Getting to Know the Computer: I*

by Masood Hasan

When we hear of the computer revolution we conjure up a picture of a lot of flashing bulbs, whirring tapes, the clack-clack of the line printer and a lot of complicated electronic circuitry. It is true that there has been a revolution in the design and manufacturing techniques progressively through from bulky valves, to transistors to semi-conductors. This is beside the point.

There has also been revolution in the techniques required to make effective use of this machine. Computer applicative technology has come a long way in the last ten years. We hear to FORTRAN, COBOL and a host of other high and low level "languages" which are meant to ease the labour involved in computer systems design and programming. This revolution is nearer the point.

What is not so obvious is that in order to get the point proper we have to revamp entirely our style of thinking, as to how administrative systems and organizations should be run. Unless this revolution in outlook comes about the other two mentioned above will not amount to much.

To get the "most bang for your buck" in this age where information technology provides effective means for co-ordination, hence control, we must appreciate what this is all about. This article is an attempt to throw some light on the computer and the implications involved in its use.

> IN an earlier article titled "Red Tape and a Means of Controlling it" the author had clearly shown that if we are interested in improving the communications or information networks of administrative systems or organizations the approach brought into play through use of Systems and Procedures methodology is valid whether it is used for purposes of:

a) Streamlining or disciplining existing manual systems, and/or
b) Introducing the use of electronic data processing in such a fashion that the maximum return for resources (human & otherwise) expended is achieved, and/or
c) Simply wishing to have a good look at oneself by holding up a true mirror which will very clearly show what the current state of affairs is.

Let us assume that a large organization having got rid of a lot of the deadweight of red tape through a proper Systems and Procedures investigation has established an efficient manual way of working. The next stage is how can we speed up and co-ordinate in a yet tighter fashion the goings on within the administrative system or organization itself?

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It follows, therefore, that it is of interest to learn as to what a computer is, what it does and how it gets about it in a general fashion.

The success of the computer, where it has been productively employed, has come through a distinct appreciation of the incapacity of the human being to do more than one thing or be in more than one place at a time. Constraints on the human being through his efforts are being steadily moved ahead. Just as automation has brought about mass production, atomic energy unlimited amounts of power, so the computer has extended the brain-power of the human being.

It is up to us to harness this work-horse to our best advantage. Difficulties arise because the computer is basically an idiot. Computers have been called brains or thinking machines. We can be pretty certain that they do not think like human beings, even though they can:

1. Read
2. Write
3. Store
4. Make Logical Deductions
5. Do Arithmetic

Home Work

It is not generally understood that in order to communicate meaningfully with the "idiot" a tremendous amount of homework has to be done. It is as if one had a moron of a servant and he had to be told how to boil an egg. It might go something like this: first the egg must be at room temperature, for if it is too cold it will crack when put in hot water (alternatively one may put a cold egg in cold water but then the concept of the 'three-minutes' egg is lost!) The water should not be boiling as at that temperature there is a release of sulphur between the yolk and the white which leaves the characteristic black ring and we don't want a black ring! He must then take a spoon put the egg in it and slip into the simmering water very carefully. Now, the fastidious who wish to have the yolk in the center of the egg (it does not look good on the side) further instruct the moron to keep moving the egg to and fro in the simmering water. The means of heating (gas, electricity, coal, wood or oil) must be regulated to keep the water just asimmer, more heat or not enough will ruin the pleasure of a perfectly 'boiled' egg. Above all since we are living at about sea level water will boil at 100 degrees C the moron must be told to time the egg for three minutes. Since he cannot read a clock a three minutes sand-glass is made use of. After three minutes the moron must remove the boiled egg immediately put it in an egg-cup (which has been previously washed) put on the egg cosy and inform the master that the half-boiled egg is ready. The hot water must be thrown away and not be used for making tea. The degree of detail given above must appear ludicrous, but because the servant is a willing moron he will go through the routine, once he has picked it up, faithfully and most probably better than a thinking servant. Of course beware of making any changes without going through a new training programme with the moron, the results will most probably be chaos and so it is with the computer!

There are two types of problems that involve the use of the computer.

1. Explicit or straightforward.
2. Implicit or iterative.

The explicit or straightforward type consists of carrying out a sequence of operations (calculations) that could be done by human beings or desk calculators. The computer in this case takes over the donkey work of excessively lengthy work-outs which an army of clerks may not be able to do in a reasonable period of time. And above all the computer work-out would be error free.

The implicit type involves assuming a solution and then substituting the assumed solutions of the problems by putting the unknown variable on both sides of the equation and then testing for equality. An example of this could be in working out a rate of interest that when applied to anticipated receipts and expenditure for each year of the life of an investment or facility, will equalize their values as of today. This approach also called the Discounted Cash Flow is used by financial analysts, economists and cost engineers who recognize present value approaches as a logical way to rank investment alternatives. The trial and error solution involves assuming an interest rate, then discounting the cash flows (in and out) of future years to find out their present values. Then if the sum of all the discounted cash inflows equals the sum of all the discounted cash outflows the interest rate selected was correct. If not another rate is selected and we go through the process again and again till such time as equality is attained.

Or take the problem of sizing a pipe where the friction factor may vary with the flow rate. It is desired that a certain quantity of a gas or liquid be delivered within a certain time. Here a pipe size (just like the interest rate) would be assumed and the solution would be correct if the selected pipe size did in fact deliver the required amounts or gas/hour or liquid/second.

Such problems are well structured (well-defined) but can require a lot of patience and time to arrive at the solution. The computer can go through each set of calculations very quickly. The solution may not be exact, however, it is acceptable if the required degree of approximation is obtained. Such an approach is made in linear programming (LP) where an object function has to be optimized or pessimised (maximized or minimized).

As mentioned before a high degree of detail is required. This is inescapable and unfortunate because senior executives are so involved in the day-to-day routine of their work that they literally have little or no time to pause and think.

Any new concept requires an open mind and patience and so it is with the computer. The speed with which it gets about doing things compresses the 'size' of any administrative system or organization just as jet travel has reduced the size of the world. Each compression in its own sphere brings about the necessity for a complete reorientation of our way of getting things done. One has to think differently. Getting a new perspective on

matters is apt to be bewildering, for so much of what one is accustomed to seeing disappears and in its place much else, albeit unfamiliar, unfolds. We are quite familiar with aerial photography. When planes could go up high enough their photographs reveal certain overall features that were not 'seen' earlier. And this with no physical change in the topography photographed earlier by planes which could not fly so high.

However, the basic steps involved in problem-solving are:

1. Defining the problem.
2. Analysis and development of a plan of action.
3. Accumulating relevant data/information.
4. Performing calculations/logical analysis.
5. Decision making.
6. Implementing/recording of the solution.
7. Filing away the solution so as to assist in future planning particularly when similar situations arise.

Mr. Shaikh's Case

Let us consider the case of Mr. Shaikh who is located in a Karachi Sales office. Shaikh's boss arranges for him to visit Lahore on Thursday to meet a client at 10 a.m. and to meet another client in Lyallpur at 8 a.m. the following day on very important company business on account of a complaint concerned with the quality of one of their principals' products for which a certain amount of trouble-shooting will be necessary. Whilst in Lahore Shaikh's must visit another prospective customer for whom a business lunch will do. Also while in Lahore a senior official is interested in knowing more about a particular machine that Shaikh's firm deals in, a dinner in a local hotel is indicated The Lyallpur appointment is expected to last up till lunch time which means energetic Shaikh can get Mr. X over the lunch table to find out his future production programme so as to submit a quotation for a particular chemical well in time. Since Mrs. Shaikh has arranged with a family friend to attend a Qawwali at their place on Saturday night Mr. Shaikh realizes he must make it to Karachi by 10 or 11 p.m. latest on Saturday. To further complicate the situation the popular Shaikh couple are celebrating their tenth marriage anniversary at their parents home in Hyderabad on Wednesday. This programme had been made months in advance and it is not possible to avoid the function, the invitation cards having been printed.

Shaikh, who has a precise and logical mind refuses to jump to any conclusions. The obvious way of doing the job is to take the evening flight from Hyderabad to Karachi, the following morning the Lahore flight from Karachi and then to get the evening flight to Lyallpur from Lahore and to make it back to Lahore the same way the following afternoon catching the evening jet back to Karachi. But is this the logical solution? It might be which means it might not be. The matter must be properly analyzed, methodically: the alternate means of transport should be evaluated, cost-wise, time-wise and convenience-wise.... to arrive at optimizing the tour programme.

If we follow the seven steps listed above we find:

1. **DEFINING THE PROBLEM**:

   a) The earliest he can reach Karachi (where the necessary documents for the upcountry visit are) is Wednesday evening/night.
   b) Shaikh must be in Lahore Thursday morning to make the 10-00 a.m. appointment.
   c) Shaikh cannot leave Lahore for Lyallpur till he has got over the senior official dinner.
   d) Shaikh must being Lahore in time for the Friday 8-00 a.m. appointment.
   e) Shaikh must get back to Karachi by Saturday 10-00 p.m or else!

Second Stage

With a clear definition of the constraints which structure the problem Shaikh then proceeds to the second stage of the exercise. (See Fig.1)

2. **ANALYSIS AND DEVELOPMENT OF A PLAN OF ACTION**:
   What is the best way of moving from Lahore to Lyallpur? By train, plane or motor car? In order to be very very sure no details are left out. Shaikh gets hold of a pencil and paper to record in the form of a flow-chart the alternatives to as to find a solution.

   a. How can he get from Hyderabad to Karachi?
   b. How should he move from Karachi to Lahore and thence on to Lyallpur?
   c. How to get back from Lyallpur to Karachi?

The flow-chart will make quite clear where Shaikh will have to spend the nights. Since Shaikh has been m medically advised to control his diet---on account of dysentery and a tendency towards hypertension, he notes down the point that the hotels that he normally stays with should be telephonically informed in good time regarding this. After all in this jet age with whatever tensions that we have in and around us Shaikh must make sure that his health is looked after carefully.

3. **ACCUMULATING DATA/INFORMATION AND WORKING OUT ALTRNATIVES**

   Having gone so far, Shaikh then has to look into what means of transport he should take, road, rail or air or a mix of any of them. Also, whether by road should it be in a taxi or a bus? Whether by air should it be by jet or a propeller plane and whether by rail should it be by rail-car or by the express or mail? In order to come to a conclusion it is necessary to get hold of the time-tables and to bear in mind that since (it is the end of March) beginning of Aril the plane/train time tables will be changed on the midnight of March 31st/April

1st, Road maps are also required and also the reservation status at the hotels where Shaikh will put up. These data are available and whatever the necessary transcribed in the form of working notes, may be on a scratch pad. The cost of each mode with the time elements involved are all considered by Shaikh as he does not wish to waste the money of his company. It is now a matter of working out the cheapest way consistent with the overall objectives of the tour. Whatever calculations money-wise and time-wise are required have to be performed.

4. DECISION MAKING

By now it is pretty obvious there are several alternate feasible solution of accomplishing the mission successfully. Shaikh decides, without going into the complexities of the case, to:

a. Take the evening plane from Hyderabad to Karachi. His driver will bring his family down to Karachi in their car later.
b. Take the jet from Karachi to Lahore.
c. Take a taxi from Lahore to Lyallpur.
d. Take the afternoon plane from Lyallpur to Lahore connecting with the evening Karachi jet to reach in time for the Qawwali!

Looking back we find Shaikh was the decision maker. He defined the problem, analyzed and developed a plan of action step by step. At each step he had access to and made use of stored data both short-term-scratch-pad work-outs-and long-term (rail and air time tables). Having done this Shaikh then performed arithmetical and logical analysis to arrive at several alternate feasible solutions. Shaikh then decided between the alternate modes of travel and finally recorded his programme ie the solution to the problem. Having done so he then filed---stored---the solution for future reference.

Waste of Time

An examination of Shaikh's problem may appear a waste of time just as our moron 'boiling' the egg, but it throws up quite clearly the approach that has to be made use of if we are at all interested in using the computer as a problem solving management tool. The method used has been basically a step-by-step investigation with a certain amount of arithmetic coupled with logical analysis to arrive at the goal. A digital computer also makes use of the step-by-step approach... to arrive at the goal. The computer program is the analog of the step-by-step approach ie a sequence of detailed, logical instructions that keeps the computer on the move on the right path.

In order to perform the five basic functions ie of reading or receiving input, memorizing or storing data, performing arithmetic, making logical deductions and writing or printing-out the results the computer consists of five basic hardware elements:

1. Input Unit which 'reads'.

2. Memory unit or 'store'.
3. Arithmetic unit or part of the central processor'.
4. Control Unit which executes the sequence of operations and makes logical decisions as work proceeds apace. This is also part of the 'central processor'.
5. Output Unit which 'prints' out the results.

Another representation (Fig.2) of the different elements of a computer compared to clerical operations would be as shown above.

The above five modules are usually referred to as the 'hardware'. The program or set of instructions is called the 'software', which the computer rigorously follows. This pre-established plan defines the problem and sequentially sets out the method of solution---the algorithm---in very very small steps. Once a program has been debugged ie it proves that it can be successfully used, it can be utilized endlessly over and over again even though the values of the parameters may alter.

The development of a program follows Shaikh's plan of action very closely. The flow-charts indicate the sequence (Fig 1). Each step is an encoded instruction that the computer can understand. There are quite a number of 'languages' that have been developed. The second generation (we are now in the third generation) languages were oriented towards a particular manufacture machine and the programming or encoding had to be done by a numeric instruction code, a laborious process at its best. Now we have high-level languages such as Fortran and Cobol which are not machine oriented but are functionally oriented mathematically or business-wise and there are relatively few instructions to achieve the same results. Since these languages use mnemonics they are much easier to handle eg multiply may look like MPY and subtract like SUB, of course add could look like ADD! Such high-level languages are essentially machine independent. But there is a price that has to be paid for such simplicity and that is the machine needs an additional built-in program called a compiler (or processor) which translates the high-level few instructions into the detailed step-by-step machine instructions called the object language program or code of the particular computer which it uses to solve the problem. Once the program is completely encoded, it is punched out on cards, tape, or recorded on some other medium and is fed into the computer storage. The computer then draws on the stored program sequentially.

At Work

If there is a program of 2,000 instructions stored in the computer and when the 'start' button is pressed the computer starts 'reading' the first instruction and then acts on it. It then goes progressively on to the second, third.... two thousandth instruction. However, as it goes along the program may instruct the computer at certain 'decision' points to 'branch' out to another sequence of instructions or sub-program if a certain predetermined condition arises. Finally at the end of the last step the computer must be instructed to start all over again and go through the same rigmarole with the new set of input data or else go on to an entirely different problem.

Computer programs (software) are as expensive and important as the hardware. In the late fifties of the total cost of computerization software was around 25% nowadays it is 50% in few years it will be 75% this increase in software expense represents:

a) Decreasing hardware manufacturing costs, on account of new technology and improved efficiencies.
b) An increasing understanding of better utilization of the machine by the human mind itself.

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