Practices Employed by Science-based Organizations to Determine the Salary, Compensation and Promotion, and Career Paths of Research Scientists

Literature Review

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BACKGROUND

The R&D management literature indicates that the management of research scientists is different from that of other employees. The major reason for a different management approach is the many unique features found in an R&D environment. Some of these are (Clarke, 2002):

- the uncertainty associated with R&D activities;
- the difficulty in assessing the contribution or impact of research results on the company/organization, and on the advancement of science/technology in general;
- the rapid changes in science and technology that result in an ongoing battle by researchers to stave off technological obsolescence in both people and equipment;
- the values, expectations and attitudes of research scientists and engineers that differ in many respects from those of other professionals (e.g., need for autonomy, and peer recognition).

These differences not only affect the way scientists are managed on a day-to-day basis, but also influence the salary and compensation systems, and the promotion and career paths that are deemed necessary to attract and retain scientists in an organization. A study of job evaluation plans for R&D personnel in 1965 found that, even then, some companies were using a different approach to evaluating engineering and scientific job positions (Rodney, 1965). Rodney found that 10 of 47 aerospace companies surveyed did not even evaluate exempt R&D positions. The main reason given by the companies was that "exempt R&D positions were filled on the basis of the individual's background and accomplishments rather than the requirements of a specific job". Of the remaining 37 firms, five used a separate plan for their R&D staff.

This review of the R&D management literature gives an overview of the recommended approaches of many R&D management authors and compensation specialists to satisfy the economic, psychological and career aspirations of scientists and research engineers.

METHODOLOGY

Most of the information for this study was obtained from R&D management literature (Clarke and Reavley, 2002), and from the Internet.

Literature dealing explicitly with salary compensation systems for research scientists is limited. The Industrial Research Institute, a major association of R&D managers, and Abbott, Langer and Associates who collect data on R&D salaries were contacted to determine whether they had information of value to this study. Unfortunately, neither organization was aware of any studies that had identified the types of salary compensation systems used for research scientists.

RESULTS

Attraction and Retention of R&D Staff

> "The demand for top-notch R&D talent must intensify because science and technology are becoming more complex, more diversified, and more interdisciplinary. The challenge of acquiring the best people will also intensify…." – Joseph F. Coates, 2003

Attraction and retention of scientific staff is dependent on more than just salary or the salary system used. The work environment and the quality of the work play a much larger role in the attraction and retention of scientific staff than they do in the attraction and retention of other professional employees. In a survey of attraction and retention of R&D staff, Kochanksi, et al. (2003) found that the "work itself" was considered by 36% of respondents as most important for attracting staff, and by 43% for retaining staff. The R&D leaders surveyed by Kochanski, et al. also believed that R&D professionals tend to stay with an organization if the organization provides long-term career opportunities and that making use of a clear technical ladder was important. Cash compensation was not considered to be a major factor in either attracting or retaining R&D professionals.

Balkin and Gomez-Mejia (1984) note that the risk of a company losing its best R&D performers is higher in high tech organizations as individual contributions are more easily recognized. This makes them an easily identifiable target for corporate "head hunters" from other companies.

Pake (1986) argues that attracting and retaining the best technical talent requires, among other supportive organizational factors:

- maintaining an honest R&D environment that is supportive and also free and open to new ideas; and

- treating talented R&D personnel as human beings and professionals.

An official at the SANDIA National Laboratory in the U.S. believes that the people-based salary system is important to attract the very best (Clarke, 1997). He also said that, "Those (U.S.) laboratories that are under the GS system (U.S. government position-based salary system for their public servants) are not necessarily considered to be first tier laboratories".

Risher (2000) notes that concern about attraction and retention of scientific staff has resulted in firms paying less attention to internal salary equity considerations, and more to the importance of having salaries that are competitive with outside employers. Some firms have introduced separate salary structures for high demand "job families" such as engineering. One official from a high technology company stated that, "we have thrown out internal equity". Pay levels for job families are based solely on market data. In a review of technical professional compensation, Despres and Hiltrop (1996) noted that common compensation patterns exist in high-tech companies. One of these "involves market-driven and non-mechanistic approaches to compensation with frequent external equity adjustments and professional perks (e.g., paid sabbaticals)".

Coombs, Jr. and Gomez-Mejia (1991), in a study of pay strategies in high-tech firms, found that because researchers tend to have a greater commitment to their profession, than to their employer, companies have had to develop "an array of creative compensation programs designed to reduce turnover, attract scarce R&D talent, …".

Several studies have shown that public sector employees rate intrinsic rewards higher than extrinsic rewards (such as salary) (Perry, 1996; Crewson, 1997). This, coupled with the many studies of reward and recognition of scientists that show that researchers in general are more highly motivated by the intrinsic rewards associated with their work (e.g., peer recognition; working on challenging, interesting projects; feelings of achievement; etc.) indicates that as long as salary is considered to be adequate and fair for the work done, it is not a great source of job satisfaction.

Demers (2001), in a review of how to hold on to your best people, stated that, "people are most likely to stay when they are satisfied with their jobs (=meaningfulness of work + felt responsibility + knowledge of the results of one's work efforts) and committed to their organization (= decision latitude + co-worker relations + compensation and benefits + organizational communication + internal job mobility). He also noted that attraction and retention of R&D staff is also dependent on the organization having state-of-the-art R&D equipment and facilities, and support for professional development. An organization's reputation is also an important factor in both attraction and retention of scientific staff.

The general conclusion is that attraction and retention of scientists depends more on the quality of the work itself and the work environment, than on salary alone. It is known from the work of Frederick Herzberg (1966), however, that if salary is considered to be inadequate or unfair, concern about salary can be a powerful dissatisfier to R&D professionals which may result in their looking for work elsewhere.

Salary/Compensation Systems

> "We want to encourage innovation and inventiveness, we want to encourage networking and aspirations to world-class standing, and all these things come from a person-based approach rather than a position-based approach" – Official of the Defence Research Agency, U.K. (in Clarke, 1997)

Salary or compensations systems can be divided into two categories: job-based systems where an employer pays for a particular job to be done (may be associated with a narrow salary range reflecting a learning phase to a fully performing status); and person-based salary systems where the focus is on the individual and his/her capability, rather than the individual's present job or duties.

Balkin and Gomez-Mejia (1984) noted that in the type of environment found in high tech companies, the "traditional job evaluation schemes (e.g., point, factor comparison) are less appropriate because their unit of analysis is jobs rather than individuals". Gomez-Mejia, et al. (1990) noted that, "Traditional pay methods are wreaking havoc with the morale and motivation of scientists and engineers in the 1990s". They suggest that executives who are considering changes to their technical reward systems should "price the person, not the job, when rewarding a technical employee". Coombs, Jr. and Gomez-Mejia (1991) found that the typical compensation package for R&D employees is characterized by the use of customized pay plans, avoidance of mechanistic pay approaches (e.g., job evaluation), front-end hiring bonuses, key contributor awards, and frequent external equity adjustments.

Ledford, Jr. (1995), in a review of competency-based pay systems for knowledge workers, noted that "increasingly, organizations are creating pay systems that reward employees for their skills and knowledge, rather than for the jobs they hold".

A 1996 study of the salary compensation system applied to research scientists found that half of the science-based companies surveyed used a person-oriented salary system for their research scientists (Clarke, 1996). Organizations such as AECL, Bell Labs, Boeing, DuPont and Xerox used a person-based salary system. One management researcher interviewed in this study thought that organizations where the scientific work is closer to research than to development and application, were more likely to use a person-based salary system for their research staff.

A later study by Stargate Consultants Limited of public and private sector laboratories found that the following organizations utilized a "person-based" salary system for their research staff (Clarke, 1997):

- Commonwealth Scientific and Industrial Research Organization (CSIRO - Australia)
- Defence Research Agency (U.K.)
- National Physical Laboratory (U.K.)
- Berkeley National Laboratory (U.S.A.)
- National Institute of Standards and Technology (U.S.A.)
- Lawrence Livermore National Laboratory (U.S.A.)

- Los Alamos National Laboratory (U.S.A.)
- SANDIA National Laboratory (U.S.A.)
- 3M Corporation
- Xerox Corporation

An official of the CSIRO stated that a position-based salary system "is an anathema to most people in the organization".

Other laboratories that appeared to employ a highly personalized, position-based salary system were the U.S. Department of Agriculture (USDA), and the Pacific Northwest National Laboratory (a GOCO managed by Battelle). The USDA has three ungraded pay levels above the General Schedule Pay System (GS) 15 level. These levels called the Scientific and Professional Pay Plan (ST), are not graded like other GS levels, but have pay bands associated with them that are used to remunerate the scientific super stars.

Risher (2000), in an extensive review of compensation for technical professionals, noted that, "the concept of a job, with defined duties, is somewhat artificial in an R&D setting". He further observed that, in the past, the differences in management approach between R&D-based organizations and non-R&D-based organizations resulted in the adoption of "maturity-curve" (person-based) compensation systems. Risher states that these differences are still a strong argument for having a separate compensation program for R&D personnel.

Risher proposed a new compensation model for technical professionals which includes:

- broad-banding to replace the traditional salary structure;
- compentency-based pay to shift the focus from the job to the individual;
- increased emphasis on market alignment rather than internal equity;
- expanded role of variable pay linked to group or team performance; and
- increased emphasis on recognizing and rewarding individual achievement.

Broad-Banding Salary System

Risher (2002, 2000) describes Gene Dalton and Paul Thompson's career ladder approach. They believe that most careers can be described in general terms as having three or four levels and that each level can have a broad and overlapping salary band associated with it (Figure 1). In effect, this is a person-based salary system. The levels are:

- Level/Band One – Developing Professional: works under close supervision while learning the job

- Level/Band Two – Independent Contributor: work checked regularly by supervisor; professional is developing his/her credibility and reputation

- Level/Band Three – Advanced Professional: serves as mentor or resource for ideas; represents work group in meetings
- Level/Band Four – Expert (Distinguished Professional): represents organization to external groups; provides strategic direction and advice

Risher (2002) noted that job families with four levels tend to be the knowledge occupations such as research scientists.

The position of the salary bands in a salary hierarchy is based on market survey data for a particular job family.

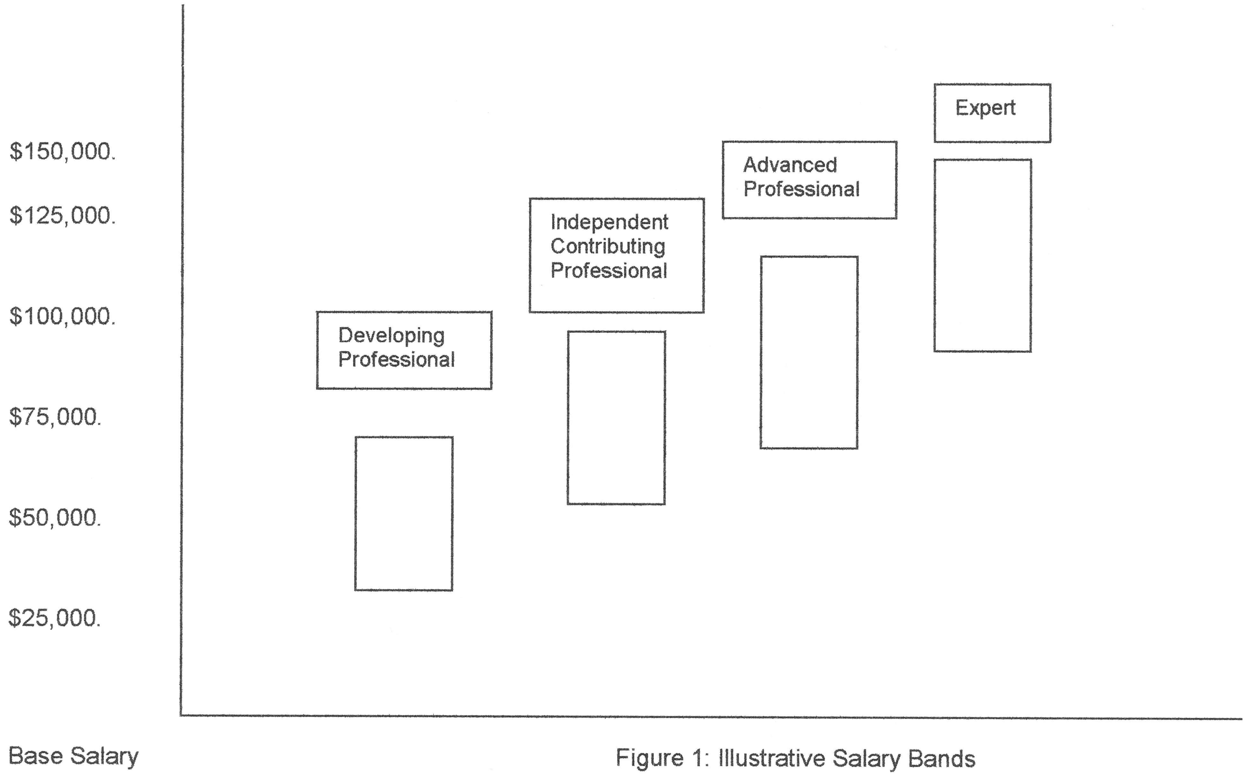

Figure 1: Illustrative Salary Bands

Edward E. Lawler, III, Director of the Center for Effective Organizations states that job-based pay systems "are on their way to being replaced by person-based pay plans".

Competency-Based Salary Systems

These are person-based salary systems that represent a shift from a focus on the job to a focus on a person's competencies or capabilities. As Risher (2000) notes, "salary decisions are no longer based on defined job duties or relative job value". This approach is, according to Risher, typically combined with broad banding. People are assigned to bands based on their career stage or level. Salary increases within the band are linked to their assessed competence that is required by the organization. Larger salary increases are given to individuals who demonstrate new or enhanced competencies needed by the firm. As Risher stated, "the focus on the individual, rather than the job, is consistent with the way researchers are managed". He further stated that Dow Chemical and Motorola have moved to competency-based salary systems.

The advantages of competency-based salary systems are (Risher, 2000):

- de-emphasizes the "job" and focuses on the individual;
- sends the "message" that individual growth and development is an important goal;
- shifts the focus from last year's performance, to the employee's future value and prospects for career advancement;
- facilitates a more positive coaching discussion between managers and subordinates; and
- provides the information needed to fully utilize the individual's capabilities.

There appears to be a general consensus that person-based salary systems are more appropriate for research scientists and research engineers whose job content involves greater uncertainty and whose employer wishes to encourage both creativity and productivity.

Promotion Systems

Another major difference between a person-based, and position-based compensation system is the method of making promotions. In a position-based system, a person cannot be promoted to a higher level unless a higher level position is vacant, or the job is reclassified at a higher level, which is often a time consuming activity. In a person-based system, promotion is based on the individual's increasing scientific contribution. The scientists does not have to wait for a vacancy or for their position to be reclassified.

In a broad band salary system, for example, a person receives a higher salary within the band based on their professional growth and contribution, and on labour market trends (Risher, 2000). Salary increases to recognize "small" promotions are granted within a band. Larger promotions involving either a change in job scope (e.g., becoming a manager) or a change in stature (e.g., becoming an Expert) are rewarded by moving the person to the next higher band. Risher points out that a perfectly competent scientist "could conceivably spend his or her entire career and move between bands only once".

Possible Career Paths for Scientists

Since the 1960s, scientists have had multiple career paths available to them, other than moving into management which was not always looked upon with pleasure. Management authors have identified several paths that a research scientist or engineer can take during his/her career (Bailyn, 1991, Petroni, 2000):

- moving into R&D management and climbing a managerial ladder;
- remaining in a scientific area and climbing a "technical/scientific ladder", if one is available;
- remaining in the scientific area, but moving from project to project, not up any "ladder";
- moving with a technology they have developed to another part of the organization such as production or manufacturing.

To this list can be added the following:

- moving into a policy or regulatory advisory role;
- moving into a business development/technology transfer role for the laboratory; or
- spinning out with a developed technology either to start a new company, or join an existing firm.

In a study of career orientations of software developers in the U.K., Garden (1990) identified and confirmed the existence of four career paths; management ladder, technical ladder, project orientation, and entrepreneurial (i.e., start one's own firm).

Management Career Ladder

In most organizations, people are promoted into management as a reward for good performance. Historically, management was the career path option for successful scientists or engineers.

Selection for advancement (promotion) to the managerial ladder must be based not only on technical competence, but also on the ability and willingness of the scientist or engineer to successfully learn and apply management principles (Cordero, et al., 1994; Maccoby, 1999). Selecting a potential R&D manager solely on the basis of his or her technical ability (called the Myth of the Single Criterion) is a recipe for managerial failure.

Some of the reasons why some scientists might opt for managerial careers are to (Clarke, 2000):

- guide technical advancement in the direction they believe it should go;
- gain recognition from senior management that can lead to involvement in international activities;
- influence the development of science-based policy or regulation;
- obtain greater authority and responsibility;
- see a complex project successfully completed under their direction;
- assist staff grow in professional ability through judicious project assignments;
- avoid technological obsolescence if their field of research is no longer required; and
- create a laboratory with a world class or industry-wide reputation.

Technical Career Ladder (Dual Career Ladder)

> "When a good scientist is made a manager, a good scientist is lost. Yet, promotion to management is the reward for competence in scientific work. Hence, the laboratory becomes a school for making non-scientists of its scientists" – Shepard, 1958

The use of a "dual promotion or career ladder" comprised of both a managerial and scientific/technical hierarchy is an attempt to avoid the problem described above by Shepard (1958).

The technical ladder allows an organization to provide scientists and engineers with both monetary and status rewards at a level commensurate with those offered to managers, and overcomes the problem of enticing people out of a career in R&D solely for the purpose of gaining better and greater compensation.

The technical ladder provides a career option for scientists who do not wish to join the ranks of management. In a study to determine the desirability that Canadian government scientists placed on becoming an R&D manager, one respondent captured the feelings of many of the scientists when he replied to the question of becoming a manager by saying, "hell no, I would rather drive a cab" (MOSST, 1983).

Studt (2002) referred to a survey by R&D Magazine that found that management and advancement opportunities rank at the bottom of the most satisfying aspects of working in R&D. "Obviously, the researchers' involvement in their work and in solving challenging problems outweighs, in general, their desire for management careers".

Some of the reasons given by Canadian government scientists for avoiding a promotion into management include (Clarke, 2000):

- value research more highly than management;
- fear of losing technical expertise and becoming stranded;

- having poor R&D manager role models;
- do not want to deal with people problems and paperwork;
- fear of failure as a manager;
- lack of R&D management training;
- dislike of "politics' associated with management; and
- a perception that the R&D manager's job is less healthy and more stressful.

The dual ladder is usually portrayed as two side-by-side hierarchies: managerial and technical. This implies that there are two chains of command. However, in practice, people on the technical ladder report to people on the managerial ladder for managerial direction. The higher up a scientist or engineer is on the technical ladder, the greater the influence he/she may have on the technical direction and goals of the organization. The senior scientists or engineers may also be members of executive committees along side senior managers. In some organizations, the technical ladder is split into two separate streams; one for scientists, and one for engineers. In this system, the two types of professionals do not have to compete directly with each other for promotion using the same performance measurement criteria. The criteria used are appropriate for each group (e.g., external publications for scientists, internal reports for engineers).

Controversy about the use and effectiveness of a dual ladder promotion system stems from two fundamental sources: the improper application of the ladder in many organizations that results in its failure to motivate scientific staff adequately, and the original belief that scientists only needed two career options, to become managers, or to remain as scientists (Bailyn, 1991).

Some of the advantages of adopting a dual ladder system are:

- it is a good recruiting tool to attract new graduates who generally do not see a move into management as a career option, at least at that point in their career;

- it allows a science-based organization to retain high performing R&D staff in research and development; and

- it allows a science-based organization the ability to offer recognition and status more in line with intrinsic rewards valued by research scientists and engineers.

It is important that advancement up the technical ladder be based on technical performance.

A study of dual ladders in research organizations in England by H.P. Gunz (1980) showed that a dual ladder system is more likely to be adopted and to be successful in organizations that have a strong set of professional values (i.e., an advancement of science orientation) and where people on the technical ladder are seen to be exceptional performers.

In 1997, Japan's NEC adopted their version of a dual ladder and abandoned their previous policy of moving R&D personnel into management, based on seniority. The result of this program called "senmon shoku sedo" resulted in increased laboratory productivity.

In a review of pharmaceutical companies, Omta and van Engelen (1998) noted that, "the best-of-the-best companies have career systems that create inspiring work environments", and that a dual ladder promotion system "was used on a wide scale only in the better companies".

Kochanski, et al. (2003) noted that the dual career technical ladder is "alive and well" but is now based on "demonstrated skill (development) rather than automatic micro-advancement as in the past".

Companies that have been identified in the literature as using dual ladder systems (this does not imply that they do not have other career path options for their scientific staff) are: General Mills, Philip Morris, Amoco, Mobil, McCormick & Company, Inc., Xerox, Union Carbide, Imperial Chemical Industries and 3M. 3M, for example, provides a dual ladder for promoting innovators. An innovator can advance to Corporate Scientist, the equivalent to their technical directors. A 1996 study by Clarke, identified DuPont, Nortel, Colgate-Palmolive, and the Ford Motor Company as using a dual ladder system. The 1997 study by Clarke identified NIST (U.S.A.), National Physical Laboratory (U.K.), and CSIRO (Australia) as using dual ladders.

It should be noted that the Canadian government's present classification system involving SE-RES and REM categories is not a dual ladder system. REM 1 is generally a very high level R&D manager. For the REM/RES system to be a true dual ladder system, there would have to be a new REM 1 level that applied to the lowest formal level of R&D supervision (e.g., section head). The salary level would be the same as a RES 2. This would allow for a pool of RES 1's that could choose to remain on a technical ladder (e.g., RES 2, 3, etc.) or to move to the managerial ladder. This would not preclude RESs from being research team leaders, but they would not occupy formal managerial positions. There would be as many levels in the new REM classification system as in the RES. The REM classification would be position-based, otherwise there would be too many managers supervising too few workers. A unique feature of the R&D environment is that it is possible to have an R&D manager supervising scientific staff who are earning higher salaries. The dual ladder approach allows for this.

Project Orientation: Recognition Without Promotion Up a "Ladder"

As noted above, past reward and motivation studies have assumed that among scientific staff, there were only two possible career orientations; moving from the "bench" into management, or staying at the "bench" doing scientific or technical work. Studies by Allen and Katz (1986) and McKinnon (1987) have identified a third career path described as a "project oriented" career path.

Allen and Katz (1986) describe "project oriented" engineers as being less concerned about their external professional reputations than their more technically oriented colleagues, and "much more influenced by the intrinsic nature of the task". Project oriented engineers prefer technically challenging projects, having the freedom to be creative and original, and working with competent co-workers. They are not particularly motivated by the prospect of promotion up either a technical or managerial ladder. They are, however, motivated to perform well by the prospect of future challenging projects of interest to themselves. Allen and Katz also noted that the percentage of engineers with a project orientation appeared to increase as a function of age. McKinnon (1987) argues that , “Interesting and challenging assignments should no longer be considered only as a means of moving toward organizational advancement, but should be regarded as rewards in and of themselves”.

At present, there is little evidence to indicate that this “project orientation” applies to research scientists. However, the fact that some scientists, when given the opportunity, return to a former employer in an “emeritus” position to continue their work with no financial remuneration, let alone any opportunity for organizational advancement, might strongly imply that the project orientation model does apply to some scientists.

Science Policy or Regulatory Career Path

Another distinctive career path that a scientist might take is that of a science or technology policy advisor, or a science regulatory advisor. This career path can be followed after a successful career as an R&D manager, but can also evolve from a scientist “at the bench” desiring a career change. This path provides a way for a scientist to apply his/her scientific knowledge in the service of a government department’s internal mandate to develop science policy in support of government S&T initiatives, or in developing regulations regarding health and safety issues in the use or application of R&D results.

Commercialization/Technology Transfer Career Path

Another career path exists in government departments (or in academia) that are trying to have greater involvement and interaction with the private sector. Turpin and Deville (1995) believe that the increased emphasis on government laboratories to either conduct research for, or transfer government intellectual property to, the private sector has resulted in a new career path for scientists. A commercialization/technology transfer career path requires scientists to “develop a whole new set of skills and behaviours that were previously quite foreign to many scientists”.

Scientists can take on the role of “business development officer or technology transfer officer” to facilitate the use of government expertise by a paying customer (i.e., contracting-in), or the transfer of government expertise or intellectual property (IP) to a paying customer for commercial exploitation (i.e., license or assignment of government developed IP). In effect, the scientist becomes the marketing person for the laboratory who identifies transferable technology or know-how, and potential customers/partners.

Entrepreneurial Career Path

Scientists or engineers can move outside their organizations to further develop and commercialize their research results. This can take the form of joining an existing company or starting up their own companies. Gomez-Mejia et al (1990) noted that a major driver for scientists to spin out and start their own company is dissatisfaction with their employer’s reward and recognition system.

Some organizations have programs in place to encourage spin outs because they believe that such spin out firms will be lucrative R&D clients in the future. In the National Research Council, for example, scientists have the option of either moving with their technology to an existing firm, or starting up their own company. Here the career path can be from government employee to private sector entrepreneur. Scientists taking this career path have a three year window in which to decide whether to make the move from the N.R.C. laboratory permanent, or return to the N.R.C.

CONCLUSIONS

That research scientists must be managed in a different way than other professionals is a well established fact. These differences also impact the way in which research scientists are compensated for their work.

Attraction and retention of scientists is more dependent on the quality of their work environment and the quality of the research projects they work on, than on salary, given that they consider their salary to be fair and equitable.

It is clear from this review that there is an emphasis on employing a "person-based" salary systems (e.g., maturity curves, broad banding or compentency) when dealing with knowledge workers in general, and research scientists in particular. A person-based salary system allows for more flexibility in rewarding or promoting scientists commensurate with their contribution to the organization's goals and objectives. Major leading edge scientific organizations wishing to encourage creativity and productivity tend to use person-based salary systems rather than the more rigid position-based systems.

Scientists are no longer restricted to one or two career paths as they have been in the past. Their scientific expertise can be put to good use either by remaining at the "bench" doing scientific work, becoming an R&D manager and possibly moving into general management, bridging the gap between science and policy or regulation, becoming the business development or technology transfer officer for their laboratory, or leaving their employer to start their own technology-based company.

Organizations wishing to encourage both creativity and productivity from their research staff must be willing to adopt suitable management practices that reinforce the motivation of their scientists. These will be quite different from those used to encourage other employees. One "size" does not fit all employees.

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