THE COMPUTER IN THE SURVEY OFFICE

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A SHORT TIME ago I was asked to prepare a paper on the uses of a computer in a land surveying office. While I am certainly no expert on computers, I have had the opportunity over the years to observe the impact they have made on small and medium sized survey companies. Consequently, this paper has been prepared with the smaller survey company in mind. For the purposes of this discussion the computers referred to, unless otherwise noted, are common microcomputers such as the Apple IIe or IBM PC.

At last count, only slightly more than half of the survey companies in Ontario had a computer in the office. I found this quite surprising; that more surveyors were not using proper tools to help them perform better, provide a better product and increase productivity - in this case, by using a computer. While computers are not an end unto themselves, they are very useful in performing some important functions, as we shall examine.

The most common use of a computer in a survey office is for performing coordinate geometry (CoGo) calculations. There probably isn't a survey office today that doesn't have a programmable handheld calculator or desktop calculator with CoGo software. While these machines have performed admirably they obviously cannot be compared to a modern computer with good CoGo software. A computer is faster, more versatile and can handle volumes more data than the old desktops ever could. When loaded with a modern CoGo program the computer is a powerful tool that will continue to be a survey company's most important reason for acquiring one.

Although the simple coordinate geometry program is the most important part of the calculation package, recently some other applications have demanded attention. A relative newcomer is the total station. (Strictly speaking, the total station can be used on its own without any automatic processing software, but in order to realize maximum benefits of this technology the data collector and processing software must be considered. Whether a total station system is a cost effective option for the average surveying company is open to debate, and beyond the scope of this paper, but for the purposes of this discussion, it is assumed that the benefits are affirmed.) Automatic computer processing of data collector measurement data requires, generally, two basic programs; the transmission program and the reduction/coordination program. The transmission program, if required, simply allows the computer to receive and store the transmitted data from the data collector. No interpretation of the data is performed at this phase. This program is often supplied with the data collector by the retailer and they are available for most common computers. The reduction/coordination program interprets and processes the measurement data. The usual result is an xyz coordinate base with point descriptors that can be accessed by calculation programs such as CoGo. Because of the close relationship between the reduction/coordination program and the CoGo program they are always purchased as a unit.

At the other end of the survey calculation spectrum is the world of Computer Aided Drafting (CAD) systems. Until recently, true CAD systems had only been available on mainframe or mini computers, but now several simpler packages have been written for microcomputers. These microcomputer-based CAD systems offer a cost effective solution for simple design and drafting but they cannot effectively handle the type of work required to produce survey plans. Expecting an efficient CAD program which runs on a DIGITAL VAX 11-780 to run effectively on an IBM PC is, to say the least, somewhat optimistic. In fact, producing survey plans on any CAD, regardless of power or price, is one of the most inefficient uses for a CAD, and it is almost impossible to turn a profit doing so. An example helps to illustrate this point. Say we want to place a block of text (lettering) on a "drawing" using a typical CAD program. Obviously the computer needs to know what the text is, so we type it in from the computer terminal. But before the computer can place the text on the drawing, it needs to know some other things as well; the location and orientation of the text block; the character font - whether the lettering is vertical or slanted, solid or dashed; the gap (distance) between the letters; the letter height, either in relative (scaled) dimensions or absolute dimensions; the text block justification of the lines within the block of text, either left, center or right; and the logical "layer" upon which the text will be placed. All of these parameters must be defined before a single piece of text can be placed on a drawing. Of course, a good CAD program would set many of these parameters by default so it would not be necessary to re-define them every time you want to place a block of text. Unfortunately survey plans are text oriented and very little lettering on a plan of survey is of similar format. This means that it is frequently necessary to change parameters which is time consuming and inefficient for production CAD work. This is only one small example of the many difficulties encountered when attempting to use a CAD for surveying applications.

There are, however, exceptions to this scenario. Subdivision and many engineering plans are based on a routine mathematical model which is better suited for CAD use. With these types of plans there is more emphasis on simple line work and text formats are more uniform. But even with these simpler drawings a microcomputer based CAD system has trouble performing in a production atmosphere. The basic problem is that the nature of computerized graphics systems is such that they are extremely CPU (central processing unit - the brain of the computer) intensive, and a CAD's processing requirement is far beyond most microcomputers capabilities. This, coupled with the relative complexity of the average survey plan and the high cost of CAD systems prohibits most survey work from being produced on a CAD. There is no doubt in my mind, however, that eventually a "standard" survey calculation package will consist

of a comprehensive data base shared by a powerful interactive CoGo program with a total station interface and a CAD system among other specialized programs. Such a system would probably run on the new generation of supermicrocomputers such as the IBM RT, Intergraph Interpro 32, or Apollo series computers. They are very powerful computers capable of multi-tasking, but they are also quite expensive. While it is true that this software technology is here today and available on some microcomputers, it is fragmented and incomplete. Some complex programs (CAD, least squares adjustment, contouring, terrain modeling etc.) will never run satisfactorily on underpowered microcomputers. In my opinion, a comprehensive, flexible and capable total calculation package that would work, is at least 5 to 10 years away - and it will not be inexpensive.

So, with regard to survey calculation software, where does this leave us today? A simple CoGo package is, without a doubt, a powerful tool, and they are relatively inexpensive. Total station packages and CAD systems can also be beneficial but they are expensive and their cost effectiveness must be given careful consideration.

The ability to perform survey calculations is only one important function of a computer in the land surveying office. The second most important use is for word processing. In fact, more microcomputers are sold for their word processing capability than for any other reason. The real power behind the word processor is the ability to recall old documents from disk storage, edit them and obtain a perfect hardcopy whenever desired. A "standard" letter such as a letter of transmittal which goes with a plan to the Registry Office for checking can be stored on disk and recalled when needed. Perhaps only the date and certain reference information needs to be changed and in a minute or so an entire new letter can be printed. The new letter can then be stored for future reference. More lengthy survey reports or proposals are easier to write simply because of the program's editing features; the ability to move words, interchange paragraphs and obtain a fresh hardcopy at will. Most quality word processors include or can be expanded to include spelling checkers and some even have grammar checkers. Of course, your secretary could probably type a simple letter before you get the computer turned on and the program loaded. But what about that condominium proposal that has to be changed for the third time? And what if you don't even have a secretary or she is too busy? The capabilities of a word processor make it much easier to cope with these routine duties and possibly even postpone the need to hire extra staff. When purchasing a word processor, I have found it is best to buy the simplest program that will fill your requirements. Some packages may be powerful enough to allow you to recreate the complete works of William Shakespeare, but keep in mind the more capable the program, the more difficult it will be to use. Also remember that word procesors won't help you write any better, they just make it easier.

Business applications are the next most important use for a computer in a survey office. There are several major applications to choose from, and which ones to consider will depend primarily on the size of the company.

The first major type is the general ledger package. This program basically replaces your ledger books with disks and keeps track of net accounts receivable and accounts payable. Setting up and maintaining the program is no faster than setting up and maintaining the books by hand. The advantage of using a computer, however, is that the month end profit/loss statement can be obtained much more quickly as opposed to the manual method. Also the figures are more reliable; as long as the information is entered correctly you don't have to worry about the computer making an adding or subtracting mistake. Your accountant will appreciate this and the way the program formats the output. But don't assume your accounting fees will be cut substantially by computerizing. They may be reduced but your accountant still has to perform various functions such as ensuring data has been entered against the proper accounts, among other things.

Another popular program is an accounts receivable package. This program maintains a file of accounts for completed or ongoing jobs. When a job is ready to be billed the particulars (such as the client's name, the work performed and amount of account) are entered into the computer and it prints a copy of the invoice with all relevant data (including the terms of payment) to be sent with the final return. When an account is paid it is deleted from the system after the month end report is generated. The benefit of computerizing this system is the ability to obtain a report of all monies in receivables very quickly. A standard report usually prints accounts in groups of current, 30, 60, and 90+ days overdue, and includes convenient information such as the client's name, address, value of account and home phone number. If your company operates on a bank loan you are probably accustomed to compiling similar reports as the banks like to see this information. If this is the case, the computer can save you a lot of time. The computer can also automatically apply an appropriate interest charge to overdue accounts and print reminder invoices which can be mailed monthly. The sight of rapidly accruing interest can work wonders on payment of overdue accounts!

Another program that can be useful is what I call a "timecard" program. This is a system which keeps track of job costs as the work is performed. In this system an employee file is set up containing the names of all your employees and their charge-out rates for various duties. A job file is also created which contains all the jobs which are currently being worked on. When a new job is taken in, a job record is created on file. Employees fill in daily time cards indicating how much time was spent on each job and what disbursements were made. The timecard information is entered into the computer daily (in order to ensure the data on file is as up to date as practical) and is posted both against the job and employee's personal record. An hour summary from the employee's record can subsequently be used as a basis for payroll calculation. When a job is ready for billing the computer can provide a complete report on time and disbursements expended on it. The report could be brief, giving total costs only, or could be detailed including the date of the work, who performed the work and in what capacity. Many surveying companies are already using a paper system similar to this to keep track of job costs, but computerizing the system has its advantages. Firstly, it is much easier and faster for the computer to provide a more detailed report of job costs than would be practical manually. Secondly, it is a simple matter for the computer to provide a complete report of all monies tied up in work in progress (i.e. not in receivables yet). The output of this system would provide the basis of input for the accounts receivable program, but don't attempt to directly link the two programs. For whatever the reasons may be, it seems survey work is rarely billed at card value.

Although a scheduling routine could easily be added to this system, (i.e. a routine that would examine and report on which jobs should be done first based on their due date) in practice it has proven not feasible to implement. In a very small survey office there is obviously no need to schedule the work. In a larger office it has been found that the rapid turnover of jobs and constant shuffling of priorities precludes any reasonable possibility of maintaining up to date job due dates that would be required by a scheduling routine.

The general ledger and accounts receivable programs are common packages that can usually be purchased "off the shelf". A rudimentary timecard system can be set up from an off the shelf package such as Visicalc, but if you want some of the "bells and whistles" mentioned it will probably be necessary to have a program custom written to suit your business operation.

The programs suggested have all been successfully implemented on various computers, but not every system should be computerized. The scheduling routine in the timecard program already mentioned is one example. Another good example is a program that automatically looks up a company's survey records based on a geographic index system. Although setting up such a system is possible by using a data base program, in practice such implementations have had, at best, limited success. The problems start with the fact that all jobs must be coded under a standard homogeneous geographical system which may not be practical. To work effectively an entire company's job index would have to be coded and entered into the computer - usually a monumental task in itself for an existing company. Few microcomputers have the storage capacity and speed necessary to perform the searches such a system would require. In addition, once the files were coded and entered the system would have to be constantly maintained, otherwise it quickly would become useless. In most survey offices everyone at one time or another must search the job index for files, and this would require wide knowledge among the staff on how to operate the program and to some extent how to run the computer. Also, job searches are often required throughout the day and probably at a time when the computer is being used for something else. Compare this scenario to a manual card index system. Although it may not be ideal, it is much more easily understood by company staff, is easier to maintain, doesn't require a complete re-coding of jobs and is accessible 24 hours a day. Above all, it probably works.

Many of these arguments against computerizing can apply to other applications as well, including the systems already mentioned. Generally, if a system is too complex to work on paper, it probably won't work on a computer either. Conversely, and perhaps surprisingly, it's the simple applications that work best on a computer.

As to which software packages a survey company should consider using, beyond a coordinate geometry package and word processor, there are no simple answers. Although it is almost always possible to computerize a particular system, the question that must be answered is: Do the supposed benefits of computerizing outweigh the costs of implementing and maintaining the system? This question can only be answered after examining the operation of each individual company.

Computers definitely have their limitations but I believe their benefits far outweigh their costs, both in terms of dollars and labour. A complete computer system with excellent software can be purchased today for less money, in real dollars, than a programmable desktop calculator cost 15 years ago. If I may humbly offer one piece of advice to the first time computer buyer, it is this: If existing (computer) technology will help you perform more efficiently and make a profit - buy it. But don't make the mistake of purchasing technology that you can't presently use in the hopes of making it pay in the future. The future is usually further away than we first imagine and if and when it arrives, it is often not as we had envisioned. ●

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