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SOFTWARE LANGUAGE REQUIREMENTS
FOR ECONOMIC USE OF COMPUTER RESOURCES
By
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The similarities of the problems addressed by agricultural economists throughout the nation provides clear evidence that application of the computer to applied problems will require essentially identical solution algorithms for wide geographic areas. In many cases, a computer program which is useful in one state will be equally useful in many neighboring states. However, the present method of operating extension and research programs has led each department (that could afford it) to spend public or semi-public funds to develop its "own" algorithm for each problem area. This has generated an extensive duplication effort.

Although some duplication may be justified in testing alternative approaches to the solution of difficult problems, the spending of X dollars for programmers, computer use and professional time in fifty states to develop essentially the same program fifty times makes little economic sense. Duplication of nearly this magnitude has been and is now occurring. It has often been justified with the argument that programs were being designed for local personnel and conditions. However, changing technology and market structure have eliminated many basic interstate differences. Further, appropriately designed computer programs should allow adaptation to peculiar characteristics of individual situations with little effort.

This process also provided some educational externalities, since many staff members learned how to use the computer through the development of these programs.

However, a major portion of program development costs is for programmers and computer use which have no educational externalities. Frequently a high level of expenditure is required to attack a relatively small problem.

The economic waste caused by duplication in the development of computer software could be viewed rather cavalierly by a few well funded departments. However, this is a short sighted point of view. First, the opportunity cost in terms of lost research or extension activities may be high. Money spent on programming, etc., cannot be used for needed research or extension activities. Secondly, legislatures can be expected to continue their increased emphasis on accountability for educational institutions. With increased scrutiny, it may not be long before we hear legislators demanding to know "why it is necessary to develop computer programs that have already been developed by other universities."

This line of reasoning leads to the conclusion that cooperation and coordination among universities will be necessary if economic use of resources is to prevail. It may also be a necessary prerequisite to insure that the funding of other research and extension activities is adequately maintained.

To allow the desired level of cooperation and coordination among universities, compatibility of the software packages developed at various institutions is necessary. One of the primary features determining compatibility is the source language of the program. To determine the language or languages which should be used for maximum software compatibility among universities, a mail survey of all departments of agricultural economics in the United States and Canada was made. Sixty-one of sixty-three institutions returned questionnaires. Sixty of the sixty-one used computers. Respondents were asked to indicate the computer systems available, languages presently in use and languages expected to be available and used in the future.

THE SURVEY

IBM 360 computer systems were most predominant (Table 1). Nine institutions used CDC 6000 series systems. Four of these also had IBM 360 systems available.

Table 1.

COMPUTER SYSTEMS AVAILABLE TO AGRICULTURAL ECONOMICS DEPARTMENTS
United States and Canada, 1972

Computer System	Number of Departments*
IBM 360 Series	46
CDC 6000 Series	9
Sigma	4
Univac	4
IBM 1130	3
Burroughs	2
PDP	2
Other	4

* Some departments used more than one computer system.

Fortran was the only general purpose computer language which was available to all sixty departments (Table 2). Cobol was available to 90 percent of the institutions with PL/1 and Basic being available to approximately 70 percent.

Most institutions did not expect additional languages to become available in the foreseeable future. Only three institutions expected to add a general purpose language to those presently available. Although the rapidly changing state of the art in computer science makes any statement about the future tenuous, this does indicate relative stability in the languages available at the present time.

Table 2.

LANGUAGE AVAILABLE TO AGRICULTURAL ECONOMICS DEPARTMENTS
United States and Canada, 1972 and Future

Language*	Number of Departments	
	Present	Future
Fortran	60	60
Cobol	54	54
PL/1	44	45
Basic	41	42
Algol	31	32

* Minor use of a few other languages was reported.

Availability of a language at an institution does not mean that it is frequently used nor well supported by computer and programming staff. Nearly all of the departments surveyed indicated that Fortran was the most important language currently used (Table 3). Fortran was the only language used in 42 departments. Only two departments indicated that PL/1 was the most important language. At all institutions where more than one language was important, Fortran was one of the important languages listed.

Table 3.

MOST IMPORTANT PROGRAMMING LANGUAGES
USED BY AGRICULTURAL ECONOMICS DEPARTMENTS
United States and Canada, 1972 and Future

Language	Number of Departments*	
	Present	Future
Fortran	58	57
Cobol	6	6
PL/1	7	11
Basic	7	5

* Sixteen institutions listed more than one language important at present and 15 expected more than one to be important in the future.

In looking into the foreseeable future, the relative importance of each of the languages is expected to be maintained. Only one university (University of Hawaii) expected the most important language to change from Fortran to PL/1. One other (Colorado State) planned to change from Fortran and Basic to Cobol. Four additional states expect PL/1 to become one of their important languages.

In total this survey indicates that Fortran is now, and is expected to be in the foreseeable future, the most important general purpose computer language used by agricultural economics departments in the United States and Canada. The use of PL/1 is increasing slightly but remains comparatively unimportant.

Two important points are implied by the survey results. First, a program written in Fortran has the possibility of being used by all agricultural economics departments in the United States and Canada. Second, practically all departments have Fortran experience and capabilities. Their support staff will be able to handle the adaptation and modification problems that may arise in transferring programs.

Thus, agricultural economists developing computer programs which are or could be of use to other universities should seriously consider writing those programs in Fortran. Use of other languages will seriously limit the number of other institutions that can use the programs developed.

SUMMARY

The high cost of computer software development and our social responsibility for deriving maximum benefit from tax or grant dollars dictates that states cooperate in the development and use of computer programs for agricultural research and extension. One requirement for cooperation is language compatibility. A survey of all departments of agricultural economics in the United States and Canada indicates that Fortran can be used at all institutions, and

further that it is now, and is expected in the foreseeable future to be the most important programming language at nearly all institutions. From this it is concluded that computer programs which could be useful in more than one state should be written in Fortran.