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COMPETENCIES IN ELECTRICITY NEEDED BY IOWA FARMERS

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Purpose of Study

The purposes of this study were: (1) to determine the electrical competencies needed by farmers, (2) to determine the degree of competence needed and possessed by members of average and outstanding Iowa farmer groups, (3) to determine the relationship of certain factors (such as years in farming, educational attainment and use of electricity) to the degree of competence needed and possessed by farmers and, (4) to provide information which will assist in planning future educational needs for farmers.

This study was one of a series of studies conducted by graduate students in agricultural education at Iowa State University of Science and Technology in cooperation with the Vocational Agriculture Section, Division of Vocational Education, State Department of Public Instruction, as a part of the Iowa Agricultural and Home Economics Experiment Station Project No. 1253.

Method of Procedure

A 12 member panel of specialists in farm electricity, composed of university staff members, electrical power supplier personnel and a vocational agriculture instructor, worked with the investigator in arriving at a list of 44 farm electrical competencies needed by farmers. A questionnaire, presenting the competencies and asking for personal and farm business information, was sent to a randomly selected group of farmers considered to be average, and to a group of farmers considered to be outstanding.

The members of the average farmer group were selected at random from 25 widely separated Iowa counties by the use of a farm directory service. The outstanding farmers were nominated by managers of Rural Electric Cooperatives on the basis of their use of large amounts of electricity and being above average farm managers.

Information from 102 useable questionnaires were returned by farmers in each group. These were used in the completion of this study.

The competencies were evaluated by farmers in terms of both degree of competence needed and degree of competence possessed by use of a 5-point scale (0 to 4). Farmers provided information concerning farm size, years in farming, years of education, years of vocational agriculture instruction completed, numbers of selected electrical appliances found on their farms,

KWH of electricity used in a one month period, and information about their farming programs.

Findings

Of the 44 competencies selected for use by the panel in this study, 18 were understandings and 26 were abilities. The understandings which were rated highest by both groups with mean scores of 2.6 or higher for competence needed were for the understandings of: (1) how pressure, time and limit switches; thermostat and humidistat controls; and magnetic relays operate in controlling mechanized feeding equipment, (2) install all electrical wiring and fixtures in a building such as a farrowing house or milking parlor, (3) determine correct pulley size for motor and equipment based upon motor speed and required equipment speed, and (4) install the wiring to a silo unloader or other major large size pieces of electrical equipment on the farm as is revealed in Table 1.

In some cases farmers indicated they possessed more competence than needed in individual competencies. Three of these were: (1) the understanding of why one should not operate light switches or any other electrical device while in the bathtub, (2) the ability to replace fuses, and (3) the ability to replace the attachment plug on the end of appliance cord.

Comparison among groups indicated the following differences: (1) average farmers had wider differences between competence needed and competence possessed scores, (2) competence possessed scores decreased as years in farming increased with both groups, (3) outstanding farmers operated considerably larger farms, (4) outstanding farmers had four times as large livestock programs as average farmers, (5) the outstanding farmers used almost four times as much KWH of electricity in one slected month than the average farmers, (6) outstanding farmers had twice as many of the selected electrical appliances on their farms as did the average farmers.

The responses indicated that the two groups did not differ to any great extent with respect to: (1) the average number of years farmed, (2) educational levels attained, (3) years of vocational agriculture completed, and (4) the closeness of the competence needed scores for all competencies, (5) the fact that neither group of farmers had been provided with much instruction in electricity.

The degree competence needed and possessed scores of both groups of farmers for selected competencies were influenced by their type of farming is reported in Table 2. Outstanding livestock and crop farmers had greater need and possessed more competence in the 10 selected understandings and abilities than did the general farmers. The highest competence possessed overall mean score was observed for the 8 crop farmers (2.2) followed by that of the 73 livestock farmers (2.0), and the score of the 21 average farmers (1.8). The crop farmers rated two competencies at 3.0 for competence needed. No other type of farmer group rated any competency this high. The two competencies were the ability to select the correct type of electric motor for a specific job and the understanding of proper methods for grounding the service entrance and appliances. The lowest competence possessed mean score was observed for the general farmers for the ability to select

Table 1. Degree competencies were needed and possessed by outstanding and average farmers

Competencies	Mean scores			
	Outstanding N = 102		Average N = 102	
	N[a]	P[b]	N[a]	P[b]
Understanding of:				
1. How pressure, time and limit switches: thermostat and humidistat controls; and magnetic relays operate in controlling mechanized feeding equipment	2.7	2.3	2.6	1.2
2. Proper methods for grounding the service entrance and appliances	2.7	2.1	2.6	1.8
3. Relationship of wattage and horsepower	2.6	1.8	2.4	1.2
4. Why one should not operate light switches or any other electrical device while in the bathtub	2.6	2.9	2.4	2.6
5. Reasons why distance and load influence wire size	2.6	2.4	2.6	1.8
6. The differences in types of electric motors	2.6	1.9	2.4	1.5
7. When a circuit is overloaded	2.6	2.3	2.6	1.8
8. Motor overload protection devices	2.5	2.0	2.5	1.5
9. The purpose of the National Electric code	2.4	2.0	2.5	1.5
10. The operating principles of the electric motor	2.5	2.0	2.4	1.6
11. Volts, amperes, watts and ohms as units of measure of electricity	2.4	1.9	2.3	1.4
12. Types of insulation for electrical conductors and where they should be used	2.4	1.6	2.5	1.5
13. Alternating and direct current	2.3	1.9	2.4	1.6
14. Parallel and series circuits	2.2	1.8	2.5	1.5
15. How the system provides 120 or 240 volts	2.2	1.8	2.4	1.4
16. The differences between single and three-phase electricity	2.2	1.8	2.4	1.4
17. Basic principles of power generation and transmission	2.2	1.8	2.3	1.3
18. The differences between systems that provide 208 and 240 volts	2.0	1.3	2.3	1.1
Overall mean score for understandings	2.4	2.0	2.5	1.5

[a] 4 = very much competence needed, 3 = much competence needed, 2 = some competence needed, 1 = little competence needed, 0 = no competence needed.

[b] 4 = very much competence possessed, 3 = much competence possessed, 2 = some competence possessed, 1 = little competence possessed, 0 = no competence possessed.

Table 1 continued.

Competencies	Mean score: Outstanding N = 102		Average N = 102	
Ability to:	N	P	N	P
1. Select the correct type of electric motor for a specific job	2.7	1.9	2.7	1.5
2. Install all electrical wiring and fixtures in a building such as a farrowing house or milking parlor	2.7	1.6	2.7	1.3
3. Determine correct pulley size for motor and equipment based upon motor speed and required equipment speed	2.6	2.0	2.6	1.5
4. Change a dual voltage motor from a low to high voltage, or vice versa	2.6	1.7	2.5	1.1
5. Install the wiring to a silo unloader or other major large size piece of electrical equipment on the farm	2.6	1.6	2.6	1.2
6. Select wire size for circuit	2.6	2.0	2.6	1.7
7. Select correct size of two-element (Fustron) fuse protection for an electric motor	2.6	1.9	2.6	1.3
8. Service and clean an electric motor	2.6	1.5	2.6	1.2
9. Use some kind of horsepower formula in determining power of electric motor	2.6	1.5	2.5	1.1
10. Design an electrical system including circuits, fuse protection, receptacles, switches, appliances and/or equipment	2.6	1.3	2.7	1.1
11. Completely wire a farm home	2.6	1.4	2.8	1.1
12. Reverse the roation of an electric motor	2.5	2.1	2.3	1.5
13. Make a grounding from a piece of equipment back to distribution panel using bare or green insulated wire	2.5	1.6	2.6	1.2
14. Locate an "open" circuit in the wiring or an "open" curcuit in an appliance	2.5	1.5	2.5	1.3
15. Install a grounded type wall receptacle	2.4	1.9	2.5	1.5
16. Use junction boxes and conduit	2.3	2.1	2.4	1.6
17. Install the wiring to a new light or wall plug	2.3	2.1	2.5	1.9
18. Replace fuses	2.3	2.9	2.2	2.7
19. Check a circuit for the presence of voltage with test lamp to see if it is "hot"	2.3	2.0	2.4	1.4
20. Figure electricity bill from the kilowatt-hour meter reading	2.3	2.6	2.1	2.1
21. Locate the outlets on an individual electrical circuit in a house	2.2	1.9	2.3	1.6
22. Hang electrical fixtures	2.2	2.3	2.2	2.0
23. Make solderless connector splices	2.1	2.2	2.2	1.8
24. Tie an Underwriters' knot	2.1	1.3	2.1	1.1
25. Replace the attachment plug on the end of appliance cord	2.1	2.7	2.1	2.6
26. Install outlet for a major home appliance such as a clothes dryer	1.9	1.8	2.6	1.3
Overall mean score for abilities	2.4	1.9	2.4	1.5
Total overall mean score	2.4	1.9	2.4	1.5

Table 2. Degree selected competencies were needed and possessed by outstanding and average farmers by type of farmer

Competencies[a]	Mean scores					
	Livestock		Crop		General	
	N	P	N	P	N	P
Outstanding Farmers	N = 73		N = 8		N = 21	
Understandings						
1	2.8	1.9	2.0	2.3	2.5	1.8
2	2.8	2.2	3.0	2.4	2.3	1.8
3	2.7	1.8	2.5	2.0	2.3	1.9
4	2.7	2.9	2.5	2.8	2.4	2.6
Overall mean score for understandings	2.7	2.2	2.5	2.4	2.4	2.0
Abilities						
1	2.7	2.0	3.0	2.0	2.6	1.3
2	2.7	1.6	2.7	1.6	2.4	1.4
3	2.6	2.0	2.6	2.4	2.6	1.9
4	2.6	1.7	2.6	2.4	2.5	1.5
5	2.7	1.8	2.8	2.1	2.3	2.0
6	2.7	1.8	2.8	2.1	2.3	2.0
Overall mean score for abilities	2.7	1.8	2.8	2.1	2.5	1.7
Total overall mean scores for all competencies	2.7	2.0	2.7	2.2	2.4	1.8
Average Farmers	N = 60		N = 13		N = 29	
understandings						
1	2.8	1.2	2.3	1.3	2.5	1.1
2	2.7	1.9	2.4	1.7	2.5	1.7
3	2.5	1.2	2.3	1.2	2.3	1.2
4	2.7	2.7	2.6	2.1	2.1	2.6
Overall mean score for understandings	2.7	1.8	2.4	1.6	2.3	1.6
Abilities						
1	2.9	1.6	2.4	1.5	2.3	1.4
2	2.9	1.4	2.4	1.2	2.3	1.2
3	2.7	1.7	2.4	1.3	2.2	1.2
4	2.6	1.2	3.0	1.3	2.3	1.0
5	2.8	1.4	2.5	1.2	2.4	0.9
6	2.7	1.7	2.2	1.1	2.4	1.7
Overall mean score for abilities	2.8	1.5	2.5	1.3	2.3	1.2
Total overall mean scores for all competencies	2.7	1.6	2.5	1.4	2.3	1.4

[a]Numbers used are for the same competencies as in Table 1.

The correct type of electric motor for a specific job (1.3).

For the average farmers, sizeable differences were observed ranging from .8 to 1.1 between the overall mean scores for competence needed and possessed for all stratifications by type of farmer. The livestock farmers indicated the greatest need (2.7), followed by the crop farmers (2.5) and the general farmers (2.3). On competency, the ability needed to change a dual voltage motor from a low to high voltage, or vice versa received a 3.0 score by the crop farmers. A very low score for competence possessed was found for the general farmers for the ability to install the wiring to a silo unloader or other major large-size piece of electrical equipment on the farm (0.9).

In a comparison of the outstanding and average farmers stratified by type of farm, the outstanding farmers tended to possess considerable more competence (scores of 2.0, 2.2, and 1.8) than the average farmers (scores of 1.6, 1.4, and 1.4). The needs of the two groups for competence were quite similar, however, the outstanding crop farmers had somewhat greater needs.

Both the outstanding and average farmers needed less competence as years of education increased as is revealed in Table 3. The smallest degree of competence needed score for the 10 selected understandings and abilities was that of the outstanding farmers with 10 or fewer grades of education completed (2.3). The highest degree of competence needed scores were those of the outstanding farmers with 11 or 12 grades completed (2.8) and the average farmers with over 12 years of education (2.7). The overall mean score for degree of competence possessed was lowest for the average farmers with 11 or 12 grades completed (1.4), whereas the highest was that of the average farmers with more than 12 years of education (1.8).

In Table 4 are presented the competence needed and possessed mean scores of both groups of farmers classified by years of vocational agriculture completed. Those outstanding farmers who had completed some vocational agriculture indicated they needed more competence than did the farmers with none (2.7 to 2.6), however, the farmers with no vocational agriculture possessed greated competence (2.0) than did the outstanding farmers with vocational agriculture (1.9).

The average farmers who had some vocational agriculture had a large difference between overall degree needed and possessed scores of 1.2 (2.7 needed and 1.5 possessed). However, a 1.0 difference was found between these scores for the farmers who had no vocational agriculture (degree needed score of 2.5 a degree possessed score of 1.5). The same relationship existed among the outstanding farmers. The outstanding farmers had a larger difference between competence needed and possessed scores if they had had vocational agriculture (.8) than if they had had no vocational agriculture (.6).

Highly significant correlations were observed with both groups between acres operated and number of animal units; and acres operated and number of selected electrical appliances found on the farm.

Table 3. Degree selected competencies were needed and possessed by outstanding and average farmers by educational attainment level

Competencies[a]	Mean score					
	0 to 10th grade		11 to 12th grade		Beyond 12th grade	
	N	P	N	P	N	P
Outstanding Farmers	N = 28		N = 54		N = 20	
Understandings						
1	2.5	2.4	2.8	2.2	2.7	1.7
2	2.3	1.9	2.8	2.1	2.7	1.9
3	2.4	1.9	2.8	1.8	2.3	1.8
4	2.2	2.9	2.6	2.9	3.1	2.4
Overall mean scores for understandings	2.3	2.3	2.8	2.2	2.7	1.9
Abilities						
1	2.5	2.1	2.8	2.0	2.7	1.6
2	2.1	1.6	2.9	1.7	2.6	1.4
3	2.5	2.1	2.7	2.1	2.5	1.8
4	2.2	1.5	2.8	1.8	2.6	1.6
5	2.3	1.5	2.8	1.8	2.5	1.3
6	2.2	1.8	2.8	2.2	2.6	1.8
Overall mean score for abilities	2.3	1.8	2.8	1.9	2.6	1.6
Total overall mean scores for all 44 competencies	2.3	2.0	2.8	2.1	2.6	1.7
Average Farmers	N = 42		N = 44		N = 16	
Understandings						
1	2.4	1.1	2.7	1.1	3.0	1.5
2	2.6	1.8	2.6	1.7	2.7	2.1
3	2.2	2.4	2.5	1.1	2.6	1.6
4	2.4	2.4	2.5	2.6	2.2	2.1
Overall mean scores for understandings	2.5	1.9	2.6	1.6	2.6	2.1
Abilities						
1	2.5	1.6	2.8	1.3	2.9	1.7
2	2.6	1.5	2.6	0.9	3.1	1.6
3	2.4	1.4	2.7	1.5	2.7	1.7
4	2.3	1.2	2.6	1.0	2.9	1.3
5	2.5	1.3	2.6	1.0	2.2	1.4
6	2.5	1.5	2.6	1.5	2.7	1.9
Overall mean score for abilities	2.5	1.4	2.7	1.2	2.8	1.6
Total overall mean scores for all 44 competencies	2.4	1.6	2.6	1.4	2.7	1.8

[a]Numbers used are for the same competencies as in Table 1.

Table 4. Degree selected competencies were needed and possessed by outstanding and average farmers by years of vocational agriculture completed

Competencies[a]	Mean scores			
	No vocational agriculture		1 to 4 years vocational agriculture	
	Needed	Possessed	Needed	Possessed
Outstanding Farmers	N = 72		N = 30	
Understandings				
1	2.7	2.0	2.7	2.1
2	2.7	2.2	2.6	2.0
3	2.6	1.9	2.3	1.7
4	2.6	3.0	2.6	2.8
Overall mean score for understandings	2.7	2.3	2.6	2.2
Abilities				
1	2.7	2.1	2.9	1.7
2	2.8	1.7	2.9	1.4
3	2.7	2.2	2.6	1.7
4	2.6	1.8	2.8	1.4
5	2.5	1.5	2.8	1.7
6	2.5	2.0	2.8	2.0
Overall mean score for abilities	2.3	1.9	2.8	1.7
Total overall mean score for all 44 competencies	2.3	1.9	2.8	1.7
Average Farmers	N = 76		N = 26	
Understandings				
1	2.5	1.2	2.8	1.1
2	2.6	1.8	2.6	2.0
3	2.4	1.2	2.6	1.3
4	2.4	2.5	2.4	2.9
Overall mean score for understandings	2.5	1.7	2.6	1.8
Abilities				
1	2.6	1.5	2.9	1.4
2	2.7	1.3	2.9	1.3
3	2.5	1.5	2.6	1.5
4	2.5	1.2	2.9	1.0
5	2.6	1.3	2.9	1.0
6	2.5	1.7	2.5	1.8
Overall mean score for abilities	2.6	1.4	2.8	1.3
Total overall mean score for all 44 competencies	2.5	1.5	2.7	1.5

[a]Numbers used are for the same competencies as in Table 1.

Implications

All of the competencies studied were deemed necessary for effective use of farm electricity on the farm. The mean scores of 43 of the 44 competencies were 2.0 or above indicating some need for the competency. The score for the remaining competency was 1.9, which approached some need. The mean score was 215 or above for 23 competencies with the outstanding farmer group, and for 26 competencies with the average group. For these competencies some to much competence was needed.

The outstanding farmers had competence possessed scores of 2.0 (some competency) or above for only 20 competencies, whereas the average farmers had scores indicating that they possessed 2.0 or above competence in only 5 of the 44 competencies.

These competencies should form the basis for farm electricity instruction and in-service training in vocational agriculture classes for high school students, young and adult farmers; in the cooperative agricultural extension service program, in area vocational and technical schools; and in the College of Agriculture resident instructional programs.