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Information System Adoption and Use in Local Cooperatives

Robert P. King and Iain G. Shuker

Advances in information technology can help local cooperatives remain competitive in a changing agricultural sector. This study examines the adoption and use of information systems by local farm supply and grain cooperatives and the relationships between information system characteristics and cooperative performance. Cooperative characteristics were found to have a significant effect on information selection, overall cost structure, and the allocation of information system expenses. Information system selection was also related to operating performance. In all size categories, farm supply cooperatives that owned computers had better operating performance than those that did not. In contrast, operating performance was not related to computer ownership in grain cooperatives.

Recent advances in information technology have come at a time when local farm supply and grain cooperatives are facing strategic challenges due to structural changes in the agricultural sector. Advances in information technology may create new opportunities for local cooperatives to perform more effectively in this new environment.

Information is an essential resource for management activities. An information system (IS) is an interrelated collection of people, technology, processes, procedures, and data, designed to facilitate the acquisition and use of information in activities ranging from day-to-day operations to strategic planning. An IS need not be computer-based. Small organizations often manage information effectively without computers, and large organizations perform some IS-related tasks manually. Computer technology is, however, an important component of many IS.

Two related developments over the past decade have had significant impacts on the technical possibilities for IS and on the economics of implementing and managing IS in both large and small organizations. First, computer hardware and software technology have evolved rapidly, while costs have fallen dramatically. Second, an extensive set of markets for data, management software, and management services has emerged, giving firms a number of new options for configuring and maintaining their IS.

Knowledge of existing patterns of IS use and an understanding of the economic relationships between IS and other inputs are important for assessing how advances in information technology will affect local cooperative perfor-

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mance. Information of this kind can be of value to cooperative managers, who face difficult choices regarding investments in IS yet often lack the resources and expertise needed to effectively evaluate new IS alternatives. This information can also be of value to organizations that develop and market information products and services used by local cooperatives. Little is known, however, about IS investment and use in local cooperatives or about the degree to which IS substitute for or complement other inputs.

This paper summarizes findings from a study of information systems in local farm supply and grain cooperatives in Minnesota. This study had two major objectives:

1. To describe current information systems in local farm supply and grain cooperatives.
2. To characterize relationships between information system investments and local cooperative performance.

In the sections that follow, we first briefly discuss the conceptual foundations for this study. We then identify data requirements for the study and describe data collection procedures. Next, we summarize findings regarding IS characteristics and relationships between IS investments and performance. In the concluding section, we discuss the implications of our findings for local cooperative managers and for regional cooperatives that supply IS-related products and services.

Conceptual Foundations: Information Production and Use

The managers of local cooperatives face two related sets of decisions regarding IS. First, they must make decisions about the level of resources allocated to IS. Second, they must decide how those resources should be used.

Decisions regarding the allocation of resources to IS activities should be based on both the value of IS services and the cost of producing or acquiring them. IS services have value because they contribute to the pursuit of organizational goals. In local cooperatives, IS services may contribute to overall organizational performance by helping reduce costs or by enhancing the value of the products and services offered to members. In planning and contracting for future transportation requirements, for example, local grain cooperatives can realize significant IS-based cost reductions for grain transportation and handling by using accurate information on current grain position, projections of future deliveries, and on-line information on freight rates. The crop and livestock production consulting services offered by local farm supply cooperatives are an example of IS-based enhancement of products and services. These help farmer members use fertilizer, pesticides, and feed more efficiently, thereby adding to the value of these inputs.

Advances in information technology create new opportunities for local cooperatives to derive benefits from their IS. They also increase the range of alternatives for producing or acquiring IS services. This is best exemplified by the range of choices local cooperatives have for accounting. Many use manual accounting systems. Others use service bureaus that provide accounting services to clients on a fee basis. Finally, an increasing number of local cooperatives use

in-house computerized accounting systems. For a particular cooperative, the choice of an accounting system depends on organizational characteristics such as size, product mix, and transaction volume. The wide range of alternatives makes finding a system that meets organizational needs more likely. It also makes the selection process more complex.

Although there is a close relationship between decisions about the level of resources allocated to IS activities and about the way IS resources are used, looking at them separately can provide useful insights on existing patterns of information production and use. Therefore, this study focused both on the importance of IS expenditures in the overall cost structure of local cooperatives and on decisions about how IS resources are spent.

Data Requirements and Data Collection

Data on both organizational and IS characteristics were required for this study. Measures of IS attributes include qualitative data on: (1) characteristics and acquisition dates for computer and telecommunications equipment, (2) characteristics and acquisition dates for major application software packages, and (3) characteristics of external accounting packages. They also include the following financial measures of IS resource allocation patterns: (1) annual cost of IS labor services (including wages and salaries for secretarial, clerical, and accounting personnel), (2) annual cost of IS capital services (defined as the annual depreciation and interest on computer hardware, software, and telecommunications equipment), and (3) annual cost of purchased IS services (including accounting, auditing, telecommunications, and market news services).

Measures of organizational characteristics include information on factors expected to be related to IS resource allocation patterns. They include indicators of the scope and complexity of operation, such as: (1) number of members, (2) number of employees, (3) number of operating locations, and (4) product mix. They also include indicators of factors expected to influence computer adoption, such as: (1) regional cooperative affiliation, (2) age of manager, and (3) manager's years of experience. Finally, data on organizational characteristics also include the following measures of productivity and resource use in primary production activities: (1) annual gross margin, (2) annual cost of management salaries and benefits and non-IS labor services, and (3) annual cost of non-IS capital services (defined as depreciation and interest on non-IS capital items plus annual lease expenses and miscellaneous capital expenditures).

Data for this study were collected from two sources: (1) a database of financial information on local cooperatives maintained by the St. Paul Bank for Cooperatives and (2) a survey of local cooperative managers. The St. Paul Bank for Cooperatives' database contains annual financial statements in a standardized format for all the Bank's borrowers. This was the primary source for financial data used in this analysis. The manager survey was the primary source of data on non-IS organizational characteristics and data on IS characteristics and resource allocation patterns.

The population for this study was defined as the 212 farm supply and grain local cooperatives that borrow from the St. Paul Bank for Cooperatives. Of these, the Bank for Cooperatives classifies 112 as grain cooperatives and 100 as farm supply cooperatives. In 1986–87, the year preceding the study period for

Table 1.—Number of Cooperatives in Sample by Size and Product Mix

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5—1.0	1.0–4.1	
	Number of Cooperatives			
Farm Supply	9 (.69) ^a	10 (.59)	12 (.63)	31 (.63)
Grain	10 (.59)	9 (.43)	11 (.41)	30 (.46)
Both Primary Product Categories	19 (.63)	19 (.50)	23 (.50)	61 (.54)

^aNumbers in parentheses are the response rate in each size and product mix category.

this analysis, 65 of the grain and 76 of the farm supply cooperatives had sales below \$5 million. The remaining 47 grain and 24 farm supply cooperatives had sales ranging from \$5 million to more than \$30 million.

A stratified random sample of 118 cooperatives was drawn from this population. The sample included one-third of the cooperatives with sales below \$5 million: 22 grain and 25 farm supply cooperatives. All cooperatives with sales above \$5 million were included in the sample. This sampling strategy ensured adequate representation of larger cooperatives that were expected to have IS characteristics quite different from those of smaller cooperatives.

A mail questionnaire was the primary data collection instrument for the manager survey. Additional data were collected in follow-up phone interviews with each manager. Complete survey instruments were received from 63 of the 118 sample cooperatives, for a response rate of 55 percent. Data on financial performance for each sample cooperative were provided by the St. Paul Bank for Cooperatives. The fiscal year ending between September 1, 1987, and August 31, 1988, was the period of analysis for this study. Two cooperatives that completed the mail questionnaire no longer borrowed from the St. Paul Bank for Cooperatives during that year. They were excluded from the analysis. Therefore, the final sample includes 61 cooperatives.

The distribution of cooperatives by size and enterprise mix is shown in table 1. Average annual gross margin for the three fiscal years ending with the base year was selected as a measure of size because it is less sensitive than sales to changes in product mix. Gross margin is defined as revenues from sales and services minus the cost of goods sold.

A Descriptive Analysis of IS Resource Allocation Patterns

The first objective of this study was to describe current information systems in local farm supply and grain cooperatives. The descriptive analysis focuses on

Table 2.—Percentage of Cooperatives with Computers by Size and Product Mix

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5–1.0	1.0–4.1	
	Percentage of Cooperatives			
Farm Supply	77.8	80.0	100.0	87.1
Grain	0.0	66.7	72.7	46.7
Both Primary Product Categories	36.8	73.6	87.0	67.2

three issues: the adoption and use of computer technology; the importance of IS costs in the overall cost structure of the local cooperative; and the distribution of IS costs among the categories of IS labor, IS capital, and IS purchased services.

The Adoption and Use of Computer Technology

Dramatic reductions in the cost of computer hardware and software have made it possible for even small organizations to incorporate computers into their IS. Computer adoption has been widespread but far from universal among local cooperatives in Minnesota. Two-thirds of the cooperatives surveyed in this study owned at least one computer in 1988. Of those owning computers, 84 percent used at least one computer to support in-house accounting activities; 59 percent used at least one computer to support the activities of a production consultant. Other uses for computers included: monitoring grain markets, inventory management, word processing, and business analysis and planning.

Variations across size and product mix categories in the proportion of cooperatives owning computers are shown in table 2. Two patterns are evident. First, computer ownership increases with size. This was expected, since larger organizations have larger sales and purchase transaction volumes, require more internal exchange of data, and are more likely to be able to hire employees with special computer expertise. The second pattern is more difficult to explain. Holding size constant, computer ownership is consistently lower for grain cooperatives than for farm supply cooperatives. This may be due to lower transaction volumes. It may also reflect a difference in “culture” or a lack of appropriate software.

Table 3 shows variation across size and product mix categories in the proportion of cooperatives using computerized, service bureau, and manual accounting systems. It provides additional insights on both these patterns. The use of computerized accounting systems increases with size and is consistently higher for farm supply cooperatives. Farm supply cooperatives tend to have higher and more regular transaction volumes because they are retail organizations.

Table 3.—Percentage of Cooperatives Using Computerized Accounting Systems, Service Bureaus, or Manual Accounting Systems by Size and Product Mix

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5–1.0	1.0–4.1	
Percentage of Cooperatives				
Farm Supply:				
Computerized	44.4	50.0	91.7	64.5
Service Bureau	11.1	20.0	8.3	12.9
Manual	44.4	30.0	0.0	22.6
Grain:				
Computerized	0.0	44.4	63.6	36.7
Service Bureau	30.0	11.1	9.1	16.7
Manual	70.0	44.4	27.3	46.7
Both Primary Product Categories:				
Computerized	21.1	47.4	78.3	50.8
Service Bureau	21.1	15.8	8.7	14.8
Manual	57.9	36.8	13.0	34.4

What is surprising about these results is that so many cooperatives with computers continue to do their accounting manually. Although accounting is usually cited as one of the first targets for computerization, only about half the cooperatives in our sample (and only three-fourths of those with computers) have their own computerized accounting systems. Many cooperatives, especially those with most of their sales coming from farm supply, purchase computers for activities other than accounting. An analysis of software packages owned by cooperatives in each size and product mix category suggests that many farm supply cooperatives use their computers primarily as support tools for production consultants. Grain cooperatives are much less active in providing consulting services to farmers. This may help explain their low computer adoption rate.

The Importance of IS Costs

Under the broad definition of an IS used in this study, IS costs include annualized costs for capital items such as computer and telecommunications equipment and computer software; wages and salary for clerical, secretarial, and computer support staff; and expenditures for externally provided accounting, telecommunications, and market news services. The importance of IS costs can be judged by comparing them with costs for other major inputs and with total operating costs. Average ratios of labor, capital, and IS costs to total operating costs are shown in table 4 for sample cooperatives in each size and primary product category. For the entire sample, the average percentage of operating expenses attributable to IS is 9.8 percent. This is well below the 61.1 percent

Table 4.—Average Ratio of Factor Shares for Labor, Capital, and IS by Size and Product Mix

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5–1.0	1.0–4.1	
Average Factor Share				
Farm Supply:				
Labor	34.3	36.0	34.0	34.8
Capital	53.3	53.5	57.1	54.8
IS	12.4	10.5	8.9	10.4
Grain:				
Labor	21.4	22.7	25.5	23.3
Capital	68.2	68.2	66.6	67.6
IS	10.4	9.1	7.9	9.1
Both Primary Product Categories:				
Labor	27.5	29.7	29.9	29.1
Capital	61.2	60.4	61.7	61.1
IS	11.3	9.9	8.4	9.8

factor share for capital and the 29.1 percent factor share for labor, but it does represent a substantial proportion of costs.

The results in table 4 point to differences in resource allocation patterns related to cooperative size and primary product. First, they show that farm supply cooperatives are more labor intensive than grain cooperatives. Average labor factor shares across all size categories are 35 and 23 percent, respectively. The factor share of labor rises and then falls with size in farm supply cooperatives and rises with size in grain cooperatives.

The factor share for capital is consistently higher in grain cooperatives than in farm supply cooperatives. As size increases, it remains essentially constant at approximately 67 percent in grain cooperatives. In farm supply cooperatives, the contribution of capital costs to overall costs is also relatively stable. The overall average factor share for capital in farm supply cooperatives is 55 percent.

For both grain and farm supply cooperatives, the IS factor share declines as size increases. On the one hand, this may indicate a declining importance of IS expenditures in larger organizations. An alternative, and perhaps more plausible, explanation for this pattern is that there are scale economies in the production of IS services that allow service levels to increase at a rate faster than IS expenditure levels.

Resource Allocation in the Production of IS Services

The distribution of IS costs among the categories of IS labor, capital, and purchased services provides further insights on how cooperative managers allocate resources in the production of IS services. Average ratios of IS labor,

Table 5.—Average Annual Information System Factor Shares for IS Labor, IS Capital, and IS Services by Size and Primary Product

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5–1.0	1.0–4.1	
IS Factor Cost				
Farm Supply:				
IS Labor	60.0	51.5	43.1	50.7
IS Capital	21.9	21.4	37.2	27.7
IS Services	18.1	27.1	19.7	21.6
Grain:				
IS Labor	55.1	54.0	48.8	52.5
IS Capital	11.8	21.1	26.5	20.0
IS Services	33.1	24.9	24.7	27.5
Both Primary Product Categories:				
IS Labor	57.4	52.7	45.8	51.6
IS Capital	16.6	21.3	32.1	23.9
IS Services	26.0	26.0	22.1	24.5

capital, and purchased services costs to total IS costs are presented in table 5 for sample cooperatives in each size and primary product category. As was the case for resource allocation at the firm level, IS resource allocation patterns are related to both cooperative size and primary product.

The labor share of IS expenditures declines as size increases, with the rate of decline being faster in farm supply cooperatives than in grain cooperatives. This may be due to higher levels of computer adoption in farm supply cooperatives. Even in large cooperatives, however, the percentage of total IS costs allocated to IS labor is relatively high.

The factor share for IS capital increases significantly with size for both farm supply and grain cooperatives. This is a consequence of increased computer use in larger cooperatives. Although the rate of increase in the IS capital factor share is similar for the two types of cooperatives, the base level is significantly higher for farm supply cooperatives. This reflects higher levels of computer adoption by farm supply cooperatives.

Finally, the factor share for IS purchased services declines slightly with cooperative size and is higher for grain cooperatives than for farm supply cooperatives. The difference associated with primary product is as expected, since grain cooperatives rely more heavily on externally provided market news services. The fact that the factor share for IS services remains high for large cooperatives is interesting because it indicates that even relatively large organizations are not able to internalize many IS costs.

Overall, these results show a substitution of capital for labor in the production of IS services as size increases. This substitution is stronger in farm supply cooperatives, which are more likely to own computers. Although the relative

Table 6.—Average Ratios of Gross Margin to Total Operating Expense for Cooperatives Grouped by Size, Primary Product, and Computer Ownership

Primary Product	Average Gross Margin <i>Million Dollars</i>			All Size Categories
	0–0.5	0.5–1.0	1.0–4.1	
Gross Margin as a Percentage of Operating Expense				
Farm Supply:				
No Computers	84.3	86.0	NA	85.1
Computers	93.2	94.2	93.3	93.6
Grain:				
No Computers	84.5	79.4	96.4	85.8
Computers	NA	85.4	94.1	90.4
Both Primary Product Categories:				
No Computers	84.5	82.0	96.4	85.6
Computers	93.2	90.4	93.6	92.6

importance of externally provided IS services declines somewhat with size, they continue to account for a sizable proportion of total IS costs in even the largest cooperatives.

Information Systems Investments and Local Cooperative Performance

The descriptive analysis of local cooperatives' IS identifies differences in IS resource allocation patterns associated with both size and primary product. In this section, we turn to the question of whether there are systematic relationships between IS characteristics and local cooperative performance. We first introduce the performance measure used in our analysis. Then we examine relationships between cooperative performance and decisions about computer adoption and method of accounting.

Output to input ratios are often used as measures of resource-use efficiency and profitability. Increases in the ratio of output to input point to increases in efficiency because more output is produced per unit of input. Similarly, such increases are also associated with increases in profitability, since profit is the difference between the value of output and the cost of the inputs used to produce it.

For retail sales and commodity marketing organizations, like the local cooperatives in this study, gross margin is an appropriate output measure. It represents the value of the supply and marketing services provided by a local cooperative. Total operating expense—the sum of labor, capital, and IS costs incurred in generating these services—is an appropriate input measure.

Average ratios of gross margin to total operating expense, expressed in percentage terms, are shown in table 6 for sample cooperatives categorized by

Table 7.—Average Ratios of Gross Margin to Total Operating Expense for Cooperatives Grouped by Size, Primary Product, and Accounting Method

	Average Gross Margin <i>Million Dollars</i>			All Size Categories
Primary Product	0–0.5	0.5–1.0	1.0–4.1	
Gross Margin as a Percentage of Operating Expense				
Farm Supply:				
Manual	90.7	87.3	NA	89.2
Service Bureau	84.9	95.3	84.5	90.2
Computerized	93.3	94.7	93.7	94.1
Grain:				
Manual	83.7	84.4	95.9	86.5
Service Bureau	86.4	87.1	100.2	89.3
Computerized	NA	81.4	93.4	89.1
Both Primary Product Categories:				
Manual	86.3	85.7	95.9	87.4
Service Bureau	86.0	92.5	92.3	89.6
Computerized	93.3	88.8	98.8	92.3

primary product, size, and computer ownership. For farm supply cooperatives, the ratio of gross margin to operating expense is relatively stable across size categories. In the two size categories where comparisons can be made between cooperatives that own computers and those that do not, there is a substantial increase in the average ratio of gross margin to operating expense associated with computer ownership. The fact that farm supply cooperatives with computers are, on average, more efficient and more profitable serves as an economic explanation for the high rate of computer adoption among this group of sample cooperatives.

For grain cooperatives, the ratio of gross margin to operating expense trends upward with size. Larger operations are more efficient and more profitable. There is no consistent relationship, however, between computer ownership and the ratio of gross margin to operating expense. The fact that grain cooperatives with computers have a higher average ratio when all size categories are considered together can be attributed to the fact that none of the smaller and, on average, less efficient grain cooperatives own a computer. The absence of a performance advantage associated with computer ownership helps explain grain cooperatives' low rate of computer adoption.

Further insights on these results can be gained by examining relationships between performance and the choice of accounting systems, since accounting is often the first IS activity to be computerized. Average ratios of gross margin to total operating expense are shown in table 7 for sample cooperatives grouped by size, primary product, and accounting method. For farm supply cooperatives,

there is, once again, no clear relationship between size and this performance measure. In general, though, improvements in efficiency are associated with the adoption of computerized accounting systems. It is also interesting to note that, in the small size category, cooperatives with manual systems perform better than those with service bureau systems, but the opposite is true for cooperatives in the middle size category. Small cooperatives' success in managing their financial records with manual systems may be attributable to their relatively low transaction volumes and simple reporting requirements. An alternative explanation may be that managers play a more significant role in accounting activities in small cooperatives. In doing so they can monitor the financial status of the business without the reports generated by a service bureau or computerized system. Larger cooperatives have higher transaction volumes, more complex reporting requirements, and a greater degree of job specialization. This makes it more difficult to manage financial records with a manual system.

For grain cooperatives, it is noteworthy that in each size category those with service bureau systems have the highest average ratio of gross margin to operating expense. In the two larger size categories, cooperatives with computerized accounting systems have the lowest ratios. The fact that grain cooperatives gain little by switching to in-house computerized systems may be attributable to lower transaction volumes, less complex inventory management problems, and smaller management staffs. It may also be due to a lack of accounting software that meets the special needs of grain cooperatives.

Implications for Local Cooperatives and Their Suppliers

The results of this study have implications for local farm supply and grain cooperatives and for the organizations that supply information products and services to these cooperatives. For farm supply cooperatives, there is strong evidence of a relationship between IS characteristics and overall performance. In all size categories, farm supply cooperatives that owned computers outperformed those that did not. This finding must be interpreted with caution, however, since it is not clear whether computerization leads to better performance or better performance facilitates computer adoption. Nevertheless, it suggests that managers of farm supply cooperatives that have not yet begun to introduce computers into their IS may want to consider doing so.

For grain cooperatives, on the other hand, there is little evidence that computerization is associated with better performance. Computer adoption is much less widespread among grain cooperatives, and this appears to be a rational response to the lack of economic incentives for computerization. Our results indicate that grain cooperatives allocate a larger proportion of their IS expenditures to external services. This is understandable, given their greater reliance on market information accessed through on-line data services and long distance phone calls to other market participants. For the managers of grain cooperatives, controlling the costs of external information and finding ways to use it more effectively will be important IS-related challenges for the future.

For both grain and farm supply cooperatives, the adoption of computers and in-house computerized accounting systems shifts the mix of IS expenditures toward a greater reliance on capital. At present, there is little evidence that this substitution of capital for labor in the production of IS services has a significant

effect on efficiency in the production of IS services or on overall IS costs. In the future, however, if computer hardware and software costs continue to fall and labor costs continue to increase, advantages associated with computer adoption could be more significant. Therefore, managers of both farm supply and grain cooperatives should give particular attention to opportunities for reducing labor requirements through computerization.

Finally, for the organizations that supply information products and services to local cooperatives, and most notably for regional cooperatives, the results of this study point to at least one area where there may be significant opportunities. Regardless of size, primary product, or computer adoption, local cooperatives spend a significant proportion of their IS expenditures on external services. These include access to market information, local and long distance telephone service, and accounting services. In the future these services may expand to include on-line ordering, electronic mail, and access to market research databases. Regional cooperatives or competing organizations that improve the quality or cost effectiveness of these services can strengthen vertical linkages with local cooperatives, thereby increasing the coordination of activities and improving their competitive position. On the other hand, organizations that ignore these IS-based linkages may lose their customer base. In the years to come, then, regional cooperatives and other farm supply and commodity marketing firms should place particular emphasis on the development of services that can strengthen their ties to local cooperatives.