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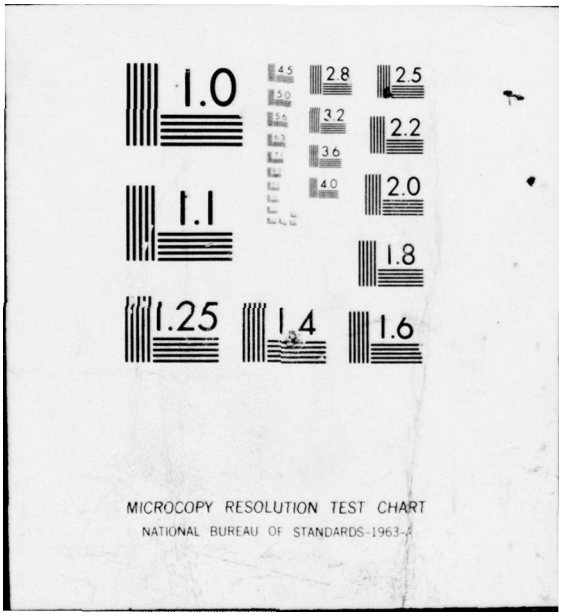
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GSM/SM/76D-36

REWARDS IN AIR FORCE R&D: AN ANALYSIS OF DESIRABILITY, PERCEPTION AND ASSOCIATION WITH THE PRODUCTIVITY OF SCIENTISTS/ENGINEERS

THESIS

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Arthur E. Stevens
Captain USAF

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(See 1473)

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THESIS

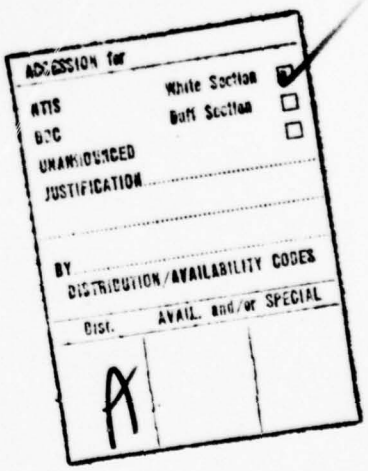
Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

by

Arthur E. Stevens
Capatin USAF

Graduate Systems Management

December 1976



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Finally I would like to thank my wife, Pat. Perhaps pity is the more appropriate term for the amount of time she had to put up with me during the many moments of dispair. I only hope she recovers from all of the descriptive language I subjected her to when things were not going smoothly.

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ABSTRACT

A survey was taken of 278 Air Force R&D scientists/engineers to determine the following: their level of desirability for 33 rewards, their perceptions of receiving 25 of the 33 rewards for innovative output, and whether they feel the distribution of rewards is fair. The respondent's perceptions were then related to six categories of output to determine if any relationships could be identified between productivity and rewards for output.

Increased promotion opportunity, competent supervisor evaluations, and salary increases were the three most desired rewards identified by the respondents. None of the 33 rewards investigated were identified as undesirable by the test group as a whole. Formal awards as a general category were the least desired rewards with the exception of Quality Step Increases and Outstanding Performance Reports.

Opportunity to write, present, or publish technical papers, good annual ratings, and increased educational opportunities were the three rewards perceived as being provided most often by supervisors for innovative performance. The perceptions of the formal awards were generally lower than for most of the other rewards.

The respondents generally felt that the distribution of rewards was unfair, although informal rewards were considered to be distributed more fairly than formal rewards.

"Compentent supervisor evaluation" was the reward most consistently related to by the survey group in terms of desirability, perception, and association with the fairness of rewards distribution.

Although contract monitoring work was the predominant form of productivity of the respondents, such output was not associated with the more desirable and more significant rewards. On the other hand, output associated with publishing technical papers and the writing of technical reports (but not associated with contract monitoring) was positively related to the perceptions of being rewarded with annual intra-laboratory awards, independent research, increased opportunity to write, present or publish technical papers, and Air Force Systems Command Awards for Scientific/ Technical Achievement.

REWARDS IN AIR FORCE R&D: AN ANALYSIS OF DESIRABILITY, PERCEPTION AND ASSOCIATION WITH THE PRODUCTIVITY OF SCIENTISTS/ENGINEERS

I. Introduction

Background

Since its creation as an independent service in 1947, the United States Air Force has been deeply involved with progressing and improving aviation technology to meet existing and future defense needs. Since 1947, aviation and aerospace technology have evolved into a highly complex science. Today the Air Force (AF) is involved in such programs as the space shuttle, utilization of satellites for communications, navigation, and observation, remotely piloted aircraft, and a wide variety of highly sophisticated and complex weapons. These programs require a high level of technical competence and scientific expertise, particularly in the Research and Development (R&D) area where most of these programs originated.

Over the past decade, government expenditures on R&D have increased to approximately $21.6 billion or seven percent of the federal budget (Ref 32:9). Unfortunately, although the total dollars have steadily increased for R&D, the buying power of these R&D dollars has been eroded away by inflation. This decrease in buying power is one of the causes of a shift in R&D policy by the government from one of getting more R&D dollars to getting more R&D for the dollars expended. Vincent identified this change in R&D policy and recommended that "in order to get more R&D for the dollars expended, it becomes imperative that management be able to identify factors which influence productivity" (Ref 44:45).

This change in R&D policy as well as the decreased value of present R&D funds has a large impact on AF programs which are dependent on the products resulting from R&D. The AF is deeply concerned over its ability to maintain a highly productive R&D technical labor force required to meet existing and future defense needs. One of the questions that arises is what can the AF R&D laboratories do to improve the performance/productivity of their scientific and engineering labor force?

As Vincent recognized, it is up to management to determine those factors which influence productivity and use them effectively to get the best performance possible from their personnel. This applies to AF laboratories also, but before these factors can be investigated in detail, it is necessary to look at the existing AF policies governing R&D in order to understand the possible constraints or limitations which may restrict the actions of the AF R&D laboratory manager.

AF R&D Policy. The AF has established a firm R&D policy as expressed in regulations and guidance documents. These policy documents recognize the need for an in-house scientific labor force dedicated to the Department of Defense (DOD) and AF interests as well as the requirement for a "balance between basic research and development research" (Ref 5: paragraphs 1b, 2f, and 2i). The relationship between AF R&D policy and the responsibility of AF laboratory managers is partially expressed in Air Force Regulation (AFR) 80-3, section C, paragraph 9,

> Since the competence of an in-house laboratory depends largely upon the performance of its personnel special emphasis is placed on personnel policy and procedures. The ability to attract and retain outstanding personnel rests not only on the prestige of the organization and the research to be done, but on the quality of the facilities and the environment created by management (Ref 4).

Although the written AF policy on R&D emphasizes the need for a competent scientific labor force, Congressional funding, DOD/AF personnel policies, DOD program decisions, and laboratory policy are often in conflict with each other and may impede or prevent attainment of stated AF R&D objectives. In addition, private and industrial laboratories create strong competition for technical labor with their highly flexible inducement programs.

Productivity versus Rewards. With all of these apparent conflicts and restraints impacting AF R&D, the question again arises, what can the AF R&D manager do to improve the performance/productivity of their scientists and engineers without creating additional problems? Since most changes to official DOD/AF policy require approval through normal command channels and inherently result in long delays, the laboratory manager requires idenfication of changes and improvements that do not require high level AF/DOD approval in order to be implemented. One area that may meet this criteria is the use of rewards and incentives to recognize exceptional performance by scientists/engineers. Many rewards and incentives can be provided by the laboratory managers and are constrained in their use only by local policy, but will the application of rewards help solve the problem of increasing productivity?

Studies in the areas of worker motivation, job satisfaction, and productivity by such researchers as Pelz and Andrews (Ref 34), Rosen (Ref 38), Vincent and Mirakhor (Ref 44), and Stahl (Ref 40) indicate that rewards and incentives may be more important to scientists/engineers than previously recognized. Unfortunately, most of the studies performed in this area were restricted to the industrial research environment and did

not recognize the restrictions imposed by federal regulations on the use and applicability of rewards and incentives. Two exceptions to this were the studies done by Vincent and Stahl.

Vincent investigated the importance of 33 job factors to 100 Army scientists/engineers. He also studied the relationships between productivity, the worker's level of job satisfaction, age, and education. His survey data indicated the existence of a "significant relationship between productivity .... and job satisfaction" (Ref 44:51). The possible relationship between productivity, job satisfaction, and rewards was probably best described by Vroom:

> Job satisfaction is closely affected by the amounts of rewards that people derive from their jobs and the level of performance is closely affected by the basis of attainment of rewards. Individuals are satisfied with their jobs to the extent to which their jobs provide them with what they desire, and perform effectively in them to the extent that effective performance leads to attainment of what they desire (Ref 45:246).

Stahl also identified the existence of a relationship between productivity and rewards after studying the responses of 154 AF R&D scientists/engineers. The objective of his research was to try and identify any underlying relationships between 36 organizational variables and two criterion variables for output: innovation and productivity. As a result of this research, one organizational variable was found to be consistently related to innovation and productivity at both the individual and group levels. The variable was "rewards for innovation" (Ref 40:181). Unfortunately, the question asked of the survey group was "to what extent does the group leader reward innovative output," and no specific rewards were identified that might have explained this apparent relationship between innovative output and the individual's perception of being rewarded.

As a direct result of the findings by Vincent and Stahl, this research effort is directed towards identifying those rewards which are available to AF R&D scientists/engineers, determination of their desirability by R&D personnel, and identification of any relationships that may exist between productivity and the worker's perception of being rewarded for innovative output.

Statement of the Problem

What rewards are available to AF R&D scientists/engineers? How desirable are those rewards to AF scientists/engineers? How are those rewards related to productivity as perceived by the scientific worker?

Stahl indicated a positive relationship existed between output, both quantitative and qualitative, and the extent to which supervisors rewarded innovative performance, as perceived by a group of AF R&D scientists/engineers. By identifying the relationship between productivity and the perception of receiving specific rewards for innovative performance (if one exists), a possible explanation of Stahl's findings may be developed. However, this latter question cannot be approached until the specific rewards applicable to AF R&D scientists/engineers have been identified.

To answer the first question, a great deal of research into existing literature on motivational factors, incentives, and rewards was required. In addition, most of the existing literature dealt with incentives and rewards that were applicable to scientists/engineers in industry. Such a literature search, therefore, had to be related to and tempered by DOD, AF, and other government policies, guidance, and regulations that might restrict or eliminate the use of some incentives, rewards, or awards by AF management.

In addition to existing literature, rewards were identified through interviews with management and working level scientists/engineers within several AF laboratories. Feedback from a pretest of the survey questionnaire also provided some very useful information that was eventually incorporated into the final list of rewards investigated. Finally, personal experience was also used to identify rewards to be investigated.

Once the rewards requiring investigation were identified, appropriate survey measuring techniques, as described in Chapter III, were used to determine the desirability of each reward, the extent that these rewards are provided for innovative performance, and the extent that laboratory supervisors actually reward innovative performance as perceived by the worker.

Limitations

Only those rewards applicable and available to AF R&D scientists/engineers were included in this research. This included recognition, rewards, and awards that are available to AF R&D scientists/engineers through organizations outside of the AF or federal government, but it did not include items which are prohibited or not provided for by federal and AF policy and regulations, such as stock options, bonuses, and increased vacation time (Ref 16:50-59). It was decided that investigation of rewards that were not available to AF R&D personnel would be of little value in improving performance over the short run.

It is not the intention of this research to identify specific deficiencies in the DOD/AF policies and regulations governing rewards and incentives, although any such deficiencies identified by the survey data

will be reported and, if possible, recommendations will be made for corrective action. A great deal of time and effort are generally required to make changes to high level policy and can at best be viewed as long run improvements. On the other hand, local command and laboratory policy changes can be implemented as quickly as management recognizes and supports the need for such changes. It is at the laboratory management level that changes or improvements can be implemented most effectively to improve production/performance over the short run.

This study investigated AF R&D scientists/engineers only. It was further limited to one AF laboratory and involved only working level scientists/engineers. This policy included both military and civilian personnel, but excluded all levels of management, staff and administrative personnel, technicians, and trainees.

Objectives

The following objectives served as guidance in the formulation and conduct of this research effort:

1. Define the terms "innovative output," "productivity," and "reward."
2. Identify those rewards applicable to AF R&D scientists/engineers.
3. Develop an instrument to measure the perception by AF scientists/engineers of specific rewards being provided by their supervisors for innovative performance.
4. Develop an instrument that measures the desirability or value of specific rewards to scientists/engineers.
5. Design a method to measure the fairness of the existing rewards system and the worker's awareness of reward policy.

6. Identify the types of informal recognition which AF R&D scientists/engineers consider most desirable.
7. Using the developed measuring techniques, collect data on a sample of scientists/engineers from an AF R&D laboratory.
8. Test the relationships among the following factors: the desirability of rewards, the extent to which supervisors presently reward innovative performance, the perception by the technical worker of receiving specific rewards for innovative performance, productivity, and certain statistical control data such as education, age, and experience.

II. Literature Review

Introduction

There are two basic problems encountered when one tries to study an area such as rewards. First, due to the inevitable behavioral differences between individuals, almost any reward identified by the research could be interpreted in a number of ways by the group being studied as well as the readers of the research report. What one person feels is a reward, another may interpret as a penalty or inhibitor. There is no simple solution to this problem except to analyze each candidate reward carefully before inclusion into the study.

The second problem deals with the confusion created by the terminology used by the existing literature. There is very little agreement among researchers on the definitions for many of the terms used. Vincent pointed out the confusion over the definitions for productivity and job satisfaction (Ref 44:45). Other terms that create confusion and are often used interchangeably are satisfaction, motivation, incentives, and rewards; morale, attitude, and opinion (Ref 44:45-47); and productivity, innovation, creativity, and performance (Ref 40:78-92). This problem can be reduced by defining terms to be used in the research effort and consistently following those definitions throughout the research.

Definitions. Several terms used throughout this research were previously defined by Stahl. Since these terms are used in the same context in this effort, his definitions shall be used here. In addition, Stahl went into some detail to explain why innovation, rather than creativity, was selected as the term to represent a qualitative measure of output (Ref 40:78-79). Therefore the definition for innovation and other

definitions are extracted from Stahl's study and will be used throughout this research effort:

1. Innovation - output that is original and useful (Ref 40:92).

2. Original - output that makes discrete jumps in knowledge, theory, technique or product that was not readily predictable before the fact (Ref 40:92).

3. Useful - output that adds to the fund of knowledge, or is workable if capable of demonstration and test, or is replicable by other researchers in logic and methodology, even if it apparently conflicts with other knowledge and is years from the point of demonstration and test (Ref 40:92).

4. Productivity - quantity or amount of output, without regard to innovativeness or any other quality (Ref 40:91).

The distinctions between motivation, incentive, and reward are a little more difficult to identify. Not only are these terms often used interchangeably, but the same term is often used in a very different context from one author to another. Webster defines the three terms as follows:

1. Motivation is the act of stimulating the active interest of in a study through appeal to associated interests or by special devices (Ref 46:1475).

2. Incentive - serving to encourage, rouse, or move to action; motivate in a particular direction or course ... designed to enhance or improve production (Ref 46:1141).

3. Reward - something that is given in return for good or evil done or received and especially that is offered or given for some service or attainment (Ref 46:1945).

Although by the dictionary definitions there does appear to be a distinction between the three terms according to their desired end, the definitions established by the general literature are not as clear cut.

Skinner identifies a reward as anything that reinforces behavior or strengthens responses, whether it be a positive or negative reinforcement (Ref 39:185).

Fester, on the other hand, distinguishes between the terms "reward" and "reinforcement." A reward is the vehicle or method used to provide recognition while reinforcement refers to whatever event or action occurs immediately following a specific act (Ref 17:16).

From these varied definitions, a reward can be almost anything that provides personal stimulation. It is also apparent that rewards can be motivators and incentives as well as vice versa. For purposes of this research, the definition provided by Skinner will be used, specifically as it applies to individuals for recognition of some event, action, or achievement.

Application of Rewards

As previously stated, rewards mean different things to different people. What one person sees as a positive and desirable reward, another person may find totally undesirable. Partly because of basic differences between individuals, there exist several problems impeding the efficient application of rewards.

The first problem involves the first line supervisor and higher levels of management trying to impose their perceptions or values of rewards on their subordinates. As Cotgrove so aptly put it, "a motivating situation only exists when the environment offers rewards which are valued by an individual" (Ref 15:157). For this reason, laboratory managers should not try to guess which rewards are desired by their workers but determine from the workers themselves which rewards are important. In short, the right reward must be applied to result in the degree of recognition intended.

The second problem involves the frequency and fairness of reward distribution to individuals. If rewards are given too frequently by

management, they will lose their value or appeal to the individual (Ref 41:208). This also holds true if rewards are given to individuals who are not deserving of recognition. On the other hand, if rewards are given infrequently by management or arbitrarily without regard to actual performance, the worker will only be confused as to the actual or intended relationship between performance and rewards.

Both the frequency and fairness of distributing rewards appear to be abused most often when policies governing the application of rewards are nonexistent, inadequate, or are not strictly followed by management. Either recognition of the wrong people who are undeserving of reward or lack of recognition for individuals who are deserving of reward can seriously undermine morale and neutralize the intent of any incentive program (Ref 37:224). McLoughlin concluded very simply that "it is certainly better not to reward at all than to reward the wrong people" (Ref 29:101).

The solution to this problem is to establish firm guidelines and policy governing application of rewards and consistently following that policy whenever worker performance merits special recognition.

The third problem is timeliness. Recognition for an outstanding achievement should be given as close to the actual completion of the achievement as possible. To the worker, delays in providing the appropriate recognition for outstanding performance indicate a lack of responsiveness and care on the part of management (Ref 29:101). This problem can be reduced if management makes a conscientious effort to reward outstanding performance as soon as it is identified.

The Scientist

There has been a great deal of controversy over what motivates the scientist and engineer and what causes him satisfaction and dissatisfaction.

The scientific worker has often been stereotyped as an individual who is bright, belligerent, and independent (Ref 12:12). For many years scientists as a group were believed to be unconcerned with material rewards, were considered self-actualizing, and were only interested in the job, not the environment. Simon Marcson breaks the scientific worker into two categories: the self-actualizing or professionally oriented scientist, and the nonself-motivating or organizationally oriented scientist (Ref 27:19).

More scientists are becoming organizationally oriented and showing more concern over the environmental rather than the material aspects of their jobs. Recent studies indicate that material rewards and their associated status and security are becoming just as important as the job itself, particularly in the light of recent economic changes. Cotgrove recognized this change in technical worker desires when he stated, "it is a fallacy that all scientists/engineers are dedicated to the expansion of scientific/technical knowledge" (Ref 15:9).

Needs. Maslow proposes that all individuals have certain needs that require fulfillment and that normally these needs are satisfied one at a time in accordance with a hierarchical structure. Maslow also suggests that in addition to the normal hierarchy of needs (physiological, safety, belongingness, esteem, and self-actualization) several other needs might be considered for scientists/engineers: curiosity (sheer knowledge), understanding, and aesthetic (symmetry, simplicity, and order) (Ref 28:14).

Herzberg, on the other hand, identifies needs as being either hygienic or motivational and distinguishes between the two by whether

they are satisfiers or dissatisfiers. Herzberg identifies hygienic factors such as supervision, company policy, working conditions, salary, status, and interpersonal relationships as being extrinsic to the job. These are factors which cause dissatisfaction when not fulfilled. Motivator factors are intrinsic to the job, lead to job satisfaction and should be promoted (Ref 21:53-62).

For purposes of this research, motivator factors as proposed by Herzberg will be primarily emphasized due to their relation to job satisfaction. Due to the lack of a clear distinction between all motivator and hygienic factors, some hygienic factors will also be considered for investigation.

Motivation. Vincent identified a significant relationship between productivity and job satisfaction for his survey group (Ref 44:51). Herzberg implies there is a distinction between satisfiers and dissatisfiers (Ref 21:53-62). Placing emphasis on the motivator factors may lead to an increase in job satisfaction and productivity.

E. Gomersall identified recognition of achievement as one of the most commonly used and most effective motivational techniques applicable to scientists/engineers (Ref 18:48). In addition, recognition of achievement is one area that application of rewards can be very beneficial. Just the act of recognition for a job well done is in itself a reward to many individuals. If the proper reward is also provided to substantiate the recognition of outstanding performance, then the worker will hopefully reflect his increased satisfaction with continued exceptional performance.

Pelz discovered a relationship between management attitudes towards rewards and the worker's attitude towards performance. He found that in

an environment where individuals were seeking achievement, management recognized actual achievement and the reward systems exhibited payoffs proportionate to the results achieved. On the contrary, where workers sought to avoid failure and were not willing to seek achievement due to the risk involved, management did not provide recognition in accordance with actual achievement but provided rewards or payoffs that were scheduled and independent of the actual results achieved (Ref 35:24-28).

This discovery by Pelz indicates that workers are not only concerned with the types of rewards provided, but also the management philosophy and policy in giving rewards are important and can have an impact on performance. Pelz summarized this concern over management philosophy very adequately when he stated, "when avoiding failure becomes the prime strategy, innovation is strongly jeopardized" (Ref 35:26).

Recognition. Recognition of achievement has already been identified as one area where rewards can be used effectively to increase worker motivation, but recognition as well as rewards take on a variety of forms. In particular, recognition can be provided formally through a number of awards and citations, or it can be provided informally by the immediate supervisor or coworkers. Regardless of the form the recognition takes, it has consistently been identified as important to scientists/engineers by research and in the existing literature.

This one factor tends to exist as both a motivator and hygienic factor. Formal and informal recognition together can cause worker satisfaction while its absence tends to create varying degrees of unhappiness and dissatisfaction. Torpey substantiated this factor duality when he stated, "lack of equitable recognition results in job dissatisfaction, loss of productivity, and job turnover" (Ref 42:63).

Within the AF laboratory environment, most formal rewards/awards are directed toward recognizing the exceptional achievements and outstanding performances of the technical worker. Although many of these formal methods of recognition are used infrequently, they may provide some value as rewards for innovative performance when applied properly.

On the other hand, informal recognition can generally be provided through a wide variety of rewards, can be provided in a timely manner, and can be applied as often as performance merits it. Because of its easy administration and general lack of restrictions, informal recognition, through various rewards, could be a very important factor in motivating AF R&D performance.

Charisma. One very interesting proposal was made by Gustin when he suggested that charisma be used as a complimentary basis for explaining scientific motivation. He proposes that recognition is an inadequate explanation of scientific motivation since the majority of the scientific labor produces very little that receives rewards or recognition. Since motivation still seems to exist in the scientific community, there must be some other factor involved besides recognition. He suggests this additional factor is the internal quality of charisma and is reflected by the technical workers character and personality (Ref 19:1119-1125).

This was the only reference found that identified charisma as a motivational factor, but its possible relationship to output and scientific motivation as proposed by Gustin shows some merit.

Although not identified as charisma, the theory of internal motivation is closely related as discussed by Maini. He discovered that although recognition by the scientific community was highly desired,

intellectual stimulation and the desire to make an original contribution were also very important and less dependent on a reward or recognition (Ref 26:200).

Rewards

Rewards can take on a variety of forms, can be classified in an infinite number of ways, and can be applied under almost any set of circumstances. Pelz and Andrews identified rewards as being either intrinsic or extrinsic. Intrinsic rewards include such factors as opportunity to use skills, increasing one's knowledge, job freedom, and challenging work. Extrinsic rewards include good salary, higher authority, and association with top executives. The basic distinction is that extrinsic rewards are considered external to the technical activity. One pertinent conclusion reached by Pelz and Andrews was that extrinsic rewards "cannot be relied upon to motivate achievement, but when achievement occurs, extrinsic rewards should be consistent" (Ref 34:139). This follows along with Pelz' earlier research where he found that workers were more innovative and less afraid of risk when rewarded for achievement rather than rewarded according to some other criteria.

Rewards can also be broken down into formal and informal as previously discussed under recognition. These two classifications do not conflict with Pelz' breakdown of rewards but instead represent subcategories.

Several studies classified rewards according to their impact on the worker's career, status, human relations, and material desires. For purposes of this research, the breakdown of rewards into various categories was only considered important for reporting purposes. The difference in

administration of rewards when they are formal or informal has already been discussed and this breakdown is considered necessary for feedback purposes to laboratory management.

Regardless of the category attached to a reward, there were many rewards that were consistently identified as being important by studies in this area and in the general literature.

Rewards in the General Literature. Raudsepp agreed basically with Gomersall when he stated that "personal recognition from supervisors, management, and peers is one of the most important incentives available, yet one of the most neglected areas" (Ref 18:221-222). This "personal recognition" was continuously identified in various forms within the general literature as being important to scientists/engineers. This recognition, as has already been discussed, can be achieved in a number of ways but can be most evidenced by the appropriate use of certain rewards, both formal and informal. Table I provides a highlight of several literature sources that identified the majority of the rewards/incentives which could be considered as appropriate methods of recognizing outstanding scientific/engineering performance.

Table I

Rewards Identified in the General Literature

References	Rewards
IRI Study Group Report (Ref 30:169-170)	One time bonuses for achievement Honorary and cash awards
Earl R. Gomersall (Ref 18:45-50)	Job independence, Delegated authority Participation in goal setting

Table I - continued

References	Rewards
Earl R. Gomersall (Ref 18:45-50	Performance appraisals Discretionary awards Promotions Merit increases Profit sharing Job transfers Educational opportunities Membership in professional societies
Bernard H. Gustin (Ref 19:1119-1123)	Money Position Peer recognition
Simon Marcson (Ref 27:75)	Salary increases Achievement awards Recognition from colleagues
William G. Torpey (Ref 42:55-62)	Meaningful performance appraisals Recognition from peers Maintenance of a realistic compensation plan More challenging work Opportunity to publish professional papers at employer expense Additional vacation Letters of appreciation and commendation Solicitation of ideas by employer and employees
Stephen Cole	Honorific awards and memberships in honorific societies
George Thomason (Ref 41:204)	Opportunity to publish research findings Participation in professional society meetings Increases in salary Educational opportunities Increases in status while being allowed to continue in strictly professional scientific work
John W. Koning (Ref 24:5)	Attendance at technical conferences Attendance and membership in professional societies Opportunity to travel Continued education Increased contact with fellow scientists

Investigation of Studies Involving Rewards. There have been several significant studies performed in the areas of scientist/engineer motivation and job satisfaction. Although most of the studies dealt with technical labor as it exists in industry, the findings in many of the studies are relevant to government employed scientists/engineers as well. One significant result of analyzing these studies is the realization that there is no single factor, motivator, or incentive that is predominant throughout all of the studies. This is not too surprising when one consideres that most of the studies involved different environments, different sample sizes, and different investigative techniques and objectives. It does indicate that any attempts to hypothesize the predominance of a single predictor variable prior to the research effort may be contradicted by the results of the research.

Although the studies tended to identify different factors as being the most important to the worker, they did tend to identify certain rewards or groups of rewards that were consistently considered significant or important by the surveyed groups.

Rosen provided a good, yet brief, summary of the more significant studies over the past two decades, pointing out their general conclusions and showing a slight change in research findings over this time frame. In 1957, Shepard reported that monetary rewards were prime motivators. Drucker in 1954 and Riegel in 1958 basically agreed with Shepard in that composite motivations including salary and renumeration were highly significant in motivating scientists/engineers. On the other hand, Shapiro in 1957, Moore and Renck in 1957, Marcson in 1960, and Pelz and Andrews in 1960 identified intrinsic job factors such as job challenge, research

freedom, and self-actualization as being of greater importance than material rewards (Ref 38:37-43).

The following studies were selected as being relevant to any study of rewards and job satisfaction and merit a brief description of their research objectives and results:

Rosen, 1963. Mr. Rosen performed a survey of 94 R&D technical workers. The survey used a questionnaire listing 93 items related to the job environment and requested each participant to identify on a five point scale the importance or lack of importance of each of the 93 variables. Analysis of the questionnaire data resulted in three groups of work conditions being identified: of vital importance, of moderate importance, and of little or no importance. There were 14 variables identified with the first group, 65 with the second group, and 14 with the last group. Table II shows the relationship of each variable in descending order of importance within each category, and what the mean score criteria was for classification in one group or another (Ref 38:37-43).

Rosen made several significant comments about material rewards. First of all, he concluded that R&D personnel's efficiency and job stability are tied-in with material benefits, and secondly, even though the data did not support the salary and renumeration variables as the dominant factors, they were consistently ranked high by the test group and were considered important factors for job stability and efficiency (Ref 38:41). Rosen also related productivity to material rewards and type of work performed: "to optimize research productivity, via stability and efficiency, it would appear that monetary and status rewards should be inaugurated without a basic change in the research task..." (Ref 38:42).

Table II

Rosen Categorization of Job Variables

Category I - of vital importance to the worker; requiring a mean score of 4.0 to 4.42 based on a 5.0 scale (in descending order of importance for all categories)

	Variable Area	Variable
1.	Nature of Job	Interest in job
2.	Salary & Promotions	Salary - Comfortable Living
3.	Supervision	Fair Supervision
4.	Salary & Promotions	Salary - Merit Based
5.	Nature of Job	Job Permits Creativity
6.	Nature of Job	Job Challenge
7.	Salary & Promotions	Equitable Salaries
8.	Salary & Promotions	Potential to Increase Salary Earnings
9.	Salary & Promotions	Advancement on Merit
10.	Nature of Job	Demands Commensurate with Abilities
11.	Supervision	Objective in Evaluations
12.	Company Practice/Policy	Lives up to obligations
13.	Company Practice/Policy	Competent Management
14.	Supervision	Keeps promises

Category II - of moderate importance; includes 65 variables with mean scores of 3.00 to 3.99. These variables were not considered to be significant for this research. (If further detail on this category is desired, see Appendix A.)

Category III - of little or no importance with a mean score of less than 2.0.

	Variable Area	Variable
1.	Company Practice/Policy	Company Permits Community Involvement
2.	Nature of Job	Has Social Status
3.	Company Practice/Policy	Company Permits Political Involvement
4.	Nature of Job	Increase in Social Status
5.	Nature of Job	Job Requires Travel
6.	Nature of Job	Pressure to Produce
7.	Salary & Promotions	Salary Based on Seniority
8.	Coworkers	Congeniality of Coworkers Off Job
9.	Salary & Promotions	Advancement Based on Seniority
10.	Working Conditions	Outside Plant Recreational Facilities
11.	Nature of Job	Job allows little deviation
12.	Working Conditions	Inside Plant Recreational Facilities
13.	Working Conditions	Housing Program
14.	Nature of Job	Routine Work

(Ref 38:37-43)

In summary, although many of the salary related variables were rated in the "highly important" category, these variables are of little value to a study of government employees. Salaries of government employees are governed by public law, and although they should be competitive with the industrial environment to ensure an adequate and competent technical labor force, there is very little control over this variable at any level of AF management. However, AF laboratory management can provide a relative degree of status and monetary reward, fair and competent management and supervision, job challenge, opportunity for advancement, and many of the other job variables investigated in Rosen's study.

Cole and Cole, 1967. Their research investigated the relationship between quantity and quality of scientific output. They determined that although quantity and quality were highly correlated, only a small percentage of the total output measured was of great significance and recognized as quality work.

They went on further to distinguish between the quantity and quality of output at different department and scientist levels. Their research involved 120 university physicists. Of special interest was their categorization of the physicists according to output. They identified the following four categories:

1. The prolific physicist who produces an abundance of fruitful papers. About 33 percent of the sample fell into this category.

2. The mass producer who produces a lot of output of little consequence. Twelve percent fit this description.

3. The perfectionist who although he publishes little has a considerable impact on the field. This accounted for eighteen percent of the sample.

4. The silent physicist who produces little and of little value. This was the largest category and accounted for the remaining 37 percent of the sample.

Cole and Cole concluded that, in general, quality of output was most likely to be rewarded rather than quantity. One problem they found in their sample group was that higher departments tended to retain and obtain the most competent technical talent and thereby create a gap in the quality of output between the various departments. Because of these differences in personnel and output between departments, even though the reward system generally operated to encourage creative scientists to be highly productive, a higher correlation between quantity and quality of output existed for the top departments than for the weaker departments (Ref 13:377).

In summary, although this study involved the academic environment and only one scientific discipline, the general categorization of physicists according to output classifications could be quite similar to the government technical labor output. In addition, the differences noted between departments due to recruiting and department status differences could be expected to exist in the government R&D environment also. This type of relationship between quantity and quality of output may be existent in the present research environment and will have to be taken into consideration when analyzing the survey data.

Porter, 1971. Porter and associates studied the motivational attitudes of 40 engineering graduates during their first year of employment. His objective was to use Expectancy Theory to predict how attitudes would change after a short period of employment. His methodology was to interview each engineer at the beginning of his employment,

periodically survey the engineers during the first 12 months of employment, and then follow-up with a final interview at the completion of the first 12 months of employment. The survey required each engineer to give his perception of 29 motivation variables: 22 were classified as positive motivators and seven were classified as negative motivators. The results of the study indicated that the rated desirability of rewards, whether classified as positive or negative, remained constant throughout the 12 month period for the entire test group, but there was a significant drop in the employees' beliefs that high levels of performance would lead to desired rewards. In addition, the belief that good performance would lead to undesirable outcomes increased significantly (Ref 36).

Porter's study indicates that certain rewards and incentives may have a constant level of desirability regardless of the job environment. In order to be used to increase job motivation, the employer, through management, must implement rewards and incentives *adequately and fairly* in accordance with some established policy so the scientist/engineer feels that he is being rewarded for good performance rather than via some arbitrary company action.

Kugel, 1974. Kugel translated a study performed in Leningrad, Russia in 1970 that attempted to identify the reasons for staff changes in the scientific community. The study identified certain variables which were consistently mentioned as factors causing job dissatisfaction. The study also indicated that a positive relationship exists between age and a decreasing desirability to change jobs.

Workers were classified into three age groups: senior (50-70), middle (31-49), and young (less than 30). The study involved approximately 1000 Russian scientific workers. Not too surprisingly, it was found that the young age group, particularly from 25 to 30, had the lowest stability index and were labeled as consistently dissatisfied and impatient. This age group was highly influenced by and concerned with salary and vertical mobility. They were also highly dissatisfied with the disparity between the work assigned, their own qualifications, and the subject of the research (Ref 25:9).

The highest stability index was found in the middle group, particularly between ages 45 and 50. This group was also dissatisfied with the disparity between their work and their qualifications, but they were less concerned with salary and more concerned with prospects for promotion.

The senior group was also concerned with the lack of job challenge, but they were more concerned with their relationship with the manager.

Men and women had similar motives for transfer, but men were generally more interested in the content and nature of the work and the associated pay while women tended to be more concerned with those working conditions involving hygienic factors.

There was a strong dependence between the level of worker stability and his length of service. Of the sample studied, workers less than 35 years of age made up more than 50 percent of the sample, and more than half of this group wanted to transfer from their present occupations.

Although no single factor for mobility was identified, promotion and pay were classified as highly significant factors influencing the

desire to transfer. Manager attitude and sanitary and hygienic conditions were identified as being of medium importance, while attitudes of colleagues and dissatisfaction with the profession were considered of little importance (Ref 25).

Vincent and Mirakhor, 1972. As previously discussed, Vincent and Mirakhor investigated the importance of 33 job factors to 100 Army R&D scientists/engineers. One other objective of this research was to identify any underlying relationships between productivity and age, years of service, annual salary, job satisfaction, and education. In determining these relationships, an initial classification was made of each individual as to whether he indicated by his responses a high or low level of job satisfaction. As a result of this research effort, Vincent and Mirakhor presented the following findings:

1. Experience did not appear to have any significant relationship with publishing papers.

2. Salary was identified as the best inducement to publish for the highly satisfied worker.

3. The highly satisfied worker produced at a higher rate and at an earlier age than scientists/engineers with low job-satisfaction.

4. For the worker with low job satisfaction, productivity increased with higher pay rates, indicating that salary may tend to compensate for job dissatisfaction at some level.

5. Productivity increased markedly for Ph.D. degree level scientists/engineers as compared to lower degree levels.

6. The survey data indicated a significant relationship existed between productivity, as measured in the survey, and job satisfaction (Ref 44).

Table III lists those job factors identified by the survey group as being the most and least important.

Table III

Job Factor Importance

Ranking (in descending order of importance)	Job Factor
Most Important	
1.	Pay
2.	Challenge of Assignment
3.	Nature of the Assignment
4.	Opportunity to Use Initiative
5.	Graphic Location
6.	Job Security
7.	Promotion Prospects
8.	Opportunity for Increased Responsibility
9.	Opportunity for Professional Development
10.	Opportunity to See Personal Ideas Applied
Least Important (in increasing order of importance)	
1.	Status in the Community
2.	Public Attitude
3.	Paperwork
4.	Writing and Signing Reports
5.	Security Restriction to Publishing
6.	Holidays
7.	Hours of Work
8.	Technical Staff Support
9.	Opportunity to Work on Highly Engineered Products
10.	Physical Condition of Work

(Ref 44:46)

Summary. Many of the factors that were identified in these studies were similar and consistently identified as being important by the individuals surveyed. It is anticipated that there will be some degree of correlation between the results of the studies discussed and the desirability and perception of rewards being investigated by this research.

AF Policy on Rewards/Incentives. The AF has established a firm policy towards the use of rewards and incentives. Unfortunately, as in the case of R&D policy, funding and the policies of lower command levels often conflict with the official AF policy and often reduce the effectiveness of rewards as a means of recognizing outstanding performance (Ref 3: para 3). As an example, AFR 40-470, paragraph 3c, places severe restrictions on the frequency of monetary rewards: "repetitive or yearly cash awards or quality step increases granted to the same individual should be avoided as being contrary to program objectives" (Ref 3). If individuals are highly motivated by these types of recognition, as the previously identified studies indicate, this restriction may easily cause dissatisfaction and perhaps adversely affect attitudes towards performance.

This type of policy on the frequency of reward usage is prevalent throughout the AF rewards and incentives program. There appears to be a possible correlation with Pelz' findings that worker attitudes towards performance are affected by the criteria management uses to reward individuals. If rewards such as cash or quality step increases are limited by time periods, as they are in the AF, it is possible the worker will become a "risk averter" as identified by Pelz. This type

of situation should not be tolerated since it will eventually impact the productivity of the R&D laboratory.

Since the worker will generally receive satisfaction only from those rewards he finds desirable, and will only strive for those rewards that are attainable, it is imperative that laboratory management find alternatives for those rewards that are highly desired but limited for one reason or another. Of course it may be possible to change the AF policy and increase the frequency of rewards, but as discussed earlier this is not a viable short run solution.

Salary and cash were used as examples of AF reward restrictions because they were also consistently identified as being very important to the scientific worker. Although these rewards do have restrictions, they are available through a number of awards. In addition, AF regulations and guidance documents identify the use and applicability of many other rewards. Table IV provides a list of many of these rewards and their reference documents.

Monetary rewards in the AF are probably less restricted than the chance of being promoted for displaying exceptional performance. Where there are many rewards or awards which provide the worker with some degree of monetary renumeration, there are no rewards or awards that will allow the worker a direct promotion.

The AF policy towards promotions does not appear as restrictive as they in reality are. The scientist/engineer

> May aspire to the maximum grade commensurate with the personnel structure of the laboratory without assuming supervisory or managerial responsibilities. The advancement of nonsupervisory scientists and engineers may be based solely upon recognition of their scientific accomplishments and be limited only by Public Law and AF Policy (Ref 4: section C, para 9b).

Table IV

Rewards Identified in AF Documentation

References	Reward/Incentive
ASDM 40-3 (Ref 10) AFR 40-451 (Ref 2) AFR 40-470 (Ref 3) AFSCR 900-1 (Ref 7) AFSCR 900-7 (Ref 8)	Scientific Achievement Awards AFSC Technical Achievement Awards Meritorious Civilian Service Exceptional Civilian Service Command Civilian Award for Valor Sustained Superior Performance Special Acts or Services Quality Step Increases AFSC Certificates of Merit Letters of Commendation and Appreciation Outstanding Performance Reports
ASDR 40-4 (Ref 11)	Merit Promotions
AFR 40-470 (Ref 3)	Presidential Award for Distinguished Federal Civilian Service DOD Distinguished Civilian Service Award AF Decoration for Exceptional Civilian Service AF Outstanding Unit or Organizational Excellence Award Patricia Kayes Glass Award for Outstanding Women Scientists, Engineers, and Technicians AF Association Awards
AFM 900-4 (Ref 1)	Recognition of Suggestions, Inventions or Scientific Achievement
AFR 80-4 (Ref 5)	Part-time and Full-time Graduate Study Participation in Seminars, Symposiums, and Meetings of Technical Societies Independent Research in Field of Expertise
AFR 80-3 (Ref 4)	Prestige of Organization and Scientific Work Quality of Facilities and Environment Promotion Within Technical Capacity Without Dislodgement Attendance at Professional and Scientific Meetings Sponsor Professional and Scientific Meetings Publishing Scientific Works Apply for Patents Participate in Educational Programs

Although direct promotion within the civil service system is not possible as the direct result of any singular achievement, many of the rewards/awards identified in AF regulations are factors considered in the normal merit promotion system.

The merit promotion system is based on many different factors, two of them being a supervisor evaluation of the worker's potential and the points received for specific awards/rewards (Ref 2). In addition to merit promotions, certain awards and their associated point credits are used for retention purposes during times of mandatory force reduction.

In summary, although direct promotion as the result of a specific achievement is not possible, recognition through awards for continued outstanding performance do increase chances of promotion through the merit promotion system and also increase the chances of job retention. It should also be noted that except for the supervisor evaluation, most, if not all, of the rewards/awards documented for merit promotion purposes can be considered formal recognition.

Rewards, Recognition, and Productivity. Air Force policy on recognition of exceptional performance reflects much of the philosophy discussed throughout the general literature regarding recognition, higher job satisfaction, and better performance: "recognition granted for achievements promotes greater job satisfaction, fosters sound employer-management relations, and contributes toward sustainment of a creative and highly productive civilian force" (Ref 3: para 1a). Unfortunately, AF policy and regulations also restrict the use of many rewards. Therefore the laboratory managers must use whatever means they have available to motivate their workers and improve performance.

For this reason, determination of those rewards that are desirable to the AF scientists and determination of the scientist's attitude towards the present methods of recognition emphasized by the AF R&D laboratories, should provide sufficient information for improving and increasing the effectiveness of laboratory rewards/incentives policy.

Rewards Included as Variables

Table V lists those rewards that were identified for investigation in this research. They were selected through analysis of the previously identified literature and studies, their applicability to government employees, and some personal judgment by this researcher. Although several of the variables do not appear applicable to federal employees, it was decided that they could be indirectly related to recognition of outstanding performance and were therefore included.

Table V

Included Reward Variables

Variable Number	Variable Title
1.	Cash*
2.	Salary Increases*
3.	Special Acts and Services Awards (SAS)
4.	Quality Step Increases* (QSI)
5.	Recognition of Suggestions
6.	Implementation of Suggestions
7.	Outstanding Performance Reports (OPR)
8.	Honorary Organizational Awards
9.	AFSC Scientific/Technical Achievement Awards
10.	AFSC Certificate of Merit
11.	Recognition/Awards for Inventions
12.	Informal Recognition
13.	Competent Evaluation by Supervisor
14.	Honorary Individual DOD/AF/AFSC Awards
15.	Annual Intra-laboratory Awards

Table V - continued

Variable Number	Variable Title
16.	Sustained Superior Performance Awards
17.	Project Related Travel
18.	Increased Promotion Opportunity
19.	Letters of Appreciation/Commendation
20.	Improved Working Environment
21.	Educational Opportunities
22.	Increased Responsibility
23.	Voice in Work Assignment
24.	Voice in Project/Equipment Expenditures
25.	Opportunity to Write, Present, or Publish Technical Papers
26.	Opportunity to Do Independent Research
27.	Opportunity to Teach, Instruct, or Lecture
28.	Participation in Professional Meetings
29.	Official/Unofficial Compensation Time
30.	Recognition from Professional Societies/Groups
31.	Awards from Professional Societies/Groups
32.	Recognition from Peers (both within and external to the Air Force)
33.	A Good Annual Civilian Evaluation or Good Officer Effectiveness Report

*There is some overlap between these three rewards. Cash is associated with several of the formal awards including suggestions. Salary Increases for civil servants are directly related to promotions while Quality Step Increases are a subset of salary increases associated with formal awards as recognition for outstanding performance.

Output/Productivity Variables

Many forms of identifying productivity are available as discussed in the various research studies, but for purposes of this research only output that can be quantitatively identified will be used to represent a worker's productivity. Although a qualitative assessment of R&D productivity is often more practical than a quantitative measure, quantity is easier to determine and measure, and much less subjective (Ref 22:50). For these reasons, each worker will be requested to identify his

productivity by relating to the number of specific types of output he has produced. The output variables used in this research are identified in Table VI.

Table VI

Types of Output*

Output Variable Number	Category
1.	New or Improved Products
2.	New or Improved Processes/Techniques
3.	Patents/Patent Applications
4.	Published Papers in Technical or Professional Journals
5.	AF Technical Reports
6.	AF Technical Memorandums
7.	Books
8.	Manuscripts
9.	Hardware/Software Specifications
10.	Test Plans
11.	Test Reports
12.	Statements of Work
13.	Requests for Proposal (in addition to Statements of Work)
14.	Oral Presentations to Technical/Professional Audiences

*These types of output will be measured over a two year time period only to allow a common frame of reference.

Statistical Control Variables

Table VII lists the control and demographic variables used in this research effort.

Table VII

Control Variables

Variable Number	Variable Title
1.	Age
2.	Grade or Rank
3.	Educational Level
4.	Years in Current Section
5.	Nature of Work
6.	Amount of Time Involved in Contract Monitoring
7.	Years of Scientific/Engineering Experience
8.	Years of Scientific/Engineering Experience while Employed by the Federal Government

Age. The age variable seemed to create the most controversy among researchers as it relates to job satisfaction, involvement, stability, and performance. For example, Hall found age strongly related to job involvement and intrinsic motivation, but his research did not indicate any significant relationship between age and performance (Ref 20:206-208). Vincent, on the other hand, identified a strong relationship between age, level of job satisfaction, and productivity (Ref 44:47-50).

Pelz and Andrews found several differences in performance attitudes and actual achievement as related to age and environment. Most scientific

workers, regardless of the type of work performed, showed a saddle-shaped age versus performance curve, but the research scientist tended to peak in performance at an earlier age than the development oriented scientist (Ref 34:176-179).

When considering the environment as an influence, the academic and industrial scientists tended to peak in achievement between 40 and 45. However, the assistant government scientists did not reflect a saddle-shaped curve for achievement but displayed a gradual increase in achievement up to the age of 50 before a major decline was noted (Ref 34:187).

Allison identified a strong relationship between productivity, age, and the application or use of recognition. In his research, he recognized a disproportionate distribution of productivity with age and proposed that this was due to "accumulative advantage." This "accumulative advantage" is based on the degree and use of recognition of accomplishments by the scientist. Highly productive scientists maintain or increase their producivity due to the proper uses of recognition as feedback; conversely, scientists who produce very little generally receive inadequate or no recognition, and produce even less with time. As a result, this phenomenon provides an accumulative advantage over time for the scientist that is productive and reinforced through recognition. This effect increases over time and creates an increasingly unequal distribution of productivity. This phenomenon also causes an increased association among productivity, resources, and esteem as career age increases (Ref 9:596-606).

Allison proposed the "accumulative advantage" hypothesis as a much more realistic explanation of the production fluctuations among

scientists than the "sacred spark" hypothesis proposed and supported by some researchers. The "sacred spark" hypothesis recognizes substantial, predetermined differences between scientists in their ability and motivation to do creative work (Ref 9:596-606).

Whether one theory has more validity than the other remains to be proven. It is the negative or pessimistic attitude that can result from the "sacred spark" concept that should be avoided. If the supervisor accepts the philosophy that scientists/engineers are inherently different and there is very little that can be done to improve their performance, then performance will undoubtedly not improve. This lack of improvement could be due more to the supervisor's attitude than the worker's ability. On the other hand, if a positive attitude is assumed, an atmosphere conducive to improvement exists.

III. Methodology

Survey Technique

The questionnaire was determined to be the best method of collecting data for this research. The sample size of scientists/engineers and the short time period allocated for collecting data were the two primary reasons for selecting the questionnaire over other data collection techniques. There were 482 scientists/engineers selected to participate in this survey and only four weeks were available for data collection. The volume of data anticipated over this short time frame made the interview or any other form of personal contact with the test group impractical.

Anonymity was another factor in selecting the questionnaire as the appropriate data collection method. Both the response rate and validity of responses from the test group tend to be higher in surveys which insure the respondents anonymity. The questionnaire, when applied correctly, provides maximum anonymity for the survey group. In addition, what little personal information was needed on each respondent was easily obtained through demographic questions on the questionnaire.

Several of the inherent disadvantages normally associated with questionnaire usage were partially compensated for by the location of the survey test group. Being located on the same government installation as the researcher, general administration of the questionnaire, any required follow-up action, and communications with the test group and laboratory management were greatly enhanced by the availability of the local mail distribution system. This one factor is credited with saving several weeks of effort in data collecting that would have been required if the normal postal system had been used.

Another questionnaire deficiency anticipated is the normally low response rate associated with this method of data collection. In addition, response rates tend to decrease as the complexity of the questionnaire increases. Although the questionnaire was reduced in complexity as much as possible, this one factor could still limit the number of responses. Aside from questionnaire complexity, there are two additional areas considered as potential problems impacting response rates.

The first problem deals with the test group's concern over their participation in the survey. Due to prior surveys and laboratory policy, the workers normally require management approval of the survey, the questionnaire, and their participation. To anticipate this problem, a cover letter was attached to the questionnaire which was signed by the commander of the laboratory surveyed and which requested each respondent's fullest cooperation and support of this research.

The second problem involves the respondent's psychological feelings about involvement. Oppenheim indicated that response rates tend to increase when the survey group feels they are actually part of the research effort and have some contact with the researcher (Ref 33:76-80). The questionnaire identified to each participant that they were welcome to contact the researcher for any questions that might arise. In addition, all interested participants were promised a short summary of the survey results.

To insure that the questionnaire was received within the time frame desired, a deadline was imposed on the response. Rather than indicate a time frame for response, which would be interpreted differently depending upon when the questionnaire was received, a date was identified. The

deadline allowed the participants four weeks to return the completed questionnaires. It was felt that this time period was long enough to include most periods of worker absenteeism, including vacations.

Questionnaire Development

The questionnaire that was eventually used in this survey was the result of several interviews with laboratory managers and workers, a pretest of the questionnaire, numerous reviews, and several major revisions. The first draft of the questionnaire consisted of the following sections: statistical and demographic questions, identification of reward desirability, measurement of the scientist's perception of how often the supervisor rewards innovative output, and a similar measurement of how often the organization rewards innovative output.

Further analysis and discussion with laboratory personnel resulted in deletion of the section dealing with the organization and addition of two more sections. Although the organization might ultimately control the use and distribution of certain rewards, it was felt the supervisor is normally recognized as the initiator for most rewards, and it is at the supervisor level that changes can best be implemented.

The two sections added were worker identification of output for a two year period and questions concerning standards on rewards and the distribution of rewards.

Finally, on 28 June, a draft questionnaire was completed and distributed to 21 scientists/engineers within a division of the AF Flight Dynamics Laboratory (AFFDL). This small group was used as a pretest of the questionnaires readibility and comprehensibility. Nine of the 21 questionnaires were returned and used in formulating the final questionnaire.

Sample. Support for this research was provided by the AFFDL at Wright-Patterson Air Force Base, Ohio. The laboratory management indicated an interest in the subject of this research and offered their support. In addition, there was a sufficient number of scientists/engineers within this laboratory to provide a good data base and a representative sample of AF scientists/engineers (Ref 6:6-1 to 6-25).

The AFFDL administrative and personnel offices provided the necessary information to identify the specific individuals to receive the survey questionnaire. Of the approximately 1000 people working within AFFDL, 482 were identified as nonsupervisory R&D scientists or engineers.

Distribution. On 22 July 1976, 482 questionnaires were distributed to the five divisions within AFFDL, excluding the group used for pretest purposes. By 13 August 1976, the response rate was 39 percent and leveling-off rapidly. Approximately 10 percent of those received did not meet the criteria for analysis and were deleted.

On 16 August 1976, a follow-up letter was sent to 425 AFFDL scientists/engineers (see Appendix B). Whether the response rate increased because of the follow-up letter or other factors is unknown, but by 20 August 1976, the response rate had increased to 55 percent. By the cut-off date, 3 September 1976, 62.8 percent of the questionnaires had been returned.

Several of the returned questionnaires were deleted from the survey analysis due to the respondents not meeting the nonsupervisory criteria or because 50 percent or more of the questions in one or more sections of the questionnaire were left unanswered. This latter criteria was decided upon by the researcher as the maximum level of missing data

acceptable. These deletions resulted in 278 questionnaires (57.6 percent of the survey sample) being included in the final data analysis.

The 278 questionnaires included in the data analysis consisted of 226 questionnaires with no missing data and 52 questionnaires with some missing data. The missing data was generally restricted to one section of the questionnaire for any one respondent and provided useful data in the analysis of the completed sections. The impact of the missing data on the analysis was considered less critical than the impact of excluding all 52 of the questionnaires from the data base. In addition, it was hoped that the missing responses would provide some useful information regarding possible trends in the responses to certain questions.

Questionnaire Structure

The final questionnaire consisted of six main sections plus two cover letters and an introduction (see Appendix C). Sections one, two, three, five, and six were similar to the pretest questionnaire and consisted of the following question categories: statistical and demographic information, output/productivity, desirability of rewards, perception of being rewarded and receiving specific rewards from the supervisor for innovative output, and the awareness of organizational standards on rewards and the perceived fairness of the distribution of rewards.

Section four was added after the pretest due to the possible importance of informal recognition as a reward and its effect on productivity and job satisfaction. This section required the respondent to identify three types of informal recognition he finds desirable, in decreasing order of desirability. Since the section on desirability also included

"informal recognition" as a reward and several specific rewards which could be classified as informal recognition, the individual's response to this section serves as a reliability check on his responses to section three.

Measurement Scales. Several measurement techniques were used throughout this questionnaire. The questions requiring measurement of the perception of being rewarded or receiving certain rewards for innovative output were based on a nine point scale (1 to 9), for compatibility with Stahl's research (Ref 40:226-229). The variable "to what extent does the supervisor reward innovative output" was duplicated from Stahl's questionnaire in order to obtain the same measure before trying to determine which rewards contributed to its rating.

The desirability of rewards variables were measured on a seven point scale (1 to 7). Although the nine point scale normally provides a higher reliability, the scale used for these variables was descriptive rather than numerical and the two additional ratings added too much complexity and confusion to an already complex questionnaire. The seven point scale was considered more reliable than a smaller scale and less confusing than a larger scale.

Output was a quantitative measure only and did not require any special measurement techniques, but a common time frame was required for reporting output to allow comparability of the different respondents. For this reason, each respondent was requested to identify his productivity over the past two years only. This time period was selected as a compromise for purposes of measurability and accuracy (Ref 40:86-87).

The three miscellaneous variables dealing with awareness of organizational standards on rewards and the fairness of the formal and informal rewards distribution were dichotomy questions and required a simple yes or no response.

No measurement scheme was attached to the open-ended question regarding identification of three forms of informal recognition. Although the question asked the respondent to list three desirable forms of informal recognition in descending order of importance, a slightly different technique was used in the analysis of this question and will be discussed in the section on analytic methods.

Output/Productivity. As indicated in Table VI, the productivity of each respondent is determined by the identification of the quantity of each output category over the past two years. Total output will be a quantitative measure determined by summing all of the output categories for each respondent. All outputs are considered to have equal weighting before summing.

Originally only one variable was to be used to represent output/productivity, but some concern arose over the placement of equal value on each output category and the survey groups adherence to the two year reporting period for output. Due to these additional considerations, the output categories were also grouped to provide a reliability check and a more meaningful analysis of productivity.

Table VIII lists the additional classifications of output for analysis purposes.

Table VIII

Output/Productivity Categories

Variable Number	Output Included
1.	All of the Output identified in Table VI
2.	Published Papers in Technical or Professional Journals
3.	Technical Reports
4.	Technical Memorandums
5.	Published papers, technical reports, and technical memorandums
6.	New or improved products, processes, and techniques, and patents or patent applications
7.	Hardware/software specifications, test reports, test plans, statements of work, requests for proposal, books, and manuscripts
8.	Oral presentations to technical or professional audiences

Variable Abbreviations

Table IX lists the different sections identified in the questionnaire and their associated variables and variable abbreviations used for analysis purposes.

Table IX

Variable Abbreviations

Variable Category and Abbreviation	Variable Title
Statistical Control Variables	
AGE	Age
AGEGP	Age according to ten year increment (20-29, 30-39, etc.)
AGELVL	Age according to fifteen year increments (20-35, 36-50, 51-65)
GRADE	Civilian grade or military rank
MILCIV	Military or Civilian Occupation
SECYRS	Years in section by one year increments up to five years
YRSSEC	Actual years in the section
SUPTME	Years the supervisor in charge of the section in one year increments up to five years
SUPYRS	Actual years the supervisor in charge of the section
EDCTN	Level of Education
NTWRK	Nature of Work (research, development, support, or other)
NWRKA	The number of working areas involved in
ASCEXP	Actual years of scientific experience
FSCEXP	Actual years of scientific experience while employed by the federal government
Productivity	
OUTPUT	*Sum of all the output categories listed in Table VI*
VAR1	Published papers in professional/technical journals
VAR2	Technical Reports
VAR3	Technical Memorandums
VAR4	The sum of VAR1, VAR2, VAR3
VAR5	New or improved processes, products and techniques, and patents or patent applications
VAR6	Hardware/software specifications, test reports, test plans, statements of work, requests for proposal, books, manuscripts
VAR7	Oral presentations to tehcnical or professional audiences
Desirability of Rewards	
RWRD1	Cash
RWRD2	Salary Increases
RWRD3	Special Acts and Services Awards
RWRD4	Quality Step Increases
RWRD5	Recognition of Suggestions
RWRD6	Implementation of Suggestions
RWRD7	Outstanding Performance Reports

Table IX - continued

Variable Category and Abbreviation	Variable Title
Desirability of Rewards (Cont'd)	
RWRD8	Honorary Organizational Awards
RWRD9	AFSC Awards for Scientific/Technical Achievement
RWRD10	AFSC Certificates of Merit
RWRD11	Recognition/Awards for Inventions
RWRD12	Informal Recognition
RWRD13	Competent Supervisor Evaluation
RWRD14	Honorary Individual Awards
RWRD15	Annual Intra-laboratory Awards
RWRD16	Sustained Superior Performance
RWRD17	Project Related Travel
RWRD18	Increased Promotion Opportunity
RWRD19	Letters of Appreciation/Commendation
RWRD20	Improved Working Environment
RWRD21	Education Opportunities
RWRD22	Increased Responsibility
RWRD23	Say in Work Assignment
RWRD24	Say in Project/Equipment Expenditures
RWRD25	Opportunity to Write, Present, or Publish Technical Papers
RWRD26	Opportunity to do Independent Research
RWRD27	Opportunity to Teach or Lecture
RWRD28	Participation in Professional Meetings
RWRD29	Official/Unofficial Compensation Time
RWRD30	Recognition from Professional Groups
RWRD31	Awards from Professional Groups
RWRD32	Recognition from Peers
RWRD33	Good Annual Evalution
Perceptions	
SUPRWRD	The extent the Supervisor Rewards Innovative Output
The perception of receiving the following rewards for innovative output:	
PRWRD1	Sustained Superior Performance
PRWRD2	Special Acts or Services
PRWRD3	Annual Intra-laboratory Awards
PRWRD4	Individual Honorary Awards
PRWRD5	Quality Step Increases
PRWRD6	Honorary Organization Awards
PRWRD7	Outstanding Performance Reports

Table IX - continued

Variable Category and Abbreviation	Variable Title
Perceptions (Cont'd)	
PRWRD8	Letters of Appreciation/Commendation
PRWRD9	Informal Recognition
PRWRD10	Competent Supervisor Evaluation
PRWRD11	Opportunity to Write, Publish, or Present Technical Papers
PRWRD12	Opportunity to Participate in Professional Meetings
PRWRD13	Increased Say in Project/Equipment Expenditures
PRWRD14	Increased Promotion Opportunity
PRWRD15	Increased Project Related Travel
PRWRD16	Increased Responsibility
PRWRD17	Improved Working Environment
PRWRD18	Say in Work/Project Assignment
PRWRD19	Official/Unofficial Compensation Time
PRWRD20	Increased Educational Opportunity
PRWRD21	Opportunity to Teach, Instruct, or Lecture
PRWRD22	Opportunity to do Independent Research
PRWRD23	AFSC Awards for Scientific/Technical Achievement
PRWRD24	AFSC Certificates of Merit
PRWRD25	Good Annual Evaluation
Miscellaneous	
STNDS	Awareness of Organizational Standards or Policy governing the requirements for and the application of rewards
FORM	The Fairness of the Distribution of Formal Rewards
INFORM	The Fairness of the Distribution of Informal Rewards

Analytic Methods

The objectives or problems being investigated generally dictate the types of analysis to be used for any research effort. In addition, the researcher must be aware that actual results do not always coincide with the anticipated results. This later occurrence requires that any assumptions or hypotheses made early in the research be verified by the actual survey data.

Several of the variables investigated in this research required very little analysis and proposed no particular problems, but other variables

were more complex in their relationships with other variables and required a more detailed analysis.

The following analytical techniques were identified for application to the survey data. In addition, most of the following techniques were available in local computer systems through the Statistical Package for Social Sciences (SPSS) (Ref 31).

Variable Relationships. A general check of the linear relationships between pairs of variables listed in Table IX was considered the first step in the analysis process. For those variables which are approximated by a normal distribution, Pearson Product-Moment Correlations will be calculated using the appropriate SPSS routine.

If groups of variables do not follow the distribution assumption necessary to calculate Pearson correlations, nonparametric techniques within SPSS will be used to calculate variable correlations. Statistical Package for Social Sciences allows calculation of either the Kendall or Spearman Correlation Coefficients. For purposes of this research, if nonparametric correlation techniques are required, both the Kendall and Spearman correlation coefficients will be calculated and the correlation technique which provides the lesser significant correlations (more conservative) will be selected for determining variable relationships.

Once the correlation coefficients between variables have been examined, further investigation of the specific questionnaire categories will be undertaken. Additional investigation involves the analysis of relationships between dependent or criterion variables and independent or predictor variables. The output variables and the "extent supervisors reward innovative output" variable were identified as criterion variables for analysis purposes.

Calculation of a correlation coefficient only identifies the degree of linear relationship between two variables and does not identify the cause of that relationship (Ref 23:222). It is also possible that a low correlation between two variables can mislead one into thinking no relationship exists between the two variables, when a curvilinear relationship may still exist (Ref 23:219). Curvilinear relationships can be extremely complex and difficult to interpret and will not be analyzed in this research.

Regression of Predictor Variables. Once the degree of linear correlation has been determined between variables, an investigation will be made of the variance displayed by the criterion variables. It is hoped through regression analysis, specific predictor variables can be identified that explain most of the criterion variables variance. There are several regression techniques available, but a technique was required that would take into account any partial correlations that might exist between the independent variables.

Stepwise regression using forward inclusion of variables into the regression equation and backward checking to delete included variables which no longer meet the preestablished criteria for inclusion, was selected as the most appropriate regression method for this analysis. Stepwise regression will be used on the productivity variables and "the extent supervisors reward innovative output" (SUPRWRD) variable. The predictor variables to be analyzed in the regression analysis will include the 25 perceptions of receiving specific rewards plus seven of the major demographic variables.

Canonical Analysis of Productivity. Regression techniques only allow analysis of the dependent or productivity variables one at a time

and do not allow treatment of the output as a group of possibly interrelated variables for simultaneous analysis against the predictor variables. Canonical analysis allows the determination of the linear relathionship between two sets of varialbes and will be applied to the analysis of the productivity variables (Ref 31:517).

Although SPSS has a program for canonical analysis, the variable loadings on the canonical variates, the root values, and the canonical variates level of significance are not provided by the SPSS routine. Therefore, the canonical program identified in the FORTRAN Programming for the Behavioral Sciences by Veldman will be used for this analysis (Ref 43).

Reduction of Variables: Factor Analysis. Many of the reward variables identified in the questionnaire may have strong correlations with each other. It may be possible to reduce this list of rewards into a smaller group of different rewards and still retain most of the information contained in the original variables (Ref 14:4-9). Factor analytical techniques allow such a determination and will be applied to both sets of reward variables used in this survey.

There are two decisions to be made when utilizing factor analysis. The method of factor analysis and the method of axis rotation to apply to the initial factors must be identified.

There are several factor analytical methods available to the researcher. The SPSS manual identifies five factor analytical methods while Comrey lists several different techniques (Ref 31:478-482 and Ref 14). Principle factoring without iteration was selected as the factor analytical technique for this research because of its frequency of use in this type

of research and the recommendation of the writers of the SPSS Manual to those individuals who are unfamiliar with factor analysis methods (Ref 31:480).

The VARIMAX orthogonal method of rotation was also selected because of its frequency of use and the same recommendations by the authors of the SPSS Manual.

Frequencies and Statistics. Means, standard deviations, frequency of responses, and the number of valid data responses will be identified for each variable, where appropriate, using the statistical routines available in SPSS. The three variables dealing with awareness of standards and fairness of rewards distribution will be reported according to response frequency and relation to other variables only.

Rankings. Two areas will involve ranking of variables. The area on reward desirability will be ranked according to the mean desirability score before factor analysis.

A ranking will also be performed on the informal rewards identified by the survey group in the one open-ended question asked. The types of informal recognition identified by the respondents will be listed according to a special weighting assigned to each response. The weighting factors decided upon by this researcher are three for first place, two for second place and one for third place. The total score and ranking for each type of informal recognition will then be determined by the position in which the type of recognition is identified and its associated weighting summed for all of the individual responses.

This method of weighting assumes an equal increment of difference between each of the three levels of importance, and any three consecutive

numbers could have served as weighting factors. It is intended only as a means of identifying the relative frequency and level of desirability of the differeint types of informal recognition mentioned by the respondents.

Content Analysis. The types of informal recognition identified by the survey respondents will be categorized according to the theme of the response. For example, a pat-on-the-back by the supervisor, verbal appreciation by the supervisor, and a supervisor thank you for a job well done could all be classified as supervisor recognition of a good job. This type of classification will be performed on the types of informal recognition prior to the ranking and weighting of the responses. The results of this content analysis should make the results more meaningful.

IV. Results and Discussion

Outline of Analysis

Due to the large amount of analysis performed on the questionnaire data, the results of this analysis will be presented in a format that allows, as much as possible, the logical flow from the analysis of one area to related areas. For this reason, the following outline will serve as a guide to the analysis results presented in this chapter:

A. Introduction
   - Deleted Variables
   - Statistical Characteristics of the Respondents

B. Fairness of Rewards and Awareness of Standards
   - Correlations with Other Variables

C. Desirability of Rewards
   - Correlations with Demographic Variables
   - Correlations Between Desirability Variables
   - Factor Analysis of Desirability Variables

D. Informal Recognition
   - Desired forms of Informal Recognition

E. Perceptions of Rewards
   - Correlations with Demographic Variables
   - Correlations with Desirability Variables
   - Factor Analysis of Perception Variables

F. Extent Supervisor Rewards Innovative Output (SUPRWRD)
   - Correlations with Perceptions and Demographics
   - Regression Analysis

G. Productivity
   - Correlations Between Output Variables
   - Correlations with Demographics
   - Correlations with Perception Variables
   - Canonical Analysis of Productivity

Introduction

A preliminary analysis of the returned questionnaires resulted in several variables being deleted from further analysis. In addition, it

was determined that the productivity variables were approximated more by an exponential than a normal distribution. As a result of this latter discovery, nonparametric Spearman and Kendall Correlation Coefficients were calculated for the productivity variables. The Spearman Rank Order Correlations were more conservative than the Kendall Correlations, and for this reason, the Spearman Correlations were used in the analysis of productivity relationships.

Deleted Variables. Two demographic and two productivity variables were deleted from the analysis. The two demographic variables, "nature of work" (NTWRK) and "number of working areas" (NWRKA), were deleted because of the unexpected variety of responses and the questionable validity associated with these two variables.

Two productivity variables were also deleted because of the questionable validity of a number of the responses. The variable "oral presentations to technical/professional audiences" (VAR7) appeared to be interpreted differently by many of the respondents than was originally intended by the researcher. The actual number of such presentations reported by some of the respondents was inordinately high for a two year reporting period.

This apparently inflated productivity value could have been caused by either the respondents reporting output for time periods greater than the two year period stipulated in the questionnaire, or the erroneous inclusion of any form of briefing or presentation as part of this output. The former problem was taken into consideration during the initial analysis of the questionnaires through a reliability check. A maximum of ten technical reports or 20 technical memorandums was considered a

reasonable or at least possible quantity of output for a two year period. Respondents that exceeded these quantity values were deleted from any further analysis.

The latter problem could not be as easily identified or related to specific respondents. There were several questionnaires that passed the reliability check but still reflected as many as 50 "oral presentations" over a two year period. Therefore, "oral presentations" were considered an unreliable measure of worker productivity and deleted from the analysis.

Deletion of "oral presentations" (VAR7) required the deletion of the corresponding overall productivity variable OUTPUT since its value included VAR7. It was decided that a new total output variable (sum of VAR1 through VAR6) was not necessary.

Demographic Statistics. Tables X and XI identify the general characteristics of the scientists surveyed.

Table X

Statistical Characteristics of the Respondents (N=278)

Variable Abbreviations[1]	Mean	Standard Deviation	Range
AGE	36.2 Years	9.1 Years	22 to 69 Years
ASCEXP	11.5 Years	7.5 Years	0 to 36 Years
FSCEXP	9.9 Years	6.8 Years	1 to 29 Years
YRSSEC	5.8 Years	5.2 Years	0 to 25 Years
SUPYRS	4.8 Years	4.6 Years	0 to 20 Years
CONMON	18.6 Percent	23.4 Percent	0 to 100 Percent

[1]See Table IX for explanation of abbreviations

Table XI

Test Group Characteristics

Variable Abbreviation[1]	Subcategory	Number of Respondents
MILCIV	Military	66
	Civilian	212
GRADE	GS 6, 7, 8, or 2d Lt	13
	GS 9, 10, or 1st Lt	25
	GS 11	21
	GS 12 or Captain	105
	GS 13 or Major	99
	GS 14 or Lt Colonel	15
AGELVL	Less than 35 years of age	140
	35 to 50 years of age	112
	More than 50 years of age	26
AGEGP	Less than 30 years of age	75
	30 to 39 years of age	112
	40 to 49 years of age	63
	50 to 59 years of age	23
	More than 59 years of age	5
EDCTN	BS Degree	41
	BS +	90
	MS Degree	61
	MS +	57
	Ph.D.	29

[1]See Table IX for explanation of abbreviations

Fairness of Rewards and Awareness of Standards

The responses to the three dichotomous variables included in the questionnaire are presented in Table XII. The three variables are: "are you aware of organizational standards governing the requirements for and the application of rewards?" (STNDS), "is the distribution of formal rewards fair?" (FORM), and "is the distribution of informal rewards fair?" (INFORM).

Table XII

Frequency of Responses to Awareness of Standards and Fairness of Rewards Distribution

Variable Abbreviation	Responses (total number/overall percentage)		
	Yes	No	No Response
STNDS	71/25.5%	206/74.1%	1/.4%
FORM	89/32 %	162/58.3%	27/9.7%
INFORM	121/43.5%	132/47.5%	25/9 %

At first glance, the number of missing responses to the two perceptions on the fairness of rewards distribution seems surprising, but most of these missing responses were associated with individuals that had worked for the R&D laboratory for less than one year. As indicated by several of the respondents, they did not feel they had been in the organization long enough to form an opinion on the fairness of rewards distribution regardless of whether the rewards were classified as formal or informal.

It is also apparent from the responses to the questionnaire, that the survey group does not feel that rewards distribution is fair, although informal rewards are felt to be distributed more fairly than formal rewards.

Although almost 100 percent of the respondents answered the question on the awareness of organizational standards governing the use of rewards, only 25 percent of the respondents indicated any awareness of, or familiarity with such organizational standards. This lack of awareness could be due to a number of organizational problems but is most likely due to

either poor communications between management and the worker about existing standards or the actual absence of any standards within the laboratory environment. In either case, documented standards governing reward achievement should be established by each laboratory, should be communicated directly to the working level scientist/engineer, and, equally important, rewards for achievement should be applied consistently by managers in accordance with the established standards.

Correlations With Other Variables. Table XIII lists the significant Pearson Correlation Coefficients between the three dichotomous variables and the other variables investigated in this research effort.

The consistently significant correlations between the dichotomous variables and the perception variables is not too surprising. The negative coefficients indicate that the more the scientist/engineer perceives he will be rewarded by his supervisor (SUPRWRD) or receive specific rewards for innovative performance (PRWRD), the more likely he will feel the distribution of rewards is fair (INFORM and FORM) and the more likely he is aware of organizational standards/policy governing rewards (STNDS).

The five perceived rewards which have the strongest correlations with the perceived fairness of rewards distribution are directly related to the organization's or supervisor's ability to recognize good performance. These five rewards are: Sustained Superior Performance Awards (PRWRD1), letters of appreciation/commendation (PRWRD8), competent supervisor evaluations (PRWRD10), Outstanding Performance Reports (PRWRD7), and increased promotion opportunity (PRWRD14).

Summary. The Respondents generally perceived that the distribution of rewards/awards is unfair, and they are generally unaware of organizational standards or policy governing the achievement or application of rewards/awards.

Table XIII

Correlations With Dichotomy Variables

Variable Abbreviations[1]	Correlation Coefficient[2] (r) Dichotomy Variables		
	STNDS	FORM	INFORM
RWRD5			-.112
RWRD7	.128		
RWRD9	.114		
RWRD30		.114	
PRWRD1	-.209	-.390	-.323
PRWRD2	-.135	-.208	-.159
PRWRD3	-.115	-.266	-.163
PRWRD4	-.188	-.288	-.211
PRWRD5	-.140	-.243	-.188
PRWRD6	-.210	-.290	-.252
PRWRD7	-.312	-.374	-.329
PRWRD8	-.238	-.374	-.350
PRWRD9	-.232	-.282	-.383
PRWRD10	-.186	-.344	-.328
PRWRD11	-.137	-.261	-.201
PRWRD12	-.161	-.309	-.248
PRWRD13	-.172	-.218	-.239
PRWRD14	-.252	-.392	-.311
PRWRD15	-.176	-.198	-.192
PRWRD16	-.225	-.253	-.242
PRWRD17	-.204	-.288	-.205
PRWRD18	-.169	-.269	-.238
PRWRD19		-.208	-.148
PRWRD20	-.167	-.255	-.216
PRWRD21	-.154	-.275	-.250
PRWRD22	-.166	-.247	
PRWRD23	-.194	-.362	-.264
PRWRD24	-.190	-.311	-.227
PRWRD25	-.174	-.279	-.280
SUPWRD	-.274	-.369	-.365
MILCIV	-.134	-.179	
AGE	-.131		
CONMON	-.105		
ASCEXP	-.133		
VAR3		.112	
VAR6	-.109		
FORM	.155		.540
STNDS			.137

[1]See Table IX for explanation of Abbreviations.

[2]For $p \leq .05$, $r \geq .099$ and for $p \leq .01$, $r \geq .139$.

The variables associated with reward desirability (RWRD) and the Dichotomy variables were reverse coded so a low rating indicates a higher desirability, a greater awareness of organizational standards, and a stronger feeling that the rewards distribution is fair.

The worker's perception of receiving specific rewards is significantly related to both his perception of whether the supervisor ever rewards innovative performance and his perception of the fairness of rewards distribution.

Perhaps the most important information provided by this section of analysis is the identification of five rewards which are significantly related to the worker's perception of the fairness of rewards distribution. It is not necessarily the number of the rewards, but the actual content of the rewards that is most significant.

The five rewards (PRWRD1, PRWRD7, PRWRD8, PRWRD10, and PRWRD14) involve both formal and informal methods of recognizing good performance, but in general, they are the types of rewards directly related to the supervisor and the laboratory organization. Although two of the rewards, PRWRD1 nad PRWRD7, are formal awards with some restrictions on their application, they are among the least constrained of the formal rewards/awards available to AF scientists/engineers. The other three rewards involve the ability and integrity of the supervisor and higher levels of laboratory management to recognize achievement and are only restricted by local or informal policy in their application (PRWRD8, PRWRD10, and PRWRD14).

The general feeling of the respondents on the fairness of rewards distribution indicates that improvements could be made to the existing laboratory incentives program. Traces of the problems mentioned in Chapter II in implementing an effective incentives program appear throughout the returned questionnaires. These negative attitudes towards the existing use of rewards can ultimately impact worker satisfaction and

productivity as identified by Vincent (Ref 44:45-47). The problems that are indicated are: emphasis on the wrong types of rewards, too infrequent application of rewards for outstanding performance, application of rewards to the wrong individuals, and a lack of visible policies governing rewards requirements.

Desirability of Rewards

Initial analysis of the desirability of specific rewards consisted of calculating the mean scores for each reward and then rank ordering the 33 rewards by this mean score. Table XIV lists the 33 rewards in rank order according to decreasing mean desirability. It should be noted that the lower the score, the more desirable the reward.

The data provided in Table XIV indicates that recognition of performance by increased promotion opportunity, competent supervisor evaluations, and salary increases are the three most desirable rewards. This result agrees somewhat with the findings of Rosen (Ref 38:41-42), and Vincent (Ref 44:46), on the importance of salary to the scientist and engineer. These results also support the contention that a strong relationship exists between what an individual desires and what he feels is important. This strong desire for job and financial security also supports Kugel's identication of salary and vertical mobility as important factors for job stability (Ref 25).

Table XIV also indicates that the intrinsic or job related factors, such as a voice in work assignment, are not as desirable as several of the more material or extrinsic rewards like salary, evaluations, and promotions. It is possible that the intrinsic rewards are being satisfied, or at least emphasized, more than the extrinsic rewards. This is

Table XIV

Ranking of Rewards According to Desirability

Rank	Variable[1]	Statistics				
				Responses (%)		
		Mean	Standard Deviation	Desirable	Indifferent	Undesirable
1	RWRD18	1.35	.81	97.8	1.1	1.1
2	RWRD13	1.48	.89	95.7	2.5	1.8
3	RWRD2	1.64	.97	94.9	3.2	1.9
4	RWRD7	1.69	.98	94.2	4.4	1.5
5	RWRD23	1.69	.94	94.2	4.3	1.5
6	RWRD33	1.72	1.02	92.8	6.5	.7
7	RWRD4	1.83	1.11	89.9	8.3	1.5
8	RWRD22	1.88	.96	92.8	5.8	1.5
9	RWRD32	1.91	1.03	92.8	6.1	1.1
10	RWRD24	2.03	1.05	89.2	9.7	1.2
11	RWRD16	2.05	1.14	87.9	10.3	1.8
12	RWRD21	2.10	.99	89.9	9.7	.4
13	RWRD6	2.12	1.15	85.9	12.6	1.5
14	RWRD1	2.15	1.14	89.2	8.3	2.5
15	RWRD25	2.19	1.17	84.2	11.5	4.4
16	RWRD9	2.23	1.12	83.7	14.9	1.5
17	RWRD20	2.23	1.07	87.8	11.2	1.2
18	RWRD26	2.29	1.14	82.4	14.7	2.9
19	RWRD11	2.34	1.09	82.2	16.7	1.1
20	RWRD28	2.42	1.11	82.2	15.1	2.6
21	RWRD5	2.42	1.17	83.3	15.1	1.4
22	RWRD19	2.46	1.18	86.7	9.4	3.9
23	RWRD30	2.48	1.08	80.9	17.0	2.2
24	RWRD31	2.54	1.14	78.4	19.1	2.5
25	RWRD3	2.65	1.16	76.3	20.5	2.6
26	RWRD10	2.70	1.29	73.6	21.7	4.7
27	RWRD12	2.77	1.45	73.4	18.3	8.3
28	RWRD14	2.78	1.24	71.8	22.3	5.7
29	RWRD29	2.91	1.26	67.6	25.2	6.0
30	RWRD15	2.93	1.25	65.9	27.7	6.0
31	RWRD17	2.99	1.54	66.4	21.2	12.4
32	RWRD27	3.01	1.34	63.3	25.2	11.6
33	RWRD8	3.16	1.32	60.8	31.3	8.0

[1]See Table IX for explanation of abbreviations

not unrealistic considering the restrictions placed on the application of many of the extrinsic awards/rewards within the civil service.

The results also indicate that the hygienic factors or dissatisfiers identified by Herzberg are to some degree more desirable or receiving much less satisfaction than many of the motivator factors (Ref 21:53-56).

As previously identified, three of the four most desired rewards in Table XIV could be considered extrinsic rewards. Pelz and Andrews identified extrinsic rewards as being unreliable for motivating achievement (Ref 34:139), yet it would seem that some degree of motivation would be achieved in providing the rewards most desired by the respondents. This result could indicate that extrinsic rewards are not being applied consistently or in sufficient quantities for exceptional achievement as recommended by Pelz.

Unfortunately, except for the reward "competent supervisor evaluations" the four most desired rewards are those that are most constrained by AF and Civil Service regulations and policy.

Table XIV also provides some valuable information on the rewards that are the least desired by the respondents. These rewards should either receive less emphasis because of their low desirability, or they should receive more emphasis in order to educate the worker as to their value and possible impact on more desired areas such as salary and position.

The least desired rewards include: most of the formal awards, informal recognition as a general category, compensation time, and job related travel. When evaluated against the policies and requirements for promotions and salary increases, the low desirability for formal awards is somewhat surprising. Although promotions and salary are highly

desired, the formal awards contribute significantly to their attainment through the merit promotion system and yet themselves are not highly desired (Ref 11).

This indicates one of two possibilities, either the worker is not aware of the impact of formal awards on his position status, or regardless of the workers knowledge about awards, the laboratories are not providing the awards/rewards consistently or in sufficient quantity.

Although Table XIV shows a definite distinction between the desirability of the 33 rewards by the test group, it should be noted that the actual percentage of respondents that identified a reward as being undesirable did not increase significantly with the increase in rank order. On the contrary, the percentage of indifference or no opinion responses increased significantly with an increase in rank order.

Correlations Between Desirability and Demographics. Table XV identifies the significant correlations between the 33 rewards and seven demographic variables.

Quality Step Increases (RWRD4) showed the most consistent relationship with the demographic variables. Not too surprisingly, civilian scientists/engineers found Quality Step Increases more desirable than their military coworkers who do not receive such rewards. Also, as an employee progresses in position, age, and experience he finds Quality Step Increases more desirable. This latter association is somewhat surprising since the importance of salary is generally associated with the younger workers who have not yet achieved their monetary or security goals. It appears that salary increases are also important to the older AF scientists/engineers and may be more desirable than many of the other

Table XV

Desirability and Demographics Correlations

Variable Abbreviation[1]	Correlation Coefficients[2] (r) Demographic Variables						
	AGE	GRADE	MILCIV	ASCEXP	FSCEXP	YRSSEC	SUPYRS
RWRD1			.120		.106		
RWRD2			.136				
RWRD3					.180	.147	
RWRD4	.107	.102	.447	.206	.184	.109	
RWRD5			-.165				
RWRD6			-.178				
RWRD7			-.206				
RWRD8			-.221			-.122	
RWRD11			-.106				
RWRD12		.118		.141	.138		
RWRD13	.176	.164		.141	.135		
RWRD16			.248		.174	.176	
RWRD17			-.112				
RWRD19	.122						
RWRD22		.106					
RWRD25			-.187				
RWRD26			-.111				
RWRD27			-.195		-.118		-.099
RWRD28		.123					
RWRD29		.102					
RWRD30			-.141				-.135
RWRD31			-.116				-.132
RWRD32		.121					
RWRD33			-.247				

[1]See Table IX for explanation of abbreviations
[2]For $p \leq .05$, $r \geq .099$, $p \leq .01$, $r \geq .139$; signs have been reversed since desirabilities (RWRD) were inverse coded, positive correlation means as the demographic variable increases the desirability increases.

factors associated with status and security. This desire does not appear to decline with increased age or position.

In addition to Quality Step Increases, "competent supervisor evaluations" and "letters of appreciation/commendation" showed a significant relationahip between desirability and age. This would indicate that there exists an increasing desire for both recognition of job performance and financial security as the worker increases in age.

In general, civilian scientists/engineers are more interested in the monetary rewards than the military scientist/engineer. This is not too surprising, since salary for the military employee is more constrained by federal regulation than civilian salaries, also, many of the monetary rewards just do not apply to military personnel.

On the other hand, salary increases for the military employee are directly related to promotions, except for longevity increases which are automatic, and promotions are directly related to good evaluations and annual ratings. Table XV indicates that the military respondents were significantly more desirous of good evaluations and recognition (RWRD33, RWRD31, RWRD30, and RWRD7) than their civilian counterparts.

Correlation Between Desirability Variables. Many of the 33 reward variables identified in the questionnaire were not independent, and the analysis of the Pearson Correlations between these rewards identified numerous inter-correlations. This large number of correlations was not unexpected and it did help to verify the internal consistency of the questionnaire. Appendix E provides the Pearson Product-Moment Correlation Matrix for the 33 rewards.

Factor Analysis of Desirability Variables. As indicated by the Pearson Correlation Matrix in Appendix E, many of the rewards were

significantly interrelated. A factor analysis of the 33 rewards resulted in eight new factors being identified with eigenvalues greater than one. Very little variance is explained by factors with eigenvalues less than one (Ref 43:147). Table XVI provides a summary of the factor analysis.

The data included in Table XVI were governed by three criterion: factor loadings had to be .4 or greater, the loadings for each factor would be listed in descending order, and only those variables that could somehow be reasonably related to each other were to be included in the summary. A suggested title for each factor is also included.

Appendix F provides a complete listing of the factor analysis including communality values and eigenvalues for each variable and factor.

Table XVI

Desirability Variables Factor Analysis[1]

Factor 1	Factor 2	Factor 3	Factor 4
Recognition of Performance With Formal Awards	Increased Involvement In Work Management	Monetary Rewards	Recognition from Peers and Professional Groups
RWRD10(.793)	RWRD24(.750)	RWRD2(.870)	RWRD30(.739)
RWRD9 (.787)	RWRD23(.735)	RWRD1(.799)	RWRD31(.715)
RWRD15(.786)	RWRD22(.701)	RWRD4(.791)	RWRD32(.559)
RWRD14(.783)	RWRD18(.608)		
RWRD8 (.667)	RWRD21(.531)		
RWRD3 (.645)	RWRD20(.519)		
RWRD7 (.474)			
RWRD16(.466)			
RWRD31(.466)			
RWRD11(.427)			

Table XVI - continued

Factor 5	Factor 6	Factor 7	Factor 8
Autonomy and Interaction with others	Recognition and Implementation of Suggestions	Informal Recognition of performance	Evaluation of Performance
RWRD28(.755)	RWRD5(.838)	RWRD12(.728)	RWRD33(.739)
RWRD27(.749)	RWRD6(.831)	RWRD19(.650)	RWRD13(.495)
RWRD25(.709)		RWRD32(.458)	
RWRD26(.636)		RWRD17(.442)	
RWRD17(.539)			

[1]See Table IX for explanation of abbreviations

When these factors are related to the overall desirability of rewards identified in Table XIV, it can be seen that factors 2, 3, and 8 consist of the most highly desired rewards while factor 1 consists of a large number of the less desirable formal awards. Using the new factors to identify rewards that should be emphasized, factor analysis techniques indicate that monetary rewards, increased opportunity to participate in job management, and recognizing achievements through competent management evaluation are the three areas which the respondents identify as being the most desirable.

Summary. Analysis of the desirability of 33 specific rewards to AF scientists/engineers indicates certain rewards such as promotion opportunity, salary, and competent evaluation of performance are more desirable than many other rewards, including formal awards and informal recognition.

When the responses to the desirability of the 33 rewards is factor analyzed, a significant grouping of the rewards is identified that is consistent with the rank ordering of the individual rewards identified in

Table XIV. The factor analysis indicated the respondents generally categorized rewards according to whether they were formal awards, monetary, involved supervisor evaluation of efforts, involved interaction with others, or were related to management of the job.

Comparing the factor analysis results with the rank order of desirability identified several rewards which could be considered exceptions to the generally lower desirability for formal awards. For example, Outstanding Performance Reports (RWRD7), which are definitely formal awards, as indicated correctly by the factor analysis, are significantly related to the supervisor's recognition of worker performance, are highly desirable, and are strong inputs to the merit promotion. The respondents did recognize this dual role of the Outstanding Performance Report as it was ranked fourth in Table XIV according to desirability.

Informal Recognition

The reward variable "informal recognition" (RWRD12) was ranked twenty-seventh out of 33 rewards according to desirability. Although "informal recognition" was not rated as highly desirable in comparison with the other 33 rewards, 73.4 percent of the respondents felt informal recognition was desirable to some degree while only 8.3 percent felt it was undesirable.

The term "informal recognition" was not defined in the questionnaire in order to leave its interpretation totally up to the respondent. There were two reasons for this lack of clarification in the survey. First of all, it would serve as a validity check against several of the other rewards investigated that were considered to be specific types of informal recognition, such as "voice in work assignment" and "increased

responsibility." Secondly, regardless of the individual's interpretation of "informal recognition" it would provide a general indicator of the desirability of this overall reward category.

In addition, the open-ended question concerning specific identification of desirable categories of informal recognition to the respondent, would serve as an indicator of the respondent's interpretation of "informal recognition" and, regardless of the level of desirability, would indicate which categories are most related to "informal recognition" by the AF scientist/engineer.

Although "informal recognition" in general was not ranked very high in desirability, several of the specific forms of informal recognition, such as "competent supervisor evaluation" (RWRD13), "increased responsibility" (RWRD22), "voice in work assignment" (RWRD23), "recognition by peers" (RWRD32), and "say in equipment/project expenditures" (RWRD24), were included in the ten most desirable rewards listed in Table XIV.

On the other hand, such rewards as "opportunity to teach, instruct, or lecture" (RWRD27), "job related travel" (RWRD17), and "compensation time" (RWRD29) were ranked low in desirability and yet could also be classified as forms of informal recognition.

There are several possible causes for the low desirability of the general category of "informal recognition" as compared to the higher desirability for several of the specific rewards associated with informal recognition. First of all, the respondents may have applied some unusual interpretations to "informal recognition," but the significant correlations between "informal recognition" as a reward and the desirability of other rewards listed in Table XVII tend to refute this possibility.

Secondly, the respondents may have recognized additional forms of informal recognition that were not identified in the 33 reward variables investigated. These additional forms of informal recognition and their associated desirability to the respondent could have been reflected in a lower desirability for the general category of "informal recognition."

Finally, it is possible that those forms of informal recognition which were least desirable were related the strongest to the general category of "informal recognition" by the respondents. This latter possibility, in addition to the consideration of forms of informal recognition not identified in the survey, appears to be the most plausible explanation of the low desirability of "informal recognition" and is the explanation most supported by the correlations in Table XVII.

Table XVII

Correlations Between "Informal Recognition" as a Reward and the Desirability of Other Rewards

Reward[1]	Correlation[2] (r)
Letters of appreciation/commendation (RWRD19)	.461
Peer recognition (RWRD32)	.364
Special Acts and Services Awards (RWRD3)	.341
AFSC Certificates of Merit (RWRD10)	.292
Annual Intra-laboratory Awards (RWRD15)	.285
Individual Honorary Awards (RWRD8)	.267
Recognition of Suggestions (RWRD5)	.260
Organizational Honorary Awards (RWRD8)	.260
Competent Supervisor Evaluation (RWRD13)	.252
Job Related Travel (RWRD17)	.247
AFSC Awards for Scientific/Technical Achievement (RWRD9)	.220
Voice in Work Assignment (RWRD23)	.218

Table XVII - continued

Reward[1]	Correlation[2] (r)
Sustained Superior Performance Awards (RWRD16)	.213
Recognition of Inventions (RWRD11)	.204
Voice in Project/Equipment Expenditures (RWRD24)	.180
Implementation of Suggestions (RWRD6)	.175
Recognition by Professional Groups/Societies (RWRD30)	.158
Awards from Professional Groups/Societies (RWRD31)	.142
Educational Opportunities (RWRD21)	.142
Participation in Professional Meetings (RWRD28)	.139
Outstanding Performance Reports (RWRD7)	.104

[1]Listed in descending order of significance
[2]For $p \leq .05$, $r \geq .099$ and for $p \leq .01$, $r \geq .139$

Table XV identified the significant correlations between "informal recognition" (RWRD12) and the demographic variables. In general, the longer the scientist/engineer has been working for the government, the longer he has worked in his present section, and the higher his position, the more desirable informal recognition becomes.

Types of Informal Recognition Desired. The one open-ended question in the questionnaire requested identification of the three most desirable forms of informal recognition to the respondent. Out of 278 completed questionnaires, only 160 respondents completed the open-ended question. Of those 160 responses to this question, numerous classifications of informal recognition were identified. Table XVIII lists the classifications most frequently identified and their level of desirability.

Table XVIII indicates that verbal and written recognition of achievement from a variety of sources are by far the most frequently identified and desirable forms of informal recognition. It should also be noted that

Table XVIII

Most Desirable Forms of Informal Recognition

Informal Recognition Category	Frequency of Identification Level of Desirability			Weighted Score[1]
	1st Choice	2nd Choice	3rd Choice	
Verbal Recognition of Achievement by Management	95	46	26	403
-Directly from Immediate Supervisor	66	18	12	246
-Directly from Higher Management Levels	19	15	13	100
-Indirectly to Higher Levels of Management, Peers, or Coworkers	10	13	1	57
Compliments/Acceptance by Peers and Coworkers	19	16	8	97
Achievements Documented i.e. Letters of Appreciation or Notices in Publications	8	6	4	40
Verbal/Written Recognition from Users, societies, or other agencies	5	7	7	36
Increased Responsibility, Authority or Independence	7	10	8	49
Consulted as expert, requests for advice, organization representative in area of expertise	11	10	4	57
Management Awareness of Abilities and Interest in Activities	5		2	17
Treated as a Professional with Opinions requested, respected, and acted upon	2	4		14
Voice in Job Assignment, funds allocation, and project decisions	1	1	4	9
Seeing Personal Work used, Cited, or Recognized by Others	2		2	8
Allowed to Give Oral Presentations to Higher Management Levels		2	3	7

[1]Weighted scores based on the sum of the products of the frequency of identification and the weighting factors for each level of desirability. Weighting factors are: 3 for 1st choice, 2 for 2nd choice, and 1 for 3rd choice.

informal recognition is most frequently associated with the scientist's/ engineer's immediate supervisor, although such recognition from other levels of management is also desirable. This tends to confirm Gommersall's contention that informal, as well as formal, recognition of achievement can be an effective motivational technique (Ref 18:48).

Perception of Rewards

Twenty-five of the 33 rewards associated with desirability were considered to be initiated or otherwise related to the scientist's engineer's immediate supervisor. Each respondent was requested to provide his perception of the supervisor providing each of the 25 rewards for innovative output based on a nine point scale ranging from NEVER to ALWAYS (see revised questionnaire in Appendix C). Table XIX lists the mean perception scores, in descending order of magnitude, for the 25 rewards.

Table XIX indicates that, in general, the rewards perceptions containing the most missing responses were also the rewards perceived as being the least likely to be provided by the supervisor for innovative performance. The two major exceptions were "letters of appreciation/ commendation" (PRWRD8) and "increased promotion opportunity" (PRWRD14) which, although not having many missing responses, were still perceived as being unlikely rewards for innovative performance.

In addition, nine of the 11 rewards perceived as the least likely to be provided for innovative performance could be classified as formal awards that not only require supervisor action, but usually require several levels of management approval before being awarded. Not too surprisingly, these awards are also the most restircted rewards concerning frequency of application.

Table XIX

Perceptions of Receiving Rewards

Variables[1]	Statistics			
	Missing Responses	Mean Score	Standard Deviation	Frequency/ Percentage of Responses Which Answered NEVER
PRWRD11	3	6.63	2.22	8/2.9 %
PRWRD25	4	6.37	2.28	13/4.7 %
PRWRD20	4	6.10	2.06	9/3.2 %
PRWRD16	0	5.99	2.09	10/3.6 %
PRWRD18	0	5.85	2.21	12/4.3 %
PRWRD10	0	5.74	2.32	20/7.2 %
PRWRD13	3	5.72	2.33	16/5.8 %
PRWRD12	2	5.70	2.42	17/6.1 %
PRWRD9	2	5.51	2.49	21/7.6 %
PRWRD19	3	5.07	2.55	39/14 %
PRWRD15	6	5.05	2.16	17/6.1 %
PRWRD21	6	4.95	2.34	30/10.8%
PRWRD22	3	4.68	2.38	31/11.2%
PRWRD17	3	4.66	2.14	29/10.4%
PRWRD7	11	4.61	2.59	46/16.5%
PRWRD14	4	4.31	2.46	44/15.8%
PRWRD1	8	4.12	2.41	57/20.5%
PRWRD8	3	3.73	2.38	73/26.3%
PRWRD5	11	3.49	2.46	83/29.9%
PRWRD3	9	3.42	2.36	83/29.9%
PRWRD23	10	3.36	2.20	78/28.1%
PRWRD4	9	3.24	2.37	99/35.6%
PRWRD6	16	3.20	2.24	92/33.1%
PRWRD24	10	3.04	2.08	87/31.3%
PRWRD2	10	2.98	2.11	98/35.3%

[1]See Table IX for explanation of abbreviations

On the other hand, the 14 rewards most likely to be provided for innovative performance in Table XIX do not require formal laboratory management approval, in general. They can be applied as frequently as the personal policy of the supervisor and the organizational policy will allow and are not necessarily restricted by AF regulations.

Correlations Between Perceptions and Demographics. Table XX identifies the significant correlations between the perception of rewards variables and seven demographic variables.

The reward identified as the most desirable in Table XIV, "increased promotion opportunity" (RWRD4), is also the reward whose perception of being provided as a result of innovative performance is most consistently related to the demographic variables, as indicated in Table XX.

According to the correlation coefficients in Table XX, the reward desired the most by the respondents, "increased promotion opportunity," has a higher perception of being provided for innovative performance by those workers who are older, have the greater scientific experience, are higher in position, have been in the section longer, or whose supervisor has been in charge of the section for a longer period of time.

This same relationship exists for several of the other formal awards/rewards, but not so consistently.

Correlation Between Perception and Desirability. The relationship between the respondent's desirability for each reward and the perception he will receive that reward for innovative performance was determined by calculating the Pearson correlations for each pair of desirability and perception measurements for the same reward variable. Table XXI lists these paired correlations.

Table XX

Correlations Between Reward Perceptions and Demographic Variables

Abbreviation[1]	Correlation Coefficients[2] (r) Demographic Variables						
	AGE	GRADE	MILCIV	YRSSEC	SUPYRS	ASCEXP	FSCEXP
PRWRD1		.122					
PRWRD2			-.153	-.141			
PRWRD4			-.244	-.181	-.134	-.122	-.142
PRWRD5		-.100	-.202	-.108		-.127	-.148
PRWRD7			-.296	-.135	-.170	-.112	-.120
PRWRD8			-.132	-.160	-.198	-.148	-.191
PRWRD9			-.105		-.110		
PRWRD12			-.145	-.136	-.194	-.128	-.114
PRWRD13					-.123		
PRWRD14	-.184	-.182	-.174	-.149	-.140	-.233	-.218
PRWRD15				-.111	-.215	-.110	-.105
PRWRD21		.160			-.138		
PRWRD22	.109	.154				.111	
PRWRD24			-.177	-.136			-.109
PRWRD25	-.104		-.123			-.133	

[1]See Table IX for explanation of abbreviations
[2]For $p \leq .05$, $r \geq .099$; for $p \leq .01$, $r \geq .139$

Table XXI

Correlation Between Perception and Desirability

Reward	Correlation Coefficient[1] (r)
Annual Intra-laboratory Awards	.205
AFSC Awards for Scientific/Technical Achievement	.172
Opportunity to do independent research	.163
Sustained Superior Performance Awards	.158
AFSC Certificates of Merit	.156
Increased Educational Opportunity	.153
Voice in Equipment/Project Expenditures	.153
Voice in Work Assignment	.139
Honorary Organizational Awards	.138
Official/Unofficial Compensation Time	.137
Outstanding Performance Reports	.120
Opportunity to teach, lecture, or instruct	.113
Opportunity to write, present, or publish technical papers	.105
Opportunity to attend meetings of professional groups/societies	.088
Increased promotion opportunity	-.078
Informal recognition	.062
Letters of appreciation/commendation	.050
Special Acts and Services Awards	.050
Quality Step Increases	-.046
Individual Honorary Awards	.037
Good Annual Ratings	.034
Increased Responsibility	.029
Competent Supervisor Evaluation	.019
Improved Working Environment	.016
Increased Job Related Travel	-.010

[1]For $p \leq .05$, $r \geq .099$; for $p \leq .01$, $r \geq .139$: positive correlation indicates a relationship between increased perception and increased desirability.

The first 13 rewards listed in Table XXI exhibit a significant correlation between the individual's perception of receiving the reward for innovative performance and the rewards desirability. Unfortunately, only three of these rewards with significant correlations are among the ten most desirable rewards listed in Table XIV. The three rewards are "Outstanding Performance Reports," "voice in work assignment," and "voice in project/equipment expenditures," and are ranked fourth, fifth and sixth respectively, according to their desirability.

An additional comparison can be made between the rank order of rewards according to their desirability, as identified in Table XIV, and the mean perception of receiving the same rewards, as identified in Table XIX.

Of the ten most desired rewards, only five are also included in the ten rewards perceived as being most likely to be received for innovative performance. Those five rewards are "voice in work assignment," "competent supervisor evaluation," "increased responsibility," "voice in project/equipment expenditures," and "good annual rating."

One surprising result of this analysis was the low mean perception of receiving a promotion as a direct result of innovative performance. Promotion opportunity, particularly with the civil service merit promotion system, can be greatly enhanced in a number of ways, particularly through good ratings, competent supervisor evaluations, and numerous formal awards.

Formal awards were generally not perceived as rewards likely to be provided for innovative performance. This could have been due to the limitations placed on the application of many formal awards and also the amount of paperwork and management effort required to get formal awards approved.

On the other hand, the scientists/engineers surveyed indicated a higher perception of receiving good ratings and competent supervisor evaluations than many of the other rewards. Since these rewards are highly related to promotion opportunity, the most desirable reward, it is somewhat surprising that the perception of "increased promotion opportunity" as a reward was not higher.

One possible explanation for this result is a lack of awareness by the respondents of the impact of good ratings and competent evaluations on the merit promotion. It is also possible that individuals that have formal awards, good ratings, and competent evaluations by their supervisors are not being promoted.

Factor Analysis of Reward Perceptions. Factor analytic techniques applied to the 25 rewards associated with being provided by the respondent's supervisor resulted in three new factors being identified. Table XXII provides a summary of the factor analysis. The complete analysis, including communality values and eigenvalues, is provided in Appendix G. The same criteria for including factor variables in Table XVI is used for the data in Table XXII.

In comparing the factor analysis of the desirability variables in Table XVI with the results in Table XXII, the groupings of rewards are extremely consistent for the two analyses. Factor1 in Table XXII consists of 11 variables, ten of which have substantial loadings on Factor2 and Factor5 in Table XVI. These rewards are related to work management, worker autonomy, and interaction with others.

Table XXII

Summary of Perception Variables Factor Analysis[1]

Factor1 Informal Rewards Associated with the Job/Work	Factor2 Formal Awards	Factor3 Rewards Associated with Promotions and Evaluations
PRWRD21(.755)	PRWRD24(.789)	PRWRD10(.745)
PRWRD20(.731)	PRWRD4 (.780)	PRWRD9 (.705)
PRWRD22(.699)	PRWRD2 (.777)	PRWRD7 (.696)
PRWRD11(.696)	PRWRD23(.770)	PRWRD25(.683)
PRWRD12(.695)	PRWRD6 (.749)	PRWRD14(.628)
PRWRD13(.666)	PRWRD3 (.734)	
PRWRD18(.653)	PRWRD5 (.606)	
PRWRD15(.642)	PRWRD1 (.587)	
PRWRD16(.605)	PRWRD8 (.566)	
PRWRD17(.510)		
PRWRD19(.502)		

[1]See Table IX for explanation of variables; perception variables in descending order of factor loadings identified in parenthesis.

Factor2 in Table XXII consists of nine formal types of awards, seven of which are also included in Factor1 of Table XVI. The two exceptions being "Quality Step Increases" and "letters of appreciation/commendation" which are more associated with salary and informal recognition than formal awards, according to the rewards desirability factor analysis.

Factor3 in Table XXII consists of five rewards, two of which make up Factor8 in Table XVI and relate to evaluation of worker performance. The other three rewards included in Factor3 of Table XXII are dispersed to three factors in Table XVI.

Summary. Several rewards indicated by the respondents as being very desirable, such as salary increases and promotions, are not perceived as

being very likely to be provided as rewards for innovative performance. In addition, none of the 25 rewards investigated for the worker's perception of receiving such rewards for innovative performance were identified as being provided often (a score of 7, 8, or 9 on the nine point scale) according to the mean scores for all of the respondents.

A comparison of the rank order of rewards according to their desirability and perception was difficult to interpret into meaningful results due to the different measurement techniques and measurement scales used in each case. One general comparison could be made from this analysis. Although none of the perceptions had a high statistical mean score, several of the rewards that were identified as more likely to be provided for innovative performance than other rewards were also identified as highly desirable. In particular, good annual ratings, competent supervisor evaluations, opportunity to do independent research, a say in work assignments, and a voice in project/equipment expenditures were included among the ten most desirable rewards (Table XIV) and the ten rewards most likely to be provided as a reward for innovative performance (Table XIX).

The Extent Supervisors Reward Innovative Output (SUPRWRD)

The frequency of responses to this variable (SUPRWRD), based on a nine point scale, was the most evenly distributed of all the variables investigated. Table XXIII provides a summary of the responses to this variable.

These results can be compared to the mean SUPRWRD value of 5.1 with a 1.34 standard deviation calculated by Stahl (Ref 40).

Table XXIII

Distribution of Responses to the Variable SUPRWRD

Rating Level		Frequency	Percent of Responses
Never	1	18	6.5%
	2	27	9.7%
	3	33	11.9%
	4	15	5.4%
	5	44	15.8%
	6	42	15.1%
	7	54	19.4%
	8	32	11.5%
Always	9	13	4.7%
Mean Score = 5.23 Standard Deviation = 2.26			

SUPRWRD Correlations With Perceptions and Demographics. Table XXIV identifies the Pearson Correlations between the SUPRWRD variable and the perceptions of receiving specific rewards plus the demographic variables.

Table XXIV indicates that there were no significant relationships between the extent supervisors reward innovative output and the demographic make up of the respondents, except that the civilian scientist/engineer generally had a lower perception than his military counterpart of the supervisor rewarding innovative output.

On the other hand, the perception of the supervisor rewarding innovative output is significantly related to the respondent's perception of receiving specific rewards for innovative performance. This result was expected since the specific rewards identified in the survey as part of the perception measurement were considered a breakdown of the overall SUPRWRD variable.

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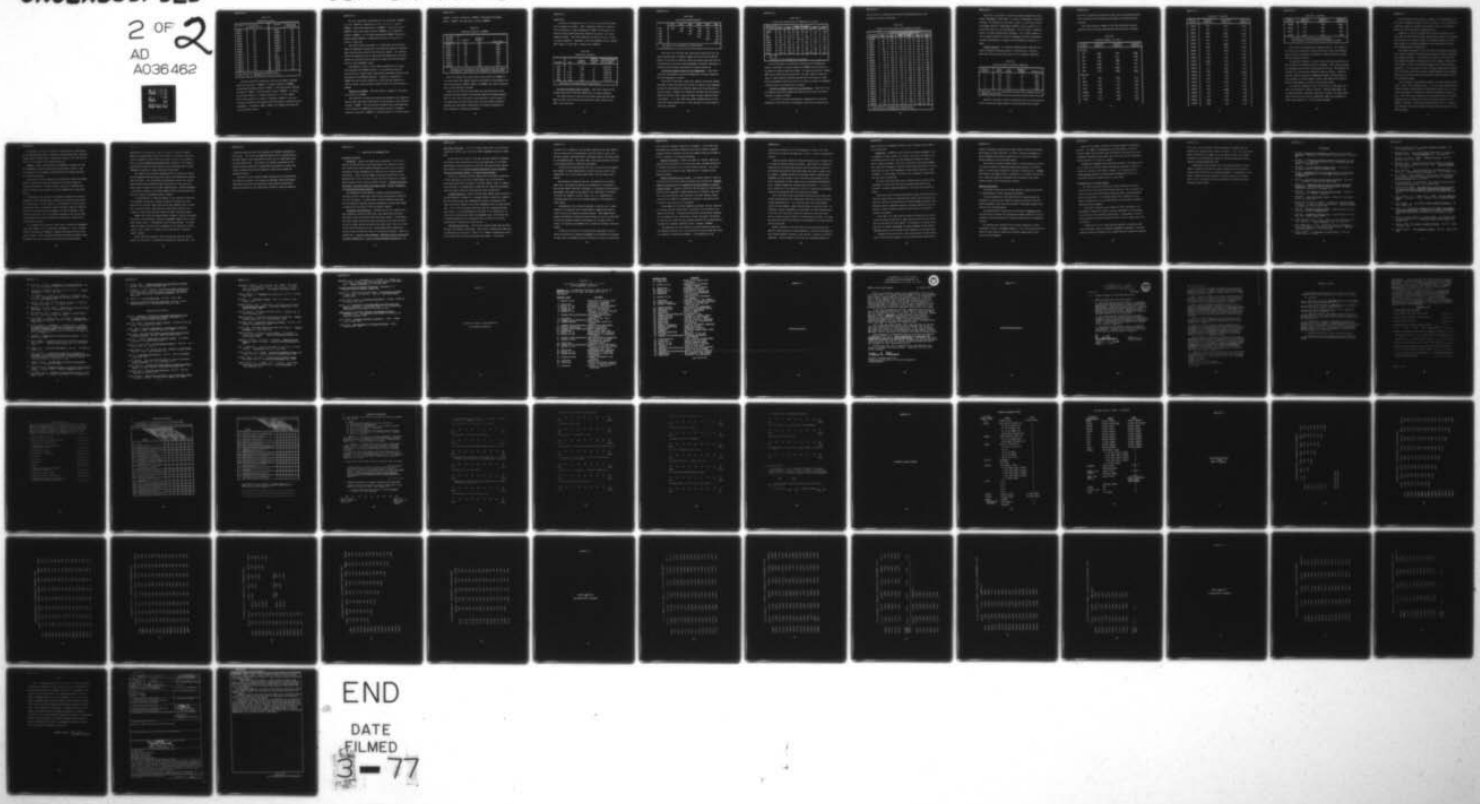

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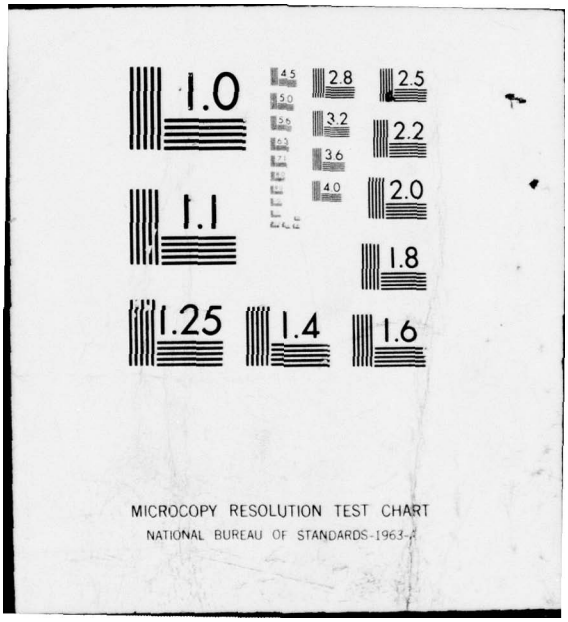
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Table XXIV

SUPRWRD Correlations

Variable[1]	Correlation Coefficient (r)[2]	Variable	Correlatio Coefficien
PRWRD1	.648	PRWRD17	.491
PRWRD2	.461	PRWRD18	.510
PRWRD3	.491	PRWRD19	.331
PRWRD4	.518	PRWRD20	.363
PRWRD5	.480	PRWRD21	.350
PRWRD6	.402	PRWRD22	.384
PRWRD7	.656	PRWRD23	.531
PRWRD8	.552	PRWRD24	.380
PRWRD9	.719	PRWRD25	.607
PRWRD10	.746	AGE	.010
PRWRD11	.488	GRADE	.058
PRWRD12	.482	MILCIV	-.112
PRWRD13	.498	YRSSEC	.008
PRWRD14	.591	SUPYRS	-.072
PRWRD15	.379	ASCEXP	-.011
PRWRD16	.488	FSCEXP	.030

[1]See table IX for explanation of abbreviations
[2]For $p \leq .05$, $r \geq .099$ and for $p \leq .01$, $r \geq .139$

The most significant correlations are with the rewards "competer supervisor evaluations" (PRWRD10), "informal recognition" (PRWRD9), "Outstanding Performance Reports" (PRWRD7), "Sustained Superior Perf ance Awards" (PRWRD1), and "good annual ratings" (PRWRD25). It shou be noted that except for "informal recognition" all of the rewards have a direct bearing on a worker's promotional potential, which was the factor considered to be the most desirable reward as indicated b respondents. In addition, PRWRD7, PRWRD10, and PRWRD25 were among t ten most desired rewards.

The least significant correlations are with the rewards "compensation time" (PRWRD19), "opportunity to teach, instruct, or lecture" (PRWRD21), "educational opportunities" (PRWRD20), "job related travel" (PRWRD15), "AFSC certificates of merit" (PRWRD24), and "independent research" (PRWRD22). All of these rewards except PRWRD24 could be considered informal methods of recognition and make up the majority of factor1 in Table XXII.

Table XXIV indicates that there is a significant relationship between the respondent's perception of the supervisor rewarding innovative output and receiving any one of the 25 specific rewards. This tends to confirm the assumption used in constructing the questionnaire that most rewards are associated with the supervisor rather than with the organization or other management levels.

Unfortunately, since all of the reward perceptions are strongly correlated with the SUPRWRD variable, it is not possible from this analysis alone to identify those rewards which contribute the most to the explanation of the SUPRWRD perception. Therefore, a regression of SUPRWRD with the variables identified in Table XXIV was necessary in order to identify which predictor variables explain the most variance in SUPRWRD.

Regression of SUPRWRD. Table XXV contains a summary of the regression analysis of SUPRWRD.

Nine predictor variables were entered and remained in the regression equation that contributed significantly to the variance of the criterion variable, SUPRWRD. The five predictor variables which contributed most to the variance of SUPRWRD were the perception variables "competent supervisor evaluations" (PRWRD10), "Sustained Superior Performance Awards"

(PRWRD1), "informal recognition" (PRWRD9), "Outstanding Performance Reports" (PRWRD7), and "good annual ratings" (PRWRD25).

Table XXV

Regression Analysis of SUPRWRD

Variable[1] and Sign of Beta Coefficient	Multiple R^2	Change in Multiple R^2	Significance
PRWRD10 +	.557	.557	<.0001
PRWRD1 +	.646	.089	<.0001
PRWRD9 +	.679	.033	<.0001
PRWRD7 +	.696	.017	<.0001
PRWRD25 +	.705	.009	.008
PRWRD3 +	.711	.006	.022
FSCEXP +	.719	.008	.013
PRWRD24 -	.724	.005	.046
PRWRD14 +	.730	.006	.016

[1]Variables listed according to the step entered into the regression equation. See Table IX for explanation of abbreviations.

Those five rewards that explain most of the variance for SUPRWRD involve both formal and informal supervisor evaluations of performance, and three of the rewards, PRWRD10, PRWRD7, and PRWRD25, are highly desired by the scientists/engineers surveyed.

Except for the limitations associated with the application of Outstanding Performance Reports and Sustained Superior Performance Reports, there is very little restriction on the supervisor's use of several of the rewards which are both highly desired by the surveyed scientists/engineers and contributed significantly to the workers perception of being rewarded for innovative performance.

Productivity

The analysis of productivity for AF scientists/engineers was based on six categories of output. Table IX identifies those six categories with the exception of "oral presentations" (VAR7) and the overall productivity measure OUTPUT which were deleted from analysis for reasons already discussed. Table XXVI identifies the statistical data for the six output categories. Seventeen of the 278 respondents did not identify their output, so Table XXVI is based on 261 responses.

Table XXVI

Productivity Statistics

Variable[1]	Mean	Standard Deviation	Maximum Individual Output	Frequency/Percentage of Responses with no Output
VAR1	.747	1.335	8	162/58.3%
VAR2	.716	1.238	10	157/56.5%
VAR3	1.061	1.9	20	130/46.8%
VAR4	2.517	2.908	22	62/22.3%
VAR5	1.490	2.751	22	143/51.4%
VAR6	5.330	5.337	32	37/13.3%

[1]See Table IX for explanation of abbreviations

Correlations Between Output Variables. Table XXVII identifies the Spearman Rank Order Correlations between the six output categories.

Since VAR4 consists of the sum of the outputs associated with VAR1, VAR2, and VAR3, the significant correlations of these variables with VAR4 is not surprising.

Table XXVII

Correlations Between Outputs[1]

	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6
VAR1	1.000	.224*	.003	.592*	-.022	.058
VAR2		1.000	.092	.598*	.072	.180*
VAR3			1.000	.601*	.038	.386
VAR4				1.000	.043	.184*
VAR5					1.000	.262*
VAR6						1.000

[1]See Table IX for explanation of abbreviations
*p < .01

Table XXVII also indicates that significant correlations exist between the publication of technical papers and the writing of technical reports, the writing of technical reports and output associated with contract monitoring, and new or improved products, processes, techniques, or inventions and the output associated with contract monitoring.

Correlations Between Productivity and Demographics. Table XXVIII identifies the Spearman Correlations between the six output categories and seven demographic variables.

Table XXVIII identifies a significant negative correlation between the number of years the supervisor has been in charge of the respondent's section and the production of technical reports and the publication of technical papers. Whether this information indicates that the amount of supervisor time can inhibit these two types of output requires further investigation. It is very likely that those respondents who are associated with these patterns work in areas involved in a high turnover of supervisory personnel.

Table XXVIII

Productivity Correlations with Demographic Variables

Demographic Variables[1]	Output Variables[1]					
	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6
CONMON	.051	.032	-.083	-.003	.019	.346**
AGE	.044	.117*	-.062	.017	.044	.115*
GRADE	.119*	.114*	-.019	.082	.113*	.058
MILCIV	-.025	.079	.163**	-.112*	.031	.128*
YRSSEC	-.034	.045	-.033	-.005	.058	.075
SUPYRS	-.215**	-.127*	.039	-.129*	-.011	.012
ASCEXP	.066	.108*	-.008	.075	.061	.139*
FSCEXP	.020	.089	-.004	.050	.084	.130*
EDCTN	.288**	.190**	.037	.290**	-.053	.060

*p < .05
**p < .01
[1]See Table IX for explanation of variables.

Not too surprising, a significant correlation exists between the amount of time spent in contract monitoring (CONMON) and the outputs associated with contract monitoring (VAR6). It should be noted that although VAR6 also included books and manuscripts, the small number of these two types of output reported indicated they had very little impact on VAR6. Only one respondent identified a book as an output, and only 16 respondents identified two or less manuscripts as outputs.

Correlations Between Productivity and Perceptions. Table XXIX lists the Spearman Correlation between the productivity variables and the perceptions of rewards variables.

It is difficult to make any meaningful interpretation of the data presented in Table XXIX due to the numerous significant correlations and

the difficulty in identifying any pattern associated productivity and perception variables correlations.

Table XXIX

Productivity Correlations with Perception Variables

Perception Variables*	Spearman Correlation Coefficients** Output Variables*					
	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6
SUPRWRD	.118	-.016	-.072	-.018	-.053	-.076
PRWRD1	.035	-.040	-.157	-.113	-.093	-.061
PRWRD2	.044	-.075	-.132	-.121	-.072	-.053
PRWRD3	.120	.069	-.060	.032	-.190	-.160
PRWRD4	.083	-.045	-.218	-.125	-.084	-.047
PRWRD5	-.082	-.014	-.127	-.147	.017	-.050
PRWRD6	-.013	.028	-.173	-.140	-.148	-.078
PRWRD7	.035	-.070	-.134	-.138	.017	.017
PRWRD8	.067	.004	-.057	-.011	-.015	.041
PRWRD9	.114	-.029	-.045	.002	-.010	.001
PRWRD10	.084	-.039	-.076	-.039	-.101	-.080
PRWRD11	.274	.100	-.016	.162	-.059	-.085
PRWRD12	.191	-.020	-.145	-.020	-.095	-.039
PRWRD13	.162	-.053	-.092	-.016	-.092	.038
PRWRD14	.039	-.028	-.138	-.104	-.067	-.043
PRWRD15	.083	-.103	-.123	-.086	-.108	.088
PRWRD16	.095	-.089	-.113	-.069	-.022	-.036
PRWRD17	-.040	-.016	-.104	-.128	-.018	-.036
PRWRD18	.077	-.033	-.070	-.033	-.040	-.040
PRWRD19	-.049	.019	-.102	-.129	-.016	-.130
PRWRD20	-.056	-.049	-.176	-.109	-.047	-.049
PRWRD21	.185	.024	-.054	.050	-.066	-.090
PRWRD22	.140	.050	-.093	.037	-.092	-.128
PRWRD23	.165	.036	-.184	-.012	-.120	-.056
PRWRD24	.054	-.029	-.170	-.098	-.140	-.100
PRWRD25	-.004	-.149	-.054	-.112	-.068	-.061

* See Table IX for explanation of abbreviations
** for $p \leq .05$, $r \geq .114$ and for $p \leq .01$, $r \geq .145$

Table XXIX is an analysis of each of the output categories as they relate, independent of each other, to a group of independent or predictor variables. As indicated in Table XXVII, there is a significant correlation between several of these output categories, and an analysis is required that takes this into consideration. For this reason, a canonical analysis of output categories was performed. This allowed treatment of the six output variables as one set of dependent variables and determining their relationship, as a group, with the predictor variables, as a group.

Canonical Analysis. Six canonical dimensions were identified as a result of applying canonical analysis to the two sets of variables. Table XXX lists the statistical data on the six canonical dimensions.

Table XXX

Statistical Data on Canonical Dimensions

Canonical Variate	Root Value*	Chi Square	Degrees of Freedom	Probability
1	.326	81.2	39	.0003
2	.292	70.9	37	.0011
3	.268	64.0	35	.0027
4	.165	37.1	33	.2880
5	.170	38.2	31	.1784
6	.124	27.2	29	.5589

*Root value = R^2, i.e., the amount of shared variance between the two canonical variate sets.

Analysis of the data in Table XXX identifies the first three canonical roots as having the largest amount of shared variance and the highest

statistical significance, whereas the other three roots decrease rapidly both in statistical significance and the amount of increased variance explained.

Table XXXI provides a summary of the three significant canonical dimensions and the loadings associated with the two sets of variables.

Table XXXI

Canonical Loadings (N = 261)[2]

Survey Variables[1]	Canonical Dimension 1	Canonical Dimension 2	Canonical Dimension 3
Criteria			
VAR1	.8303	.2045	.4400
VAR2	.4922	-.2321	.1686
VAR3	.3149	.3489	-.1586
VAR4	.8078	.2292	.2237
VAR5	-.3166	.5919	.2724
VAR6	-.1967	.6706	.6014
Predictor			
AGE	.0405	-.0088	.0712
GRADE	.2007	.1174	.1694
MILCIV	.0497	.1573	.2247
EDCTN	.5109	.0318	.1557
CONMON	-.2804	.2732	.2267
AFSCEXP	.1124	.0465	.1551
FSCEXP	.3053	.0306	.0307

Table XXXI - continued

Survey Variables[1]	Canonical Dimension 1	Canonical Dimension 2	Canonical Dimension 3
PRWRD1	.0152	-.1440	-.1228
PRWRD2	.1044	-.1276	-.2416
PRWRD3	.3534	-.3461	-.3435
PRWRD4	.0872	-.1084	-.1718
PRWRD5	-.1075	-.1198	-.3139
PRWRD6	.0305	-.4356	-.2522
PRWRD7	-.0386	.0740	-.1282
PRWRD8	.1453	-.0039	-.0912
PRWRD9	.1495	.1145	-.0070
PRWRD10	.1025	-.1208	-.0601
PRWRD11	.4058	-.0137	-.0375
PRWRD12	.2344	-.0318	.1347
PRWRD13	.1124	.0554	.1286
PRWRD14	-.0296	-.2040	-.3517
PRWRD15	.0490	.0815	.0100
PRWRD16	-.0200	-.1076	-.1693
PRWRD17	-.1152	-.0634	-.1658
PRWRD18	.1069	-.1162	-.0524
PRWRD19	-.1466	-.3688	-.2360
PRWRD20	.0792	-.1064	.0298
PRWRD21	.2933	-.1266	-.0446
PRWRD22	.3402	-.2085	-.2300
PRWRD23	.3202	-.1464	-.1324

Table XXXI - continued

Survey Variables[1]	Canonical Dimension 1	Canonical Dimension 2	Canonical Dimension 3
PRWRD24	.1408	-.2885	-.3637
PRWRD25	.1336	-.0400	-.2826
YRSSEC	-.2851	.0354	.0350
SUPYRS	-.2831	.0712	.0795

[1]See Table IX for explanation of abbreviations
[2]See reference 31 for an explanation of canonical loadings

Using canonical loadings with an absolute value of .3 or greater as the criteria for considering a loading significant, Table XXXI indicates there are several substantial relationships between the output variables and the perception variables.

For canonical dimension 1, the set on the criterion side consists of four variables with substantial positive loadings. These output variables are associated with technical and professional writing. The predictor set includes five variables with substantial positive loadings. These five variables represent education, independent research, the opportunity to write, present, or publish technical papers, AFSC Awards for Scientific/ Technical Achievement, and annual intra-laboratory awards.

For canonical dimension 2, the criterion set has three output variables with substantial canonical loadings: technical memorandums, new or improved products, processes, techniques or patents, and output associated with less critical forms of output which would not be expected to receive heavy emphasis in a strictly R&D environment.

On the predictor side of canonical dimension 2, three perception variables exhibit substantial negative canonical loadings. These variables are organization awards for innovative performance, annual intra-laboratory awards, and official/unofficial compensation time.

Comparison of the two variable sets of canonical dimension 2 indicates that the three forms of rewards identified are negatively associated with the more trivial forms of output in the R&D environment, while the major rewards for innovative performance are not associated with these less important forms of productivity.

For canonical dimension 3, only two criterion variables have substantial canonical loadings: published technical papers and output associated with contract monitoring. The predictor set consists of four variables with substantial negative loadings: Quality Step Increases, AFSC Certificates of Merit, annual intra-laboratory awards, and increased promotion opportunity. This set consists of two of the more highly desired rewards. This set could be identified as formal recognition/awards for performance that are not associated with the publishing of technical papers and contract monitoring output.

Only one reward is substantially loaded on all three canonical dimensions: annual intra-laboratory awards. It is positively associated with technical reports and publication of professional papers, but it is negatively associated with productivity resulting from contract monitoring work. This latter result should not be too surprising since a scientist/engineer devoting a great deal of time to contract monitoring is not generally involved in creative and innovative tasks, and it is creative and innovative output which generally receives the top recognition in the R&D environment.

Unfortunately, the data in Table XXVI indicates that a large portion of the laboratory work force is involved in contract monitoring. Therefore, rewards should be emphasized for individuals involved in this type of work as well as the scientist doing research work only.

Summary. Contract monitoring was the category of productivity that more respondents associated with than any other types of output. Only 13.3 percent of the respondents indicated they had no output associated with contract monitoring.

Surprisingly, only one significant correlation was identified between technical report writing and the perception of receiving rewards for innovative performance. The more technical reports the respondent produced, the lower was his perception of being rewarded with a good annual rating.

Unfortunately, the survey did not attempt to determine the relative importance of the different forms of output to the supervisor and laboratory organization. For this reason it is not possible to identify specifically which areas of recognition should continue as they are, should be increased, or should receive less emphasis in order to improve or even increase productivity, but the information provided in this section does allow identification of which rewards are significantly related to the various forms of output.

It is apparent that there are certain types of output that management places more emphasis on or attaches more importance to. This is substantiated by the types and frequency of rewards associated with the various forms of output. There are many more negative correlations between reward perceptions and contract monitoring work than exist between reward

perceptions and publication of papers or writing of technical reports. When Cole encountered this type of relationship, he recognized that under normal circumstances, only a small percentage of output in any organization is actually recognized and rewarded (Ref 13:370-376). This tends to agree with the results of this research in that the perceptions of being rewarded for quantity of output alone are not very high.

Cole found a high correlation between quality and quantity of output, but he recognized that quality was more likely to be rewarded than quantity (Ref 13:372-375). This relationship could partially explain why contract monitoring work, which made the largest contribution to the quantity of output, does not appear to be the most rewarded output. Perhaps management is indicating a negative relationship between contract monitoring work and quality in terms of achievement worthy of rewards.

If the perceptions of receiving rewards is any indication of the relative frequency or quantity of rewards received for productivity, then publication of technical papers would be the most important form of output. This is the only form of output that was significantly related to the variable "to what extent does your supervisor reward innovative output."

Whether this distinction between types of output is actually associated with quality, innovativeness, creativity, management subjectivity, or some other unknown factor is indeterminable from the data obtained. The actual number of rewards received by each respondent was not identified, preventing any further analysis of productivity and the affects of receiving specific rewards.

Porter found that employees' beliefs concerning receipt of desired rewards for high levels of performance decreased over time (Ref 36). This

circumstance may exist within the laboratory environment investigated by this survey. This belief that good performance will be rewarded with undesirable rewards, also encountered by Porter, was not identifiable from the questionnaire data. Since none of the rewards investigated in this research could be identified as undesirable to the group as a whole, this latter circumstance would not be expected to show itself through the questionnaire data.

The results of this research tended to agree quite consistently with the findings of Vincent in his research of Army R&D scientists/engineers. Experience did not have any significant relationship with publishing papers and productivity was significantly related to grade and education.

V. CONCLUSIONS AND RECOMMENDATIONS

Discussion of Results

Perceptions. Twenty-five rewards were investigated in an effort to identify the variables which would help explain the significant correlations identified by Stahl between performance and the criterion variable "perception of being rewarded by your supervisor for innovative output" (Ref 40:181). Eight of the 25 rewards contributed significantly to the predictability of this criterion variable with the following four rewards explaining most of the criterion variables variance: competent supervisor evaluations, Sustained Superior Performance Awards, informal recognition, and Outstanding Performance Reports.

The perception of being rewarded in general and the perception of receiving a specific reward were significantly and positively related for all of the 25 rewards. In other words, the more individuals perceived that the supervisor rewarded innovative performance, the more they tended to perceive the likelihood of receiving specific rewards.

Perceptions and Desirability. Although none of the 25 rewards had a mean perception of being provided often, some rewards were definitely perceived as being provided more often than other rewards. Unfortunately, the actual rewards perceived as being provided most often were not necessarily the rewards desired the most by the survey group. Only five of the ten most desired rewards were also included among the ten rewards perceived as being provided most often for innovative performance. These five rewards were: a voice in work assignment, competent supervisor evaluations, increased responsibility, a voice in project/equipment expenditures, and

good annual evaluations. All five of these rewards could be classified as rewards that involve very little or no formal management approval or paperwork.

On the other hand, several of the more desirable rewards are severely restricted in their application by policy and regulations, or are formal rewards/awards requiring supervisor initiation and organizational approval. These rewards include increased promotion opportunity, salary increases, Outstanding Performance Reports, and Quality Step Increases.

Since six of the most desirable rewards are only minimally restricted in their application, and five of those rewards are also perceived as being applied more often than many of the other rewards, these six rewards should continue to be emphasized as recognition for innovative performance (the five rewards previously underlined plus "peer recognition").

Informal Recognition. Many of the desirable rewards involve unofficial, informal methods of recognition. Although informal recognition in general was not highly desired, many respondents indicated a strong desire for verbal and written feedback from various management levels for good performance. This is one of the more significant areas for recognizing achievement since it is only psychologically restricted in its application, requires only a conscientious effort on management's part, and provides the scientist/engineer with the reassurance that his efforts are not only appreciated but recognized for what they are.

Desirability and Policy. Clarification should be made about the desirability of the rewards investigated. None of the 33 rewards were identified as undesirable by the group as a whole, but a number of rewards were consistently identified as being less desirable than others. Particularly

included in this category of less desirable rewards are the more formal or official awards such as organizational excellence awards, annual intra-laboratory awards, Sustained Superior Performance awards, and honorary DOD, AF, and command awards. These more formal awards were generally perceived as not being provided for innovative performance.

It should not be inferred from this lack of desirability that management emphasis of these rewards would not have a positive effect on the organization, but it could require more effort than the results would justify.

Three possible explanations for this low desirability for formal awards are: the awards are applied too infrequently for the worker to perceive any benefit from their attainment, as indicated by the perception measurements; the awards do not support or aid the worker in satisfying his desire for promotion, salary, status, etc.; or a combination of infrequent application and lack of worker awareness of the benefits of formal awards.

Corresponding to the scientist's/engineer's possible lack of understanding is the apparent lack of established or communicated organizational policies and standards concerning rewards. Good communications between the laboratory organization and the worker, as well as established policies and standards governing requirements for the application of rewards, are necessary requirements for an effective laboratory incentives program.

In addition, once policy is established and understood it must be applied consistently by laboratory management to be effective and credible. In other words, achievement deserving recognition according to established

policy should be rewarded, regardless of frequency. On the other hand, performance not considered exceptional should not be formally rewarded, although informal recognition and positive feedback should be provided as often as warranted, to stimulate performance.

Rewards Distribution. Neither the formal nor informal rewards distribution were considered fair by the survey group, although distribution of informal rewards was felt to be the fairest of the two. This could also be partly attributed to poor communication of laboratory policy governing rewards.

Rewards Highlighted by this Survey. Two rewards seemed to stand out more than any of the other rewards throughout the investigation: competent supervisor evaluation and the opportunity to write, present, or publish technical papers. Competent evaluations from the supervisor were strongly desired by the respondents (ranked second out of 33 rewards); they were felt to be provided more often than many of the other rewards (ranked sixth out of 25 rewards); and generally increased in desirability with the worker's age, position, and experience.

The perception of receiving competent evaluations from the supervisor was strongly related to the worker's evaluation of the fairness of the rewards distribution. Although the desirability and perception responses for this reward were not significantly related, the worker's perception of receiving this reward was the strongest predictor for the perception of the supervisor rewarding innovative output in general (SUPRWRD).

The opportunity to write, present, or publish technical papers was only moderately desired, but it was perceived as being provided most often as a reward for innovative performance. This perception was not

significantly related to any of the demographic variables, but it was significantly related to the publishing of papers in technical/professional journals.

These two rewards provide the laboratory manager with a possible tool for enhancing existing incentives programs. Both rewards are informal in nature and are not restricted by policy, with the possible exception of the funding associated with publishing papers and travel in order to present papers. Competent supervisor evaluations should be emphasized by management not only because of their desirability but because of their direct relationship to other rewards such as Outstanding Performance Reports, informal recognition, and good annual evaluations. It is also a direct reflection on the supervisor's ability to recognize and perpetuate exceptional performance within the laboratory environment.

Two of the three factors associated with professional writing, publishing and presenting, have already been identified as being restricted through funding policies. It is these two areas that should perhaps receive the most emphasis concerning professional writing activities. As indicated by several respondents, writing papers is often considered part of the job, while laboratory funding for publication costs and travel costs to present research findings is often severely restricted. Yet these two areas associated with professional writing appear to be highly desired by the survey group.

Another significant trend identified in the survey group was the generally lower perception of being rewarded for innovative performance as the scientist/engineer increased in age, position, and years of scientific experience. The one exception to this was the increased perception of

being allowed to do independent research as one increased in age, experience, and position.

Productivity. Productivity associated with contract management, such as statements of work, requests for proposal, test plans and reports, and requirements specifications, was the predominant category of output, in terms of quantity produced. There was a significant relationship between this output and the amount of time the scientist/engineer spent in contract monitoring, the age of the respondent, and the actual experience of the respondent. On the average, 18 percent of the respondent's working time involved contract monitoring.

The output associated with contract monitoring was perceived by the respondents as productivity that was not rewarded with Quality Step Increases, increased promotion opportunity, and annual intra-laboratory awards.

Output associated with publishing technical papers and the writing of technical reports (but not associated with contract monitoring work) was positively related to the perceptions of being rewarded with annual intra-laboratory awards, independent research, increased opportunity to write, present, or publish technical papers, and AFSC Awards for Scientific/ Technical Achievement.

There seems to be some disparity between the output most related to by the test group and the type of output which receives the more significant and often more desirable rewards. Unfortunately, the survey instrument did not include a measurement of output weighting or the relative importance placed on the different output categories by the supervisors.

Although the survey does not allow a determination of which outputs should receive the most emphasis, the data provided does indicate which

rewards are generally associated with which types of output and indicates which rewards are most desirable. Therefore, laboratory management can easily determine which types of productivity it values and increase or decrease emphasis on the associated rewards.

The writing of technical reports tends to increase with age, position and years of scientific experience, whereas the publishing of technical papers is significantly related to an increase in position only. Somewhat surprisingly, the number of years a supervisor is in charge of the section has a significant negative relationship with the worker's publishing technical papers and writing technical reports.

Research Shortcomings

The survey involved only one AF R&D laboratory, greatly restricting its interpretation to other laboratory environments.

An actual comparison of the desirability of a reward against the perception of receiving that reward was impractical because of the different measurement scales used and the general differences between a perception and an indicated desire.

The determination of output was not restricted to innovative forms of productivity, therefore the relationships between productivity and perceptions of receiving rewards for innovative output may not be completely accurate.

No importance was attached to the different categories of output (Importance in terms of management emphasis). This restricted the identification of those types of outputs and associated rewards which should receive the most emphasis.

Several of the rewards included in the survey should have been more specific. For example, the opportunity to write, present, or publish technical papers should not have been identified as one reward since some respondents indicated writing reports was part of the job, but presenting reports was more of a rarity as a reward.

Although the respondents were asked their opinion on the general fairness of formal and informal rewards distribution, they were not asked to relate this fairness to the specific rewards. It is possible that a reward could be perceived as being provided infrequently and still be considered as being distributed fairly or vice versa.

Recommendations for Further Analysis

This same survey could be applied to other government and AF R&D laboratories with only minor modifications required. Specific rewards and types of output associated with each laboratory being investigated would have to be identified. This research would allow a comparison of the worker attitudes as well as the effectiveness of the different laboratory rewards/incentives programs.

In addition to expanding this research to other laboratories, the measurement of productivity should include a measurement of output importance and value to the laboratory organization. A measurement of the perceived fairness of reward distribution for each specific reward should also be included.

A modification of this survey should be applied to laboratory supervisors and higher levels of laboratory management to determine if they feel rewards are being distributed fairly, whether they feel changes are required

in the application and policy concerning rewards, and whether they are imposing their reward values on their subordinates. This latter possibility could be identified by a comparison of the reward desirabilities between the workers and the supervisors against the workers perceptions of which rewards are being applied most often.

A study should also be made of the relationships between the actual number of rewards or the specific types of rewards received and productivity, reward desirability, and reward perceptions. A measurement of the types of rewards and actual quantity of rewards received by the respondents in this survey would have provided valuable information on worker attitudes towards rewards.

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Appendix A

Job Factors in Rosen's Study Identified

as of Moderate Importance

Appendix A

Job Factors in Rosen's Study Identified as of Moderate Importance

Category II - of moderate importance: mean scores of factors from 2.00 to 3.99, in descending order of importance.

Variable Area	Variable
1. Nature of Job	Opportunity to advance professional knowledge
2. Supervisor	Technically competent
3. Nature of Job	Independent Job Performance
4. Nature of Job	Job meets aspirations
5. Supervisor	Loyal to subordinates
6. Nature of Job	Potential to achieve desired professional level
7. Company Policy/Practices	Encourages professional development
8. Coworkers	Coworkers I can trust
9. Company Policy/Practices	Looks Ahead
10. Communications	Knowing whose orders to follow
11. Company Policy/Practices	Offers steady employment
12. Working Conditions	Adequate equipment
13. Company Policy/Practices	Stable organization
14. Supervisor	Gives credit where due
15. Nature of Job	Commensurate with training
16. Nature of Job	Participation in research decisions
17. Company Policy/Practices	Good professional reputation
18. Nature of Job	Opportunity to increase professional status
19. Supervisor	Consistent orders
20. Company Policy/Practices	Cooperative with employees
21. Nature of Job	Potential to achieve desired organizational level
22. Supervisor	Understands work problems
23. Nature of Job	Independence in planning
24. Communications	Opportunity to talk with management
25. Communications	Adequate information and feedback
26. Coworkers	Cooperative
27. Supervisor	Permits subordinate participation in decision making
28. Coworkers	Working in cooperative department

Variable Area	Variable
29. Supervisor	Knows how to handle subordinates
30. Nature of Job	Opportunity to increase company status
31. Supervisor	Cooperates upon request
32. Nature of Job	Professional status
33. Supervisor	Consistent in discipline
34. Coworkers	Accepted as professional by coworkers
35. Nature of Job	Opportunity to contribute to company
36. Coworkers	Coworkers whom I can respect
37. Communications	Informed on personnel policies
38. Salary & Promotion	Competitive holiday and vacation pay
39. Communications	Free access to management
40. Communications	Personnel procedures policy
41. Coworkers	Pride in Department
42. Supervisor	Not autocratic
43. Company Policy/Practices	Interested in me
44. Communications	Informed on company goals
45. Communications	Informed on how I stand
46. Supervisor	Lets me know how I am doing
47. Supervisor	Available for consultation
48. Supervisor	Is courteous
49. Salary & Promotion	Increase job market potential
50. Working Conditions	Clean work place
51. Supervisor	Delegates authority
52. Coworker	Abilities augment each other
53. Working Conditions	Safe Job
54. Coworker	Congenial on the job
55. Company Policy/Practices	Encourages management development
56. Communications	Clear, concise instructions
57. Supervisor	Appreciates good work
58. Nature of Job	Having company status
59. Nature of Job	Contributing to society
60. Coworker	Pride in work team
61. Company Policy/Practices	Leave-without-pay permitted
62. Coworker	Accepts me as a person
63. Company Policy/Practices	Safety conditions enforced
64. Supervisor	Encouragement when needed
65. Supervisor	Available for assistance

(Ref 38:37-43)

Appendix B

Follow-up Letter

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (AU)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

AFFDL Survey Participant: 12 August 1976

This is a follow-up letter to my questionnaire sent to you on 28 July 1976. As Colonel Harrison stated in the questionnaire cover letter, your cooperation is essential to the completion of this study on rewards for scientists and engineers in the Air Force. At the present time, insufficient questionnaires have been returned and the data is not enough to allow analysis. I realize this may be a difficult time of year to approach people with surveys due to vacations, but my thesis completion is the guiding factor and it must be completed during this time frame.

If you have already sent me your completed questionnaire or are in the process of doing so, I would like to thank you again for your trouble and help. If you have not yet responded, please take the time to complete and send me your questionnaire. Receipt of your completed questionnaire will help provide a significant sample size of AFFDL scientists/engineers for analysis purposes and lend further weight to any recommendations that I may make on changing the rewards system.

This study and questionnaire have been approved by the Air Force as indicated by the Survey Control Number (SCN 7T-03) in the lower left corner of the introduction to the questionnaire. The study has also been coordinated with Colonel Preyss, Colonel Harrison, and Mr. Max Davis of AFFDL/CC and AFFDL/XP respectively.

Your anonymity is guaranteed and all data will be reported in aggregate form only. Your cooperation in completing the questionnaire can not be emphasized enough. The results of this study will hopefully benefit all of the AFFDL scientists/engineers, particularly in the area of informal rewards/recognition which are governed by local laboratory policy.

Please take the time to complete your questionnaire and return it through base distribution. Thank you for your help in my research.

Arthur E. Stevens

Arthur E. Stevens, Capt, USAF
Student/Graduate School of Systems Management
AFIT/ENS/Box 49

Appendix C

Revised Questionnaire

DEPARTMENT OF THE AIR FORCE
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES (AFSC)
AIR FORCE FLIGHT DYNAMICS LABORATORY
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: CC

16 JUL 1976

SUBJECT: A Study of Rewards in the AF R&D Laboratories

TO: AFFDL Non-Supervisory Scientists/Engineers

1. Capt Arthur Stevens, an AFIT student, is conducting a survey of the R&D Laboratories by means of the attached questionnaire. The data from this survey should help to identify those rewards and incentives which are considered most important by our R&D Scientists/Engineers and which should receive the most emphasis. Capt Stevens needs your help in collecting this data through your timely and thorough completion of this questionnaire.

2. The envelope provided should return your answers directly to Capt Stevens through base distribution and anonymity should be maintained throughout his investigation. If there are any questions, please contact Capt Stevens at 52549. A summary of the survey results will be provided to all interested respondents.

3. The purpose of Capt Stevens' study is to identify the importance of specific rewards to AF R&D Scientists and Engineers. I believe we can all profit from a survey of this type and your assistance is requested.

Everett V. Harrison

EVERETT V. HARRISON, Colonel, USAF
Director, Plans and Programs

1 Atch
Questionnaire w/
return envelope

Dear Survey Participant:

I am asking for your voluntary cooperation in a study concerned with rewards that may be provided by Air Force R&D Laboratories for innovative performance. I am also concerned with the value of specific rewards to the individual scientist/engineer, regardless of the source or availability of the reward.

Your responses will be kept in the strictest confidence and your anonymity is guaranteed. All questionnaire data will be reported in aggregate form only. The label attached to your envelope was a computer generation of all AFFDL scientists/engineers and there will be no attempt to relate these names to completed questionnaires.

When you have completed your questionnaire, place it in the attached self-addressed envelope, seal the envelope, and place the envelope in base distribution. I will provide a summary of the results of my survey to any interested respondents. If such a summary is desired, address the enclosed white envelope with your name and office symbol and either enclose it with the questionnaire or send it under seperate cover to Capt Arthur Stevens, AFIT/ENS, Wright-Patterson AFB, OH, 45433 through base distribution (this latter method will assure anonymity).

The number in the bottom left corner of this survey is a USAF control number only and is required on all surveys within the AF. The same number is on all questionnaires and in no way can it be used to identify the respondent.

This study is being conducted in partial fulfillment of the requirements for my master's degree in Systems Management with AFIT. It is hoped that the information from this study will serve two purposes: provide guidance for improving the AF Awards and Incentives Program as applied to R&D scientists/engineers, and provide R&D management the feedback required to improve the fairness and effectiveness of rewards distribution, particularly in the area of informal rewards which do not require upper management approval.

Your cooperation in completing and returning this questionnaire by 3 September 1976 is vital to the completion of this study. Responses received after this date will not be included as data in my thesis but please return the questionnaires regardless of the date since the data will be extremely useful in follow-on research. The data and analysis for this study is totally dependent on the quantity, quality, and completeness of your responses. The quantity of questionnaires is as important as the quality of the responses in order to provide a sufficient sample size of scientists/engineers within AFFDL to draw valid conclusions about the rewards system.

I apologize for the amount of time and effort required to complete this questionnaire, but I feel, as Col Preyss does, that this study can be of benefit to all scientists/engineers and your time and labor is greatly appreciated. Thank you again for your valuable assistance.

Arthur E. Stevens

Arthur E. Stevens
Graduate Student in Systems Management
Air Force Institute of Technology/ENS/Box 49

USAF SCN 7T-03

PRIVACY STATEMENT

In accordance with paragraph 30, AFR 12-35, the following information is provided as required by the Privacy Act of 1974:

a. Authority

(1) 10 U.S.C., 80-12, Secretary of the Air Force, Powers, Duties, Delegation by Compensation; and/or

(2) EO 93-97, 22 Nov 43, Numbering System for Federal Accounts Relating to Individual Persons; and/or

(3) DOD Instruction 1100.13, 17 Apr 68, Surveys of Department of Defense Personnel; and/or

b. Principal purposes. The survey is being conducted to collect information to be used in research aimed at illuminating and providing inputs to the solution of problems of interest to the Air Force and/or DOD.

c. Routine Uses. The survey data will be converted to information for use in research of management related problems. Results of the research based on the data provided, will be included written master's theses and may also be included in published articles, reports, or texts. Distribution of the results of the research, based on the survey data, whether in written form or presented orally, will be unlimited.

d. Participation in this survey is entirely voluntary.

e. No adverse action of any kind may be taken against any individual who elects not to participate in any or all of this survey.

INTRODUCTION: I am concerned with types and distribution of rewards to Air Force R&D scientists/engineers as recognition for innovative performance. Rewards can be either formal or informal and can include honorary, cash, and professional awards/rewards as well as many other means of recognition that may be identified as rewards. Innovative Performance, for the purposes of this study, is synonymous with innovative output and is defined in Section III.

This questionnaire is divided into five sections: section one requests identification of certain demographic characteristics of the respondent to help categorize the results of the questionnaire into possible groups; section two requests identification of respondent,s productivity for a period of time; section three requires the respondent to relate certain rewards to a specific level of desirability; section four is a measure of the respondents perception of how rewards are provided by the supervisor for innovative performance/output; and section five includes several short questions about the rewards system in general.

I. Demographic Data

Please complete the following:

A. Age (in years using your last birthday) _____

B. Current Grade (GS level or military rank) _____

C. Years in Current Section _____

D. Educational Level (Circile highest degree) B.S. B.S. +

M.S. M.S.+ Ph.D. Other (please specify) _____

E. Nature of Current Work (%of time per category): Research _____,

Development Engineering _____, System Program Office Support _____,

Supervisory _____, other (please specify) _____

F. Percent of total working time in contract monitoring _____

G. Years of Scientific/Engineering experience (research, consulting, etc.) since first degree (to nearest year) _____

H. Years of Federal Government Employment in a Scientific/Engineering capacity (to nearest year) _____

USAF SCN 7T-03

II. Output/Productivity

How many of the following have your authored, presented, prepared, etc. over the past two years (or less than two years if you have been in your present section for a shorter period of time). NOTE - If you have been in your present section for less than six months but was previously in another R&D laboratory section, use your previous assignment to answer this and following questions and identify the period of time in your previous section _____.

A. New or improved products _____

B. New or improved processes/techniques _____

C. Patents/Patent Applications _____

D. Published papers in technical or Professional Journals _____

E. AF Technical Reports _____

F. AF Technical Memorandums _____

G. Test Plans _____

H. Test Reports _____

I. Manuscripts _____

J. Books _____

K. Oral presentations to technical/ *Professional Audiences* _____

L. Statements of Work (SOWs) _____

M. Hardware/Software Specifications _____

N. Requests for Proposal (in addition to preparing specifciations and SOWs) _____

III. Desirability of Rewards

A. Indicate your level of desirability for the following rewards or categories of rewards by placing an X in the appropriate column opposite each reward:

REWARD	HIGHLY DESIRABLE	MODERATELY DESIRABLE	SLIGHTLY DESIRABLE	INDIFFERENT - NO OPINION	SLIGHTLY UNDESIRABLE	MODERATELY UNDESIRABLE	HIGHLY UNDESIRABLE
1. Cash							
2. Salary Increases							
3. Special Acts and Services Awards							
4. Quality Step Increases							
5. Recognition of Suggestions							
6. Implementation of Suggestions							
7. Outstanding Performance Reports							
8. Outstanding Unit/Organizational Excellence Awards							
9. AFSC Awards for Scientific/ Technical Achievement							
10. AFSC Certificates of Merit							
11. Recognition/Awards for Inventions							
12. Informal Recognition							
13. Competent Evaluation by Your Supervisor							
14. Honorary DOD, AF, and AFSC Awards							
15. Annual intra-laboratory Awards							
16. Sustained Superior Performance							
17. Project related travel							
18. Increased Promotion Opportunity							

REWARD	HIGHLY DESIRABLE	MODERATELY DESIRABLE	SLIGHTLY DESIRABLE	INDIFFERENT-NO OPINION	SLIGHTLY UNDESIRABLE	MODERATELY UNDESIRABLE	HIGHLY UNDESIRABLE
19. Letters of Appreciation/Commendation							
20. Improved Working Environment							
21. Educational Opportunities							
22. Increased Responsibility							
23. Voice in Work Assignment							
24. Voice in Project/Equipment Expenditures							
25. Opportunity to Write, Present, or Publish technical papers							
26. Opportunity to do Independent Research							
27. Opportunity to teach or lecture							
28. Participation in Professional Meetings							
29. Official/Unofficial Compensation Time							
30. Recognition from Professional Societies/Groups							
31. Awards from Professional Societies or groups							
32. Recognition from your peers (both within and external to the AF)							
33. Good Annual Civilian Evaluation or Good Officer Effectiveness Report							

B. As an expansion of Reward number 12, Informal Recognition, list three types of informal recognition that are important to you (In descending order of importance)

1. _____

2. _____

3. _____

IV. Individual Perceptions

A. The following definitions are provided for terms used throughout this section:

1. OUTPUT
   a. New or improved products, processes, techniques;
   b. Patents/Patent Applications;
   c. Published papers in technical or professional journals;
   d. AF technical reports or memorandums;
   e. Books or manuscripts;
   f. Oral presentations to technical/professional audiences;
   g. Specifications/Statements of Work/Requests for Proposal;
   h. Test Plans/Reports

2. INNOVATIVE: Output that is original and useful. Originality and usefulness are necessary and sufficient characteristics output must possess to be classified as innovative. Innovativeness may be viewed as a quality dimension of output.

   a. ORIGINAL: The output makes discrete jumps in knowledge, theory, technique, or product that was not readily predictable before the fact. At best, non-original output is a continuous somewhat predictable extension of knowledge, theory, technique, or product.
   b. USEFUL: The output adds to the fund of knowledge, or is workable if capable of demonstration and test, or is replicable by other researchers in logic and methodology, even if it apparently conflicts with other knowledge and is years from the point of demonstration and test.

B. How long has your present section's supervisor been in charge?

_____

If your present supervisor has been in charge for less than six months or you have been in your present section for less than six months but previously worked in another laboratory section, relate the following questions to your previous supervisor and identify how long the previous supervisor was in charge (up to the period of time you have been in the section)

_____

C. Individual Perception of Rewards Provided by the Supervisor.

Please complete the following by placing a check mark or an X above the category you feel is most appropriate.

1. To what extent does your supervisor reward innovative (orignial and useful) output:

1	2	3	4	5	6	7	8	9
Never-He never rewards innovative performance								Always-He always provides meaningful rewards

a. To what extent are the following rewards provided by your supervisor for innovative output:

1) Sustained Superior Performance (SSP) Awards:

1	2	3	4	5	6	7	8	9
Never								Always

2) Special Acts or Services (SAS) Awards:

1	2	3	4	5	6	7	8	9
Never								Always

3) Annual intra-laboratory awards (Cleary, Foulois, etc.):

1	2	3	4	5	6	7	8	9
Never								Always

4) Individual Honorary Awards (Meritorious Civilian/Military Service, Commendations, Valor, Distinguished Service, etc.):

1	2	3	4	5	6	7	8	9
Never								Always

5) Quality Step Increases (QSI):

1	2	3	4	5	6	7	8	9
Never								Always

6) Organizational Honorary Awards (Outstanding Unit, Organizational Excellence, etc.):

1	2	3	4	5	6	7	8	9
Never								Always

7) Outstanding Performance Reports (OPRs):

1	2	3	4	5	6	7	8	9
Never								Always

8) Letters of Appreciation or Commendation:

1	2	3	4	5	6	7	8	9
Never								Always

9) Informal Recognition:

1	2	3	4	5	6	7	8	9
Never								Always

10) Competent Evaluation of Efforts:

1	2	3	4	5	6	7	8	9
Never								Always

11) Opportunity to write, present, or publish technical papers:

1	2	3	4	5	6	7	8	9
Never								Always

12) Opportunity to participate in professional meetings, seminars, or conventions:

1	2	3	4	5	6	7	8	9
Never								Always

13) Increased say in project or equipment expenditures:

1	2	3	4	5	6	7	8	9
Never								Always

14) Increased promotion opportunity:

1	2	3	4	5	6	7	8	9
Never								Always

15) Increased project related travel:

1	2	3	4	5	6	7	8	9
Never								Always

16) Increased responsibility:

1	2	3	4	5	6	7	8	9
Never								Always

17) Improved Working Environment:

1	2	3	4	5	6	7	8	9
Never								Always

18) Say in work/project assignment:

1	2	3	4	5	6	7	8	9
Never								Always

19) Official/Unofficial Compensation Time:

1	2	3	4	5	6	7	8	9
Never								Always

20) Increased educational opportunities:

1	2	3	4	5	6	7	8	9
Never								Always

21) Opportunity to teach, instruct, or lecture:

1	2	3	4	5	6	7	8	9
Never								Always

22) Opportunity to do independent research:

1	2	3	4	5	6	7	8	9
Never								Always

23) AFSC awards for Scientific/Technical Achievement:

1	2	3	4	5	6	7	8	9
Never								Always

24) AFSC certificates of merit:

1	2	3	4	5	6	7	8	9
Never								Always

25) Good Annual Civilian Rating or Good Officer Effectiveness Report:

1	2	3	4	5	6	7	8	9
Never								Always

V. General Questions:

A. Have you been briefed, notified, or otherwise made aware of any standards, guidance, or policy that has been established by your organization that identifies the application/requirements, distribution, or preparation necessary to acheive rewards/awards?

____ Yes ____ No

B. Do you feel that rewards are fairly distributed within your organization?

Formal Rewards ____ Yes ____ No Informal Rewards ____ Yes ____ No

Appendix D

Variable Coding Scheme

Variable Coding Scheme

Variable Abbreviation	Value	Code
AGE	Actual Years	Actual Years
AGEGP	Less than 30 years old	1
	30 to 39 years old	2
	40 to 49 years old	3
	50 to 59 years old	4
	more than 59 years old	5
AGELVL	Less than 35 years old	1
	35 to 50 years old	2
	more than 50 years old	3
GRADE	GS 6,7,8 or 2nd Lt	1
	GS 9,10, or 1st Lt	2
	GS 11	3
	GS 12 or Capt	4
	GS 13 or Major	5
	GS 14 or Lt Col	6
MILCIV	Military	1
	Civilian	2
SECYRS	Less than 1 year	0
	1 but less than 2 years	1
	2 but less than 3 years	2
	3 but less than 4 years	3
	4 but less than 5 years	4
	5 or more years	5
EDCTN	B.S.	0
	B.S.+	1
	M.S.	2
	M.S.+	3
	Ph.D.	4
YRSSEC	Actual Years	Actual Years
SUPYRS	Actual Years	Actual Years
NTWRK (Predominant Category)	Support	0
	Development	1
	Research	2

Variable Coding Scheme - continued

Variable Abbreviation	Value	Code
NWRKA	Actual Number	Actual Number
CONMON	Actual Percentage	Actual Percentage
ASCEXP	Actual Years	Actual Years
FSCEXP	Actual Years	Actual Years
OUTPUT	Actual Number	Actual Number
VAR1	Actual Number	Actual Number
VAR2	Actual Number	Actual Number
VAR3	Actual Number	Actual Number
VAR4	Actual Number	Actual Number
VAR5	Actual Number	Actual Number
VAR6	Actual Number	Actual Number
SUPTME	Less than 1 year	0
	1 but less than 2 years	1
	2 but less than 3 years	2
	3 but less than 4 years	3
	4 but less than 5 years	4
	5 or more years	5
SUPRWRD	Scale Value	1 thru 9
	Missing Answer	0
PRWRD1 thru PRWRD25	Scale Value	1 thru 9
	Missing Answer	0
RWRD1 thru RWRD33	Scale Value	1 thru 7 (highly desirable thru highly undesirable)
	Missing Answer	0
STNDS,	Yes	1
INFORM, and	No	2
FORM	No Answer	0

Appendix E

Correlation Matrix
for
RWRD1 to RWRD33

CORRELATION MATRIX - DESIRABILITY VARIABLES*

	RWRD1	RWRD2	RWRD3	RWRD4	RWRD5	RWRD6	RWRD7
RWRD1	1.000	.671	.072	.412	-.024	.052	.016
RWRD2		1.000	.030	.606	-.017	.149	-.011
RWRD3			1.000	.116	.308	.230	.291
RWRD4				1.000	.093	.143	-.066
RWRD5					1.000	.721	.222
RWRD6						1.000	.255
RWRD7							1.000

*for $r \geq .099$, $p \leq .05$
for $r \geq .139$, $p \leq .01$

CORRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD8	RWRD9	RWRD10	RWRD11	RWRD12	RWRD13	RWRD14	RWRD15
RWRD1	-.095	.001	-.004	-.042	.084	-.029	.010	.024
RWRD2	-.092	-.006	-.005	-.068	-.050	-.020	-.003	-.020
RWRD3	.414	.429	.503	.347	.341	.166	.510	.481
RWRD4	.134	.039	.069	.030	.079	.074	.010	.036
RWRD5	.393	.217	.340	.371	.260	.216	.253	.245
RWRD6	.284	.192	.245	.333	.175	.149	.144	.161
RWRD7	.346	.430	.378	.274	.104	.152	.380	.303
RWRD8	1.000	.500	.590	.331	.260	.108	.513	.472
RWRD9		1.000	.684	.447	.220	.096	.588	.604
RWRD10			1.000	.506	.292	.172	.640	.618
RWRD11				1.000	.204	.263	.425	.413
RWRD12					1.000	.252	.267	.285
RWRD13						1.000	.176	.095
RWRD14							1.000	.639
RWRD15								1.000

CORRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD16	RWRD17	RWRD18	RWRD19	RWRD20	RWRD21	RWRD22	RWRD23
RWRD1	.115	-.051	.124	.040	.010	.006	-.040	.153
RWRD2	.150	-.024	.295	-.012	.063	.020	.099	.256
RWRD3	.402	.226	.091	.401	.077	.228	.233	.117
RWRD4	.362	.066	.236	.035	.095	.039	.106	.217
RWRD5	.103	.237	.150	.299	.236	.154	.110	.206
RWRD6	.135	.191	.141	.183	.216	.152	.170	.295
RWRD7	.339	.181	.098	.202	.102	.256	.146	.149
RWRD8	.198	.300	.022	.335	.035	.223	.108	.131
RWRD9	.370	.157	.066	.253	.039	.331	.183	.187
RWRD10	.355	.182	.002	.413	.059	.221	.129	.184
RWRD11	.333	.230	.043	.354	.129	.192	.127	.180
RWRD12	.213	.247	.002	.461	.084	.142	.093	.218
RWRD13	.170	.191	.165	.314	.148	.159	.201	.293
RWRD14	.356	.203	.102	.354	.017	.237	.200	.134
RWRD15	.402	.229	.053	.280	.051	.157	.074	.123

CORRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD24	RWRD25	RWRD26	RWRD27	RWRD28	RWRD29	RWRD30	RWRD31
RWRD1	.068	-.046	.028	-.115	-.032	.211	.066	.097
RWRD2	.163	-.074	.033	-.139	-.037	.188	.051	.068
RWRD3	.136	.207	.119	-.012	.167	.047	.276	.324
RWRD4	.169	-.050	-.018	-.101	.038	.174	-.005	.013
RWRD5	.247	.188	.069	.099	.182	.154	.191	.130
RWRD6	.309	.184	.166	.178	.185	.132	.200	.178
RWRD7	.161	.333	.242	.142	.234	.043	.293	.264
RWRD8	.090	.191	.158	.181	.178	.078	.280	.345
RWRD9	.130	.352	.264	.156	.237	.107	.495	.472
RWRD10	.120	.267	.223	.132	.208	.090	.437	.481
RWRD11	.203	.259	.199	.070	.270	.187	.426	.447
RWRD12	.180	.095	-.007	.055	.139	.100	.158	.142
RWRD13	.180	.237	.060	.101	.195	.027	.126	.158
RWRD14	.102	.265	.183	.188	.265	.067	.474	.513
RWRD15	.112	.247	.220	.116	.172	.024	.416	.444

CORRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD32	RWRD33
RWRD1	.039	-.000
RWRD2	.070	.006
RWRD3	.312	.163
RWRD4	.089	-.014
RWRD5	.253	.110
RWRD6	.212	.038
RWRD7	.214	.381
RWRD8	.202	.276
RWRD9	.267	.219
RWRD10	.252	.280
RWRD11	.392	.201
RWRD12	.364	.040
RWRD13	.355	.336
RWRD14	.268	.194
RWRD15	.238	.170

	RWRD16	RWRD17	RWRD18	RWRD19	RWRD20
RWRD16	1.000	.180	.028	.334	.026
RWRD17		1.000	.085	.265	.191
RWRD18			1.000	.049	.231
RWRD19				1.000	.131
RWRD20					1.000

	RWRD31	RWRD32	RWRD33
RWRD31	1.000	.463	.246
RWRD32		1.000	.355
RWRD33			1.000

COPRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD21	RWRD22	RWRD23	RWRD24	RWRD25	RWRD26	RWRD27	RWRD28
RWRD16	.197	.145	.167	.116	.196	.105	.051	.200
RWRD17	.271	.195	.199	.212	.373	.154	.271	.427
RWPD18	.282	.364	.298	.306	.161	.094	.073	.030
RWRD19	.301	.239	.236	.131	.197	.093	.111	.260
RWRD20	.310	.220	.377	.383	.250	.208	.112	.266
RWRD21	1.000	.366	.352	.325	.410	.246	.257	.325
RWRD22		1.000	.469	.443	.390	.162	.259	.280
RWRD23			1.000	.691	.380	.306	.158	.278
RWRD24				1.000	.343	.269	.185	.244
RWRD25					1.000	.593	.538	.604
RWRD26						1,000	.468	.437
RWRD27							1.000	.495
RWRD28								1.000
RWRD29								
RWRD30								

CORRELATION MATRIX - DESIRABILITY VARIABLES (cont)

	RWRD29	RWRD30	RWRD31	RWRD32	RWRD33
RWRD16	.003	.252	.335	.323	.239
RWRD17	.149	.184	.171	.233	.185
RWRD18	.004	.038	.042	.143	.197
RWRD19	.034	.254	.292	.443	.278
RWRD20	.158	.066	.032	.161	.096
RWRD21	.126	.310	.261	.244	.171
RWRD22	-.009	.218	.178	.273	.222
RWRD23	.155	.255	.199	.399	.193
RWRD24	.231	.212	.116	.280	.094
RWRD25	.059	.505	.416	.367	.395
RWRD26	.126	.369	.316	.225	.159
RWRD27	.043	.306	.248	.145	.216
RWRD28	.134	.445	.368	.330	.334
RWRD29	1.000	.189	.113	.140	-.010
RWRD30		1.000	.877	.481	.256

Appendix F

Factor Analysis of Desirability of Rewards

FACTOR ANALYSIS OF REWARDS - DESIRABILITY MEASUREMENT

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
RWRD1	-.00290	-.01403	.79901	.09358	-.02691	-.01184
RWRD2	-.02224	.16643	.86991	.04129	-.08051	.03511
RWRD3	.64522	.11921	.08936	-.00942	-.01979	.07590
RWRD4	.01949	.13672	.79060	-.08369	-.04655	.04795
RWRD5	.24155	.12537	-.02793	.00722	.03309	.83797
RWRD6	.15834	.17959	.10173	.05713	.09652	.83090
RWRD7	.47387	.06699	.01515	.01031	.23064	.21001
RWRD8	.66700	.00675	-.15945	-.04257	.13624	.29373
RWRD9	.78681	.11685	.00197	.20850	.13568	.03263
RWRD10	.79327	.02841	-.00089	.17980	.06599	.16920
RWRD11	.42695	.05074	-.05122	.43214	.04581	.35015
RWRD12	.24767	.09853	.01268	.03829	-.01850	.08353
RWRD13	-.03759	.19747	-.03428	.20935	.00790	.16882
RWRD14	.78288	.07080	-.00743	.17808	.09772	.00231

FACTOR ANALYSIS OF REWARDS - DESIRABILITY MEASUREMENT (cont)

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
RWRD15	.78611	.02158	.02285	.12024	.08025	.02567
RWRD16	.46580	-.00071	.35003	.05792	.09208	-.08789
RWRD17	.16693	.08713	.03658	-.20387	.53887	.15165
RWRD18	.05913	.60802	.21955	-.10345	-.06523	.06014
RWRD19	.31707	.12359	-.00575	.12483	.06041	.07037
RWRD20	-.05429	.51933	.01698	-.05142	.21326	.25141
RWRD21	.27122	.53102	-.02060	.00727	.31504	-.05828
RWRD22	.12681	.70109	-.02044	.03104	.14685	-.09720
RWRD23	.02434	.73536	.17186	.23105	.13195	.13612
RWRD24	.01946	.74993	.08886	.13913	.14218	.21346
RWRD25	.18350	.31940	-.07431	.24252	.70857	.02047
RWRD26	.15691	.20334	.03009	.24049	.63554	.04575
RWRD27	.05691	.11669	-.14248	.04026	.74898	.03418
RWRD28	.09241	.12040	.01759	.18363	.75516	.06677

FACTOR ANALYSIS OF REWARDS - DESIRABILITY MEASUREMENT (cont)

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
RWRD29	-.02364	.04552	.28825	.24661	.18008	.27323
RWRD30	.40297	.09405	.03719	.73913	.33928	.01397
RWRD31	.46571	.02409	.07018	.71527	.25011	-.03328
RWRD32	.11861	.23577	.06009	.55871	.11592	.09833
RWRD33	.15099	.06419	.02256	.13680	.27372	.03393
FACTOR EIGEN-VALUE	8.286	3.028	2.547	1.912	1.536	1.374

	FACTOR7	FACTOR8	COMMUNALITY
RWRD1	-.00927	-.06706	.65293
RWRD2	-.12022	.01505	.80904
RWRD3	.33006	.06462	.55787
RWRD4	.12520	.01464	.67148
RWRD5	.17532	.05417	.81186
RWRD6	.01304	.02758	.77157
RWRD7	-.10543	.40577	.50228

FACTOR ANALYSIS OF REWARDS - DESIRABILITY MEASUREMENT (cont)

	FACTOR7	FACTOR8	COMMUNALITY
RWRD8	.11893	.05890	.59463
RWRD9	-.03271	.01569	.69699
RWRD10	.12288	.05852	.71391
RWRD11	.21243	.07794	.55013
RWRD12	.72749	-.13649	.62787
RWRD13	.43576	.49532	.54921
RWRD14	.11365	.04755	.67442
RWRD15	.10647	-.03666	.65319
RWRD16	.29350	.27570	.52119
RWRD17	.44234	-.00124	.58740
RWRD18	-.15895	.30185	.55634
RWRD19	.64977	.19560	.60048
RWRD20	.11074	-.08830	.40433
RWRD21	.12435	.00339	.47414
RWRD22	.08539	.20081	.58762
RWRD23	.16460	.01892	.68766

FACTOR ANALYSIS OF REWARDS - DESIRABILITY MEASUREMENT (cont)

	FACTOR7	FACTOR8	COMMUNALITY
RWRD24	.09083	-.12612	.67996
RWRD25	.01376	.21331	.74820
RWRD26	-.18666	-.03768	.56698
RWRD27	-.03787	.05800	.60572
RWRD28	.21334	.11383	.69026
RWRD29	.11961	-.40519	.43210
RWRD30	.00017	.00600	.83427
RWRD31	.02928	.06331	.80253
RWRD32	.45843	.26223	.68744
RWRD33	.08489	.73895	.67546
FACTOR EIGEN-VALUE	1.167	1.129	

Appendix G

Factor Analysis of Perceptions of Rewards

FACTOR ANALYSIS OF REWARDS - PERCEPTION MEASUREMENT

	FACTOR1	FACTOR2	FACTOR3	COMMUNALITY
PRWRD1	.16823	.58709	.44609	.57197
PRWRD2	.13866	.77730	.14887	.64559
PRWRD3	.29107	.73355	.10263	.63335
PRWRD4	.21096	.78032	.25028	.71605
PRWRD5	.10380	.60599	.36123	.50849
PRWRD6	.10285	.74865	.12742	.58729
PRWRD7	.15782	.40714	.69618	.67534
PRWRD8	.11701	.56556	.49403	.57762
PRWRD9	.35133	.24163	.70506	.67893
PRWRD10	.32305	.26563	.74486	.72974
PRWRD11	.69562	.19378	.23633	.57728
PRWRD12	.69479	.19643	.30140	.61216
PRWRD13	.66550	.10131	.40681	.61865
PRWRD14	.40782	.26971	.62777	.63315

FACTOR ANALYSIS OF REWARDS - PERCEPTION MEASUREMENT (cont)

	FACTOR1	FACTOR2	FACTOR3	COMMUNALITY
PRWRD15	.64198	.11709	.34208	.54274
PRWRD16	.60526	.13337	.45515	.59129
PRWRD17	.50953	.26106	.45211	.53218
PRWRD18	.65257	.16107	.40523	.61601
PRWRD19	.50241	.12845	.21284	.31422
PRWRD20	.73093	.12402	.12835	.56612
PRWRD21	.75502	.24081	.01241	.62820
PRWRD22	.69886	.29307	.03681	.57564
PRWRD23	.28014	.76964	.18479	.70497
PRWRD24	.24300	.78939	.12408	.69757
PRWRD25	.29900	.14476	.68266	.57638
FACTOR EIGEN-VALUE	11.1	2.614	1.397	

VITA

Arthur E. Stevens was born on 3 February 1947 in Burbank, California. He received his Bachelor of Science Degree in Electrical Engineering in 1968 from the University of Southern California. He received his commission as an Air Force officer after completing Officer's Training School in November 1968. His first assignment was with the Air Force Logistics Command (AFLC) at McClellan AFB, California, where he specialized in Space Track Radar Systems and the computer diagnostic programs used in the maintenance of the systems. In January 1973, he was reassigned to the Space and Missile Systems Organization, Los Angeles, California, as the liaison engineer between AFLC and the Air Force Systems Command in the development of the Defense Support Program and the AF Satellite Communications System. He subsequently enrolled in the Air Force Institute of Technology in August 1975.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A survey was taken of 278 Air Force R&D scientists/engineers to determine the following: their level of desirability for 33 rewards, their perceptions of receiving 25 of the 33 rewards for innovative output, and whether they feel the distribution of rewards is fair. The respondent's perceptions were then related to six categories of output to determine if any relationships could be identified between productivity and rewards for output.

Increased promotion opportunity, competent supervisor evaluations, and salary increases were the three most desired rewards identified by the

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respondents. None of the 33 rewards investigated were identified as undesirable by the test group as a whole. Formal awards as a general category were the least desired rewards with the exception of Quality Step Increases and Outstanding Performance Reports.

Opportunity to write, present, or publish technical papers, good annual ratings, and increased educational opportunities were the three rewards perceived as being provided most often by supervisors for innovative performance. The perceptions of the formal awards were generally lower than for most of the other rewards.

The respondents generally felt that the distribution of rewards was unfair, although informal rewards were considered to be distributed more fairly than formal rewards.

"Competent supervisor evaluation" was the reward most consistently related to by the survey group in terms of desirability, perception, and association with the fairness of rewards distribution

Although contract monitoring work was the predominant form of productivity of the respondents, such output was not associated with the more desirable and more significant rewards. On the other hand, output associated with publishing technical papers and the writing of technical reports (but not associated with contract monitoring) was positively related to the perceptions of being rewarded with annual intra-laboratory awards, independent research, increased opportunity to write, present or publish technical papers, and Air Force Systems Command Awards for Scientific/Technical Achievement.