whether it owns or leases equipment, will often maintain a fleet of trucks for (1) transporting member-owned material for its members, (2) bringing members products (for example, grain, vegetables, or milk) to market, (3) carrying farm supplies from a distribution center directly to retail outlets or farmers, (4) transferring farm supplies from one distribution center to another and in addition, (5) bringing material from vendors into a distribution center or to the farmer directly.

Specific tractors, trailers, and other transport equipment of a regional cooperative's fleet may be dedicated exclusively to a particular distribution center to transport products moving through that center. This practice is the exception, however, as greater efficiencies may be generated by pooling equipment use when ever possible. This is evidenced by the extent that tractors and trailers are used to transport related materials of distribution centers and are also used by other divisions within the cooperative.

All of the cooperatives responding to the question concerning the number and kind of repair facilities reported the existence of facilities at at least one of the distribution centers. While some facilities were reported to handle all major repairs, including engine overhauls, others were limited to only functions such as periodic maintenance and minor repairs.

Again, we found that the facilities commonly serviced transport equipment which was used both for DC-related material movement and for other previously mentioned purposes.

Only one cooperative indicated it leased railcars (11) in connection with distribution center activities. The cars were used to haul petroleum products onto the distribution center sites.

Having noted the limitations of the collected data as a measurement of transport potential relating to the distribution function, a brief display of that data by cooperative is shown in table 8. The dollar sales of each cooperative are also listed to allow for purposes of comparing the amount of equipment to sales throughput.1/

This overview of transportation characteristics and the next section on transport operating characteristics describe only one function of the distribution system. Although costs are available on particular activities within this function (for example, the cost of repair facilities), the ability to allocate those costs to particular product lines as they move through the system is more important (and more elusive).

1/ Throughput, a term common to physical distribution, is the total amount of goods received and shipped over a specified time. It may be expressed by weight, cubic volume, number of items or value.

Table 8 - Number of tractors and trailers, and ownership and leasing arrangements by cooperative

Cooperative	Sales	Tractors	Trailers	Acquisition terms	
	Million dollars	Number	Number	Own	Lease
I	89.9	56	113	X	X
II	81.0	83	176	X	X
III	20.7	8	8	X	X
IV	283.5	295	223	X	
V	35.6	10	19		X
VI	24.4	14	22	X	
VII	35.2	71	195	X	X
VIII	69.0	51	85	X	X

OPERATING CHARACTERISTICS OF DISTRIBUTION CENTERS

Warehouse Operations

Identification of Functions

The study's farm supply distribution center managers and their warehouse managers identified 11 major functions which are performed in the operations of their warehouses. They are listed below:

a. Receiving
b. Stocking
c. Storage
d. Replenishment
e. Order picking
f. Checking
g. Packing and marking
h. Staging and order consolidation
i. Shipping
j. Clerical and administrative
k. Order taking

All of the warehouse functions listed above were reported as being performed within the warehouse by each manager, with the exception of replenishment, staging and order consolidation, and order taking.

Replenishment as used in this study refers to transferring the merchandise from storage areas to the order picking bins as stocks become low.

The replenishment function was reported as not being performed by three of the distribution centers. The reason given was that the orders were filled directly from the storage areas, since there was not sufficient space available in the three warehouses for order picking bins.

Only one distribution center reported that it did not perform the commonly accepted warehouse function of staging and order consolidation. This function involves assembling the filled orders in a designated location near the shipping area so that the orders and documentation may be checked and the orders designated as to priority of loading on a "first in, last out" basis.

In lieu of staging and order consolidation, the particular distribution center pulled and loaded the orders directly into the delivery trucks. This was done not out of choice but rather of necessity, since the distribution center lacks space for a staging area. A not surprising result of bypassing the staging and order consolidation function is an increase in errors in the delivered orders as reported by the DC manager. The alternative, requiring a major business decision, is the possibility of expanding the existing warehouse facility.

This involves exploring the magnitude of the tradeoff of less errors in delivered orders and thus better customer service against the costs of building expansion or perhaps of having to go to a new facility in this period of relatively high interest rates and capital financing.

A similar decisionmaking process may be called for in the case of the three DC's which do not have sufficient space for order picking bins and thus are filling orders directly from storage areas. It would appear that this system may lack the necessary flexibility and control that can be obtained through picking bins with backup storage areas.

Seven of the 29 distribution center managers stated that their centers were not involved in order taking; that is, contacting the customers directly on a regular basis and receiving their orders. This function for the seven DC's is performed at the regional cooperative headquarters.

Three other distribution center managers reported that they may obtain some orders directly from their customers, but on a limited basis. For example, customers may call in directly to the DC a supplementary order to one that was placed earlier in the day at the headquarters of the regional farm supply cooperative. The customer does this so as to try to have his supplementary order filled and consolidated with his original order. Because of generally fixed schedules for order and computer transmittal of them to the DC's by the cooperative supply headquarters, these supplementary orders have a somewhat better opportunity of being loaded on the same truck as the original order if communicated directly to the DC by the customer. There are other instances where a few customers want to deal directly with the local distribution center rather than with personnel at the headquarters' office facility. This may be the result of close contacts being built up over the years between the personnel at the retail cooperative and the distribution center.

Further clarification is necessary regarding the warehouse function of checking. By far the majority of the warehouse managers characterized this function as one being done on a spot-check basis only. In some cases it would be performed by order picking personnel during slack periods. In other cases, inventory personnel perform this function. Finally, checking is also performed by all distribution centers for inventory verification purposes on an annual basis, or at some other scheduled period.

Number of Line Items

The number of line items stocked by each distribution center ranges from a high of 27,500 down to only 200, with the average at about 7,700 (table 9). Of the 29 distribution centers, 19 are below the average and 10 are above. This illustrates the influence of a few large distribution centers upon the average. Of the 224,000 line items stocked by all of the distribution centers, the top five DC's accounted for 46

Table 9 - Number of line items stocked by study distribution centers

Number	DC code	Ranked by number of line items
1	W	27,500
2	D	26,000
3	E	18,000
4	AA	16,000
5	F	15,000
6	J	10,000
7	B	9,600
8	A	9,000
9	C	9,000
10	O	8,152
11	Q	7,106
12	V	6,800
13	L	6,500
14	P	5,995
15	N	5,622
16	K	5,200
17	H	4,500
18	G	4,200
19	I	4,000
20	M	4,000
21	O	3,500
22	R	3,450
23	T	3,000
24	BB	3,000
25	Z	3,000
26	Y	3,000
27	U	2,500
28	X	200
29	CC	200

percent of the total.1/ In addition, thousands of other items, not stocked by the distribution centers, are shipped directly to the cooperative retail outlets.

For purposes of control and to more effectively perform the function of the distribution centers, the line items are placed into major product groups such as:

- Animal health products
- Chemical products
- General farm supplies
- Fertilizer
- Lawn and garden equipment
- Seed
- Tires, batteries, and accessories

Labor Characteristics

Number and major categories of personnel

The eight regional farm supply cooperatives employed an aggregate total of 856 warehouse personnel in the operations of their 29 distribution centers (table 10). The total includes managers, supervisors and foremen, clerical and secretarial personnel, warehouse materials, handling personnel and maintenance persons. Excluded from this total, as well as from the individual center personnel totals (table 11) are personnel employed by some of the DC's in such activities as antifreeze production and packaging, blending and packaging of petroleum lube oil products and farm gate assembly. Truck drivers, dispatchers, and other personnel associated with inbound and outbound transportation are also excluded from the above total since their activities are discussed under Transportation Operations Labor Characteristics. Similarly, top management at headquarters and their support personnel associated with physical distribution are not included in the personnel data of tables 10 and 11. The reason for their exclusion is that in those cases where the regional cooperative has more than one distribution center, the management time would have to be allocated on fractions of a work year among the various DC's, an unnecessary refinement for the purpose of this initial study. A further and perhaps even more important reason is that many of the managers responsible for physical distribution have other

1/ The accumulative total of line items for all the DC's contain some duplications because of the same line items being stocked in some cases by the various DC's.

Table 10 - Number and percentage of warehouse personnel of regional cooperatives by major categories, 1981

Regional cooperative code	Supervision		Clerical and Secretarial		Warehousing		Maintenance		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
VIII	60	29.3	28	13.7	112	54.6	5	2.4	205	100
III	24	12.8	42	22.5	112	59.9	9	4.8	187	100
II	15	9.9	16	10.6	112	74.2	8	5.3	151	100
I	22	16.5	21	15.8	85	63.9	5	3.8	133	100
VII	5	5.6	2	2.2	76	84.4	7	7.8	90	100
IV	12	34.3	7	20.0	15	42.8	1	2.9	35	100
VI	6	20.0	3	10.0	20	66.7	1	3.3	30	100
V	3	12.0	3	12.0	19	76.0	0 1/	-	25	100
TOTAL	147		122		551		36		856	

1/ Performed by warehousemen as part of their tasks.

Table 11 - Number and percentage of warehouse personnel at cooperative distribution centers by major categories, 1981

Regional cooperative code	Supervision		Clerical and Secretarial		Warehousing		Maintenance		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
D	9	9.1	8	8.1	77	77.7	5	5.1	99	100
W	5	5.6	2	2.2	76	84.4	7	7.8	90	100
AA	16	26.7	10	16.7	32	53.3	2	3.3	60	100
B	8	16.3	6	12.2	34	69.5	1	2.0	49	100
J	2	4.3	8	17.4	33	71.7	3	6.6	46	100
A	8	17.8	8	17.8	27	60.0	2	4.4	45	100
C	6	15.4	7	17.9	24	61.6	2	5.1	39	100
BB	10	25.6	4	10.3	24	61.5	1	2.6	39	100
Y	11	31.4	5	14.3	19	54.3	0	-	35	100
V	6	20.0	3	10.0	20	66.7	1 1/	3.3	30	100
Z	9	30.0	5	16.7	14	46.6	2	6.7	30	100
E	3	11.1	4	14.8	19	70.4	1	3.7	27	100
K	3	11.5	7	26.9	15	57.8	1	3.8	26	100
F	3	12.0	4	16.0	16	64.0	2	8.0	25	100
O	3	13.6	5	22.7	12	54.6	2	9.1	22	100
X	7	33.3	2	9.5	12	57.2	0	-	21	100
L	3	15.0	5	25.0	12	60.0	0	-	20	100
C	7	35.0	2	20.0	11	45.0	0	-	20	100
H	3	15.8	5	26.3	10	52.6	1	5.3	19	100
M	1	11.1	5	27.8	10	55.5	1	5.6	18	100
R	5	33.3	2	13.3	8	53.4	0	-	15	100
I	3	23.1	3	23.1	7	53.8	0	-	13	100
G	3	23.1	2	15.4	7	53.8	1	7.7	13	100
Q	5	38.4	4	30.8	4	30.8	0	-	13	100
S	1	9.1	1	9.1	9	81.8	0 2/	-	11	100
N	2	20.0	2	20.0	6	60.0	0	-	10	100
T	1	12.5	1	12.5	6	75.0	0 2/	-	8	100
P	2	28.6	1	14.3	3	42.8	1	14.3	7	100
U	1	16.7	1	16.7	4	66.6	0 2/	-	6	100

NOTE: Transportation personnel of the distribution center (drivers, dispatchers, etc.) are reported in the section entitled TRANSPORTATION.

1/ Covers both warehouse and truck maintenance.

2/Performed by warehousemen as part of their tasks.

responsibilities than just the warehousing operations. One example is that of an executive director of crops and agronomy with the following responsibilities:

Tech services	Plant food
Special projects	Seed
Farm supply	Administration and accounting
Chemicals	

The wide range in number of warehouse personnel by cooperative, from 205 to 25 (table 10), reflects one of the criteria in the original selection of the study cooperatives, that of size distribution.

Among the individual DC's the range in numbers of warehouse personnel is about double that of the regional cooperatives. Table 11 shows that the total number of warehouse personnel by DC ranges from 99 down to 6, which is equivalent to a ratio of about 16.5/1, while for the regional cooperatives the ratio is 8.2/1 (205/25). The average number of warehouse personnel by regional cooperative is 107, while for the individual DC's the average is about 30.

The largest major category of personnel among the DC's is warehouse materials handling, which is to be expected. In some instances, however, table 11 shows the ratio of managers, supervisors, and foremen to warehouse materials handling personnel to be high. This is especially so in the small and medium-size DC's. If the comparison is carried further to add the clerical and secretarial personnel to the management category to form the administrative staff, the comparison becomes even more striking. In some cases there are nearly as many administrative staff members as materials handling personnel.

One reason given for the high ratio of administrative staff personnel to materials handling personnel is that a number of the foremen out on the warehouse floor are actually working alongside the warehouse personnel, or they have special work tasks which they must perform in addition to their supervisory duties and responsibilities.1/

Maintenance duties for many of the small DC's are performed by the materials handling personnel during slack periods.

Unionization

The question of unionization versus nonunionization of warehouse personnel was included in the questionnaire because of the interest of the cooperative supply management in comparisons of warehouse labor wage rates among union versus nonunion distribution centers, and their impact upon costs.

1/ See for example DC codes X, Y, Z, and AA, BB, and CC.

Responses to this question revealed that only two of the eight regional supply cooperatives had unionized warehouse personnel. The term warehouse personnel, as used in this sense, excludes managers, supervisors, foremen, and clerical personnel (secretaries and office clerks).

The approximate average hourly wage rate, excluding benefits for warehouse personnel, ranged from a high of $14.20 down to a low of $4.50, as shown in table 12. Employee benefits costs ranged from about 20 percent to 40 percent. Where applicable, the benefits included, among other items, unemployment compensation, medical and health plans, retirement or social security, vacation and paid holidays.

Table 12 - Approximate wage rate per hour for warehouse personnel of study cooperatives, 1981

Cooperative code	Approximate average hourly wage rate, including benefits 1/
II	$14.20
III	13.38
VII	13.27
V	10.90
VIII	10.00
I	9.75
IV	4.70
VI	4.50

Weighted average hourly wage rates, including benefits, show a difference of 6 percent for the two cooperatives with the highest wage rates, one union and one nonunion. The union wage rate is the higher of the two. Among the top six cooperatives with the highest wage rates (two union, four nonunion), the weighted average differential between union and nonunion is 24 percent with the union rate being higher. Weighted average hourly wage rates are $13.82 (union) and $11.14 (nonunion).

A conclusion could be drawn from this portion of the analysis (wage rate data from individual distribution centers) to the effect that there is a greater differential between wage rates of warehouse personnel on a geographic basis than on a union or nonunion basis. This may reflect a tendency for cooperatives which are located in areas where unions are widespread to rather closely follow the union wage rates, even though their warehouse personnel are not unionized. The above conclusion may also illustrate the immobility of at least a portion of the U.S. labor force with regard to movements among geographic regions.

1/ Wage rate plus benefits is a weighted average of each regional cooperative's distribution centers when there is more than one.

Hours of employment

Eighteen of the 29 distribution centers work a single 8-hour shift, while 8 of the DC's work two shifts of which all but is an 8-hour shift. The exception is a 10-hour shift from Sunday through Wednesday for four nights a week. Three of the DC's operate with three shifts over five consecutive 24-hour periods during the week.

Starting times for day shifts range from 6 a.m. to 8:30 a.m., and quitting times from 2 p.m. to 5 p.m., depending upon length of lunch period. For the second shift, starting times may overlap quitting times of the day shift by 30 to 60 minutes so that better coordination may be achieved between the two shifts. In some cases, however, there is no overlap.

Two of the three regional cooperatives have night shifts work from midnight to 8:30 a.m., while the hours for the third cooperative extend from 11:30 p.m. to 7:30 a.m.

Overtime

All of the distribution centers report that they pay overtime. Twenty-three of the DC's reported overtime work largely during certain seasons. Typical comments on this question as reported by the DC managers are shown below:

- Highest in spring peak of business
- Wheat and sorghum harvest
- Fall and spring
- Chemical season (spring)
- Mostly February to May
- Usually spring, work overtime only when absolutely necessary

Five of the distribution center managers reported overtime to be an infrequent occurrence and due to such cases as:

- a shortage of workers on a particular shift or for a few days
- heavy orders
- decrease in personnel
- taking of inventory

Only one DC manager reported overtime as a regular occurrence, while at the same time, indicating that it was influenced by the season since more overtime occurred in the spring.

The amount of overtime paid was reported by 17 of the 29 DC managers. The other 12 distribution centers in the study reported that data on overtime paid were not available. Unfortunately, the amount of overtime paid was reported by 8 DC's in dollars, while 9 DC's reported it in hours.

The amount reported in dollars by the 8 DC's ranged from $1,200 to $172,000 for the 1980-81 fiscal year, while the number of hours for which overtime was paid by the 9 DC's for the same period ranged from 24 to 932 hours.

Data from the 10 DC's reporting overtime paid over the two most recent years generally show a substantial drop in overtime paid the latest year compared with that of the prior year. This trend may reflect the decline in the economy, as well as a greater cost consciousness among the DC managers.

Overtime charges were reported as being assessed against the distribution centers in nearly all cases. Some of the DC managers elaborated further by explaining that the assessment against the DC is in turn allocated against commodity classes or operating divisions. One distribution manager described his company's policy on overtime cost assessment as one that is applied to those who used the facility outside of regular shift hours.

Utilization of Materials Handling Systems

There is a substantial difference among the distribution centers in the degree of technology exhibited by their various materials handling systems. (See table 13.) The systems range from strictly forklift truck operations to those that are highly mechanized and utilize such equipment as automatic storage retrieval, man-aboards, tow lines, reach trucks and in one case, pallet loaders, automatic identification equipment, and automatic case-picking equipment.

The forklift truck is still the most widely used of all the materials handling equipment. It is followed by order pickers and conveyors in that order. Largely because of EPA regulations, only a few gasoline-powered forklifts are now operated by the farm supply warehouses.

Most of the forklifts used by the distribution centers are primarily powered by battery, although there are some powered by propane. For example, of the total number of forklifts operated by a DC, one out of eight may be powered by gasoline and the balance powered by battery. In other cases, all forktrucks may operate by electricity or LP gas.

Driverless tractors which were installed by three DC's some years ago have not proved to be satisfactory for at least two of the three DC's. The result is that they are not being used by these particular DC's. The dissatisfaction expressed by one of the DC managers with his driverless tractors was that it seemed the units were always at the other end of the warehouse when needed. It was also pointed out that the driverless tractors were not workable with random storage and product variety.

Six of the DC's report that they use the forklift exclusively for their materials handling, while five additional DC's use forklifts and order pickers as the basic equipment for their materials handling systems.1/ Three DC's use forklifts in

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1/ Includes the two DC's which have installed driverless tractors but do not use them.

Table 13 - Types of materials handling systems used by distribution centers

Materials handling system	Distribution center code designation																																Number of DC's utilizing equipment
	A	B	C	D	E	F	G	H	I	J	K	L	M	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC					
Automatic identification equipment				X																													1
Automatic case picking equipment				X																													1
Sorting equipment																																	0
Cranes & monorail (Man-a-boards)				X	X	X																											3
Automatic storage retreival	X	X	X	X		X																											5
Pallet loaders				X																	X												2
Conveyors				X	X	X									X	X	X					X	X	X	X	X	X	X					13
Driverless tractor							X	X	1/					X	2/																		3
Industrial (forklift) trucks	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					29
Tow lines	X	X	X	X																													5
Order pickers (cherry pickers)	X	X	X	X	X	X	X	X		X		X	X		X								X	X	X	X	X	X					20
Bin pickers																																	1
Tow tractor/flat cars (tuggers)				X	X	X																											4
																					X												1
Reach trucks	X	X	X	X	X	X															X					X							8
Pallet jacks (hand)												X	X		X																		3

1/ Installed but not used.

2/ Have 2 tractors and 20 trailers but don't use them.

combination with conveyors, while five other DC's base their materials handling system upon a combination of forklifts, conveyors, order pickers, and, in one case, driverless tractors.

These 20 DC's, nearly 70 percent of the total in the study, may be described as utilizing sound but less sophisticated materials handling systems. This is not meant as a criticism of these systems since it has been previously pointed out that forklifts, order pickers, and conveyors, or combinations thereof are basic ingredients for all of the materials handling systems of the study DC's. The remaining nine DC's have built upon these systems by designing and constructing new facilities into which the more sophisticated and automated equipment could be incorporated.

Among the most sophisticated of this equipment is the automatic storage retrieval system, also known as the "high-rise" stacker crane. This system is operated by five of the DC's, and is used for retrieving merchandise from a mechanized storage area to replenish supplies in the order-picking area. The computer-controlled, high-rise stacker crane will upon command, that is, by inserting the computer card in the command control center, retrieve the merchandise from the designated storage bin and transport it to the front platform where it is then moved by forktruck to the order-picking area.

A major advantage of this system is that it operates in a storage area 70 feet in height by contrast to conventional forktruck operations of about 20 feet. An additional important advantage of the high-rise stacker crane is that the storage space in which the equipment operates (usually 70 feet in height by 500 feet in length) is considered a part of the equipment rather than a building. As a result, the entire installation--building and equipment - has a tax writeoff over 5 years by contrast to 30 years for buildings.

The man-aboard, is an example of mechanization combined with manual order picking. It is a high-lift truck with tow-cart pickers in which one man can hand pick up to four cooperative orders at one time. The man-aboard moves horizontally and vertically through aisles up to 25 feet in height. It is used primarily for order-picking of small bins containing nuts, bolts, repair parts, and other small items. Three of the DC's operate this equipment in their respective warehouses.

Tow lines, a third example of warehouse mechanization, are used by five of the DC's. The tow line, imbedded in the floor, is electrically powered and moves the carts from the packing area to the shipping dock.

Four of the DC's use an electrically powered tow line to move the loaded carts from the order-picking areas to the shipping dock. The system is magnetically operated so that the carts

can be dropped off at the specified location. A variation of this system is that of the tow truck, in which incoming merchandise is placed on the tow trucks and the latter are moved by being hooked to a tow chain in the floor. Trucks are programed to stop at preselected points. This system is operated by one of the study DC's.

A detailed analysis and evaluation of the various materials handling systems listed in table 13 is beyond the scope of the present study.

Productivity measurements determine the influence, if possible, of the more highly mechanized versus conventional handling systems upon output per hour or other similar warehouse measurements. The problem will be to isolate the technology influence from that of other causative factors, even assuming that some comparable productivity measurement can be developed from the rather diverse universe of the 29 distribution centers.

Utilization of Computers

All of the eight regional farm supply cooperatives in this study reported that they used computers in their distribution (warehouse) operations. A summary of this use by individual functions in table 14 shows that one regional cooperative utilized computers in all 21 of the distribution operations listed in the interview guide. Three others reported computer use ranging from 14 to 16 functions, while the four remaining cooperatives reported computer use ranging from 9 to 11 functions.

Tabulation on the basis of function shows that computers are used in shipping, order entry, and billing by all of the regional cooperatives, while seven of the eight cooperatives use computers in addition for purchasing, inventory control, receiving, stock location, and picklist preparation. Other distribution functions, in which at least four of the eight cooperatives use computers, are forecasting, product identification, routing and scheduling, load setup, rating, bill of lading, and communications.

Distribution functions which have been computerized by less than half of the regional cooperatives are label printing, warehouse layout, engineering analysis, quality control, and labor scheduling. The last two listed functions are computerized by only one supply cooperative.

Two of the cooperatives in particular have provided comments in the remarks column of the interview guide which highlight their computerization of the individual functions. (See appendix table 1.)

Other remarks were also made about specific functions by some of the study cooperatives, especially order entry, where a request was made for an explanation of the methodology. The responses on this particular function show that for most of the study cooperatives, order taking is centralized at the

Table 14 - Summary of computer use in distribution functions of selected regional farm supply cooperatives 1/

Distribution functions	Code designation - regional cooperatives								
	I	II	III	IV	V	VI	VII	VI	Total
Purchasing	X	X	X	X	X	X	X	X	8
Inventory	X	X	X	X	X	X	X	X	8
Receiving	X	X	X	X	X	X	-	X	7
Shipping	X	X	X	X	X	X	X	X	8
Order entry	X	X	X	X	X	X	X	X	8
Forecasting	X	X	X	-	-	-	-	X	4
Product ident.	X	X	-	X	-	X	X	X	6
Quality control	-	X	-	-	-	-	-	-	1
Stock location	X	X	X	X	-	X	X	X	7
Pick-list prep.	X	X	X	X	-	X	X	X	7
Label printing	X	X	X	-	-	-	-	-	3
Warehouse layout	-	X	X	-	-	-	-	X	3
Engineering analysis	-	X	-	-	-	-	-	X	2
Routing & scheduling	-	X	X	-	-	X	X	X	5
Load setup	X	X	X	-	-	X	X	-	5
Rating	-	X	X	-	X	-	-	X	4
Bill of lading	X	X	-	X	-	X	-	X	5
Communications	X	X	X	-	X	-	-	X	5
Labor scheduling	-	X	-	-	-	-	-	-	1
Billing	X	X	X	X	X	X	X	X	8
Order verification	-	X	-	X	X	X	-	X	5

1/ Use is indicated by X.
Source: Appendix table 1.

regional headquarters with releases to the individual distribution centers on a scheduled time basis.

On the basis of personal observations and discussions with the distribution center managers and their staffs, areas where the computer has made its largest contribution to modern warehousing are those of order entry, receiving, stock location, inventory control, and shipping.

For example, the installation of an online order entry system tied in with a computerized inventory update resulted in substantial reductions in numbers of order takers required under the precomputer system. Generally there has also been a reduction in order taking errors once the order-taking personnel had become thoroughly familiar with the new system. Improved customer service has also resulted from the ability of the computer to produce instantaneously information on the order such as the merchandise description, quantity on hand, quantity on back order, price, and merchandise substitutions.

A typical order-taking procedure is as follows:

1. Customer uses a preprinted form to call in order by stock (code) numbers via WATS to computer center (headquarters or individual DC's depending upon cooperative operations).

2. Order is entered by a keyboard input device to the computer and confirmed by a clerk through a cathode ray tube (CRT) attached to the entry terminal for removing data.

3. Pick ticket is printed out by computer and contains such information as merchandise description, quantity on hand, amount on backorder, amount ordered, price, and location of merchandise in warehouse.

4. After the pick ticket is printed, the invoice is printed.

5. Weight and cube (the latter is not used by all regional cooperatives) are shown on the pick ticket and invoice. One cooperative reports that cube is requested from the manufacturer. If cube is not shown on the manufacturer's invoice or shipping ticket, it is determined by the cooperative's receiving department through measurements. Both measurements, weight and cube, are used in warehouse allocation and in truck loading by the shipping department.

The contribution of the computer to stock location is that it has enabled this function to be operated on a random location basis in contrast to a fixed location in precomputer days. Random location provides great flexibility to stocking since

it allows utilization of space without regard to any particular sequence. Manual stock recordkeeping is also eliminated through use of the computer.

Computerized operations have made possible better inventory control and direction, including a "first in and first out" product movement. Substantial time savings in inventory of stocks have resulted from computerizing the operation. For example, one distribution manager stated that the computer allows them to do precounting, which greatly reduces the amount of time spent on spot checking. In addition, the entire inventory can now be checked in one day by contrast to one week without the computer.

Costs and Assessment

The determination of costs and their assessment against the responsible warehouse functions, commodities, or commodity groups are one of the two major elements commonly used in establishing performance measurements within a distribution center or among distribution centers on an industrywide basis.

Cost data are generally more readily available than physical data (the other major element used in productivity measurements) because of the necessity for determining various costs under the conventional accounting system. In many instances, however, cost data produced by conventional accounting systems are not in sufficient detail to serve as productivity measurements except in rather broad, general terms.

An even more serious disadvantge of costs as a performance element, especially during periods of substantial inflation, is the difficulty of distinguishing between inflationary effects and real performance. Deflation indices for various national economic indicators such as wholesale prices and wage rates are available, but they may not adequately cover the variations in costs experienced by an industry as diverse as the regional farm supply cooperatives with their large number of line items covering an extremely wide range of products.

In the present study all of the eight regional cooperatives reported that their warehousing operations were considered to be a cost center rather than a profit center 1/. None of the eight cooperatives, however, are maintaining cost or profit

1/ One of the study cooperatives is currently in the process of converting its warehouse operations to profit centers.

data on each of the eleven major warehouse functions. Despite its recognized deficiencies, financial data are useful to compare relative changes among warehouse functions. Within a given time period, year-to-year assessments may lack preciseness because of variations in inflation rates.

One regional cooperative estimated the relative cost importance of each function as follows:

	Function	Percent of total cost
1.	Receiving	10
2.	Stocking	10
3.	Storage	5
4.	Replenishment	5
5.	Order picking	35
6.	Checking	2
7.	Packing and marking	15
8.	Staging and order consolidation	1
9.	Shipping	15
10.	Clerical and administrative	2
11.	Order taking	-
	Total	100

These relative percentages were determined by taking the total warehouse personnel and estimating the amount of time devoted to each function by the various categories of employees or of individual employees. Adjustments were made for seasonal fluctuations, assignment changes, and related matters so as to reflect insofar as possible the average percentage of employee time associated with each warehousing function.

Five of the study cooperatives reported that their warehousing costs were allocated among major product groups, while one reported that a product cost allocation system was in the process of being developed. Another cooperative reported that warehousing costs were "allocated to each individual product using a standards system." The remaining cooperative stated that it had no cost allocation system for product groups. Examples of product groups assigned warehousing costs by the study cooperatives were:

Animal health products	Agricultural chemicals
Seed	Lawn and garden products
Fertilizer	General farm supply products
Chemicals	Tires, batteries, and accessories
Petroleum	Animal service products
Catalog item products	

One method of allocating warehousing costs was described by a regional cooperative official as follows: "Each commodity carries a storage rate and a handling rate based upon weight and cube. The storage rate is assessed on the basis of inventory at the end of the month. The handling rate is assessed at the time the merchandise moves out of the warehouse, with no distinction made between sales or intracooperative transfers." The combination of the two rates are supposed to cover total warehouse expenses. If they do not, the costs are reallocated and the rates are increased so that they will cover all expenses.

Six of the eight cooperatives reported that their purchasing departments were not assessed warehousing costs based upon relative turnovers of the various commodities. One cooperative reported that its purchasing department was assessed warehousing costs based upon relating sales and profitability of the various commodities. Another cooperative reported that warehousing costs were assessed against the purchasing department on the basis of actual (rather than relative) turnovers.

The reason for this question was to ascertain the extent of responsibility borne by the purchasing department for possible judgmental errors in filling up much of the warehouse space with low turnover merchandise as a result of special quantity discounts. In these instances, the discounts may have been more than offset by the high interest costs of inventory.

Only three of the eight regional cooperatives reported that cost of space was allocated to specific commodity groups within the warehouse. These three cooperatives also indicated that the cost allocation took into account special space requirements (and added costs) for such commodities as tires and medicines. One cooperative described this procedure as follows:

> "The Accounting Department has been furnished space requirements and labor input for each commodity group (division); this along with sales provide cost allocation criteria."

An official of one of the cooperatives that reported it did not use dedicated space allocations, added that he believed there was a real need for such allocations.

Transportation Operations

Transportation may be operationally divided into two, often distinct, functions--those inbound movements that arrive primarily from vendors or suppliers and the outbound movement or product distribution primarily to retail outlets. While cooperatives have traditionally had substantial control over distribution functions, distribution managers are attempting to organizationally and operationally integrate the inward flow of traffic with the outward flow. A common example would be the use of a peddle delivery to backhaul incoming material.

This section examines in detail inbound and outbound movement from a number of standpoints. First, to capture the organizational and structural framework by which these operations are executed, a discussion of financial, policy, personnel assignments, and personnel characteristics is presented. Next, inbound transportation operations are analyzed with respect to volume, type of carrier, backhaul utilization and data collection activities. Last, outbound transportation operations are defined in terms of their volume, method of distribution, and data collection and utilization.

Functional Organization

The overall organization of the transportation functions within a cooperative varies as do other functional relationships within a cooperative. From a regional cooperative standpoint, a vice president of transportation may exercise operational and functional control over all aspects of both inbound and outbound transportation. From a policy standpoint, this would mean the regional places emphasis on transportation operations rather than the material distribution function of which transportation is a part, a workable approach if purchasers, warehousemen, and marketers are party to those transportation decisions. Another, and more common approach, places inbound transportation and transportation equipment control at a regional level, but allows greater distribution center control over the outbound (especially the peddle delivery operations) transportation function. This structure, which gives greater autonomy and control to the distribution center and justly emphasizes the importance of the distribution operation, may impede the needed coordination between inbound and outbound movements necessary to contain inbound costs. Cost savings possible through backhaul, truckload shipments, and lower cost carriers are possible only through cooperation from purchasing departments and individual distribution center outbound transportation managers. The latter groups may find little incentive to consider changes in operation if those benefits are not apparent in their own financial offices statements.

Methods of Cost Accounting

Transportation managers at the regional level were asked to describe the accounting stance given their divisions by the regional headquarters. Of the eight cooperatives studied, six identified their transportation divisions as cost centers and two as profit centers.

Profit, strictly defined, is that which is left when all the cost of goods or services (plus value added) is subtracted from the amount of money received. In this case, a transportation function operating at a profit within a cooperative must be viewed as an autonomous unit which sells its services to the rest of the cooperative to distribute and supply its material. The definition of profit would hold if autonomy were carried to the extreme, the transportation division as a separate company. This is never the case, however, as any profit (savings realized through cost containment) may be distributed to any other cost or profit category based on the

decision of top management. Financing of the transportation function begins as a company decision. A transportation operation is a budgeted expense and its costs are nearly always covered from the sale of services and goods to customers. But transportation operations on the whole are only one part of value added to the goods and services delivered. The profit center argument holds for a cooperative only if the money realized from transportation services not connected with farm supply sales were greater than the costs of the delivered business.

Transportation Policy

Outbound transportation policy and service policy are often viewed synonymously by the cooperatives in the context of the farm supply operation. Although outbound transportation is only one facet of product delivery, the costs of service betterment is many times more apparent to the outbound transportation manager. If a service policy directs transportation to deliver, as ordered, without regard to the timing or the size of the order, then cost containment in transportation operations becomes difficult if not impossible. A rational approach adopted by many cooperatives certainly emphasizes service but recognizes the costs of immediate delivery and the costs of excessive less-than-truckload peddle or common carrier deliveries.

Although service policy certainly affects transportation costs, the accounting policy regarding transportation operations is of concern to transportation managers. Accounting policy describes how the costs of transportation of particular products are assigned within the cooperative. Some small, heavy, and less fragile products (for example, tool sets) may be transported at a much lower cost than bulky light and easily damaged products (for example, organic mulch). Unless there is some way to transfer the costs of transportation (any material handling costs for that matter) back to the product, then the transportation operation will not receive adequate credit for handling certain products. For example, a record of product movement may show low volume in terms of sales and weight but reveal an increase in transport operating costs. The transportation operation may actually be working more efficiently than when last recorded; but because of a change in product mix, will seem to be functioning at a lower level of productivity. In addition to the problems created in the transportation function, other material handling functions may be similarly taxed. If no clear cost signal is transmitted to purchasing (or whoever controls pricing) through a system that attributes material handling costs to products, or at least product groups, then not only will material handling costs be mismeasured but also the cooperative is more apt to incorrectly set profit margins for particular products.

Operations Defined

In defining the transportation activities, the answers of cooperatives were nearly the same. All transportation activities associated with farm supply operations may be grouped into the following four areas: inbound, direct, transfers, and outbound. Inbound transportation refers to the

movement of goods from a supplier into a cooperative distribution center (DC) warehouse. Direct transfers would apply to a vendor's goods shipped to a retail outlet without first going through a DC. In either case, the type of carriage may be common, independent, or private carriage. Transfers would be shipments from one distribution center to another. These shipments are ordinarily performed by the cooperative's own fleet, either DC or regionally based. Outbound shipments are those from the distribution center to the retail outlet.

When asked, six of the regional cooperatives responded that emphasis was placed on outbound transportation rather than inbound shipments. The other two cooperatives replied that inbound and outbound operations received equal emphasis. A case can be made for both policies. Based on cooperative responses, emphasis was placed on outbound shipments because (1) customer service was a priority, (2) there was little control over inbound shipments, and (3) outbound shipments represented an immediate "sale" and inbound represented future sales. The two cooperatives that responded that equal emphasis was placed on both movements did not cite reasons for their policy. An explanation is offered.

Although "service" and "immediate sale" are certainly legitimate explanations for outbound emphasis on a shortrun basis, the delivery of a product represents a series of operations including the inbound shipment. Certainly if a DC transportation manager is faced with using a driver and equipment to perform a peddle delivery versus a transfer run, the resources will more than likely be used for the former rather than the latter; that is, provided the operations of the entire regional cooperative do not suffer. On the other side, the longer run view would emphasize that maintenance of adequate inventories and attention to inbound costs assure that immediate sales may be made and service (which at some point must be included in the selling costs) would remain at a high level.

Assignment of Management Responsibilities

In assigning transportation responsibilities within a cooperative, regional managers tend to segregate inbound and outbound transportation functions, at least in a nominal sense. Referring to table 15, a traffic manager is more likely to be placed in charge of inbound movements and a distribution center manager in charge of outbound. Some cooperatives attempt to integrate responsibilities by using dual assignments on one side or another of the traffic flow. Another method, not apparent from the table, would attempt integration of responsibilities through cooperation between inbound and outbound transportation managers. To more effectively fuse this relationship, top management may insist on a measure of shared responsibility of cost containment for both inbound and outbound budgets for both managers. No cooperative was reported as having one manager in charge of both functions.

Table 15 - Responsibility for inbound and outbound transportation

Regional cooperative	Inbound responsibility	Outbound responsibility
I	Traffic manager	DC manager
II	Traffic manager	DC manager
III	Traffic manager	DC manager
IV	Purchasing and transportation manager	Transportation manager
V	Purchasing, traffic and DC manager	DC manager
VI	Purchasing and DC manager	Marketing and DC manager
VII	Traffic manager	DC manager
VIII	Purchasing and traffic manager	DC manager

Labor Characteristics

Number and type

A distribution center will commonly maintain its own transportation unit comprised of a transport manager, his staff, dispatchers, and drivers. In a small DC, the manager may also be responsible for dispatching and share administrative personnel with the warehouse operations.

Table 16 contains information on the number of drivers, both full and part time, and the number of dispatchers. Where no dispatchers are reported, it is assumed that the manager completes that function. The number of drivers in each regional cooperative is compared with the amount of farm supply sales through each regional and the ratio is computed revealing dollar sales per driver. Cooperative III, with the lowest dollar sales, has sales of $2.54 million for each driver. Cooperative IV, with the largest sales volume, has a sales of $0.78 million for each driver. Ranked by dollar sales, the cooperatives closely follow a trend exhibiting fewer dollar sales per driver as the driver force and dollar sales increase. Part time drivers were given half time status in the cursory analysis.

Table 16 - Personnel participation in transportation functions by regional cooperatives

Regional cooperative	Farm supply sales through DC	Full-time drivers	Part-time drivers	Sales/driver ratio	Dispatchers
	Million dollars	Number	Number	Million dollars	Number
IV	283.5	362	6	0.78	10
I	89.9	69	0	1.30	0
II	81.0	78	4	1.01	4
VIII	69.0	59	0	1.17	2
V	35.5	20	0	1.77	5
VII	35.2	14	10	1.85	1
VI	24.4	15	0	1.62	1
III	20.7	8	0	2.54	1

Division of labor

When asked to divide the driving force between inbound and outbound transportation functions, most regionals were either unable to make the distinction or reported that no distinction existed. A small percentage of distribution centers were able to supply that information, however.

As an aside, one cooperative did report that drivers were randomly chosen to perform warehouse duties for a day to acquaint the driver with the operations of the warehouse. The same DC would also assign a warehouseman to accompany a driver on a run on an infrequent basis. The role change was designed to give each labor force member an appreciation for the other tasks.

Hours of service

Drivers are constrained by Federal law in both the total hours they may be on duty and the number of hours they may actually drive between periods. Cooperatives reported drivers' hours of service within those parameters. Drivers worked from one to three shifts per day and were on duty 8 and 15 hours each shift.

Drivers' duties and hours differ from those of many workers who complete assignments in one location. Because it is often imperative that a driver complete a full run rather than work a given number of hours, the length of shift, number of shifts, and shift period vary considerably from one DC to another and sometimes from one driver to another within a cooperative.

As with the warehouse labor force, about half the DC's reported some seasonality of driver employment. This force increase may take a number forms. The most common would be the hiring of individuals for a period to increase the force, although some cooperatives would contract with an owner-operator to meet an increased demand for transportation services. Of the eight regionals, only two reported they paid no overtime to drivers.

Wages

Drivers were found to be paid an average of $11.51 per hour including benefits. Pay scales ranged from $7.50 per hour to $15.37 per hour. Dispatchers are paid an average of $10.36 per hour and scales range from $8.50 per hour to $13.36 per hour. Two of the eight regional cooperatives reported a unionized driver force. No dispatchers were reported as belonging to unions. Union drivers were paid between $4.06 to $2.13 more than nonunion drivers in comparable geographic/economic regions.

Inbound Transportation Statistics

Cooperatives, like many firms, if pressed will be able to generate data on almost any aspect of their operation. The process of generating and assimilating data into usable information often consumes more resources than can be justified for its projected use. In the case of transportation data, like data generated by the activity of other operations, the cooperatives often would have been able to compile the data but were not requested to do so for this study. As an approach to determining appropriate performance measures, the study foremost seeks to identify the information that is presently compiled and used as well as identifying potentially useful and easily accessible data sources.

In the case of inbound transportation, several cooperatives noted that more emphasis was placed on outbound operations rather than inbound operations. It was suspected that data assimilation and possibly collection would emphasize outbound movements rather than inbound movements among the cooperatives. The suspicion was well founded. What was also revealed was the lack of inbound data as compared to outbound data among the cooperatives that reported placing equal emphasis to both movements.

Given the lack of compiled or assimilated data, regional cooperative managers and, in many cases, distribution center personnel were asked to estimate the percentage of inbound shipments by mode and percentages by class of carrier (common, contract, private, independent) within each mode. The percen-

tages are reported as regional cooperative data, but many were averaged from individual distribution center reports and are so identified.

Value received

Only two of the regionals had data readily available on value of inbound farm supply sales. Those figures compared favorably with other published figures revealing regional farm supply sales through distribution centers. As a measure of performance, the value of inbound alone would not be used. That value must be compared with outbound shipment value and the value of inventory stocks before and after the period being measured. While the throughput value would then be known, actual performance might be inaccurately measured if the weight and cubic volume of throughput were not considered. These measures will be addressed more fully in subsequent sections of this study.

Modal shares

Cooperatives receive nearly all inbound farm supplies by motor carrier. In recent years, railroads have increased their volume of traffic shipped by trailer-on-flatcar (TOFC). The bimodal concept adds more flexibility to rail carriage but has yet to make a significant impact on farm supplies received by cooperatives, at least for those farm supplies that pass through distribution centers. One cooperative reported, however, that up to 30 percent of inbound material arrives by regular (for example, boxcar or tank) rail carriage. No farm supply material was reported to have arrived by water, although some supplies may use water during some part of transport.

Table 17 reveals the amount of inbound material that arrives by various modes, that is, for hire and private motor carrier and regular and TOFC rail. An average of 51 percent of all material arrives by for hire (common or contract) carrier, representing a range of 26 to 90 percent of total inbound shipments. A nearly equal amount, averaging 42 percent, arrives by private carriers (both cooperative and other private carriers) and ranges from 9 to 64 percent of total inbound shipments. Regular rail (averaging 6 percent of total shipments) and TOFC rail (averaging 1 percent) contribute to total shipments arriving by all modes of the regional cooperatives studied.

Table 17 - Percent of inbound shipments arriving by all modes by regional cooperatives

Cooperative	Motor Carrier		Rail	
	For-Hire	Private	Regular	TOFC
	Percent			
I	47	48	1	4
II	90	9	1	-
III	34	64	2	-
IV	52	44	4	-
V	39	60	1	-
VI	70	26	4	-
VII	26	44	30	-
VIII	50	42	8	-

"For-hire" motor carrier service

Cooperatives estimated that the largest amount of inbound material arriving by for-hire carriers was handled by common carrier (regular and irregular route). Estimates of inbound material averaged 66 percent and ranged from 95 to 30 percent. (table 18.)

Deliveries by contract carriers averaged less (20 percent), although one cooperative reported that all for-hire arrivals were through contract carriers. The percentage of materials delivered by contract motor carriers ranged from 0 tc 100 percent. The percentage of for-hire material delivered by independent or owner-operators ranged from 0 to 38 percent, and averaged 14 percent for all regional cooperatives. Table 18 presents estimated percentages of deliveries made by specific cooperatives.

Table 18 - Percent of "for-hire" motor carriers deliveries by class of carrier, by regional cooperative, 1980-81

Cooperative	Common	Contract	Independent
	Percent		
I	95	5	0
II	95	0	5
III	90	0	10
IV	30	32	38
V	-	100	-
VI	50	15	35
VII	90	5	5
VIII	75	4	21

"Private" motor carrier service

A private motor carrier service is one wholly owned and operated by a firm or cooperative. When goods are to be transported to a cooperative distribution center, the cooperative manager (or DC manger) often has the option of letting the vending firm (supplier) bring in the product or, if cooperative equipment is available, letting the firm bring in the material using cooperative trucks. A transportation manager will seek opportunities to utilize excess equipment or drivers or bring the material in as a backhaul from a peddle run or distribution center. Data presented in table 19 reveals that cooperatives have achieved a measure of success in accomplishing such utilization.

Table 19 - Percentage of inbound shipments arriving by cooperative private fleet and other private fleet, by specific cooperatives, 1980-81

Cooperative	Cooperative fleet	Other private fleet
	Percent	
I	90	10
II	35	65
III	94	6
IV	15	85
V	92	8
VI	90	10
VII	100	0
VIII	66	34

Private inbound averaged 73 percent for all cooperatives and ranged from 15 to 100 percent. Other private carriage averaged 27 percent and ranged from 0 to 85 percent.

Utilization of cooperative private fleet

Data provided above demonstrates the ability of transportation managers to use their private fleet to transport supplies into distribution centers. Table 20 further identifies other use of that fleet to accomplish peddle and distribution center transfer functions.

Table 20 - Utilization of cooperative private fleets, by specific cooperatives 1980-81.

Cooperative	Inbound	Peddle	Transfer
	Percent		
I	49	50	1
II	35	64	1
III	20	70	10
IV	40	55	5
V	35	60	5
VI	10	90	0
VII	20	75	5
VIII	32	52	16

On the average private cooperative inbound fleets were used to transport inbound commodities 30 percent of the time. The range for this activity was from 10 to 49 percent among those cooperatives. Over half of all the fleet activity, 65 percent, was attributed to peddle deliveries and ranged from 52 to 90 percent. DC transfer operations averaged 5 percent of total fleet utilization.

Cooperatives also estimated that 90 percent of private fleet use was for full truckload deliveries and 10 percent less-than-truckload deliveries. Truckload and less-than-truckload deliveries by "other private fleet" was the reciprocal, 10 and 90 percent respectively.

Outbound Transportation Statistics

Peddle deliveries versus "will call"

Peddle deliveries, transportation of farm supplies from the distribution centers to retail outlets, account for the greater percentage of movements of goods out of the centers. "Will call" movements, shipments made at the request of retail outlets are infrequent occurrences, and have diminished with the advent of centralized order-processing systems (table 21).

Table 21 - Percentage of will call versus peddle deliveries, by regional cooperatives, 1980-81

Cooperative	Peddle	Will call
	Percent	
I	99	01
II	95	05
III	90	10
IV	95	05
V	99	01
VI	90	10
VII	90	10
VIII	85	15

Retail outlets usually dealt with individual distribution centers in placing their orders before central (regional) order processing was instituted. As the retail outlet communicated directly with the distribution center, a "will call" order was easier to set up. As central order-processing became a regional policy, "will calls" were not as easy to process, and because warehouse operations were sometimes disrupted by "will call" orders, the process was discouraged.

Customers placing "will call" orders are given a transportation allowance by only four of the study cooperatives. Aside from the temporary disruption of the warehouse operation, cooperatives noted that little savings accrued when a retail outlet called for an order. The order might have been as easily transported as a peddle delivery in conjunction with normal DC peddle routing.

If a "will call" allowance is given, it most often occurs as a reduction in the price of the product by the amount attributed to peddle transportation costs. Two cooperatives have a special tariff structure with which to compute the "will call" allowance. One cooperative offers no reduction because the transportation charges are added upon delivery of the products. Special hauls (unscheduled deliveries) are charged a special rate above the normal transportation charges.

Cooperative backhauls

As noted, cooperatives use returning peddle delivery vehicles and distribution center transfer vehicles to bring in farm supplies to distribution centers whenever practicable. Table 22 contains the estimates on the percentage of backhaul, by cooperative, and the percentage of those backhauls operating intrastate and interstate. The latter categories are meant as a proxy measurement of the distance a backhaul is carried when no firm data is available.

Table 22 - Percent backhauls, by intra- and interstate movements, by regional cooperative, 1980-81

Cooperative	Percent backhaul	Percent interstate	Percent intrastate
I	50	75	25
II	60	67	33
III	5	17	83
IV	28	55	45
V	70	50	50
VI	30	30	70
VII	10	75	05
VIII	25	75	25

Cooperatives were, on the average, able to obtain backhauls in 37 percent of all peddle delivery and transfer movements. The range for backhauls under these circumstanes was from 5 to 75 percent. Backhauls were largely interstate movements (56 percent) as opposed to intrastate (44 percent).

Cooperative truck costs

Average fleet costs per vehicle mile were the most widely compiled and computed of all data available on transportation costs. The table 23 below shows the data the study cooperatives reported. This data shows a substantial variation in the average vehicle costs, with the range running from $0.94 to $1.69 per vehicle mile, a difference of 80 percent. Since some of the cooperatives did not reveal cost components, it is possible that part of the variation may be due to differences in the system of accounts maintained by each of the cooperatives. This matter will be explored as part of the implementation phase of the productivity measurements.

Table 23 - Fleet cost per vehicle mile, by cooperative, 1979-1981

Cooperative	1979	1980	1981
	----------Dollars----------		
I	1.35	1.32	1.69
II	0.94	1.13	1.22
III	0.92	0.93	0.94
IV	0.89	0.96	1.03
V	-	-	1.16
VI	-	1.07	1.10
VII	1.16	1.34	1.49
VIII	0.92	1.07	1.23

One cooperative compiles data on individual and total fleet by loaded and unloaded miles.

All cooperatives reported collecting data on individual routes (that is, length of route, frequency of delivery, cost per mile, etc.), but no cooperative is yet compiling this data on a regular basis for route analysis. One cooperative did report that compilation was in process.

Driver-assigned routes

Five of the eight cooperatives reported that at least some routes were assigned to drivers on a fixed basis. Advantages of this practice were:

* drivers were familiar with retail outlet locations and unload procedures;
* routes were well known and more effeciently traversed;
* assigned drivers operated the routes more safely; and
* retail outlet customers preferred the fixed route driving assignments.

Disadvantages reported were:

* loading and scheduling were not as flexible;
* equipment and drivers were sometimes underutilized;
* drivers became bored with the same route;
* security problems (pilferage) sometimes developed because of the relationships between drivers and retail outlet personnel; and
* backhaul potential was reduced.

This section has provided background statistics and information on cooperative transport operations. Little has been said about the need for more data compilation or the applicability or universality of collected and reported data.

References to transportation data and other cooperative physical distribution functions, including the concept of tradeoffs, will be treated in the following sections on tradeoffs and productivity measurements.

Table 24 is a matrix of tradeoffs that are possible within the farm supply division of a regional cooperative.

Table 24 - Tradeoff matrix of physical distribution functions

Function cost reduced	Function(s) Affected				
	:PUR	:ITR	:INV	:WHS	:OTR
Purchasing costs (PUR)	-	+	+	+	+
Inbound trans. costs (ITR)	+	-	+	+	+
Inventory costs (INV)	+	+	-	+	+
Warehousing costs (WHS)	+	+	+	-	+
Outbound trans. costs (OTR)	+	+	+	+	-

According to the functional tradeoffs presented, the reduction of any one area will increase each of the other functions but not always simultaneously. Of course, the trade-offs are not always this absolute but a case (extreme in some instances) can be made for each cause and effect.

Purchasing costs represent the price paid by the cooperative for goods FOB the supplier's location. To reduce purchasing costs, a cooperative might:

* purchase from far-away suppliers (+ITR);
* purchase in great quantities (+INV, +WHS); and/or
* purchase only at low prices, causing stockouts and special runs to out-of-stock retail outlets (+OTR).

Inbound transportation costs are those paid to common, private ("hidden" in purchase price), or independent carriers, or are accounted for as inbound costs on the cost ledger of cooperative truck fleets. Costs could be reduced by:

* ordering only from vendors in immediate area (+PUR);
* ordering only truckload quantities (+INV, +WHS); and/or
* rerouting outbound deliveries to increase the backhaul potential (+OTR).

Inventory costs are the costs of capital (interest), sometimes referred to as capital carrying charges. The greater the stock of goods carried or stored, the greater are the inventory costs. To reduce inventory costs a cooperative might:

* purchase frequently and in small lots to keep stocks low (+PUR, +ITR); and/or
* keep low stocks in the warehouse, increasing order processing costs (backorders) special deliveries, and fixed warehouse costs (on a cost per item basis) (+OTR, +WHS).

Warehouse costs include not only the building costs but also the cost of labor to unload, stock, replenish, check, pick, load and process orders. A cooperative could reduce warehouse costs by:

* fully loading each truck to a maximum, with emphasis on driver unloading efficiency (+WHS);
* rerouting peddle deliveries without considering back-haul possiblities (+ITR); and/or
* purchasing and maintaining stocks to assure full truck-load peddle embarcation (+PUR, +INV).

Outbound transportation costs are those related to vehicle and driver activities directed toward peddle or retail supply operations. These costs are most commonly perceived as increasing proportionately with increases in customer service levels.

Cost reductions are possible by:

* fully loading each truck to a maximum, with emphasis on driver unloading efficiency (+WHS);
* re-routing peddle deliveries without considering backhaul possibilities (+ITR); and/or
* purchasing and maintaining stocks to assure full truckload peddle embarcation (+PUR, +INV).

As mentioned, some of the adverse tradeoffs may seem forced, but the point is that each action by a manager of a particular function may cause increased costs in another functional area. Cost reductions in one area may, however, create cost reductions in another area. For example, inventory cost reductions may be accompanied by warehouse cost reductions if stocks are actually reduced over a long enough time period.

It is apparent to most managers that cost tradeoffs in connection with a distribution function do exist. The function costs that increase or decrease are often readily recognized. But quantifying the extent of change within and between each function is a challenge to most cooperatives. Moreover, quantifying change by product group (for example, petroleum products, garden supplies, or animal health products) or even by line item is more elusive still.

Two analytical approaches are generally used to determine the extent of change in functional area costs caused by the change of another functions cost: optimal solution and dynamic simulation modeling. Optimizing models, which include some necessary assumptions, have proven to be useful. The method suffers if time-related variables such as seasonality of demand, supply, or ability to serve (weather related) are considered. Dynamic simulation models will explicitly incorporate time related variables, but they are expensive due to the need for extensive data collection and analysis.

The more data a cooperative has collected and has available on computer memory, then the less is the cost to develop either modeling technique.

Functional tradeoff analysis generally uses a cost base versus physical measures because of the comparative advantages inherent in cost figures. For example, if a warehouse is able to increase its pounds throughput per man-hour ratio and finds its driver (peddle) man-hour/weight ratio has decreased, it is difficult to determine if the net effect of the changes is positive or negative. For this reason, cost data is generally used if explicit determinations of functional tradeoffs are made.

Regional physical distribution managers were asked if they considered the tradeoffs between warehousing and transportation and between warehousing and other cooperative operations. All mangers except one responded in the affirmative. One cooperative qualified the answer by admitting to tradeoff analysis only in situations involving the location of new warehousing and levels of inventory versus service levels.

Cooperatives were not asked specifically what type of analysis was used in making cost tradeoffs. Conversations indicated that most cooperatives were involved in measuring the "service levels" provided to cooperative members. Service levels were often analyzed by product line, using data generated through computerized order-processing system. The process involved a measurement, usually a percentage of stockouts, of the times a particular order could not be filled. While some cooperatives computed and tried to attain a particular overall level of service, others were able to measure and attempt service levels according to particular product lines.

Five of the eight cooperatives cited service, which impacts outbound transportation costs or performance most, as being a policy-determined measure of cooperative performance. Some policies cited:

* immediate delivery of products the absence of which would jeopardize farm production;

* service over costs (but costs were charged back to product line); and

* no minimum order on weekly delivery with no extra charge.

PERFORMANCE MEASUREMENTS

State of Art Among Study Cooperatives

The eight regional farm supply cooperatives in the study reported that they were using productivity measurements. Of this group, four stated their measurements were based upon both cost and physical data, three utilized cost data only, and one cooperative confined its measurements to physical data only.

Of the four cooperatives which use physical data for measurements along with costs, one based its physical data upon "shop floor" measurements exclusively, another cooperative relied upon its computerized data base exclusively, a third cooperative used its computerized data base on a partial basis with supplementary support manually, and the fourth cooperative combined its computerized data base with estimates based upon spot checks.

The difficulties in applying productivity measurements to the distribution operations of a regional farm supply cooperative were pointed out by one cooperative official as follows:

* warehouse mix varies among the DC's;
* line items vary among the DC's; and
* value of items varies among the DC's.

The functions or activities covered by the productivity measurements vary from total distribution center operations on the basis of labor costs to the total distribution center costs as a percentage of total sales as shown in table 25.

All of the eight study cooperatives reported that they used their productivity measurements to measure performance but with substantial qualifications in some cases. Cooperative comments were:

- Only used in relation to budget and historical data trends.
- As a program to monitor daily performance of all distribution center labor force.
- Although measurements are not accurate, they are of some value at budget time.
- They are used as management objectives for warehouse personnel. Budget estimates will be based on these production standards.
- By comparing past standards, we can tell if we are getting better or worse.
- Used only in the sense of measuring aggregate warehouse cost versus aggregate sales.
- By measuring performance through cost per weight shipped and historical line-item/cost-handling comparisons. The data is not old enough to know whether it can be used for staff performance appraisals, but it is giving us a better indication of the effectiveness of the programs and systems we institute and maintain.

Table 25 - Functions or activities covered by productivity measurements

Regional cooperatives code	Item
I	- All material handling in the warehouse as a total operation (pounds handled per hour).
	- Total distribution center (payroll costs per dollar volume and net expenses per dollar volume).
II	- Total distribution center operations (labor force).
III	- Distribution center and its costs.
IV	- Material handling, maintenance, inventory control, and assembly and repair.
V	- Primarily cost per sales dollar, and expense comparison data from month to month and year to year.
VI	- Aggregate distribution center cost as a percentage of aggregate sales. For the 1981/82 fiscal year, information will be collected to reflect cost in relation to weight and cube of product shipped.
VII	- Total group, not specific.
VIII	- Cost of warehouse operation as a whole versus sales.

- Used only to a very limited extent. Actual and budgeted costs have some very limited use in this respect, but cost comparisons are limited because of inflation.

All but one of the cooperatives reported that they were not satisfied with their present productivity measurements. Among the obstacles to improvement of the productivity measurements cited by the distribution managers were lack of time and personnel to study, improve, and implement the measurements. These reasons were emphasized by officials of three cooperatives. Closely related to these reasons is that of the current heavy workload on staff at DC's, which interferes with better productivity measures, as stated by an official from another cooperative. One physical distribution manager reported that the costs of gathering data often exceeds the value rendered. In spite of this obstacle, however, the same manager stated that he wants more measurements. But a major problem and complexity in developing more measurements, according to this manager, is that in the warehouse one is working with multiple functions. In view of this fact, he considers the task of keeping account of time to be a near impossibility.

Ability to establish criteria and collect data by individual or work group was cited by one physical distribution manger as the major obstacles to his cooperative's efforts to improve the present productivity measurements.

Finally, one of the cooperatives reported that it was in the process of developing information by use of weight and cube statistics that will permit more indepth productivity analysis of the shipping and warehousing functions.

Cooperative Performance Measures

General

In the A. T. Kearny study previously cited, physical distribution firms were found to be in various stages of measuring performance as an approach to effective management of their physical distribution systems. The stages and percentage of firm attainment in each stage are presented.

Stage I - Distribution costs per dollar sales are computed and tracked from year to year (30 percent of firms).

Stage II - The measure in stage I used to set future budgets and performance is evaluated in light of the projections. The budgets may be broken down to product line. A separate system of physical measures may be initiated (55 percent of firms).

Stage III - The use of industrial engineering techniques to develop standards but to take into account demand seasonality in the budgeting process (10 percent of firms).

Stage IV - Financial (stage I) and physical measures (stage III) are integrated for use in formal tradeoff analysis (5 percent of firms).

Financial Measures for Warehousing

Performance measures based upon financial records are the most common, since the base data such as dollars of sales, dollars of cost, and even dollars of cost per unit and function are more readily available than physical data.

In view of this availability, financial performance measures are also those which are frequently used to determine industrywide performance. But because monetary measures are subject to distortion from inflation and other causes, the dollar figures in the data base may be adjusted by various deflation indices in order to arrive at constant dollar values. These indices are generally not sufficiently finite to permit measurement of small changes, but they can give relatively satisfactory results on an industrywide basis over time.

Among the eight regional farm supply cooperatives, all but one reported that they used cost and/or sales data as a basis for their productivity measurements. The use of these cost data and the type of productivty measurement achieved are shown below on a case-by-case basis for each of the seven cooperatives involved:

Case I

1. Measure - Net expenses as a percentage of throughput volume
   Output unit - Sales, actual and budgeted
   Input - Net expenses, actual and budgeted
   Time period - 1978/79, 1979/80, and 1980/81 (fiscal year, July 1 - June 30.)
   Reporting level - Distribution center by major departments

2. Measure - Payroll (excluding payroll costs) as a percentage of throughput volume
   Output unit - Sales, actual and budgeted
   Input unit - Payroll costs, (excluding administrative costs), actual and budgeted
   Time period - 1979/80 and 1980/81 (fiscal year, July 1 - June 30)
   Reporting level - Distribution center by major departments

Case II

1. Measure - Net operating expense as a percentage of sales
   Output unit - Sales, actual and budgeted
   Input unit - Net operating expense
   Time period - Three years, 1978/79 - 1980/81 (fiscal year, October 1 - September 30)
   Reporting level - Distribution centers

Case III

1. Measure - Total operating expense as a percentage of total volume
   Output unit - Sales volume, actual and budgeted
   Input unit - Total operating expense, actual and budgeted
   Time period - 1976/77 - 1980/81 (fiscal year, September 1 - August 31)
   Reporting level - Distribution centers, monthly and annually.

2. Measure controllable warehouse expense per $1,000 sales
   Output unit - Sales
   Input unit - Controllable operating expenses, actual and budgeted
   Time period - Fiscal year 1976/77 through fiscal year 1980/81
   Reporting level - Distribution centers, monthly and annually

3. Measure - Service level by line item
   Output unit - Service level (equals actual demand less back orders/demand).
   Input Unit - Dollar volume of orders received (actual demand at time of order received) and dollar volume of back orders.
   Time period - Fiscal year 1976/77 through fiscal year 1980/81
   Reporting level- By line item, monthly and annually

Case IV

1. Measure - Gross margin as a percentage of net patrons purchases
   Output unit - Net patrons purchases
   Input unit - Net cost and gross margin
   Time period - 1977/78 - 1980/81 (fiscal year, July 1 - June 30)
   Reporting level - Distribution center warehouse, annually

Case V

1. Measure - Distribution cost per dollar sales by product area
   Output unit - Sales
   Input unit - Warehouse cost
   Time period - 1980-81 (fiscal year, January - December 31)
   Reporting level - Distribution center by major product groups, monthly and yearly.

Case VI

1. Measure - Net margin as a percentage of sales
   Output unit - Sales, actual and budgeted
   Input unit - Net margin before income tax, actual and budgeted.
   Time period - 1980/81 (Fiscal year, June 1 - May 31)
   Reporting level - Distribution center by operation and division

Case VII

1. Measure - Total warehouse expense as percentage of sales
   Output unit - Sales, actual and budgeted
   Input unit - Total warehouse expense
   Time period - 1980 and 1981 (fiscal year, January - December 31)
   Reporting level - Distribution center and by major account (warehouse expense, property and occupancy, general and total expense).

Critique of Financial Warehouse Measures

Outputs units

The most common unit of output utilized by the regional cooperatives for their financial measures was sales. It was not possible to determine from the data presented in some instances how the sales data might differ among the cooperatives reporting, as well as how the sales data and throughput volume or net patrons' purchases might differ. For example, total sales volume may include warehouse transfers, association use and transfer to subsidary, or it may be the net of these items as well as merchandise returns. Similarly throughput volume may or may not include transfers, return merchandise, and other similar items. When the warehousing expense is computed as a perentage of sales, not including transfers and other merchandise handlings, it has the effect of overestimating the warehousing expense percentage. Although one can understand the need for elimination of possible duplication which could result from intracorporate warehouse transfers or transfers to subsidaries if they were registered as sales at both warehouses, at the same time the

resources of personnel and equipment utilized in receiving, handling within the warehouse, and shipping are not recognized if total warehouse activity is measured by sales net of such transfers.

All of the study cooperatives maintain warehousing and transportation expense data on an actual and projected budgeted basis, with month-to-month and year-to-date comparisons with similar data for the previous year. These data, as reported in the statement of operations, are on an individual account basis and, in some instances, are grouped into major accounts.

Input units

Input units for the financial measures appear to vary considerably among the regional farm supply cooperatives. This variation is shown in the following terminology reported:

- Total Expense
- Warehouse Cost
- Total Operating Expense
- Net Expenses
- Net Operating Expenses
- Gross Margin
- Net Margin
- Total Warehouse Expense

It may very well be that there is more uniformity in the above inputs than meets the eye. Total expense, warehouse cost, total operating expense, and total warehouse expense may be essentially the same inputs, but a more detailed definition of each of these items will be necessary before this comparability or lack of comparability can be determined.

Comparable definitions will be required as well for net expenses, net operating expenses, and net margin.

Time period

The time periods of the financial data vary among the cooperatives because of the differences in fiscal reporting periods. For example, the fiscal year for three of the cooperatives is July 1 through June 30, while another three cooperatives have fiscal years beginning with either June, September, or October, and the remaining two cooperatives operate on the calendar year.

Although it is probably unlikely that the study cooperatives are willing to adjust their reporting to a common period because of the expense and other difficulties, it does not necessarily mean that this lack of uniformity would rule out the use of performance measures and comparison on an industry wide basis. Since industrywide measures are generally used for trend and macro evaluations, these measures on a year-to-year basis should be of value even though the time periods are not completely comparable.

The study cooperatives, in nearly all cases, were able to provide data on financial measures for the three most recent years, as requested in the interview guide.

Since, in most instances, detailed cost data are computerized, it would appear that a uniform input, or inputs, could be worked out that would be acceptable to the farm supply cooperatives and would provide the basis for one or more workable financial measures.

Reporting level

All of the cooperatives reported that the above discussed financial data and measurements were compiled at the individual distribution center level. Summaries were then made for the entire operation when cooperatives had more than one distribution center. In addition, data are mostly on a monthly and annual basis. The monthly reporting is essential for control purposes during the year and to check on progress.

In some instances, the reporting level included financial data and measures on a functional, departmental, or product basis.

Physical Measures for Warehousing

Five cooperatives were found to use physical measures to measure the output or performance within the physical distribution system. Each cooperative's measures are cited below on a case-by-case basis.

Case I:

Output units - Pounds shipped, pounds received
Input units - Hours worked, hours paid
Time period - By week and year
Reporting level - Distribution center warehouse, warehouse function (material handling, inventory)

Case II:

Output units - Number of truckloads
Input units - None
Time period - By week and year
Reporting level - Distribution center, by merchandise group (tires, general merchandise, chemicals, etc.)

Case III:

Output units - Pounds received (include tag or returned merchandise); pounds shipped (broken down by type of carrier); orders, picks, and line items shipped; tag items dispatched; shipments received; stocking; inventory counted by bay and address; and variances.)
Input unit - Hours worked, hours paid
Time period - By month and year
Reporting level - Distribution center warehouse

Case IV:

Output unit - Pounds shipped, pounds received
Input unit - Hours worked, hours paid
Time period - By month and year
Reporting level - Distribution center warehouse

Case V:

Output unit - Pounds shipped, pounds received
Input unit - Hours worked, hours paid
Time period - By day, month, year
Reporting level - Distribution center warehouse

Records also were kept on straight and overtime paid, and the cost of returned merchandise (damage and labor costs).

Critique of Physical Warehouse Measure

Output units

The most common measure of units of output was pounds shipped and pounds received. Weight data are generally available on all commodities received from invoices supplied either by the vendor or transporter. All cooperatives input this data into their computers as a shipment received along with cube, number of items, line number, commodity grouping, and oftentimes warehouse location. Data are often kept for years on magnetic tape.

A higher degree of data collection occurs when items are shipped. As orders are processed, computers often handle the task of deciding which items will be loaded on what trucks for peddle or transfer operations. Data on loading sheets often include number of items, weight per item, cube per item, line numbers, commodity grouping, and peddle run number. This data are also filed and may be accessed by computer.

Access to and compilation of any particular series of data (for example, weight) may be performed easily if software programs permit. Most data access and compilation programs are standard with the regional's order processing computer system. Self-contained programs also often make up a loading sheet, for a particular peddle run based on weight. In

addition, some cooperatives have volume (cube) compilations on the loading sheet, as volume was often found to be a constraining factor in forming a full truckload. Trucks were more often found to "cube out" rather than "weight out."

As a measure of productivity, performance or just plain work, weight alone is not entirely adequate. Even the physicist's basic definition of work, 1 pound moved 1 foot, had to be qualified with the advent of the wheel and other "labor-saving" mechanisms. Today, with the use of motorized and nonmotorized material handling equipment, most often only one man is needed, whether the item weighs 40 pounds or 4000 pounds. Packaging, stacking, and access items are carefully designed to take advantage of mechanization.

If one were given a choice of tasks, both of which involved restacking 100 individual units, what characteristic would be asked about if limited to only one: weight of each item or the cube of each item? Given the weight of each item, would one take number of items or cube per item? Given the cube per item, would one want the weight per item or the number of items?

Given the degree of mechanization and the common density (weight/volume) of most warehouse items, one would probably want to know the number of items. In the first question, it would probably make little difference but weight could be more important if the items could not be handled effeciently with mechanization.

The most common measure reported by cooperatives however, is weight in or weight out. In this case, a man with four pallets of drum oil to unload may be perceived as doing far more work per hour than a man with a hundred many different items (of the same weight) to unload.

One cooperative reported only number of truckload shipments received and shipped. The measure suffers from the same problems as those listed above in addition to the absence of information as to what defines a truckload (e.g., weight, cube, or item numbers).

Input units

Four of the five cases recorded included some measure of input. That data is absolutely necessary as a base for any measure. Input units most commonly measured are hours worked and hours paid.

"Hours worked" is a good input measure as long as it includes only that time crews are actually on the floor to perform some task, that is, excluding breaks, lunches, and the like. Managers may also want to exclude time spent unproductively waiting for transport vehicles or orders. One would then have a better guage of worked performed when the potential actually exists for work performance.

"Hours worked" was divided into shipping and receiving output categories. Receiving, (unloading and stocking) and shipping (picking and loading) are functions which are not always clearly defined by crew or man, especially in smaller warehouses. Workers may also be involved with bay or address inventorying, replenishing from other warehouse locations, correcting variances, or working with tag items.

"Hours paid" is not a physical performance measure but a financial one. Financial measures may and should be combined with physical measures. To accomplish this, however, one must have data on crew pay composition so hours paid may be weighted by pay scale.

Hours worked and paid are available in payroll departments records and are often computerized. Special programs may be necessary to integrate computerized payroll records with shipping and receiving records.

Time period

Input and output measures are often collected daily and are reported to be compiled by week, month, and year. Weekly measures are particularly important if one is to measure the effects of seasonality evident in farm supply operations. Bad weather may or may not occur at the beginning of a month. Generally, if data are available by day, compilation over a longer period is not difficult with a computer.

Reporting level

Cooperatives reported collecting information most often on overall functions within the distribution center warehouse. One cooperative reported categorizing measurements by function (for example, inventory, material handling) and another categorized by product group, (for example, tires, general merchandise, chemicals, and the like). Given the complexity of categorizing work and item, cooperatives generally found greater accuracy with the gross warehouse function figure. But, if more complex data can be collected and compiled accurately, the measures obtained will be of greater assistance to management.

Financial Measures for Transportation

Summary

Productivity measures of transportation developed by the regional farm supply cooperatives are primarily based upon financial data or a combination of financial and physical data.

Typically, the transportation costs are related to sales and to total miles driven, although in some instances the sales

may be broken down by major product areas.1/ The two measures resulting from these data are:

* total transportation expenses (or costs) as a percentage of total sales, and
* vehicle costs per mile.

Output units are thus sales and vehicle miles (total miles driven), while inputs are individual and major expense items, generally on an actual and budgeted bases, that are kept current throughout the year for control purposes.

Time periods covered by the financial data are the same as those reported for the warehouse data, which in most cases is available for the three most recent years on a monthly and annual basis.

The reporting level is at the distribution center, with truck and shop expense shown separately by a number of the farm supply cooperatives.

Critique

The difficulties encountered with the warehousing financial measures in their relationship to sales definitions (with or without transfers, association use, or merchandise return) are also applicable to the transportation productivity measures.

Financial measures of transportation productivity have as their main purpose to provide the transportation management a guage for evaluating the amount of transportation provided for the amount of money spent. Although the present method used by regional farm supply cooperatives of relating total vehicle miles to sales is better than none at all, total vehicle miles say nothing about the distance traveled loaded or empty. A very favorable ratio could be obtained by a transportation department by substantially increasing its total miles, but these increased miles may have been largely the result of more unproductive miles through circuitious routes, empty return hauls, or offline miles.

An improvement over total vehicle miles would be to use ton miles. Data on weight, along with distance for both inbound and outbound transportation, is generally available in the present computer programs of the farm supply cooperatives.

1/ One cooperative breaks down the total cost per vehicle mile into driver cost per mile and truck cost per mile.

Physical Measures for Transportation

Summary

Only one cooperative reported collecting physical measures of transportation activities. One such measure used is the number of miles driven per unit (ton or gallon) hauled. The tons are applicable to the distribution centers and the gallons to the bulk petroleum deliveries. Measurements of miles per ton (and miles per gallon) are shown by facility location.

The second productivity measurement used by this cooperative emphasized increased backhauls to reduce costs per ton hauled. Data are computed on backhaul tonnage and dollar value of backhauls on the basis of location. An average value of backhaul tonnage for the year is then computed and comparisons are made by location over time.

Critique

Discussion with the transportation and distribution managers revealed that a considerable amount of raw data is generated and compiled daily from the cooperatives' transport operations, but much of this data are not used for analysis purposes or for measurements. Data such as the above on miles driven and tons hauled could probably be assembled with a minimum amount of computer programing, since the one output unit (miles driven) is already part of the productivity cost measures for all of the cooperatives. This overall measure however, would not be the equivalent of the railroads' "ton-mile", which represents an accumulation of individual tons moving a mile. The latter equivalent could be developed only through use of a specifically designed software program for that peddle operation.

Appendix Table 1 - Computer use in distribution functions of regional cooperative farm supply warehouse operations

	I	II	III	IV	V	VI	VII	VIII
Forecasting Remarks	X Uses IBM 5120 mini-computer to capture and compare sales forecasts to actual sales, also to produce turn-around document.	X Sales Targets	X Only at headquarters.	-	-	-	-	X Use for forecasting activity for next three months so that can determine to store and where.
Product Iden. Remarks	X Six digit code used in entire thruput system.	X Code number and description of product.	-	-	-	-	X	X
Qual. Control	-	X Verification of shipments.	-	-	-	-	-	-
Stock location Remarks	X Stock location is captured at time of storage decision (when receivers are processed).	X Section Aisle Bin Location System.	X	-	-	X	X	X
Pick List Preparation Remarks	X Pick stickers generated within a few hours after orders are taken DC has control of timing.	X Computerized pick label.	X	X	-	X	X	X
Purchasing Remarks	X Production of ordering systems sheets and vendor purchase.	X Computer purchase order systems.	X This done by computer center at headquarters rather than by individual DC's.	X	X	-	X Farm and home; Energy (Limited)	X
Inventory Control Remarks	X Realtime update of current inventory status.	X Commodity Systems Control.	X	X	X	-	X	X

Appendix Table 1 - Computer use in distribution functions of regional cooperative farm supply warehouse operations

	I	II	III	IV	V	VI	VII	VIII
Receiving Remarks	X Real time update of inventory records.	X Computer purchase order system and set-up immediately.	X	X	X	X	-	X
Shipping Remarks	X Production of store invoice.	X Total shipping program - pick dock, invoice, bill of lading, etc.	X	X	X	X	X	X
Order Entry Remarks	X On line entry of orders and update of inventory records. Order processing clerks call stores weekly and enter orders (6 digit codes) via a video display unit.	X CRT Wats call System. (Other orders keyed and held in computer for release on specified schedules. Computer control of back orders and future order files.	X Centralized ordertaking takes place at headquarters calls made by DC's at scheduled times and picking tickets are printed out on computers. A few co-ops place order directly with DC's This option available.	X On line terminals located at each DC where orders from stores are taken on weekly basis.	X Orders are called in by accounts and entered by CRT to computer. Later called for by DC's.	X Customers call orders which is entered and confirmed by clerk using terminal.	X Use WATS, Norand, T.F. and EOE. Each location is polled once each week by one of three EOE devices.	X CRT WATS System. Call
Label Printing Remarks	X Picks stickers used as labels.	X Picks labels.	X	-	-	-	-	-
Warehouse Layout Remarks	-	X Section, Bin and Aisle. Obtain runs of locations needed.	X	-	-	-	-	X Using cube of commodities.
Engineering Analysis Remarks	-	-	X Industrial engineer program.	-	-	-	-	X Limited amount.
Routing and Scheduling Remarks	-	X Unavailable routing system.	X Printed by headquarters for DC's.	-	-	-	X Day Freight truck.	-

Appendix Table 1 - Computer use in distribution functions of regional cooperative farm supply warehouse operations

	I	II	III	IV	V	VI	VII	VIII
Load Setup (for routing) & scheduling Remarks	X Using weights and cube off computer.	X Unavailable routing computerized freight system on invoice.	X This is for trip carriers.	-	-	-	-	X
Rating Remarks	-	X	X This is for transportation carriers	-	-	-	-	-
Bill of Ladings Remarks	X Store invoice is used as bill of lading.	X Computerized.	- Done manually, but need system so can computerized.	X	-	X	-	-
Communications Remarks	X Beginning of day inventory status, pricing, vendor information.	X WATS phone operational statements	X Limited between headquarters and DC's.	-	X	-	-	- From headquarters to DC's, DC's to headquarters and from DC's to DC's
Labor Scheduling	-	X Work standard program.	-	-	-	-	-	-
Billing Remarks	X Invoice is produced from each order at DC.	X Computer invoice	X Invoices computerized at headquarters and sent directly to retail cooperative.	X Invoicing	X	X	X Invoicing	X
Order Verification Remarkn	-	X Computer acknowledgements all manuel.	-	X	X	X	-	X

Productivity Measurements of Regional Farm Supply Cooperatives