

COMPUTER TIME-SHARING AND THE PETROLEUM EVALUATION ENGINEER

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Computer utilization, commonly referred to as time-sharing, is a logical outgrowth of the fact that present day computers have such large capacities and speeds that they are difficult to keep up with. Why not a method whereby many users are feeding data and problems to a central processor unit at the same time, each paying only for the amount of time he actually uses the facility. The comparison to an electric power utility or a gas company is obvious. Certain economies of scale are of benefit to all and like electric power it is there to use only as one needs it.

Briefly, a complete time-sharing system consists of a user's terminal, a phone line to a local vendor and a multiplexing system to field many calls at once to a buffer and a central processor unit, quite often in a distant city.

When I was asked to undertake this assignment, my first reaction was to feel that it would be very presumptuous of me to address this particular group on this subject. After all, consultants have been using computers in their evaluations for years. Discounted cash flow calculations by a computer are routine inclusions with almost every consultant's report. Also flash, material balance and gas solution drive calculations are especially suitable for solutions by computers.

Briefly, I was originally exposed to computers in a college course on Statistics. Prior to this I had long felt that they could be used economically by my predecessor company in the property acquisition field. However, not having an inhouse computer, I prevailed on them to let us experiment with time-share. Since most time-sharing vendors will give you a 30 day cancellable contract, and since the monthly fixed charges are quite low (about \$200), they condescended to humor me.

What largely promoted me to accept the invitation to give this talk was the feeling that my own excursion into the realm of time-sharing was both satisfactory and profitable, and, as a result, I may have something of a message to pass on. So deciding I might have something to say, I started putting my thoughts down on

References and illustrations at end of paper

paper.

Concurrently I had just accepted my present position and had not as yet undertaken to set up any of my already developed programs at my new locale. Although a variety of terminals were available at the Bank, I was too busy orientating myself into the job to get right on it.

Of course, when I finally got down to modifying and mounting my programs, I had already been introduced to New York's Bell System. You may have heard that the use of this particular component of the Bell Telephone System in the normal course of business leaves much to be desired. Time-sharing being totally dependent on the existing phone system is very much at the mercy of the local conditions. "Dirty" lines result in garbled instructions to the computer, garbled output and frequent disconnections from the system. After a frustrating week of coping with this condition in the New York area, my first impulse was to call the Program Chairman and tell him the deal was off. I had just about decided time-sharing was completely unworkable, at least in the New York area. I will add, in fairness, that local power conditions and voltage cutbacks during hot weather were not helping the situation any.

However, I was assured that nowhere in the United States were conditions as worse as those which existed in lower Manhattan. In fact, many of the time-sharing vendors have finally given up and moved their multiplex terminals over into New Jersey. Direct trunk lines are then leased and made available to Manhattan users. It appears that this may solve quite a bit of the problem. I don't wish to belabor the point as to the situation in New York, but it does illustrate a very important thing -- the weakest link in the time-sharing system is the existing communications system.

As an aside, you probably are familiar with attempts made by certain computer companies and others to establish their own nation-wide communications systems. Also, experiments have successfully been concluded whereby instructions have been sent to the computer via satellite.

Let us then proceed under the assumption that the communications system will improve,

and time-sharing being a valid concept will demand clean lines and, therefore, workable conditions. In the Southwest where most of you live and work, the system is reasonably tolerable.

My message, which I shall attempt to persuade you to accept, is as follows:

1. Even though you have your own inhouse computers, you should investigate the use of time-sharing; and
2. Every petroleum evaluation engineer should become a programmer.

The advantage of 1. above is that the computer is there when you want it. A petroleum engineer's use of computers cannot be scheduled routinely like most uses of inhouse computers. It is usually very disruptive, and most inhouse computers operate on very tight schedules and on batch principles. This is especially true in banks. Almost every bank in the country now is geared to the use of electronic data processing, but, when departments such as oil and gas come to them and request use of them, they are usually told that they would prefer for the departments to use time-share. Their own computer people encourage time-share. They say it is cheaper than using their own computers and, of course, not disruptive.

Even though you disagree and feel you can legitimately use your own inhouse computer, the only realistic way to originally write and debug your programs is on time-share. Those of you who have ever programmed know that it is quite costly to develop and debug on inhouse computer facilities. It is very disruptive as much trial and error is frequently involved. Quite often the nonprofessional programmer will work on programs on an off-and-on basis, working it in with his other work. The time-share terminal is ready and waiting whenever the spirit moves.

Assuming the engineer concedes that computers would be useful in his business, the reasons why he should become a programmer are as follows: it is easier and faster for an engineer to become an accomplished programmer than to teach a programmer petroleum engineering. Besides, the programmer wants to be primarily a programmer. Presumably, if not, he would have learned something else. Teaching an engineer to program cuts out the middleman. This is not only more economical, but it obviously eliminates misunderstanding and problems of communications. Also, programming requires you to think through a problem methodically. Your own thought processes are examined in detail, and, quite often, solutions

not readily apparent suddenly fall into place. You might argue that certain methods or techniques that the programmer-engineer uses might be more costly in central processor unit time than those employed by the expert programmer. In some cases I will concede this point, but all things considered, this is relatively minor.

Program modifications, both temporary and permanent, are more quickly and economically made. Many times a onetime modification to a program is necessary. The engineer-programmer can accomplish them on the spot and at the time-share terminal.

Before we go further, let's talk about some uses of time-share, assuming you are convinced that you should investigate the use. First, a terminal to suit your specific needs must be selected. Although certain brand names will be mentioned, it is not my intention to recommend any one brand, but in a broad sense to show what is available. It has not been intended that this would be all inclusive, but generally all available terminals will fall into one of these groups. The state of the art being what it is, I would expect much change and advancement in this area, though, in the next few years.

Initially, when time-share was marketed, the only terminal available was the conventional Teletype Models 33 and 35. You will note they have a punched tape capability, but the disadvantages of them are that they are slow and have a narrow width. Eventually IBM marketed the 2741 terminal. This was 50% faster than the teletype machine and had a wide carriage and featured the IBM ball head. They do not have tape input/output capabilities. However, there are various versions of the 2741 marketed by Datel and others that incorporate other features. The Datel people have recently marketed a terminal under their name which, in reality, contains IBM component parts but does have a neat little mag tape cartridge that attaches to the unit and can be used for input and output at quite high speeds. Newer terminals such as the Execuport are now able to receive data at 30 characters per second, which is three times the speed of the teletype terminals and twice the speed of the 2741. Obviously, since you are paying for terminal connect time under the time-sharing concept, the faster your input and output the cheaper your cost. This terminal weighs about 27 pounds and is completely portable; all you need is a telephone and you are in business.

Having made the choice of terminal, the next step is installation. As mentioned earlier, as clean a possible telephone line is essential. A

private line to the terminal is desirable. This bypasses the office switchboard and leaves one less problem area. These direct lines usually do not cost more than \$6-10 per month. In real critical applications, lease lines can be had.

Now, by way of illustration, I should like to discuss a specific application of time-share -- that of oil property evaluation. This might be for acquisition purposes, estate evaluation, future planning, economics of proposed development drilling or wildcatting, etc.

The problem can basically be stated as follows:

1. Engineering
2. Cash Flowing and Discounting
3. Tax Calculations
4. Rate of Return on Equity Calculations

In my opening remarks, I mentioned various engineering applications. Here I would confine it to aid in flowing future production after the engineer has made his reserve determination or in simple cases determined trends such as constant percentage decline etc. The computer can easily project exponentially, harmonically, hyperbolically, so many years at current rate, the same and then decline, incline, or, if the desired curve cannot readily be expressed mathematically, each individual year can be inputted. I have also found it very helpful to let the computer make the determination when the economic level of production has been reached.

The cash flowing and discounting is routine, and this is precisely what computers are all about. Whenever a problem is repetitious and time-consuming, computers will be the most economical answer. Other than being faster and cheaper than hand calculations, a 100% degree of accuracy is obtained together with readily available by-products that normally are not achieved from desk calculations.

Since the demise of the ABC transaction, tax calculations have suddenly become all important in proposed property acquisitions. The nature of oil and gas taxation is such that certain elections are available. The computer can be relied on to make the correct choice and to optimize results. This again is a repetitious and time-consuming problem.

Finally, to the all important rate of return on equity calculation. Almost all acquisitions, wildcatting and development programs utilize some form of financing and therefore leverage. Surprisingly, in these cases many people are more concerned with rates of return on the total monies spent rather than on their equity money. It appears intuitive to me that the real problem is twofold: 1) what can I expect to

make on my money and 2) what are the probabilities of achieving 1). Again, a time-consuming, laborious trial and error calculation.

Another problem readily solved by computers is material balance predictions of reservoir performance. If you ever have run out a solution gas balance of using ϕ factors (see Tracy, Tech Note 256, JPT, January 1955), you have been involved with rather laborious trial and error procedures. Not only does the computer handle this procedure readily, but can also easily depict the results when one manipulates the variables such as the K_G/K_O extrapolation.

Those of you who are consultants are usually called upon to put your results in a finished report form. This quite often calls for cash flows from each lease, by states and by various categories. The result is considerable output which is too expensive and time-consuming for time-share. I know of at least one consultant that takes advantage of using his time-sharing vendor's high speed terminal, i.e., he inputs his data through his conventional terminal and causes it to be outputted at the vendor's location and then the printout is delivered to him.

In my discussions of time-sharing with various engineers around the country, I have found that the one and two-man shops have really found the concept to be very attractive and have developed their use of time-share to a high degree. This has been partly for competitive reasons, i.e., they were initially forced into it, but once they developed the necessary skill to operate and program the system, it does give a small shop a considerable feeling of power. Two specific things they realize is that it is adding very little to the overhead when not in use, and it allows them to work right up to deadlines knowing that the final results can be obtained very quickly.

As to the ultimate, let us examine some of the possibilities for time-sharing systems. One, I would visualize a complete production-financial computerized accounting system starting with the pipeline gauger in the field and ending with the filing of income tax and financial statements. Small hand-card punch devices are available. Rather than fill out a gauge report or a run ticket, they could be utilized, or a small electrical operated keypunch is available for about \$750. These could be placed in the district offices and the raw data prepared there. The data could be transmitted or the cards delivered to the regional or home office where it would be used in the following ways (all by the computer):

1. Prepare state and federal reports
2. Establish data banks of production history

for engineering personal use. As an accessory plotters would be available to prepare decline curves, P/Z curves, rate/cum curves, water cut/cumulative curves, etc.

3. Update previously prepared reserve studies.

At the same time, this data would merge with income and expense data as prepared by the Accounting Department.

Ultimately, in our data storage files we would have by lease:

1. production history
2. oil and gas runs
3. monthly income
4. monthly operating expense
5. reserves
6. district overhead
7. general and administrative overhead
8. state, federal and local taxes other than income taxes

From this information the calculations and preparation of income tax and financial statements could readily be prepared.

In addition, a well-testing program, well allowable and engineering estimates could be incorporated. The computer would periodically scan the actual results lease by lease and pinpoint problem areas.

How feasible is all of this on time-share? Right at the present, most conventional terminals are too slow. However, eventually high speed terminals should be readily available, or, perhaps, the larger companies at least could in

effect set up their own time-sharing system with the central processor unit with high speed output in their home office corrected to each district office's conventional time-sharing terminal.

Finally, I wish to mention Cathode Ray Tube (CRT) display devices. These are used to great advantage by security dealers and analysts. Large data banks of company financial history together with instantaneous market activity are available on the screen at the touch of a few buttons.

Why would it not be feasible for a group of companies or consultants to go together and prepare data banks of lease production history, well histories including logs, pressure history, etc. This information stored in one location would be instantly available at each remote terminal to be typed out or displayed on a CRT device.

So, while it has not been my intention to give you a blueprint for success, it is my belief that learning to program and exposing yourself to time-share will open up new worlds to you and result in expanding considerably on your present capabilities. Basically, we are talking about problem solving. Programming forces you to think through the problem more methodically. As such, you will understand the problem better and organize your thought process in a manner that will result in satisfactory conclusions.

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TABLE I

Type	Speed	Carriage Width	Punched Tape	Built In Coupler	Magnetic Tape	Remarks
Teletype	10 CPS	72 char.	yes	yes	no	some models are readily moveable
BETA	10, 15 & 30 CPS	132 char.	reads 150 CPS from tape	yes	optional	easily moved
"2741"	15 CPS mainly, but individual models go from 10, 15 & 30 CPS	11" (72 char.) & 15" (130 -) (156) (char.) wide carriage	no	no	yes typical: 90,000 char. capacity on each tape; read/record 60-300 CPS synchronous	can be used off line as a selectric typewriter
Portable	10, 15 or 30 CPS	72 char.	no	optional	option is available	weight: 27 lbs.