THE FLOWCHART IS AN INCREDIBLY USEFUL TOOL FOR TRAINEES AND WILL OFTEN PROVIDE ALL THE GUIDANCE NEEDED TO ENABLE THEM TO MASTER A TASK.

FLOWCHARTING PRIMER

BY DAVID D. CRAM

The flowchart is to the instructor, student, manager and employee what radar is to the pilot or the X-ray is to the physician. It is the magic lens that allows us to see through fog and obfuscation. It is the most efficient tool ever devised for laying open how things are done, and the flowcharter can often point to ways of improving the performance of tasks that people skilled in the task have overlooked. Furthermore, flowcharting is easy to learn, interesting to do, and as valuable to those who need to know how a task is done as a map of the city is to the new taxi driver.

What is a flowchart? It's nothing more than a graphic way of laying out in sequence the steps and decisions that go into performing a task. It's a simple way of making the components of a task visible.

There are at least four good reasons for flowcharting:

1. *Flowcharting unveils mysteries.* Frequently, experts will insist that the only way to learn a task is through "experience," yet when a proper flowchart is done, you'll find that you can zero in on discriminations and steps, and give highly specific practice which will make novices into competent performers very quickly. Naturally, that's threatening to the "old timers" and you have to be careful with them. But that's not reason enough to make someone learn the slow way — just to guard the sensibilities of the incumbents.

2. *Flowcharting provides a systematic way to search for subskills.* When a task is broken into clearly specified steps, all laid out in order, we can look at each step in turn and ask ourselves what skills a person would have to be able to perform that step. We can then arrange the skills in a hierarchy and teach them in the order in which they must be learned.

3. *Flowcharting frequently will turn up ways in which a task can be performed more easily, or will expose unnecessary or dead-end steps which might have been useful at one time but which are no longer necessary.* I flowcharted a clerical task and discovered that the secretary was making four copies of certain records, filing two of them in separate files that were no longer being used. Not only were we able to eliminate two filing operations, but we got back an entire file cabinet. Small potatoes, sure, but multiply that by the number of clerical tasks and the number of people doing them and it can mean enormous savings.

4. *If a person has the required subskills, a flowchart can very often provide all the guidance necessary to help that person perform a task.* A book of flowcharts (or checklists made from flowcharts) sitting on a clerk's desk could enable anyone who knows the alphabet and can type to do most of the tasks that might come up during the clerk's absence. The substitute might be slower, but the essential work would get done, and correctly.

What Can Be Flowcharted?

What is a task, and what isn't? A task is a coherent lump of activity that usually is done by one person, and that has a meaningful outcome. It has a start and a finish.

It's the sort of thing that would follow a phrase like, "I'll give you *n* dollars if you'll go and . . . balance the checkbook . . . figure the standard deviation of these scores . . . assemble a bibliography on price controls . . . rotate the tires on my car . . . figure out my horoscope . . . make a weather forecast . . ." and so on. A task can be psychomotor or cognitive, large or small. If it gets too large, we can break it up into smaller conceptual units. Writing a proposal can be thought of as a task, but it's easier to think of it in sections — design a plan, develop a budget, write justifications, etc.

A job is a collection of tasks. Being manager of a training department is a job, comprised of tasks like preparing budgets, designing evaluation instruments, filling out government forms, answering letters, saying "no", and whatever else managers of training departments do.

The basic process is easy. It consists of watching a task being performed, or having someone describe its performance, or thinking of yourself performing a task. As you work through the task, each operation will be either a step ("take the square root," "press lever G," "Make incision"), or a decision ("Is X bigger than Y?" "Has red light come on?" "Is diastolic pressure below 60?"). For visual clarity, the steps are usually put in rectangles and the decisions in diamonds.

A decision means a branch, and is used where the task has a different track depending on the outcome of the decision. For me, the easiest and most convenient way to handle decisions is to word them in such a way that they have a "yes" and "no" alternative (Figure 2).

Figure 1.

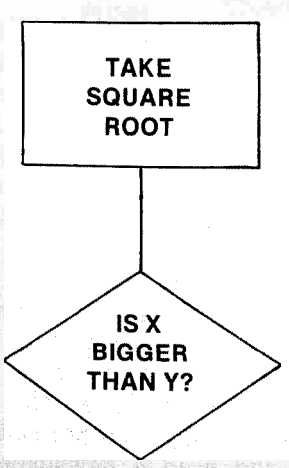
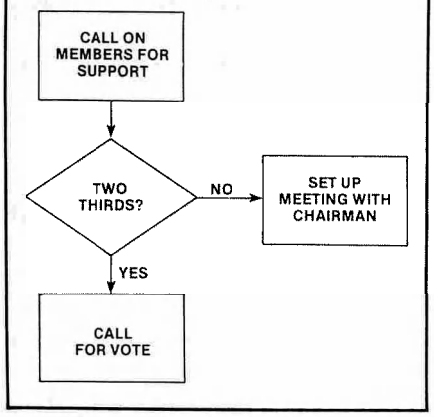


Figure 2.



That's my personal preference, but since out object is to make things visible, it would certainly be clear if you used any branching alternatives — over-under, on-off, more-less, etc. Suit yourself.

There's one other handy symbol. A small circle with a letter inside is a connector, to connect one page to another or one part of the flow chart to an earlier or later part without drawing a lot of long lines. That's all you need to know to start practicing flowcharting.

Evolving the Flowchart

Evolve is the right word. If you assume that the first effort will not be the final product, it will make starting easier. Just start, and scratch out as necessary, and before long it begins to shape up.

The easiest way to illustrate this evolution is to show you how an imaginary conversation between a flowcharter and an expert might go. I'll be the flowcharter, and the task will be selecting a sure-fire, guaranteed - to - double - in - six - months common stock. The first thing I have to do is find someone who can do that, so I go to the brokerage, find the most expensive car in the employee's parking lot, and ask to talk to the owner.

"I'm looking for someone who can select winning stocks, and I understand you're the best." (Always be nice to your experts — it makes them more willing to show off and tell you their secrets.)

"It's easy — all you have to do is buy low and sell high. How much do you want to invest?"

"Oh, I don't actually want to buy anything, but I'm trying to do a flowchart that shows what the selection process is like when it's being done competently. You know, what goes into picking a winning stock."

"Experience!"

"Yes, but if we can capture what it is that your experience has taught you, perhaps we can get even better at it. . . ." (What we're really thinking is not that we might get better at it but that we might get good, faster. But you can very quickly threaten people into silence, especially if you imply that you can give a novice knowledge worth 20 years' experience in a few hours. It's often true, but you don't get very far if you say that sort of thing to the expert who has a vested interest in protecting that expertise.)

I continue, "Suppose you were going about your business and I came along and asked you to pick a stock for me to buy. What would you do first?"

"Well, I'd examine the market."

"I see." (I don't, yet, but we have to start somewhere, so I begin my flowchart (Figure 3).)

"What's the next thing you'd do?"

"If the market is OK, then I select a strong industry. . . ."

('If the market is OK' means that a decision has to be made, so I word it as a question and put it in a diamond. I know I'll have a 'yes' and a 'no' alternative coming out of the diamond. 'Select a strong industry' is a step — the 'yes' alternative. I'll find out now what the 'no' alternative is. . . .)

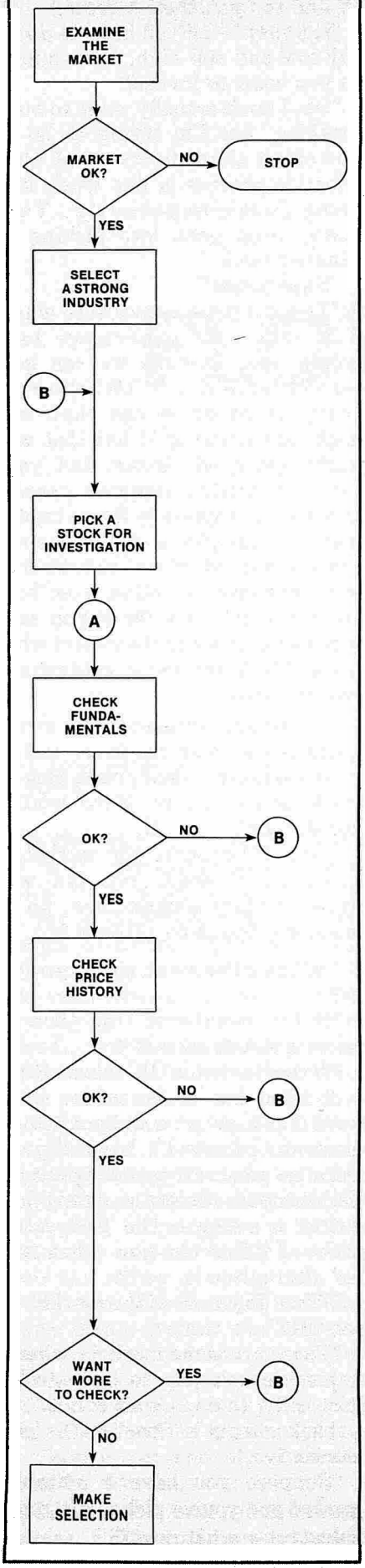
"What do you do if the market is not OK?"

"There are some markets where it just doesn't pay to buy stock. Best thing to do is wait it out." (I go back and put a "Stop" on the 'no' alternative.)

"Suppose you have a suitable market and you've picked a strong industry — what next?"

"You pick a stock to look at with-

Figure 3.



in that industry." (There must be more to this — after all there are 25,000 stocks to choose from — but for the moment I'll just add the step.)

"What then?"

"Well, you check the fundamentals. You don't want to buy any stock that isn't basically healthy. Then if it's OK you look at the price history and if that's OK . . ."

"Hold it! Let me get this down . . ."

(I add the decision, 'fundamentals OK?' and then the next step, 'check price history.' That leads to another decision, 'history OK?' and I add that to the flowchart. Now I want to pick up the 'no' alternatives.)

"If the fundamentals or the price history aren't OK? . . ."

"Pick another stock to look at!"

(My 'no' alternative sends me back to step 4, so I establish a loop.)

"Suppose you find a stock that meets all your criteria — is that it? Are you finished?"

"Not necessarily. We hardly ever buy the first stock that passes the tests because we want to see if there are any better ones. So we might look for several to choose from."

(I add a decision.)

"Suppose you now have a handful. What then?"

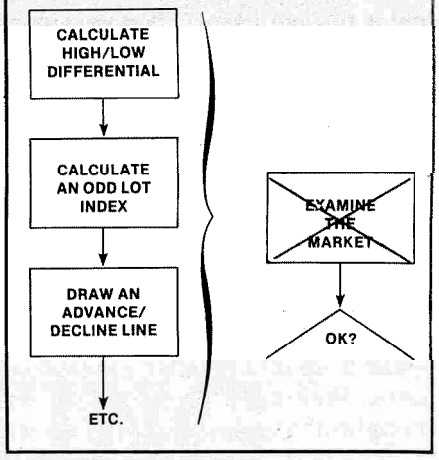
"Why, you pick one and buy it!"

So far we have a nice looking flowchart that doesn't tell us a thing. That is, unless we know how to "examine the market" we won't know what to *do*. But at least we have the scaffolding up. Now we have to go back and see if we can start building the structure by determining what the steps are. Here's how the first part of the second round might go (Figure 4).

"Let me go back to that first step again. When you say, 'Examine the market,' just what do you do? For example, do you pick up the *Wall Street Journal*, or do you look in the back of *Barrons?* What are the things that you examine that tell you whether the market is sick or healthy?"

"Well, let me see. First I'd calculate a high/low differential, and

Figure 4.



then an odd lot index, and then I'd draw an advance/decline line . . ."

"Hold it while I jot that down . . ."

(I scratch off the "Examine the market" box and enter the steps my expert has just mentioned. Now if the person for whom the flowchart is being prepared knows how to calculate these things, this flowchart will be at a meaningful level and it would be unnecessary to go into any more detail. In my case I still won't know what to *do*. We're getting closer, but I still need to see where the individual bricks go.)

So I start round three: "How do you calculate a high/low differential?"

"Golly, don't you know anything?"

"You're the best in the business, and I want to be sure we get this whole process down correctly."

"Oh. Yes. Well, the way to do it is, you make a 10-day moving average of the highs and lows, and then subtract . . ."

"Hold on — I'm really dumb. What highs and lows are you talking about?"

"Why, the daily highs. Every day on the stock page there is a listing of all the stocks that have reached new highs and all the stocks that have reached new lows. You take the number of new highs for the past 10 days and add them up. Then you take the number of new lows and add them up, then subtract the lows from the highs and divide by 10."

"Let me get that down . . ."

(Aha! Now we're at the level where anybody who can add, subtract and read a newspaper can

function. If I'm writing the flowchart for me, I'd have to stay at this level of detail throughout the rest of the process. However, it may not be possible to do the entire flowchart at this level of specificity. That is, when you get to the part where all the indices have been calculated and all the fundamentals of several stocks have been examined, the conversation may go like this:

"OK, expert, now we've done all this figuring. How do you decide which one to buy?"

"Well, you look them over and pick one."

"What tells you to pick one over another?"

"Experience."

(I ignore that.) "Do you count up the number of positive indicators, or do some indicators weigh more heavily than others, or what?"

(Often there will be a long pause here, while the expert is groping back in the recesses of memory to find a way to answer.)

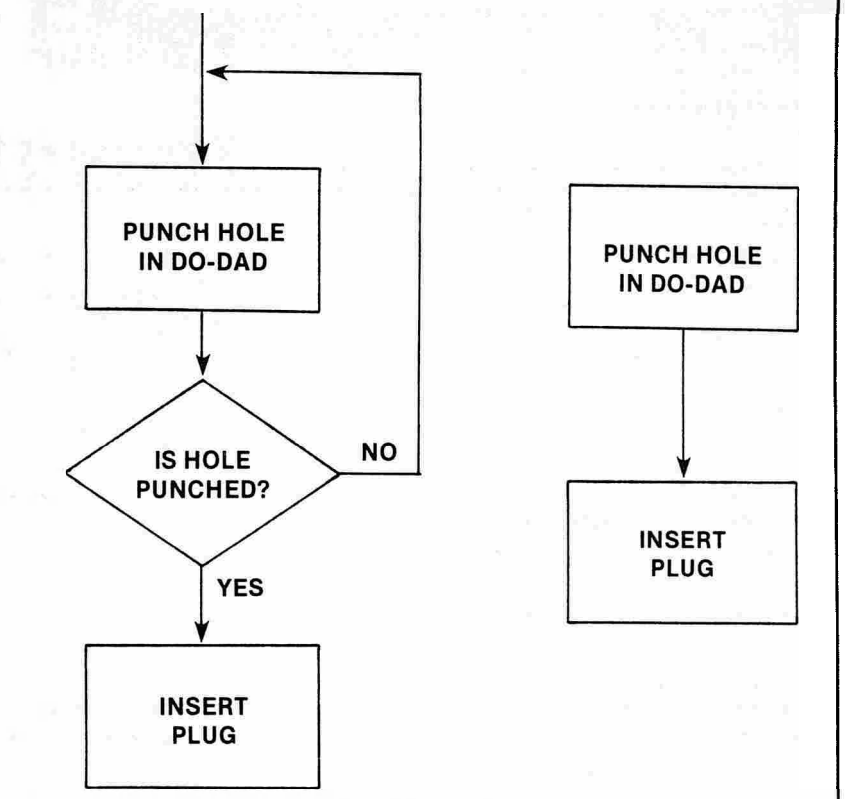
"I don't know how to tell you. You just get a feel for it. Sometimes one stock will glow at you and you pick it even though another one may do better in the numbers."

"When they glow at you like that, do they always go up?"

"Sure they do." (Uncontrollable laughter, bordering on hysteria.)

Even when you reach a point of impenetrability, don't be discouraged. A good flowchart will serve to isolate those points and make the rest transparent enough to speed people to the skill.

Figure 5.

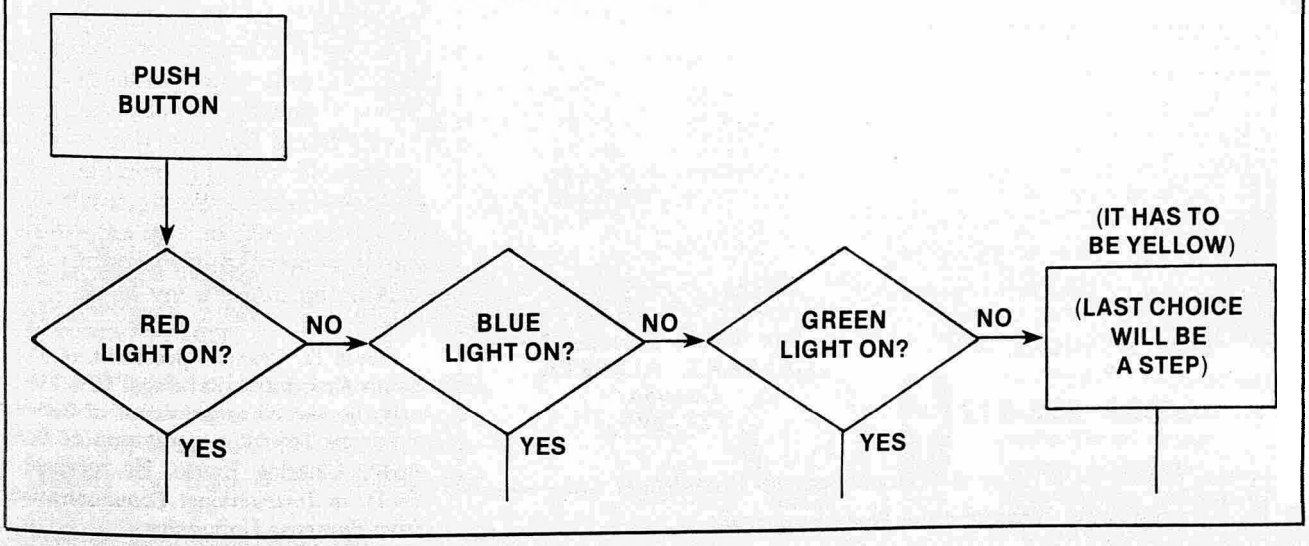


Some Flowcharting Tips

The best way to get good at flowcharting is to do a few, but there are some common problems that people run into when they are first learning how that can make their early flowcharts a bit cumbersome. For example, there's a temptation to flowchart the learning process as well as the task. The flowchart is a map of what the skilled person does.

The process of turning unskilled people (students) into skilled people is called instruction. Before you

Figure 6.

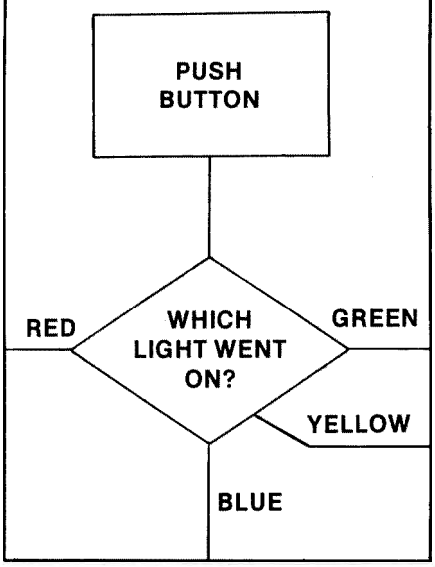


can design instruction, you must know what the desired end-product looks like, and that is what the flowchart tells us. If we put the instructional process ("Read instructions") in the flowchart we imply that even skilled people have to undergo instruction in order to perform a task.

Avoid unnecessary redundancy. In a flowchart, assume that if there is a step, it is performed. That is, it is not necessary to put in a loop which merely asks if the previous step was in fact performed. In Figure 5, the instruction is to punch a hole, and you can't get to the next step without punching it.

Some decisions will have more than two branches as outcomes. For example, imagine a process where the instruction is to push a button, say, and the outcome will be that one of three or four different colored lights will go on. If you diagram it as a series of "yes" "no" decisions (Figure 6) it can imply a sequence when in fact there is none. The other alternative isn't as tidy, but takes less room and doesn't suggest sequence (Figure 7).

Figure 7.



It sometimes happens that a flowcharter will start flowcharting a task that is very long but where the performer does not work constantly at that particular task. In a lab experiment, for example, the technician might every 20 minutes have to stir and measure temperature of something and note time on a log, and then go about other business in the lab until time to go back and make another entry. The question is sometimes asked, "How can I possibly flowchart every task the technician might do while waiting for the 20 minutes to pass?" Of course, the answer is that you don't. The flowchart is a map of the *task*, not the doer. If the task required waiting 20 minutes, the flowchart will have a decision asking whether the 20 minutes is up. If it isn't, the doer has to wait. What the person does during that 20 minutes is no business of this flowchart.

A flowchart is a road map of the task, and a road map tells us the route to follow, but doesn't care whether we walk, ride a unicycle, drive, or whether we stop off to buy an ice cream cone on the way. Also, a road map remains the same whether we are a skillful driver or a beginner.

Remember that most flowcharts are tools used by the designer to help decide what to teach students. It's easier to teach if we can follow a model of the process. A flowchart also makes it easier to tease out the subordinate skills a person needs to do the steps in a task. A flowchart makes it easier to stick to the subject, because the subject is delineated.

Those are the primary reasons for flowcharting. But it turns out that the flowchart is an incredibly useful tool for the trainees and often will provide all the guidance they need to enable them to master a task. Naturally you will want to make available anything that will help your students to sail forward quickly. Finally, as a manager I found flowcharting to be an invaluable tool for solving work flow problems, getting work done in the absence of key employees, and in general understanding what was being done in my name.

David D. Cram is president of D.D. Cram Associates, Saratoga, CA. Formerly, he served as president of General Program Teaching, a division of Commerce Clearing House. He received a Ph.D. in Instructional Communications from Syracuse University.