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**Out of the Test Tube and Into the Fire:
Preparing Technologists for Managerial Responsibility**

by Craig Collins

Managers with engineering or scientific backgrounds have risen to the top of many of the world's leading organizations. Indeed, one of the traditional routes to corporate success has been to add an MBA to a first degree in a technical discipline. Clearly, a technical background is not a bar to highly effective managerial performance.

Yet, in reality, the leap from technical to managerial responsibility is a difficult and even daunting one for many technologists. They are initially attracted to a technical discipline because it allows them to apply their strength in analysis, to focus on hard facts and to deal with a world built on known and predictable phenomena.

Management, on the other hand, is a highly subjective area of human endeavour. Often the manager must resolve conflicts between individual viewpoints without the luxury of waiting until hard facts emerge. Managerial solutions require interpersonal skills as often as analytical problem-solving.

Technologists can be just as competent as managers as their non-technical counterparts if they have developed the appropriate skills. However, these managerial skills have usually had a low priority in their previous career and education. In order to redress this balance, it is helpful to design management activities with the specific needs of prospective technical managers in mind. This paper examines several ways in which such management development strategies differ from those intended for potential managers from non-technical backgrounds.

Whenever individuals are lumped together into arbitrary categories, there is the danger of overgeneralization and stereotyping. This is certainly the case here, where a conscious attempt is made to draw many individuals from a wide range of technical disciplines under a common umbrella simply because they share the common experience of a scientific or engineering background. I believe that this approach is a valid one. Nevertheless, it is always wise to be alert for those who are exceptions to the general trend and to deal with them accordingly.

One category of potential technical managers provides a case in point. Many organizations try to identify incoming staff with the talent, ability and motivation to move into the very highest levels of management and to prepare this pool of potential future leaders accordingly. Some members of this group may well come from technical backgrounds. Admission to the "fast track" usually presupposes a broad array of management-related talent and skills. Management development requirements for technical members of this elite group will differ little from those of their non-technical colleagues. These prospective leaders of tomorrow are not the topic of this paper.

Rather, the focus is on the much larger pool of scientists and engineers who enter their organizations as technical professionals. When they join the organization, they may or may not aspire to technical management positions (many will not). During the initial stages of their careers, however, the day-to-day focus is clearly that of a professional rather than of a manager (or potential manager). This is the group with whom we are dealing here.

My background is in the practice of training and development and not in research; my experience is more practical than theoretical. My own undergraduate training is in electrical engineering, and I have conducted management skills training for many technical professionals and managers from a variety of organizations in a range of cultural contexts. The remarks which follow are based on direct experience and first-hand observations as well as on relevant literature. I do not purport to offer original research, but I do aim to present some fresh and original ideas.

Technologists as Managers

What skills and abilities do technologists need to function effectively as managers? Are the requirements the same as for managers and prospective managers from accounting, marketing or any other functional background, or do scientists and engineers represent a special case?

The answer seems to be a clear-cut "yes-and-no", with the emphasis on "no". A century of observation and debate has produced a welter of sometimes conflicting analyses of the manager's work and job roles. Whatever school of thought you may subscribe to, however, it is clear that technical managers, including research managers, face the same types of managerial challenges and fill similar roles to managers in any other functional area. Like other managers, they must plan, organize, staff, direct and control, and they must fill decisional, interpersonal and informational roles.

If the effectiveness of technical managers depends on the same management processes as the effectiveness of other managers, then it is reasonable to assume that they need the same categories of skills and abilities - hence the emphasis on "no". The caveat is an area called "establishing an environment for creativity", which pops up repeatedly in lists purporting to describe the requirements for effective technical management.¹

Clearly, the ability to promote creativity and innovation in the workplace is a valuable and perhaps indispensable asset for a technical manager. On the other hand, is it not an equally valuable asset for a manager in any other functional area? Perhaps the difference is that, in other functional areas, it was possible to be a reasonably effective manager without this ability - at least, until recent years - whereas in research and technical management, weakness in this area is a major management handicap. I tend to believe that this phrase will show up in more and more job descriptions - regardless of functional area - in the future. Thus we can conclude that, broadly speaking, technical managers carry out the same functions as other managers and require a similar set of skills and abilities.

What sets technical managers apart from their counterparts in other disciplines is not the management skills they must develop and apply but rather *the baseline from which this development begins*. Many years ago I read an article about the tennis pro Rod Laver. One snippet of information from this article which has remained with me was the observation that the circumference of one of the star's upper arms (the one which wielded his deadly racquet) was *twice* that of the other.

Technologists tend to show a similar imbalance in the development of their talents. Broadly speaking, analytical and quantitative thinking skills tend to be overdeveloped in comparison with those of other managers and professionals. Interpersonal skills, on the other hand, may be woefully underdeveloped. It is not just a coincidence that the stereotypical "nerd" is usually portrayed as a physicist, mathematician or software engineer.

I would not go so far as to claim that technologists as a group *pride* themselves on lacking interpersonal skills (although some undoubtedly do). The cheerful willingness of many technologists to acknowledge shortcomings in their interpersonal skills, however, suggests that, for them, these skills occupy a place so low in their value system that an admission that such skills are lacking can be made with a clear conscience and with little or no threat to the ego.

A grayer area is that of conceptual and creative thinking. Generalization is riskier, but my own experience, at least, is that many (but not all) technologists have developed their analytical and rational thinking skills to a markedly greater extent than their conceptual and creative thinking skills. That said, however, conceptual and creative thinking - unlike interpersonal skills - is an area which commands respect among technologists. Given suitable opportunities, they eagerly make up for whatever deficit exists and frequently develop their considerable potential (sometimes not obvious from first impressions) to become excellent creative and conceptual thinkers.

It is because of this markedly different baseline that it makes sense to make use of management development programmes designed especially for scientists and engineers (one writer

have a different finish line than other managers-in-development; it is simply that they have a *different course to run* to reach a common finish line.

Scientists vs. Engineers

Is it valid to lump scientists and engineers under the generic term of "technologists" for the purposes of management development? I believe that it is as long as we do not lose sight of the fact that they do tend to differ in several ways. My own experience is largely with engineers who, according to most authorities, commonly find the transition to management an easier one than do scientists.²

The engineering disciplines, like management, are applied sciences. Thus engineers are likely to take a pragmatic rather than theoretical approach to problems (a clear management asset). Moreover, they tend to be goal-oriented and so can identify with organizational values such as profitability, efficiency and growth. If they identify with organizational values, then organizational loyalty follows easily.

Scientists, on the other hand, emerge from a more rarefied tradition with a different set of values. These include the scientific method, the search for truth and belief in the value of basic research for its own sake. Even organizations dedicated exclusively to research have limited resources and must show results to justify their continuing use of those resources. Scientists may find this constraint distinctly unsettling; their ability to succeed as managers as well as their inclination to try may suffer accordingly.

Thus the specific mix of scientists and engineers among the cadre of prospective technical managers in the organization might dictate a slightly different structure or emphasis in the organization's management development activities. However, I would not suggest that engineers and scientists should have separate management development programmes. The differences between them are small compared to the common needs, and mixing them in syndicate sessions may encourage some of the engineer's predisposition toward pragmatism to rub off on the scientist.

Strengths and Weaknesses of Technologists as Managers

We have looked at the typical baseline from which technological managers begin their ascent into the regions of technical management. But exactly what assets and liabilities do they bring to the managerial job by virtue of their *technical* backgrounds? Technical professionals and managers with whom I have worked have responded to this question with honesty and insight. The list given in Table 1, which reflect the consensus of sixteen technical participants in a recent course, is representative of those of other such groups.

<i>Pros</i>	<i>Cons</i>
<ul style="list-style-type: none"> □ Systems-oriented <ul style="list-style-type: none"> ▪ systematic approach ▪ analytical ▪ precise ▪ comfortable with simulations, models and abstract thinking □ Thinking styles <ul style="list-style-type: none"> ▪ rational ▪ logical ▪ creative ▪ practical □ Organizational orientation <ul style="list-style-type: none"> ▪ loyal ▪ respect for formal procedures □ Credibility <ul style="list-style-type: none"> ▪ with technical subordinates ▪ with outside technical staff (e.g., client, suppliers, regulators) ▪ with other departments □ Act as a link <ul style="list-style-type: none"> ▪ between technical and non-technical staff ▪ technologically "bilingual" 	<ul style="list-style-type: none"> □ Attitudes <ul style="list-style-type: none"> ▪ tunnel vision ▪ narrow view of issues ▪ one-track thinking □ Interpersonal skills <ul style="list-style-type: none"> ▪ held in low esteem ▪ low confidence ▪ lack of expertise ▪ little interest ▪ little effort to improve □ Ambiguity <ul style="list-style-type: none"> ▪ preference for clear-cut, certain situations ▪ tendency to ignore ambiguous situations □ Detail/analysis <ul style="list-style-type: none"> ▪ preoccupation with details ▪ tend to interpret everything literally ▪ paralysis by analysis

Table 1: Strengths and Weaknesses of Technologists as Managers

Aptitude and Attitude: Critical Factors for Managerial Success

Aptitude as well as attitude are critical factors in the development of any manager. Certain talents or abilities - the basis for desired management competencies - are prerequisites for a successful transition to management. But without the appropriate attitude - the motivation to develop these competencies and a positive image of the managerial role - it is unlikely that even the most promising prospective manager will realize his potential.

The issue of attitude is more critical for technical professionals than for potential managers in other areas. Newly hired graduates in other functional areas tend to see the entry-level position as a sort of organizational purgatory which they must pass through before they are admitted to supervisory or management heaven. They join the organization in the full expectation of moving into management ranks. In fact, the prospect of a fast track into management is a valuable recruiting tool for enticing high-potential recruits away from the competition.

Scientists and engineers, in contrast, choose science and engineering specialties precisely because they want to be scientists and engineers. Their early jobs as professionals in their chosen discipline, far from being purgatory, are commonly the closest approximations to "professional heaven" which they achieve during their entire careers. From this perspective, a tap on the shoulder and a move up into management represents, at best, expulsion from the

this value orientation, it is not surprising that first-rate technologists can turn out to be reluctant, half-hearted second- or third-rate managers.

William Oncken, Jr. has eloquently described his own first taste of the bitter fruit of the managerial tree:

"One day my boss's boss called me into his office to announce my promotion to succeed my boss; he had been transferred to the field . . . I learned at the outset that as a reward for excellence in coil winding the company terminated my coil-winding career and held me accountable instead for the quality of coils that would be wound by six other men who weren't good enough at it even to get promoted. And I was soon to learn that this promotion would turn out to be not a reward but cruel, sadistic punishment administered without let up, hour after hour, day after day."³

Numerous factors have been cited to explain why technologists choose to move (or allow themselves to be pushed) into management roles. These include: financial inducements, desire for authority/responsibility/leadership, status and prestige, advancement/achievement/recognition and fear of technical obsolescence². Some of these reasons may have value as predictors of managerial success; other are almost completely irrelevant for this purpose.

The widespread antipathy of technologists to management roles is reflected in the now common practice of offering dual career ladders so that those so inclined can continue to advance in their technical specialization without entering the management track. Whatever flaws this approach may have, it has the great advantage of removing a number of pressures which can push technologists into the management track for the wrong reasons.

Thamhain has highlighted the critical role of *attitude* by treating it as an integral part of *aptitude*: A professional who views managerial activities in a negative light is unlikely to make a successful manager no matter how strong his interpersonal skills and other managerial attributes.

He has identified five broad components of technical management aptitude and has developed an instrument to assess these attributes⁴. The five categories are:

- Personal desire to be a manager
- People skills
- Technical knowledge
- Administrative skills, and
- Business acumen

Thamhain maintains that technical managerial aptitude, as assessed above, plus demonstrated mastery of current assignment is a good predictor of technical management success.

Because of the vital role played by the prospective technical manager's attitude toward the nature of managerial work, it is important that this situation be reflected in the selection and development strategies of the organization.

Selecting and Recruiting Prospective Technical Managers

In selecting new technical hires, I would suggest that it makes sense for large research organizations to consider a dual selection strategy which parallels the dual career paths available to technologists later in their careers. The majority of new entrants, perhaps nine out of ten, would be selected in line with existing criteria for technical professionals, i.e., mainly on the basis of technical competence in their discipline.

A minority, say, one out of ten, would be selected against a more balanced profile. This group must be technically competent (although not necessarily outstanding), but this is not enough. They must also demonstrate strong interpersonal skills and a positive orientation towards managerial work. Like their colleagues, however, they are hired as specialist professionals, not as manager trainees.

In other words, both entry streams flow into the same pot. Some years later, both the senior

which ladder is a matter of matching personal choice with organizational needs. If a researcher who was initially hired for his technical competence subsequently demonstrates interest and aptitude for the management ladder, all sides benefit. And if an all-rounder performs strongly as a researcher and prefers to stay on the professional ladder, this is also well and good.

The objective of recruiting a minority of new hires whose profiles align more closely with technical managers than technical professionals is not to earmark anyone for one stream or the other but simply the hedging of bets; it is a way of seeding the clouds of technical professionals to improve the chances that, sometime down the line, a cloudburst of competent candidates for technical management will emerge when they are needed.

A seeding process such as this will also reduce the chances of falling foul of the "Best Salesman as Sales Manager" syndrome. It is a universal human tendency to promote the highest-performing salesman to the vacant position of sales manager on the assumption that the best salesmen will make the best sales managers. Too often, companies have discovered to their chagrin that they have not only lost a star salesman but have gained a third-rate sales manager in the bargain.

Sol Hurok, the great impresario, went into the business of promoting musical events because he recognized early in life that, while he loved music, he was not exceptionally talented at it. But he was spectacularly successful as an organizer and manager of major musical events.

Early in his career, Mark McCormack, now president of the International Management Group, was a run-of-the-mill professional golfer. He recognized that his talent lay less in his own athletic prowess than in his ability to manage the careers of other professional athletes. Out of that talent and realization he built the world's leading agency for athletic representation.

In the same vein, the best researcher is not necessarily (in fact, probably not) the best research manager. Having a dual track system is of little use if there are too few technical professionals who are qualified or prepared to enter the management ladder. The dual input concept is intended to provide a small pool of technical professionals who may be less technically outstanding than their colleagues but more qualified and eager to enter the management stream and make a success of it. They are the potential Sol Huroks and Mark McCormacks of the research world.

Attitudinal Issues in Technical Management Development

Whatever the source of the pool of potential technical management talent, that pool must be developed. As I have indicated above, I believe that it is important to bear in mind that this group is likely to display a profile which differs substantially from those of their non-technical counterparts. For this reason, it is often advisable to design management development activities to take special account of the group's strengths and weaknesses. Strengths are likely to fall in the area of systematic analytical thinking skills and an openness to improving creative thinking skills, while underdeveloped interpersonal skills and a low motivation to improve such skills are likely to be the prime areas of weakness.

I would urge that content of management development activities not be limited to skills and knowledge. In the development of successful technical managers, the attitude component is vital and should receive a great deal of attention. Its importance grows in proportion to the degree of perceived pressure (from whatever source) which technical professionals feel to move from the technical professional stream into technical management positions.

Most of those who have chosen and/or been selected to make the transition from workbench to office desk will benefit from some hand-holding during this transition. They are in the position of a trapeze artist who has let go of one trapeze but not yet grasped another. Suspended in mid-air, they may be excused for belatedly questioning the wisdom of the decision to challenge the laws of physical and organizational gravity. There are many ways to assist them:

(for the appropriate reasons) is a significant contributor to subsequent success in filling a managerial role.

- 2) Bring in successful senior technical managers to present brief cameo sessions. Aside from the motivational value (which, in turn, influences participants' attitudes toward the managerial role), this provides participants with role models of success in technical management.
- 3) Bring in one or two mid-level technical managers who have successfully made the transition from technical professional to technical manager within the last five years. Ideally, these individuals would be frank in sharing their apprehensions of moving into management and should speak openly of the difficulties they encountered during this transition and how they dealt with them. An informal venue for a follow-on question-and-answer session (lunch or a cocktail) provides participants with an opportunity to raise personal issues. These contacts also provide the basis for a network of contacts who can be helpful in the future.
- 4) Mentors can be of great value in this context. In practice, there may be a shortage of suitably qualified and motivated technical managers to fill the mentor role. Where mentoring proves difficult or impossible, other strategies above may help to fill the gap.

Reinforcing Technical Management Development Through Organizational Culture

How does the organization's culture deal with technical professionals and technical managers? Who are its heroes and villains? For instance, does organizational folklore revere those guerrilla technologists who set up their own backroom skunk works in violation of known policy, diverted resources from other budgets, ignored management priorities and deadlines in order to lavish their attention on a pet project which management had terminated six months earlier and, as a result of all this, produced the greatest success story on the organization's history?

Who is accorded the greater prestige in the organization, the Senior Technical Officer or the Chief Scientist? If the organization's cultural values paint the workbench as the place to be and depict technical management offices as repositories of second-rate has-been's, we should not be surprised if qualified technical professionals are hesitant to move into management.

Organizational culture is a deep topic and beyond the scope of this paper. Nevertheless, a few suggestions can be offered for organizations in which technical management is not held in high cultural esteem:

- 1) Be on the lookout for potential technical management heroes. When such "stars" are identified, publicize their success widely through appearances in seminars, public recognition by top management, in-house newsletters, etc.
- 2) Look for opportunities to recognize, reward and publicize excellence in technical management. In order to qualify for such recognition, a technical manager does not have to reach the status of a star; if he has done something which is worth emulating, even just once, then the event is worth recognizing and publicizing.
- 3) It may be appropriate to import a potential hero or star from another organization whose culture places a high value on technical management competency. If your organization lacks this value, a highly competent outsider can bring with him the "war stories" of his former organization in support of technical management excellence.

Conclusion

In this paper, I have focused in principle on the development of managerial skills in scientists and engineers. In practice, I have found it necessary to digress into the related but separate territories of the selection process, career ladders and organizational culture.

As a group, engineers and scientists bring a number of assets to the managerial task. High among these are comprehension and credibility in the management of highly technical activities and the ability to function as a communications bridge between technical and non-

However, technologists also tend to bring significant weaknesses as well. Chief among these are underdeveloped interpersonal skills and, sometimes, a low motivation to improve such skills. Unlike staff in most non-technical areas, many technical staff attach great value to a "hands-on" job and have negative or mixed feelings about moving into a management position.

Given a positive predisposition toward management, the necessary skills for success in management can be developed among technologists just as among prospective non-technical managers. Many technical managers will require a programme of management development which reflects their particular needs, especially in the area of interpersonal skills.

This positive predisposition toward management is not always present, however, and its absence can be a barrier to developing competent technical managers in that, without it, there is no pool of suitable prospects to develop. One approach is to "seed" new intakes with technical professionals whose profile more closely resembles that of the manager than the professional.

Another is to address the attitude issue explicitly in management development activities. Senior and middle managers who have successfully negotiated the transition from professional to technical manager can provide role models, personal advice, encouragement and a sympathetic ear to those who are making or preparing for the same transition.

Attitudes are also influenced by cultural values. An organization whose culture values the team leadership role of the technical managers is more likely to attract and develop such managers than one whose culture emphasizes the role of the professional at the expense of the manager. Influencing organizational culture is a large-scale, long-term undertaking. As the organization's culture provides the backdrop against which all management development activities are played out, however, it is important to identify any aspects of this culture which discourage development of competent technical managers and to initiate actions to modify it accordingly.

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