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Management Of Professional-Technical Personnel

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MANAGEMENT

OF

PROFESSIONAL-TECHNICAL PERSONNEL

By

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CHAPTER I

THE PROBLEM OF TECHNICAL MANAGEMENT

Statement of the Problem

One characteristic of man, evidenced from the beginnings of recorded history, has been his tendency to organize. Any task or endeavor beyond the abilities of one man or more efficiently performed by a group has been sufficient cause for some form of organization. By creating relationships, authority, responsibility and proper integration of skills, the sum of individual efforts could be increased.[1] From this, it develops that the purpose of organization, whether it be in elementary societies or in the complex industrial situation of the 1960's, must be to integrate people and their skills in order to effectively perform some function. "One of the imperatives in the logic of industrialization is the building of the requisite organizations to combine natural resources, capital, technology and labor for productive purposes."[2] It also follows by definition that organization cannot exist or develop without leadership and direction. Organization without

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[1]Chris Argyris, Executive Leadership, Harper and Brothers, New York, 1953, p. 128.

[2]Fredrick Harbison and Charles A. Meyers, Management in the Industrial World, McGraw-Hill Book Co., Inc., New York, 1959, p. 117.

purpose or reason is not organization. Thus, the development of industrialization has brought with it the development of management.[3]

Since one of the underlying purposes of organization is to improve the effectiveness of the individual efforts, it is requisite that management enable the organization to achieve such efficiency. Herein lies one of the basic problems of management. How should people be managed or directed in order to achieve maximum efficiency or greatest productivity? As it is the purpose of this paper to examine the management of professional-technical personnel, consider for a moment the techniques or philosophies of management which have been tried or proposed in an effort to "best" manage this type of employee.[4] According to R. Likert the various methods of management, not restricted to technical management, form a spectrum of which only the limits are accurately defined.[5] At one end of the spectrum is what is termed "Exploitive Authoritative" management.[6] Organizations having this form of supervision consider their human resources in the same analytical, detached way that they consider their other resources.

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[3] Ibid.

[4] The terms "professional-technical personnel" or "scientists and engineers" for the purpose of this study shall be as defined by the U. S. Department of Commerce as "all persons engaged in scientific and engineering work at a level which requires a knowledge of physical, natural, or mathematical sciences equivalent at least to that acquired through completion of a four year professional college course." This category includes the administrators and supervisors of those persons defined above. Statistical Abstract of the United States, U. S. Department of Commerce, 1961, p. 539.

[5] Rensis Likert, New Patterns of Management, McGraw-Hill Book Co., Inc., New York, 1961, p. 234.

[6] Ibid., p. 223.

Workers are told what to do, how to do it, and at what rate they are to do their job in a dictatorial fashion.[7]

At the opposite end of the spectrum is the laissez-faire type of management.[8] Under this form of management the "leader" acts only as a source of information while the group manages itself by establishing its own goals and making its own decisions as a joint effort of the members. Between these two extremes lies a continuum of managerial philosophies. Further definition of the spectrum between the extremities is provided by Likert. He defines very general bands with inexact boundaries as "Benevolent Authoritative," Consultative," and "Participative Group" progressing from his "Exploitive Authoritative" to the laissez-faire approach.[9] These are not distinct points but only broad classifications within the boundary limits defined.

The question then arises, where on this spectrum of philosophies is the optimum point or area with respect to the management of professional-technical personnel? The hypothesis of this paper is that there is indeed an optimum point on this continuum of managerial philosophies under which professional-technical employees will achieve a maximum output or optimum productivity. This is not to be construed as a claim for the solution to the problems of technical

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[7] Ibid., p. 82.

[8] I. L. Heckmann, Jr., and S. G. Huneryager, Human Relations in Management, South-Western Publishing Co., Cincinnati, Ohio, 1960, pp. 48-49.

[9] Likert, op. cit., p. 82.

management. On the contrary, the "optimum managerial philosophy" is only an aiming point from which the individual manager may have to deviate according to the requirements of each case.

The Importance of the Problem

The problem of finding an optimum technique for directing or integrating the efforts of scientists and engineers as an employee group is one of growing significance. During the period from 1945 through 1958 there was a 400% increase in the employment of engineers and scientists versus an increase of only about 6% in employment of production workers.[10] Considering just engineers as a separate group it is found that they are forming a larger and larger percentage of the employment picture. Data showing this trend are presented in Figure 1. As a proportion of the employed workers of this country, engineers have grown steadily since the beginning of the century. Nor are these data invalid when considering both engineers and scientists. First, scientists represent only about 15% of the employment of the professional-technical personnel as previously defined.[11] This, coupled with the composition of the degrees granted to scientists and engineers, points out the validity of the data presented in Figure 1. During the period from 1950 to 1960 approximately one science degree was granted for each two engineering degrees.[12]

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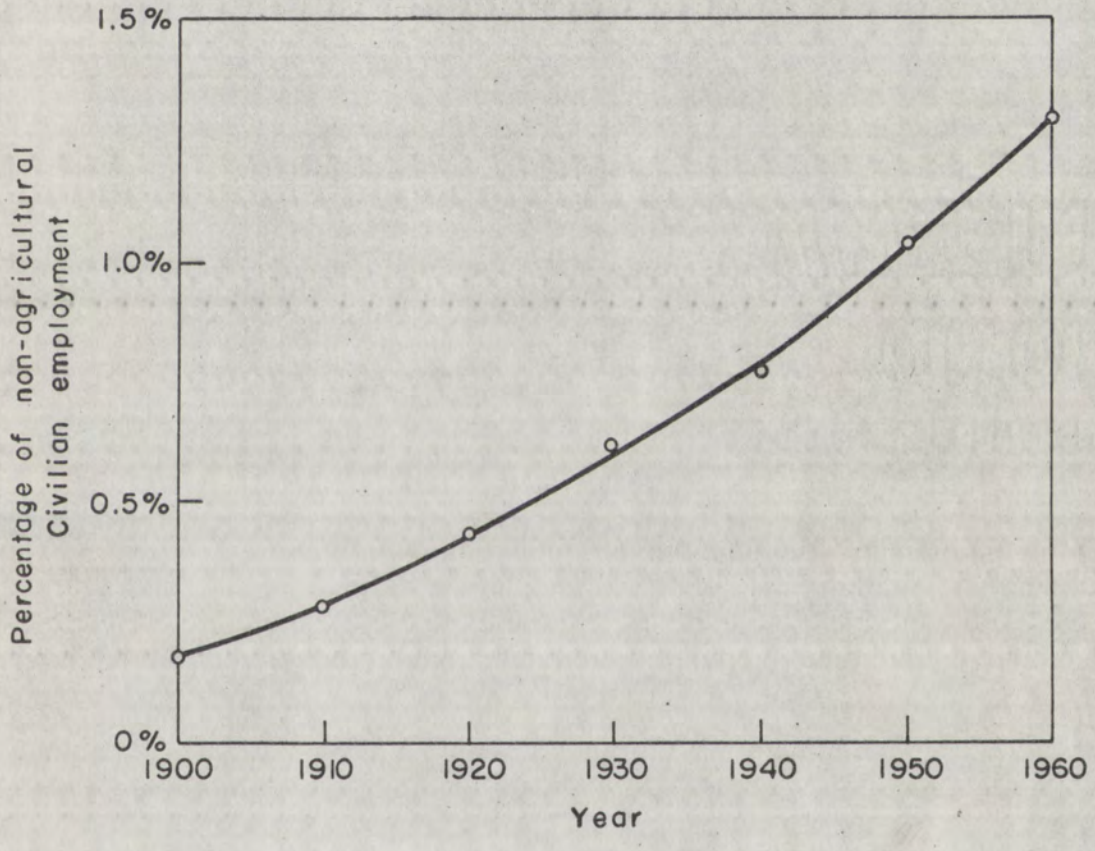
[10] C. Wilson Randle, "Problems of R & D Management," Harvard Business Review, Jan.-Feb., 1959, p. 128.

[11] Scientists include chemists, geologists, physicists, life scientists and metallurgists and exclude geographers. Statistical Abstract of the United States, U. S. Department of Commerce, 1961, p. 539.

[12] Statistical Abstract of the United States, U.S. Department of Commerce, various issues.

Figure 1

EMPLOYMENT OF ENGINEERS IN PRIVATE INDUSTRY



Source: Historical Statistics of the United States - Colonial Times to 1957, U.S. Department of Commerce, Series D-7, D-123, and D-145.

Statistical Abstract of the United States - 1961
U.S. Department of Commerce, Table #268, p. 203.

Had all of these entered the professional-technical ranks, and stayed there, surely the proportion of scientists to engineers would have risen higher than the 15% figure cited above. Thus, the effect of the inclusion of scientists in the data presented in Figure 1 would be to accentuate the slope of the curve as well as boosting its percentage level. This upswing in the employment of professional-technical personnel is to be expected as a result of the continually increasing technical emphasis in our society. As a consequence, the problem of how to manage the professional-technical employee assumes increasing significance if for no other reason than the numbers of employees involved.

To complicate the problem of determining the "optimum" managerial technique and to add to its significance in regard to the professional-technical employee, a secondary problem appears. Efficiency is classically defined as the ratio of output to input. Since it is one of management's objectives to obtain or strive for optimum efficiency (i.e., maximum long range efficiency), one faces the difficulty of defining the output of scientists and engineers. Unlike the factory worker whose output is a product of some determined value, the scientist or engineer works more in the realm of ideas. While some of these ideas may have readily established values, many others will not. How many injection molded plastic spoons equal one unique idea? How does management determine whether a professional-technical employee is properly applying himself? Of what value is a paper published in a technical journal? Of what value is the disproof of a thesis? Is the conclusion that an approach is invalid or unworkable after pursuing it for some time nonproductive? These and other questions of this nature

are beyond the scope of this investigation. But, the problem of determining the optimum managerial philosophy requires some form of measurement however subjective. While accurate measurement on an individual basis is uncommonly difficult, there are some very adequate means of measuring over-all technical output. The highly technical industries of this country are faced with rigorous competition from a variety of sources. The ability to keep abreast or excel under these conditions is one measure of technical output. One example of this competition is the present-day world struggle between Capitalism and Communism. Each side must continually improve its technological weapons -- if it expects to gain the advantage or even keep up. The pressure of this situation is to achieve higher output through greater technical employment or higher technical productivity.

But, this is not the only demand for efficiency on the technical employee. If profit is to remain as the motivating force behind our industrial society, that is, if private capitalism is to be our approach to economics, then the employers of professional-technical talent must expect an eventual return on their investment in this as in any field.[13,14] This does not mean that a profit must be seen at the end of every accounting period but there must be some prospect of eventual profit. This orientation toward profit is only a little less

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[13] Paul A. Samuelson, Economics: An Introductory Analysis, Second Edition, McGraw-Hill Book Co., Inc., New York, 1951, p. 517.

[14] Val Cronstedt, Engineering Management and Administration, McGraw-Hill Book Co., Inc., New York, 1961, p. 5.

obvious and certainly as important in a government supported technical endeavor. The public quite reasonably expects results from expenditures directed toward the operation of such laboratories or agencies.[15]

Because of such pressures to increase technical output, a situation has evolved within the United States as well as some other parts of the world which is described by some as a shortage of talent.[16] One popular example of this shortage is found in the comparison of the number of engineers and scientists in the Soviet Union and the United States. From these data and data concerning the number of graduates in the technical professions in the years to come, evaluations of the relative technical strength of these two countries are derived. On this basis the United States is not only behind at present but will lag still further behind in the future.[17] Other measures based upon such indicators as technical employment advertising analysis and/or manpower projections by selected industries also point out the present and future shortage of professional-technical talent.[18,19] In contrast to these evaluations and predictions there

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[15] Burton F. Barrows, "The Case for Scientific Management in Science," Research/Development, December, 1960, p. 96.

[16] Harold G. Seashore, "The Search for Talent," Test Service Bulletin #43, The Psychological Corporation, February, 1952.

[17] Carl Frey, "Supply and Demand Outlook and Its Effect on Salary Levels," Research Management, November, 1963, p. 424.

[18] _____, "ECPD Frets Over Engineering Shortage," Engineering News-Record, October 10, 1963, p. 51.

[19] W. Newton Ryerson, "Shortage of Technical Personnel," Advanced Management - Office Executive, May, 1963, p. 34.

are those who express the opinion that the shortage is not a problem of numbers but one of proper utilization.[20] In other words, the shortage exists because the professional-technical employee is being utilized in non-professional jobs. These are jobs which in many cases not only do not require the attention of the engineer or scientist but might, in fact, be more effectively performed by non-professional employees.[21]

Whether the shortage is one of quantity or utilization, the social status, salaries, and working conditions of these professional-technical people (scientists and engineers) have been bid up continually over the past fifteen years as the economy strives to overcome the problems of technical output.[22] In at least some cases, the increased attention to technical endeavors and to the technical employee has paid off (e.g., witness the financial growth of such highly technical organizations as Texas Instruments and other similar corporations). Products, industrial as well as military, were conceived, designed, produced and sold at a profit. The shortage of technical talent still exists, though. Competitive pressures within and without our society emphasize this problem and demand its solution.

Efforts to increase the available supply of professional-technical personnel have had mixed results. Figure 1 shows a slightly increasing rate of growth of engineers as a percentage of the labor

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[20] Clinton J. Chamberlain, "Coming Era in Engineering Management," Harvard Business Review, Sept.-Oct., 1961, p. 88.

[21] D. M. Keezer and W. H. Chartner, "The Shortage of Engineers -- An Opportunity as Well as a Problem," Problems and Practices of Management, American Management Association, New York, 1957, p. 26.

[22] Ibid., p. 23.

force over the years. Evidently this acceleration of growth is insufficient to overcome the numerical shortage. In fact, there are indications these efforts have seemingly forced recruiting beyond the point of diminishing returns, so that the technical professions are beginning to attract persons who are not capable of professional quality work.[23]

If the quantitative supply of technical talent is limited, as it would seem, then another way to strike a balance between this supply and the demand upon it would be to reduce the demand. But, in our increasingly complex (technically) society, this approach too appears doomed.

If the demand is inflexible and quantitative supply is limited then quality must be stressed. The existing technical talent must be better utilized.[24] The productivity of our scientists and engineers must be increased.[25]

As hypothesized above, this increased technical efficiency may be achieved through the proper managerial philosophy and the resulting techniques applied to directing the efforts of scientists and engineers. The determination of the existence or non-existence of this optimum managerial philosophy or approach is the problem to be considered in the remainder of this paper. The proof of the existence

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[23]George A. Whittington, "Trends in R & D Management," Research/Development, Sept., 1961, p. 101.

[24]William G. Torpey, "Conserving Our Technical Manpower," Personnel, March-April, 1960, p. 61.

[25]I. Hirsch, W. Milwett and W. J. Oakes, "Increasing the Productivity of Scientists," Harvard Business Review, March-April, 1958, p. 66.

of such an optimum philosophy and its adoption could lead to noticeable improvements in productivity of the available technical talent.

Resources on the Problems

To properly study this problem at least three areas of information should be considered. Behind the existing technical organizations and their management lies a vast amount of experience. This experience has at least some value since it was collected while managing scientists and engineers under actual conditions. For those organizations still in existence such management might be considered successful on the basis of survival alone. While many of the viewpoints or observations expressed suffer from the personal bias of the proponents, at least some of the observations should be valid. This is particularly true of those attitudes or philosophies which find general acceptance among the successful practitioners.

A second area of consideration might be called conjecture. By extending the knowledge of other disciplines, notably psychology, a substantial amount of theory as to the optimum managerial approach could be and has been produced. But, neither practice or pure theory is sufficient by itself. The "successes" of management are relative to the conditions of the times. There is no readily available measure of how much more brilliant the successes might have been if different managerial techniques had been applied. Likewise, the extrapolation of knowledge from one field into another -- even though allied -- leaves openings for error.

Therefore, a third area of consideration should be that of research. Carefully conducted and carefully evaluated research on the

proper management of professional-technical personnel should serve to validate or disprove the philosophies advanced by the practitioners.

Limitations of Consideration

The reader should be fully aware that it is not the intent of this paper to report on an original research project on "optimum managerial techniques." On the contrary, this commentary is a survey of the existing knowledge coupled with some attempt to evaluate it. This particular subject, the management of professional-technical personnel, has been immensely popular for the past several years. A great number of articles and books of varying value have been published on this subject. By reviewing and collating the published material written by "practitioners of the art," the more general information available from the field of behavioral science and the results of research on technical management, it should be possible to develop a clearer image of the "optimum" management philosophy as applied to professional-technical personnel.

Summary

In the complex technically oriented society of the 1960's a great deal of attention has been focused on the scientists and engineers. This group of industrial employees attempts to combine the academic background of their university training with the practicalities of modern industry to produce profitable products.[26] Dealing with more abstract quantities than the traditional industrial employee, this new group of professional-technical people has illuminated problems

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[26] _____, "The New World of Research," Business Week, May 28, 1955, p. 108.

previously unconsidered. They have forced management to reconsider its traditional philosophies. Through the competition for talent caused by a shortage of such talent, industry has bid up the cost of the technically trained professional employee. This further forces management to consider "what is the optimum technique for managing these persons?"

This paper makes an effort to determine if there is an optimum philosophy for the management of the professional-technical employee. By considering the experience of practitioners, and reflecting this against the more theoretical approaches of the behavioral sciences along with the research performed on the specific subject, it should be possible to determine whether or not such an optimum philosophy exists.

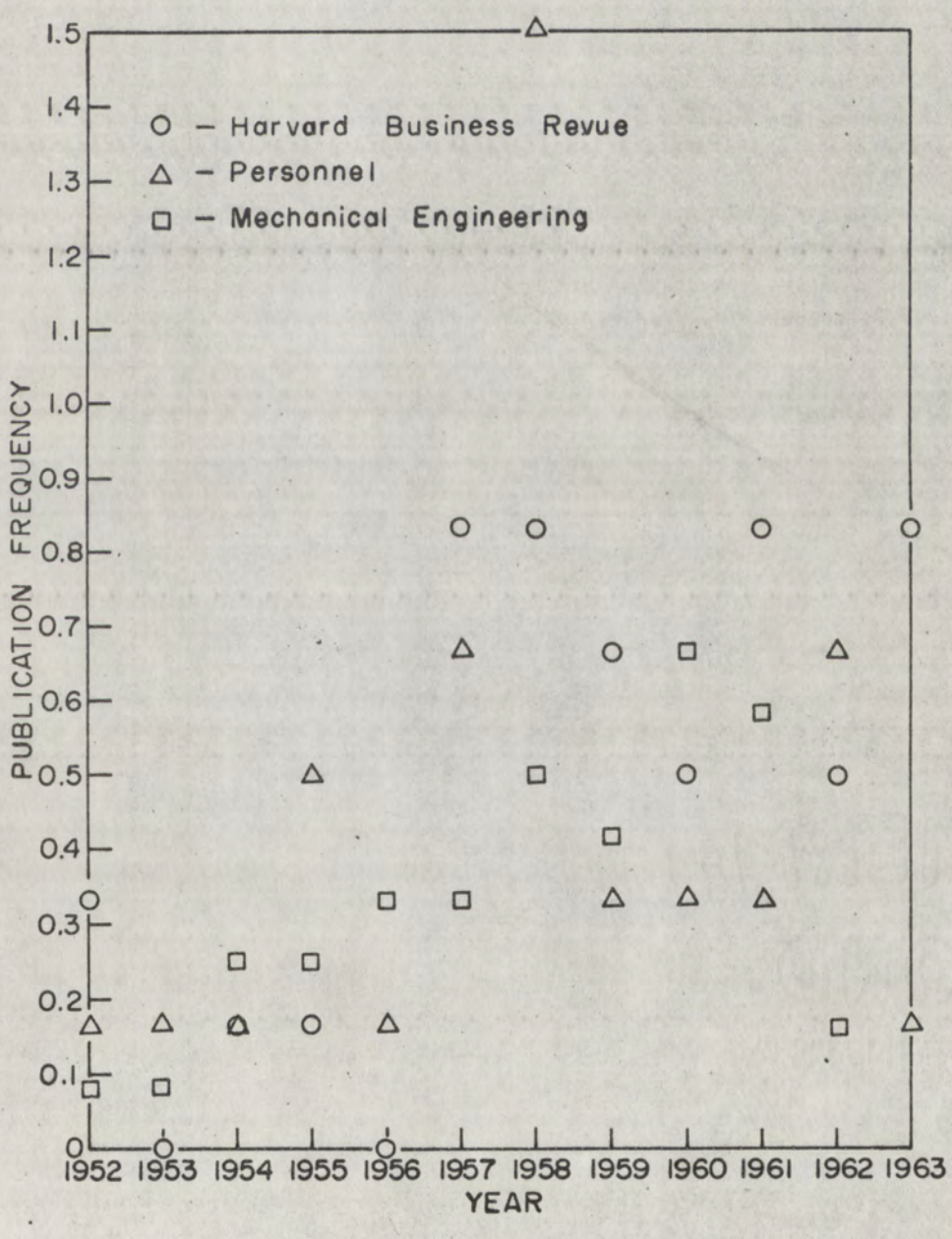
CHAPTER II

THE VOICE OF EXPERIENCE

As pointed out previously, the subject of managing professional-technical employees has become immensely popular the past few years. For the reasons pointed out in Chapter I, a distinct effort has been made to analyze the problems of technical management and project possible solutions. Most of these attempts have been offered by practitioners of the art. The popular technical journals of recent years abound with "How to do it" articles on technical management. One measure of the growing popularity of expressing oneself concerning "The Proper Care and Nurture of Technical Talent" is to review the number of feature articles published in various periodicals. The Harvard Business Review, Personnel and Mechanical Engineering are published at different intervals so it became necessary to reduce these to some common factor describing the relative frequency with which they have published articles on technical management. This common denominator is the average number of articles appearing per publication during each calendar year. The results of this cursory survey are displayed in Figure 2. Since the mid-1950's there has, in at least the three magazines surveyed, been a notable increase in the publication frequency of articles concerning the direction of scientists and engineers as distinct from other industrial groups. Experience in researching other periodicals reveals this

Figure 2
PUBLICATION FREQUENCY OF ARTICLES ON MANAGEMENT OF PROFESSIONAL TECHNICAL PERSONNEL

(IN SELECTED PERIODICALS)



to be a fairly valid observation for the majority of the current popular publications. There are, of course, a few periodicals such as Administrative Science Quarterly, Behavioral Science, and the Academy of Management Journal which are exceptions. Publications such as these specialize in reporting empirically derived data and resulting theory in the over-all field of management and/or human behavior. It remains for interpreters to popularize these writings so their information may be assimilated by practicing management.[1] Just how much of the fundamental data offered by these more exacting publications have found expression in the popular writings is difficult to judge. But, most of the articles found in the current popular periodicals must be classed as reporting of the "voice of experience."

The Validity of Experience

In almost every case these articles, published by practitioners of the art of technical management, report the convictions and beliefs of the authors. These convictions and beliefs are not based upon formal theory or hypothesis but reflect viewpoints developed on the job. These attitudes have evolved in the day-to-day effort to manage an emerging industrial group which seems to have brought new and perplexing problems with it.

The most convincing argument in favor of each of these viewpoints is that the philosophy expressed has worked in the situation in which the author is involved. Were this success merely that of survival alone it might be sufficient in view of the extreme technical

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[1] _____, "Strengthening the Behavioral Sciences," Behavioral Science, July, 1962, p. 277.

competition in effect today. The success, though, of these practitioners is reflected not only survival but, in a great number of cases, growth of their particular enterprises.

Assuming that this context is sound, there is some validity in what these people have said.

Lack of a Unified View

Upon first consideration there appears to be a great deal of disagreement among the many who propose how technical people should be managed. This disagreement stems from the very starting point of most considerations. There is considerable difference of opinion on whether or not the scientist or engineer is different from other industrial employees. As perhaps might well be expected the entire range of opinions on this particular question is represented in the current literature.

The viewpoint that professional-technical persons are a great deal like their fellow industrial employees is represented by such statements as "...research (as the author of the article interprets it) has as yet revealed no great basic difference in personality between scientists and non-scientists."[2] From this interpretation this practitioner further concludes that scientists are not different, after all; "and the management that regards its scientists as different is all the more handicapped in its attempts to understand them."[3] While this particular author refers to scientists, others

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[2]Herbert E. Krugman, "Top-Sacred Scientists?" Personnel, July-Aug., 1955, p. 45.

[3]Ibid., p. 46.

express similar views regarding engineers, thus encompassing the general category of professional-technical employees.

The middle ground in this controversy is represented by other "voices of experience" who say, "In comparison with other company personnel, research and development personnel are different enough to make understanding and handling them a problem. On the other hand they are enough like other company personnel so that the same managerial techniques can be used."[4]

Thus, progressing through the spectrum of opinion we reach what might be classed, by considering the number of adherents, the more predominant opinion that professional-technical employees are different from other industrial groups. Many of the adherents to this viewpoint are themselves managers of professional-technical people who have entered management from a technical profession. Thus, their writings may well reflect the majority opinion of the professional-technical employees who feel "the particular values about themselves and their work that researchers (i.e., scientists and some engineers) bring to their jobs are atypical in the sense that they are by and large strange to the business world."[5] They emphasize differences in basic attitudes between professional and non-professional employees.[6] These "men of science differ as individuals from each other, of course, but they differ even more significantly -- typically and in general --

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[4]C. Wilson Randle, "Problems of R & D Management," Harvard Business Review, Jan.-Feb., 1959, p. 129.

[5]Charles D. Orth, III, "The Optimum Climate for Industrial Research," Harvard Business Review, March-April, 1959, p. 55.

[6]Peter F. Drucker, "Management and the Professional Employee," Harvard Business Review, May-June, 1952, p. 84.

from other people. ...they tend to be logical, opinionated, impatient, intense, thorough, meticulous, reserved and clannish."[7]

Thus, it appears that there is a great deal of difference of opinion among practitioners concerning the entity with which they are dealing. The broadest possible spectrum is represented. It should be recognized that these opinions are based upon individual experience which must also represent the broadest imaginable spectrum. To imagine a few of these possibilities, some of the writers may reflect the experience and viewpoint of the old established industrial manager who is certain he knows people and, obviously, engineers and scientists are people. His viewpoint might be substantiated by the less experienced supervisor whose observations prove to him that professional-technical people are not freaks and misfits and therefore the claimed differences appear as exaggerations. This end of the spectrum perhaps also includes the technically trained professional employee who doesn't want to be different. On the other hand there is the technically trained manager inexperienced in the other phases of modern industry who tries to utilize "tried and true" management tools and finds he cannot make these tools work. He might well decide that the people (i.e., his employees) will not accept these managerial efforts and therefore must be different from other industrial groups (whose characteristics he does not know). Then, of course, there are those among the professional-technical employees who enjoy being different and will try to create and perpetuate that general belief. Thus, from a variety of experience comes a somewhat discordant voice.

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[7]Orth, op. cit., p. 57.

In the midst of all this disagreement almost all of these writers attribute certain characteristics to professional-technical employees. They feel these employees possess some measure of creativity, are highly intelligent, and for the most part dedicated to their work.

From this confused starting point it is reasonable to expect that there should be similarly divergent viewpoints on how professional-technical personnel should be managed. Some practitioners feel the management of scientific and intellectual manpower requires administrative practices different from those used in other fields.[8] Just exactly how these practices should differ from "convention" are left undefined other than to point out the feeling that these creative employees should be managed by relatively open organizational systems in contrast to the more closely controlled and regulated management systems in use in other industrial groups.[9]

Retreating from this position there appears to be evidence from experience that there should be less favoritism, less babying, and less motivational research and similar ethereal approaches to managing technical employees if output (both volume and quality) is to reach higher levels.[10] Progressing toward the other extreme, there are those who feel that "...management in research and development establishments (i.e., management of scientists and engineers) does the same as

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[8] Val Cronstedt, Engineering Management and Administration, McGraw-Hill Book Co., Inc., New York, 1961, p. 10.

[9] Louis B. Barnes, Organizational Systems and Engineering Groups, Harvard University, Division of Research, Boston, Mass., 1960, pp. 164-165.

[10] Elmer J. Tangerman, "The Management Pendulum Swings," Product Engineering, Feb. 6, 1961, p. 10.

management everywhere. It is engaged in those activities essential to good management."[11,12] This viewpoint is hedged a little by recognizing that the problems in managing professional-technical employees might be different from those encountered in managing other industrial groups.[13] An extreme viewpoint on the management of technical groups is represented by claims that "the same processes of management that maximize capital effectivity can also increase the effectiveness of dollars spent in research and development."[14]

It is interesting to note that over the past decade there has been a swing in the opinion expressed by some practitioners. In the early 50's there was some detectable agreement that, being different, scientists and engineers had to be handled in a special way. From this viewpoint opinion has progressed to recognition of the usefulness of more conventional managerial techniques. One striking example of this changing opinion is found in the writings of Peter F. Drucker. In 1952 Mr. Drucker felt that the best way to manage professional-technical employees was to recognize that they are different and, being different, must be handled in ways unlike other industrial employees.[15] He proposed to find the "friction

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[11] George W. Howard, "A Philosophy for R & D Managers," Research/Development, Nov., 1961, p. 93.

[12] Philip Marvin, "Engineering Productivity," Machine Design, April 12, 1962, p. 106.

[13] Howard, loc. cit.

[14] Burton F. Barrows, "Scientific Management in Science," The Management of Scientific Talent, American Management Association Report #76, Edited by J. W. Blood, 1963, p. 194.

[15] Drucker, op. cit., pp. 84-85.

points" between these employees and the industrial organization and to "lubricate" these points.[16] Mr. Drucker felt that the traditional administrative process was one of these friction points. By 1963 Mr. Drucker's attitude had been modified somewhat. Although he now addresses his remarks at scientists rather than the broad category of professional-technical personnel, it appears reasonable to assume that his viewpoint would be applicable to engineers as well. Mr. Drucker expresses the opinion that "actually researchers, like other people in a business, produce the most when the demand for economic results are high."[17] "The researcher who can not be effectively supervised requires sharper organization defined objectives, closer watching to assure his hard work, and greater insistence by management for significant results."[18]

Thus, while there appear to be widespread differences of opinion on how to manage professional-technical employees, these differences are not perhaps so vast as they seem but merely represent the variety of managerial experience, the wishes of some individuals, or the swing of popular opinion over the years.

What Do the Practitioners Agree Upon?

One point upon which almost all practitioners agree is that creative people (e.g., the professional-technical person) are individuals. As an individual, they agree that he should be managed

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[16] Ibid., p. 86.

[17] Peter F. Drucker, "Twelve Fables of Research Management," Harvard Business Review, Jan.-Feb., 1963, p. 105.

[18] Ibid.

as an individual rather than in a more impersonal way. From this viewpoint the factor most apparent in successful management of professional-technical persons appears to be the motivation of the individual.[19,20] Individuals can be motivated by an almost endless variety of stimuli to act in ways beneficial or detrimental to the organization. Thus, those practitioners recognizing the role of motivation feel that the efforts and actions of managers and supervisors play a very important part in employee motivation.[21,22,23,24]

From the confusion of widely varied viewpoints there appears a certain unity among the practitioners as to the importance of good management within technical organizations. This good management they feel should include not only proper utilization of technical talent through such things as adequate facilities and sufficient clerical and technical assistance but must also include techniques of control and review normally considered a part of good management

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[19]Lauren B. Hitchcock, "Increasing the Payoff on Research and Development," The Management Review, Oct., 1959, pp. 10-11.

[20]Robert J. Hoe, "Managing the Engineering and Research Laboratories," Managing Engineering and Research, Ed. Delmar W. Karger and Robert G. Mordick, Industrial Press, New York, 1963, p. 504.

[21]Charles D. Orth, III, "More Productivity from Engineers," Harvard Business Review, March-April, 1957, pp. 61-62.

[22]Estill I. Green, "Conservation of Technical Manpower," The Management of Scientific Talent, American Management Association Report #76, Edited by J. W. Blood, 1964, pp. 195-198.

[23]Hugh F. Colvin, "Controls for Research & Development," Controls and Techniques for Better Management, American Management Association, General Management Series #176, 1953, pp. 24-34.

[24]H. M. Miller, "The Day-to-Day Supervision of Engineers," Optimum Use of Engineering Talent, American Management Association, The Riverside Press, Cambridge, Mass., 1961, p. 243.

in other employee groups.[25,26] Beyond all this it appears to most of the experienced managers that major strides in improving technical productivity lie within the realm of proper motivation of the individual.

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[25] Green, loc. cit.

[26] Colvin, loc. cit.

CHAPTER III

BEHAVIORAL SCIENCES

The babble of the voices of the practitioners of the art of technical management, while not quite as bad as it might at first seem, nonetheless does present a picture of some confusion and some indecisiveness. Even those who agree that motivation is very important often disagree on how such motivation may be best implimented. It might be well, then, to take a look at the management of professional-technical personnel from a more dispassionate viewpoint.

Since the management of men implies the necessity for control of their behavior, it would be worthwhile to know something about this behavior. This is not something new to consider. Man has pondered the question of behavior for some time although he has only recently (within the past century) begun to apply scientific methodology to this effort.[1] The study of man's behavior encompasses a broad range of academic disciplines. Psychology is obviously one of these. Perhaps equally important are the fields of anthropology and sociology. The behavioral sciences should also include such studies as economics, political science and linguistics since these factors play a major role in the behavior of man.[2] All of these

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[1] _____, "Strengthening the Behavioral Sciences," Behavioral Science, July, 1962, p. 276.

[2] Ibid.

are currently considered behavioral sciences at least insofar as they shed some light on behavioral problems.

If the study of behavior is truly a science, then perhaps it falls victim to the same problems facing other scientific fields. It appears that in the scientific disciplines concerned with physical phenomenon each new discovery serves not only to shed some additional light on the question under consideration, but, at the same time, to point out new and hitherto unconsidered areas in need of investigation. This paradox might be paraphrased by saying the more you find out the less you know. Thus, while behavioral science can offer a great deal of enlightening information, there are those who feel that this branch of knowledge is still in its infancy.[3] From such an infant state this discipline cannot be expected to provide pat answers to particular management problems.[4] With these limitations in mind one proceeds into a mass of concepts and theories which are available to explain human behavior. For the most part these theories can be unified to a great extent and thus reduced to what appears to this writer, at least, to be the basic concepts.

Cause and Effect

One plausible concept which can act as a starting point for determining the answer to the question of why people act as they do would be that there is some cause and effect relation involved in the behavior of people. This concept says that persons must have

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[3]Maneck S. Wadia, "Management Education and the Behavioral Sciences," Advanced Management, Sept., 1961, p. 10.

[4]Ibid.

reasons for their behavior even if these reasons appear irrational to others.[5] These reasons or causes of behavior include an unlimited number of considerations. Individuals, as seen by the behavioral sciences, are integrated composites of their social, economic and religious backgrounds. Their experiences, their expectations, current conditions, etc., all play some part in their behavior.[6] Indeed, the life history of an individual _is_ his personality according to one author.[7]

This cause and effect relationship in individuals may be described as a four-part sequence of stimulus, organism, behavior, and accomplishment.[8] Stimuli include physical and mental inputs, environmental conditions, and other such conditions or changes in conditions met by the individual. The organism involved is the individual who is, as pointed out above, a composite of heredity, society, knowledge, skills, needs, attitudes, values, etc. The stimuli acting upon this organism will produce behavior such as body movements, vocal and physical expression, emotional response, and thinking. Through these behavior patterns the individual produces an accomplishment the effect of which is to reduce or change the stimulation involved.[9]

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[5]Mason Haire, _Psychology in Management_, McGraw-Hill Book Co., Inc., New York, 1956, p. 44.

[6]Chris Argyris, _Personality and Organization_, Harper & Bros., New York, 1957, p. 21.

[7]C. A. Dailey, "The Life History as a Criterion of Assessment," _Journal of Counseling Psychology_, 1960, Vol. 7, p. 22.

[8]Norman R. F. Maier, _Psychology in Industry_, 2nd Edition, Houghton Mifflin Co., New York, 1955, p. 18.

[9]_Ibid._, p. 21.

From this cause and effect chain relation, it appears that in order to alter behavior or accomplishment or both one must change either the stimulus or the organism.[10]

In terms of the industrial situation it can be recognized that management provides at least part of the stimuli and the organism comes at least partially ready-made (however crudely) in the form of the employee. Thus, management may alter the behavior of its employees by altering the stimuli or the individual employee or both.

Management may well feel it can alter the individual (the organism) to some degree since it can introduce experiences which will change his behavior by altering his skills, knowledge, attitudes, values, etc. An extreme example of the effectiveness that can be achieved in this respect is the "Brain Washing" accomplished by the Communists during the Korean War. But, such drastic alterations of the individual take time and considerable effort. Thus, if management is to affect some control over the behavior of its employees, it appears that it should not expend an inordinate amount of effort to alter the individual but perhaps should concentrate upon tailoring the stimuli used to the individuals concerned.

The Individual and His Need Structure

A problem in analyzing industrial employees as a group might be foreseen in light of the necessity for recognizing individuals as individuals. While it is true that each individual has his own private way of seeing and experiencing the world around him, these individuals are at the same time very much alike for a variety of

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[10] Ibid., p. 19.

reasons.[11] Some portion of his personality is derived from biological roots. The worker is born, reared and lives in a cultural situation and must adjust to the traditionally defined expectations of that culture. He is like others because he depends upon others for his own development. And, like all employees, he experiences satisfaction and disappointment. In this context, industrial employees may be viewed as having some characteristic psychological unity. What then are the characteristics of this group?

One of man's basic characteristics is need. He always needs something. As soon as one need is satiated other previously unseen needs demand attention.[12] If this need development is viewed on the basis of income, there appears to be an order to the satisfaction of these needs. Those persons of very low income use their income to satisfy the basic necessities of life. These are the needs for food, shelter, clothing, etc. As income rises and the basic necessities of life are satisfied, needs arise for health and education. Beyond these two levels persons acquire special needs for luxuries, social position, and power.[13] This order of satisfaction on the basis of income might be classified into three other categories. There are those physiological needs, represented by the first two levels above, which must be satisfied before the individual recognizes his social needs.[14] These social needs would include the necessity for companionship, giving and receiving affection and protection from

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[11] Argyris, op. cit., pp. 48-49.

[12] Haire, op. cit., p. 19.

[13] Maier, op. cit., p. 387.

[14] Argyris, op. cit., p. 32.

loneliness. Beyond the social needs are the egoistic needs. The desire for social position is one manifestation of such egoistic needs.[15] One very definitive outline of the individual need structure has been advanced by A. H. Maslow.[16] Maslow claims there is an hierarchy of needs, the satisfaction of which, to some extent, depends upon the satisfaction of all the lower needs in this hierarchy. This structure begins with the basic physiological needs and proceeds upward through the needs for safety, love, esteem, and self-actualization. The breakdown into physical, social and egoistic needs is still apparent.

To the man deprived of everything, the most important problem in the world becomes the satisfaction of his basic physical needs. These include his hunger for food, water, and air; his need for sleep or rest when he is fatigued; the necessity for maintaining some measure of control over his temperature; the requirement for exercise and stimulation and on and on through a list of physiological needs. Without these necessities nothing else will be important. Unless these physiological needs are satisfied freedom, love, respect, philosophy, etc., will be waved aside. But once these physiological needs are cared for, other needs begin to arise. In spite of the claims that nearly one-fifth of the population of this country is poverty stricken, very few of the population are actually starving.[17] Thus, with a few exceptions, today's society in this country adequately satisfies this

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[15] Haire, op. cit., pp. 20-24.

[16] A. H. Maslow, Motivation and Personality, Harper & Bros., New York, 1954, p. 8.

[17] _____, "Poverty USA," Newsweek, February 17, 1964, p. 20.

level of need. Physiological needs, therefore, in the context being considered contribute little in the behavior of individuals, particularly professional-technical personnel.

Thus relieved of the physiological needs, man progresses to his next higher level of needs. These are the needs for protection from danger, for shelter, clothing, and for freedom from threat and deprivation. These are the safety needs. The individual will behave as necessary to keep himself from experiencing the unexpected. In this area industrial unions have played a part in reducing these needs to a relatively inactive state. Through unions workers find at least partial guarantees of such things as job security and protection from financial distress through illness. A great number of workers, not members of any union, enjoy similar guarantees through industry policy on layoff, sickness, etc. Still others, particularly the professional-technical employee, finds this security through a high level of individual bargaining power.[18] Even though relatively well satisfied, it may be seen that safety needs are still somewhat active. Union members, for example, are often quite jealous about their seniority positions even in the midst of plenty.

When the physiological and safety needs are somewhat satisfied, a further need arises which becomes an important factor in the individual's behavior. This is the need for belonging, for giving and receiving love. Maslow calls this the love and affection and belongingness need.[19]

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[18] Carl Frey, "Supply and Demand Outlook and Its Effect on Salary Levels," Research Management, Nov., 1963, pp. 411-413.

[19] Maslow, op. cit., p. 89.

Beyond these needs for love and even when this more complex need (love) is not fully satisfied, is an area of needs related to the individual's ego, his self-esteem, and his reputation.[20] Individuals reaching this level in the hierarchy seek self-confidence, independence, and achievements recognition, in addition to the appreciation and deserved respect of his fellows. These might be termed the ego-demand satisfactions or the esteem needs. As the need structure proceeds upward from this point, man recognizes a need for self-actualization or self-fulfillment.[21] People desire to realize their own potentialities and to be creative at this highest level. Thus, man has an endless variety of psychological needs. As soon as one level of needs is satisfied, a higher level becomes apparent.[22]

The need structure, though, is not a single line with distinct levels. Once the physiological needs of man are satisfied, all of the other needs may begin to express themselves even though the safety need may be most pronounced. Once safety needs are fulfilled, the order of importance of these various needs may shift so that the structure becomes less rigid yet.[23] One way of visualizing this structure is presented in Figure 3. As can be seen from the figure, need levels may be bypassed, or developed simultaneously in some cases. In

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[20] Ibid.

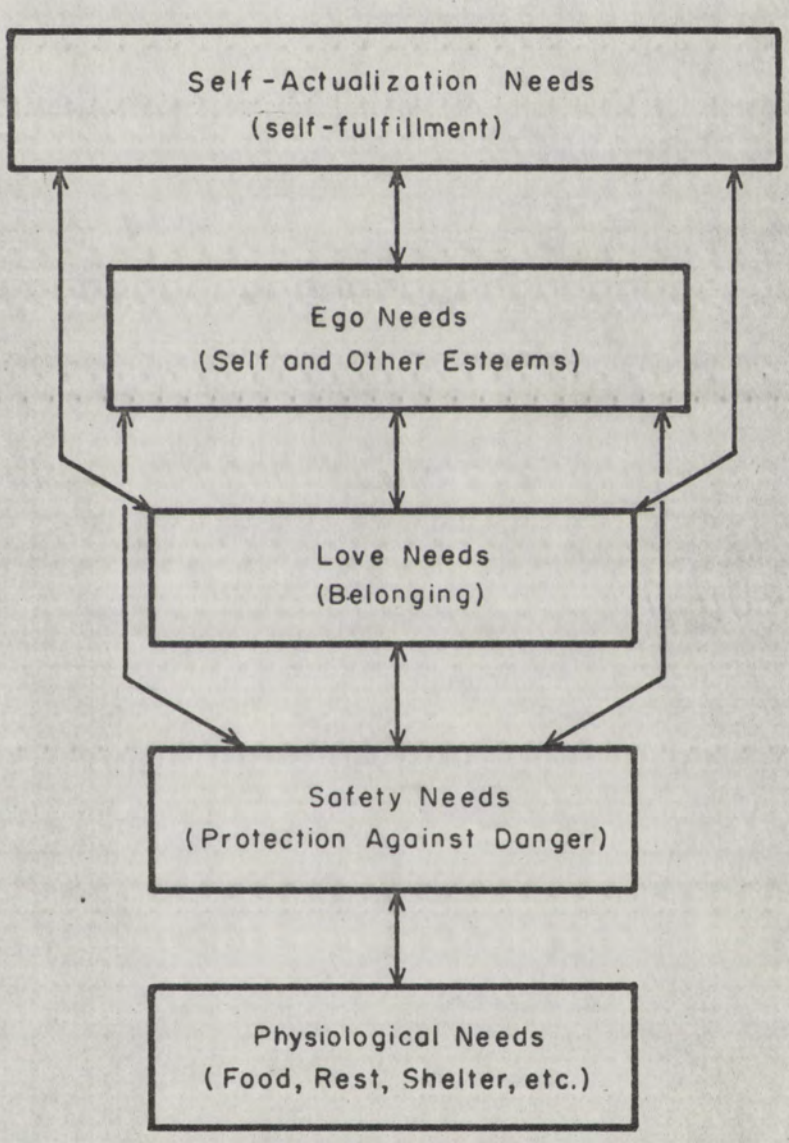
[21] Douglas M. McGregor, "The Human Side of Enterprise," Human Relations in Management, Edited by I. L. Heckmann, Jr., and S. G. Huneryager, South-Western Publishing Co., Cincinnati, Ohio, 1960, p. 149.

[22] Ibid., p. 147.

[23] Maslow, op. cit., pp. 98-101.

Figure 3

MASLOW NEED STRUCTURE



the present industrial situation and particularly with the professional-technical employee (i.e., creative people), it would seem apparent that the more complex needs become important factors in the behavior of individuals.

Self-Actualization

Assuming for the moment that the most advanced of these needs (i.e., the need for self-actualization or self-fulfillment) is active in the professional-technical employee, what might be the manifestations of this high order need? Persons with a highly developed sense of need for self-actualization are seen by the behavioral scientist as individuals with certain distinct characteristics.[24] Among these are such things as a realistic orientation toward life. These people accept themselves, other people, and the world about them for what they are, without pretense. Such persons are problem-centered rather than self-centered people. They tend to be autonomous and independent thus seeming detached. They are jealous of their privacy, resist conformity, and have a great fund of creativeness.[25]

These characteristics appear to be expressions of the very attributes which the practitioners point to as the problems with professional-technical personnel.[26,27] Thus, it appears reasonable to

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[24] Dr. Ralph D. Norman, Employee Development, Speech before Sandia Corporation Management Development Conference, Albuquerque, N. M., March, 1962.

[25] Ibid.

[26] Charles D. Orth, III, "The Optimum Climate for Industrial Research," Harvard Business Review, March-April, 1959, p. 57.

[27] Elmer J. Tangerman, "Horizons," Product Engineering, Nov. 13, 1961, p. 4.

assume that professional-technical employees (as a group) have at least some noticeable need for self-actualization.

What is this high order need, then, and how is its fulfillment accomplished? According to one author, the degrees of fulfillment of the need for "self-actualization" may be determined by studying the degree to which each of seven factors of individual development are met.[28] These factors are:

1. Development from a state of passivity to one of increasing activity.
2. Development from a state of dependence upon others to one of relative independence.
3. Development from a limited behavior pattern to multiple, more complex behavior patterns.
4. Development from erratic, casual and shallow interests to deeper interests characterized by challenge.
5. Development from a short time perspective to one of increasing length involving the exercise of foresight.
6. Development from a subordinate social position to a superordinate position relative to one's peers.
7. Development from a state best described as a lack of self-awareness to a state of awareness of and control over one's self.

At the same time, though, the same author expresses the opinion that the well developed individual is not one who totally fulfills these needs (i.e., not one who has developed each of these factors to

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[28] Argyris, op. cit., p. 50.

its limit) but instead is one who has achieved a balance between these needs for development and the needs of the organization, be it society or industry.[29]

Considering that the professional-technical employee has a more highly developed need for self-actualization (or at least as a group display more of the manifestations of this need), it might be well to reconstruct the need structure presented in Figure 3. One possible arrangement of such a reconstructed need structure is presented in Figure 4. Here ego and love needs are shown on the same level superimposed upon the safety and physiological needs and providing the stepping stone to three areas of self-actualization. These three areas are broad categories which include the seven factors given above. In our present-day society where almost everyone, and certainly the highly trained professional-technical person, has his physiological and safety needs fairly well satisfied, this modified structure perhaps gives a clearer presentation of the relationships of the various needs of the individual.

Application to Technical Management

A problem exists in the management of the professional-technical personnel in correlating the needs of the individual and the needs of the organization. The term "management" implies control. Since the output of the professional-technical employee is primarily a product of his mind rather than his hands or a machine, technical management

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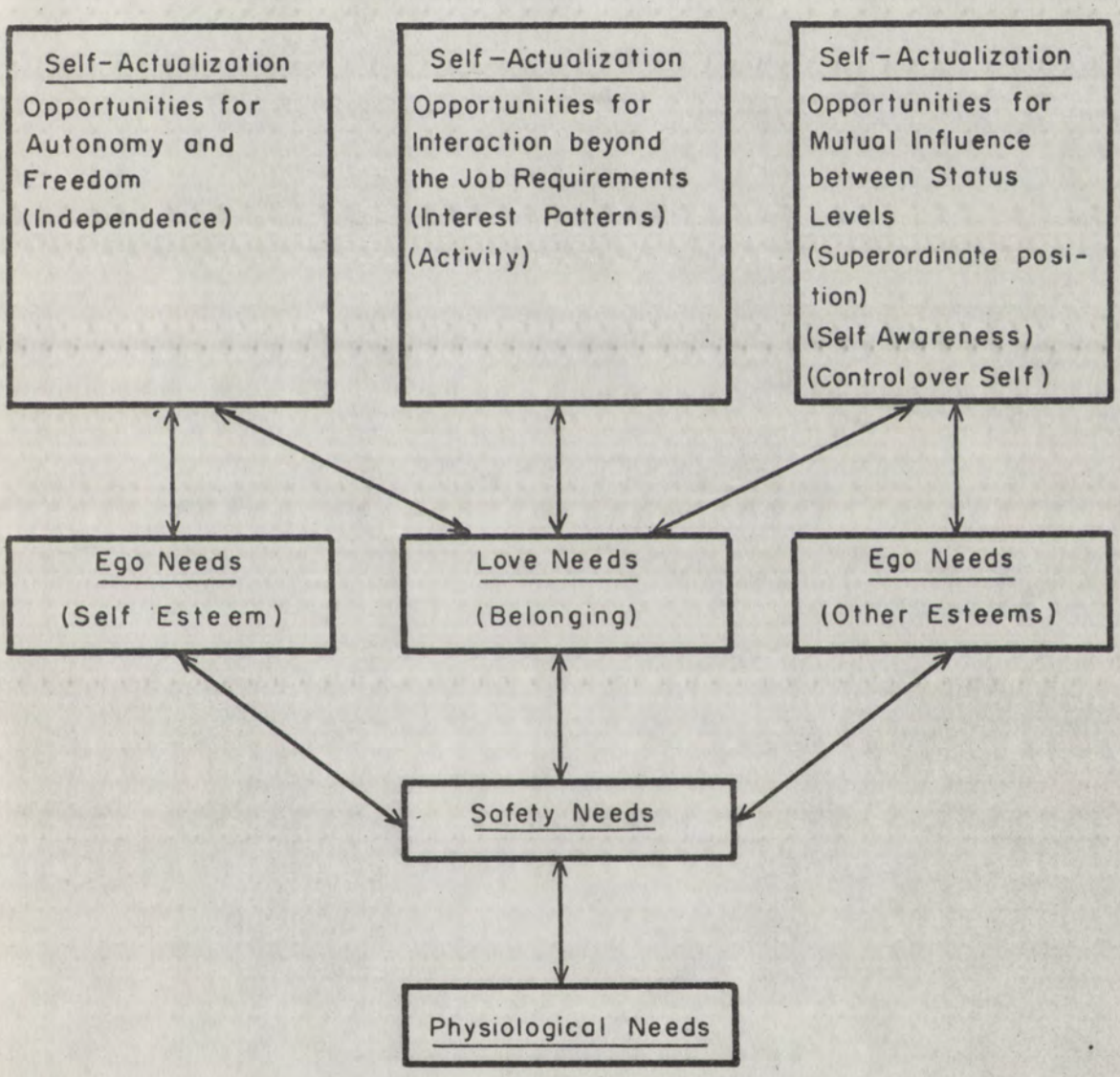
[29]Argyris, op. cit., pp. 51-52.

Figure 4

SUGGESTED NEED STRUCTURE OF PROFESSIONAL TECHNICAL PERSONNEL



Source: Louis B. Barnes, Organizational System and Engineering Groups, Harvard University, Division of Research, Boston, 1960, p. 168.

implies control of the mental capacities of human beings.[30] "The success of any form of social influence or control depends ultimately upon altering the ability of others to achieve their goals or satisfy their needs."[31] The problem thus becomes one of utilizing this theory of needs advanced by the behavioral scientists in the day-to-day practice of management. How do you best motivate employees to affect the desired behavior and thus exercise some measure of control over them?

Part of the answer to this question might perhaps come from the practitioners. According to some opinions, the technical person is already highly motivated toward his own goals. Evidence of this is found in the requirements for professional training involving years of schooling and some degree of specialization. It appears then to some practitioners that the primary function of management is to provide a climate which is least likely to inhibit this self-motivation.[32] This viewpoint is supported by the realization that in today's industrial situation it is highly unlikely that anyone, technical or nontechnical, is working to his physiological limit. Thus, it should be possible for individual productivity to be improved markedly.[33] If individual output is presently at some level below the physiological

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[30]Clinton J. Chamberlain, "Coming Era in Engineering Management," Harvard Business Review, Sept.-Oct., 1961, p. 91.

[31]Douglas McGregor, The Human Side of Enterprise, McGraw-Hill Book Co., Inc., New York, 1960, p. 20.

[32]Horace A. Secrist, "Motivating the Industrial Research Scientist," paper presented at conference on Creativity in an Organizational Environment, Harvard University, July 22, 1959.

[33]Haire, op. cit., p. 140.

limit, then there must be something which keeps it down (e.g., group pressure, individual confort, safety, etc.). Conversely, something must be present to keep productivity from dropping to zero (e.g., group pressure, self-respect, economic pressure, etc.). Individual effort then must be in equilibrium between the positive forces tending to push it up and those negative forces which tend to restrain it.[34] A new balance at a higher level may be achieved by either increasing the pressures to improve productivity or by reducing the effect of those negative factors which are keeping output down. Because each effort to bolster productivity by pushing it up meets increasing resistance from the restraining or negative forces, it appears reasonable that more effect might be produced by reducing the restraining negative forces.[35] In other words, it might be worthwhile to provide a climate which is least likely to inhibit self-motivation.

It should be recognized that there are many ways to stimulate people to achieve the desired behavior. Among these is stimulation by crisis. Certainly the Manhattan Project during World War II is a striking example of this type of stimulation. Some persons are stimulated by the desire for service to their company, their community, or to mankind. A great number of professional-technical persons, particularly those involved in the scientific research fields, are stimulated by the joy of the work itself. Most important, though, people are stimulated to the desired behavior by good management.[36]

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[34] Ibid., p. 141.

[35] Ibid., p. 144.

[36] Clement J. Berwitz, "Beyond Motivation," Harvard Business Review, May-June, 1960, pp. 123-125.

Since we are concerned with management aspects of the problem, the question then arises, "What is good management?"

From the viewpoint of the behavioral scientists, good management might be defined as the recognition of the needs of the individual and support by management in the individual's effort to fulfill these needs. This definition is perhaps expressed more succinctly by Rensis Likert who claims "the leadership and other processes of the organization must be such as to ensure a maximum probability that in all interactions and all relationships with the organization, (each member) will in light of his (own) background, values, and expectations (i.e., his need structure) view the experience as supportive and one which (contributes to the satisfaction of his needs)."[37] Thus, there appears to be general agreement between the theories of behavioral science and the opinions of some of the practitioners.

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[37]Rensis Likert, New Patterns of Management, McGraw-Hill Book Co., Inc., New York, 1961, p. 103.

CHAPTER IV

RESEARCH ON THE SUBJECT

When a particular subject receives a great deal of popular interest over an extended period, someone is sure to conduct a research effort in that field. The art or science, whichever it might be, of management is one such subject. The problem of how to manage people has attracted a great deal of popular attention particularly since the advent of "Scientific Management" at the beginning of this century.[1] For the past few years there has been a growing interest, as indicated in Chapters I and II, in the how's and why's of technical management as a distinct subdivision within the broader classification of management. Thus, in addition to the background of research into management in a general sense comes a more recent research effort into the management of professional-technical personnel. But, not all of the relevant research on this problem is directed solely at the management of professional-technical personnel. There are other allied fields which can provide information of significance to this subject as well. Some of the research performed by the behavioral scientists has direct applicability to the questions of technical management.

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[1] Dale Yoder, Personnel Management and Industrial Relations, Third Edition, Prentice-Hall, New York, 1948, pp. 49-50.

As with any research one must be concerned with the validity of the conclusions reached. All of these various research efforts produce data. The data may or may not reflect the truth and may or may not include bias intentionally or unintentionally introduced. From such data the researcher draws conclusions which in many cases are the only parts of the whole program which find their way into print and are thus available in readily accessible published form. In such cases where only conclusions are presented and all of the background information left out there is no way short of additional research to even superficially judge the validity of the effort. Even when complete information leading to the conclusions is available the conclusions are in many cases based upon subjective evaluation of the data and thus sometimes open to question.

Added to the problem of validity is the problem of digesting the quantity of directly and indirectly applicable research based conclusions. Any evaluation must use, to some extent, subjective judgment as to what is relevant and what is not; what to include and what to reject.

Thus, faced with the many problems of evaluating research while keeping this evaluation brief, a great deal of selection was necessarily exercised in picking the research programs to be included in this review. Those authors who claimed substantiation of their results simply "on the basis of research conducted" without defining or elaborating on their research were not considered. Further, the search was limited by including only those research efforts which were most obviously applicable to the problems of managing professional-technical personnel as distinct from other industrial groups. This

selection necessarily eliminates a number of works of more indirect -- but nonetheless contributory -- nature. Over and above these considerations was of course the limitations of availability. Those efforts as yet unpublished or published in such limited form as to be unavailable (e.g., proprietary corporate reports) were simply left out of consideration except as portions of them might appear in other literature.

On the basis of these considerations, then, several research efforts emerge.

Characteristics of Engineers and Scientists

One of the basic differences of opinion among the practitioners of technical management concerns the characteristics of professional-technical personnel. Are these people different from the "standard industrial employees" or are they much the same? As part of a study conducted by the Bureau of Industrial Relations at the University of Michigan, a group of 170 engineers and scientists and a second group of 95 of their supervisors were questioned concerning the existence or non-existence of such differences.[2] After a very careful selection process to assure themselves they were getting a representative sample, this group of researchers asked the rather leading question, "Do you feel that engineers and scientists as a group differ from other groups of workers like technical, clerical and manual workers, particularly in regard to their goals, needs, and personality traits? If you do, in what ways are they different?"[3] In spite of such a

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[2] Lee E. Danielson, Characteristics of Engineers and Scientists, Bureau of Industrial Relations, University of Michigan, Ann Arbor, Michigan, 1960.

[3] Ibid., p. 7.

leading question, 39% of the professional-technical employees and 17% of their supervisors expressed the opinion that they were not significantly different from other industrial groups.[4] In addition, those who answered the question affirmatively were far from unified in their opinion as to how they differed. The persons conducting the survey were able, though, to classify the voiced opinions into differences in:

Personality traits

Approach to the job

Goals

Supervision required

Recognition desired.

Even within these categories there was a broad variety of opinion.

The conclusions drawn by the author of the report on this portion of the research was that the importance of any difference is overshadowed by the mixed feelings of the group as to whether such differences existed and what the difference might be. Professional-technical workers, as this portion of the study would indicate, are a mixed group without any general concurrence as to their own characteristics. Beyond this, the conclusions reached and the opinions offered on this portion of the research appear to be primarily subjective.

One such subjective conclusion offered by the University of Michigan group was that professional-technical persons desire to be

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[4] Ibid., p. 8.

treated (i.e., managed) as individuals and not as a group.[5] While this conclusion is based to a great extent upon subjective observations, the existence of this desire is fairly well substantiated by the inclusion of many comments gleaned directly from the interviews. Thus, Professor Danielson found a need for treating scientists and engineers as individuals because of their desire for such treatment and because of the wide divergence in the characteristics of the individuals comprising this group.

Motivation and Productivity

Assuming a professional-technical employee is capable of working (i.e., he is mentally and physically able) and capable of handling the job he faces (i.e., his education and experience supply him with the proper tools) there is a general feeling on the part of the practitioners that his productivity will bear a direct relationship to his motivation.[6,7,8] In an effort to evaluate this hypothesis Dr. Donald C. Pelz working with the Survey Research Center of the Institute for Social Research at the University of Michigan conducted an abbreviated survey in 1955. He interviewed 19 professional-technical individuals of one firm. During the interview he asked

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[5]Donald C. Pelz, "Motivation of the Engineering and Research Specialist," Improving Managerial Performance, American Management Association, General Management Series #186, New York, 1957, p. 119.

[6]Charles D. Orth, III, "The Optimum Climate for Industrial Research," Harvard Business Review, March-April, 1959, p. 58.

[7]C. Guy Suits, "The Managability of Scientific Research," The Management of Scientific Talent, Ed. J. W. Blood, American Management Association Report #76, 1963, p. 25.

[8]George W. Howard, "A Philosophy for R & D Managers," Research/Development, Nov., 1961, p. 101.

such bald faced questions as: "What motivates you, anyhow? What are you striving for? What keeps you going?"[9]

Pelz ranked each of these 19 individuals on a seven point scale as to how well motivated they were. These data were then compared to the performance of each man. This performance evaluation, based upon company records, rated each individual on the basis of the pooled judgment of several supervisors. The result was a merit ranking of the men being studied. To this general rank order a correction was applied to account for time of service since it was felt that this factor affects merit ranking. The result of this project is displayed in Figure 5. This plot would tend to indicate a definite positive correlation between motivation and performance. Dr. Pelz even explains the one highly motivated low performing individual. Secrecy requires his separation from his supervision as well as the rest of the group thus preventing the development of a true appreciation of his efforts.

Management and Motivation

Assuming, then, that motivation can make a marked difference in the productivity of scientists and engineers and the obvious question arises: How can high motivation be created and maintained? Since management is to some extent responsible for motivation then an analysis of management techniques and their effect on motivation seems in order. This is precisely the direction taken by the Institute for Social Research Study. As a part of this study of motivation and productivity among engineers and scientists the Institute considered several factors that they felt might affect the individual in these

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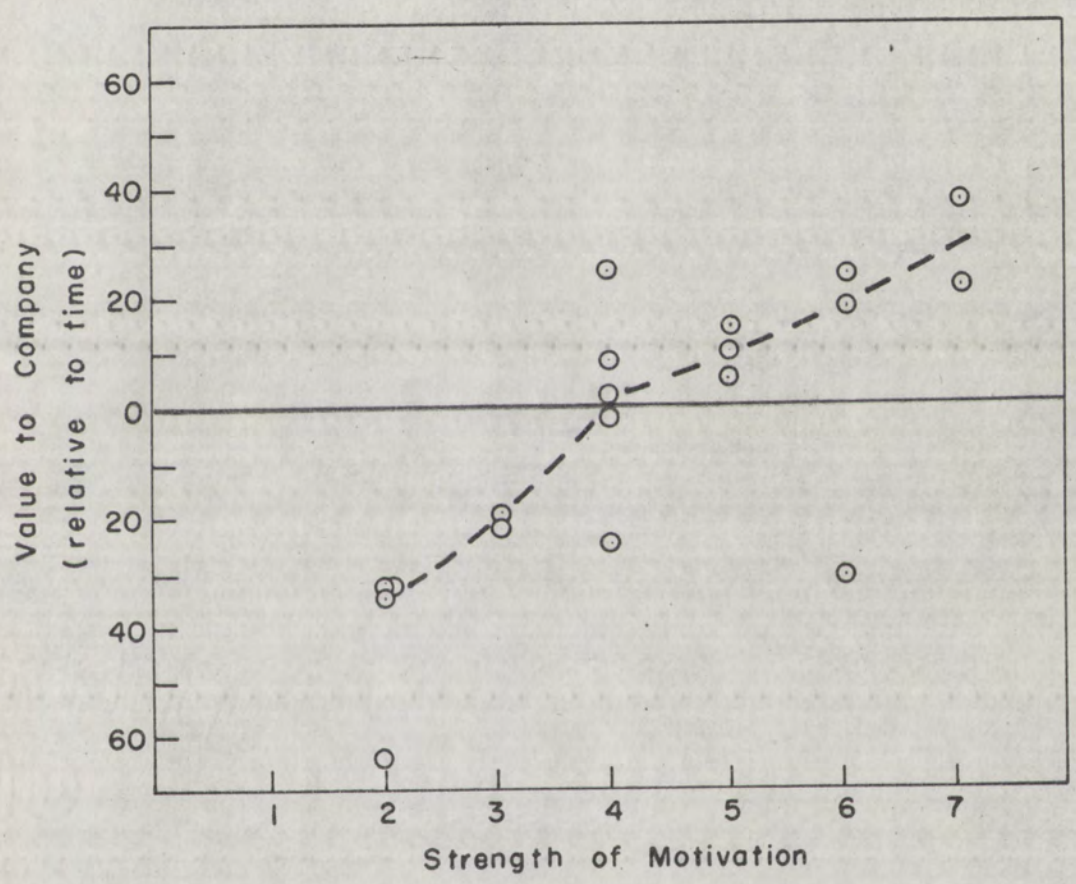
[9]Pelz, op. cit., p. 26.

Figure 5

MOTIVATION AND RESEARCH PERFORMANCE OF 19 TECHNICAL MEN AND GROUP HEADS



Source: Donald C. Pelz, "Motivation of the Engineering and Research Specialist", Improving Managerial Performance, American Management Association, General Management Series # 186, New York, 1957, p. 27.

two areas. It was found that such things as age, the basic orientation of the individual scientists or engineer (i.e., maintenance oriented or achievement oriented) and the availability of funds have some effect on productivity. Output was even found to be related to the individual's choice of colleagues. More important, though, are the findings of the Institute concerning the effect of various managerial approaches on the productivity of professional-technical personnel. It was revealed that a significant positive correlation exists between productivity and freedom (i.e., freedom to choose what to work on and how to conduct the work). For the purpose of this study the Institute divided the spectrum of management approaches into three categories: "underdirective," "overdirective," and "participative." The "underdirective" and "overdirective" approaches represent the two extremes of the available managerial approaches; abdication and total authoritarianism. The "participative" leader is one who avoids dominating the individual subordinates but on the other hand does not ignore them. He shows an active interest in his employees and their development but avoids the temptation to interfere or inject himself into their work.[10]

From a study of data gathered about technical performances and technical freedom several important points came to light. Plotting independence versus performance of scientists, Dr. Pelz found under certain conditions a positive correlation between these two factors while under other conditions a negative correlation. The third factor which seemed significant in altering the correlation was contact with the supervisor. Figure 6 is a display of these data. On the

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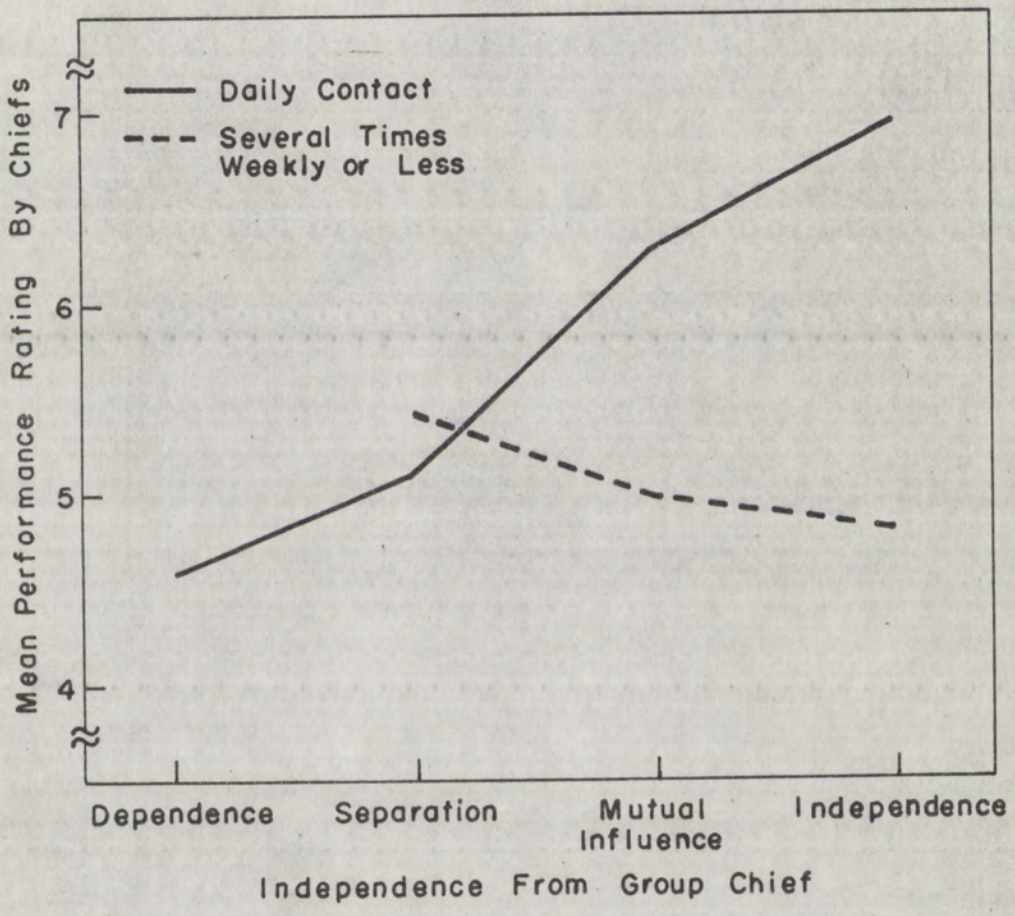
[10]Pelz, op. cit., p. 34.

Figure 6

SCIENTIFIC PERFORMANCE VS INDEPENDENCE FROM GROUP CHIEF, AND CONTACT WITH CHIEF



Source: Donald C. Pelz, "Motivation of the Engineering and Research Specialist", Improving Managerial Performance, American Management Association, General Management Series # 186, New York, 1957, p. 33.

independence scale (abscissa), "Dependence" is the condition where the supervisor informs the subordinate what he is to do and in some cases how he is to do it. The individual employee has little if anything to say about his work. Under "Separation" neither the employee nor his supervisor has much to say about the work. Although not explicitly stated by Pelz, it is assumed by the author that this level represents the condition where the organization has so little latitude that little or no influence on the work may be exerted by superior or subordinate. The term "Mutual Influence" represents that situation where both the supervisor and the subordinate affect some measure of influence over each other and the job. In the sense that the two categories of "Dependence" and "Separation" represent "overdirective" management (i.e., the individual employee has little or no control over his work), the "Mutual Influence" category represents "participative" management.

The category of "Independence" on Figure 6 represents that condition where the scientist asserts a large measure of control over his work with very little influence exerted by his supervision. Here the type of supervision associated with the degree of independence is not quite so straightforward as in the other categories. Those individuals who experience a high degree of independence in their work and who seldom see their supervisor (i.e., interact with him) are being managed in the "underdirective" sense. On the other hand a high degree of independence and frequent supervisory interaction may be classified more as "participative" management.

Having previously concluded that performance is dependent upon motivation and that motivation to at least some extent is modified by management action, Dr. Pelz further concludes that the "participative"

form of management results in higher motivation and thus higher productivity than do the other forms of management studied.[11]

The results of another study, conducted by the Survey Research Center (a division of the Institute for Social Research of the University of Michigan) can be considered further substantiation of the conclusion that the participative approach to management results in greater productivity.[12] This earlier study conducted on office workers found, among other things, that the attitude of supervision toward employees was a significant variable between high and low producing groups. The supervisory attitude in the high producing groups was employee centered while that in low producing groups was production centered.[13]

Such findings are not universally supported, though. Another research study (on production workers) found that while employee satisfaction (i.e., attitude toward the job) was higher under employee centered supervision, productivity, at least in the situation studied, was higher under more authoritative leadership.[14]

So, the question remains: what motivates people to produce more? While some of the research would indicate that the supervisory technique or attitude is a major determinate, other studies indicate

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[11] Pelz, op. cit., pp. 45-46.

[12] Daniel Katz, Nathan Maccoby, and Nancy C. Morse, Productivity, Supervision and Morale in an Office Situation - Part I, University of Michigan, Ann Arbor, Michigan, 1950, pp. 62-63.

[13] Ibid., p. 21.

[14] Nancy C. Morse and Everett Reimer, "The Experimental Change of a Major Organizational Variable," Journal of Abnormal and Social Psychology, #52, 1956, pp. 120-129.

that it is certainly not the sole factor. Thus, the relationship between managerial technique and productivity is tenuous indeed.

In reviewing such contradictory evidence a group at the Psychological Service of Pittsburgh detected what appeared to be a difference between the factors which made people happy with their jobs and those which made people unhappy with their jobs.[15] This led to the hypothesis that certain factors within the context of a job must lead to positive motivation while other (different) factors must be responsible for negative motivation. In an effort to test this hypothesis the Pittsburgh group conducted a very carefully conceived and executed research project on a selected group of engineers and accountants. This particular group of professional level employees was chosen partly because preliminary research pointed out some difficulties in obtaining usable data from some other industrial groups (e.g., unskilled labor). In contrast to many other studies of motivational factors, this project approached the problem from the standpoint of the individual rather than the group.[16] Instead of analyzing individuals within groups of obviously high or low morale, the technique used in this study was to ask the individual respondent to describe any period in his working career when his feelings about his job were extremely good or extremely bad. Once such an incident was established the interviewee was asked to elaborate on such details as what caused these feelings, how long these feelings lasted, how

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[15] Frederick Herzberg, Bernard Mausner, and Barbara Snyderman, The Motivation to Work, Second Edition, John Wiley & Sons, Inc., New York, 1959, p. 111.

[16] Ibid., p. 12.

his work (productivity) was affected, and if his health or personal life was markedly changed by the event.[17] At least one high and one low sequence was sought from each person with more than two sequences reported by many. It was felt that this approach to gathering the data was preferable to the group method since group attitudes are not always homogeneous.

The analysis of the data collected revealed several factors to be statistically significant as motivators while several other factors were found to have high positive correlation with dissatisfaction. Further, it was found that in better than 60% of the cases the level of motivation (high or low) was directly reflected in performance.[18]

Those factors found to be significant in developing high motivation, in order of their importance, were:[19]

Achievement

Recognition

The Work Itself

Responsibility

Advancement

The meaning of each of these factors is fairly self-explanatory. It is important to notice that all of these factors are centered on doing the job.[20] Herzberg feels that these motivators, as he titles them, are factors which aid the individual in his efforts at self-actualization.[21]

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[17] Ibid., p. 141.

[18] Ibid., p. 87.

[19] Ibid., p. 72.

[20] Ibid., p. 113.

[21] Ibid., pp. 68-70.

In contrast to these factors leading to high motivation a different group of factors was found to be present in a significant percentage of the cases of low motivation. These negative motivators were termed "hygiene" factors. In order of importance these were:[22]

Company Policy and Administration

Supervisory Inability

Interpersonal Relations - with the Supervisor

Working Conditions

Interpersonal Relations - with Peers

Salary was found to be effective both as a motivator and as a hygiene factor.

In the case of the motivators it was discovered that while their existence led to high motivation, their absence would in some cases lead to dissatisfaction as well. Their general influence was still positive. On the other hand, the hygiene factors displayed very little positive component. The satisfaction of these factors merely prevented excessively low motivation. It was on this basis that these were termed hygiene factors in that they did not lead to good health but served to prevent poor health.[23]

Interest in these reported findings induced Texas Instruments (TI) to undertake an almost identical research project on their own employees. Their findings were very similar to the findings of the Pittsburgh group.[24] Since the group of employees interviewed at TI

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[22] Ibid., p. 72.

[23] Ibid., p. 113.

[24] M. Scott Myers, "Who Are Your Motivated Workers," Harvard Business Review, Jan.-Feb., 1964, p. 76.

was somewhat less monolithic than the Pittsburgh group, several other interesting points were revealed when analysis by job classification was conducted. Scientists and engineers were found to have significantly different patterns of motivation from those of hourly paid assemblers for instance.[25] In fact, there were detectable differences in the motivation patterns of engineers versus those of scientists.[26] The major differences between these groups were not in the existence of the motivators and hygiene factors but in the duration and importance of these factors.

Thus, it appears from these two studies that there might well be certain factors around which a managerial philosophy could be built. If this is correct, such a philosophy in practice should lead to higher motivation of professional-technical employees (and of other employees, too, for that matter) and should result in detectable gains in productivity.

The Unity of Research Results

Since research into management is such a popular subject and since there is no guarantee that the person conducting such research is relatively unbiased, supporting research data may be found for almost any managerial attitude.[27,28] Some of this research has been conducted to justify existing belief while other research efforts have

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[25] Ibid., p. 80.

[26] Ibid., pp. 77-78.

[27] Herzberg, op. cit., pp. 108-109.

[28] Robert Tannenbaum, Irving R. Weschler, and Fred Massarik, Leadership and Organization, McGraw-Hill Book Co., Inc., New York, 1961, p. 5.

been undertaken to test hypothesis and to subsequently build or modify these theories. Thus, the term research in the popular context does not guarantee unified results.

In spite of this, there is a fair degree of agreement as indicated above in the findings of those research efforts which are properly conceived and executed. Truly worthwhile research projects should be capable of being repeated -- even by other independent researchers -- with similar results. Such repetition serves to increase the validity of the original research. In at least two of the cases cited above such independent tests have been applied. Vroom conducted a study on scientists and engineers similar to that pursued by the Institute of Social Research and found similar results leading to supporting conclusions.[29] The results of the work of the staff at TI very strongly agree with those of Herzberg.[30] Yet, there remains a vast amount of missing information. While there is a substantial amount of apparently valid data concerning the individual and his relationship with his job, there are still no reliable answers to the question of how to best manage professional-technical employees. A wide gap still exists in the information necessary to successfully utilize the broadly stated theories within specific operating conditions.[31]

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[29]Victor H. Vroom, Some Personality Determinants of the Effect of Participation, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1960, p. 60.

[30]Myers, op. cit., pp. 73-88.

[31]Rensis Likert, New Patterns of Management, McGraw-Hill Book Co., Inc., New York, 1961, p. 241.

CHAPTER V

CONCLUSIONS

The most immediate conclusion formed as a result of the author's study and personal experience is that professional-technical personnel must be wonderfully resilient as individuals. Based upon the needs of these workers and the frequent thwarting of their needs by mismanagement it appears indeed fortunate that the technical professions have progressed to the stage they have.[1] From the viewpoint of the author this is in itself proof of the very high personal motivation of professional-technical employees.

The Existence of Disagreement

For the purpose of reviewing the literature on the subject of technical management a distinction has been made between the claims of the practitioners, the theories of the behavioral scientists and the conclusions drawn by the researchers. To some extent this classification has been artificial. Most of the research presented for the reader's consideration was performed and evaluated by psychologists. Further, it is primarily the psychologists who address themselves to the problems of modern technical management from the standpoint of the behavioral sciences. Certainly this situation must cross-link the

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[1] Lyman Bryson, "Panel: Human Relations in Industrial Research," Human Relations in Industrial Research Management, Robert T. Livingston and Stanley H. Milberg, Editors, Columbia University Press, New York, 1957, p. 326.

work of these two groups. It should not be surprising, then, if the viewpoints of the behavioral sciences and the research groups on the subject of technical management were close to parallel. But, this was not found to be true in all cases. While a substantial proportion of the literature of these two fields is complementary there are still disagreements.

But, any apparent agreement between these two somewhat artificially defined groups, runs head-on into disagreement from the practitioners of the art. The practical minded persons engaged in the day-to-day management of professional-technical personnel express -- with some degree of unity -- the opinion that control is important and that control is a function of management. From this vantage point the practicing manager seems to feel it necessary to apply "conventional techniques of good management" to directing the efforts of engineers and scientists. This approach appears to be somewhere in the region of "Benevolent Authoritative" or "Consultative" on the spectrum of management philosophies expressed by Likert.[2] There are evidences of increasing efforts to use "human relations" in technical management but these seem to represent excursions into other forms of management and not wholehearted adoption of these philosophies.[3]

A further emphasis of the disagreement between the practitioners and the theorists is evidenced by the relatively few organizations which have adopted the less authoritarian forms of management such as

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[2]Rensis Likert, New Patterns of Management, McGraw-Hill Book Co., Inc., New York, 1961, p. 234.

[3]Douglas McGregor, The Human Side of Enterprise, McGraw-Hill Co., Inc., New York, 1960, pp. 41-42.

the Scanlon Plan.[4] Inertia is as much a part of social organizations and individuals as it is of mechanical systems. There is quite naturally a reluctance on the part of the "successful" manager to alter his methods when he is already obtaining satisfactory results. In fact, efforts to improve management by adopting new philosophies are often met with hostility by the employees thus discouraging further attempts.[5]

Areas of Agreement

In spite of this inertia which resists change the practitioners are beginning to recognize some of the facts concerning their professional-technical employees. The popular writings by these working managers contain indications that problems exist in the management of technical workers. The somewhat prevalent attitude that these people are somehow different from other industrial workers is at least tacit admission that old established managerial philosophies and techniques are to some extent unsuccessful in the context of technical organizations. Recognition of the fact that professional-technical employees exhibit a high degree of individuality is in perfect agreement with the theorists. Emphasis by the practitioners on motivation is further evidence of growing agreement in spite of the difference of opinion on how motivation may be accomplished.

Thus, there appears to be an inconsistency in the existing philosophies of practicing management. On the one hand there is recognition of -- or at least lip service to -- the needs of the

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[4] Ibid., p. 119.

[5] Likert, op. cit., p. 245.

individual professional-technical employee. On the other hand these same managers wonder -- perhaps unconsciously -- why employees do not order their own needs secondary to the needs of the organization. Technical management is in many cases currently practiced by placing engineers and scientists in positions of dependence in spite of recognition of their needs for independence.[6]

The Resulting Residue

Selecting an optimum managerial philosophy for use with professional-technical employees is an immensely complex problem. The disagreement between practice and theory serves to further accentuate this complexity. Inconsistencies between theory and experience or within either of these areas alone are not contributory to clearer understanding either. Aside from these factors, human behavior is an enormously complex mechanism in itself. The multiplicity of factors involved in every human action is almost beyond imagination even in this day of astronomical numbers. The task of understanding and predicting or controlling human behavior seems overwhelming. Unlike the physical sciences where statistical accuracy is sufficient, management must deal with individuals. An example of the sufficiency of statistical accuracy might be found in the concept of radioactive decay. Statistically one-half of the atoms of a piece of radioactive material will decay in a known period of time (dependent upon the material). This relationship holds true, at least within the accuracy of measurement, regardless of the amount of material present or the

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[6] McGregor, op. cit., p. 42-43.

point in time chosen for observation. There is at present, though, no way for the physicists to predict when any one individual atom will decay. Management, whether in the technical organization or elsewhere, is charged with a task comparable to predicting when the individual atom will decay. Statistical evidence may be useful in the larger population but the first line supervisor is faced with individual cases.

It should be pointed out that absolute perfection is not necessary either. The inability to produce a perfect vacuum has not prevented the physical sciences from utilizing man-made vacuums almost as if they were perfect. In fact, in only the most critical of cases is this inability to achieve perfection significant. In other words even partial understanding is better than none.

In spite of the disagreement between practice and theory, there is a trend among the practitioners toward new forms of management utilizing the theories of the behavioral sciences.[7] The recognition of the fact that scientists and engineers are individuals is one step in this trend. The current introspection on the problems of motivation is another step. The willingness of at least some managements to venture into the less authoritarian managerial philosophies is further evidence of this trend. Thus, from the working, practical viewpoint the optimum managerial philosophy must be somewhere beyond the present day broadly accepted working point.

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[7]Robert Tannenbaum, Irving R. Weschler and Fred Massarik, Leadership and Organization, McGraw-Hill Book Co., Inc., 1961, p. 9.

Conclusions and Recommendations

While there is a wealth of information which points to the possibility of an optimum managerial philosophy for professional-technical leadership, the definite proof is as yet incomplete.

Any measurement effort in the physical sciences is faced with a broad variety of possible sources of error.[8] It appears valid to assume that measurements in the social sciences would suffer corresponding problems of accuracy. One such source of error that may be suspected of the research on human behavior is the possible effect of the observation on the persons being observed. A classic example of this effect is found in the Hawthorne Studies.[9] Thus, until there is widespread adoption of any new managerial philosophy, no ultimate evaluation of its validity may be made.

This should not be interpreted as a sign of desperation, though. Quite the contrary, the possible benefits which might be realized by improved management of the professional-technical groups within industry should offer sufficient justification to persuade some to adopt new forms of management. This is particularly true of those managerial philosophies which appear to have sound basis in logical psychological theory. Thus, progressive management should be willing and in fact eager to find ways of assimilating available theory from research and the behavioral sciences. Only in this way may existing

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[8] E. Bright Wilson, Jr., An Introduction to Scientific Research, McGraw-Hill Book Co., Inc., New York, 1952, p. 232.

[9] Mason Haire, Psychology in Management, McGraw-Hill Book Co., Inc., New York, 1956, p. 170.

management successfully develop toward improved philosophies with the resulting improved employee productivity.

Such exploration on the part of practicing management is not enough, though. There still exists a drastic need for further research in the behavioral sciences and in the structure and operations of working groups. While there appears to be a unity to the research results from both technical and non-technical worker groups, there should be further study of professional-technical workers as distinct from other employee groups because some research has revealed the possibility that significant differences might in fact exist between these groups. It might even be worthwhile to subdivide professional-technical employees into categories of engineers as distinct from scientists or persons in research in contrast to those in development.

In addition, a great deal remains to be done in the area of developing techniques for accurately determining the output of professional-technical workers. Without such tools no accurate measurement of the productivity of this group can be made. Here, too, the professional-technical employee group differs from some other industrial groups lending justification to further study of this particular group.

More important, though, additional effort should be directed toward the investigation of managerial attitude and awareness. Without the necessary awareness of his function or without the proper attitude concerning his function all of the proper managerial philosophies, techniques or tools may be misused by the practicing manager.

Closing Comment

It appears to this writer that practicing management has been seeking solutions to the wrong problems. Instead of seeking the optimum managerial philosophy or technique which will enable management to do its job better they should be looking for the managerial philosophy and techniques which will enable the professional-technical employee to perform his job more effectively.

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