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EVALUATION OF ELEC COM:  
AN EXPERIMENTAL AUTOMATED ACCOUNTING SYSTEM\*

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Modern management practices in today's expanding farm business require an increased amount of management information. The size of the individual farm business in the South is growing rapidly. According to the 1964 Census of Agriculture for 10 Southern States, there were 20 per cent fewer farms in 1964 than in 1959, but commercial farms with more than 5,000 dollars gross sales increased in number. The number of farms with more than 20,000 dollars gross sales almost doubled. Data resulting from larger businesses speedily summarized into a form suitable for decision making will greatly enhance management efficiency. Electronic record keeping at a central location is one answer to improving management skills needed for growth.

Advances have been made in automating centralized accounting systems. Central processing of farm accounts has progressed from hand computation, to tabular machine computation, to today's electronic processing.

Growing interest among farm leaders, farmers, and bankers in Alabama for knowledge about the use of computers in management resulted in a project named Elec-com initiated to provide a source of information about cost, use, and design of a computerized system. The project was accomplished in three phases:

- (1) A survey was made of all known central record keeping programs, 26, to obtain cost and returns data that could be compared with the experimental system Elec-com.
- (2) The experimental system, Elec-com, was tested in use among 30 farmers in the Sand Mountain area of Alabama. A field agent was hired to assist the voluntary group of farmers.

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\*Research in which this report is based was carried out under Ala. 1-033.  
\*\*Resigned September, 1968

- (3) The Elec-Com system, including computer programs, was designed specifically for using automated input via an optical scanner or an optical reader.

Costs and Returns in  
Central Record Keeping Programs

The survey of all known central record keeping programs conducted in Fall, 1966 gave results useful in an economic comparison of Elec-Com to other systems. Eighteen replies were received from 26 program supervisors. Thirteen programs were under the direction of various university personnel and five were directed by private enterprise. Most prominent of the private groups were programs now under the direction of the Farm Bureau and the Farm Journal. The largest programs were university related, up to 1,367 farmers in one state; but some private groups were forecasting 2,000 cooperators in 1968. One important interested private group was banks. The American Bankers Association has estimated that 100 banks are now offering some type of computer service. (5) Several banks were participating in university and private programs included in the survey. Services offered by programs surveyed were in five categories: (1) tax records, (2) tax filing service, (3) cost and return for each enterprise on the farm, (4) general farm management analysis, and (5) research and education. Commercial services tended to be highly oriented to tax filing whereas the university-related programs tended to be management analysis-research oriented. The oldest programs were university related; three in the survey were more than 35 years old. New programs were closely related to availability of computers. Ten new programs, all less than 5 years old, began as computerized systems.

Results of the survey were used in evaluating the attainment of study objectives. As stated in the introduction, objectives were to minimize two kinds of costs: (1) processing costs and (2) cost of professional and clerical staff.

### Costs of Input Conversion

Automation figured on an hourly basis was expensive. An optical scanner rented for approximately \$425 per month. To determine an hourly charge, the monthly rental was divided by 160 hours (40 hours per week for 4 weeks) and \$2.65 was obtained as the hourly cost of the scanner. The same calculations were computed for a keypunch (\$50 per month) and an hourly charge of \$.31 was obtained. An optical scanner was thus 755% costlier per machine hour of use than a 026 keypunch. A clerk operator was paid a minimum wage of \$1.50/hour and raised the total cost per hour of scanning to \$4.15. Table 1 gives the comparative rate for keypunching and verification of transactions obtained from the survey of central record keeping program.

Transactions per hour of key punching were highly variable because of differences in amount of coding. Table 2 gives the cost of key punching and verification from the production rates in Table 1. The cost of computer cards, electricity and repair, are deleted since they are incurred by each system.

Simple economic analysis was applied to determine whether a system should change from its present non-automated input processing to optical scanning. Assuming that a system's code could express a transaction in less than 26 numbers:

$$\frac{\text{Monthly Added Value}}{2000} = \frac{\$.31 (320,000 - \text{Monthly Transaction})}{2000} = \text{value of key punch availability}$$

$$\begin{aligned} &\text{Monthly Added Costs} \\ &\$425 = \text{machine rental costs} \\ &\frac{\$.15 (\text{number of transaction})}{2000} = \text{total labor cost} \end{aligned}$$

Table 1. Hours of Keypunching and Verifying in  
Ten Electronic Record Systems, 1966

State	Trans- actions/ mo. (1)	Hr. key punching (2)	Trans./hr. key punching (1)/(2)=(3)	Hr. verify- ing (4)	Trans./hr. ver- ifying (1)/(4)=(5)
A	2,199	10.	219.9	10.	219.9
D	6,985	35.	199.6	15.	465.7
E	19,110	262.5	72.8	262.5	72.8
H	132,736	300.	442.4	300.	442.4
I	11,666	100.	116.7	100.	116.7
J	9,250	200.	46.2	120.	77.1
L	8,000	30.	266.7	30.	266.7
O	7,425	100.	74.25	76.	97.7
R	10,600	21.	504.8	20.	530.0
T	23,862	92.6	257.8	78.	305.9
Summary	231,833	1151.1	312.1	1011.5	356.8
Alabama	601	.3	2,000.	--- <u>1</u> /	--- <u>1</u> /

1/Keypunching and verifying done simultaneously by an optical scanner.

Table 2. Costs of Key punching and Verifying in Eleven Electronic Record Systems, 1966

State	Trans. month (1)	Total hr. keypunch. month (2)	Cost hr. keypun. (3)	Cost trans. keypunch (2) (3) / (1) = (4)	Hr. Ver. month (5)	Cost hr. ver. (6)	Cost trans. ver. (5) (6) / (1) = (7)	Av. trans. cost (4) + (7) = (8)
A	<u>Hr.</u> 2,199	<u>Hr.</u> 10.0	\$3.50	\$.016	<u>Hr.</u> 10.0	\$3.50	\$.016	\$.032
D	6,985	35.0	\$3.51 <sup>1/</sup>	\$.017	15.0	\$3.50	\$.007	\$.024
E	19,110	262.5	\$2.20	\$.030	262.5	\$2.20	\$.030	\$.060
H	132,736	300.0	\$3.65	\$.008	300.0	\$3.65	\$.003	\$.011
I	11,666	100.0	\$3.50 <sup>1/</sup>	\$.030	100.0	\$3.50 <sup>1/</sup>	\$.03	\$.06
J	9,250	200.0	\$1.81 <sup>2/</sup>	\$.039	120.0	\$1.81 <sup>2/</sup>	\$.023	\$.062
L	8,000	30.0	\$3.00	\$.011	30.0	\$3.00	\$.011	\$.022
O	7,425	100.0	\$1.96	\$.026	76.0	\$2.01	\$.021	\$.047
R	10,600	21.0	\$2.50	\$.005	20.0	\$3.50	\$.007	\$.012
T	23,862	92.6	\$3.50	\$.014	78.0	\$3.50	\$.011	\$.025
Alabama	601	.3 <sup>3/</sup>	\$4.15 <sup>4/</sup>	\$.002	-----	-----	-----	\$.002

<sup>1/</sup>Average commercial rate.

<sup>2/</sup>\$.31/hr. for keypunch + \$1.50/hr. labor.

<sup>3/</sup>2,000 transactions/hr. or 1,000 sheets/hr. punched and verified.

<sup>4/</sup>\$2.65/hr. + \$1.50/hr. labor = \$4.15/hr. for punching and verifying.



Monthly Reduced Value

\$0.00

Monthly Reduced Costs

$$\text{Average cost}_{kp-v} = \frac{\text{Number of transactions}}{2000} = \text{Present total cost}_{kp-v}$$

Value of keypunch availability is equal to the number of hours per month not utilized by the scanner's keypunch multiplied by \$.31 (cost of keypunch/hour). A keypunch is obtained as a part of the rented rate of the scanner. Number of hours per month is equal to 320,000 transactions (number of transactions which could be processed in 160 hours) minus number of transactions processed by the scanner in a month divided by 2000 transactions/hour.

Change-over point (COP) was defined as that volume of transactions per month at which optical scanning's total cost (TC<sub>OS</sub>) equals the total cost of keypunching and verifying (TC<sub>kp-v</sub>) for that volume of transactions presently to be processed by the account system.

$$TC_{OS} = \text{Monthly added costs} - \text{Monthly added value.}$$

$$TC_{kp-v} = \text{Monthly reduced costs}$$

At the change-over point:

$$TC_{kp-v} = TC_{OS} = COP$$

$$TC_{OS} = \text{Number of transactions}_{cop} \cdot AC_{kp-v}$$

$$\text{Number of transactions}_{cop} = \frac{TC_{OS}}{AC_{kp-v}} = COP$$

Grouping constants from the analysis resulted in the following equation for change-over-point:

$$COP = \frac{\$375.40 - \$.000905 (\text{volume transactions/month})}{\text{average cost/transaction}}$$

Table 3 indicates the change-over points for the systems responding to the previously mentioned mail questionnaire. The code structure of many of the systems may not fit in less than 26 numbers required by an Elec-Com transaction. The change-over points in Table 3 are thus biased downward in some relationship to size of code. The amount of this bias is one representation of the efficiency of the Elec-Com code. In other words, there would be no bias in the change-over-points if each system had a code as efficient as Elec-Com. Based on Table 3, 50 per cent of the reporting States could have been utilizing scanning; and one State could have changed over when a 4.3 per cent increase in volume was obtained.

#### Other Data Processing Costs

Processing costs other than costs of input conversion were divided into 3 types: (1) variable computer processing costs, (2) variable labor costs, and (3) fixed labor costs.

Computer processing costs were determined by an assembly language timing subroutine in which computer time was evaluated at two dollars per minute. Table 4 is an enumeration of the computer processing costs including scanning by individual program.

Variable labor costs were for a clerk who was responsible for the physical handling of the transactions. This included opening of the envelopes, correction of returned transactions and mailing of processed transactions. It was estimated that a full-time clerk could process 1,000 transactions per hour or 160,000 transactions per month. The other expenditure of variable labor cost was expense of an assistant county agent. The assistant county agent's principal duty, after five hours of initial instruction, was to evaluate, with the cooperator, the quarterly and yearly farm management and tax output. This was approximately one hour per quarter or four hours per annum.

Table 3. Change-Over Points in Ten  
Electronic Record Systems, 1966

System	Trans- actions/ mo.	Average cost/ transaction	Hr. scanner available for key punching	Number of transac- tions at COP	Should be utilizing scanning
	No.		Hr.	No.	
A	2,199	\$ .032	158.9	11,669	No
D	6,985	.024	156.5	15,378	No
E	19,110	.060	150.4	5,968	Yes
H	132,736	.016	93.6	15,955	Yes
I	11,666	.025	148.0	5,921	Yes
J	9,250	.062	155.4	5,920	Yes
L	8,000	.022	156.0	16,734	No
O	7,425	.047	156.3	7,844	No
R	10,600	.013	154.7	28,139	No
T	23,862	.025	148.0	14,152	Yes
Average	23,235	\$ .026	148.4	13,630	Yes

Table 4. Variable Processing Costs of the Computer and Scanner in Elec-Com's Accounting System, 1966

Operation	Dollars/ trans- action	Dollars/788 transactions <sup>1/</sup>	Minutes of computer time per 1000 transactions
	Dol.	Dol.	Min.
Scanning	.003	2.36	1.5
Checking & correcting	.002	1.58	1.0
Addition of master data	.001	.79	.5
Sort 1	.0006	.47	.3
Journal listing	.005	3.94	2.5
Sort 2	.0006	.47	.3
Merge	.0006	.47	.3
Income statement	.003	2.36	1.5
Schedule F	.002	1.58	1.0
Depreciation schedule	.023	.57 <sup>2/</sup>	11.5
Annual data processing costs		14.59	

<sup>1/</sup>Farms nationally sent in annually, on the average, 788 transactions.

<sup>2/</sup>Farms averaged 25 depreciable items.

Table 5. Total Variable Cost Per Cooperator of Elec-Com's Accounting System, 1966

Average data processing cost	14.59
Clerk	1.18 <sup>1/</sup>
Supplies	4.00
Assistant county agent	27.08 <sup>2/</sup>
Average variable costs	46.85

<sup>1/</sup>160,000 transactions/month at \$1.50/hour.

<sup>2/</sup>Four one hour visits per year at \$6.77 per visit concerned with record keeping procedures and explanation of record output. Time does not include management counseling.

Variable costs also included four dollars per cooperator for scan sheets, postage, envelopes, and reporting forms. All variable costs are enumerated in Table 5.

Fixed costs to be borne by the system are salaries of two state office personnel: (1) a state supervisor and (2) a computer programmer. The state supervisor would devote his time to the supervision of the processing procedures, supervision of county personnel, and to the determination of any changes that would improve the system. The programmer would be responsible for accomplishing any changes determined necessary by the state supervisor. The salary of the state supervisor would be approximately \$10,000 per annum and that of the programmer approximately \$8.00 per hour. If the number of cooperating population is 250, the average fixed cost becomes \$40.19. Costs of initial programming and initial contact with cooperators is excluded.

How do these costs compare to other systems? The comparison of 14 farm processing systems to Elec-Com showed that total costs of Elec-Com were less than the reported full costs of all other systems except one. One system not yet in operation estimated all costs to be less than Elec-Com, but the proposed system is to offer only tax accounting as a service, Table 6.

Table 7 is the summarization of professional and clerical time spent by 15 farm accounting systems for checking, editing and transposing. The average cost for all systems responding to the survey was \$24.79 per cooperator per annum. This figure was compiled by evaluating professional time at \$5.20 per hour (\$10 M per annum) and clerical time at \$1.50 per hour. Utilization of Elec-Com in which the cooperator performs these functions provided the system with a reduced cost.

Table 6. Annual Cost to Cooperators of 15 Farm Record Systems, 1966

System	Cost to	Cooperators	Cost covered <sup>1/</sup>
	cooperator		
	Dol.	No.	
A	100	30	Data processing costs
C	75	800	Forms & data processing
D	221	55	Processing costs
F	120	50	All costs
G	168	295	Processing costs
H	105	1367	All processing cost
I	50	300	Forms & data processing
J	75	200	Processing costs
L	100	160	2/3 of total costs
M	112	150	All costs
N	54	--- <sup>2/</sup>	All costs
O	130	90	Office processing
S	250	93	1/5 of total cost
T	60	830	Processing
Alabama	87.04 <sup>3/</sup>	250	All fixed & variable costs

<sup>1/</sup>From statements of supervisors of the systems.

<sup>2/</sup>Undetermined as system was not in operation.

<sup>3/</sup>Fixed costs of \$10,048 allocated for 250 cooperators or \$40.19 per annum.

Table 7. Professional and Clerical Time and Cost for Checking, Editing and Transposing Transactions of 15 Farm Accounting Systems, 1966

System	Coopera- tors	Checking & Editing		Transposing		Checking, Editing & Transposing				Total Time		
		Profes- sional hrs. per farm per month	Clerical hrs. per farm per month	Profes- sional hrs. per farm per month	Clerical hrs. per farm per month	Profes- sional hrs. per farm per month	Profes- sional hrs. per farm per annum	Clerical hrs. per farm per annum	Clerical hrs. per farm per annum	Clerical hrs. per farm per annum	Profes- sional costs per farm per annum 1/	Clerical costs per farm per annum 2/
	No.	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.	Dol.	Dol.	Dol.
A	30				1.00			1.00	12.00	0.00	18.00	18.00
B	30	.70	1.30	.30	1.30	1.00	12.00	2.60	31.20	63.40	46.80	109.20
C	800	.19				.19	2.28			11.86	0.00	11.86
D	55	.91	3.10			.91	10.92	3.10	37.20	56.78	55.80	112.58
E	525	.08	.86			.08	.96	.86	10.32	4.99	15.48	20.47
F	50	1.00		.25		1.25	15.00			78.00	0.00	78.00
G	295	.50				.50	6.00			31.20	0.00	31.20
H	1367		.40		1.50			1.90	22.80	0.00	34.20	34.20
I	300		.53					.53	6.36	0.00	9.54	9.54
J	200		.10		.45			.55	6.60	0.00	9.90	9.90
L	160	.20	1.00	.30	.60	.50	6.00	1.60	19.20	31.20	28.80	60.00
M	150		.25		.25			.50	6.00	0.00	9.00	9.00
O	90	.83	1.38	.75	1.25	1.58	18.96	2.63	31.56	98.59	47.34	145.93
Q	100	.03	.30	.12	.90	.15	1.80	1.20	14.40	9.36	21.60	30.96
T	830	.01	.06			.01	.12	.06	.72	0.62	1.08	1.70

<sup>1/</sup> Evaluated at \$5.20 per hour for 1920 hours at \$10,000 per annum.

<sup>2/</sup> Evaluated at \$1.50 per hour.

### Use by Farmers and Evaluation of the System

The transactions of each cooperator of 30 in the test group were obtained from January 1, 1966, and were received by the state office in April, 1966. The system continued throughout the year with bimonthly journal listings, quarterly income summaries, a yearly depreciation schedule, and a yearly schedule F. Thirty cooperators received year-end reports although all appeared to have not reported enough information for a complete report.

#### Characteristics of Cooperators

An average cooperator could be described as a 48 year old high school graduate whose gross income was \$19,000 in 1965 and who spent \$24 last year for preparation of income tax forms. Two-thirds of the cooperators would keep records if they were not required to do so for income tax preparation; and one-fourth had kept records broken down by enterprise. All cooperators at time of initiating the Elec-Com system kept some kind of records.

Elec-Com cooperators were above average in most respects, Table 8. In terms of gross farm income they were similar to the class of commercial farmers whose numbers have been increasing in recent years. Data in Table 8 were collected by personal interview with 23 Elec-Com cooperators. During the interview, four yes-no questions were asked and the results appear in Table 9. In general farmers thought the system was easy to learn and use. They were equally divided on the use of non-cash inputs that are essential for management information.

What types of enterprises were operated by the 23 cooperators? During 1966, 28 enterprises were offered by Elec-Com. All were requested by cooperators except for peanuts and horticultural crops:



Table 8. Socio-Economic Characteristics of 23  
Elec-Com Cooperators V. Alabama Farmers, 1966

Characteristic	Average cooperator	Average Alabama farmer <sup>1/</sup>
Age	48 years old	52 years old
Education	12 years	7.9 years
Value of farm products	19,000 dollars	804 dollars
Row cropland operated	80 acres	40 acres
Improved pasture	50 acres	65 acres

<sup>1/</sup>Includes commercial, part-time and part-retired.

Source: U.S. Bureau of the Census, 1964 United States Census of Agriculture. Preliminary Report, AC 64-P1, pp. 2-3.

Table 9. Responses of 23 Elec-Com Cooperators to Four  
Yes-No Questions Concerning Farm Records, 1966

Question	Yes		No		No response	
	No.	Pct.	No.	Pct.	No.	Pct.
Was the Elec-Com code difficult to use?	2	8.7	20	87.0	1	4.3
Were non-cash inputs necessary for proper accounting?	11	47.8	11	47.8	1	4.4
After practice can the coding be done without help?	21	91.3	2	8.7	0	0.0
Should the Farm Bureau offer Elec-Com as a continuing program?	5	21.7	11	47.8	7	30.5

- |                        |                         |
|------------------------|-------------------------|
| 1. Cotton              | 15. Independent pullets |
| 2. Corn                | 16. Contract layers     |
| 3. Beef cattle         | 17. Independent layers  |
| 4. Hogs                | 18. Dairy               |
| 5. Capital goods       | 19. Johnson grass       |
| 6. General farm        | 20. Peanuts             |
| 7. Field tomatoes      | 21. Oats                |
| 8. Southern peas       | 22. Wheat               |
| 9. Sweet potatoes      | 23. Grain sorghum       |
| 10. Snap beans         | 24. Soybeans            |
| 11. Pimientos          | 25. Alfalfa             |
| 12. Lima beans         | 26. Coastal burmuda     |
| 13. Pickling cucumbers | 27. Temporary grazing   |
| 14. Bell peppers       | 28. Home gardening      |

Tape recorded interviews to determine cooperator acceptance were made with six cooperators and the responses were transcribed from magnetic tape.

Some representative statements follow:

#### Unfavorable Comments by Cooperators

In response to the question: Are monthly journal listings easy to check against source documents? One cooperator felt that in the beginning it was difficult but he had devised a system to aid in checking.

"I just write my code number in the corner of the check somewhere and just turn it down and take the next one and then come back through and (mark) your sheets."

Concerning the same question another cooperator said:

"Well, I couldn't have checked that one (monthly output).

In fact, I could have made a new record quicker than I could have checked that one out."

Use of the previous comment would have made the checking task easier. One of the problems that made the task more difficult was that most of the cooperators waited two to three months to send in entries and this made the volume of output large and rechecking more difficult. The same cooperator admitted: "Well, my mistake was I let it pile up and I mailed too many at one time."

A problem encountered by several cooperators was to find an enterprise on the journal listing that was not on the farm. This error prompted the following comment from one cooperator:

"One of the biggest ones that was really standing out was where they (Elec-Com) had broilers. We don't have a chicken on the farm."

This type of error was difficult to explain to a cooperator. It was found upon rechecking this cooperator's scan sheets, as well as others, that the error was one of the cooperator incorrectly entering the account number. Poor erasure or light marking also explained a number of these types of errors. One solution to this problem was to incorporate a routine into the journal listing program to point out any transactions in enterprises not on the cooperator's farm.

One cooperator said of the farmer acceptance of Elec-Com coding:

"Well, they can do it but it wasn't simple at first. I mean it was too easy to make mistakes."

Questions 1 and 3 in Table 9 summarize the position of most cooperators. Eighty-seven per cent of the cooperators felt that the Elec-Com code was easy to use and 91.3 per cent felt that after practice the coding could be done without assistance.

#### Favorable Comments by Cooperators

In response to the question: Was Elec-Com beneficial to you in record keeping? The following reply was recorded.

"It was a great benefit to us; we just started farming and the first year our records were a mess and with this system it helped us work our problem out quite a bit."

This cooperator was enrolled the previous year in another state's central record keeping project. He felt that the Elec-Com's code was much easier to comprehend than his previous system's code structure. How had this individual felt concerning the utilization of optical scan sheets for an input media?

"I believe anybody could use them. All it takes is to be careful when you are marking them. After you learn how, why, anybody, I believe, could mark them."

When another cooperator was asked if the 1967 Elec-Com User's Manual was self-explanatory a favorable response was obtained. When another cooperator was asked if the use of scan sheets were time consuming in respect to your present record system the following reply was obtained:

"No, I don't think it takes as much time to do that as it would to write it out on the ledger."

Do farmers use records for management decision-making? One set of records showed a cooperator that the \$417.00 per year spent for labor to sweep out the broiler houses was more than enough to justify purchase of sweeper attachment for his tractor. This type of decision was made possible by keeping detailed accounts, but most farmers were still against this type of breakdown.

#### Design of the Elec-Com System

A system that minimizes costs to the cooperator is necessary to help low and middle income farmers in management decisions. This system would also minimize the amount of cost borne by the processing organization

John Doneth, extension economist at Michigan State University, has indicated some weaknesses in electronic mail-in records. Two weaknesses cited were:

- (1) Cash cost of the mail-in system to the cooperator is usually greater than his present accounting costs. Low and middle income farmers have, in general, indicated no motivation to keep records except for tax purposes. They have seen no need for management analysis.
- (2) A central system requires skilled personnel to make the program successful. (3)

The problem of this study was to overcome these weaknesses by minimizing two kinds of costs: (1) cost of converting cooperator records to an input that can be digested by electronic data processing equipment, and (2) cost of a professional and clerical staff.

One readily available answer to costs of converting records to computer input is an automated input device. The second cost factor, reducing the use of professional and clerical staff, is closely associated with type of code system, the person doing the coding, and where the coding takes place.

Six possible objectives have been listed by Vincent (3) as dictating the form of a code:

- (1) Objectives seen by the user cooperating in a group accounting program.
- (2) Objectives seen by accountants serving agriculture.
- (3) Objectives seen by farm management specialists.
- (4) Objectives seen by research workers.
- (5) Objectives seen by programmers and systems personnel.
- (6) Objectives seen by coding personnel.

Objectives of the cooperators fall into two areas: (1) recording transactions needed for income tax accounting and (2) recording transactions needed for management decision-making. The entries required for management decision-

making are more numerous than entries necessary for a tax system. Entries for management include unpaid family labor, opportunity cost of interest on investment, land charges, and many types of inter-farm transfer of resources.

#### Automated Input and Code Structure

Some of the automated input devices available today include:

- (1) Mark sense cards
- (2) Port-a-punch cards
- (3) Optical scanner
- (4) Optical reader
- (5) Magnetic input character reader (MICR)
- (6) Voice interpretation device

Devices one and two were not considered since the using and mailing of the input forms (computer card) would have created processing problems at the processing center. A card reader is less tolerant than other devices in acceptance of folded and swelled input forms and port-a-punch cards create a problem as they are non-correctable. An optical reader and voice interpretation device were commercially unavailable in March, 1966. MICR has been utilized by the commercial banking industry for many years and its success has been established. An IBM 1232 optical scanner was selected as an input conversion device that was to be used in conjunction with a tape oriented IBM 7040-1401 data processing system.

A code for use in an IBM 1232 optical scanner used in the study placed several restrictions on the code: (1) it had to be all numeric; (2) it had to be uniform for all entries; and (3) it had to conform to a scan sheet capable of containing two columns of 50 numbers each. Efficient use of this space indicated use of less than 26 numeric digits for an entire transaction entry or four transactions per sheet.

The code system originally developed for use in the Elec-Com system met all requirements set forth by Vincent except double-entry bookkeeping. This feature was added to Elec-Com at the end of the study. The code provided tax accounting and enterprise analysis for the farmer. Uniform code and comparable enterprise analysis were provided for the management specialist. Unlimited breakdown of production inputs was provided for research workers. Identical input for all firms was provided for the programmer and analyst. In the final version of Elec-Com, a three-step decision process was provided the cooperator to determine a transaction code number.

The code originally consisted of an account number that identified the following questions:

- (1) Was the transaction a variable or fixed cost?
- (2) In what enterprise should the transaction have been debited or credited?
- (3) Was the account a production, harvesting, or storage function?
- (4) Was the transaction an expense, income, or interfarm transfer?
- (5) What was the account name?
- (6) In what units was the amount reported?
- (7) Where on a tax return did the item belong?

This information was internally coded by the computer using a specific account number. Figure 1 illustrates graphically the original Elec-Com code structure.

As Figure 1 is read from left to right, branch one indicates fixed or variable cost. The second set of branches indicates enterprise number. The third set of branches indicates production, harvesting and storage input by enterprise. The fourth set of branches identifies an input as an expense,

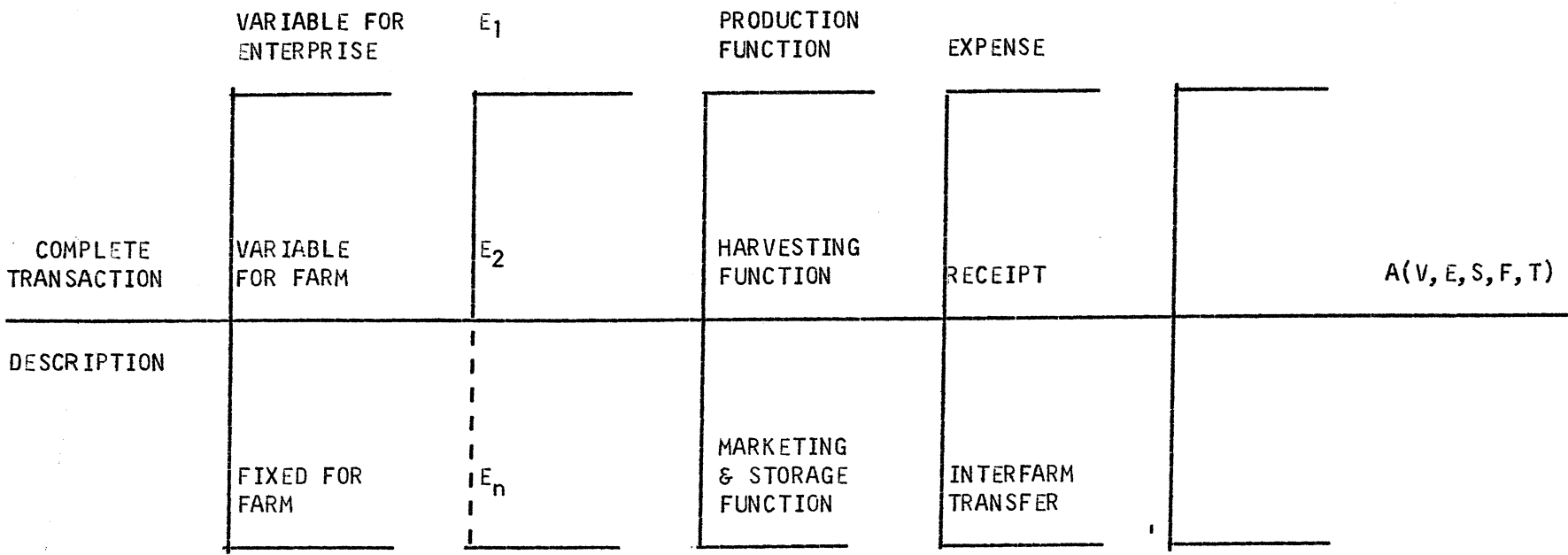


FIGURE 1. ELEC-COM CODE TREE



income or non-cash transfer to another enterprise. The final set of branches identifies the subscripted account name A(V, E, F, S, T) where V identifies branch one, costs; E identifies branch two, enterprise; F identifies branch three, stage of production; S identifies branch four, income or expense flow; and T converts the account number to a function of reporting farm income or expenses for tax purposes.

The cooperator made two coding decisions and reported only step two. Step one was accomplished by selecting one of the pages in his code book labeled  $E_1, E_2 \dots E_n$ , Table 10. Step 1 is a sample page from the cooperator's code book from which he obtained the code numbers. This system had fewer decisions requiring a code than had been employed by other farm accounting systems because a code number is not required at every branch of the tree in Figure 1.

The decision of an account number was recorded on a scan sheet, Figure 2, along with the cooperator's social security number (SSN) the date of the transaction, the number of units sold, bought, or used, and the cash value of the transaction. As an example of its use, the cooperator filled in his social security number, 123456789, the date December 5 (12/05), the account number, (0051), as looked up previously in a code book supplied to the farmer, and the number of cwt. of fertilizer bought for the corn enterprise. He had to convert one ton to 20 cwt. (0200) since the code book specified this to be the units used with this corn fertilizer transaction. He recorded the cash value \$40.27 (0004027) of the fertilizer and the transaction record was completed, Figure 2. As indicated in Figure 1 all other information was coded in the computer as a part of the account number. Every month the

TABLE 10

## PORTION OF AN ELEC-COM CODE BOOK

LISTING OF THE CORN

ENTERPRISE. ( 2 )

ACCT NUM	TAX CODE	ACCOUNT NAME	ACCT UNITS	TRANSACTION TYPE
848	3 7	ACS PAYMENT RECD	ACRE	INCOME
55	1 20	CUSTOM BREAKING	HRS	EXPENS
54	1 20	CUSTOM CULTIVATE	HRS	EXPENS
61	1 20	CUSTOM DUSTING	HRS	EXPENS
56	1 20	CUSTOM FERTILIZING	HRS	EXPENS
59	1 20	CUSTOM HARVESTING	HRS	EXPENS
85	2 21	CUSTOM HAUL SUPPLY	HRS	EXPENS
84	2 21	CUSTOM HAUL TO MKT	HRS	EXPENS
57	1 20	CUSTOM PLANTING	HRS	EXPENS
60	1 20	CUSTOM SIDE DRESS	HRS	EXPENS
58	1 20	CUSTOM SPRAYING	HRS	EXPENS
80	3 16	DUES		EXPENS
51	1 19	FERTILIZER	CWT	EXPENS
93	0 0	FL FOR BREAKING	HRS	NC
71	0 0	FL FOR CULTIVATING	HRS	NC
99	0 0	FL FOR DISKING	HRS	NC
97	0 0	FL FOR DUSTING	HRS	NC
94	0 0	FL FOR FERTILIZING	HRS	NC
100	0 0	FL FOR HARROWING	HRS	NC
825	0 0	FL FOR HERBICIDE	HRS	NC
826	0 0	FL FOR HOEING	HRS	NC
95	0 0	FL FOR PLANTING	HRS	NC
98	0 0	FL FOR SIDE DRESS	HRS	NC
96	0 0	FL FOR SPRAYING	HRS	NC
827	0 0	FL HAND HARVEST	HRS	NC
828	0 0	FL MECH HARVEST	HPS	NC
1116	0 0	HAULING SUPPLIES		NC
72	0 0	HAULING TO MARKET	HRS	NC
92	1 14	HL FOR HERBICIDE	HRS	EXPENS
91	1 14	HL FOR HOEING	HRS	EXPENS
66	1 14	HL FOR PLANTING	HRS	EXPENS
87	1 14	HL FOR SIDE DRESS	HRS	EXPENS
67	1 14	HL FOR SPRAYING	HRS	EXPENS
70	1 21	INSECTICIDE	LBS	EXPENS
787	0 0	LABOR TOTAL A	HRS	NC
83	0 0	LAND PLANTED	ACRE	NC
76	3 12	LAND RENTAL REC'D	ACRE	INCOME
52	1 19	LIME	CWT	EXPENS
74	1 21	MISCELLANEOUS SUPP		EXPENS
1031	0 0	PLACE IN STORAGE	HDBU	NC
79	2 20	RENT LAND	ACRE	EXPENS
75	1 14	SALES COMMISSIONS		EXPENS
53	1 18	SEED	CWT	EXPENS
78	2 8	SELL AT HARVEST	CWT	INCOME
81	0 0	SELL CORN TO SELF	CWT	NC



cooperator mailed his scan sheets to the Agricultural Economics and Rural Sociology Department, Auburn University, Auburn, Alabama.

The cooperator-computer interaction is shown by means of five sets of flows in Figure 3. Flow I was accomplished by the cooperator when he selected an account number and recorded this decision on a scan sheet. The State office accomplished Flow II when the scan sheets were converted into punched cards and read by the computer. The computer completed the remaining three flows. In Flow III the computer found the proper master code information for the account on a magnetic tape. This master code information was transferred to the computer in Flow IV. The computer output in Flow V was the complete transaction described by Figure 1 plus the date, social security number, cash value and amount. The output in Flow V was contained on a magnetic tape from which accounting and management information could be summarized and printed in tabular form for mailing to the cooperator.

The program was reviewed at the end of the first year and it was decided that double-entry bookkeeping and financial position was a desirable, if not necessary, feature of an electronic farm accounting system. Farmers seeking loans indicated a trial balance would be helpful in talking to creditors.

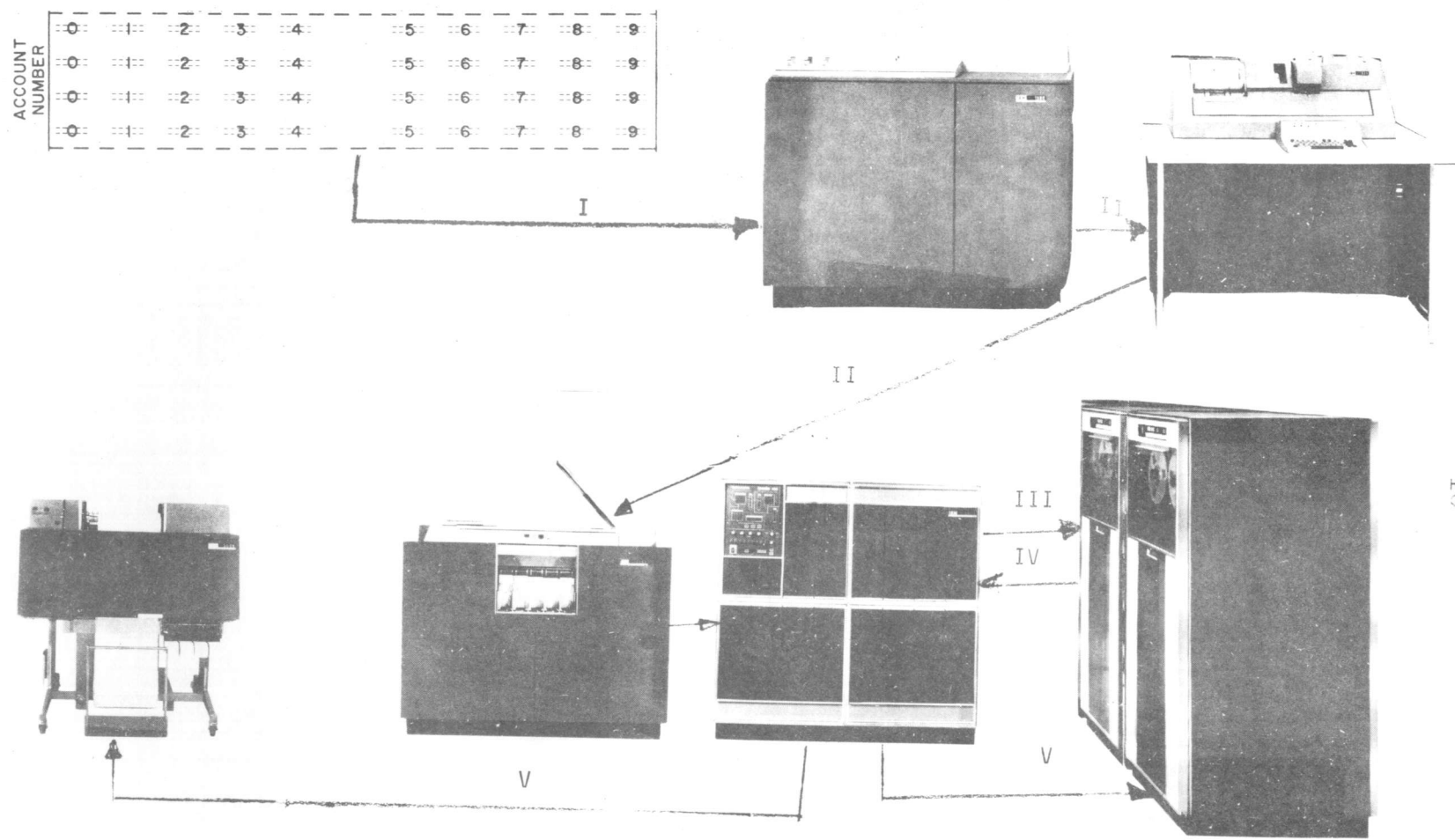


Fig. 3.--System flow of Elec-Com code structure

A vendor number field was added to obtain a financial position by use of the account's trial balance and the account number was used to accomplish all the remaining functions of a total accounting system.

Vendor number field was used in the following manner. The field was left blank for a cash transaction and the bank (cash assets) was either credited or debited as determined by the account number. The appropriate enterprise was likewise either debited or credited. If a number appeared in the vendor number field, this was a credit transaction and identified the vendor to which the individual has either sold or purchased an item as indicated by the account number. The appropriate enterprise or bank (cash assets) was then likewise debited or credited.

The Elec-Com transaction block with vendor number added as a field is compared with the original block in Figure 4. One more decision requiring a code number was required for the vendor number, but the additional flexibility gained was necessary for full accounting. The account codes A(V, E, F, S, T) did not have a subscript added for vendor number, but were thought of as being on one of two basic branches, cash or credit.

#### Processing

Processing was divided into four areas: (1) error detection and correction, (2) monthly accounting, (3) quarterly summaries, and (4) yearly summary and tax output.

Upon arrival of the coded material at Auburn a clerk opened the envelopes and checked for missing social security numbers, blank account number fields, and lightly

AMOUNT IN OR OUT	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

WITHOUT  
VENDOR  
NUMBERS

WITH  
VENDOR  
NUMBERS

Vendor Number	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

Fig. 4.--Elec-Com transaction block with and without Vendor Number Provision

marked transactions. If any blank account number fields were found, the sheet was returned to the cooperator for correction. The missing social security number or lightly marked data were rectified by the clerk. The data were then converted in flow II from scan sheets to card output by the IBM 1232 Optical Scanner and placed on tape.

#### Error Detection and Correction

In the process of going from card to tape, transactions were checked for three types of errors. The number and kinds of errors are summarized in Table 11. The errors were: (1) errors that were correctable by the system, 11.4 per cent, (2) errors that were uncorrectable by the system, 1.3 per cent of total entries, and (3) errors that were undetectable by the system as determined by an analysis at the end of the year, 1.4 per cent of processed transactions. About 1.6 per cent of type three errors were eventually corrected by the cooperator. Type 1 errors consisted of two kinds: (1) incorrect permutation of the digits in the cooperator's social security number and (2) incorrect or non-reporting of the date. An error routine was developed and programmed for the 7040 in which all valid social security numbers were stored in the computer and the reported social security number was checked against the valid list.

Consider the following example:

A cooperator reported the following social security information: 421579603. The correct cooperator social security number was 421569713. The cooperator has three incorrect digits. If and when the computer would find a stored and valid social security number with at least five correct digits in the correct sequences, it generated the following printed line of output.

SSN 421579603 CHANGED TO 421569713



Table 11. Errors in the Use of Elec-Com by Type and Number for 7300 Transactions, 1966

Field in error	Type 1 correctable errors	Per cent error of all submitted transactions	Type 2 errors	Per cent error of all submitted transactions	Type 3 errors <sup>1/</sup>	Per cent error of all processed transactions
SSN	426	5.8	37	.5	N/A	
Date	431	5.9	--- <sup>2/</sup>			
Account code	--- <sup>2/</sup>		47	.6	94	1.2
Amount in or out	--- <sup>2/</sup>		7	.1	8	.2
Cash value	--- <sup>2/</sup>		8	.1	1	
Total	857		99		104	
Number of transactions <sup>3/</sup>	831	11.4	94	1.3	104	1.4

<sup>1/</sup>Seventeen of the transaction errors were returned by cooperators and the remaining were estimated by system personnel by means of a questionnaire.

<sup>2/</sup>Unchecked by the computer.

<sup>3/</sup>More than one error of type one or type two can occur per transaction.

The computer tied this correct number to the transaction as shown above. If a social security number had not been found the following message would have been generated:

421579603  
EEEEEEEEEE

The transaction would have been deleted for processing at this time. In the case of an incorrect date, the computer corrected the error. No correction was made if the date was missing. The most common error when reporting dates can be illustrated by the following example. The month of August may have been reported as 80 instead of 08. In such a situation the computer simply reversed the two columns and proceeded. All fields were checked for type two errors that were of three types: (1) unidentifiable social security number, (2) an alphabetic character in a field (caused by making two marks on the same line), and (3) blank account number field. Type 3 errors may only be discovered by the cooperator upon checking monthly transaction sheets.

#### Monthly Accounting

After incoming transactions had been checked for errors and transferred to tape, they were ready for the addition of master data. Corresponding to Flows III and IV, the account numbers were sequentially stored on tape and the following information added to the scanned transaction:

- (1) Enterprise number
- (2) Tax code
- (3) Account descriptive name
- (4) Units of amount reported by cooperator
- (5) Type of transaction: income, expense, non-cash

The journal listing in Figure 5 was produced after obtaining the final transaction tape from Flow V. The primary purpose of this output listing was for the cooperator to check and determine if he had any type three errors or errors of omission. If a type three error was discovered, the cooperator made the correction on a carbon copy and returned it to the central processing office for transaction updating.

One revision made on the system was to introduce an aid in checking. A list of enterprises the farmer had on his farm was checked during journal listing against the enterprise coded to each transaction. If the enterprise was not found in the valid enterprise list, an error message was generated to warn the cooperator of a possible error. This occurrence was usually caused by incorrectly recording an account number. The warning must have been cleared by the cooperator before the transaction was fully processed.

Any transactions which were returned by the cooperator were processed by a program to correct the Y-T-D transaction type by inserting, deleting, or replacing an incorrect transaction. The list of cooperators who had transactions updated was stored on an intermediate tape and this tape was used as input for an extracting program which produced corrected journal listings.

#### Quarterly Summaries

The transaction tape merged with the Y-T-D transaction tape and a quarterly aggregated cash income statement by enterprise was produced, Fig. 6. This output reflected the cash income position by enterprise of the farmer at the end of each reporting period. Revisions were made in this program to produce a net farm income statement. This output produced a net farm income figure for the year after all yearly transactions were reported.

ELEC-COM  
 DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY  
 AUBURN UNIVERSITY  
 AUBURN, ALABAMA 36830

TRANSACTIONS OF E.C. RECORDKEEPER  
 ROUTE 5  
 FORT PAYNE ALABAMA 35967

SSN-41764554

FOR THE PERIOD 1/1/66 to 12/20/66

PAGE 1

BROUGHT FORWARD PREVIOUS MONTH

\$ 0.00

34

MO	DAY	YR	ENT COD	ACCT NUM	ACCOUNT NAME	AMOUNT IN OR OUT	ENTERPRISE NAME	DEBIT	CREDIT	BALANCE
5/10/66			7	346	BUY PLANTS	-0.0	TOMATOES	\$ 200.00	\$	\$ 200.00CR
5/14/66			7	363	F L DISKING	8.0 HRS	TOMATOES	\$ 0.00		\$ 200.00NC
5/15/66			7	325	FERTILIZER	50.0 CWT	TOMATOES	\$ 0.00		\$ 200.00NC
5/15/66			7	340	H.L. PLANTING	32.0 HRS	TOMATOES	\$ 25.00		\$ 225.00CR
5/15/66			7	354	LIME	20.0 CWT	TOMATOES	\$ 55.00		\$ 280.00CR
5/15/66			7	359	H L HOEING	5.0 HRS	TOMATOES	\$ 0.00		\$ 280.00NC
7/-0/66			7	327	INSECTICIDE	-0.0 LBS	TOMATOES	\$ 48.00		\$ 328.00CR
8/30/66			7	875	SELL AT MARKET	599.0 CWT	TOMATOES		\$ 938.00	\$ 610.80
9/-5/66			7	361	H L HARVESTING	-0.0 HRS	TOMATOES	\$ 279.99		\$ 330.81

FIGURE 5. SAMPLE JOURNAL LISTING OF ELEC-COM ACCOUNTING SYSTEM, 1966

ELEC-COM  
 DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY  
 AUBURN UNIVERSITY  
 AUBURN, ALABAMA 36830

INCOME STATEMENT OF E. C. Recordkeeper  
 ROUTE 5  
 FORT PAYNE ALABAMA 35967

SSN-417564554

FOR THE PERIOD 1/ 1/66 TO 01/09/68

PAGE 1

BROUGHT FORWARD PREVIOUS MONTH

\$ 0.00

MO	DAY	YR	ENT COD	ACCT NUM	ACCOUNT NAME	AMOUNT IN OR OUT	ENTERPRISE NAME	DEBIT	CREDIT	BALANCE
5/10/66	7			346	BUY PLANTS	-0.0	TOMATOES	\$ 200.00		\$ 200.00CR
5/14/66	7			363	F L DISKING	8.0 HRS	TOMATOES	\$ 0.00		\$ 200.00NC
5/15/66	7			325	FERTILIZER	50.0 CWT	TOMATOES	\$ 0.00		\$ 200.00NC
5/15/66	7			340	H L PLANTING	32.0 HRS	TOMATOES	\$ 25.00		\$ 225.00CR
5/15/66	7			354	LIME	20.0 CWT	TOMATOES	\$ 55.00		\$ 280.00CR
5/15/66	7			359	H L HOEING	5.0 HRS	TOMATOES	\$ 0.00		\$ 280.00NC
7/-0/66	7			327	INSECTICIDE	-0.0 LBS	TOMATOES	\$ 48.00		\$ 328.00CR
8/30/66	7			875	SELL AT MARKET	599.0 CWT	TOMATOES		\$ 938.80	\$ 610.80
9/ 5/66	7			361	H L HARVESTING	-0.0 HRS	TOMATOES	\$ 279.99		\$ 330.81

Figure 6. SAMPLE QUARTERLY INCOME STATEMENT LISTING OF ELEC-COM ACCOUNTING SYSTEM, 1966

In order to obtain a net farm income statement, two things must be computed: (1) value of non-paid family labor and (2) change in inventory. The new program computes the value of non-paid family labor by summing the number of hours of labor and multiplying it by an average opportunity cost for the labor. During the study the amount of interfarm transfers, including family labor, was under-reported. In particular, very few cooperators reported amounts of input used. Inventory of non-depreciable items must be reported as a regular Elec-Com entry with a vendor number of 401. Change in inventory is the difference between two consecutive years.

#### Yearly Summary and Tax Output

The final Y-T-D transaction tape of the year produces a yearly income statement in which depreciation is included in the value of change in inventory. The amount of capital depreciation for the year was determined as part of the output of the depreciation program. The income statement is put into its final form when non-capital inventory is reported at the beginning of the next year.

A depreciation schedule and Schedule F were additional yearly outputs necessary for aid in filing a federal income tax report. The depreciation program produced a depreciation schedule and total value of depreciation for the income statement. Eight totals were generated: (1) total depreciation for this year, (2) total straight line depreciation for this year, (3) total declining balance depreciation for this year, (4) total sum of the digits depreciation for this year, (5) total additional first year depreciation, (6) total investment credit this year, (7) total capital gains this year, and (8) total value of capital this year. Figure 7 illustrates the depreciation schedule output. When a cooperator acquired

FLEC-COM  
DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36830

DEPRECIATION SCHEDULE FOR 419449855  
FOR THE TAX YEAR 1966

ITEM DESCRIPTION	FARM ID	ORIGINAL COST	INVESTMENT CREDIT	SALVAGE VALUE	DEPRECIATED PAST YEARS	MTD LIFE	DEPRECIATED THIS YEAR	BOUGHT	SOLD	DIFFERENCE
BARN		\$ 3000.00	\$ -0.00	\$ -0.00	\$ 1950.00*STL	20YRS	\$ 150.00	1/ 1/52	-0/-0/-0	\$ 150.00
POULTRY HOUSE	00001	\$ 2500.00	\$ -0.00	\$ -0.00	\$ 1750.00*STL	10YRS	\$ 250.00	1/ 1/58	-0/-0/-0	\$ 250.00
POULTRY HOUSE	00002	\$ 2000.00	\$ -0.00	\$ -0.00	\$ 800.00*STL	10YRS	\$ 200.00	1/ 1/61	-0/-0/-0	\$ 200.00
FEED MIXER OR SHAK FEEDERS		\$ 3850.00	\$ -0.00	\$ -0.00	\$ 1540.00*STL	10YRS	\$ 385.00	1/ 1/61	-0/-0/-0	\$ 385.00
NESTS		\$ 875.00	\$ -0.00	\$ -0.00	\$ 350.00*STL	10YRS	\$ 87.50	1/ 1/61	-0/-0/-0	\$ 87.50
NESTS		\$ 1300.00	\$ -0.00	\$ -0.00	\$ 520.00*STL	10YRS	\$ 130.00	1/ 1/61	-0/-0/-0	\$ 130.00
TRACTOR	00001	\$ 1300.00	\$ -0.00	\$ -0.00	\$ 585.00*STL	4YRS	\$ 325.00	1/ 1/63	-0/-0/-0	\$ 390.00*
POULTRY EQUIPMENT		\$ 1061.44	\$ -0.00	\$ -0.00	\$ 212.29*STL	5YRS	\$ 212.29	1/ 1/64	-0/-0/-0	\$ 212.29*
HAY CRUSHER OR CRI		\$ 450.00	\$ -0.00	\$ -0.00	\$ 90.00*STL	5YRS	\$ 90.00	1/ 1/64	-0/-0/-0	\$ 90.00*
LIME SPREADER		\$ 650.00	\$ -0.00	\$ -0.00	\$ -0.00*STL	10YRS	\$ 65.00	1/ 1/64	-0/-0/-0	\$ 130.00*
PLOW		\$ 150.00	\$ -0.00	\$ -0.00	\$ -0.00*STL	10YRS	\$ 15.00	1/ 1/65	-0/-0/-0	\$ 15.00*
TRACTOR	00002	\$ 2745.00	\$ -0.00	\$ -0.00	\$ -0.00*STL	10YRS	\$ 274.50	1/ 1/65	-0/-0/-0	\$ 274.50*
TRACTOR		\$ 2745.00	\$ -0.00	\$ -0.00	\$ -0.00*STL	13YRS	\$ 211.15	1/ 1/65	-0/-0/-0	\$ 211.15*
TRUCK		\$ 500.00	\$ -0.00	\$ -0.00	\$ -0.00*STL	5YRS	\$ 100.00	1/ 1/65	-0/-0/-0	\$ 100.00*

TOTAL DEPRECIATION FOR THIS YEAR	\$ 2495.44
TOTAL STRAIGHT LINE FOR THIS YEAR	\$ 2495.44
TOTAL DECLINING BALANCE FOR THIS YEAR	\$ 0.00
TOTAL SUM OF THE DIGITS FOR THIS YEAR	\$ 0.00
TOTAL ADDITIONAL 1ST YEAR DEPRECIATION	\$ 0.00
TOTAL INVESTMENT CREDIT FOR THIS YEAR	\$ 0.00
TOTAL VALUE OF CAPITAL THIS YEAR	\$ 12833.71
TOTAL DIFFERENCE	\$ 2625.44

- NOTES. 1) IF A STAR APPEARS AFTER DEPRECIATED PAST YEARS, COMPUTED TOTAL DOES NOT AGREE WITH REPORTED TOTAL.  
 2) IF A STAR APPEARS AFTER METHOD USED EITHER .15 TIMES SL USED FOR DECLINING BALANCE IF METHOD DBL\* OR SUM OF THE YEARS CHANGED TO STRIGHT LINE IF METHOD STL\*.  
 3) IF A STAR APPEARS AFTER DEPRECIATED THIS YEAR, VALUE SHOWN INCLUDES ADDITIONAL FIRST YEAR DEPRECIATION.  
 4) MAXIMUM PERCENTAGE ALLOWED, USED FOR ALL COMPUTATIONS.  
 5) IF A STAR APPEARS AFTER ITEM DESCRIPTION, ITEM CLOSED OUT THIS YEAR. IF A + APPEARS AFTER ITEM, ITEM CLOSED OUT IN A PREVIOUS YEAR.  
 6) POSITIVE DIFFERENCE INDICATES COOPERATOR LOSS. ADD DIFFERENCE TO DEPRECIATED PAST YEARS TO OBTAIN COMPUTED VALUE FOR PAST YEARS.  
 7) IF A STAR APPEARS AFTER DIFFERENCE, YOU CAN FILE ADMENDED RETURN(S) TO REGAIN DIFFERENCE.

FIGURE 7. SAMPLE DEPRECIATION SCHEDULE IN THE ELEC-COM ACCOUNTING SYSTEM, 1966

or sold a capital item he sent a record of the transaction on an Elec-Com supplementary form and also made an entry on scan sheets. The depreciation program was revised to eliminate double reporting of a capital purchase or sale by generating card output in the exact form of a scanner generated transaction and this output was processed with the monthly journal listing. The program also produced, at the end of the year, a card in transaction format to enter the amount of depreciation for this year to be utilized in the income statement program.

Five message flags were set by the program. Flag one indicated that the depreciation taken in the past was incorrectly computed. A routine was used to determine if this difference could have occurred when the farmer failed to indicate he had taken additional first year depreciation. If this was the case the cooperator oversight was corrected and the flag turned off. Flag two was used to indicate two computing changes: (1) one and a half times the straight line rate was used instead of two times the straight line rate in computing depreciation by the declining balance method; or (2) the sum of the years method was replaced by the straight line method. Change one occurred if the item had a tax life of two years or less or the item was purchased before 1953. Change two occurred when the sum of the digits method was requested but either the item had a tax life of two years or the item was purchased before 1953. Flag three indicated that additional first year depreciation was included in this year's depreciation for the item. A check was made to ensure total additional first year depreciation was not more than \$20,000 or the tax life of the item was six years or more. Flag four indicated whether an item, if closed out, was closed this year or in a previous period. An item would



have been closed out in two ways: (1) sale of the item or (2) completion of depreciation process. If an item was sold a capital gains check was made and computed. Flag five indicated that if a difference had occurred between computed and reported depreciation, an amended return(s) could be filed to regain or pay any differences.

Additional income tax output was produced from the merged transaction tape. Schedule F was divided into 3 columns and 25 rows and each transaction was subscripted to represent a position on this form. The output, Figure 8, was produced by putting the amounts in a 3 by 25 array position determined from the tax code generated in Flow IV. Family items, such as family automobile used in the farm business, were included in the expenses but a maximum of 50 per cent was allowed. This conforms to IRS regulations since all cooperators indicated they requested maximum deductions. All interfarm transfers of family labor, capital purchases, and statistical items had a subscript of (0,0) and they were not included in the totals. The schedule F received by cooperators did not adequately account for sales of purchased livestock and other items for resale.

The new version of the program incorporates the handling of livestock fed for resale by assigning an internally coded lot number during the addition of master account data. The farmer reports the sale of this livestock by making such notation on the yearly generated output of inventory of feeder livestock. These sales are fed into another program which generates transactions, buying and selling, which are only recognized by the Schedule F program.

ELEC-CCM  
DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY  
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SCHEDULE OF FARM INCOME AND EXPENSES FOR-421569713

FARM INCOME FOR TAXABLE YEAR - CASH RECEIPTS AND DISBURSEMENTS METHOD

PART I.

\*\*\*\*\*SALES OF LIVESTOCK AND PRODUCE RAISED AND HELD FOR RESALE\*\*\*\*\*OTHER FARM INCOME\*\*\*\*\*

**	KIND	QUANTITY	VALUE**	KIND	QUANTITY	VALUE**	KIND	QUANTITY	VALUE
RAISED CATTLE		0.0	5034.52	EGGS	0.0	0.00	MDSE. REC'D FOR PRODUCE	0.0	0.00
		0.0	0.00	MEAT PRODUCTS	0.0	0.00	MACHINE WORK (CUSTOM)	0.0	0.00
RAISED SHEEP		0.0	0.00	PULTRY, DRESSED	0.0	0.00	WOOD AND LUMBER	0.0	0.00
RAISED SWINE		195.0	9031.25	WOOL	0.0	0.00	OTHER FOREST PRODUCTS	0.0	0.00
PULTRY		0.0	0.00	HONEY	0.0	0.00	INTERST RECEIVED	0.0	0.00
BEEES		0.0	0.00	SIRUP AND SUGAR	0.0	0.00	PATRONAGE DIVIDENDS	0.0	0.00
GRAIN		0.0	0.00	COTTON SEED	0.0	0.00	AG PROGRAM PAYMENT CASH	0.0	0.00
HAY		0.0	0.00	CORN	0.0	0.00	AG PROGRAM MAT +SERVICES	0.0	0.00
COTTON		0.0	4149.51	MISCELLANIOUS	0.0	0.00	COMMODITY CREDIT LOAN FO	0.0	0.00
VEGETABLES		0.0	0.00	MAURE AND LITTER	0.0	0.00	OTHER	0.0	0.00
FRUITS AND NUTS		0.0	0.00		0.0	0.00	BREEDING FEES	0.0	0.00
		0.0	0.00		0.0	0.00	RENT RECEIVED	0.0	0.00
DAIRY PRODUCTS		0.0	0.00		0.0	0.00	INSUREANCE	0.0	0.00

TOTALS OF COLUMNS 1,2, AND 3. ENTER HERE AND IN PART IV, LINE 1 BELOW..... 18215.28

PART II.-SALES OF PURCHASED LIVESTOCK AND OTHER ITEMS PURCHASED FOR RESALE

\*\*\*\*\*DESCRIPTION\*\*\*\*\*AMOUNT RECEIVED\*\*\*\*\*COST OR OTHER BASIS\*\*\*\*\*PROFIT (OR LOSS)

FEEDER CATTLE	0.00	0.00	0.00
FEEDER PIGS	0.00	0.00	0.00
TOTALS (ENTER AMOUNT IN COLUMN E, IN PART IV, LINE 2 BELOW)...	0.00.....	0.00	0.00

PART III- FARM EXPENSES FOR TAXABLE YEAR

**	ITEMS	VALUE**	ITEMS	VALUE**	
LABOR, HIRED	1602.76	VETERINARY, MEDICINE	967.99	RETIREMENT PLANS	0.00
REPAIRS, MAINTENANCE	2264.06	GASOLINE, FUEL, OIL	1758.16		0.00
INTERST	0.00	STORAGE, WAREHOUSING	0.00	DUES	0.00
FEED PURCHASED	12091.41	TAXES	0.00	REGISTRATION	555.25
SEED, PLANTS, PURCHASED	530.50	INSURANCE	138.94	OTHER	0.00
FERTILIZERS, LIME	3694.72	UTILITIES	0.00	HATCHING EGGS	0.00
MACHINE HIRE	852.08	RENT OF FARM PASTURE	0.00	BUY EGGS FOR RESALE	0.00
SUPPLIES, PURCHASED	1862.74	FREIGHT, TRUCKING	254.54	ADVERTISING	0.00
BREEDING FEES	110.00	CONSERVATION EXPENCES	0.00		0.00

TOTALS OF COLUMNS 1,2, AND 3. ENTER HERE AND IN PART IV, LINE 4 BELOW..... 26683.14

PART IV- SUMMARY OF INCOME AND DEDUCTIONS - CASH RECEIPTS AND DISBURSEMENTS METHOD

1. SALE OF LIVESTOCK AND PRODUCE RAISED AND OTHER FARM INCOME.....	18215.28	4. FARM EXPENSES (FROM PART III).....	26683.14
2. PROFIT (OR LOSS) ON SALE OF PURCHASED LIVESTOCK AND OTHER PURCHASED ITEMS....	0.00	5. DEPRECIATION (SEE SEPARATE SCHEDULE).....	( )
3. GROSS PROFITS.....	18215.28	6. OTHER FARM DEDUCTIONS (SPECIFY).....	( )
8. NET FARM PROFIT (OR LOSS) SUBTRACT LINE 7 FROM LINE 3. ENTER HERE AND ON PAGE 2, PART II, LINE 6, FORM 1040.....	( )	7. TOTAL DEDUCTIONS.....	( )

An accountant's trial balance was desired by the cooperators. To satisfy this demand a trial balance was obtained from the merged transaction tape. The manipulation of assets, liabilities, and capital was handled by the use of vendor number, account number, and sign of the cash value. Consider the following eight examples which cover the range of entries in the trial balance.

- (1) Cash purchase: e.g. bought 10 tons of fertilizer for corn.  
 Elec-Com entry: Vendor number-blank, account number-51,  
 cash value \$0.00    Action: - cash assets (bank), + corn enterprise.
- (2) Credit purchase, e.g. bought 100 feeder calves from  
 merchant 10  
 Elec-Com entry: Vendor number - 10, account number - 140,  
 cash value \$0.00  
 Action: + account payable 10, + beef cattle enterprise.
- (3) Cash sale: e.g. sold 100 bales of cotton  
 Elec-Com entry: Vendor number - blank, account number-808,  
 cash value \$0.00  
 Action: + cash assets (bank), - cotton enterprise.
- (4) Credit sale: e.g. sold a truck to merchant 12  
 Elec-Com entry: Vendor number - 12, account number-2050  
 cash value \$0.00  
 Action: - account payable 12, - capital goods enterprise <sup>1/</sup>
- (5) Cash repayment of debit: e.g. Paid 1/3 of feeder calves  
 debt to merchant 10  
 Elec-Com entry: Vendor number - 10, account number - 2200,  
 cash value \$0.00

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<sup>1/</sup>For footnote see bottom of next page.

Action: - account payable 10, - cash assets (bank).<sup>1/</sup>

- (6) Cash payment from creditor: e.g. Received refund from Merchant 9

Elec-Com entry: Vendor number - 9, account number-2201, cash value \$0.00

Action: - account receivable 9, + cash assets (bank).

- (7) Capital entering farm business: e.g. Payment for non-farm employment

Elec-Com entry: Vendor number - blank, account number-2207, cash value \$0.00

Action: + capital, + cash assets (bank).

- (8) Capital leaving farm business: e.g. Household living expenses

Elec-Com entry: Vendor number - blank, account number-2206, cash value \$0.00

Action: - capital, - cash assets (bank).

Owner's equity was increased when a negative enterprise asset was encountered. The enterprise account was closed out and owner's equity increased by that amount. Change in inventory was determined as it would be in the income statement and a negative difference would decrease owner's equity.

#### SUMMARY AND CONCLUSIONS

The review of current literature in the field of electronic farm accounting revealed a lack of uniformity in any of the numerous systems. Problem areas fell into two categories: (1) high cost of the system's operation and (2) difficulty in the cooperator's comprehension of the system.

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<sup>1/</sup>An account receivable was established for the account payable that became negative and the account payable was closed out.

The high cost of the existing systems prompted a study of the systems to determine where technology and reorganization could reduce costs. Two areas became apparent, (1) cost involved in coding the information from a check or receipt to a form to be digested by a computerized accounting system and (2) cost of converting the coded transactions into a form suitable for data processing. Evaluation of devices for automated input data pointed to optical scanning. An IBM 1232 optical scanner was chosen to be used in conjunction with an IBM 7040-1401 data processing system. The scanner reduced the cost of converting a transaction from an average of \$.06 in other systems to less than \$.01.

Other farm accounting systems surveyed indicated that an average of \$24.79 was spent annually to check, edit, and transpose each farms' transactions. These types of costs were completely eliminated by Elec-Com.

The feeling of a professional farm management specialist was that if a code required two or three decisions by the cooperator that most Alabama farmers could code the transactions by themselves. A survey of cooperators at the end of the trial period of Elec-Com's operation supported this conclusion. Eighty-seven per cent of the cooperators felt that the code was not difficult to use and 91 per cent felt that cooperators would require no assistance after a brief learning period. The original Elec-Com code required the cooperator to make two decisions: (1) enterprise of the transaction and (2) account number within that enterprise which described the transaction. The cooperator was required to enter the account number on the transaction block of a scan sheet.

Double entry bookkeeping was considered a necessary part of any complete accounting system. To satisfy this need, a vendor number block was added to the transaction block on the scan sheet. If this block was left blank, the transaction was a cash transaction; whereas, if a vendor appeared therein, it was a credit transaction.

A programming system was developed to use the output of the scanner. Programming was divided into four areas: (1) error detection and correction, (2) monthly accounting, (3) quarterly summaries, and (4) yearly summary and tax output.

Programming was developed to check for three types of errors: (1) errors that were correctable by the system, 11.4 per cent of the total entries, (2) errors that were uncorrectable by the system, 1.3 per cent of the total entries, and (3) errors that were undetectable by the system but detectable by the cooperator, 1.4 per cent of processed transactions.

Monthly accounting consisted of a journal listing which served two purposes: (1) give the cooperator a cash flow listing and (2) a check on the entries he had sent into the system. If any errors were found corrections were made on a carbon copy of the output and returned to the processing point. Making and returning corrections was a problem for farmers. The rechecking problem had a suggested solution of placing the code number on the source document. The rechecking procedure would also have been easier if the cooperator had sent records in to the processing point monthly instead of every two or three months. Improper accounts on an individual farm were caused only by the cooperator. This was true because the scanner could only translate the markings on the scan sheets. Poor erasures, light markings, and incorrectly looking up an account number in the code book caused

these errors. To aid the cooperator in checking for possible coding errors, a programming routine was added to check a transaction's enterprise against a valid list of enterprises on the cooperator's farm.

A quarterly summary was obtained from the combined corrected journal listings. The output reflected the cash income position by enterprise of the farmer at the end of each quarter. In general, this type of input-output record was not in great demand by farmers.

Tax output, probably the most desired output by the cooperators, consisted of two items, (1) schedule F and (2) depreciation output. The depreciation output showed the poor tax management currently being used by farmers today. All farmers had some underdepreciated items and failed to depreciate many others.

Processing costs of Elec-Com were divided into three farm totals: (1) total variable data processing cost per year, (2) total variable costs per year, and (3) total cost per year. Cost one consisted of scanning cost and computer processing of the farm transactions and amounted to \$14.59 per farm per annum. Variable costs other than data processing consisted of a full-time clerk, a field agent, and cooperator supplies. Other variable costs added \$32.26 to the variable data processing cost and total annual variable cost per cooperator was \$46.85. This estimate is based on a cooperator submitting 788 transactions per year which was the national average of 18 systems surveyed. The field agents time was based on four one-hour visits per year at \$6.77 per visit. Fixed costs borne by the system consisted of a state supervisor and programmer. Their annual rates were divided among 250 cooperators to obtain a fixed cost of \$40.19. Annual fixed cost added to annual

variable cost gave an annual average cost figure of \$87.04. This cost was lower than the rate charged to cooperators by 64 per cent of the other systems reporting costs and the systems with lower cost (1) charged nothing and received all operating expenses from public funds, (2) did not cover any costs other than processing costs, or (3) had not yet been tested.

Elec-Com was in the cost range of low and middle income farmers and will provide them useful data if they are properly supervised. Based on incomplete reporting of data by farmers in this study who were above average for Alabama, no accounting system for the average farmer can succeed without close field supervision. Furthermore, the \$87.04 cooperator cost of Elec-Com can be reduced by the utilization of county extension personnel as field agents when such visits are part of their regular duties. State support of supervisory personnel can be justified by the use of the system as a data collection tool for farm management research.

The number of enterprises (with 100 accounts per enterprise) that can be handled by the Elec-Com code in a 25 row transaction block of the Elec-Com sheet is 100,000 enterprises. The number of transactions that can be handled by three eight-hour shifts of scanning is 960,000 transactions per month which would be 14,500 cooperators averaging 788 transactions per year. The volume of transactions from one scanner used in this way would use 90 hours of computing time per month with the computer used in this study.



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