WHAT MATTERS TO R&D WORKERS

Now we can add data to our hunches as a result of this study at three major Energy Department laboratories on what constitutes a good research environment.

Gretchen B. Jordan

OVERVIEW: Surprisingly little empirical information is available to help laboratory managers attract and retain productive R&D workers. Most employee attitude surveys do not focus on the specific attributes that scientists and engineers consider to be particularly important for research organizations. To address this deficiency, the U.S. Department of Energy, in the most comprehensive study on the subject to date, surveyed 2,200 R&D workers in 40 organizations within three major laboratories to determine what constitutes a good research environment and what improvements might be needed to best serve the needs of R&D workers. Thirty-six factors were found to be most important to R&D workers. These findings can help managers to plan their next employee attitude survey and to take actions that improve attraction and retention of R&D workers and R&D performance.

KEY CONCEPTS: Motivating scientists and engineers, improving R&D performance, employee attitude surveys.

Two questions addressed with some frequency in articles on research and development management are, “How do we attract and retain R&D staff?” and “How can organizations support and encourage high performance?” From a big-picture perspective, the answers to these questions are intertwined. High performance in R&D depends on having top-notch, motivated individuals on board. However, organizations can and do make a difference in how and when these individuals generate new ideas and new or improved products and processes. Managers at Sandia National Laboratories, for example, wanting to maintain and improve on an already good record of performance, worry about attracting and retaining talented employees, keeping skills current, and increasing motivation and morale. They also want to change the way the laboratory does business to “do more with the same or less,” recognizing that obstacles such as micromanagement, short-term thinking, and insularity inhibit innovation, especially in an era of increased specialization and collaboration.

Despite this interest in managing, attracting and retaining R&D workers, surprisingly little empirical evidence exists that tells how to accomplish this goal. Many surmise that researchers work less for money than for "glory"—that is, the challenge of overcoming scientific or technical problems, the satisfaction of exercising their creativity, and the approval of their work by their peers. At one time, newspapers near Silicon Valley carried advertisements aimed at R&D workers featuring pictures of legs outfitted in unusual and casual footwear, indicating a flexible organization with an environment that welcomes different ideas and nonconformity.

Perhaps this lack of empirical data is what spurred the Industrial Research Institute to support surveys to determine what factors motivate R&D workers. In one such study, published in the Jan.–Feb. 2003 issue of Research • Technology Management, Kochanski, Mastroolo and Ledford conclude that companies are concerned about attracting top talent and keeping employee skills current (J). They found that whereas “productivity and cost reduction reign as the people priorities in other functions such as sales and operations . . . in R&D labs, issues such as innovation, leading-edge skills, discovery and collegiality are the drivers of success through people.”

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The lack of empirical data also motivated managers at U.S. Department of Energy (DOE) laboratories to better understand what constitutes a good research environment and to develop tools to gather reliable data that could lead to improvements. However, existing employee attitude surveys used by DOE laboratories failed to address many of the factors that scientists and engineers consider to be particularly important for a research organization, such as a commitment to critical thinking, the cross-fertilization of ideas, and the presence of a strong foundation of basic research. As a result, managers have been frustrated by survey results that do not address their immediate concerns, reflect the factors most relevant to innovation and discovery, or provide clues about how to improve the research environment.

The study reported in this article, conducted by the DOE’s Office of Science, provides empirical evidence about what R&D workers perceive they need to achieve high levels of performance. This study developed a survey based on extensive literature review and input from 15 focus groups (which included bench scientists, engineers, and technologists as well as their managers) across various R&D tasks. The factors and the related language of the questions are derived from R&D workers. The factor set is comprehensive, boiled down from hundreds of suggested important factors. In addition, the factors and questions are balanced across four approaches to improving performance: developing human resources, encouraging innovation and cross-fertilization of ideas, setting and achieving relevant goals, and providing resources and support processes. These approaches capture the tension between a flexible and a controlled organizational structure and between focusing on internal issues and focusing externally on customers and growth. With two exceptions, the eight similar studies reviewed by the author in this article are based on a small number of respondents, many of whom are managers rather than rank-and-file employees, and do not cover the four approaches to improving performance as clearly or as completely.

Framework for Thinking

Creating a mental framework is a helpful way of organizing the many variables involved in attracting, retaining and motivating R&D workers. This framework reminds us to look at all parts of the big picture, including the relationships among the framework’s various parts. These parts are: (1) actions for change, (2) the impact of that change on individuals, (3) the organization, and (4) the performance of individuals and the organization (see Figure 1). This article ignores the external environment, although it is understood to play a role in all elements of the framework.

The quality of the research staff is near the top of everyone’s list of what is important for excellent R&D. Because we know that workers can be motivated and supported by the organizations in which they work, we also want to look at organizational variables, such as structure, use of skills, challenge, clear direction, positive tension, and cross-functional teams. Also, high performance of the organization and its workers is the ultimate goal, and this framework encompasses several aspects of performance, including efficiency, excellence or quality, effectiveness, and creativity. Finally, because managers want to attract, retain and maintain the skills of good workers so that both employees and the organization can perform well, the framework also reflects aspects of organizational change, directed at the individual or organization and management.

Four Approaches to Improving Performance

Historically, the organizational effectiveness literature has articulated numerous perspectives on what makes an organization effective; that is, able to produce the desired performance. The DOE study applied Cameron and Quinn’s Competing Values Framework in order to capture four different and sometimes competing approaches to improving organizational performance and to reflect the differences in R&D strategy and...
primary tasks (including capacity building, basic and applied research, and technology or product development and improvement).

The work of Cameron and Quinn and others at the University of Michigan suggests that two "value dimensions"—organizational structure and organizational focus—underlie conceptualizations of organizational effectiveness and can be used to organize traditional and often conflicting models of effectiveness. Organizational structure distinguishes between those activities and attributes that emphasize the organization's flexibility, adaptability and breadth versus those that stress control and stability. Organizational focus distinguishes between internal issues, such as the well-being and development of the people within the organization versus external issues, such as the development and well-being of the organization itself or its relationships with outside entities.

The DOE study developed a list of the 36 factors most important to R&D workers (Figure 2). The DOE then organized these factors into a framework, illustrated in Figure 3, that modified the approach of Cameron and Quinn to reflect R&D processes. The four perspectives or approaches to creating a high-performing R&D organization are Human Resources Development, Innovation and Cross-Fertilization of Ideas, Setting and Achieving Relevant Goals, and Internal Resources and Processes.

Drivers Analysis

As with the other studies, the DOE study attempts to evaluate what individuals feel most strongly about, that is, "drivers" of their ratings of the research environment. Although laboratories and their circumstances differ, factors that are drivers in many of the organizations that participated in the DOE study should be the high priorities for managers wishing to improve their laboratory's or firm's ability to attract and retain R&D workers and get the highest possible performance for the organiza-

![Diagram](image.png)

Figure 1.—There are individual, organizational and external factors to consider when trying to attract, retain and motivate scientists and engineers, as well as different types of performance the organization hopes to influence. Looking at this "big picture" helps organize our thinking about what changes might be needed.
Table 1.—Eight Additional Studies on What Matters to R&D Workers

<table>
<thead>
<tr>
<th>Study</th>
<th>Size</th>
<th>Motivation/Approach</th>
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<tbody>
<tr>
<td>Pelz and Andrews (4), 1976</td>
<td>1,300 scientists and engineers.</td>
<td>11 government, industrial and academic laboratories—1966–1976; comprehensive. Technical performance is a result of repetitive reinforcement of individual resourcefulness and environmental facilitation.</td>
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<td>The Hay Group (5), 2000–2001 study.</td>
<td>One million responses over the past 4 years at several hundred firms.</td>
<td>300 commonly asked employee attitudes questions; analyzed for professional and technical staff. On retention: in 2000–2001, “tight labor markets, with the attendant shortage of people with required technical skills, have forced employers to redouble their efforts to [develop strategies to] retain key employees” (p. 10.2).</td>
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<td>Kochanski, Mastropolo, and Ledford (6); study co-sponsored by IRI. Kochanski and Ledford (7).</td>
<td>2002 study had 159 respondents from 114 major U.S. industrial companies. 2001 study sampled 210 high-technology workers.</td>
<td>Individuals in industrial companies, 2001 “reflected the views of U.S. high-technology professionals.” Uses a construct they call the Employee Value Proposition to concentrate on how organizations can attract and retain talented employees and keep their skills current.</td>
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<td>Tampoc (8).</td>
<td>Surveyed 322 of 800 staff in R&amp;D establishments (131 were managers).</td>
<td>Explores the motivational needs/organizational environments best suited to knowledge workers. What individuals desire and what they need to achieve their work goals depend on their stage in their professional development (fulfillment, transition, developmental, and plateaued) (pp. 182–183).</td>
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<td>Manners, Steger and Zimmerer (9).</td>
<td>From 10 years of observation during interactions.</td>
<td>Industrial and government R&amp;D laboratories. Focus on individual performance as it is affected by motivational practices. Described 10 basic tenets about the motivation of R&amp;D staff such as protecting individuals when they fail.</td>
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<td>Bommer and Jalajas (10).</td>
<td>61 engineers in 31 Canadian firms and 59 engineers in 11 U.S. firms.</td>
<td>Focus is the work environment in high-technology small and medium-sized business; “innovation depends on a supportive and encouraging organization where creative ideas can emerge and be deployed effectively” (p. 380).</td>
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<td>Gupta, Wilemon and Atuahene-Gima (11).</td>
<td>R&amp;D directors in 120 technology-based firms.</td>
<td>Focus is management practices that distinguish between high-performing and low-performing R&amp;D organizations. The directors first rated their organization’s R&amp;D management practices and then rated themselves on how effective R&amp;D is “in achieving their organization’s performance objectives” (pp. 52–53).</td>
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I shall review the factors respondents in the DOE study most closely associated with ratings of their research environment and discuss the reasons given for why these factors are important from both the DOE study and the other studies with similar findings.

Included among these are four strong drivers in the 40 organizations in the DOE study that are not often found in the other studies.

The DOE study analyzed how strongly each of the 36 factors was associated with the overall ratings of the research environment and with the sense that the research environment is improving. This analysis can shorten a survey by taking the place of the questions, “What is most important . . .?” and “What would you most like to improve . . .”. The level of association was determined using Kendall’s Tau-b, a nonparametric measure of association for ordinal data.

Table 2 shows those of the 36 factors that were most often a stronger driver (in the top 10 drivers) across the 40 organizations in the DOE study. Eight of the 36 factors are drivers of either overall ratings or the trend in the research environment in 17 or more of the 40 organizations. Three are drivers of both in at least that many organizations. Six of the top 10 drivers appear in almost half or more of these organizations.

One caveat of these findings is that driver analysis is time- and situation-dependent and may change as circumstances change, even without management action. This means that factors that are routinely done well may not appear in the list of drivers because they are not uppermost in people’s minds.
Human Resources Development

<table>
<thead>
<tr>
<th>Value the Individual</th>
<th>Encourage Exploration, Risk Taking</th>
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<tr>
<td>□ Respect for People</td>
<td>□ Time to Think and Explore</td>
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<td>□ Optimal Use of Skills</td>
<td>□ Pursuit of New Ideas</td>
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<td>□ Management Integrity</td>
<td>□ Autonomy in Decision-Making</td>
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<tr>
<th>Build Teams and Teamwork</th>
<th>Integrate Ideas, Internally and Externally</th>
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<tr>
<td>□ Teamwork and Collaboration</td>
<td>□ Internal Cross-Fertilization of Technical Ideas</td>
</tr>
<tr>
<td>□ Internal Communication</td>
<td>□ External Collaborations and Interactions</td>
</tr>
<tr>
<td>□ Value-Added Management</td>
<td>□ Integrate Ideas and R&amp;D Portfolio</td>
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<th>Commit to Employee Growth</th>
<th>Encourage Change and Critical Thinking</th>
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<td>□ Technical Career Advancement</td>
<td>□ Sense of Challenge and Enthusiasm</td>
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<tr>
<td>□ Educational and Professional Development</td>
<td>□ Commitment to Critical Thinking</td>
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<tr>
<td>□ Quality of Staff</td>
<td>□ Identify New Projects and Opportunities</td>
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<th>Internal Resources and Processes</th>
<th>Setting and Achieving Relevant Goals</th>
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<td></td>
<td>Provide Capital, Knowledge Resources</td>
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<tr>
<td>□ Equipment and Physical Work Environment</td>
<td>□ Clearly Define Goals and Strategies</td>
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<tr>
<td>□ Research Competencies/Knowledge Base</td>
<td>□ Research Vision and Strategies</td>
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<tr>
<td>□ Salaries and Benefits</td>
<td>□ Sufficient, Stable Funding</td>
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<td></td>
<td>Ensure Good Technical Management</td>
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<td>□ Informed, Decisive Management</td>
<td>□ Investing in Future Capabilities</td>
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<td>□ Rewards and Recognition</td>
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<td>□ Internal Resource Allocation</td>
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<td></td>
<td>Insist on Efficient, Low Burden Systems</td>
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<td>□ Laboratory Services</td>
<td>□ Plan and Execute Well</td>
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<td>□ Laboratory Systems and Processes</td>
<td>□ Project Planning and Execution</td>
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<td>□ Competitiveness/Overhead Rates</td>
<td>□ Project-Level Measures of Success</td>
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<td>□ Laboratory-Wide Measures of Success</td>
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<td></td>
<td>Build Strategic Relationships</td>
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<td>□ Relationship With Sponsors</td>
<td>□ Relationship With Sponsors</td>
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<td>□ Champion Foundational Research</td>
<td>□ Champion Foundational Research</td>
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<td>□ Reputation for Excellence</td>
<td>□ Reputation for Excellence</td>
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Table 2 also shows those factors where there was the most agreement on what was done very well and least well. Only three factors in the top or bottom five of ratings on individual factors are also drivers of the overall ratings. Employees in 23 of 40 organizations say that a sense of challenge and enthusiasm is being accomplished to a greater extent than most of the other factors in their environment.

The presence or absence of a sense of challenge is also a relatively strong driver of research environment ratings. This finding could mean that this driver is done well and should be maintained, but it could also mean that even more improvement is needed.

The Most Important Factors

A closer examination of the DOE drivers of ratings of the research environment reveals the following environmental factors that are most important to R&D workers and that R&D managers should consider addressing in their organizations.

Research vision and strategy

Research vision and strategy is the factor that is most often a driver of both overall rating of the research environment and the trend—whether things are getting better or not. The degree of agreement is large, with two-thirds of respondents associating it with the trend. When questioned about this factor, respondents were given, at a minimum, the following statement:

The vision, strategies, and goals of my organization [smaller unit than the entire laboratory] provide focus and energy for decisions and action throughout the organization, and my work contributes to achieving my organization's goals.

Researchers in the DOE focus groups wanted to feel valued and to know that their work was valued by the organization. They are rewarded primarily for contributing to the organization’s bottom line, be that its mission or its sales and profit. Many respondents were also concerned that they were being pressed by circumstances to do more short-term, applied research, or that they and...
Flexible Organizational Structure

- Human Resources Development
  - Value the Individual
  - Build Teams and Teamwork
  - Commit to Employee Growth

- Innovation and Cross-Fertilization of Ideas
  - Time to Explore, Risk Taking
  - Integrate Ideas, Internally and Externally
  - Encourage Change and Critical Thinking

Internal Focus

- Rich in Capital and Knowledge Resources
- Good Technical Management
- Efficient, Low Burden Systems

External Focus

- Clearly Define Goals and Strategies
- Plan and Execute Well
- Build Strategic Relationships

Internal Resources and Processes

- Setting and Achieving Relevant Goals

Controlled Organizational Structure

Figure 3.—Underlying the four approaches to improving R&D management and performance, shown here, are two structural tensions: flexibility vs. control and external vs. internal focus. The organization to which this diagram applies has decided it needs to stimulate innovation and human resources, and both of these will require a more flexible organizational structure.

their organization were struggling to pull together diverse projects into thematic areas. The Hay Group data for 2000–2001 showed that, particularly among professional occupations, a clear sense of corporate direction is important to employee retention.

Invest in future capabilities

Although this factor does not appear in the questions or findings of other studies, management’s planning and investment in future capabilities was a strong driver of what respondents thought about both their current research environment and the kind of research environment they would have in the future. So that respondents would answer with similar time frames and definitions of capabilities, the following statement was provided:

Management in my organization [smaller unit than the entire laboratory] is thinking about the future and investing in the people, skills, facilities and equipment the organization will need 5–10 years from now. A sufficient number of new projects are started each year.

The importance placed on investing for the future captures the nature of R&D and the need for long time frames to achieve goals. It reflects the concern that core competencies need to be built or maintained, and, for some, a concern about insufficient turnover of projects in the portfolio. It embodies the tension between building the next state-of-the-art facility and funding the quality operation of existing facilities. It requires making decisions about where science and technology will be in the future based on what is known today and about which existing research should be terminated to fund new projects.

Sense of challenge and enthusiasm

A sense of challenge and enthusiasm, as mentioned earlier, is a factor that many think is being done well: in more than half the organizations studied, it is among the top 10 of the 36 factors that drive people’s overall rating of the research environment. Respondents rating this factor were provided with the following description:

Work is stimulating, people are motivated to excel and contribute, and are persistent when they encounter technical challenges and setbacks. Visitors can sense the energy and dynamism here.

This factor was often the first mentioned in brainstorming discussions of what is important to attract and retain R&D workers. Researchers are drawn to challenges as well as rewarded for solving challenging problems. A longtime manager of DOE fundamental research said he could tell the state of the research environment by...
The DOE Office of Science Study Approach

One of the challenges facing managers who want to attract and retain R&D workers is that no single defined scope or set of factors is included in the decision-making process. Every manager uses a different set of factors, or management practices, to help the organization be high performing, which can be defined as to \textit{do the right things on time, with the right resources, the right way, the first time.}

The DOE study developed a list of the 36 factors most important to R&D workers. The study team surveyed the literature in several fields, including general and R&D management, organizational behavior, sociology, economics, and program evaluation (13), and held 15 focus groups at four laboratories. The study was designed to ensure that the factors covered different views on what is important in a research environment. As a result, the DOE study and its 36 factors provide managers with a comprehensive “menu” and a reminder of the different approaches to improving management practices. The 36 factors are listed in Figure 2.

Although many similarities exist between the factors included in the DOE study and the other R&D studies reviewed here, the coverage of most of the other studies does not appear to be as comprehensive. The exception is Pelz and Andrews, whose questions were extensive. Pelz and Andrews also recognized the existence of tensions, for example, between autonomy and coordination, between investing in the future and providing sufficient resources for current work, and between executing organizational priorities and developing human resources.

Gupta, Wilemon and Atuahene-Gima’s focus is on new product development, and Bommer and Jalajas’ focus is on creativity.

DOE Study Adds to Limited Empirical Data

The questions generated in focus groups were used to design the DOE research environment survey instrument. Between 1998 and 2001, responses to the DOE survey were received from more than 2,200 scientists and engineers in 40 organizations within three national laboratories. Two of these, a federal defense research and engineering laboratory and a federal science laboratory, are large, with annual budgets of more than $500 million each; the third is a large industrial laboratory. In all cases, more than half of the respondents were members of technical staff, 15 to 30 percent were technologists and 6 to 19 percent of respondents were managers.

The work covered in these laboratories ranged from tackling problems of fundamental understanding to technology development and manufacturing. Respondents were divided roughly into thirds among basic, applied and technology development. Technical areas covered included the physical and chemical sciences and engineering; mathematics, computation and information technology; biology, geology, environment, and energy; and manufacturing. Staffing levels within the 40 organizations surveyed ranged from 20 to 290. The Web-based survey had a 50 percent response rate, but in the two labs where managers were directly involved in urging and tracking participation, the response rate exceeded 90 percent.

The questions asked and the participation rate suggest that the findings reported in the DOE study may be more representative of rank-and-file R&D workers than findings of other studies reviewed in this article. Other studies contacted fewer than 300 R&D workers, and often half or more of these held management positions. Because a small number responded and because managers typically have much rosier impressions of the research environment than do rank-and-file R&D workers, such a sample raises concerns about applying those findings to R&D workers without more empirical data.—G.J.
matic reviews by multiple oversight groups. When findings of reviews from external groups were not provided to the researchers for their information and use, the benefits of reviews seemed to be less than the costs.

In all three laboratories surveyed, workers experienced pressure to demonstrate and even predict the relevance of research in economic terms, in addition to the more expected to provide quantitative measures of the impact of fundamental and applied research. Some were also considered less important for stimulating achievement.

The DOE study’s focus groups of R&D workers pointed out the importance of technically competent managers who could understand the value of their work and make informed decisions about that work. Members of the focus groups also expected managers to represent the work to senior laboratory management and to investors. Managers were expected to make timely decisions and be agile enough to take advantage of technical opportunities as they arise.

The Hay Group study reinforces the importance of this factor. It shows that one of the largest gaps in satisfaction between those staying with an organization and those planning to leave is that opinion of the competence of upper management. Pelz and Andrews found that among professional and technical employees, the greatest innovation occurred under supervisors who knew the technical details of their subordinates’ work, could critically evaluate it, and could influence work goals (p. 399). These abilities were more important than the supervisor’s human relations skills.

**Reward and recognize merit**

For R&D workers in nearly half of the 40 organizations surveyed, the degree to which they felt management rewarded and recognized the merit of their work was a driver of trends in the research environment. Included in this factor were the following aspects:

*Performance reviews, bonuses, praise, and other nonmonetary awards are tied to merit and inspire me to do my best. Steady contributions as well as less frequent major contributions are valued.*

DOE focus groups talked about the importance of both intrinsic and extrinsic rewards. Pelz and Andrews found that both intrinsic rewards (the opportunity to use skills, gain knowledge, solve challenging problems, and follow up on one’s own ideas) and extrinsic rewards (salary increases and the attention of top executives), were important. They also found that extrinsic rewards were considered less important for stimulating achievement.

**Identification of new opportunities**

The existence of a systematic process for identifying new projects and opportunities is a factor that does not appear often in discussions of R&D employee surveys. It is a common problem, ranking in the bottom 5 of 36 factors in 29 out of the 40 research organizations, and is also a driver in the rating of the perceived future research environment in 20 organizations. Included in this factor are the following aspects:

*My management has systematic, efficient and effective methods for identifying, selecting and pursuing new partnerships, funding opportunities and projects. The system makes good use of my time.*

Many in the focus groups felt that they spent too much time “chasing money” and that managers could do a better job of giving them requests for proposals promptly.
and filtering out those with little chance of success. In some organizations, instead of having a single principal investigator approach sponsors, a more coordinated laboratory-wide approach is being implemented, which leaves researchers feeling less in control of the funding process.

Product development literature contains considerable discussion of the importance of cross-functional integration and the need for early and good communication between an R&D group and other business functions, both internal and external. Gupta, Wilemon and Atuahene-Gima suggest that this is related to the need to "reduce duplication of effort and reduce opportunities to hoard information" (9).

Championing long-term foundational research

A fourth factor not often seen in discussions of what matters to R&D workers is whether senior management champions long-term foundational research (12). In the DOE study this was a driver of people’s perceptions of the direction in which the research environment is headed in 18 of 40 organizations. The following statement describes the factor:

Senior management demonstrates a commitment to a strong foundation of fundamental research and advocates the importance of fundamental research to laboratory and mission success.

In the DOE study’s focus groups, researchers working in technology development, applied research and basic research alike believed that their organizations needed to participate in more foundational research to keep their work on the cutting edge and ensure that those involved in such research felt valued and secure; they understood that this would happen only if senior laboratory managers were actively engaged in making it happen. Gupta, Wilemon and Atuahene-Gima found that "while maintaining a business-driven culture, high-R&D effective organizations also often encourage high-risk basic research projects and provide incentives to pursue truly innovative research that may not have immediate business applicability” (9).

Interpret results carefully

Although important lessons can be derived from the results of the DOE study, it is important to know under what conditions these lessons apply to other organizations.

- The DOE study found that basic researchers, applied researchers and technology developers had different opinions about which environmental factors are important for achieving excellence, but no patterns were found in these differences across the three laboratories.
- Differences among subgroups within an R&D organization should not be overlooked. Different research units, age groups and job classifications may have very different opinions about how their R&D organization is doing overall and about which factors drive its performance.

For example, there was little agreement in the DOE study about what the drivers were for researchers working in technology development, applied research and basic research. The only factor any of the three groups agreed was a top driver was reputation for excellence for applied researchers in all three laboratories. In two of the laboratories, research vision and strategies was a primary driver for basic researchers and technology developers. In the laboratory where researchers had a great deal of autonomy, however, that was not the case.

Differences among different departments were also evident. Although the items included in the top ten drivers for overall ratings were similar, the order of these differed considerably across the 40 organizations. For example, although one department ranked integrity of line management third with a favorable response rate of 91 percent, another department ranked the same attribute 10th with a favorable response rate of 69 percent. In some cases these differences could be tied to recent changes in management structure or funding levels, but in others the explanation was more elusive.

The DOE study found, as the Hay Group and others have, that managers give both individual factors and the overall research environment higher ratings than do technical staff. Also, younger or newer employees and older or senior employees rate the research environment more favorably than those between 45 and 49 years old or who have been working at the laboratory for 10 to 20 years. This finding probably reflects Tampoe’s conclusions on the effect of career stage on motivation and will be explored further in future surveys.

Applying the Study Findings

The DOE study checklist is a good one for managers wanting to know what to include in R&D employee attitude surveys because it includes and organizes the many aspects of the research environment that might be important for attracting and retaining R&D workers and improving their performance and the performance of the organization. The checklist may also be helpful for organizing and viewing research on what matters for improving R&D performance in a way that captures the four views of effectiveness described in the DOE study.

Managers might also use the findings of the DOE study in combination with findings from their own employee attitude studies when considering where to direct action plans for improvement in hiring and performance. Although the factors covered in the DOE survey may not reflect every R&D organization, they certainly bear investigation by R&D managers. The DOE study found
that the following matter to R&D workers in 50 percent or more of the 40 organizations surveyed:

- Have a clear research vision, communicate that vision well to staff members, and develop and sustain strategies to reach that vision.
- Invest in future capabilities, looking 5 to 10 years out and building core competencies, great scientific equipment, people, and ideas.
- Make sure staff members have challenging work that they can tackle with enthusiasm. Managers must challenge staff without overwhelming them.
- Champion long-term foundational research all the way to the top of the R&D organization and fund it.
- Have a systematic way to identify new partnerships, projects and opportunities that cultivate the ideas, customer contact and entrepreneurship of technical staff without burdening them.
- Measure the success of each project appropriately rather than adopt a "one size fits all" approach. Do not over-review, and ensure that the benefits of evaluation outweigh the costs.
- Ensure that managers are technically competent and make timely and informed decisions.
- Recognize that in addition to paying competitive salaries, researchers appreciate non-monetary rewards, particularly recognition of the value of their work.

Finally, further research is needed to understand and document the connections between management practices and performance. Current research concentrates on one or the other, but seldom on the linkages. For example, empirical data are needed to demonstrate theories such as which organizational structures are linked to radical new ideas, as opposed to new product development, or to R&D to standardize a manufacturing process. Two approaches to this research, which the DOE study (and hopefully others) will pursue, are to find and study naturally occurring "experiments" or to initiate experiments with management interventions and deliberately study the change in R&D performance that occurs as a result.

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References and Notes

12. "Foundation" is used here to cover both fundamental and applied research in the engineering and industrial laboratories.