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Incentives as viewed by scientists, engineers and their management

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INCENTIVES AS VIEWED BY SCIENTISTS, ENGINEERS AND THEIR MANAGEMENT

By

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

In 1964 Dr. Albert B. Chalupsky conducted a mailed questionnaire survey[1] to determine incentives being used to motivate scientists and also to explore the effectiveness of these incentives. Since that time little or no research has been done in this field and the problem of motivating highly talented manpower is still with us. In an effort to determine the changes which have taken place and the progress made in motivating scientists, Chalupsky's survey was redone. The two surveys spanning eight years have been presented together in tables in an effort to show similarities and differences that exist between the findings in each.

The growth in number and importance of scientists employed in industrial laboratories has caused an increasing awareness of the problems associated with their management. Incentives as viewed by the scientists, especially the more productive, can prove to be a valuable tool for management in determining which to use to create an effective work climate. The study was done to determine how managers view certain

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[1]Albert B. Chalupsky, "Incentive Practices as Viewed by Scientists and Managers of Pharmaceutical Laboratories," Philco Corporation, (Palo Alto, California, n.d.). (Mimeo.)

incentives compared to the way the same incentives were viewed by scientists of different ages and levels of productivity. Dr. Chalupsky stated that the major objectives of the study were to obtain a general view of incentives being used for scientific personnel and to survey a number of scientists in a single laboratory. He wanted to find to what extent scientists and research managers agreed in their appraisal of incentive effectiveness and to what extent scientists of different ages and productivity levels agreed in their appraisal of incentives.

Throughout the presentation the findings of Dr. Chalupsky have been listed on the left side of the tables while the findings of the present study have been presented on the right. Comparative data have been shown in all tables. All rankings of the scientists and management use the median as the means of measurement. The incentives used by management and the rankings of these incentives are included in Table 1. The presence of incentives as seen by management and the scientists is depicted in Table 2. The influence asserted by the motivators as judged by employer and scientific employees is illustrated in Table 3. The rankings of the high and low ranked scientists in the two studies is made in Table 4. The scientists were ranked by management based on productivity and contribution to the company. The same comparison is shown for the high and low output scientists in Table 5. The output of the scientists was judged on the number of patents and publications these

scientists produced. The high ranked and high output scientists are then compared. This is depicted in Table 6. The views of younger and older scientists are compared and illustrated in Table 7. The final table lists the non-financial incentives that scientists and management feel to be most effective.

Method

A questionnaire developed by Dr. Chalupsky was used for gathering data (see Appendix). It was compiled following a review of literature in this field and after interviews with a group of scientists. It included twenty-three incentives that seemed appropriate for scientific personnel while excluding job incentives that could be used for all employees or come as a result of time on the job such as vacation time and pension plans. Incentives for this study are defined as those factors, monetary as well as nonmonetary, which are intended to enhance the productivity of employees or to acknowledge their contribution to the company. Scientists are defined to include all persons holding a bachelors degree or its equivalent in science or engineering and involved in work which requires this academic degree. Research is defined to include systematic study aimed at fuller scientific knowledge in the physical, life and social sciences, engineering, and psychology. It does not include market research, research in law, education arts, humanities, and the routine gathering of statistics.

Development is defined to include the activity on nonroutine problems encountered in translating research findings or other scientific knowledge into products or services. It does not include production engineering or routine technical services such as quality control, evaluation or testing.

Dr. Chalupsky sent the questionnaire to the vice-presidents or directors of research in seventeen pharmaceutical laboratories and research institutions and received a return from thirteen. This was a return rate of 76 per cent of the group selected. The present questionnaire was sent to sixteen such laboratories and institutions. A return was received from ten yielding a 62.5 per cent rate. The thirteen organizations represented over 3,000 scientists engaged in research and development while the ten received in the present study represented over 4,000 dealing in the same activity. The same questionnaire was sent to a group of scientists from one of the participating organizations. The only difference in the questionnaire was the addition of professional background information.

The sample of scientists included groups of workers with different years of total professional experience. It was also divided into age groups and was appraised by management into thirds based on productivity or scientific contribution. A return envelope was included with the questionnaire to insure anonymity of participating scientists. Both resulted in over a 60 per cent return, which indicated high interest from the respondents. The fields of chemistry,

mechanical engineering, biochemistry, chemical engineering, and others in the field of biology were represented.

Management Survey

A comparison of the results as to which incentives were used by one or more of the organizations for scientists in research and development is illustrated in Table 1. The median ranking for the same incentives which received at least six responses is also illustrated. This indicated the importance that management placed on these incentives.

In addition to the incentives listed in the questionnaire, others were written in and judged to be effective by management. One was using challenging general assignments with an understanding of their importance and discussing progress as the project moved along without interfering with the scientist. Other write-in incentives included providing contacts with other scientists in the same field, showing the importance of research and development in improving company performance, giving a feeling of real accomplishment to the scientist, and describing the accomplishments of scientists and engineers in the house organ. The present study had other incentives written in, including paid transportation for wives to certain professional meetings, first class air travel, peer recognition, overseas premium pay, and assigned parking spaces. One other "write-in" was funding for a project of the scientist as a reward for work well done on regular work assignments.

TABLE 1

UTILIZATION OF INCENTIVES BY MAJOR LABORATORIES

	Based on 13		Based on 10	
	No. of companies using incentive	Median ranking	No. of companies using incentive	Median ranking
Merit salary increases	13	1	10	2
Encouragement to publish	12	6.5	9	5
Time to attend professional meetings	12	11	10	7.5
Transportation to professional meetings	12	9	9	9
More complex and challenging assignments	12	6	9	3
Tuition or other educational aid	12	15	9	8
Promotion to higher rank	11	2	9	2
Increased technical assistance	10	4	8	10
Participation in company seminars, meetings	9	10	6	7.5
Recognition for superior performance	8	6	4	
Better technical equipment	6	9	4	
Greater freedom to come and go	6	10	3	
Restricted stock options or purchases	5		3	
Monetary rewards for superior performance	5		7	4
Added clerical assistance	4		4	
Dues paid in professional organizations	4		2	
Educational leave - sabbaticals	3		6	10.5
Profit sharing	3		5	
Improved office space	2		1	
Reward patent disclosure/issuance	1		1	
Royalties or commissions on inventions	1		1	
Rewards for suggestions	1		2	

The effectiveness of incentives as judged by management in the two studies showed certain changes in attitude. Merit salary increases and promotions were ranked as the most effective incentives in both studies. The increase in the complexity and challenge of assignments was also ranked highly by both groups. Increased technical assistance, which was ranked as the third most effective incentive by the first study, dropped in importance in the present study. Its place was taken by a motivator not considered important previously. This incentive is special monetary rewards for superior performance. It has also replaced special recognition or commendation for superior performance. There seems to be a shift in favor of monetary rewards as an incentive for special job performance rather than other non-monetary recognition. The two incentives judged as being least effective in the previous study were believed to be more effective motivators in this study. The least effective incentives are now thought to be educational leave and increased technical assistance. These were originally considered very effective.

The changes that have taken place in this area involve additional incentives that are now considered important that originally were not and a rearranging of the relative effectiveness of the incentives listed in the questionnaire. The changes in the "write-in" incentives were considered of little importance since these motivators

were either little used or considered of little importance. The shuffling of the rankings of the incentives is more important since it indicates management's conception of the relative effectiveness of the incentives that it employs. This in turn will be passed on to the employees through the method management uses in presenting the incentives.

CHAPTER II

INCENTIVE AWARENESS

As Dr. Chalupsky noted, an incentive must be perceived as present before it can motivate. The incentives management stated that it used and the degree to which the scientists perceived these incentives as being present is illustrated in Table 2. In the Chalupsky study, participation in company seminars or meetings was not indicated by management as an incentive. It was indicated as a possible motivator in the present study. On the other hand greater freedom to come and go (a less structured work situation) and the availability of stock options or special stock purchase plans were not. The per cent of scientists recognizing the incentives agreed, for the most part, with the exception of encouragement to publish, which dropped, and merit salary increases, which was recognized by a greater number of scientists. Rewards for worthwhile suggestions, which was not indicated as an incentive in either study, dropped in the number of employees recognizing it as a motivator. Another incentive that was not indicated as present by management in either study, special recognition for superior performance, again was perceived by the majority of scientists.

TABLE 2

PRESENCE OF INCENTIVES AS VIEWED BY LABORATORY SCIENTISTS AND THEIR MANAGEMENT

Incentive Practice	Survey A		Survey B	
	Indicated by management	% scientists recognizing	Indicated by management	% scientists recognizing
Transportation to prof. mtgs.	x	100	x	96
Time to attend prof. mtgs. . .	x	99	x	96
Attend co. seminars, mtgs. . .		91	x	88
Tuition - educational aid. . .	x	88	x	80
Recognition for performance. .		81		78
Encouragement to publish . . .	x	77	x	55
Promotion to higher rank . . .	x	76	x	80
More challenging assignments .	x	67	x	76
Better technical equipment . .	x	67	x	52
Merit salary increases	x	63	x	80
Rewards for suggestions. . . .		59		32
Greater freedom to come and go	x	55		56
Stock options or purchases . .	x	53		
Increased technical assistance	x	52	x	52
Educational leave-sabbaticals.	x	32	x	25
Added clerical assistance. . .	x	16	x	28

There still appeared to be a need for better communication between scientists and management in regard to what incentives were actually present and being used within an organization. Few of the incentives used by management were judged as being present by a majority of the employees. Only five incentives in either study were perceived by 80 per cent or more of the scientists responding. Incentives should be recognized to a much greater degree than they are presently in order to be an effective tool of management.

Incentive Influence

The area of incentive effectiveness deals with the degree to which management and employees agree on the appraisal or value of the incentives. There is a great deal of agreement within each study. There has been a shift, however, in the importance or rankings of the incentives. This is shown in Table 3. Management's rankings were compared to those of the scientists' in this table. Merit salary increases, encouragement to publish, paid transportation to professional meetings, increased technical assistance, and better technical equipment were all judged as less important by management in the present study than was true previously. The increase in the complexity and challenge of assignments and tuition and other educational aid were judged to be more important by management. Tuition and other educational aid was judged to be less important by scientists. Monetary rewards for superior performance were not listed as an

incentive in the original study. Rewards was ranked second most important in this study. It was also ranked very high by the scientists. Another incentive not included in the first study was participation in company seminars or meetings. Both management and employees agree now on its effectiveness. Stock options or purchases were not listed by scientists or management as present in this study. Greater freedom to come and go was not listed by management as an incentive while the scientists viewed it as present and ranked it.

There was a great deal of difference in the ranking of the incentives when the two studies were compared. However, this is not of great importance. The important factor is the degree to which management and scientists agreed in their rankings within each study. This agreement does exist. Consider the present study. The most important incentive viewed by management was the increase in complexity and challenge of assignments. It was also the highest ranked incentive of the scientific group. This was also true of all the top eight incentives with the exception of educational aid and tuition. Management and scientists agree on the relative importance of each. Tuition and other educational aid remained the exception. This incentive was ranked higher in the study done by Dr. Chalupsky. Now, management ranks it much higher while scientists consider it less important. A re-evaluation of the relative importance of this incentive is necessary.

TABLE 3

INFLUENCE OF COMPANY INCENTIVES AS JUDGED BY LABORATORY SCIENTISTS AND THEIR MANAGEMENT

Incentive Practice	Mgmt Ranking	Median Scientist Ranking	Mgmt Ranking	Median Scientist Ranking
Merit salary increases	1	2	5	4
Promotion to higher rank	2	3	3	5
Increase in challenge of assignments	3	3	1	3
Encouragement to publish	4	5.5	7	8
Paid transportation to professional meetings	5	8	10	9
Time off for attendance at professional mtgs	6	6	6	7
Increased technical assistance	7	6	12	11
Stock options or stock purchases	8	10	NA	NA
Better technical equip.	9	6	11	10
Greater freedom to come and go	10	8		9
Tuition and other educational aid	11	8	4	8.5
Educational leave - sabbaticals	12		9	
Added clerical assistance	13		13	
Monetary reward for superior performance			2	4
Participation in company seminars or meetings			8	8

There is also agreement on the least effective motivators. Both groups agree on which incentives they consider relatively unimportant. The exception here is greater freedom to come and go. It is not listed by management. The scientists feel it to be in the top ten effective incentives. Once again, re-evaluation may be necessary.

In this section it has been found that communication between management and the scientists was necessary to state which incentives were used within the organization. Management had not been successful in showing which motivators were present. The scientists, for the most part, were unaware of the incentives that were employed within the company. The area of incentive influence showed a high degree of agreement between the scientists and management. They agreed on the relative importance of most of the motivators. There was disagreement on tuition and other educational aid, and greater freedom to come and go. Educational aid was valued higher by management while freedom to come and go was considered higher by scientists.

CHAPTER III

SCIENTIFIC PRODUCTIVITY AND INCENTIVE INFLUENCE

The scientists were divided into high and low productivity groups using two different types of criteria. The first of these was management appraisal. The entire group of scientists was divided into thirds by management based on productivity and scientific contribution to the organization. only the top and bottom thirds were used for comparisons. The other type of criteria used was to differentiate high and low output of the scientist based on patents issued and the number of publications the scientist contributed to professional journals or magazines within the last five years. A score was established to numerically differentiate these groups. Three points were given for each patent issued and one point for each publication. The main group was then divided into halves to determine the two groups.

The group appraised by management was listed as the high and low ranked scientists. The group evaluated on their production of patents and publications was listed as the high and low output scientists. Most of the total output group had no patents issued in either study. There was also high agreement between management appraisal and output within each study.

Incentive Views of High and Low Ranked Scientists

The incentives used for comparison in this section were selected as present by at least 50 per cent of the scientists responding. One incentive in each study was not listed in the corresponding study. Restricted stock options or stock purchases were not included in the present study while they were in the initial one. Monetary rewards for superior performances were not listed in the initial study but considered important in the second study. Each incentive was evaluated within its own framework.

The views of scientists ranked by management as being in either the high or low third are depicted in Table 4. Dr. Chalupsky found six incentives that were perceived differently by the two groups. The incentive of greater freedom to come and go was viewed higher by the higher ranked group. It had a median ranking of five for the high ranked group compared to 9.5 for the low ranked group. Another that was perceived differently was restricted stock options or stock purchases. It had a ranking of six for the high group and ten for the low. This incentive was not included in the present study. Neither of these two incentives was considered important either by management or the scientists. Greater freedom to come and go was ranked tenth by management and eighth by the scientists. Restricted stock options or purchases was listed as eighth by management and tenth by

TABLE 4

INCENTIVES AS VIEWED BY HIGH AND LOW RANKED SCIENTISTS

Incentive	Mgmt Appraisal High One-third	Mgmt Appraisal Low One-third	Mgmt Appraisal High One-third	Mgmt Appraisal Low One-third
Encouragement to publish	5.5	5.0	7.5	7.0
Time for attendance at professional meetings	5.0	6.0	6.0	6.0
Merit salary increases	3.0	3.0	4.0	5.0
Transportation to professional meetings. . .	8.0	7.0	7.0	9.0
Rewards for worthwhile suggestions	10.0	6.0	12.0	10.0
Promotion to higher rank	3.0	2.0	3.0	4.0
More complex and challenging assignments . .	2.5	3.0	2.0	4.0
Restricted stock options or purchases. . . .	6.0	10.0	NA	NA
Better technical equipment	8.0	4.0	11.0	7.0
Recognition for superior performance	6.5	6.0	7.0	6.5
Increased technical assistance	6.0	6.0	8.0	8.0
Tuition or other educational aid	10.0	5.5	8.0	7.0
Greater freedom to come and go	5.0	9.5	5.0	10.0
Participation in company meetings, seminars.	9.0	8.0	8.0	8.0
Monetary rewards for superior performance. .	NA	NA	3.0	5.0

the scientists. Time off for attendance of professional meetings, ranked sixth by both groups was also ranked slightly higher by the high ranking group.

There were three incentives that were viewed higher by the low ranked group. The first of these was better technical equipment. It had a ranking of four for the low group and eight for the high group. Overall, this incentive was viewed as being more important to the scientists than to management. The second incentive perceived higher by the low ranked group was tuition and other educational aid. The third was rewards for worthwhile suggestions. Neither of these was considered important by management or scientists.

The present study is evaluated below. Once again, there were various incentives that were perceived differently by the two groups. Restricted stock options or purchases was replaced by monetary rewards for superior performance. Paid transportation to professional meetings was considered higher by the high ranked group. This was a reversal of the previous study where it was ranked higher by the low group. It was not ranked highly, however, by either management or the scientific group as a whole. Increases in the complexity and challenge of assignments was ranked very high by both groups. It was the highest ranked incentive for the high ranked group. Greater freedom to come and go was also ranked higher by this group. The other motivator considered more important by the group appraised higher by management was

monetary rewards for superior performance. It was also ranked highly by management and the scientists as a group. High agreement was found between high ranked scientists and management as to which incentives were most important.

The incentives judged to be more effective by the low ranked group were tuition and other educational aid, better technical equipment, and rewards for worthwhile suggestions. None of these was considered very important to the general scientific group. Tuition and other educational aid was fourth among incentives as ranked by management. The importance of this motivator must be reconsidered.

Incentive Views of High and Low Output Scientists

Dr. Chalupsky found four incentives that were viewed differently by high and low output scientists. The first of these was time off for attendance at professional meetings. This point is illustrated in Table 5. This incentive was perceived higher by the high output group. The other motivator ranked higher by the high output group was greater freedom to come and go. Participation in company seminars or meetings and encouragement to publish were ranked higher by the low group. It seemed that the group that published consistently did not need to be motivated to do so. Although not mentioned by Dr. Chalupsky, merit salary increases as well as increase in the complexity and challenge of assignments were ranked higher by the low output group.

TABLE 5

INCENTIVES AS VIEWED BY HIGH AND LOW OUTPUT SCIENTISTS

	Patents/Pub High 1/2	Patents/Pub Low 1/2	Patents/Pub High 1/2	Patents/Pub Low 1/2
Encouragement to publish	8.0	5.0	7.5	6.0
Time for attendance at professional meetings	4.0	6.0	5.0	6.5
Merit salary increases	3.5	1.5	4.0	2.5
Transportation to professional meetings	7.0	7.0	7.0	7.5
Rewards for worthwhile suggestions	10.0	10.0	10.0	11.0
Promotion to higher rank	3.0	2.0	4.0	4.0
More complex and challenging assignments	4.0	2.0	2.5	4.0
Restricted stock options or purchases	8.0	8.0	NA	NA
Better technical equipment	8.0	6.0	7.0	6.0
Recognition for superior performance	3.0	4.0	4.5	4.0
Increased technical assistance	6.0	6.0	8.0	9.0
Tuition or other educational aid	10.0	8.0	9.0	9.0
Greater freedom to come and go	7.0	9.5	5.0	7.0
Participation in company seminars, meetings	10.0	7.0	8.0	4.5
Monetary rewards for superior performances	NA	NA	4.0	4.5

In the present study, the high output group listed three motivators higher than the low output group. These motivators are time off for attendance at professional meetings, increases in the challenge and complexity of assignments, and greater freedom to come and go. Two of the three agree with the previous study. Increases in the challenge and complexity of assignments was previously ranked higher by the low output group. The low output group listed four incentives higher than the high output group. These are encouragement to publish, merit salary increases, better technical equipment and participation in company meetings or seminars. This is the same pattern found in the study of Dr. Chalupsky.

High Ranked vs. High Output Scientists

As would be expected, there was a high degree of agreement on the rankings of these two groups. This was primarily due to the similarities that existed in the composition of the groups. The rankings are depicted in Table 6. Each group considered merit salary increases, promotion to higher rank, increases in the challenge and complexity of assignments, and time off for attendance to professional meetings as being important. In addition the present group considered monetary rewards for superior performance to be an effective motivator. Special recognition or commendation for superior performance was ranked higher by the high output group in both studies.

TABLE 6

INCENTIVES AS VIEWED BY HIGH RANKED AND OUTPUT SCIENTISTS

Incentive	High Group Ranked	High Group Output	High Group Ranked	High Group Output
Encouragement to publish	5.5	8.0	7.5	7.5
Time for attendance at professional meetings	5.0	4.0	6.0	5.0
Merit salary increases	3.0	3.5	4.0	4.0
Transportation to professional meetings	8.0	7.0	7.0	7.0
Rewards for worthwhile suggestions	10.0	10.0	12.0	10.0
Promotion to higher rank	3.0	3.0	3.0	4.0
More complex and challenging assignments	2.5	4.0	2.0	2.5
Restricted stock options or purchases	6.0	8.0	NA	NA
Better technical equipment	8.0	8.0	11.0	7.0
Recognition for superior performance	6.5	3.0	7.0	4.5
Increased technical assistance	6.0	6.0	8.0	8.0
Tuition or other educational aid	10.0	10.0	8.0	9.0
Greater freedom to come and go	5.0	7.0	5.0	5.0
Participation in company seminars or meetings	9.0	10.0	8.0	8.0
Monetary rewards for superior performance	NA	NA	3.0	4.0

Both the high ranked and high output groups judged rewards for suggestions, tuition or other educational aid, and participation in company meetings or seminars to be the least effective incentives. There was a difference in the present study in viewing better technical equipment. The high output group thought this incentive to be more effective than their high ranked colleagues. Other than this, there was an overall agreement on the relative importance of incentives.

Views of Younger and Older Scientists

The age of scientists was another factor considered in the study (See Table 7). The younger scientists considered tuition and other educational aid to be of more value than did their older counterparts. This was not nearly as evident in the present study. Both the younger and older scientists ranked educational aid low in comparison to the previous study and also in relation to other incentives in this study. This is very much in contrast to management which ranked this incentive very highly. They ranked it as the fourth most effective motivator that they use. None of the subgroups of scientists throughout the entire study ranked tuition or other educational aid as being a very influential incentive.

TABLE 7

INCENTIVES AS VIEWED BY YOUNGER AND OLDER SCIENTISTS

Incentive	Age			
	20-29	40-49	20-29	40-49
Encouragement to publish	6.0	5.0	7.0	6.5
Time for attendance at professional meetings	6.0	5.0	7.0	7.0
Merit salary increases	3.0	2.5	3.0	2.0
Transportation to professional meetings	9.0	7.0	8.0	5.0
Rewards for worthwhile suggestions	9.0	10.0	11.0	10.5
Promotion to higher rank	4.0	2.0	3.0	3.0
More complex and challenging assignments	2.0	2.5	2.0	3.0
Restricted stock options or purchases	10.0	5.0	NA	NA
Better technical equipment	5.0	6.0	6.5	7.0
Recognition for superior performance	7.0	4.0	7.0	3.5
Increased technical assistance	5.0	5.5	6.0	8.0
Tuition or other educational aid	6.0	8.5	8.5	9.0
Greater freedom to come and go	8.0	10.0	9.0	9.0
Participation in company seminars or meetings	9.0	5.0	6.0	8.5
Monetary rewards for superior performance	NA	NA	3.0	3.5

The older scientists placed a higher value on special recognition or commendation for superior performance and paid transportation to professional meetings than did the younger group. Both studies found the same. A difference exists in participation in company seminars or meetings. In the first study, the older group considered this incentive more highly than did the younger scientists. The direct opposite was true in the present study. The younger group wanted to participate in company decisions and take an active part in the internal workings of the organization. Both older and younger scientists agreed on the more important incentives. Promotion in rank, increase in the challenge and complexity of assignment, merit salary increase, and monetary reward for superior performance were rated highly. There was consistent agreement throughout the entire study on the importance of these incentives.

Most Effective Nonfinancial Incentives

Both management and research scientists were asked to indicate nonfinancial incentives believed to be most effective in motivation. Their responses are shown in Table 8. Dr. Chalupsky found appraisal and recognition the most mentioned incentive followed by research freedom and increased involvement in company decisions. Most of the employees that indicated appraisal also stated that it must be fair. There was a desire to know exactly where one stood. They wanted "constructive criticism" rather than "arbitrary appraisals" or merely praise.

TABLE 8

NON-FINANCIAL INCENTIVES JUDGED MOST EFFECTIVE FOR MOTIVATING RESEARCH SCIENTISTS

Non-Financial Incentive	A Percentage of Scientists	B Percentage of Scientists
Appraisal and recognition	40	28
Research freedom	32	48
Increased involvement in company decisions	25	44
Encouragement to publish	21	20
Attendance at professional meetings	19	24
Educational support - sabbaticals	18	8
Added technical and clerical assistance	17	12
Good technical equipment	14	12
Challenging assignments	11	36
Peer recognition	NA	12
Job security	NA	20

Other incentives mentioned included encouragement to publish, attendance at professional meetings, educational support, and added technical and clerical assistance. The motivators with the fewest "write in" responses were good technical assistance and challenging assignments. The low showing of the importance of challenging assignments was a surprise.

The management side of the organization considered public recognition to be the most effective nonfinancial motivator. This was to be accomplished primarily through company newspapers and trade journals. Communication and prestige symbols such as special job titles were also considered highly effective by management. Other incentives written in included challenging assignments, participation in planning and decision making, and research freedom.

The findings of the present study are reviewed below. The responses of the scientists can once again be found in Table 8. The most effective incentive was found to be research freedom. Scientists and engineers desired the opportunity to choose the projects in which they wanted to participate. Appraisal and recognition dropped in importance from first to fourth place. Increased involvement in company decisions was once again considered an effective

nonfinancial motivator. It ranked second in importance in this study. This incentive was written in primarily by the younger scientist and also the high ranked scientist. The third most mentioned incentive was challenging assignments. It was stated by a majority of scientists responding that if they could not choose the project that they wanted to participate in, they wanted an assignment that was meaningful or important. They also had a strong desire to work within their own field rather than being required to work in areas in which they did not feel "comfortable or at home."

Two other incentives appeared in this study which were not represented in the previous one. The first of these was peer recognition. It was written in primarily by the younger scientists and the mid-ranked group. The second motivator which appeared was job security. There seems to be a growing concern among the scientific community as to the security of their position within the organization. The scientists and engineers in this company had a desire to be reassured that their jobs were safe. The reason for this concern was not apparent. The aspect of job security was not mentioned at all by any management respondent.

The other incentives written in included educational support, added clerical and technical assistance, better equipment, encouragement to publish, and attendance at professional meetings. Educational support was considered the least important of these and attendance at professional

meetings the most important.

The incentive most often written in by management was research freedom. They also stated that this was not possible in most cases, and in such situations, projects of interest to scientists and engineers could be given out as a reward for work done on required projects. Job content itself was also written in. A quote from one of the questionnaires describes the situation.

> Scientists and engineers seek a maximum of responsibility and freedom. They sometimes forget that rules and regulations are necessary to maintain order in an organization. They also dislike administrative details which are necessary to provide management with essentials for running a viable business. The greatest incentive for any scientist or engineer is to permit him to engage in projects that are of interest to him.

Other incentives written in by management included better lines of communication between management and scientists, participation in decision making, and recognition. One other incentive included was an atmosphere of growth and excitement within the organization itself. Management feels that scientists and engineers can be made to feel an integral part of the company and that this in itself is an effective motivator. This was management's answer to the problem of job security that seemed to bother some of the scientists. They also stated that scientists should assume some financial responsibility in the handling of projects given to them. Management also considered success on a project as an incentive to the scientist or engineer to try to achieve that same success on his next assignment.

CHAPTER IV

CONCLUSIONS

Dr. Chalupsky concluded from his study that the incentives most used by management to motivate scientists and engineers in research and development were: (1) merit salary increases, (2) time off for attendance and transportation to professional meetings, (3) challenging assignments, (4) tuition or other educational aid, and (5) promotion to higher rank. The least used incentives were rewards for patents, inventions or worthwhile suggestions.

The most effective incentives as viewed by management were thought to be merit salary increases, promotions to higher rank, increased technical assistance, challenging work assignments, and nonfinancial recognition or commendation for superior performance. The least influential motivators were said to be tuition or other educational aid and time off for attendance at professional meetings.

The scientists responding in one of the organizations showed that only one incentive was viewed as being present by 100 per cent of the group. This incentive was paid transportation to professional meetings. The other incentives were perceived as being present by from 16 to 99 per cent of the scientific group.

Scientists and management were in agreement for the most part on the relative influence of incentives used within the organization. This was true especially when the most influential incentives were considered. Merit salary increases, promotion to higher rank, increases in the challenge and complexity of assignments, and encouragement to publish were considered of prime importance by both groups. The scientists placed a higher value on tuition and other educational aid and better technical equipment. Management placed a higher value on restricted stock options or purchases and paid transportation to professional meetings.

The scientists were then broken into various subgroups. High producing workers preferred greater freedom to come and go and time off for attendance at professional meetings. Both high and low producing scientists considered merit salary increases, increases in challenging and complex assignments, and promotions to be of high importance. Younger scientists valued educational aid higher than did their older colleagues. The older scientists liked the incentives of stock options or purchases, recognition for superior performance, and participation in company seminars.

Nonfinancial incentives were also investigated. Appraisal and recognition was listed most often. This coincided with the high ranking given to special recognition or commendation for superior performance. Research freedom and involvement in company decisions were also mentioned in this area.

Dr. Chalupsky summarized his study by noting that while management and scientists agree on the most obvious incentives, more emphasis was needed particularly in the area of communication. The publicizing of the existence of incentives as well as learning which factors influence research productivity was necessary. He suggested that the ordinary everyday types of recognition by management may be the most effective method of motivating scientific personnel.

The incentives used most often by management remained the same in both studies. This was also true of the least used incentives. Merit salary increases and time off for attendance at professional meetings were used most often. Rewards for worthwhile suggestions, patents, and inventions were the least used incentives by management.

The most effective incentives as viewed by management changed from the previous study. Increased technical assistance and nonfinancial recognition for superior performance were replaced by monetary rewards for superior performances. The other most influential incentives remained the same. Tuition and other educational aid moved up in importance in the present study. The other less effective motivators remained the same.

None of the incentives in the present study were viewed as being present by 100 per cent of the scientists responding. Twelve of the fifteen incentives were perceived by over 50 per cent of the group. Only six were perceived by 80 per cent or more of the group.

The next area considered was the influence of incentive practices as judged by laboratory scientists and their management. The rankings of the incentives was considerably different from the first study. This was not considered of great relevance since both scientists and management agreed on the rankings within the study. The major exception was tuition and other educational aid. Management ranked this incentive much higher than did the scientific group. The most influential incentives were increases in the challenge and complexity of assignments, monetary rewards for superior performances, promotions, educational aid, and merit salary increases as judged by management. With the exception of educational aid, the scientists agreed. They also agreed on the least important incentives which were better technical equipment and increased technical assistance.

The various subgroups the scientists were divided into showed certain differences in this study. High output ranked scientists judged increases in the complexity and challenge of assignments higher than did their lower ranked counterparts. High and low output scientists agreed on the relative importance of the most influential incentives. Younger scientists did not care for educational aid as was indicated in the previous study. They considered participation in company seminars more highly than the older group. Dr. Chalupsky's findings were completely different. Recognition for superior performance and paid transportation to professional meetings impressed the older group more.

Two additional nonfinancial incentives were included in the present study. These were peer recognition and job security. Challenging assignments placed higher on the list. This is also true of involvement in company decisions. Research freedom was the most highly thought of nonfinancial incentive by both management and the scientific group. There is a high degree of agreement in this area.

In summary, the results of this study lead one to believe that while progress has been made in the area of motivation, much work still needs to be done. Communication between management and employees still must be improved. A concentrated effort with emphasis on feedback from scientists is required. Monetary rewards are being used to a much greater degree with a high rate of success according to management. Appraisal by management, particularly by those with the most contact with the scientist, is deemed necessary. Feedback to the scientist is required to let him know what is happening in the organization and where he stands in relation to it. The scientist needs to feel important to the organization and be recognized by it. He also wants financial compensation commensurate with his abilities and contribution to the organization. Research freedom is a continuing problem for management. All aspects presented here must be considered with particular emphasis on two way communication.

APPENDIX

SURVEY OF INCENTIVES FOR SCIENTISTS AND ENGINEERS EMPLOYED IN INDUSTRIAL RESEARCH AND DEVELOPMENT

EMPLOYER QUESTIONNAIRE

Nature or type of industry_____

Total number of employees at this location_____

Number of scientists and engineers*_____

Number of scientists and engineers engaged full time in research and development**_____

* Scientists and engineers: For the purpose of this study, they are defined to include all persons who hold at least a bachelors degree or its equivalent in science or engineering (including physical and engineering sciences, life sciences, and the social sciences) and who are engaged in work requiring this education.

** Research and Development: Research is defined to include systematic, intensive study directed toward fuller scientific knowledge in the physical, life, and social sciences, engineering and psychology. Does not include research in law, education, arts, humanities, market research, and the routine gathering of statistics. Development involves activity on nonroutine problems encountered in translating research findings or other scientific knowledge into products or processes. Does not include production engineering or routine technical services such as quality control and testing.

1. Listed below are examples of incentives* (financial and nonfinancial) which you might find in companies today. Indicate by a check in the first column those which are currently used by your company for scientists and engineers in research and development. Add to the list those incentives present in your company (applicable to scientists and engineers) which are not included in the list.

Encouragement to publish.	___	___
Rewards for patents	___	___
Royalties or commissions on inventions.	___	___
Time off for professional meetings.	___	___
Merit salary increases.	___	___
Paid transportation to professional meetings. .	___	___
Rewards for worth while suggestions	___	___
Promotion to higher rank.	___	___
Profit sharing - cash plan.	___	___
Profit sharing - deferred plan.	___	___
Increase in challenge of assignments.	___	___
Improved office space	___	___
Restricted stock options or stock purchases . .	___	___
Better technical equipment.	___	___
Monetary rewards for superior performance . . .	___	___
Nonmonetary rewards for superior performance. .	___	___
Increased technical assistance.	___	___
Added clerical assistance	___	___
Tuition or other educational aid.	___	___
Greater freedom to come and go.	___	___
Dues paid in professional organizations	___	___
Educational leave - sabbaticals	___	___
Participation in company seminars or meetings .	___	___

OTHER: Please describe_____

_____

_____

2. Review the incentives which you have indicated as present in your company (including those written in) and rank them according to their importance in motivating performance. Place 1 as the most important, 2 as the second and so on until all incentives are ranked.

* For the purpose of this study, incentives are defined to include all factors in the work environment, monetary as well as nonmonetary, which are intended to acknowledge the contribution and/or enhance the productivity of employees. Not included are those benefits which apply to all employees or come automatically as a result of time on the job, e.g. vacation time, pension plans, etc.

3. Considering all aspects of the job and company environment, what do you feel are the most important factors which facilitate or enhance the effectiveness of research scientists in your organization?

4. Following in the same vein as the previous question, what do you consider to be the most important factors which inhibit or interfere with the effectiveness of research scientists and engineers in your organization?

5. What skills do you believe should receive greater emphasis in the training of research scientists and engineers?

6. Considering only financial methods of incenting, indicate your preferences for the methods listed below. Place a one (1) after the method you feel would be the most effective as a motivational tool, place a two (2) after your second choice and so on until all five methods are ranked.

	Preference rank
A. Base salary plus individual incentive (based on a percentage of net return from the patents or other contributions of each scientist). _____	_____
B. Base salary plus group incentive. Each member of the research team or work group would receive the same percentage of his base salary in incentive compensation (determined on the basis of the net return from patents or other contributions of all group members).	_____
C. Base salary plus group incentive. Same as "B" above except that each scientist would not receive the same percentage of his base salary in incentive compensation. Instead, he would share according to his contribution to group productivity, as judged by his supervisor. (This judgement would include an individual's output plus his contribution to the work of others and to over-all <u>group</u> effectiveness.)	_____
D. Base salary plus a company-wide profit sharing program. The scientist would share in the <u>company-wide</u> increase in productivity in proportion to his base salary. _____	_____
E. Straight salary only. No needed incentive compensation; however, the performance of each scientist would be appraised regularly for the purpose of reviewing the adequacy of his base salary. _____	_____

7. Considering nonfinancial incentives, please list below the ones you feel might be most effective as motivational methods.

_____

_____

_____

8. Please list below any suggestions you have for increasing the effectiveness or enhancing the potential contribution of scientists and engineers in industrial research and development.

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