Management and Leadership of Scientists: How Can We Improve?

by Thomas E. Clarke

Effective management and leadership of scientists is a major challenge; it is not easy, and well-trained, dedicated people are needed to accomplish it successfully.

Abstract

Knowledge about how to effectively manage and lead scientific personnel has been known for decades. However, the application of that knowledge has fallen far short of expectations. This paper provides an overview of what we know about motivating and leading scientists and engineers in the unique envi-

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ronment of a laboratory, and presents two of the major reasons why the quality of management has not improved commensurately with the level of knowledge we have about what constitutes effective R&D management practices.

It is still common to hear R&D managers complain about managing and motivating their scientific staff. What is the problem?

We have known how to effectively manage and motivate scientists and engineers for the past 40-50 years. When I first took an interest in this area back in the mid-1960s, there were already two major journals dealing with the topic: IEEE Transactions on Engineering Management (1953) and Research Management (1957) (now called Research-Technology Management). Now there are at least 15 dedicated R&D management journals, including Managing the Modern Laboratoru.1

Why, then, do we still have difficulty in this area of management?

Effective management of scientific staff must take into account three general factors:

- The unique environment in which research managers work in a scientific organization
- The prime motivators of scientific staff, which differ somewhat from other professionals
- The characteristics and actions required of an effective leader of scientific staff.

The unique R&D work environment

Several features that are unique to the R&D environment must be taken into account in the management process.²

Uncertainty associated with scientific activities

A distinguishing feature of R&D that differentiates it from other functions in an organization is the level of uncertainty associated with it. R&D is characterized not only by uncertainty in terms of how long a research project might take or

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how much it will cost, but also by the nature of the results. This is especially so at the research end of the R&D spectrum, which is usually regarded as the stage from basic scientific research through experimental development.

Most other professionals, such as medical doctors and lawyers, usually deal with an existing knowledge base (e.g., well-understood diseases or prior case law) or known technology. This is not the case for scientists. They are either promoting a new understanding of a natural phenomenon, developing new analytical techniques, or solving a problem for which there is no known solution. In some cases, they must discard what they think they know and work in totally unknown territory. No other professional occupation faces the situation of pushing back the frontiers of science or engineering.

Difficulty of assessing the contribution or impact of research results

The output of research is knowledge, and it is difficult to predict in advance, with any accuracy, the quality, quantity, or usefulness of the knowledge that will be generated from any given research project. On more than one occasion, Nobel Prizes in science have been awarded years after the initial scientific discovery, because the value or importance of the discovery to the field or to a completely different field of science was not realized at the time of discovery.

In many cases, the results of one line of research must await development in other areas of science or technology before their impact or application is evident. Laser technology, for example, languished for years before practical applications were developed. No one could have predicted such widespread uses, from a substitution for

record player needles to optical surgery.

Rapid advancement of scientific or technical knowledge

In no other area of human endeavor is pace of change more dominant than in science and technology. Medical procedures change relatively slowly; changes in management practices and theory can be measured in years; changes in law can take decades. In contrast, it has been estimated that the half-life of initial engineering education is less than five years.

Motivating an employee involves identifying the psychological needs of each employee and making job performance the path to satisfying those needs.

Technological obsolescence is a constant fear of scientists and engineers because it is very easy to fall behind. If an assignment takes a scientist away from his or her regular work for six months, the scientist may have to study the field anew for a year just to catch up with colleagues. This does not occur in most other professional occupations.

Technological obsolescence also applies to equipment and analytical procedures. Out-of-date equipment or techniques hinder the scientist's involvement in cutting-edge R&D and also limit the services a laboratory can offer its clients.

Failure to avoid technological obsolescence in either people or equipment will result in inadequate, or overly expensive, solutions to problems; problems sidestepped but not solved; and a general reduction in the organization's ability to fulfill its

mandate or survive. Thus, avoiding technological obsolescence in the face of rapidly evolving science and technology is another unique characteristic of the R&D work environment.

Prime motivators of scientific staff

Research scientists and engineers, while sharing many attributes with highly trained people in other professions, have some traits that are associated more readily with them than with other professionals. Some of the more distinctive characteristics are:

- Ability to better relate to things, not people, which makes many scientists reluctant to take on managerial responsibilities
- Affinity for their profession rather than their employer, which makes some of them more loyal to scientific goals than to organizational objectives
- Expectation that their immediate supervisors have undergone extensive scientific training.

An effective manager must take these attributes into account when trying to motivate his or her staff members to work to the best of their ability on projects of value to the organization. How does an effective manager do this?

Simply put, motivating an employee involves identifying the psychological needs of each employee and making job performance the path to satisfying those needs (i.e., What I want to do to feel good is what the company wants me to do to make a profit).

There are many theories of motivation that apply to scientific staff, and each provides some useful insight into effective methods of motivation. Their many lessons can be summarized as follows.

Scientific staff members are highly motivated and therefore

productive and creative when allowed to satisfy their psychological needs for:

Experiencing achievement

Attaining recognition from peers and colleagues

• Working to the best of their

Growing professionally or advancing.

These needs are fulfilled when employees are allowed to work on projects that are challenging, important, and/or interesting to them. Supervisors must guard against assuming that what is challenging and/or interesting to them is the same for the employee whom they are trying to motivate.

Knowing what the various theories of motivation tell us, how can they be put into practice?

Characteristics and actions of an effective manager

Numerous studies of leadership/management in the scientific setting overwhelmingly emphasize the need for leaders to manage in a participative/ consultative style. Participativestyle managers understand that their primary job is to create a work environment that promotes productivity and creativity through careful listening and by sharing their decision-making and managerial power with employees. This does not mean that situations will not arise in which the effective manager must be more directive in dealing with employees, but his/her normal style should be consultative.

Managerial actions to promote productivity and creativity

1. Allowing scientific staff the freedom and autonomy to make decisions about their work. This stands out from all others as being critical to the creative process of scientists and research engineers. It also fulfills the need for achievement by scientific staff held responsible for

project outcome.

The main form of freedom or autonomy mentioned in the literature is freedom to determine how a project or problem will be handled (operational autonomy). This form of freedom to act is in line with general management best practices, which state that authority and responsibility should be delegated as far down the managerial ladder as possible. Operational autonomy permits employees to feel they are in charge of their project, to feel in control. Other forms of freedom described in the literature are freedom to: follow up on ideas; change research direction when necessary; work on areas of greatest interest; see projects through from the idea stage to the finished product; and pursue, without penalty, ideas that do not have official approval.3-8

Total freedom, however, is not conducive to useful creativity. Thus, most authors recommend that freedom/autonomy be generally confined to the determination of approaches to solve a problem, rather than strategic autonomy, which involves setting the R&D agenda. 9,10

2. Providing challenging, interesting project assignments. The assignment of technical projects that fit their training and talents is an important managerial tool for motivating employees to be both creative and productive. Challenging, interesting assignments, when successfully completed, allow researchers to gain respect and recognition from their peers and experience achievement and self-fulfillment on the job. Uninteresting, unchallenging assignments do not satisfy these criteria and can be a major demotivator.

In reality, it is not always possible to provide an unending stream of challenging or interesting projects. What is important to the employer is not always challenging or interesting to the scientist. A good manager can make sure that tedious, unchallenging work is occasionally interspersed with projects that interest the employee.

3. Reinforcing the importance of the work. Managers should never assume that scientists understand the importance of a particular assignment to the organization or the client. The importance of the research project to the organization or to the advancement of science or engineering is a major factor in guaranteeing the involvement of scientific personnel.3 This, in turn, has been noted as a factor in productive R&D organizations.11 The assignment of a low-importance project to a creative person will not result in creativity or productivity.

One way to emphasize the significance of the job is to introduce the employee to the client. The employee can even be part of the team requesting the work. He or she will then understand why the work is necessary and how it will be used by the client group. The reasoning behind this is that it is harder for an employee to let down someone with whom he or she is acquainted.

4. Providing adequate resources. To encourage creativity and productivity, scientists must have adequate resources in terms of personnel, equipment, facilities, and time. It is extremely frustrating to scientific staff to be given a challenging, interesting assignment but not the necessary resources to complete it in an effective or efficient manner. If inadequate resources force scientists to do what they consider to be a substandard job, then they will not get any satisfaction on completion of the project. For those scientists who seek recognition from their peers, having to work with equipment that is several generations behind that used by their colleagues will not likely lead to results that are acceptable for publication or presentation at a conference.

More time can be made available for creative people to conduct their research by reducing their administrative burdens. ¹² Unfortunately, it is not uncommon to hear first-level science managers say that science is what they do on weekends or after dinner. The downloading of administrative tasks through unwise cutbacks turns many science managers into parttime clerks.

5. Encouraging risk-taking. A primary function of an effective science manager is to reduce the "terror quotient" in the organization for trying new, potentially risky activities.

Risks will be taken only if it is safe to take them. If an organization severely penalizes employees for trying challenging assignments and failing, then no risks will be taken. If attempting something new that results in a success is not rewarded, then employees will play it safe and stick with the status quo, no matter how ineffective the present practice. This is the situation in many government organizations, where taking a risk and being successful is more or less ignored, but failing is pounced upon with the full weight of penalties.

6. Ensuring a responsive and equitable reward and recognition system. Although creative scientific staff are generally selfmotivated and have a high need for achievement, it is important for the organization to have in place a system of rewards and recognition that reinforces the creative/productive behavior of its scientific staff. ¹³ Feelings of achievement and recognition can be influenced by the reward and recognition process present in the work environment.

Forms of reward and recognition can be classified into several broad, nonexclusive categories:

a) Intrinsic-extrinsic rewards/

recognition. These are experienced by an individual as a result of good job performance (e.g., feelings of achievement, pride, and competence).

b) Extrinsic rewards or recognition. These are provided by the employer for a job well done (e.g., promotions, salary increases, bonuses, public recognition at company functions).

Intrinsic (internal) rewards (psychological need satisfaction) appear to be associated more with creativity than with extrinsic rewards such as salary or promotion. Therefore, management should ensure that its actions provide for intrinsic rewards or forms of recognition.

Among the intrinsic rewards sought by R&D staff are:

- The feeling of self-fulfillment that comes from completing a difficult task
- Recognition for hard work and good performance from supervisors, peers, and colleagues
- Being treated like a valued professional
- Experiencing significant achievement for a job well done
- Senior management showing a genuine interest in their work
- The opportunity to grow and develop as a professional
- The authority to make decisions about their work (e.g., operational freedom)
- Appreciation of creative contributions and ideas
- Receiving constructive feedback on their progress.

A dual career ladder that recognizes and rewards professional employees for their work and dedication has been used successfully by many organizations. Lack of a dual promotion ladder for researchers has been associated with low creativity. ¹⁴ The dual ladder has the greatest impact on scientists whose focus is more on their profession rather than on their employer.

The use of a simple and timely pat on the back for a job

well done is also a powerful motivator. Fear that such recognition will raise expectations of higher monetary rewards should never be an excuse for not thanking an employee for a job well done.

7. Encouraging interaction with colleagues. Praise and recognition from peers is a strong motivator for some scientists. The work environment and, if possible, the physical layout of the work place, should encourage communication among the scientific staff and others in the organization, as well as among the scientific staff elsewhere

Conference attendance cannot and should not be considered a luxury. In addition to being a vital conduit for new information about the latest scientific or technical advances or potential new business opportunities to enter the organization, it also provides a major mechanism for scientists to fulfill their psychological needs for personal growth (i.e., learning about new techniques, etc.).

Interaction with the outside world can also be facilitated by the use of temporary exchange programs with similar laboratories, or by encouraging adjunct professorships at local universities or colleges.

Why are we not motivating and leading our scientific staff more effectively?

I believe there are at least two fundamental reasons for this problem. First, the selection of potential science managers has been based too heavily on a person's scientific or technical skills to the detriment of selection based on their scientific or technical skills and their ability to learn and apply management skills with the result that unfit or autocratic people get appointed to management. These people may have the attitude that they do not need to learn anything about managing people.

Secondly, even if a potentially good science manager is selected, some organizations still have the bad habit of moving bench-level scientific or technical staff into a supervisory position without any training as a scientific or technical manager. These newly appointed R&D managers have had no exposure to the vast pool of knowledge and information that has been accumulated over the past 50 years on R&D management. As a result, many scientists and engineers fail to make the grade as managers and cause considerable harm to the organization in the form of lower morale and productivity. I am no longer surprised when science managers who have been in managerial positions for several years sign up for my R&D management workshops and admit that this is the first time they have had any management training.

The first level of R&D management is a critical management level in the hierarchy of an R&D-based organization. The actions of a first-level science manager can have immediate effects on the morale, creativity, and productivity of a laboratory. Therefore, it is important that potential science managers be selected wisely, and that the prospective science manager/ supervisor be exposed to R&D management principles and theories before they are assigned a management position.

This training reinforces that their role in the organization will change from being a technical contributor only to facilitating the technical contributions of others. They will also learn that there is a body of knowledge on R&D management that is important to understand and apply. It will help them avoid the trap of trying to manage scientific staff by relying only on their technical skills and personal experiences. Such training will also convince them that their actions shape the work environment and determine whether the organization will survive in these turbulent times.

Conclusion

Since a great deal of material has been covered in this paper, I would like to close by emphasizing the following points:

- Better selection and training of first-line science managers is critical to overall improvement in the motivation and leadership of scientific staff
- The effective science manager motivates employees by creating opportunities in the work environment for them to satisfy their psychological needs, to gain satisfaction from their work, to reinforce their self-esteem, and allow them to gain the recognition of colleagues inside and outside the organization
- Task assignment is key to keeping scientific staff highly motivated
- Effective management and leadership of scientists is a major challenge; it is not easy, and well-trained, dedicated people are needed to accomplish it successfully.

The difficulty in effectively managing scientists is captured in a quote by Joseph Martino, Associate Editor of *Technological Forecasting and Social Change:* "It has been said that managing scientists is like herding cats. I've raised cats and I've managed scientists. I am not sure but what I would prefer to herd are cats."

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