PREPARING THE ENGINEER OR SCIENTIST

FOR MANAGEMENT

Thomas E. Clarke, M.Sc., M.B.A.

Stargate Consultants Limited http://www.stargate-consultants.ca

Background

The effective management of research engineers and scientists, or research and development (R&D) projects requires the development of interpersonal skills and the utilization of knowledge of the technological innovation process.

Unfortunately,, most scientists and research engineers are not even aware that a vast body of knowledge that deals with the management of research and development/ technological innovation exists in the form of thousands and thousands of articles, books or conference proceedings (Clarke, 1992).

In addition, the education received by research engineers and scientists while in university emphasizes technical training to the virtual exclusion of the development of interpersonal skills. In fact, there is some evidence that science graduates are encouraged by their professors to consider R&D management as unimportant (Clarke and Reavley, 1987).

Academia appears to be under the impression that scientists and research engineers are still solitary workers, shut up in their laboratories, interacting with no one. Reality, of course is quite different with the necessity of research engineers and scientists working in teams, and also working closely with non-technical personnel in order to solve technology-based problems and/or develop applications for new technology.

Given this educational orientation and lack of knowledge of the literature, many new R&D managers do not always realize that they should acquire formal R&D management training. For example, one senior research manager in a federal government laboratory was once overheard to say, "management training, why do I need management training? I have a Ph.D. in physics". Thus ill-informed scientists and research engineers try to "wing it" on their technical skills, with the result that most are ineffective supervisors. Ineffective R&D managers can cause organizational disruptions in the form of lowered morale, reduced creativity and productivity, increased complaints and grievances, and unnecessary turnover. In the case of turnover, usually it is the better

STARGATE CONSULTANTS LIMITED, 1997

scientists and research engineers who leave first thus reducing the organization's overall technical ability to deal with rapidly changing science or technology.

This lack of effort into providing adequate training for prospective R&D managers is not unique to Canada. The American National Research Council in a 1991 study "observed that while US industry had spent \$64 billion on R&D in 1989, it spent less than \$1 million 'learning how to manage this huge effort more effectively'" (Research-Technology Management, 1992). As a result, the American National Science Foundation has established a new program to improve the ability to manage the development and adoption of new technology, and to integrate technology strategy with business strategy.

Deficiencies in Existing R&D Management Preparation

Poor Attitude Towards Training and Making Use of the R&D Literature

As noted above, universities provide very little in the way of education and training for prospective R&D managers while they are acquiring their technical degrees. This results in a negative attitude towards any management training and a reluctance to acquire the necessary knowledge even when its need is pointed out. This reluctance usually takes the form of the excuse, "Yes, it is important, but I don't have the time".

Richard McBride (1984), in a Science Council of Canada study of biologists and science managers, found that they displayed a lack of appreciation for R&D management as a formal body of knowledge requiring the same professional dedication as the practice of science or engineering. He also found that many of the science managers had developed their own "pet theories" of management and few had shown any interest in comparing their theories against the professional R&D management literature. This lack of comparison is not surprising as most scientists and engineers do not know such literature exists. The most common of the pet theories was the "sink or swim" theory that states that the success or failure of an individual scientists is solely due to the actions or ability of that scientist, and is completely independent of the actions (or inactions) of the manager or the organization. McBride also found that while many of the science managers admitted to their lack of skill in several managerial areas, they rarely expressed any interest in formal training in the subjects.

Lack of use of information contained in the R&D management literature was noted in a British article by Ian Barclay (1992). He found that few UK companies made use of the vast literature on the new product development process when developing their own procedures for new product development.

Specific Topic Deficiencies

Many management researchers have noted the lack of R&D management knowledge and training in specific areas of the technological innovation process.

This lack of management knowledge and training can be divided into two main categories: that which is specific to one organization and can only be obtained from senior managers, and that which is general to any science or engineering based organization, and can be obtained from courses, lectures or the literature.

In the first category, is information on such matters as the goals and objectives of the organization, how the organizational structure works, the organizational climate, the lines of authority and communication, and the financial and budgeting process employed. In effect, newly appointed R&D managers require education, training and coaching from senior people in the organization in how to cope with, and manipulate the organizational environment that involves the administrative, personnel and financial systems.

The second category is more generic and the educational deficiencies across many science-based organizations have been identified.

McBride (1984) in his study of Canadian science managers found that they required more training in the following areas:

- personnel management;
- project management;
- financial management;
- seminar presentations; and
- writing of scientific reports and papers.

This author conducted a management needs analysis in the mid-1980s for the Department of Fisheries and Oceans and identified the following topics as those required by F&O scientists:

- examination of the total role of the R&D manager;
- overcoming the problems faced in making the transition from the "bench" to management;
- understanding of the leadership styles appropriate to the R&D environment;

- motivation and reward of scientists and research engineers;
- interpersonal communication skills;
- management of change;
- management of conflict;
- understanding of technology transfer/commercialization of government R&D;
- management and prevention of technological obsolescence;
- stress management and prevention of burnout;
- time management and delegation; and
- selection, evaluation and termination of R&D projects.

These topics were grouped to form a seven day R&D management course that was presented to scientific personnel in several government departments, including Fisheries and Oceans. [This course was subsequently divided into two, three day courses which are available today. See http://www.stargate-consultants.ca]

Most management researchers agree that a major cause of managerial failure among scientists and research engineers is their poor interpersonal skills (Hower and Orth, 1963, Koplow, 1967, Bayton and Chapman, 1973, Badawy, 1983). Many scientists and engineers are more comfortable dealing with "logical" things in the laboratory than they are in dealing with "illogical" people. They are used to doing things for themselves and find great difficulty in working with others to accomplish their objectives. As noted earlier, their previous university education will not have provided them with any information on motivation and leadership, so they "wing it" when put into a supervisory position.

Suggested Course Topics for R&D Managers

Based on a review of the extensive R&D management literature, recent consulting studies by the author, and from conversations with hundreds of scientists and engineers during their attendance at the author's R&D management courses, the following three clusters of topics is recommended. The three clusters loosely represent three managerial levels: first line R&D supervisor, middle level and senior level.

This listing assumes that the R&D managers have successfully learned and put into practice the knowledge gained in their previous management level.

First Level R&D Management Topics

- understanding of the total role of the R&D manager;
- awareness of the potential difficulties in making the transition from the "bench" into management;
- knowledge of the most appropriate leadership/management styles that encourage creativity and productivity in an R&D environment;
- developing and sustaining the motivation of R&D staff;
- interpersonal communications with people at all levels;
- effective delegation;
- managing conflict;
- effective introduction of change;
- understanding of the technology transfer process, including intellectual property management; and the importance of projects being completed on-time and on-budget;
- establishing, motivating and rewarding R&D teams;
- dealing with problem employees;
- R&D project monitoring and control;
- R&D project evaluation and selection;
- R&D performance appraisal;
- selection of new R&D personnel (e.g., interview skills);
- understanding the informal organizational structure and group behaviour; and
- marketing the R&D unit's capability to internal and external clients.

Second Level R&D Management Topics

The second level is defined as the managerial level to which the first formal level of R&D manager reports. In addition to the above topics, the second level R&D manager would require the following knowledge or skills:

- an understanding of what actions should be taken to reduce or eliminate prospective transition problems in newly appointed R&D supervisors;
- knowledge of how to effectively monitor and mentor lower level managers;
- program evaluation and selection;
- how to successfully plan and introduce change at the unit level;
- program/project planning;
- preventing technological obsolescence;
- managing effective reward systems for R&D personnel;
- holding effective meetings;
- new product development process used by their private sector clients;
- effective decision-making and problem-solving;
- clear understanding of how business is conducted among their private sector clients;
- selection of first level R&D supervisors;
- career planning in R&D (operating a dual promotion ladder);
- preparation of R&D program budgets;
- methods to reduce stressors/ stress management;
- scientific information acquisition and flow in an R&D organization;
- in-depth understanding of intellectual property management; and
- advanced sales and marketing skills to identify and successfully market to potential internal or external clients.

Third Level R&D Management Topics

The third level of R&D management is responsible for, or has considerable influence over the strategic direction of the R&D organization. Third level managers, in addition to the above knowledge/skills, require the following:

- ability to identify and set strategic R&D directions for the organization;
- an understanding of the total technological innovation process;
- ability to establish an organizational structure that is appropriate to the objectives;
- ability to establish and successfully operate a dual/triple ladder promotional/reward system;
- understanding of the impact of government science policy on industrial innovation;
- an appreciation of the impact of organizational climate on creativity and productivity;
- a sensitivity to how the organization is perceived by others, especially clients;
- ability to deal with a rapidly changing global economy (e.g., competition from other foreign government laboratories for Canadian work);
- ability to deal with public relations crisis;
- ability to establish and maintain a continuous improvement environment (e.g., not to rest on their laurels);
- the skill to balance the demands of internal clients with those of external clients, and enhance the organization's scientific/technological ability in the process;
- skill to make decisions in a political environment; and
- ability to monitor world technology and business trends.

Courses Are Not Enough

Courses covering the above topics are a necessary but insufficient effort towards developing effective R&D managers. Along with courses must be the expectation by the organization that the person will apply what they have learned. The organization must also eliminate any barriers that prevents the person from applying the new knowledge otherwise frustration will set in.

The use of temporary managerial assignments for "bench" researchers to identify those with both the ability and interest in becoming full-time R&D managers is also necessary. Once such an individual is identified, a career plan involving both R&D management training and management assignments should be developed. It will be the responsibility of senior management to monitor the candidate's progress. Only those successfully mastering the skills and knowledge outlined above should be advanced in the management structure.

ONLY THOSE WHO WANT TO BE EFFECTIVE R&D MANAGERS WILL BE SUCCESSFUL BECAUSE ONLY THEY WILL TAKE THE TIME AND MAKE THE EFFORT TO LEARN WHAT IS NEEDED TO BE SUCCESSFUL.