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A TEST OF THE TECHNICAL FEASIBILITY

OF

ON-LINE CONSULTATION USING APL

by

Stan Wilson*

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KEYWORDS

Telecommunications/transportation vs. communication/ Man-
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A TEST OF THE TECHNICAL FEASIBILITY

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I. Introduction

Land grant universities and state agricultural experiment stations are faced, like all state agencies, with rising per unit cost of the items and services they purchase. In order for the same or higher levels of service to be provided these agencies must have increased appropriations. But often there is a resistance to the higher taxes necessitated by increased funding and appropriations do not grow as fast as cost.

Travel expenditures are one of the items increasing in cost. Experiment stations and other agencies must compensate their employees for travel on state business. With increased prices of food, lodging and gasoline these compensations increase. For example, the mileage allotment of the state of Texas is increasing from ten cents a mile to twelve cents as of September 1. Per diem is increasing from sixteen dollars a day to eighteen.[1] It is likely that food and lodging costs will increase even further over the next few years. The prospects of gas shortages seem to guarantee that the price of gasoline will increase also. Thus one may project further increases in per diem and mileage compensation throughout the rest of this decade.

In contrast to the above, the cost of telephone service is projected to decline substantially over the next decade.[2] By 1980 it is predicted that long distance telephone rates will be one-tenth or less

of their current level.[3] A number of states have special agreements with the telephone company to provide long distance service between various state offices located anywhere in the state. These agreements provide for substantially lower long distance rates and may even provide for virtually unlimited communications between certain state offices at fixed rates.[4]

State agricultural experiment stations are strongly affected by increases in travel expenditures. For several reasons it is necessary that experiment stations maintain a system of off-campus stations and centers dispersed throughout the state. Researchers often find that it is desirable or even vital to consult with researchers, statisticians, programmers, system analysis and other specialized support personnel at other locations. One center may not have enough consulting needs to support in-house specialists but several centers might share the time of a statistician or other specialist. In this case he would reside at the main station and travel to centers for consultation or their scientist could travel to the main station.

Given the projected increases in the cost of travel and projected decreases in the cost of long distance telephone calls, it would seem that a shift over to increasing use of the telephone instead of travel for consultation would promote economy.[5] This approach could be taken only if it were possible for consultation to be carried on over the telephone. Often consultation involves viewing numeric data or the numeric results of computer program processing on raw data. If the consultation involves programming help then it might be necessary to examine the actual computer output including a listing of the programs and any error messages. It would appear to be awkward to carry on such consultation using the telephone. The paper containing the data, program listing and

the output of the program would have to be mailed to the individual

called on for consultation.[6] This would be particularly awkward and time

consuming if the examinations of the output resulted in decisions to have

additional computer runs. Two or more days might elapse between runs if

the output was sent by mail. (See the discussion of interactive consul-

tation below on pages 9 and 10.)

It would seem possible however, to transport numeric data, program

listing and output between sub-stations if each sub-station had a com-

puter terminal. A number of experiment stations are locating terminals at

their sub-stations.[7]

II. Procedure and Method[8]

Given the possibility of transferring data and program information

between sub-stations, it was necessary to project a specific procedure

for attempting to test whether such a tranfer could take place. In

addition, the transfer technique would have to be an easy and effec-

tive method of consultation. It was believed that the APL software

system contained certain features which would allow such a transfer.

Therefore, it was decided to use the APL software system in a test.

The specific characteristic of the APL software system which could

achieve a transfer was believed to be the APL library system.[9] When

an individual acquires an APL account number he may reserve to that num-

ber one or more units of on-line storage. These units are called library

workspaces. The collection of such workspaces associated with a parti-

cular APL number are referred to as the private library of that number.

When an individual signs on the APL system he is allocated a section of

the computer's main core memory. This section is called his active work-

space. In this active workspace all calculations must be performed. If

an individual wishes to store the contents of his active workspace on-line

so that he can access it at a later time, he may by giving one simple command, store the content of his active workspace in a workspace of his private library. One may think of this simple command as taking a photograph of his active workspace at that point in time and placing the photograph in his private library. The command does not affect the content of his active workspace. It only puts an exact copy of the content in storage. A second simple command will bring the content back into his active workspace. A third simple command will eliminate a particular workspace when it is no longer needed. In order to refer to a specific workspace in his library, the user must assign a name to that workspace. He does this as part of the command which saves the contents of his active workspace in a library workspace.

In order for different individuals to be able to share programs and data it is possible for one individual to copy the contents of another individual's library workspace if he knows the APL number of the individual whose library workspace he wishes to copy. He may copy the contents of the other individual's library workspace into his active workspace. But this copying will not affect the contents of the other individual's library workspace and he can not eliminate the other individual's library workspace. It was believed that the ability to copy another individual's library workspace could be utilized to affect a transfer of data, programs and the numeric output of the program run on the data.

At the time of the proposed test two sub-stations at TAES had APL terminals. These were Prairie View, which was fifty two miles from the main station and the Blackland Research Center at Temple, which was seventy-seven miles away. Blackland was chosen. The terminal had been

at Blackland less than six weeks and no organized training in APL had
been given to the staff. Yet two researchers were using it to run
statistical analysis of thier data.[10] The other terminal taking part in
the test was in the Agriculture Building on the Main Campus of Texas A&M
(TAMU).

The computer programs selected for the test were a multiple linear
regression program (MLR) and a residuals program.[11] Both programs were
"canned" routines available on the TAMU APL system. The MLR routine was
chosen because it is one of the most frequently used programs and because
a number of regressions are often run on the same data. The intention
was to fully test the techniques by performing a series of transfers.
This would require a series of different outputs. This series of differ-
ent outputs could most easily and realistically be generated by running
a sequence of regressions on the same data but specifying different com-
binations of variables for each run. The residuals program is often
run in conjunction with the MLR program. Finally both programs produce
results in the form of easily identifiable but large matricies.

The raw data used consisted of four variables, each of which had
ninety-seven observations. The data were inputed at the terminal on the
TAMU compus. The observations of two or the variables were transformed
by raising them to various powers. This would allow the data to be
fitted to non-linear functions and resulted in a data matrix of nine
columns (nine variables) and ninety-seven rows (niney-seven observations).
Next a telephone call was placed to Blackland and a researcher there
signed on the Blackland terminal. The regression and residual programs
were run. For the first test the regression program was instructed to
use only variables one through seven. The results of the MLR and resi-

duals programs were saved in a library workspace associated with the APL number used to sign on the terminal at the TAMU campus. This took one command. Then the researcher at Blackland was told how to copy the saved library workspace into his active workspace. This took one command and he succeeded on the first try. Next the results of the MLR and residuals programs were printed out on both terminals.

The MLR program produces its results in the form of a matrix with five columns. The number of rows is three more than the number of variables used in the regression. In this first test, with variables one through seven used, the regression matrix would have ten rows. Certain specific values in specific cells of the matricies printed out at the two locations were compared by reading the values over the telephone. Then the residuals matrix was printed out at each location. It contained four columns and ninety-seven rows.

To re-test the procedure, the regression and residuals programs were run three more times. The second time variables one through eight were used. The third time variables one through seven and variable nine were used. The fourth time variables one through nine were used. Each time the regression matrix and the residual matrix were saved in a library workspace associated with the APL number used to sign on at TAMU. Each time the library workspace was copied into the active workspace being used by the Blackland terminal. The second time both the regression matrix and the residual matrix were printed out. The third and fourth times only the regression matrix was printed out. This was done because of the slow speed of the printer and the size of the residuals matrix. Each time the regression matrix was checked to be sure that the latest

one was transferred. These checks showed that all four regression matricies were transferred. This concluded the test. The procedure took less than forty-five minutes.[12]

III. Results and Implications

The successful transfer of the four MLR matricies indicates that on-line transfer of data and results between terminals at distant locations is technically possible using the APL software system. The ease with which it was accomplished indicates that it can be an easy and natural technique for on-line consultation. The test could not demonstrate that it can be an effective method of consultation. For this to be demonstrated the test would have had to be an actual consultation session.[13] During such a session, a more detailed discussion of the numeric output would take place. It is also possible that a consultation would have included a two way transfer of data and/or results. For example, data could be inputed into one terminal, copied into the active workspace of another and used as input for a program. Then the results matrix could be transferred back to the first terminal, printed out on both and then a detailed discussion would occur (see below).

The results of the test do indicate that there is no technical barrier to a two way transfer or a consultation session and it is projected that an opportunity for an on-line consultation session will occur in the near future.[14]

At the present time three distinct types of on-line consultation can be delineated: (1) APL consultation, (2) Statistical consultation and (3) Colleague consultation. In order to indicate the implications of the test, these three types will be described in some detail. To facilitate this description it will be assumed that an individual (called

the researcher) at a sub-station has some numeric data he wishes to use

as the input to an APL program. He wishes to discuss this data and the

results of the program run with an individual (called the consultant)

at the main station or another sub-station. He initiates the consul-

tation with a phone call. Both locations must have APL terminals.

APL consultation consists of aid in running APL programs and

giving APL commands. The researcher inputs his data using the termi-

nal and calls up one or more programs, then he initiates the execution

of the program on the data. During the run, execution is halted by an

error message. He calls a consultant, who, in this case is an individ-

ual with more experience and knowledge in APL usage. The researcher

also saves his data in one of his library workspaces. The consultant

signs on his terminal, copies the data into his active workspace, calls

up the program and commands execution of the program on the data. When

the error message occurs the consultant is better able to deduce its

cause and deal with it because of his greater experience. This solu-

tion usually involves a command to branch to another line in the pro-

gram. The consultant achieves complete execution of the program and

saves the results in one of his library workspaces. The researcher

copies this library workspace into his active workspace and prints out

the results. The consultant explains the error and correction proce-

dure to the researcher so that he is better able to handle it in the

future and the session can end there.

Statistical consultation consists of advice as to the appropriate

statistical test to run on a set of data and aid in interpreting the

implications of the run. The consultant is a statistician. The research-

er usually enters his data into the computer system before calling the

consultant. The data are saved in a library workspace of the researcher.
They can then be copied by the consultant into his active workspace and
printed out if this is deemed desirable. The consultant may have been
called in when the experiments were designed. Even if he was, it may be
advisable for him to see the actual data which were gathered before a
final decision is made about which statistical test to run. It might
also be useful if the researcher inputs the data into a program which
produces descriptive statistics before contacting the consultant. Then
these descriptive statistics as well as, or in place of, the raw data
can be passed to the consultant for his opinion.

Once the appropriate statistical operations have been decided on,
the researcher can call up a canned routine which performs these and
executes the routine on the data. The results, usually in the form of
a matrix, can then be saved in his library workspace and copied by the
consultant into his active workspace. Then both terminals can print
out the results matrix and the researcher and consultant can each
examine their copies while they are conferring, over the telephone, on
interpretation. Their discussion may produce a decision to execute
another type of statistical operation on the data or they may decide
to run the same operation but in a somewhat different way. For example,
they may decide to run a regression including one or more additional vari-
ables or excluding one or more variables. The experiment described in
Section II above is an example of this. Once this decision is imple-
mented by running the appropriate program the results matrix can be
passed to the consultant's active workspace, printed on both terminals
and more discussion can take place based on it. The results of this
discussion may be additional program runs. Thus a consultation session

of an hour may consist of a series of runs; each run being based on an examination of the results matrix generated by the previous run. This will be called interactive consultation.

Colleague consultation may be similar to statistical consultation. The consultant would be a member of the researcher's discipline or in the case of an interdisciplinary project a member of another discipline.[15] The program could be statistical or it could be a simulation or model of the particular system under study or it could be a lineary programming routine. The consultation might be interactive. The results of each run would be passed to the active workspace of the individual who did not execute the program. The results would be printed on both termi-nals and form the basis of a discussion leading to additional runs. The results of these runs would be discussed and lead to further runs. The discussion might also lead to a decision to modify the program. The cne executing the runs could then command the necessary program modifications and re-execute the corrected program. The results would be passed to the other active workspace, printed out and used to discuss further runs or modification.

It is unlikely that the various types of usages outlined above have exhausted all possible applications of this technique. Further uses, particularly by different individuals, can be expected to result in additional applications.

FOOTNOTES

[1] An increase of two cents a mile seems small but it is an increase of twenty per cent. The per diem increase is twelve and a half per cent. These figures were provided by Dan Snyder.

[2] These estimates of telephone cost in the future are from Martin (1971). See particularly Chapter 3.

[3] The predictions concerning the drop in telephone rates to one-tenth their size by 1980 is on page 30-31 of Martin (1971).

[4] A good example of this type of agreement is the Texas Agency Network (TEX-AN). This statewide agreement for all state offices is projected to be operational by January 1974.

[5] The idea of replacing transportation by communications is of interest to at least one source of research funding, the National Science Foundation. One of their recent notices (number 45) dated November 24, 1972 and concerned with research in Telecommunications Policy speaks of the tradeoff between transportation and telecommunications. They propose as one of the possible topics of tele- communications research: "Transportation-telecommunications trade- off: What are the possible tradeoffs between broadband communi- cations and transportation? Applications that have been suggested include teleconferences, electronic mail, decentralization of rou- tine office services. To what extent can the potential for one or more of these areas by investigated theoretically or experimentally in greater detail?"

[6] This would create a delay of at least one day. If the situ- ation required interaction as described on pages 9 and 10 then at least a one day delay would occur between each interaction.

[7] For a description of the use of terminals at sub-stations and other remote locations see the Proceedings of the First Inter- national Conference on Computer Satellites in Agriculture.

[8] The method and procedure of the experiment are discussed in extensive detail so that the test can be repeated by other researchers. A repeat of the experiment by independant researchers is vital to an objective determination of the accuracy of the findings. In addition, further test by others will develope other applications not forseen. (See pages 7,8,9, and 10.)

[9] A good description of the APL library system is given in Gilman (1970), pages 95-113.

[10] These researchers are Dr. Gerald F. Arkin and Dr. Lloyd B. Fenn. They had been provided with printed material on APL and had

been shown how to sign on. Dr. Fenn was the researcher on the Temple terminal during the experiment described on pages 5, 6 and 7. During part of the experiment Dr. Arkin was also in the room at Temple. The author was operating the terminal on the TAMU campus during the experiment.

[11] For a description of the MLR program and the residuals program see Smillie (1968), pages 28,29.

[12] The savings which are possible include not only the difference between the cost of travel and the cost of telephone service but also a savings in professional time. During the time a staff member is traveling to and from a remote location he is usually not able to do any useful work, particularly if he is driving. The travel time from College Station to Temple is about two hours. Thus for an hour of consultation an individual would have to spend four hours driving. The mileage cost alone to Temple and back is $15.40 at 10 cents a mile. A WATS call to Temple which lasts an hour would cost $ 3.72 . Thus the hour conference over the telephone is substantially cheaper. For on-line consultation the additional expense involves two terminals in operation for an hour and this would cost a minimum of four dollars. The difference might be eliminated if the individuals used a great deal of computer time, but this would require that they use approximately a minute and a half of computer time and such an amount is not likely when one is running canned programs on APL. It seems probable that the savings in professional time will be of overwhelming significance compared to the savings in mileage and per diem. But it might be more difficult to quantify the savings in professional time. Studies of all types of possible savings should be made and may be the next logical step.

[13] The human element is vital in determining whether this is an effective method of consultation. For some it will be and for others it will not. The difference will probably depend on personality. Some will adapt this method quickly and others will wait until it is in more general use.

[14] It is important that actual consultation be tested several times and by different individuals before this procedure is universally adopted as a partial alternative to travel. Independant tests are facilitated by a detailed description of the procedure (See footnote 8).

[15] For a discussion of the interrelationship between interdisciplinary research, communications and the computer see Billingsley (1972).

BIBLIOGRAPHY

Baran, Paul and Andrew J. Lipinski
        1971   The Future of the Telephone Industry: 1970-1985, The
               Institute of the Future, A Special Industry Report (Sep-
               tember): R-20.

Billingsley, Ray V.
        April 1972   "System Simulation as an Interdisciplinary Interface
               in Rural Development Research", Unpublished, Texas Agri-
               cultural Experiment Station Technical Article 9915, College
               Station, Texas.

Blose, William F.
        January, 1973   Background Study for Regional Processing Center
               Planning, Texas A&M University Data Processing Center,
               College Station, Texas.

Gilman, Leonard and Rose, Allen J.
        1970   APL/360 An Interactive Approach, John Wiley & Sons, Inc., New
               York.

Martin, James
        1971   Future Developments in Telecommunications, Prentice-Hall, Inc.,
               Englewood Cliffs, New Jersey.

Ohio State University College of Agriculture and Home Economics
        November, 1972   Proceedings of the First International Conference
               on Computer Satellites in Agriculture, Ohio State Univ., Ohio.

Smillie, K. W.
        1968   STATPACK 1: An APL Statistical Package, Department of Computing
               Science Publication No. 9, University of Alberta, Edmonton,
               Alberta.

Turoff, Murray
        1971   "Delphi Conferencing (i.e. computer-based conferencing with
               anonymity.)", Technological Forecasting 3, No.2,159.

Turoff, Murray
        1971   Implementation of an Interactive Conference System", Spring
               Joint Computer Conference Proceedings.

Turoff, Murray
        October, 1972   "Party-line and 'discussion'--computerized conference
               systems", International Conference on Computers and Communica-
               tions, Washington, D.C. .

Weingarten, Fred W. et al
        1973   A Study of Regional Computer Networks, University of Iowa, Iowa.

Whisler, Thomas L.
        1970 The Impact of Computers on Organizations, Praeger , New York.