I: Putt's Law

Beginning a disquisition on the vagaries of upward mobility through the ranks of your fellow workers in today's r and d community—how to do it and what to do when you get there

by Archibald Putt

Years of study of the sociology of organizations dealing with modern technology have convinced me that such organizations are quite different from those in other fields. Thus the excellent "P-literature," by Parkinson, Peter and Potter, which describes so clearly most social hierarchies, is inadequate and misleading when applied to the fields of technology.

The *Peter Principle*, for example, states that "In a hierarchy every employee tends to rise to his level of incompetence." We are all familiar with the workings of this principle in typical hierarchies that do not deal primarily with sophisticated technology.

Upon reflection, the *Peter Principle* seems to be self-evident. One may ponder why it took so long to be recognized. The corollary to it is that "In time, every post tends to be occupied by an employee who is incompetent to carry out its duties." This explains why even simple things are so often bungled in large organizations.

Avoiding reaching one's level of incompetence in a hierarchy is virtually impossible. Once a promotion has been offered, a person's ego conspires with social pressure to force its acceptance. The hapless engineer who turns down a job as Corporate Vice President because he prefers working as an engineer can only expect problems. How can he explain this to his family and how can his wife explain his lack of ambition to her parent! or to her friends? He may refuse the first offer of a promotion, but he is unlikely to refuse the next. Thus begins his inexorable rise to his level of incompetence.

The only satisfactory way to avoid reaching one's level of incompetence, according to Peter. is through *creative incompetence.* This is achieved by developing a high level of incompetence in some area that does not affect one's present performance, but does assure there will be no further offers of promotion. This is a very uncommon tactic for persons in most hierarchies.

It may readily be observed, however. that creative *incompetence* is the rule rather than the exception in hierarchies in science and technology. Consider, for example, the case of Mr. Bottomly, who had been employed in the development laboratory of a large electronics firm for several years. He learned that his superior was to be promoted and that he was the most likely candidate for the vacated position. The next day he took off his shirt in the laboratory and continued to work in his undershirt, complaining loudly about the heat. When his superior was promoted, it was another member of the group who was chosen to fill the vacancy. Mr. Bottomly soon returned to wearing a shirt, except on the rare occasions when he felt promotions might be under consideration.

Then there is the case of Dr. Schwartz, whose phenomenal grasp of the literature in physical chemistry made him a great asset in the central research laboratory of a major corporation. He was able to carry hundreds of references to the literature in his, head and had perhaps 10,000 or more carefully filed away in his office. A query to him about almost any subject in this broad field would invariably produce more information in a few minutes than could be obtained from a library after weeks of searching

Dr. Schwartz was under consideration to become the manager of the chemistry group until it was learned that he continually misplaced time cards and other administrative records. Even more annoying to the administrative group was the fact that he frequently forgot to cash his own pay checks for weeks at a time, thus making it hard to close out the books at the end of each month. Such traits were unacceptable in a manager,

and thus Dr. Schwartz continued for years doing his own research and keeping his well-organized file of the chemical literature as a service to himself and the other chemists in the laboratory.

Perhaps the best known case is that of Albert Einstein, the preeminent scientist of this century. In a time when long hair was not common, his was not only long but bushy. He typically wore an open collared shirt, old sweater and baggy trousers, and was never known to known to wear socks under his shoes. Thus he never had to contemplate major administrative jobs and spent his life at positions in university hierarchies where he could concentrate on theoretical physics.

Such examples of creative incompetence are so numerous in science and’ technology that many low-level positions remain staffed by competent persons who never reach their level of incompetence. Many of these persons find their satisfaction in technical work itself and would be bored and frustrated by administrative responsibility.

However, successful technocrats are not found among the ranks of such plodders of limited vision and ambition. Instead, they are found among those

who aspire to eminence through their position in the technical hierarchy. Such men will find their climb upward made easier by the large number who choose to remain behind by practicing creative incompetence.

If the large number of persons practicing creative incompetence were the only anomaly in technological hierarchies, we might conclude that individuals aspiring to higher placement would be promoted to their level of incompetence as in any other system. However, there is another anomaly with more interesting consequences; namely. there frequently is no way to judge whether individual is competent or incompetent to hold a given position. Stated another way. there is no adequate competence criterion for technical managers.

Consider. for example. the manager of a small group of chemists. He asked his group to develop a nonfading system of dyes using complex organic compounds that they had been studying for some time. Eighteen months later they reported little success with dyes but had discovered a new substance that was rather effective as an insect repellent.

Should the manager be chastised for failing to accomplish anything toward his original objective, or should he be praised for resourcefulness in finding something useful in the new chemical system? Was 18 months a long time or a short time for this accomplishment? Because no one had ever worked in this chemical system before, how could one judge if the results of the group demonstrated competence or incompetence?

When the first US space laboratory was placed into orbit in May, 1973, its meteoroid and thermal shielding and one of its solar cell wings were torn away. A third solar cell wing was jammed closed so that only two of the wings deployed properly. This threatened the mission with failure. Should the project leader have been fired for failure to prevent this problem. or should he have been given a citation for subsequently getting a makeshift parasol erected to shield the laboratory from the sun and getting the jammed wing deployed during a space walk by the astronauts?

In an advanced research or development project, success or failure is largely determined when the goals or objectives are set and before a manager is chosen. While a hard-working and diligent manager can increase the chances of success, the outcome of the project is most strongly affected by preexisting but unknown technological factors over which the project manager has no control. The success or failure of the project should not, therefore, be used as the sole measure or even the primary measure of the manager's competence.

Putt's Law Is promulgated

Without an adequate *competence criterion* for technical managers, there is no way to determine when a person has reached his level of incompetence. Thus a clever and ambitious individual may be promoted from one level of incompetence to another. He will ultimately perform incompetently in the highest level of the hierarchy just as he did in numerous lower levels.

The lack of an adequate *competence criterion* combined with the frequent practice of *creative incompetence* in technical hierarchies results in a *competence inversion*, with the most competent people remaining near the bottom while persons of lesser talent rise to the top. It also provides the basis for Putt's Law, which can be stated in an intuitive and non-mathematical form as follows:

Technology is dominated by two types of people: those who *understand what they do not manage, and those who manage what they do not understand.*

As in any other hierarchy, the majority of persons in technology neither understand nor manage much of anything. This, however, does not create an exception to Putt's Law, because such persons clearly do not dominate the hierarchy. While this was not previously stated as a basic law, it is clear that the success of every technocrat depends on his ability to deal with and benefit from the consequences of Putt's Law.

Next: Three Laws of Crises

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience in observing and analyzing the always intricate — and often paradoxical— interplay of personalities in the r and d hierarchy.

Editor's Note: We consider ourselves fortunate indeed to be able to present to the r and d world the original work of Archibald Putt. leading (and possibly sole) analyst of the hierarchical intricacies of that world. This Is the first in a series of articles in which Putt will describe laws and corollaries he has developed to explain the sociological structure within which all r and d workers must live.

The Successful Technocrat

2: Three laws of crises

Our expert on the hierarchical intricacies of the r and d world discusses the hazards of excessive perfection and promulgates a trio of governing conditions for building your own crises

by Archibald Putt

The first installment of this series (January, 1976) dealt with two anomalies of the technical hierarchy that provide a major basis for Putt's Law. However, there is yet another important anomaly: *A person must rock the boat to get ahead***.** This is just the reverse of the situation in most hierarchies, where rocking the boat is socially unacceptable and definitely not conducive to promotions.

This third anomaly results from the fact that rapid progress in technology is always accompanied by great uncertainty. *Blue sky research*, for example, refers to projects where both the problems and benefits are unpredictable, but are expected to be large. In such research it is expected that target dates will be slipped and that additional people and equipment will be required. *Pushing-the-state-of-the-art* is another popular phrase used to describe applied research projects designed to advance technology more rapidly than in the past. Such projects invariably lead to problems and crises in the organization. In fact, if there were no crises, it would be presumed that the goals were not aggressive enough—and no technologist can afford to have projects with insufficiently aggressive goals if he intends to get ahead.

First Law is stated

Thus, the importance of rocking-the-boat or having some imperfections or crises on the projects of a technical hierarchy is evident. The First Law of Crises follows rather logically from these observations and may be stated formally as follows:

Technological hierarchies
abhor perfection.

The implication to ambitious technologists is clear. They must avoid perfection. This admonition is unnecessary for most persons who could not achieve perfection even if they tried. However, it will be of help to some. Consider, for example, the case of Roger Proofsworthy, whose excessive competence caused him to Labor needlessly at the bottom of the hierarchy for many years.

Proofsworthy was hired into the Development Laboratories of the Ultima Corporation shortly after receiving his PhD in electrical engineering. He was a man who combined a solid academic background and good technical insight with a dogged refusal to be less than perfect in all his activities. Once he was given an assignment it was as good as done.

In his second year with the company he was placed in charge of the transfer of a technical innovation from the Development Laboratory to the Manufacturing Division. As usual, his performance was outstanding When technical problems were uncovered, he personally set to work to solve them, often working around the clock until the job was completed. At other times he found himself embroiled in the difficult "political" problems associated with the reluctance of the Manufacturing Division to accept the work done in the Development Laboratory. However, he managed to resolve all of these difficulties before they became major issues in the corporation. Within a few months, he had accomplished a task that normally would have taken several years and would have involved individuals at the highest levels of the corporation.

In spite of this outstanding performance, Proofsworthy did not receive the next promotion. It went instead to a colleague of substantially less capability who frequently had difficulty handling his projects. These difficulties often went unsolved until after corporate officers became involved. As a result, the colleague had become known throughout the corporation as an individual who handled difficult assignments. He was found to be personable in his interactions with management and quite level-headed. He was thus a logical choice for promotion.

Proofsworthy, in contrast, was un-known beyond his immediate manager, and even his own manager was unaware of all the difficult problems Proofsworthy had personally solved.

The colleague chosen for promotion in this case went on to achieve further promotions and rapidly reached a high level in the hierarchy. Proofsworthy remained a staff engineer for many years. He finally left Ultima in disgust. Unfortunately, the problem that plagued him at Ultima continued to plague him else- where. He always achieved such a high level of perfection that his accomplish-ments went unnoticed.

Perfection brings no reward

Such perfection is seldom seen near the top of a technical hierarchy because individuals so afflicted with perfection are usually unable to progress beyond the first or second levels. Nevertheless, my extensive research has found one such case in a very small company, and it is well to reflect upon it.

Cosmo J. Draper was hired as director of research and development for a small company whose major product line was becoming technically obsolete. Within a year, he put together a cadre of creative individuals who saved the line from obsolescence and went on to assure the company's technological leadership in this area.

As the years went on, Draper continued to strengthen the company's research activities, expanding their scope to include all fields of interest to the company. He also established effective working relationships with the product groups so that innovations moved smoothly from research to development and then into the manufacturing division.

The members of top management no longer had cause to become involved in technological issues; they spent most oftheir time with marketing and financial problems. The memory of the crises that caused them to hire Draper gradually faded. Finally, in an economy move, they gave Draper early retirement and dismissed four of his top technologists and some support personnel. What remained of Draper's organization was absorbed into the manufacturing groups. The chairman of the board was pleased to advise the stockholders at the company's next annual meeting of the belt4ightening measures, which had re suited in a small increase in profits. Draper, however, was conspicuously missing from the meeting.

These examples of the hazards of excessive perfection clearly confirm the validity of the First Law of Crises. They further suggest that any manager who is competent enough to avoid crises entirely should nevertheless introduce some into his operation, thus assuring his survival and upward progress in the technical hierarchy. In this way, even an exceptionally competent person should be able to rise as rapidly as an individual with just the right amount of incompetence for the job.

Fixing Incompetence level

But what is the right amount of incompetence or the right amount of crises to introduce into a given job? A partial answer to that question is given by the **Second Law of Crises:**

The maximum rate of *promotion is achieved at a level of crises only slightly less than that which will result in* dismissal.

Because of the precarious nature of the boundary between cause for dismissal and the maximum rate of promotion, a prudently ambitious technocrat should not begin a new assignment with this high a level of crises. Care is especially recommended because the exact level of crises permitted before dismissal may not be well understood until after some time has been spent in a new assignment. Furthermore, some crises may occur quite spontaneously and unavoidably. Thus, the best strategy is to begin a new assignment with as low a level of crises as possible. The level should then be increased gradually until the desired promotion occurs. The optimum timing for this, as defined by the Third Law of Crises, can be stated in mathematical form as

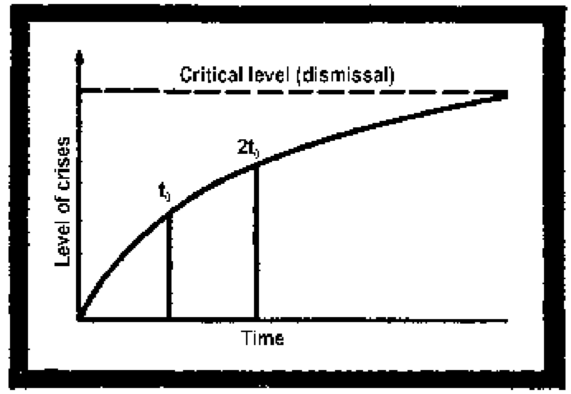
$$C = C_0(l — e^a)$$

where C is the actual level of crises; C_0

is the upper level of crises that will be tolerated; a is the quotient of time t since the last promotion divided by expected time t_0 between promotions; and e is the universal constant, found throughout the technical literature, which has an approximate value of 2.7182818285.

This equation can be represented by the simple curve shown in the accompanying figure, where the dashed line

represents the maximum level of crises that the corporation will tolerate before firing the individuals responsible, and the solid curve is the desired level of crises to be achieved at each point in time following a promotion to a new assignment. It is evident from the curve that a person should begin a new assignment with as much perfection as possible. He should then increase the level of crises gradually until the attention of top management has been gained. Usually this can be accomplished with



Third Law of crisis in graphic form.

about one-third the maximum tolerable level of crises.

One-third of maximum tolerable level should, therefore, be reached as soon as the next promotion can reasonably be expected. This time is given as t_0 in the figure. The time 2t0 is also of interest, because a person will by then have waited twice as long as expected for a promotion. Furthermore, the optimum level of crises will have reached two-thirds of the maximum permitted level.

If the desired promotion does not occur at this point, the individual should begin looking for another job, because further increases in the level of crises will place him dangerously near the upper acceptable limit. Furthermore, any company that does not respond by the time two-thirds of the maximum permitted level of crises has been reached will not survive unless it operates in an area where technology is unimportant. And such a company is no place for an ambitious technocrat.

Next: The Law of Failure

3: The law of failure

In the r and d world it's "To the *loser* belong the spoils" (if you play your cards right). Our expert on getting ahead tells how, when failure strikes, you can salvage your career

by Archibald Putt

In earlier installments (January, March) we have seen how a person can rise in the technical hierarchy by having. the right amount of incompetence or by artificially adding crises to compensate for his own excessive perfection. But what about the person with more than the desired amount of natural imperfections? Can a person succeed if his own incompetence prevents him from staying below the maximum tolerable crises level?

Fortunately for most, the answer is yes. There is hope of promotion even for the truly incompetent. However, a good appreciation is needed of the Law of Failure:

Technology abhors little failures
but rewards *big ones.*

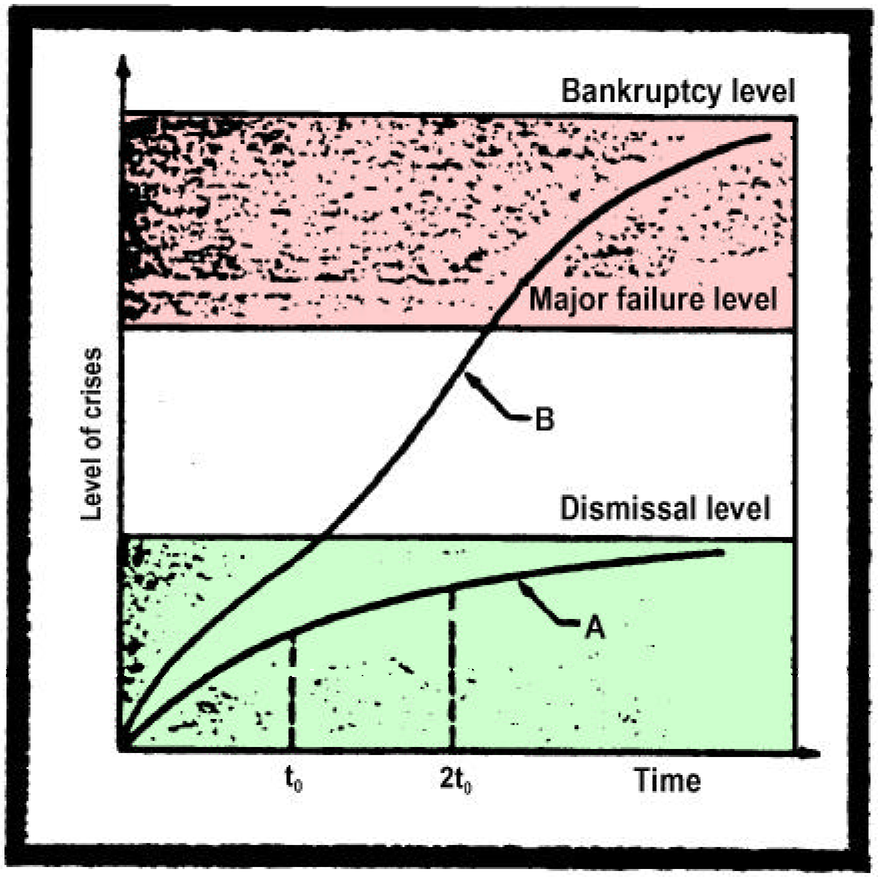
Consider, for example, the problem faced by two corporate officers trying to select a manager for an important development project. The first person under consideration managed three minor projects in the past and each one failed. Such a person is clearly not the right choice! The second person has successfully managed several small projects and is thus a very good candidate. The third person, however, had managed a project that became one of the largest technical failures in the history of the company. As a result, he had greater technical management experience than either of the other candidates and had, no doubt, learned a great deal from the failure.

The corporate officers had the wisdom to know that failure in high-technology projects is frequently unavoidable. So, after due consideration, they selected• the third candidate to manage the new project.

Seems unlikely? Not at all! When management is forced to choose between a person with demonstrated successes in small projects and a person with a demonstrated failure in a large poject, it more often than not opts for the large failure.

For the ambitious technocrat, the Law of Failure provides an obvious course of action that is summarized by a corollary to the law: If you must fail. fail big. An important refinement to this corollary is knowing the optimum timing for big failures. The mathematics for this is quite difficult, but the resultant curve (in the accompanying figure) can be discussed simply. Curve A is the optimum strategy for introducing crises; it was discussed in an earlier installment. Curve B shows what to do if you find yourself unavoidably too far above curve A.

If one's level of crises exceeds two-thirds of the dismissal level before time to (when the earliest promotion might be expected) quick action is needed. New crises should be introduced as rapidly as possible in order to pass quickly through the zone of minor failure. Every effort should be made to exceed the major failure level in a time less than $2t_0$. Once a person is “safely” above the major failure level, his job is once again secure. Management will be unable to find anyone “qualified” to take over such a project.



It is generally best to stop increasing the level of crises before the company becomes bankrupt However, there is a more advanced ploy in which the company actually is driven into bankruptcy. In the simple version presented here, the manager holds the level of crises above the major failure level but below the bankruptcy level until he and top management solve the problem. An important aspect of the solution must of course be a satisfactory new assignment for the troubled technologist.

Some scholarly individuals have suggested that a technologist should not waste his time trying to follow the con-trolled introduction of crises of curve A. Rather, he should immediately target a course to get above the major failure level as quickly as possible. This suggestion, however, fails to take proper account of the uncertainties at each step.

My analysis shows that a person who follows curve A has a probability of being promoted before time $2t_0$ of 97.3 per cent. Thus, if one assumes ten pro-motions will be required to reach the top, the probability of getting there through ten consecutive promotions is quite good: 76.1 per cent.

On the other hand, it is in no sense a certainty that every big failure will be followed by a big promotion. My studies show, in fact, that the probability is only slightly better than 50-50; that is, 57.4 per cent. Assuming that five big promotions are needed to get to the top, the probability of getting there through five big failures is thus 6.2 per cent, or only about twice as good as the probability, in tossing a coin, of turning up heads five times in a row.

Most people would not be willing to risk their careers on odds like this. However, for the person of virtually no technical competence at all, the path of big failures does provide a 6.2 per cent chance of reaching the very top!

Next: The S-Curve Law.

4: The S-curve law

Having told how to manage projects to best advantage (yours) Putt now discloses the secret of selecting the best project (for you) and how to foresee the best time to get out of it

by Archibald Putt

The Laws of Crises and the Law of Failure, described in earlier installments, provide a formal structure on which the technologist can base his management of high-technology projects. But what about the selection of projects? Is there any methodology that can be followed to select projects likely to succeed?

There is little advice that I or anyone else can offer in this regard. The success or failure of a project is largely determined by technological factors that are not understood until after the project is well underway. The probability of success for advanced development projects at their inception, is only about 30 per cent, and there is no general method for predicting which ones are most likely to succeed.

It has been rumored that a Harvard graduate student of management became intrigued with this problem and investigated a technique in which random numbers were assigned to research projects. The success or failure of these projects was then predicted using a formula based on the numbers carried by horses in the win, place and show columns at Belmont. News of the remarkable success of his method, as compared to the more heuristic methods now used by the research directors themselves, was said to have been suppressed by a clandestine International Association of Research Directors. The members of this august group rightfully feared that their own hard-won positions as technology soothsayers would be placed in jeopardy if the success of the method became generally known.

It occurred to me that if one good approach may have been suppressed then there could be other concepts worth considering that had also been sup.. pressed. With this in mind, I proceeded to interview research directors and other high-level managers of technology. These interviews were, however, unproductive. There

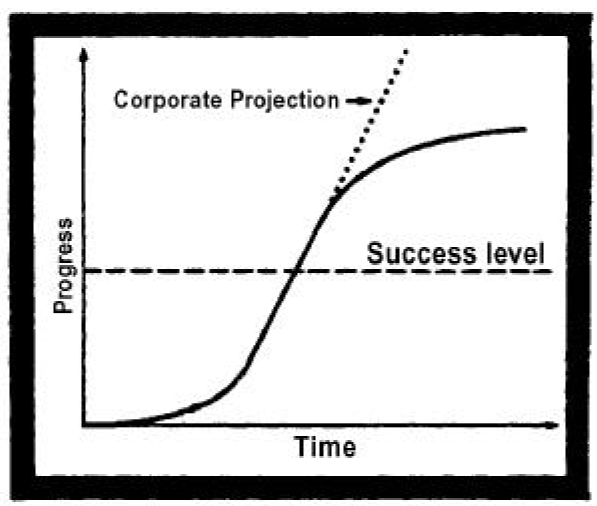


Fig. 1. **Putt's aptly named curve.**

appears to be a paucity of ideas on how research or development projects should be selected.

The most universal suggestion I got from successful managers was. "Just ask me, and I'll tell you." However, when I queried any one manager about the quality of advice I should expect from one of his colleagues, the response was usually noncommittal; all too frequently, it was accompanied by a bit of a sneer.

Fortunately, I did not terminate my quest here, but turned my attention to more promising areas. The stock market was particularly interesting because the problem of selecting a good stock is quite similar to the problem of selecting a good research project. Selection of stocks on "fundamenta1s" is generally not successful unless the fundamentals include Inside information." In technology. however, all the expletives uttered in God's name do little to make available to man any "inside information" that He may possess.

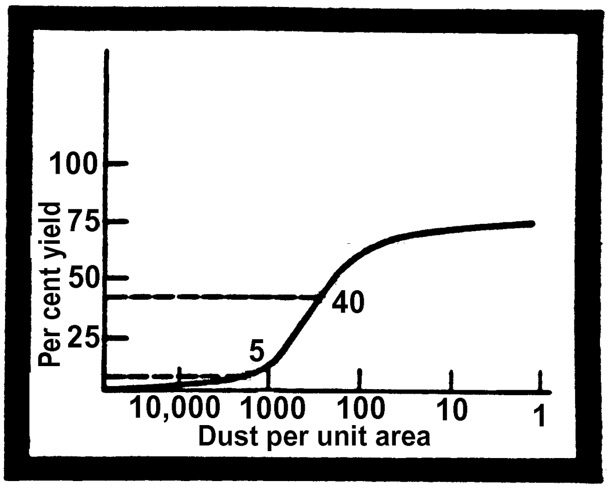


Fig. 2. Another S-curve manifestation.

Because most stock market services don't have inside information either. and would hardly share it if they did, they base their recommendations on "technical factors," relying primarily on curves of past performance projected into the future. Even this approach has quite limited success for stocks because of the lack of universal laws governing their performance.

This I realized was the key to success in technology, for there is a universal law governing all progress in technology. the S-Curve Law:

All progress in technology
follows an S-Curve.

The S-Curve is the solid line in Fig. 1. While it does not provide any insight into the value of projects before they are initiated, it can be used to determine when projects will become successful.

In the early part of the curve, a lot of time and effort is expended for very little progress. At this stage there appears to be little chance of reaching the successful level indicated by the dashed line in the figure. However, in projects that are destined to be successful, the pace of progress gradually quickens. as indicated at point A on the curve. By point B the rate of increase of progress is quite noticeable, and yet the rate will continue to accelerate further, until a yet higher rate of progress is achieved well before the level of success is reached at point C.

Following the initial success of the project, progress usually continues at a rapid rate, leading to an over-optimistic corporate straight-line projection. as shown in the figure. Then a gradual leveling-out occurs. This causes great trauma in the marketing and financial sectors of the company, which results in increased pressure on the technical groups for it is their job to solve the problems and get the technical progress back onto the optimistic straight-line projections.

Clearly there is no reason to seek responsibility for a project in the early stages when progress is slow and success uncertain. It is best to be given responsibility after point B (when progress is picking up) but before C (when the project has already been proclaimed a success).

There is great temptation to remain with a project long after the point of success has been reached. This is technically referred to as "basking in the glory." It is. however, an ill-advised luxury. For once the rate of progress begins to level out at point D. it may be too late to avoid the recriminations

associated with failing to meet the straight-line projections.

Even worse than staying on a project too long is the mistake of stepping in to carry the ball once point *C* has been reached. By this point, further progress is already assumed, but it is more likely to be attributed to the technology than to the project manager. Furthermore, incompetent management cannot be masked at this stage by the myriad of uncertainties and technical problems that can cover a manager's incompetence in earlier stages of a program.

This qualitative discussion of the S-Curve is sufficient for most purposes and provides a good initial basis for project selection by ambitious technocrats. Substantial refinements are, however, available through mathematical analyses. Of particular interest is the application of the S-Curve Law to progress in the development and manufacture of semiconductor components.

No field of modern technology has moved more rapidly and provided more opportunity and risk than this one. The first replacement of electronic vacuum tubes (once called radio tubes) by transistors occurred in the 1950s. Since then a two-fold improvement in the cost-performance of semiconductor devices has occurred every two to three years.

For many years, these improvements have been closely linked with size reduction, which in turn has been made possible by reducing the amount of dust and other contaminants during fabrication. This has been accomplished through the use of carefully designed "clean rooms." A detailed analysis of the yield of devices in manufacturing showed that it was related to the density of dust par-tides, according to the well known S-Curve. In this case percentage yield was plotted on the vertical (progress) axis and the reduction of dust density was plotted along the horizontal (time) axis as shown in Fig. 2.

Several years ago, an engineer for a major manufacturer of semiconductor devices became aware of this recently derived relationship at a most opportune time. He was serving on a five-man task force established by the president to find out why there was still no yield of a newly designed semiconductor device. The task force learned that recent steps taken to reduce dust in the "clean room" had improved yield from some-thing less than 1 per cent to about *5* per cent. This, however, was still far below the 40 to 50 per cent yield required to achieve profitability in the program. The project leaders and the task force members were, therefore, not optimistic about the chances for success.

The mathematical analysis of yield versus dust particle density, however, revealed that the improvement in cleanliness required to get from a 1 to a 5 per cent yield was actually greater than that needed to get from a 5 to a 40 per cent yield. Since this recent analysis was known only to the engineer, only he had reason to be optimistic.

He wrote a damaging report on the incompetence of the program's manager and submitted it with a long list of recommended actions. Most of these actions, he failed to note, were already being implemented or were in the planning stage by the present manager.

When top management reviewed the various reports on the project, they were understandably distressed at the very low semiconductor yield. The negative comments about the present project leader suggested a solution on which they were eager to act.

Proof of the wisdom of this decision came in less than six months, when the engineer from the task force, now the new manager of the project, was able to report a 43 per cent yield, with further improvements expected. In making the recommended change in project leaders, management had truly done its work effectively.

Unfortunately, the engineer became so enamored by his own success that he continued to manage the project beyond the point where rapid progress could be expected. His reputation tarnished, and his opportunities in the company vanished. Eventually he was replaced by one of his younger and presumably more innovative subordinates.

Next: L*aws Governing Values*

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience In observing and analyzing the always intricate -- and often paradoxical --- interplay of personalities in the r and d hierarchy.

5: Laws governing values

Your hierarchical position can be enhanced if you draw on the abilities of others—but only if they are of equal or higher rank. Putt provides the postulational principles to prove it

by Archibald Putt

Few things are as important to the success of a technocrat as his ability to recognize good concepts and ideas. Yet there are few courses on this subject in colleges and universities, and those that do exist are misdirected.

One of the best known courses of this type was initiated some twenty years ago at a major school of technology. It was called Engineering Analysis I and II. It has since been modified many times and copied by schools throughout the country. Students were given several different technical solutions to a problem and asked to evaluate them, or they were simply presented with the problem and asked to develop a solution. They were then graded on the quality of their analyses and on their ability to find the most cost-effective solutions. These were presumed to be the correct solutions. Never, to my knowledge, were students asked to consider the social or political implications of their ideas.

They and their professors were living and working in the proverbial ivory tower and ignoring some of the most important factors in

---

Sketch above depicts the Ultimate Journal Article, as envisioned by Putt. Note that at this point (in the future) the prestige of the multiple-person "authoring group" is so great that only the Abstract, Acknowledgments and Citations (to the authors' previous works) are needed. Citations would continue for several pages. Text is now superfluous and need not appear (nor, indeed, need it even be written).

---

the evaluation of ideas. The importance of these otherfactors is stressed in the Law Governing the Value of Ideas:

The value of an idea is measured
less by its *content than by the*
structure *of the hierarchy in*
which *it is pronounced.*

This law is so well known in most hierarchies that the average reader may be surprised by the lack of under-standing of it in the technical hierarchy. This lack of understanding results from an educational system for science and engineering that is totally preoccupied with the sterile evaluation of technology. There is an underlying presumption that the world will automatically adopt the “best" engineering solution. How educators in technology can be so successful in promoting this erroneous concept and so unsuccessful in teaching useful concepts is not clear.

It is interesting to postulate that children with irrational and authoritarian parents may do better in the technical hierarchy than children of more per-missive or thoughtful parents; the former will be less convinced by a technical education that the "best” engineering solution will be adopted. They will recall that, right or wrong, the ideas of their parents were always acted upon, never those of the children. When a difference of opinion between the parents existed, it was the ideas of the dominant parent that survived. Children from such families would be likely to suspect that similar phenomena might occur even in the “completely rational” technical hierarchy.

We clearly need a detailed and scholarly study of the correlation between success in the technical hierarchy and the degree of authoritarianism in the home. The results should be most interesting and might provide a valuable additional guide for the hiring of technologists. They might also be helpful to parents who aspire to raise their children to become successful technocrats.

The results should also be compared with those of a recent study that suggests there is an optimum amount of education for success in the technical hierarchy. The normal four years of college followed by three to five years for a PhD may be too much. By then, most students have probably become so adjusted to thinking in terms of the “best” technical solution that they are unable to readjust to the real world. This difficulty could be alleviated either by reducing the length of the graduate program or by requiring that a graduate student’s time be devoted largely to non-academic pursuits.

There is, of course, an alternative to an authoritarian home life during childhood or a reduction in the length of the graduate program. The alternative is to introduce courses into the graduate program that deal effectively with the evaluation and selection of ideas. A prerequisite to that, however, would be a methodology that could be taught in the formalized manner of a college course. Such a methodology has only recently been developed by me through a detailed analysis of the hierarchiology of technology in which particular emphasis is placed on the levels and inequalities in a hierarchy.

Analyzing the hierarchiology

The analysis begins by referring to the president, or the Number I person in the hierarchy, as P_1. Senior vice presidents are labeled as P_2, the junior vice presidents as P_3, and other persons in descending order of importance as P_4, P_5, P_6 . . . P_B, where P_B is the bottom group within which most persons must begin. Then, using well-known mathematical symbols, it is possible to derive relations such as

$P_1 > P_2$ and $P_2 \geq P_3$

and, very clearly, $P_1 > P_3$—an obvious statement, because presidents certainly do outrank junior vice presidents. Stated in a very general way, $P_j > P_{j+1} > \mathbf{P}_{j+2} > P_{j+3}$ . ...

One can also evaluate ideas in a strictly technical sense without consideration of political or social values. Because of the complexity of technical evaluations, it is best to give only three ratings: $\boldsymbol{I_g}$ for a good idea, $\boldsymbol{I_i}$ for an indifferent one, and $\boldsymbol{I_b}$ for a bad idea. Thus the intrinsic value of ideas will be ranked as $\boldsymbol{I_g} > \boldsymbol{I_i} > \boldsymbol{I_b}$. The actual value of an idea is approximately equal to the product of its pure technical worth and the level of the individual promoting it. Thus the total value of a good idea promoted by a president is given by $\boldsymbol{I_g}\mathbf{P_1}$ and it follows that

$$\boldsymbol{I_g}\mathbf{P_1} > \boldsymbol{I_g}\mathbf{P_2}$$

That is, a good idea promoted by the president is better than a good idea promoted by a senior vice president. In general one can write

$$\boldsymbol{I_g}\mathbf{P_j} > \boldsymbol{I_g}\mathbf{P_{j+1}} > \boldsymbol{I_g}\mathbf{P_{j+2}} \text{ etc.}$$
$$\boldsymbol{I_i}\mathbf{P_j} > \boldsymbol{I_i}\mathbf{P_{j+1}} > \boldsymbol{I_i}\mathbf{P_{j+2}} \text{ etc.}$$
$$I_bP_j > \boldsymbol{I_b}\mathbf{P_{j+1}} > \boldsymbol{I_b}\mathbf{P_{j+2}} \text{ etc.}$$

It is somewhat less clear as to what happens if, for example, a vice president is promoting a good idea while the president is promoting a bad one. However, it is safe to assume that generally

$$\boldsymbol{I_b}\mathbf{P_1} > \boldsymbol{I_g}\mathbf{P_2}$$

Using this additional assumption, most inequalities among ideas in the hierarchy can be derived.

It should further be noted that ideas with multiple sponsors are more valuable than those with single sponsors, so that, for example,

$$I_gP_2P_2 > \boldsymbol{I_g}\mathbf{P_2}$$

Furthermore,

$$I_gP_3P_3P_3P_4 > \boldsymbol{I_g}\mathbf{P_3P_3P_3}$$

This is democracy at work, for each man's contribution counts!

An immediate application for this principle can be found in the hierarchy. If you are a member of the bottom group (P_B) and you have a good idea ($\boldsymbol{I_g}$), its value is only $\boldsymbol{I_g}P_B$ This is of less value than practically any other idea in the hierarchy. However, if you can gain the support of a person ranked P_3 or P_2, or best of all P_1, then your idea will have great value. Because highly ranked people are too busy being prestigious to generate ideas of their own, you will be surprised how readily they will "admit" to having helped create yours.

Rating scholarly publications

Another obvious application is in the publication of scholarly papers. All other things being equal, a paper with three authors is superior to a publication with only one or two authors. After writing a paper, it is thus worthwhile to find a prestigious person who is willing to become a coauthor. Such persons are generally too proud to respond favorably to such a crass invitation as "Please let me place your name on my paper as a coauthor. This will help me get recognition and also help you because you are much too busy now to write original papers yourself."

It is far better to try a subtle approach, such as asking the person to comment on the paper. Then note that his comments have been so significant and helpful that you believe he should be a coauthor. Few men of position can resist an offer like this.

It is generally not wise, however, to load your paper with authors of equal or lesser rank just to raise its value. While the value of the paper will go up, the fact that this value must be shared among all the authors will far outweigh the benefit to you. However, if you can get one or more colleagues to agree to include you on their papers as a coauthor, if you do the same for them, then there is a definite gain for all.

In addition to the prestige and number of the authors on a paper, there is yet another way to measure a paper's value without trying to read and understand it. That method is to see how many subsequent papers refer back to it. This system has become so popular in recent years that several computer programs have been written to implement it. It is based on the premise that authors refer only to papers that have been helpful to them or that would be helpful to others. The use of these evaluation methods has led to the Law Governing the Value of Technical

Publication: The value of a technical article when first published Is proportional to the sum of the prestige of its authors, but its ultimate value is proportional to the sum of tile subsequent references to it.

It should be noted that this law refers to the value of the paper to its authors, U opposed to any value it may also have to the technical community. This is because a technologist is advanced in the hierarchy by contributions of value to him. Contributions of value to technology serve only to advance technology. Mathematically inclined readers will find the formal representation of the law to be more satisfying:

$$\mathbf{V_P=(P_1+P_2+\ldots P_n)/(1+T)+N_R}$$

In this equation V_p is the value of the publication to its authors; P_1 is the prestige of the first author, P_2 the prestige of the second, etc., N_R is the number of references in subsequent publications; and T is the time since its publication. When the article is first published, T = 0; and because it could not yet have been referred to, NR is also zero.

Thus, initially, $V_P= P_1 + P_2 + P_3 + \ldots P_n$ or, the value of the paper is simply equal to the sum of the prestige. of all the authors. Five years after the article is published, 1 + T = 6 and the importance of the author's prestige is reduced to a sixth of its original value. The value of the paper will then be more dependent on the number of literature references to it, N_R. After a long time, its value will be almost exclusively contained in N_R as stated by the Law Governing the Value of Technical Publications.

Group approach pays off

It is clear from this law an associated procedures for determining the value of publications that there is considerable stimulus for technologist to band together into authoring groups If we assume an authoring group of four persons in which each individual writes three papers per year and includes the other three individuals and coauthors, then each member of the group will have 12 papers to his credit at the end of one year, 24 at the end of two, and 60 papers after only five years.

Even more important are the references to each other's papers in all subsequent papers. Assuming a one-year delay between writing a paper and having it cited, each of the 12 papers written the first year would be cited by 12 papers in the second year, making a total of 144 citations for each member of the group. By the end of five years, each member would have accumulated 1440 citations! By increasing the group from four to eight persons, each member would after five years acquire part credit for 120 publications and 5760 citations, and after ten years have 240 publications and over 26,000 citations. Even an Einstein would have trouble matching a record like that!

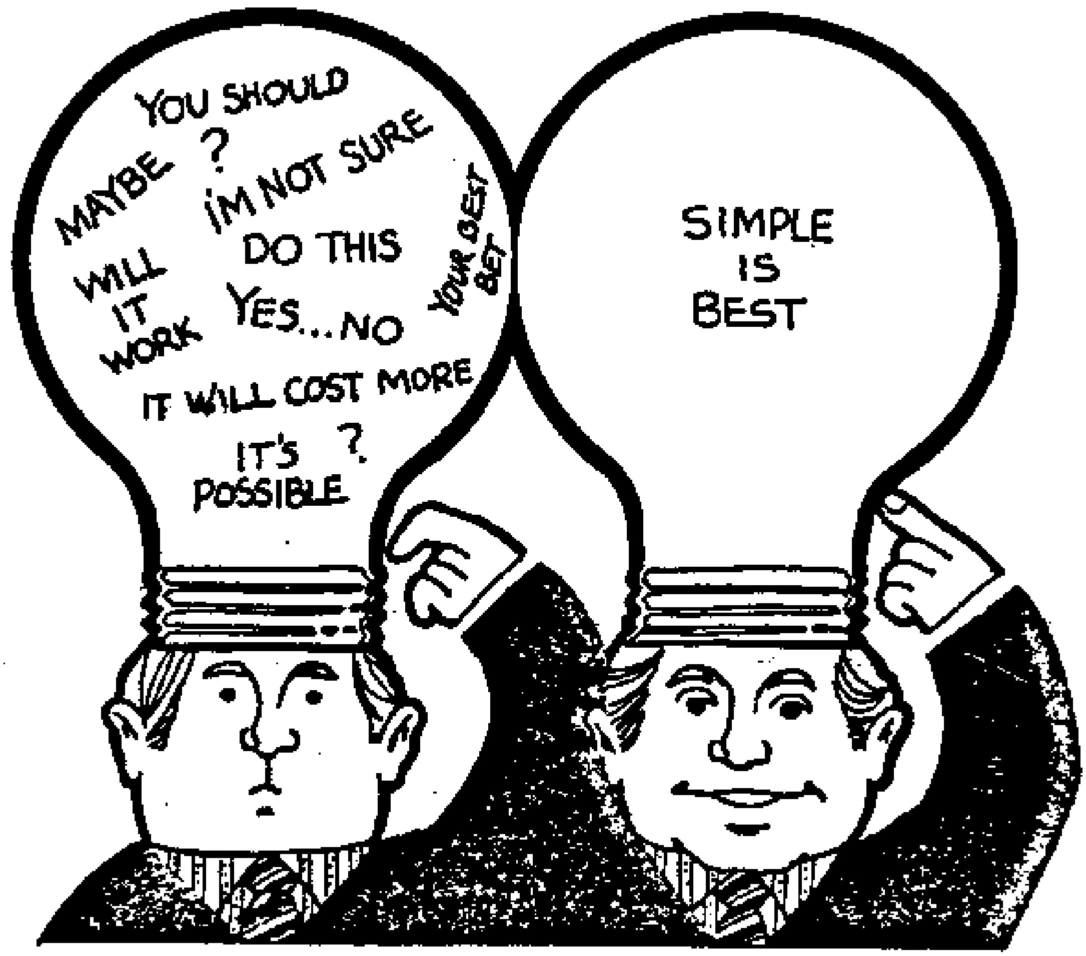
A potential problem in this scheme is the rising cost of printing, coupled with the increasing size of the list of citations required at the end of each paper. After ten years, each paper would carry over 200 references to past publications even if no citations were given to persons outside the group.

Fortunately, this problem is easily overcome. After ten years, each of the eight authors would be so prestigious (with 240 publications and 26,000 citations to past publications) that the technical content of all future articles by the group would be incidental to their actual value.

The verbose articles of the past would no longer be needed. The authors could: now concentrate on getting the concepts covered in as few words as possible. This would be greatly appreciated by younger technologists who would feel compelled to read all papers by such a prestigious group of authors. Eventually each article could consist only of the title, the list of authors, a brief abstract, acknowledgements, and citations to past articles by the authoring group.

The ultimate in compact value would be a publication with no text and no abstract at all. Further shortening of the paper would, however, cut too heavily into its value to be seriously considered.

Next: Three *Laws of Advice*



6: Three laws of advice

Some readers may be familiar with the First Law of Advice, but the Second and Third Laws are neither so well-known nor so obvious, so our expert provides two illustrative examples to show how they work

by Archibald Putt

Learning to give good advice is so important to technologists that special Laws of Advice have been developed. The first of these is often stated as "The correct advice is the desired advice." However, this form of the law leaves ambiguous whether the recipient wants correct advice or whether the desired advice is by definition the "correct advice." A much clearer and completely unambiguous statement is this form of the First Law of Advice:

The correct advice to give is the advice that is desired.

One of the truly classic examples of good advice is that given to the mayor of Pittsburgh in the fall of 1920. A ma jor city highway, built on the side of a hill, began sliding one piece at a time down onto some railroad tracks below.

With every heavy rain, more mud and parts of the road washed down, causing many of the railroad tracks to be unusable. All efforts to remove the mud and keep the tracks operational were ineffective against the massive force of the mud slide.

Ideas (?) pour In

Several solutions were offered by local engineering and construction firms and by "concerned citizens." One was to pave the entire side of the hilt to prevent erosion. Another was to build a metal structure to support the road and protect the tracks from further mud slides. All the suggestions would have been quite expensive, and this caused thoughtful people to wonder how the city could pay for the necessary work. Furthermore, no one knew if any of the proposed ideas would really solve the problem.

The mayor recognized that he needed good technical advice, and he ultimately hired 0. W. Goethals as a consultant. Goethals had served as chief engineer for the Panama Canal and had acquired considerable experience with landslides. His expertise was evident not only in his past experience but also in his consulting fee: $1000 per day—an unheard-of sum at that time.

After only one day of study, Goethals was ready with his advice and with his bill. His advice to the city was simply, "Let it slide."

The opposition party and one of the newspapers made sport of the city ad-ministration for paying so much for this advice. The mayor rightly argued, however, that it was a small price to pay to learn that none of the more expensive proposals would work. The mayor chose to follow this most economical advice and permitted the hill to slide.

Whether technically right or wrong, the consultant's advice was the desired advice. It called for no construction expenses for which funds would have to be obtained. Furthermore, any other solution would have been open to attack by those engineering and construction firms whose proposals had been rejected in favor of the winning contractor. The desired advice was clearly the correct advice.

Two more laws promulgated

This classic example also stands up well in terms of the Second Law of Advice:

The desired advice is revealed by the structure of the hierarchy, not by the structure of technology

and the Third Law:

Simple advice is the best advice.

Another classic example that obeys all three Laws was the advice given to the vice president of a petroleum company during the 1920s. The company had discovered a major oil deposit of high quality that could be refined economically into gasoline and other products. But there was a problem. The resultant gasoline had a greenish tint that the refinery had been unable to remove. Because all gasoline at that time was clear, like water, the marketing group believed there would be considerable customer resistance to an "impure looking" gasoline even though it worked as well as any gasoline then available.

The production manager submitted his proposal for solving the problem, a proposal that called for complete modernization of the refinery. Such improvements, he reasoned, provided the best hope for producing a clearer liquid. The company's chief chemist objected. on the grounds that there was no proof that refinery modifications would result in a better product. Removing the greenish tint was a very difficult chemical problem that had defied every attempt at solution by the chemical research group. The chief chemist, therefore, recommended an expanded research program to find a solution in the shortest possible time. While this would be substantially cheaper than modernizing the refinery, it would require an expansion of the laboratory and the hiring of several chemists and laboratory assistants.

For advice, go outside

Rather than adopting either solution, the vice president wisely turned to an outside consultant, a chemical engineer of good reputation in academic circles who had consulted before in the petroleum industry.

The consultant listened to the proposal of the chief chemist and then to that of the production manager. He talked to engineers and managers at the refinery and to chemists in the laboratory. Then he returned to his university for further study and deliberation. If he were to recommend more experimental work, the chief chemist would be pleased. This was clearly the chief chemist's desired advice. On the other hand, a recommendation to modernize the refinery was the desired advice of the production manager.

The important thing for the consult-ant, however, was to determine what advice was desired by the vice president. The vice president clearly did not want to be responsible for choosing either of the proposals already presented. He wanted to avoid responsibility for any decision that would appear to favor either of his subordinates. If such a decision had to be made, it would be best to attribute it to an outsider. This, the consultant discerned, was the real reason why he had been hired by the vice president. But even better for the vice president would be totally different solution that played no favorites. Finding such a solution became the real challenge for the consultant.

After several weeks of additional work, the consultant was ready with a uniquely neutral recommendation — one that required neither research work nor modernization of the refinery. His ad-vice to the vice president was simple:

"Advertise the color."

The marketing success of the greenish gasoline and the fact that all gasoline is now artificially colored demonstrate once again that advice found by studying the structure of the hierarchy—not the structure of technology—is the desired advice. It also substantiates the Third Law. Indeed, simple advice is the best advice.

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience in observing and analyzing the always intricate — and often paradoxical—interplay of personalities in the r and d hierarchy

7: The consultant's law

If you've ever dreamed of becoming a consultant, read this advice from our expert on the hierarchiology of technology; two examples show how the Consultant's Law works and why you can't ignore it

by Archibald Putt

Behemoth Insurance Company had developed one of the finest groups of computer software experts in the business. By the mid-1970s, it was generally recognized in the industry that Behemoth's improved profit position and renewed growth were due largely to its effective use of data processing techniques.

One man who played a key role in this development was Ed Vise. He had come direct from college to Behemoth shortly after the Data Processing Center was established. There he had matured as a systems analyst and programmer. No one in the Center had a better understanding of the idiosyncrasies of the computer hardware and software systems. Nor had anyone at the Computing Center made a greater effort to learn about the insurance business. When there was a problem at the Center or a requirement for an innovative approach, the manager of the Center invariably turned to Ed for help.

Very satisfying, but ...

Thus, while Ed managed a small group of programmers at the Center, his primary role evolved to that of chief adviser or consultant to the Center's manager. It was a very satisfying position, and Ed was rewarded with the highest salary next to that of the manager himself. Yet Ed gradually became dissatisfied. He longed for a more challenging and rewarding position. There was little chance that he would be made manager of the Center in the next few years, and there was no other position for him in the company. While his salary was good, it in no way reflected the hundreds of thousands of dollars the company had earned as a result of his unique contributions.

it is, therefore, not surprising that Ed Vise began to think of becoming an in-dependent consultant. He could supply his experience and skills to insurance companies throughout the industry. There were so many of these that he could consult for them, one at a time, and never run out of clients. Because Ed's unique skills were largely unknown outside of Behemoth, he decided to charge his clients a fairly standard daily rate, but with a bonus for early completion of assigned tasks.

His first job was most successful. By using the same techniques he had developed at Behemoth, he was able to solve the problem given to him in about half the estimated time. He was reward-ed with a large bonus and a letter of thanks that was invaluable in securing his next consulting assignment.

For several years, Ed Vise was successful at giving advice to data processing groups throughout the insurance industry. Gradually, however, things became more difficult. The solutions he provided one company tended to be passed along to other companies through informal discussions or through presentations at professional meetings. Such presentations typically were made by heads of data processing centers who credited their own employees for the new concepts and felt no obligation to acknowledge the contributions of outside consultants. The presentations not only reduced the opportunities for Ed to apply his ideas, they failed to give him much-needed publicity.

Each new consulting job required more innovative ideas from him, because his original ideas were by now rather broadly adopted. Bonuses became rare. Even a man as competent as Ed could not repeatedly invent and implement on short schedules. More and more, he was scratching for his next job while trying to complete the last one. The pressure mounted until he finally began to look again for a secure job in industry where pay and productivity were more loosely coupled.

A formula for success

Ed's major problem as a consultant arose from his paying too much attention to technology and not enough attention to the hierarchiology of consulting. if he needed to be convinced of how important this was, he had only to observe the fortunes of Harvey Goodfellow, who had worked for him at Behemoth Insurance Company and who had also left to become a consultant.

Harvey was a good programmer and quite dependable; however, he lacked innovative capability. Under Ed Vise's management and guidance at Behemoth, he had done very well. Ed determined how the problems should be solved, and Harvey carried out the solutions. When Ed left, Harvey's performance dropped noticeably. Without Ed's innovative leadership, Harvey's solutions to problems became circuitous. No longer could he be counted on to get his assignments completed promptly.

The basis for his decline in performance was not understood by his new manager, and Harvey himself did not appreciate what had happened. He felt he was working as hard and effectively as ever, but that his new manager failed to appreciate his efforts. Within a year after Ed left, Harvey Goodfellow also left Behemoth to become a consultant.

His first customer was the same company that first hired Ed. Harvey followed through on some of Ed's suggestions that had not yet been implemented and then returned frequently to discuss the . plans and problems at the Data Processing Center. Harvey showed himself to be competent by completing the work outlined by Ed. He was an interesting talker and always most congenial. Because he was unable to develop innovative solutions to problems himself, he could discuss the ideas of the members of the Computer Center at length without getting bored. He never embarrassed them by his brilliance. Frequently, he was invited to finish a day of consulting at a round of golf with the data processing manager and the executive vice president. Eventually, he was placed on a permanent retainer to consult a minimum of two days a month for the company.

Good references from this first consulting job led to new jobs where a similar pattern developed. Within two years Harvey Goodfellow had acquired 11 regular customers and was forced to advise his clients that he was now too busy to do any computer programming himself. This, however, only served to increase his value.

Top price for advice

Programming is a relatively routine task for which only a limited fee could be charged, whereas general advice has no set value. Harvey, who was now regarded as an expert consultant for data processing throughout the insurance industry, could command a top price.

Each of his clients had the benefit of all of the information he had gleaned from his other clients. As these continued to increase in number, the information he could share increased almost in proportion.

Harvey was careful not to give the identity of his sources lest he reveal proprietary information. To better protect the identity of his sources, he frequently felt obliged to claim borrow-ed ideas as his own.

Harvey's business was booming just when Ed's was in steep decline. After several unsuccessful attempts to find a corporate job, Ed accepted Harvey's offer of a job. With Ed working for him, Harvey could now look forward to providing clients with innovative solutions. He believed, perhaps erroneously, that such a capability would bring additional business to the new firm of Goodfellow Associates.

Harvey had no formal training in the hierarchiology of consulting, yet he managed his career as effectively as if he had been a student of the Consultant's Law:

A successful consultant never gives
as much information to his clients
as he gets in return.

While the truth of this law is affirmed by Harvey's success and Ed's failure, its validity should be logically self-evident. It can also be derived through simple mathematical relationships.

The value Vc to a customer of a discussion with a consultant is equal to the information given (Ig) times the price per unit (Pu) that the customer is willing to pay for the information. Stated mathematically, this becomes

$$Vc = Pu \times Ig$$

The value V_0 of the same discussion to the consultant can also be represented mathematically by

$$Vo = (Pu \times Ir) - (Pu \times Ig) + F$$

where $(Pu \times Ir)$ is the value of the information received by the consultant, $(Pu \times Ig)$ is the value of the information which he gives in return, and F is the fee paid to the consultant in dollars. Assuming the customer pays a fee equal to the value of the advice he receives (an interesting even if naive assumption), then $F = (Pu \times Ig)$ and the value of the discussion to the consultant becomes

$$V_0 = (Pu \times Ir) - (Pu \times Ig) + (Pu \times Ig)$$

or simply

$$V_0 = (Pu \times Ir)$$

This equation states that the value to a consultant of each discussion is proportional to the information he receives and completely independent of any information he may give in return. Even if one assumes the fee paid to him is not exactly equal to the value of advice given, the analysis produces a very similar result.

When is comes to advice, it is more important for *a consultant to receive than to give.*

The failure of most technical consultants can be traced directly to their mistaken presumption that the function of a consultant is to give information and advice. In reality, a consultant's job is just the reverse.

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience in observing and analyzing the always intricate — and often paradoxical — interplay of personalities in the r and d hierarchy

8: Laws of survival

Our expert has already told us the ploys for getting ahead in the hierarchy of technology, but you can't get ahead if you've been kicked off the team; here's how to make sure you're not

by Archibald Putt

There are times in any organization when advancements and promotions are not likely. The prudently ambitious technocrat then settles for survival. This requires a substantial adjustment in his methods; for, as described in the law governing advancement and survival in technology,

> Advancement *demands risk*
> *but survival is achieved*
> through *risk reduction.*

The primary methods are the same as in any other hierarchy: conformity in dress, conformity in behavior and, above all, conformity with the boss. These methods are learned early in life.

For example, a seven-year-old heads off to school. It's cool and threatening rain, so he has been dressed in his raincoat. A number of the other children are not so dressed and tease him. He becomes unhappy and refuses to wear his raincoat again even when it is actually raining.

For another example, Bill has begun his first job after graduating from high school. He works with a group of other fellows changing tires and balancing wheels for an auto tire store. After two weeks on the job, he has mastered the technique and can change tires faster than any of his co-workers. But the group puts pressure on him to slow down. No one else wants to work that hard. He soon learns to make unnecessary moves and to dawdle. At his slow pace he finds the work dull and uninteresting, but he doesn't dare work harder. Bill and the seven-year-old have already learned to adjust their lifestyles to be consistent with the First Law of Survival:

> *To get along, go along.*

A local grocery store operator notes that his customers are unable to keep up with the cash register as it rings up purchases. By overcharging for some items or by charging for more items than purchased, his profit is increased. All clerks at the checkout counter soon learn that "errors" in favor of the store are part of the unwritten job description. To keep their jobs they go along.

A group of engineers in a large firm finished writing a contract proposal. The proposed engineering schedule and estimated cost were very tight, but still their management wanted a tighter schedule and lower cost estimate to be sure they got the contract. While the engineers could rewrite the proposal as requested, they knew it would be impossible to do the engineering work on schedule. Reluctantly, they went along.

The rewritten contract proposal was accepted by the government, which soon had one more contract running well over the estimates, thanks to the efforts of the engineers who joined the ranks of those who *get along by going along.*

The nature of the First Law of Survival and the conformity it engenders is well understood by technical management. Furthermore, management knows that too much conformity in large organizations leads to *stagnation.* While this might be acceptable in some organizations, it would never do in an organization devoted to innovation. Methods for avoiding stagnation are therefore in great demand.

One of the most popular approaches is to reorganize or to move employees to new locations. This is so popular in high-technology growth industries that many people believe IBM really stands for I've Been Moved.

As a means of avoiding stagnation, moving people around or reorganizing has at least one major failing. By accelerating the rate at which positions are created or changed, the rate is also increased at which the hierarchy moves toward the inevitable competence inversion predicted by Putt's Law. This is beneficial to technocrats who have studied the lessons of the Two Laws of Crises, for they have laid the groundwork for their own promotions with each reorganization. However, if avoiding stagnation is the goal, then other methods must be found.,

According to William Shockley, co-winner of the 1956 Nobel Prize in physics, the capability differences among workers in scientific laboratories becomes larger exponentially, as one moves up the scale of productivity. It is thus most important to motivate the best workers as effectively as possible. Peter Drucker, however suggests, "We know nothing about motivation—all we can do is write books about it."

This leaves management with one alternative for improving productivity. They must fire the least productive workers. This management procedure is technically referred to as getting rid of the deadwood.

A variety of approaches are available, but the most common one is simply to fire 5 to 10 per cent of the work force every year—presumably from the bottom. Because it works so well in theory, it is frequently employed in practice. Ambitious technocrats must, therefore, be prepared to protect their own interests if such firing policies are adopted.

Good firing procedures

An excellent procedure for meeting arbitrarily established firing goals is to hire some people each year with the intent of firing them the next. This avoids the unpleasantness of firing associates of long standing and helps to build a good manager-employee relationship among the "regulars."

A more sophisticated method is available that also addresses one of the greatest concerns of many well established technocrats. The concern is that they will be replaced or by-passed by their energetic and ambitious subordinates. if management institutes a mandatory firing policy one can avoid being displaced by someone from within the group by following a Law of Survival which commands:

To protect your position fire the
fastest rising *employees first.*

This approach to firing also avoids the common error of firing the lowest ranking employees first. Managers who do this quickly learn who was doing the work. The remaining employees are much too senior to be asked to perform the mundane tasks that kept the project moving in the past. Progress diminishes and the manager comes under pressure to fire more employees.

This is known as the *domino firing strategy;* for if the manager continues firing from the bottom, the process continues until he is the last remaining member of the group. At this point there is no further progress in the project and management can turn its attention elsewhere.

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience I1n observing and analyzing the always intricate — and often paradoxical—interplay of personalities in the r and d hierarchy.

9: Five laws of decision-making

Our intrepid explorer of the technological hierarchy looks at the complex process of making up the corporate mind; he finds, and sets down here, five rules that should be invaluable to the upward-oriented technologist

by Archibald Putt

Successful managers know they are measured on their ability to make decisions and then—right or wrong— take quick action. Thus they readily grasp the significance of the First Law of Decision-Making:

Managers make decisions

Nonmanagers, by contrast, seldom concern themselves with this law. They may therefore commit the fatal error of making all decisions themselves. This is particularly true in technical hierarchies, where low-level technologists continually make decisions in their areas of expertise. Finding so few issues that the manager is qualified to decide, they are likely to forget to bring any issues to him at all. This was one of Roger Proofsworthy's many problems at the Ultima Corporation, where he performed all of his assignments so perfectly that his accomplishments went unnoticed. Thus he never progressed beyond the first level in the hierarchy and finally left in disgust.

The final blow to Proofsworthy at Ultima was management's rejection of his best project proposal, which was intended to provide Ultima with a continuing stream of new products. Proofsworthy called it project HOPE, an acronym for Highly Original Product Exploration.

Management was at first quite interested, and Proofsworthy was asked to make numerous presentations. At first, the questions were limited in scope; but as interest increased, they were broadened to include competition, patents, manufacturing, marketing and finance. Each time, Proofsworthy was ready. No matter what the question, he had already considered it and had an answer at hand. If management accepted Proofsworthy's project, Ultima's future exploratory activities would be fully determined. No additional decisions would be needed by management either now or in the foreseeable future. Proofsworthy's excessive perfection thus threatened to deprive management of its primary function—decision-making.

Members of management reacted in the only way they could. They rejected the project.

One of their first decisions, after Proofsworthy left Ultima, was to assign a technologist named Brightman to look again into new product explorations. After careful study of Proofsworthy's proposal, Brightman made an "entirely new" proposal called MOPE, an acronym for Management Originated Product Exploration

It was immediately well received.

With the help of Proofsworthy's earlier study, Brightman solved most problems associated with the proposal. However, he was careful to reserve several items specifically for decision by management. With their involvement in the project thus assured, management eagerly supported it. Even the chairman of the board took delight in selecting the color for the walls of the laboratory in which project MOPE would run.

Now, such a decision may sound trivial, but it was one of the few topics on which all members of management could express an opinion. All felt qualified to comment, and did—until the *final and correct* view was given. It was correct not just because it was given by the chairman of the board, but also because it was expressed by a man with full command of the Second Law of Decision-Making:

Any decision is better
than no decision

and also the Third Law:

A decision is judged
by the conviction
with which it is uttered.

The analytical approach

Decision-making in the technical hierarchy is distinguished mainly by the use of analytical decision-making methods (also known as operations research).

An example of the use of analytical methods is provided by the case of Xavier Y. Ziegler, newly appointed director of advanced development for the Solid Status Company, an electronics firm. His promotion to director was based partly on his success in using cost-benefit analyses—a skill he had acquired in his previous association with a "think tank."

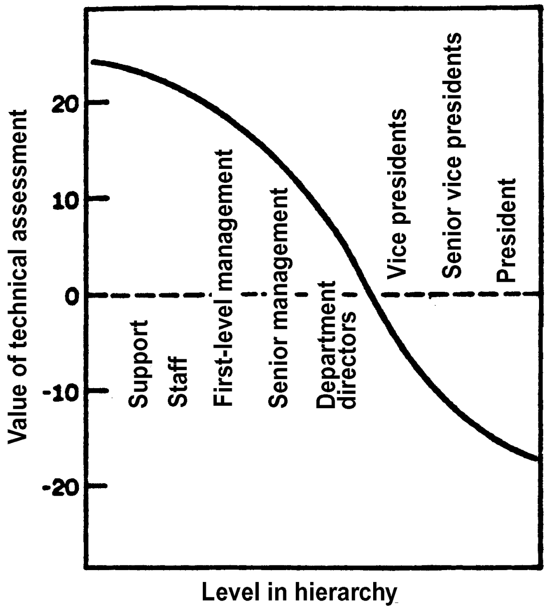
Shortly after his promotion, some scientists and engineers proposed a new product. The idea was exciting but it would require considerable development effort. X. Y. Ziegler was delighted with the opportunity to demonstrate his analytical decision making skills so soon. Within a week, he had assembled the talent required to evaluate the proposal, including specialists from research, manufacturing, marketing and finance. Ziegler worked on the entire study, but he paid particular attention to the cost-benefit analysis.

When the study was completed, a special meeting of the corporate officers was called, to which selected members of the financial and technical staffs were invited. Ziegler began the presentation with a simplified version of the technical evaluation. However, even this much technology was beyond many of those present. The president and two of the vice presidents excused themselves for important phone calls. Several of the others began doodling or whispering among themselves.

Matters worsen

X. *Y.* Ziegler tried to skip over material in order to reach his conclusions more quickly, but this was not possible. The technical staff members present felt obliged to demonstrate their knowledge by asking for clarification of many points and challenging some of the assumptions. Several of their questions revealed their lack of understanding or their technical ignorance to Ziegler, but not to the corporate executives, who were increasingly bored.

It had not occurred to Ziegler before, but leaders in a technical hierarchy become accustomed to having all the technical decisions made by specialists at lower levels. Their own analytical skills atrophy—perhaps more rapidly than those of leaders in other hierarchies where analytical skill is less usual in the lower levels. The selection of Ziegler for a mid-management job was not intended to help management have a better understanding of the technical issues.



Putt's ubiquitous S-curve shows that value of technical analyses Is greatest to support and staff people who have time and expertise to understand them.

Just the reverse was true. His job was to interpret technology at his level so that management would not have to concern itself with such intellectually difficult problems.

Above Ziegler's level, all decisions regarding the technical direction of the organization were to be made without considering the technical issues. Ziegler was learning, through this presentation, about an important law of decision making that may be unique to the technical hierarchies:

Technical analyses have no value above the mid-management *level*

This law is illustrated more quantitatively in the accompanying figure. The value of technical analyses is highest among support and staff personnel who have the time and expertise to understand them. The value drops rapidly through the management levels, reaching zero between the department director and vice presidential levels. At all higher levels, it has a negative value. Not only would the president and senior vice presidents be unable to understand a technical analysis, they would feel uncomfortable if confronted with one.

Some observant individuals have noted that the curve in the figure looks like a backwards S-curve. This is indeed so; and because all progress in technical hierarchies follows S-curves, such hierarchies might function better if the president were at the bottom and the support and staff personnel were at the top. This possibility deserves more careful study.

A resounding No!

Ziegler finally got to the summary and cost-benefit issues, the gist of which was that the return on investment for the new product, even if it were successfully developed, would not be as good as for the current products. Furthermore, it would require new facilities, large expenditures, and a considerable risk for the company. In contrast, Ziegler showed that a relatively small additional expenditure on the present products would be expected to provide the same increase in revenue and even greater profits. This would involve very little risk for the company.

Ziegler ended his presentation with a recommendation *not* to initiate the proposed product program. The attendees were stunned. The program would have resulted in a substantial in-crease in Ziegler's responsibility. For the sales manager, it would have meant a larger sales force and new areas to cover. The director of manufacturing would have needed an addition to the plant. For all, it would have enhanced the standing of Solid Status Company by broadening the product line.

After the presentation, discussion began hesitantly. The analysis appeared to be correct, but no one said so. A number of meaningless questions were asked and there were uncomfortable moments of silence. Finally, the director of product development sensed the feeling of the group and spoke up.

"The arithmetic is OK," he said, "but that's all it is—arithmetic. This company didn't get where it is through arithmetic. It got here through imagination, hard work, and taking risks. Men smart enough to come up with ideas like this proposal can also come up with better ways to implement it than have been assumed by our director of advanced development. Put those men into an aggressive product development group like mine and you can throw out all that arithmetic."

After further discussion, the other corporate officers agreed. The analysis indicated there was risk, but it did not rule out the *possibility* of some success. Management, after all, was paid to take risks—and in this case, they would. The program and several of Ziegler's best people were transferred out of his area and placed under the director of product development. The program was initiated rapidly and had full support a all the officers of the corporation.

X. Y. Ziegler's failure to find support for his recommendation resulted from his failure to consider the costs and benefits to the decision-makers as well as to the company. The question of *who* benefits is all-important in any practical cost-benefit analysis. In making decisions, decision-makers are generally concerned primarily with the costs and benefits to themselves. This is clearly stated in the Fifth Law of Decision-making:

Decisions are justified by
benefits to the organization*;*
decisions are made by considering
benefits to the *decision-makers*

In time a number of difficult technical problems arose that had been predicted by Ziegler's original evaluation. To solve these, he and his remaining people were placed under the supervision of the director of product announced the elimination of development. The president of Solid Status simultaneously Ziegler's previous position of director of advanced development. That function, he explained, was now contained within the product development group.

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience in observin`g and analyzing the always intricate and often paradoxical — interplay of personalities in the r and d hierarchy.

10: Laws of reward and punishment

If your organization is in a state of malevolent stagnation as defined here by our hierarchiologist there's little hope—but you should at least read his remarks to find out how you got there

by Archibald Putt

The Law of Failure, described in detail earlier in thee pages (May, 1976), clearly reveals that

Failure to fail fully
is a fool's folly.

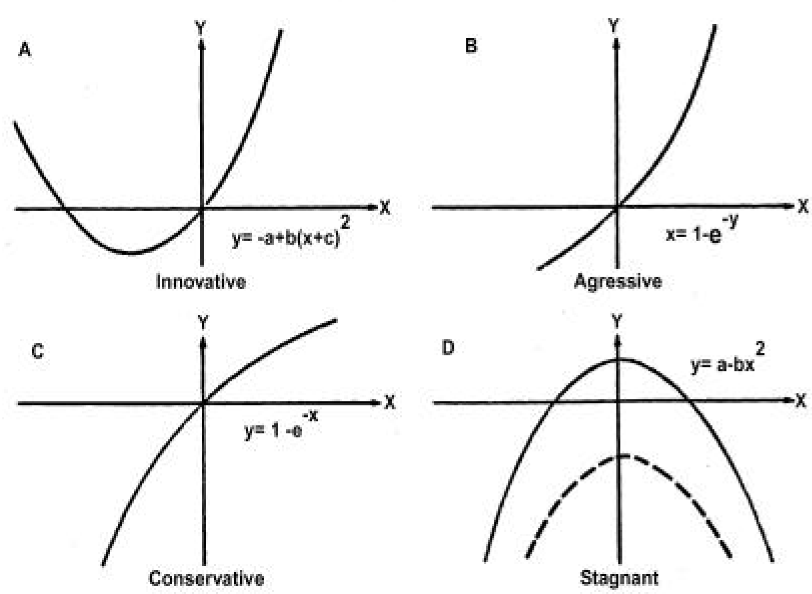
Specifically, the Law holds that if one's level of crises exceeds 63 per cent of the dismissal level before the earliest promotion might be expected, quick action is needed. New crises should be introduced as rapidly as possible in order to pass quickly through the for-bidden zone of minor failure. Every effort should be made to exceed the major failure level quickly, for once a person is "safely" above the major failure level, his job is secure. Management will be unable to find anyone "qualified" to take over such a project. This strategem has since become known as *Putt's Ploy.* It is one of the most effective tools for achieving success in most large technical organizations.

But is Putt's Ploy an aberration of an otherwise smoothly running organization? Or is it a logically consistent component of a well-tuned innovative technocracy?

Surprisingly, the latter may be the case, because many innovative organizations use a punishment-reward system that literally invites troubled technocrats to seek success through Putt's Ploy.

This is shown by Curve A, for innovative hierarchies, in the accompanying illustration. Increasingly large positive values of ***y*** correspond to increasingly large rewards, and negative values of ***y*** correspond to punishment. Similarly, positive values of x correspond to success, and negative values, to failure. In innovative systems, it can be seen that small punishments occur only for small failures. Otherwise, relatively large rewards can be expected

as the magnitude of either success or failure increases.



Punishment-reward curves for Putt's four types of organizations.

Such a reward system may be justified because major innovations are not achieved without substantial risks and because success or failure of high-technology projects cannot be predicted until long after they have been initiated. To encourage necessary risks, it is thus argued, rewards should be given to employees in proportion to the risks. they take—whether these risks lead to successes or failures. A number of experiences have revealed, however, that some punishment for failure is necessary in order to assure that there are more *desirable* innovations than *undesirable* ones. These concepts are revealed both in Curve A and in a formal law

Reward big failures *and successes;*
punish small *failures.*

The other curves in the illustration characterize substantially different reward systems for aggressive, conservative and stagnant hierarchies. Readers are urged to ponder the impact of these other systems on employee performance. Theoretically inclined readers will want to make use of the equations as well as the curves, because this provides greater flexibility. By properly adjusting the parameters ***a, b*** and ***c,*** these equations can be tuned to satisfy the requirements of almost any organization.

Analyzing aging problems

All organizations, in time, become more conservative. The weight of maturity and experience forces the ends of the punishment-reward curve down— particularly along the negative x-axis where failures occur. The technical name for this process is *hierarchiological aging.*

It begins as the innovative reward system is transformed, first into the aggressive type and then into the conservative type, shown graphically in the illustration. Finally, heavy penalties, given even for small failures in conservative organizations, engender a sense of resentment toward those who succeed. A destructive undercurrent thwarts projects that might otherwise have been successful. Persons responsible for successful innovations are vigorously attacked by the system. Eventually, the punishment for success is as large as for failure. The employees refuse to accept any risk at all, and the organization finally succumbs to the Law of Stagnation:

Organizational stagnation *occurs*
when the punishment *for success is*
as large as for failure.

In advanced cases of hierarchiological aging and organizational stagnation, no decisions are made that are not fully specified by "the book." Any attempt to deviate from the status quo is resisted. This is the familiar condition of most government bureaucracies, of the military and of educational institutions.

Two punishment-reward systems for stagnant hierarchies are shown in Part D of the illustration. The lower, dashed curve represents *malevolent stagnation,* in which all activity, including inactivity, is punished. Enlightened stagnant bureaucracies have learned, however, to offer some small rewards for those who follow the conformist path. This is depicted by the solid curve.

Although the degree of stagnation is not altered, positive rewards do make life more pleasant for the employees. Thus, stagnant organizations with positive rewards are properly described as being in the formal state of *beneficent stagnation.*

The manager's goal

Avoiding hierarchiological aging must be the Number 1 goal of informed technical managers. They should stand firmly on the positive and negative *x*-axes, holding high the two ends of the reward-system curve. Skill is required to maintain the proper sag of the curve to provide the desired level of punishment for small failures.

Employees who understand the system can rise in it. Soon they too can experience the satisfaction of holding both ends of the curve.

Archibald Putt is the pseudonym (for obvious reasons) of a person with long experience in observing and analyzing the always intricate --and often paradoxical --interplay of personalities in the r and d hierarchy.

e

11 Law of the estimated fact

Beware of giving the "ball park" estimate; if it's credible, it will be accepted and disseminated as fact. Rowe's Law continues advice for the professional initiated by Archibald Putt

by W. D. Rowe

How often have you been asked, because you are considered a scientific or technical expert, for an estimate based upon your best judgment? Will you be willing to guess, for example, how long it will take to design a partially specified PC board or will you estimate its cost when completed? If you respond, "I need more information, more time to investigate and more facts," you will be pressed for a firmer reply— "just a ball park estimate, even ±*50* per cent will do." You then provide your best estimate, qualified with all necessary disclaimers, limitations and warnings, and, feeling certain that your questioner is suitably impressed, watch him depart.

The recipient of the information now transmits the data he obtained from you, but without your attached conditions and limitations. For all purposes, your estimate now becomes "fact" and will continue to be accepted as such.

Any estimate within the
realm of credibility,
given by anyone considered
an expert, will immediately be accepted
by the received and promulgated
as a fact.

Or, to put it another way: *Credible estimates are propagated as facts.* One does not have to be an expert or authority on the subject being discussed, but only considered one. And, if enough

people begin to believe in the "fact" it will actually become real because all resources are focused on making it come true. This situation happens often when the estimate is given in an information vacuum.

Even though the operation of the Law of the Estimated Fact is obvious to all of us, we continue to make estimates without strict, technical, documented restrictions and limitations. Why then do we accept the associated risks? The answer is that the two processes existing in association with the law dilute its impact.

Process 1: The original authority or source of the estimate is often untraceable after several levels of transmission and the originator suffers no direct penalty for making a peer estimate.

Process 2: When multiple estimates are provided, an averaging process takes place. That is, some estimates will be on the high side and some on the low side. Some errors may be cancelled due to averaging. However, there may be a bias error due to conservatism or optimism, depending upon the objectives of the propagator of the estimate. (For example, if one wants a low-cost estimate, one tends to accept lower values and reject the high figures.)

According to Process 1, there seems little reason for not making the estimate, since this is one time you can exercise your authority without accepting the responsibility that goes with it. But don't be misled, because sooner or later

your estimate may come back to haunt you. For example, the cost estimate for that PC board may become a firmly fix-ed price commitment.

In Process 2, the whole subject of statistical estimation comes into play. The analysis of means and variances on estimates (to sharpen them up) is left as an exercise for the reader—and is probably a waste of time.

Practicing lawmanship

Now that the law and its associated processes have been stated, we must ask how it may be used advantageously. We might say that we should make our estimates as accurately as possible with narrow limits on variance. But we knew this before we started, since this is a requirement for making good estimates. Forewarned is forearmed, and the law provides us with a means of slanting "facts" to our own best advantage. That is, you may bias your estimates for sup-port of your own purposes with little fear of repercussion. The bias may be used both positively and negatively. However, to assure your making a "credible" estimate, keep these conditions in mind:

1. Your estimate should be safe for you. That is, it should include contingency for risk. (If you're ever nailed to the wall, you can use that contingency as an escape clause.)

2. You must consider what the recipient of your estimate wants to hear. (Of course, this may be all he hears anyhow.)

3. You must be aware of to what degree your recipient considers you to be an expert or authority.

Operating in reverse.

If you are in the chain of "fact" propagation. you can the chain by asking for source data, backup information and the circumstantial justification for the estimate. In the business world, some people do this as a matter of course.

A corollary to the law of estimated fact is written:

When the source of an estimate
is identified as an authority
for the estimate, his
conclusions are propagated,
but not his estimation parameters.

Consider the case where a manager asks an engineer for a cost estimate on a job. The estimate comes in too high and the manager asks the engineer to re quote with less contingency (i.e., he specifies a more optimistic set of conditions for the job). The manager iterates the procedure until the engineer provides conditions so optimistic that they are virtually impossible to meet. However, the manager gets the cost figure he wanted in the first place. He then goes to his boss, saying, "The engineers say we can do the job for X dollars." With this statement, he transmits none of the conditions or reservations implied. Who wins? Who loses? If the cost estimate isn't met, perhaps the engineers are blamed, but the manager lives with his profit/loss statement.

Also, if you receive an estimate from an expert, you can modify it with little repercussion. Modification, however, depends upon your rating of the expert and what your recipient wants to hear. In fact, the whole chain of estimate passing is useless when all information is tailored to what the highest-level recipient wants to hear; he will be given the information he wants regardless of the path it takes to reach him. This is called the potential rule of human nature:

Regardless of the path
followed from the expert
to highest-level recipient,
that person will only accept
what he wants to hear.

This rule can be stated as the familiar:

One only hears *what he wants to hear*