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Administration Of Air Force Research And Development Programs:An Examination Of Manpower Standards And Their Impact On Organizational And Management Patterns And Practices.

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THESIS

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ABSTRACT OF THESIS

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ABSTRACT

This study examines the problem of application of manpower standards to the United States Air Force research and development organization. Personal observations and experience in the Air Force R&D system of the dysfunctional aspects of manpower standards appear sharpest to those required to implement and work within them. The desire to know the conditions and effects of standards and what caused their application becomes the motivator for this study.

In looking back on the study the research methodology utilized has combined a historical, descriptive and analytical approach. This not only describes the problems and their setting, but also provides a method for analysis as though policies were in the development phase and could undergo change for improvement.

The environment in which the Air Force and the R&D organization is set is presented as background. The approach chosen for assuring efficient utilization of the large investment in R&D facilities culminates in a review of policies and regulations and their impact on the organization

An analysis is performed through a comparison of models used as a tool for viewing policy. The first model is one formulated by the Air Force and demonstrates the difficulty

in adhering to regulation in identification and quantification of the output of an R&D organization and suggests modified procedures are in order. The second model describes the practices used prior to implementation of standards and suggests this process is better than those requiring standards. The analysis of the third model suggests decentralization, management by objective and self control as an approach to maximum productivity and that the application of standards may be causing adverse effects on the R&D organization.

A modified case study approach is used to help become more objective in looking at the historical events and their effects on Air Force policy. Analysis of the case graphically illustrates that the output of the R&D organization is not readily measurable and investigations by the United States Civil Service Commission support the thesis contention that manpower standards are having an adverse effect on the R&D organization and that the effects observed in this thesis are common throughout the Air Force R&D facilities.

Finally recommendations are made for improved organizational policy that if applied might produce an environment for increased productivity. This is done through recognition of the importance of human relations and individual contributions through innovation and decentralization.

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ABBREVIATIONS

AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFR	Air Force Regulation
AFSC	Air Force Systems Command
BOB	Bureau of the Budget
DOD	Department of Defense
MEP	Management Engineering Program
MET	Management Engineering Team
M/P	Manpower
OR	Operation Research
PEE	Program Estimating Equation
R&D	Research and Development
RD&T	Research Development and Test
SAC	Strategic Air Command
TWP	Technical War Plan
USAF	United States Air Force
USCSC	United States Civil Service Commission

CHAPTER I

INTRODUCTION

An Overview of the Study

This study examines the organizational and management patterns and practices of the United States Air Force in the research and development area, and manpower resources and their development for maximum productivity. It begins with the development of concepts to provide an understanding of the setting in the bureaucracy and the influencing factors on behavior. The development and application of manpower standards in the Air Force and the need for efficiency, including the changing leadership role of Air Force Manager are presented as a prelude to analysis.

The policies established by regulations for manpower decisions and the impact of application on research producitvity provide the basis for an analysis. The analysis is performed through a comparison of models used as a tool for viewing policy. The model approach forces an examination of objectives and effects of alternatives. The first model being examined is an Air Force model which attempts to demonstrate the difficulty of attaining correlation of manpower to a quantifiable output and suggests modified procedures may be in order. The second model is a descriptive model of practices prior to

implementation of the standards attempts to show that this process is somewhat better than the Air Force model and implies that the Air Force Manpower Engineering Team may be restrained from providing a full service because of the intangible nature of the output of R&D. Finally the analysis of the third model which is normative suggests that management by objective and self-control through an indirect approach may produce the highest productivity. This approach has emphasized that manpower standards appear as an abstraction of reality and as applied to R&D may be causing adverse effects on the basic R&D mission of the Air Force.

A modified case study approach was also chosen to help become more objective in looking at the historical events, their interrelationships and effects of policy. In particular the study provided a tool for projecting analysis into the policy-formulating process and provided a common ground which is developed while exploring the conflicts relating to the issues. This analysis by case study graphically illustrates that workload factors selected in the R&D area are not an adequate measure for the R&D organizations output. The varying size and magnitude of the work elements by time and difficulty graphically imply that the use of historical data as a basis for projecting future manpower needs is incorrect. This analysis supports management's claim that research productivity appears intangible and that manpower standards are having an adverse effect upon R&D.

Consideration is given to improved organizational policies

that if applied might reduce the need for rigorous controls by producing an environment conducive to increased productivity. Improvements include the fostering of innovation, decentralization, and a recognition of the individual within organizational setting and his needs.

Finally "objective management" is seen as emerging as the key principle indispensible to managerial control through target setting and post audits. This implies a self-control to meet objectives and a replacement of the hard, coercive, dominating management by objective stress for attainment of organizational goals. The research methodology utilized combines a historical, descriptive and analytical approach to illustrate and analyze problems as though they were in the development phase and could undergo change to improve procedures.

A Review of Organization and Management Concepts

This material provides an understanding of the organizational and environmental setting in which manpower standards are applied. The traditional and current view of bureaucracy and the ideas and ideologies that come from this background are influencing factors on behavior and attitude for the individual and the organization. The historical material provides the base in which productivity and the need for efficiency and manpower measurements have developed. The growth of productivity measurements and the need for efficiency are included to provide a history of their growth as they apply to efficiency measurements in the R&D organization.

History influences action and policy which change with time. Background is therefore required to set the period and influencing factors on policies that are being given primary consideration in the thesis.

The information to be presented in this chapter will help provide an understanding of the organizational environment in which performance is required. With an increased understanding of the traditional legal and historical framework, it will also be easier to relate the impact of policy decisions upon the individual and organization, and in so doing will provide a stepping stone to the establishment of better policies.

The Traditional Background

The traditional background description of modern society begins with the growth of man in his changing environment. The growth has accelerated to an unprecedented rate and changes have evolved in the practices of society. An understanding of the traditional background and change should be of aid to those concerned with establishment of policies.

In reviewing history, we are aware that ideas and ideologies are the aspects of the human chronicle. We see these factors in all countries and all people. As their countries grew and developed, it took many individuals to accomplish the large-scale administrative tasks through systematic coordination of work.

The historical development from the patriarchal order to the patrimony and feudal forms of government has led to

the bureaucratic society. Bureaucracies in a nonpejorative sense are the authority of men, offices, and methods in organizations designed to carry out large-scale administrative tasks. One of the primary conditions for development of the modern society is a money economy.[1] Money economies have not always existed, i.e., ancient Egypt, Rome, India, and China have used compensation in kind.

The Protestant Ethic, as fostered by Calvin, contributed to the great cultural and political struggles in Europe and America of the 17th and 18th century. The "Ethic" of hard work carried with it condemnation of pleasure and emotions; this generated detachment and sobriety. Protestants striving to live by this ethic gained position, wealth, power, and prestige to a much greater extent than Catholics. The Protestants studied the technical, industrial and commercial arts while the Catholics tended to remain in the humanities and art and crafts.[2]

Weber would argue that these factors are conducive to rational conduct from which the perfect image of an efficient bureaucracy, with no irrational or emotional behavior exists. He would also argue that the bureaucracy with rationality is one of the most efficient of organizations.[3] Capitalism grew

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[1]Peter M. Blau, Bureaucracy in Modern Society (New York: Random House, 1956), pp. 36-37.

[2]Max Weber, An Intellectual Portrait, trans. Reinhard Bendix (Doubleday Anchor Books, 1962), pp. 55-63.

[3]Max Weber, The Theory of Social and Economic Organization,

through the idea of accumulation of wealth in excess of basic requirements for survival. This principle became known as the "Spirit of Capitalism." John Wesley, the founder of the Methodist religion, also contributed rationality to the idea of saving and the accumulation of wealth. This also stimulated capital and industrial development.

Manpower mobility also grew from the ideas of "election" or "calling." Men were willing to demonstrate their "election" by helping the world improve. From this concept, performance in office fostered rationally conducted business enterprises.

A disciplined bureaucracy developing from paying an employee in money maintains a balance between independence of the employee from the employer and the dependence of the employee upon wages while fostering disciplined work and responsible conduct. This is uniquely different, for example, from the unpaid volunteer who is too independent of organizational discipline and the slave who is totally dependent.[4]

As business grew in size and complexity, the owner-manager was forced to create a bureaucracy for control. He also selected specialists in administration for management to maintain efficiency. This resulted in the transfer and separation of the owner from management. This separation of management from traditional owner became a pivotal event in

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trans. A. M. Henderson and Talcott Parsons (Glencoe, Ill: The Free Press, 1947), pp. 175 ff.

[4]Blau, p. 37.

social and economic history.[5]

Large-scale organizations or bureaucratic structures within the United States have grown at a rapid rate. They include government, military, and large private enterprise which are the most important human institutions in the world. Their growth can be attributed to favorable historical conditions.

Many of the traditional factors that have historically been the foundation of the American bureaucracy have, through the successful growth of the bureaucracy, demonstrated their legitimacy through tradition.

All governments tend to relate authority to legitimacy because legitimacy is based on a belief in the sanctity of traditions and in the need for obedience to authority. Weber suggests that most leaders claim legitimacy for their rule based on tradition, legality, and charisma. These are the three pure types of legitimate authority.[6] All authoritative systems tend to establish and cultivate a belief in their legitimacy. For example, the government in England has been influenced by tradition because the rule by a constitutional monarch is based on tradition.[7]

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[5]Thorstein Veblen as listed in Absentee Ownership and Business Enterprise in Recent Times (New York: B. W. Huebsch, Inc., 1938).

[6]Weber, Economic Organization, p. 328.

[7]Robert A. Dahl, Modern Political Analysis (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963), pp. 20-30.

Legitimacy may also be founded on legal authority within a bureaucracy through establishment of agreements or by imposition based on expediency or rationality.[8] Weber believed that legality was the usual basis of legitimacy; laws, rules and practices of today often acquire their legitimacy because of the legal process of enactment.[9] Legality is characterized by the struggle against the arbitrary rule of the monarch. In this struggle against arbitrary government, the "rule of law" was born reflecting precedent, legal sanction, and due process which was necessary before men could be deprived of life, liberty or property.[10]

Legitimacy, the sanction of law, custom, or heredity, is often based on charisma. Charisma is that exceptional prophetlike power and qualification that separates personal leadership from the ordinary man. The person subject to charismatic commands obeys out of personal loyalty or regard for the time-honored legitimate status. This characteristic of charisma may have its authoritative base opposite to tradition where officials may be selected on personal devotion other than qualifications.[11]

Weber often draws attention to the importance of charisma in economic life. He points out that charismatic leadership

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[8]Weber, Economic Organization, p. 329.

[9]Dahl, pp. 20-28.

[10]John M. Pfiffner and Robert Presthus, Public Administration (New York: The Ronald Press Co., 1968), p. 45.

[11]Weber, Portrait, p. 295.

may be one characterized by risky financial transactions often found in our colonial period. Transactions for slave trade, private financing of military ventures, and piracy were forms of capitalism in which success depended on charismatic leaderships.[12] Weber's view is opposite to our world of legitimate, methodical management of large organizations in which success depends on professional competence and regularity of conduct. In these modern times many of the giants of business have achieved success through exercising charisma.

History has demonstrated that the basis for authority can change from charisma to legality. Franklin D. Roosevelt, through his extraordinary personality, and superb historical timing, proposed reform measures which were enacted into law and caused deviation from the traditional limits on the authority of the Chief Executive. Winston Churchill, Franklin D. Roosevelt, Charles DeGaulle, Nikolai Lenin, Adolph Hitler, Huey P. Long, Mehatma Gandhi and Fidel Castro are examples of charismatic leaders.[13] Charisma can be found not only in statesmen but demagogues and is characteristic of inspiring followers to pursue their "lofty" goals.

Legitimacy, based on personal force, can have a tendency to negate existing norms and become a force for change. This form of authority, though not common in democracies, is more often found as a driving force in totalitarian governments.[14]

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[12] Ibid., p. 306.

[13] Dahl, pp. 20-30.

[14] Ibid.

Domination based on charisma can be just as effective as legal domination where legitimacy is based on devotion to exemplary character and to a revealed order. Legitimacy of the charismatic leader which is gained in this way may be the opposite of tradition. Authority to command comes to the charismatic leader through his extraordinary gifts or magical powers, and those who obey do so as disciples who believe in the rules that become sanctified by tradition.[15]

Under a charismatic leader subordinate officials are selected in terms of their personal devotion rather than special technical qualifications. The sphere of activity and power of the "disciple-officials" depend on his charismatic leadership.[16] Unlike Weber's charismatic leader, the bureaucratic leader will depend mainly upon skills to assert his will. This assertion of domination is seen as legitimate.

Traditional domination is based on the belief of legitimacy of an authority that has always existed. This is characterized by the patriarch who is considered generally the authority or master over his own household. The person exercising this power of command enjoys authority by virtue of his inherited status.

The patriarchal prerogatives are designated by definite rules of inheritance and upon willingness of the group member to accept his authority. Solidarity of the household arises

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[15]Weber, Portrait, p. 295.

[16]Dahl, pp. 20-30.

from members sharing lodging, food and tools and living together because of the dependence of women and helplessness of children. Respect for the head of the family differs from the legal contractual obligation or the faith of a disciple in a charismatic leader. Patrimonial government is an extension of paternal authority. The partiarchal form of government was followed by feudal forms of government which are two major variances of traditional domination. Traditional domination is typified by government in which authority is handed down through the family and occurs when obedience is claimed on the basis of established uses. Feudal governments replaced the paternal relationship by contractually fixed loyalty on the basis of knightly militarism which eventually lead to a strong central government. Feudalism originally served this purpose by creating a cavalry. The transition from the patriarchal form of government left rules of a legal order that were implemented and obeyed on a belief that they were legitimate because they conform with the statutes of government that monopolize their enactment and which include the legitimate use of physical force.[17]

Legal domination or the sanction of law, custom, or heredity, exists on a system of rules and a belief that power is exercised in a way that is legal. These rules are applied judicially and administratively by officials and are accepted as binding because they are legal and legitimate.[18] Historically,

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[17] Ibid., pp. 330-360. [18] Dahl, pp. 20-30.

the base of legal domination, as Weber would indicate, is from charismatic revelation to theocratic innovation with emergence of canon law which has a formal effect on the rationality of the law. Gradual extension of legal domination by ruler and the outgrowth of tradition producing the lawmaking by legal notables followed.[19]

It is now traditional that citizens who are not subjects obey the law rather than the legally constituted authorities who produce or enforce the laws and authorities are now temporarily elected office holders. Legal domination, therefore, is an "end product" of the development toward legal rationality,[20] where rules acquire legitimacy because the process of formulation is assumed to be legal. In the modern world, and its different kinds of organizations, laws, rules and constituted practices acquire their legitimacy in large part because the process by which they are enacted is assumed to be legal. Legal domination exists in our modern bureaucratic structure by virtue of statutes.

Weber insists that the great modern American state is absolutely dependent upon a bureaucratic base. His generalizations are drawn from Western European and ancient civilizations where social mobility was limited and civil service entry and advancement were related to social class. His inferences are most useful in appraising the rational and structural aspects

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[19] Weber, Portrait, p. 401.

[20] Ibid., p. 422.

of the American bureaucracy; however, he does not stress the informal aspect or the political environment in which bureaucracy developed. The accomplishment of large scale administrative tasks[21] may be the cause of bureaucracies. Some organizations have been generated from a criteria of need while others have split off from existing organizations. An example would be the separation of the Air Force from the Army.

Weber would argue that bureaucracy is based on three factors; first, the traditional belief that the organization should not be changed because of age, experience and maturity; second, legality, as the basis for the organization seeking good for all, which accordingly merits support; and third, charismatic legitimacy as a basis for faith in the values and goals of the organization and its leaders with personality to inspire sacrifice and devotion. Most modern organizations enlist these factors in utilization of manpower and in their claims for loyalty.

In the formal traditional base for bureaucracy, the rational and structural form of organization is stressed. This has consisted of a highly centralized "oligarchic" control with authority demanded by virtue of position or right of office. The formal model was oriented to written rules and traditions and is ideally rational.

A Current View of Bureaucracy

In contrast with the formal bureaucratic structure the

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[21] Pfiffner, p. 42.

informal might be defined as a system of structured personal relations with individuals differentiated in terms of authority, status and role. Authority within the bureaucracy, in this sense, is permissive in nature and is not imposed from above but comes from the willingness of the subordinates to accept commands.[22] Legitimacy, also in the informal sense, cannot be commanded if there is a lack of status or image. The informal organization sets goals that are generally higher than those formally established and efficiency and productivity is directly related to these goals.[23]

The informality of a bureaucratic organization can be contrasted by Weber's concept of an original administrative staff under supreme authority which consists of individual officials who are appointed and function according to the following criteria:

1. They are personally free and subject to authority only with respect to their impersonal official obligations.
2. They are organized in a clearly defined hierarchy of offices.
3. Each office has a clearly defined sphere of competence in the legal sense.
4. The office is filled by a free contractual relationship. Thus, in principle, there is free selection.
5. Candidates are selected on the basis of technical

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[22]Chester Barnard, Organization and Management (Cambridge: Harvard University Press, 1948), pp. 1-30.

[23]Herbert A. Simon, "Administrative Decision Making," Public Administration Review, 25 (March 1965), pp. 31-37.

qualifications. In the most rational case, this is tested by examination or guaranteed by diplomas certifying technical training, or both. They are appointed not elected.

6. They are remunerated by fixed salaries in money, for the most part with a right to pensions. Only under certain circumstances does the employing authority, especially in private organizations, have a right to terminate the appointment, but the official is always free to resign. The salary scale is primarily graded according to rank in the hierarchy; but in addition to the technical criteria of the position the incumbent's social status may be taken into account.

7. The office is treated as the sole, or at least the primary, occupation of the incumbent.

8. It constitutes a career. There is a system of "promotion" according to seniority or to achievement, or both. Promotion is dependent on the judgment of superiors.

9. The official works entirely separated from ownership of the means of administration and without appropriation of his position.

10. He is subject to strict and systematic discipline and control in the conduct of the office.[24]

The above ten points are a brief summary of the formal bureaucratic structure of Weber which are in addition to the informal structural influences on the individual. Both the formal and informal factors should be included when looking at the total environment of the bureaucratic worker.

In the last decade there has been a change in the environment of the worker from the "gospel of efficiency," in accordance with Frederick Taylor's concept of human motivation, to that of dignifying the worker.[25] This is accomplished

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[24]Weber, Economic Organization, pp. 333-334.

[25]F. W. Taylor, Scientific Management (N. Y.: Harper, 1947).

by fostering participation and democracy which stimulates innovation and corresponding increases in efficiency and productivity.[26]

In the modern bureaucracy, organizations separate the office from private possession of the office holder where official activities are separate from private life. Public monies and equipment do not belong to the office holder and officials are found in public as well as in private companies.[27] In private enterprise the principle extends even to the leading entrepreneur. In principle, the executive office is also separated from possession by the officials the same as business and private correspondence, and business assets are separated from private fortunes.

Even though there has been a formal separation of the office from the office holder, in large scale bureaucratic organization, there still is a need for control and the association of the "office" and related powers of the office holder. In the Weber and Taylor period consideration of manpower utilization in Weber's traditional organization hierarchy and unity of command are preserved. Bureaucracy is commonly defined as a closed hierarchial system with unity of command in which, presumably, each person has a supervisor who directs his efforts. The various layers of the bureaucracy

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[26]Bureau of the Budget, Measuring Productivity of Federal Government Organizations, (Washington, D. C.: Government Printing Office, 1964), pp. 3-18.

[27]Pfiffner, p. 47.

are stratified according to authority and ultimate control at the top.[28] Formally this is the case in many large-scale organizations. An error that is often made however is that of assuming that authority always follows the formal chain of command. We find various conflicting bases of authority which are formal, permissive, technical skills or specialization, social, seniority, experience and empathy.[29] Perhaps the most persistent challenger is specialization. This emphasizes conflict and detracts from the hierarchial concept of the organizational authority and decision making as emphasized by Weber.[30]

Organizations are however formed to achieve a purpose that cannot be obtained without the coordinated efforts of a number of persons. This assumes willingness of members to modify their behavior and be subordinate to the group with a minimum of conflict.[31]

The bureaucracy of today, as indicated by Merton, is oriented to precedent, seeks accountability and leans to inflexibility.[32] This also leads to competitive conflict as

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[28]Weber, Portrait, pp. 423-425.

[29]D. R. Hampton, et. al., Organizational Behavior and the Practice of Management (Scott Foresman & Co., 1968), pp. 434-446.

[30]Pfiffner, pp. 44-45.

[31]Herbert A. Simon, Administrative Behavior (2nd ed.; New York: The Macmillan Co., 1957), pp. 1-19.

[32]Robert Merton, "Bureaucratic Structure and Personality" in Merton, et. al., Reader in Bureaucracy (New York: The Free Press of Glencoe, Inc., 1953).

pointed out by Gulick. Hierarchy's four characteristics of modern bureaucratic organization, which encourage conflict, are (1) specialization, (2) hierarhcy of authority, (3) a system of rules, and (4) impersonality.[33] If coordination occurred spontaneously, there would be little need for an explicit hierarchy. In large organizations spontaneous coordination is prevented by obstacles such as "conflict of interest" and "technical expertise." Both cause inconsistent behavior and conflict. The need to reduce such conflicts, however, fosters hierarchial authoritative structures.[34]

Hierarchies can be classified over a spectrum varying from extreme "tallness" at one end to extreme "flatness." Coordination by vertical communications is characterized by the tall hierarchy while decentralization characterizes the horizontal hierarchy.[35] Flatness is desirable in organizations performing routine activities, not because it minimizes vertical distortion but because it increases efficiency by permitting each supervisor the control of the maximum number of subordinates.[36] The decentralization of manpower controls by corporate management demonstrates the philosophy that manpower is just one more of the several types of resources

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[33] Luther Gulick, "Notes on Theory of Organization" in Gulick and L. Urwick (eds), Papers on the Science of Administration Institute of Public Administration (Columbia University, 1937), p. 9.

[34] Anthony Downs, "Bureaucratic Structure and Decision Making," Memo of the Rand Corporation, October 1966, p. 38.

[35] Ibid., pp. 44-45. [36] Ibid., p. 44.

for which corporate management is responsible.[37]

As ownership became divorced from direct management, hierarchy became even more essential and as the complexity of organizational structures increased there was more need for hierarchial structures.[38] The hierarchy of the bureaucratic organizations has devised many means of control over static and dynamic quantities of the organization.

To minimize manpower and the need for manpower changes, it is obvious that there is a need for efficiency or maximum productivity in large scale organizations. Organizations characterized by size generally thwart vigorous action and have low circulation tending to inefficiency, bigness and red tape, generating an understandable need for efficiency.[39] The "hierarchy of decision" process not only increases the time required for communication but has a tendency to remove the decision from the technical expert. The hierarchy specializes in corporate decisions which are generally a collective process while maximizing rationality and efficiency in the formulation of such policy.[40]

Decentralization seems to increase the participation of

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[37] R. F. Lackman and B. H. Manheimer, Manpower Control Utilization and Requirements VII: Survey of Manpower Studies and Practices (Univ. of Rochester: Center of Naval Analyses, Jan., 1968), pp. 68-72.

[38] Ibid., p. 41.

[39] Pfiffner, pp. 42-50.

[40] C. I. Barnard, The Function of the Executive (Cambridge: Harvard Univ. Press, 1968), pp. 185-199.

subordinates, while increasing their feeling of worth to the organization. This places the decision closer to the problem where technical expertise can be brought most effectively and efficiently to bear on the problem for rapid decisions. Generally, however, some compromise in centralizing decisions is desirable to ensure goal congruence and to maximize decision effectiveness by setting limits on the individual. Centralization can be used to improve rationality if the expert is used as an advisor rather than as the final decision maker.[41]

The Development of Manpower Standards for Air Force R&D programs

Even though Max Weber indicated that the "monocratic bureaucracy," in his opinion, was capable of attaining the highest degree of efficiency, there has been a search for a value-free approach to administration. Weber also urged social scientists to aim at "ethical neutrality." This neutrality was approached in the writings of Luther Gulick by his statement on administration that "good is efficiency."

It would be difficult to list all of the founders who fostered the principles of administrative efficiency. However five men deserve special attention. They are Fredrick Taylor, Henri Fayal, Max Weber, Luther Gulick, and Lyndall Urwick. Each of these men made a special contribution to the development of administrative efficiency.

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[41] Robert Presthus, Behavioral Approaches to Public Administration (University of Alabama Press, 1965), pp. 46-54, 141.

Administrative efficiency has been characterized by Fredrick Taylor's writing of 1909, "The Principles of Scientific Management," and by his work in promoting the principle of efficiency. This principle is perhaps best understood by his statement that "it is only through enforced standardization of methods . . . that faster work can be assured."

Taylor's study lead to the tabulation of data on the measurement of workers motions and output which was finally standardized into a set of rules through the expression of a mathematical formula. This approach has been applied to the public and the private sectors of the economy in an attempt to increase efficiency and the utilization of manpower as one of the principal resources of management. The term productivity or efficiency is used somewhat interchangeably in the application performance standards.

Productivity measures perhaps initially began as early as the 1890s with a small group of industries being measured in order to determine the impact of mechanization.[42] In the 1930s the U. S. Bureau of Labor Statistics expanded measurements to study productivity and to relate production to the amount of labor. In the late 1950s J. W. Kendrick introduced the broader concept of "total factor productivity" which added measurements of capital input to labor. Outputs also were expanded and related to capital and labor.[43] Most productivity

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[42] Measuring Productivity, p. 24.

[43] Ibid.

measurements have been made in the private sector of the economy at the industry plant or farm level.[44] Probably the development of the first measurement in the federal area for management use was the Bureau of Labor Statistics attempt to produce measures of productivity in the Post Office Department in the period from 1908 to 1932.[45]

As discussed, productivity measurements as a tool for management are comparatively new. The spotlight cast by productivity measurements can contribute to more informed decisions in planning and budgeting. However, the value or benefit cannot be estimated from output and productivity data alone.

The productivity measures may contribute to the process of program selection and emphasis by providing better estimates of true costs of producing different kinds of goods and services. The production of better information can, however, become an end in itself which then in terms of progress may well not be considered a benefit. The analysis of productivity data can assist in achieving a greater capability at the same cost.[46]

Fundamentally the public sector does not differ from the

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[44]Hiram S. Davis, Productivity Accounting (Philadelphia: University of Pennsylvania Press, 1955).

[45]Witt Bowen, Technological Changes and Employment in the United States Postal Service (Washington, D. C.: U. S. Gov. Printing Office, 1932 [U. S. Dept. of Labor, Bureau of Labor Statistics Bulletin No. 574]).

[46]Measuring Productivity, pp. 37-53.

private sector, because it produces goods and services for outside consumption. However, the major difference between the two sectors is that generally public services are not sold in the open market and therefore are not related to market valuation.

Public services cannot always be defined as benefiting individual consumers, but more generally apply to the society as a whole.[47] The choice of outputs to be measured in the public sector cannot be evaluated by the efficiency of production alone but one must also consider the value of the product being produced.

Barnard[48] defined organizational effectiveness as the ability to accomplish its primary goals or mission. He considered efficiency in relation to the cost of accomplishing these objectives. It is appropriate to consider efficiency this way because manpower evaluations of efficiency are also related to costs. However, because of the difficulty of measuring efficiency this study looks at a few factors of research effectiveness.

The development and application of appropriate methods to measure productivity are needed in all government activities and become especially important in research organizations within the government. The greatest immediate value of productivity measurement is its potential to contribute to

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[47] Ibid., p. 25.

[48] Barnard, Function of Executive.

improvement in production and hence to savings in manpower and money.[20]

In the public sector the Bureau of the Budget was charged with assuring efficiency of the Executive Branch of Government, and in 1921 the Budget and Accounting Act instituted a reform movement designed to make all government more responsive. However, the influence of the first director, Gen. Charles G. Dawes, conceived the role differently than initially intended for he saw the Bureau of the Budget to be simply a business organization whose activities were devoted constantly to the consideration of how money, appropriated by Congress, could go as far as possible toward the accomplishment of the objectives of legislation. Dawes also fostered correct business principles and routine business administration. It was not until the Reorganization Act of 1939 however, as a result of the First Hoover Commission, that the Bureau of the Budget was moved from the Treasury to the Executive Office and its role changed from concern only with management improvement in a narrow sense to one concerned with program review and efficiency. The efficiency of the Executive Branch has become a primary concern of the Bureau of the Budget since 1939 and they have initiated a positive program for improved manpower utilization and improvements in productivity.[50]

Taylor's "Principle of Scientific Management" had an

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[49] Measuring Productivity, pp. 1-18.

[50] Ibid.

influence in both the public and private sectors in looking at the increased utilization of manpower resources. The manpower program, as Taylor expressed it, was geared to the measurement of efficiency by measuring the countable end product or service that represents the work performed. In short, it is the determination of the workload factors with the objective of a dollar's worth of labor for a dollar spent.

Productivity estimates compare the amount of resources used with the volume of products or services produced. Measurements of productivity can enable management to determine efficiency in government, evaluate the effectiveness of past actions, and may determine appropriate future actions as long as the organization is static or stable enough to produce maximum efficiency.[51] However, even with this emphasis, significant improvements in production through innovation have remained untouched.[52]

In the public sector, as the demand for public goods and services grew, the demand for getting the job done with the minimum application of manpower also grew. Government traditions and the Bureau of the Budget after extensive review and study of the inputs and outputs could see no all-purpose formula for measuring productivity; however, since manpower undoubtedly is our most important single input

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[51]Department of the Air Force, "Air Force Manpower Determinates," AFM 26-3 (8 May 1969), pp. 1-5.

[52]Taylor, pp. 1-10.

resource requiring control, measurement in units of manpower was selected by them for the control factor.[53]

Measurements were used generally to determine productivity or efficiency and with the end products of an organization defined as the outputs. In the course of producing these outputs, various resources are used which are defined as the inputs. Organizational productivity measures therefore deal with the relationship between the output and the inputs.[54]

The basic prerequisite for productivity measurements is that both the inputs and the outputs be measurable. In many organizations however suitable measures of outputs or inputs cannot be made. Suitable measures cannot be made in many cases and especially in the research organizations the difficulty in making any measures comes in the measurement of the output.[55]

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[53] Measuring Productivity, p. 23.

[54] Ibid., pp. 1-18.

[55] Ibid.

CHAPTER II

THE APPLICATION OF MANPOWER STANDARDS IN THE AIR FORCE R&D PROGRAM

The purpose of this chapter is to provide first the organizational setting for Air Force R&D management, second the historical development of efficiency measurements of the Air Force and the technique of measurement of organizational output used primarily for repetitive tasks, and third a few of the problems associated with scientific management. This material is presented primarily as organizational background for an understanding of a few of the environmental considerations that are conducive to increases in research productivity.

The United States Army Air Corps manpower system was adopted in 1947 by the U. S. Air Force. Authorizations for manpower were controlled by Tables of Organization and Equipment and by bulk authorization. This adopted system, originally intended for troop programming, was used until the early 1950s when it was replaced by the Table of Organization, a system primarily designed for combat units and a system of Table of Distribution for support units. All of these systems were primarily for accounting of manpower and did not emphasize

future requirements.[1]

The need for improved control grew as resources became scarce, and in the mid-1950s the USAF Unit Manning Document became the single manpower authorizing document. With this consolidated information a review of requirements and a validation of personnel assignment were possible. This new manpower information also permitted a consolidation and projection of skills and budget requirements.

As systems for reporting continued to improve, the system for manpower management also improved and methods for utilizing basic resources associated with or controlled by manpower were initiated.[2] The Air Force followed the direction established by the Bureau of the Budget and the Department of Defense by adopting early in the 1950s the principle of scientific management espoused by F. W. Taylor as a tool for improving manpower production. The key was minimizing the use of critical manpower resources by work simplification and time and motion studies. Productivity did increase materially in the routine work areas and the ability to use measurement of job standards and evaluation of performance resulted.[3]

The manpower team measures the output of the organization

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[1]Victor J. Cavagrotti, Manpower Authorization Data System, a paper presented at the Worldwide Manpower Management Symposium (ENT AFB, 12 September 1960), pp. 1-5.

[2]Elmer J. Beth, Manpower Management Career Staff (prepared by Management Engineering and Improvement Branch DCS/O, 22 March 1960), pp. 1-2.

[3]Measuring Productivity, pp. 1-18.

in terms of the number of units being produced in a given period of time. The output was then related to the magnitude of the input required for production. Standards of efficiency were then established relating output to the manpower required for production. This technique permitted the establishment of the minimum manpower needs for repetitive tasks. The extension of this technique from repetitive tasks to the R&D organization is the primary concern in this study.

Manpower staffing criteria have developed, particularly for repetitive tasks and manpower utilization have been calculated based on a comparison of the measurement of workload and the output of goods and services. Management of any organization has the responsibility for evaluation of the efficiency of all organizations' output, especially is this true for the intangible products of its research efforts. It would seem intuitively that evaluation should be handled in the same way as for other parts of the organization. To evaluate productivity, appropriate objective methods of performance evaluation must be developed that are not only useful and meaningful to management but which are at the same time accommodating of the standards and values of the scientist or professional man. The selection of standards for the professional also becomes one of our primary concerns in this thesis.[4]

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[4]H. M. Vollmer, Applications of the Behavioral Sciences to Research Management (Stanford Research Institute AFOSR-64-2555 AD609356, Nov. 1964), p. 42.

With the adoption of scientific management in the Air Force, productivity increased primarily for repetitive tasks. The key contribution of scientific management was the minimizing of resources by work simplification and time studies. Measurements made permitted the determination of labor requirements as well as labor accomplishments. From these measurements job standards and evaluation of performance resulted. These techniques not only improved manpower efficiency but assisted in preventing over-staffing.[5]

The Management Engineering Team (MET) is the term applied to the Air Force team responsible for scientific management and manpower utilization. Today it concentrates on the efficient use of existing resources and the analysis of problems generated by the ever-changing objectives of government. Probably the most difficult area in which a management engineering team has to work is in the evaluation of efficiency in research, development and engineering organizations.

The Problem of Scientific Management Measurement

Over the years there has been considerable attack on scientific management because it dealt only with the mechanical and not the human side of production and because people resisted being asked to behave like machines, and finally

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[5]John W. Carter, III, Work Simplification, Work Sampling and Management Engineering Capabilities (Edwards Air Force Base, Calif.: Air Research and Development Command USAF, n.d.), pp. 1-12.

because it destroyed the informal group.[6] This management approach continues to be in question today as it is applied to the area of RD&T.

In the RD&T area, scientific management is extremely difficult to apply because of the relative intangible nature of the research products and because scientists and other professionals strongly resent the application of standards to their work.[7] Many of those establishing standards are not scientists and have little or no knowledge of the job of the scientist or process being tested. This also adds to their resentment. The scientists would also claim that the establishment of standards should be done in the scientific manner and tested prior to implementation. Finally General Ferguson, Commander of the Air Force Systems Command (AFSC), seemed to recognize the difficulties in this area, while speaking to the Technical Management Council of AFSC, when he stated that "manpower standards are readily established for wrench turning organizations, but are exceedingly difficult to establish in organizations that are probing technological horizons."[8] The development and application of appropriate measures of research efficiency or productivity would seem to be at the heart of the conflict between the scientist and the

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[6]B. M. Gross, The Managing of Organizations (London: Collier-McMillan, Limited, 1964), pp. 120-126.

[7]Vollmer, pp. 40-45.

[8]James Ferguson, "Keynote Address at the Technical Management Meeting Headquarters AFSC," Andrews Air Force Base, Washington, D. C., Jan. 4-5, 1967.

manager and perhaps in the measurement of any research efficiency itself. To overcome this difficult problem, a reemphasis of the need for useful and meaningful performance evaluations that can be accommodated to the professional standards of the scientists must be found.

The application of efficiency standards to any organization has a tendency to limit innovation by requiring strict compliance with production standards. It can also be seen that the standards may cause dysfunctional effects by replacement of organizational goals with the goals of production. Standards also established on a historical data base generally do not consider future changes.

A single criterion has primarily been attempted in the establishment of the relationship of manpower to productivity. However, because of the complexity of research the question regarding the use of multiple criteria must be raised. Since the single criterion does not consider all factors of performance it is at best an abstraction of reality; therefore once applied it should be tested in the scientific manner to verify the truth of the relationship. Once standards are established by the Air Force system there can be no shifting of manpower to new work areas because this could cause a drop in production and a corresponding loss in people. This factor causes a dilemma for the research manager for he cannot keep up with the ever-changing requirement of the Air Force. This also raises the question regarding decentralization of manpower to the organizational commander to pursue a degree

of flexibility in meeting changing requirements. An attempt will be made in this thesis to further consider these factors.

The Organizational Setting for Air Force R&D Management

In order to examine the concepts of organization and management and their effects on productivity on the R&D within the air Force it is first necessary to understand the structure and dynamics of the organizational setting in which it is found. The changes that are occurring in the military and in particular in the Air Force can have a direct effect on management policy for research organizations. In the past many viewed the military organization in the formal structural manner espoused by Max Weber. Even though differences do exist between the military and the civilian bureaucracies, the gap between them appears to be narrowing. However, the military structure is unique since its goals must be dual in purpose and include the possibility that hostilities with a foreign power may occur.

We must look at the military organization in which RD&T is to be performed. The nature of the military manager is changing and it would appear that this transition will provide improvements in the RD&T leadership and environment required for maximum productivity. The military manager no longer finds himself in a rigid authoritarian organization demanding obedience in a highly stratified social system with extensive emphasis on tradition. Many of the traditional forms of

authoritarian leadership practices were modified as a result of the Doolittle Committee which forced curtailment of many rigid traditional disciplinary measures.[9] Many Air Force publications have recognized the following trends as also contributing to this process of change:

1. The expenditure of defense funds has brought a broad association with a wide variety of civilian institutions.
2. The revolution in military technology and employment of skills normally found in civilian society.
3. With the introduction of weapons of mass destruction, the distinction between military roles and civilian roles in warfare has lessened.
4. Compulsory military service has caused the Air Force to become a more heterogeneous group causing a closer linking with the non-military segment of society.
5. The coordinating of military policy with political, social and economic policies has led the military establishment to a better integration into civilian society.[10]

The overall effect has been a significant change in the structure of the military organizations and in the prevailing attitude towards authority and discipline. Today military discipline is more a positive concept based on loyalty which in turn presupposes obedience.[11]

Perhaps the most astute observer of this process of change in the military has been Morris Janowitz who wrote, "The

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[9]Charles Russell Homan, "The Leadership Role of Military and Civilian Supervisors in a Military Setting as Perceived by Supervisors and Subordinates" (Thesis, University of Washington, 1965).

[10]The Air Force as a Profession (Maxwell Air Force Base, Alabama Air Force ROTC, Air University, 1963), pp. 127-128.

[11]Cecil E. Combs, "Loyalty: The Military Touch Stone," Air University Quarterly Review, 7:30-36, Spring 1955.

contemporary military establishment has for sometime tended more and more to display characteristics typical of any large-scale non-military bureaucracy." Janowitz has also indicated that the basis for authority has been changing from one of domination to one of manipulation, which would be a significant factor in the management of Research and Development organizations.[12]

Even though the basis for authority is changing, it would appear that there may be some limit to the extent to which change can be made. To be combat effective, it would seem desirable to maintain the combat unit as its organizational prototype which would tend to make the authoritarian structure most desirable. However, neither the increase in automation of military technology, the change from war making to deterrence, nor the decline in the traditional military opposition to innovation can give a completely civilian form to its authority. It is undergoing change, and the chances that it will produce a desired climate for research and development through participative behavior appears to be beneficial; especially if it maintains separation of the research organization from the organizational structure required for the combat function.

The pseudo-participative organization developed would appear to cause the appointed leaders to increasingly act as if they were elected representatives of the people whom they

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[12]Morris Janowitz, "Changing Patterns of Organizational Authority: The Military Establishment," Administrative Science Quarterly, 3:473-493 (March 1959), p. 475.

serve.[13] The pure military role is not needed in supervising R&D. A separation of the purely military function from the participative leadership required for efficient R&D management can it would appear be made. The changing leadership pattern conducive to R&D management is not only brought about by congressional direction resulting from inquiry into extremely rigid authoritarian practices, but also by the natural evolution from changing trends in requirements.

This change also appears to come from a closer tie with the civilian forms of technology. The change from the extreme authoritarian to a participative form of management supports a decentralized atmosphere most conducive to good R&D management. This seems especially true with the evidence from Van Riper and Univatta that the trend of the military is towards being a technological management organization.[14] The military and in particular the Air Force must be able to fill its dual role by remaining a deterrence to war and still serve in a technological management capacity. This helps in the understanding of the background setting for leadership of the R&D organization under consideration.

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[13] Ibid.

[14] P. O. Van Riper and D. B. Univatta, "Military Careers at the Executive Level," Administrative Science Quarterly, Vol. 9 (1965), p. 435.

CHAPTER III

THE ADMINISTRATION OF AIR FORCE R&D MANPOWER PROGRAMS: AN ANALYSIS OF RELEVANT POLICIES

The Approach

The use of the model technique was chosen as a tool for analysis of policy. This technique permits a comparison of the Air Force manpower standards with techniques employed prior to implementation and with the ideal or normative condition. The moden approach forces management to examine their primary objectives and effects of alternatives through the analysis of the output. Finally this approach emphasizes that the efficiency standard is only an abstraction of reality and the efficiency standards as applied are causing distractions from the R&D mission and that a change is in order.

In the manpower management organization, there is a strong tendency to state numerically as many of the possible variables that are required for establishing manpower standards. This mounting interest requires quantifiable variables which is a problem for the research and development individual and organization. The interest in quantification fosters the idea that if progress towards goals can be measured, efforts and resources can be rationally managed.

Models may ultimately approximate reality and provide added

rationality to the selection and distribution of manpower. It will be by analysis of the model that progress will be made in this chapter. Our problem will be to view the impact of the concepts of organization and management policy on the research and development organization as they relate to manpower. The advantages of the use of models are that the model provides a frame of reference for the consideration of the problem. In addition the model suggests gaps which are not otherwise immediately apparent and consequently may suggest fruitful lines of action. When the model is analyzed or tested, the modes of failure may also provide clues to deficiencies and consequently call attention to policy.

There are disadvantages to the use of models for they are subject to oversimplification. Finally this oversimplification suggests a need for continuous contrast with the real world and a process of evolution through testing and re-evaluation and re-application.

Model Rationale

The Closed Model

One of the more commonly used tools for organizational decisions is the closed or rational model where all information is available for making the decisions. A decision is said to be rational when all possible consequences can be considered in the decision and the selection is made of the best of all of the consequences which have been ranked preferentially. As in all models the results are the real test of performance;

i.e., does the model truly show the relation to reality? This is especially important when considering the important commodity of manpower.

The Open Model

At the other end of the continuum of choice we have the open or behavioral model. This model relies on the experience and learning of the individual and organization. A decision is said to be made in an open way when a number of alternatives have been defined and through a sequential search some satisfactory solution is chosen. This is contrasted with the optimum solution for the closed model. This open solution is produced to satisfy the aspiration level of the individual or the organization which may be changed with time. The open model does not require a full knowledge of the environment or the alternatives.

There are bounds to open decisions because of the difficulties of optimization. There are also sharp limitations on the availability of information. Sometimes in contrast there are limitations on the quantity of information that can be handled. Finally, in all of the variables and unknown conditions the open decision process may have distinct value because there is no decision process either behavioral or rational that can take all information into account. The application of restricted bounds by the organization also has value in adding a measure of rationality. A factor that also contributes heavily to rationality in either model is

the credibility of the data and the method of quantification.

The O. R. Model

The Operations Research (O. R.) approach to formulation of decision model requires the use of scientific mathematical or logical means for the structuring and resolving of decisions. This approach is utilized by the Air Force for their manpower decisions. This system is primarily closed and rational. It requires complete knowledge of the environment and consequences of selection.

A distinction that can be made in any model including the O. R. model is that it can be either descriptive or normative. The descriptive is used to present facts and relations as they have historically existed. The normative on the other hand provides a standard or condition of what ought to be.

Boundaries and Constraints Imposed on the Model

The models are bounded and constrained by the organization utilized for test which is a development and test organization of the Directorate, within a Test Center of the Air Force Systems Command. This Directorate for Test and Engineering manages and executes testing in the field as well as in the laboratory. The theoretical work and advanced developmental work of the Directorate borders on the state-of-the-art and RD&T, and is considered as R&D.

It would perhaps have been more desirable to have been able to select an organization that engaged exclusively in

basic research. Reaching the ends of the continuum emphasizes and highlights differences more precisely. However, the Directorate for Test and Engineering falls somewhere on this continuum between basic research and production. This organization, like those doing basic research, has not had its output quantified.

The Air Force Regulation imposes constraints not only on the Air Force Manpower Unit but also on the manager. Central control by direction from the headquarters not only restricts his flexibility in hiring but also restricts his flexibility of shifting personnel where and as needed. It is necessary that he, however, be in a defensible position to present a valid justification for use of manpower resources to perform his mission.[1]

Because organizations are constrained by regulations which require measurements of all organizational productivity in order to establish manpower standards, the search for rationality through modeling in the RD&T area will probably continue until measuring techniques are fully developed.[2] One of the primary constraints in establishing standards in the RD&T area is our inability to quantify scientific outputs. The output may be only in terms of publications, contributions

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[1]Air Force Manual (AFM 25-1), "Management Engineering - USAF Management Process" (Department of theAir Force, 15 October 1964), p. 23.

[2]Air Force Manual (AFM 25-5), "Management Engineering Procedures" (Department of the Air Force, 7 June 1968), pp. 4-1 - 404.

to scientific knowledge, stature, eminence, numbers of original thoughts, inventions, innovations, and patents or consulting which may only be intangibly related to measure of performance. Quantification of performance leads to the establishment of norms. Once these norms are established then they can be used in conjunction with workload to establish manpower requirements. However, there is reasonable doubt at this time that production norms can be established for the RD&T organization.

The Air Force Model as Applied to the Directorate for Test and Engineering

The Air Force Model is in fact the descriptive model shown in Figure 2 with the use of a standard Figure 1 in Block F from which to predict manpower. When a decision is required at F, the requirement for manpower is compared with the manpower standard that has been established. If productivity exceeds the standard, then the equation is used as a determinant in the predicting and programming of manpower.

The U. S. Air Force Decision Model for Manpower shown in Figure 1 is used in Block F and Figures 3-9 are support detail steps used in the formulation of the manpower decision.

The Air Force Model is based on the scientific principles of management as fostered by Fredrick W. Taylor and deviations or innovation cannot be recognized within this Air Force institutionalized system.[3]

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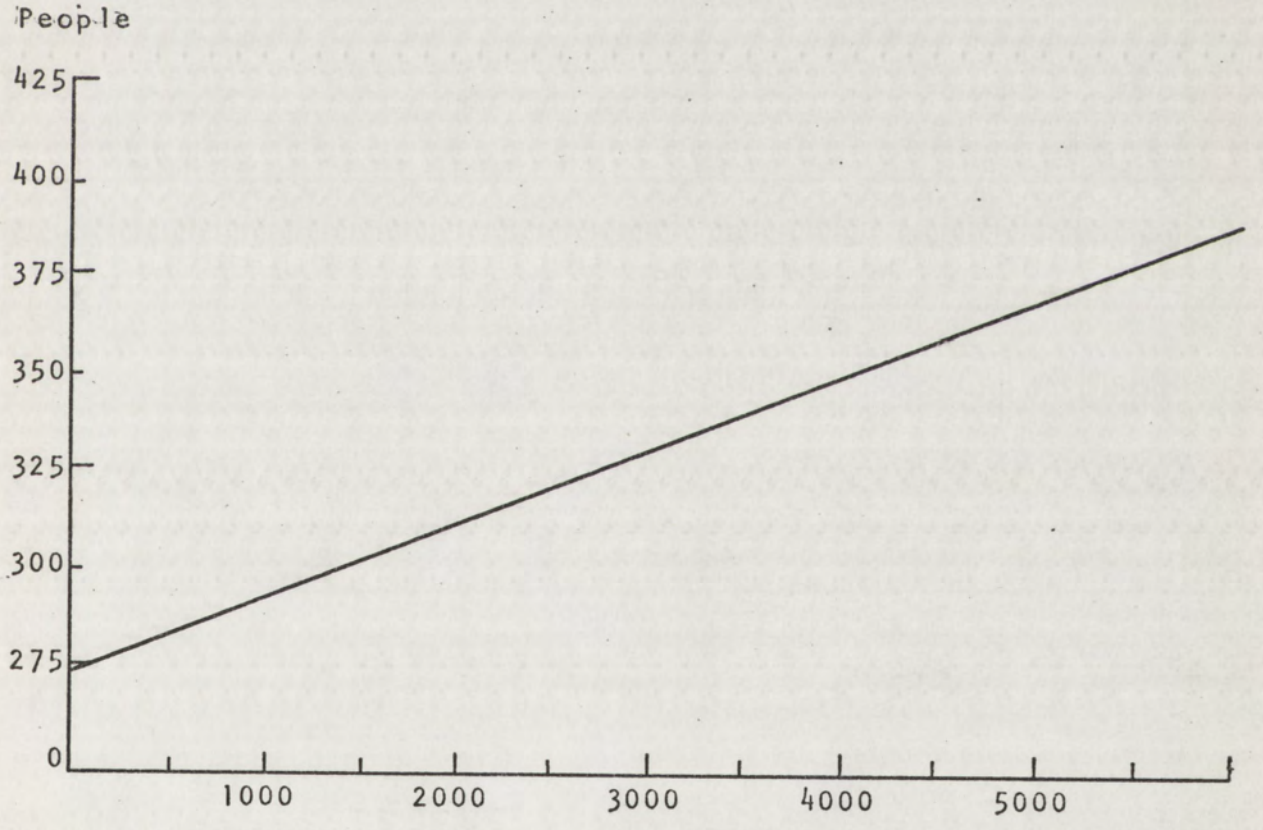
[3]E. M. Glass, "Evaluating R&D Organizations," Research and Development (January 1970), p. 25.

USAF MANPOWER UNIT O. R. DECISION MODEL
RELATING AFSWC DIRECTORATE FOR TEST
AND ENGINEERING TO AIR FORCE
SYSTEMS COMMAND PROCUREMENT
DOLLARS



Manpower Baseline Directorate of Test and Engineering or
Air Force O. R. Model B.

Figure 1

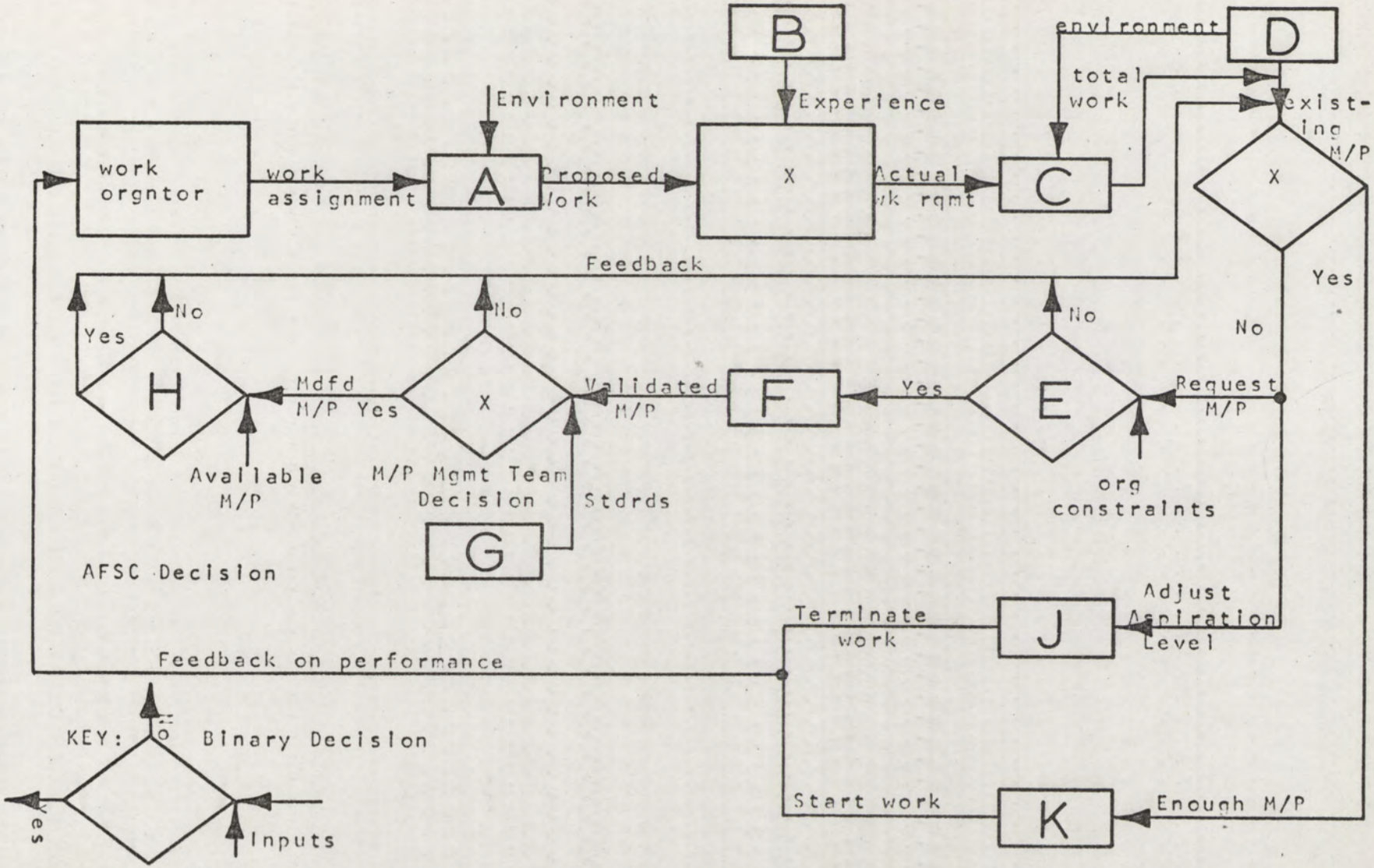
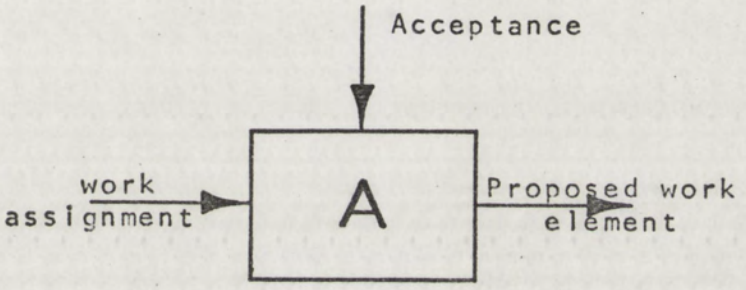


Figure 2.--The descriptive model showing the steps in deciding manpower requirements and the decision nodes involved by the supervisor, management, the manpower team and the Air Force Systems Command (AFSC)

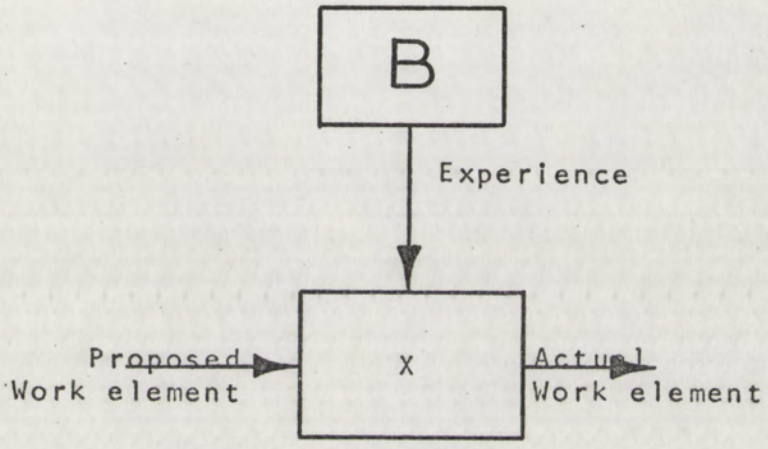
Figure 3.--The initial step in the supervisory decision process showing details omitted from Figure 2 for clarity.



Things that affect A

1. Conferences
2. Trade off studies
3. Constraints
4. System factors
5. Act solutions
6. Probability of contracting
7. Probability of additional resources
8. Final tech approach
9. Decision makers impressions
10. Schedules

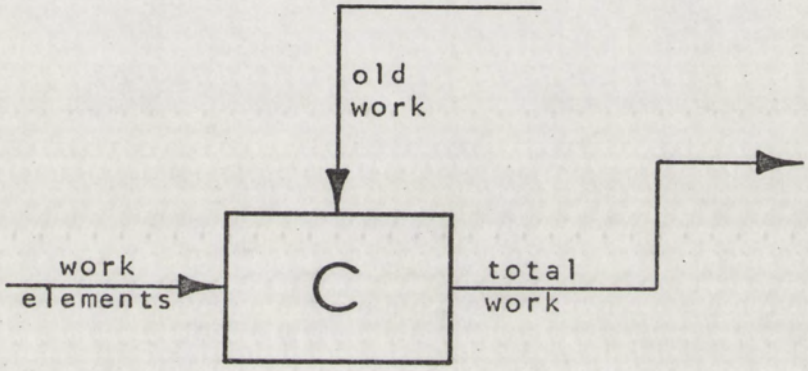
Figure 4.--An additional detailed step in the supervisory manpower decision process, Block B of Figure 2, showing details that were omitted from Figure 2 for clarity.



Effects on B

1. Experience level of proposed manpower
2. Experience level of existing manpower
3. Past experience of decision maker
4. Judgment of decision maker
5. Environment in which element conducted
6. Productivity level of proposed or existing M/P
7. Required level of performance for completion (aspiration)
8. Time

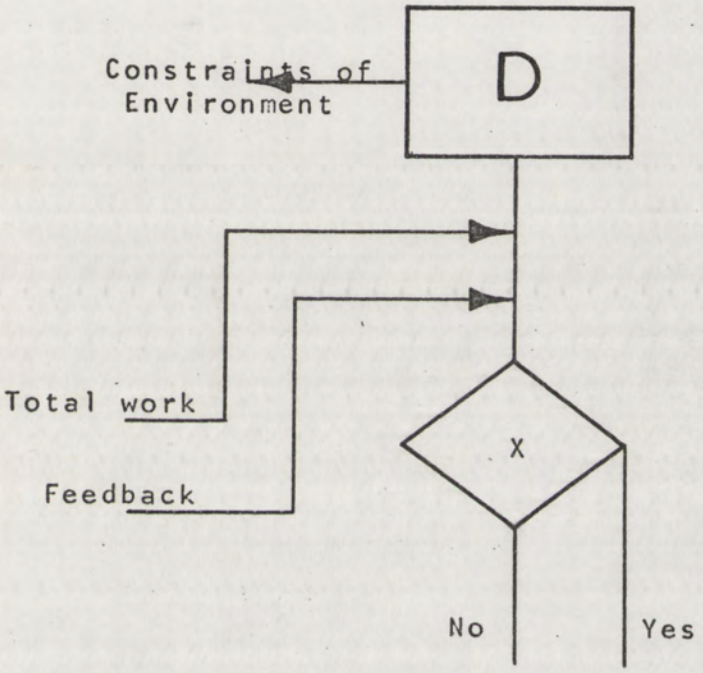
Figure 5.--Showing an additional detailed step in the supervisory manpower decision process, Block C of Figure 2, for additional clarity originally omitted from Figure 2



Effects on C

1. Existing work
2. Performance factors
3. Time
4. Actual new work elements

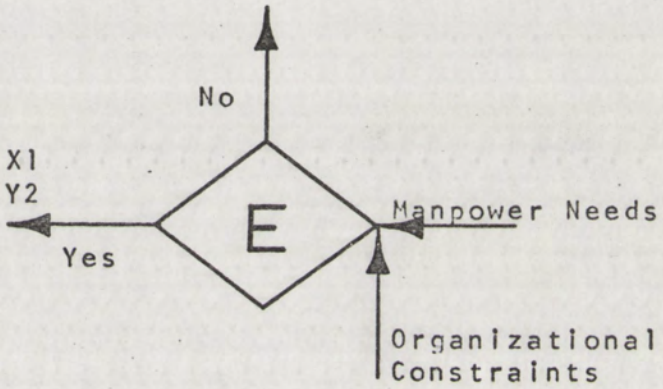
Figure 6.--Showing an additional detailed step in the supervisory manpower decision process, Block D of Figure 2 for additional clarity originally omitted from Figure 2.



Effects of D & Decision

1. Magnitude of work
2. Productivity level of M/P
3. Aspiration level of decision maker
   A. Time (extensions)
   B. Requirements
   C. Release M/P from exist jobs
   D. Release M/P from support orgs.
   E. Contract support
4. Environment of decision maker, i.e., constraints & pressures
5. Feedback on approval of additional M/P

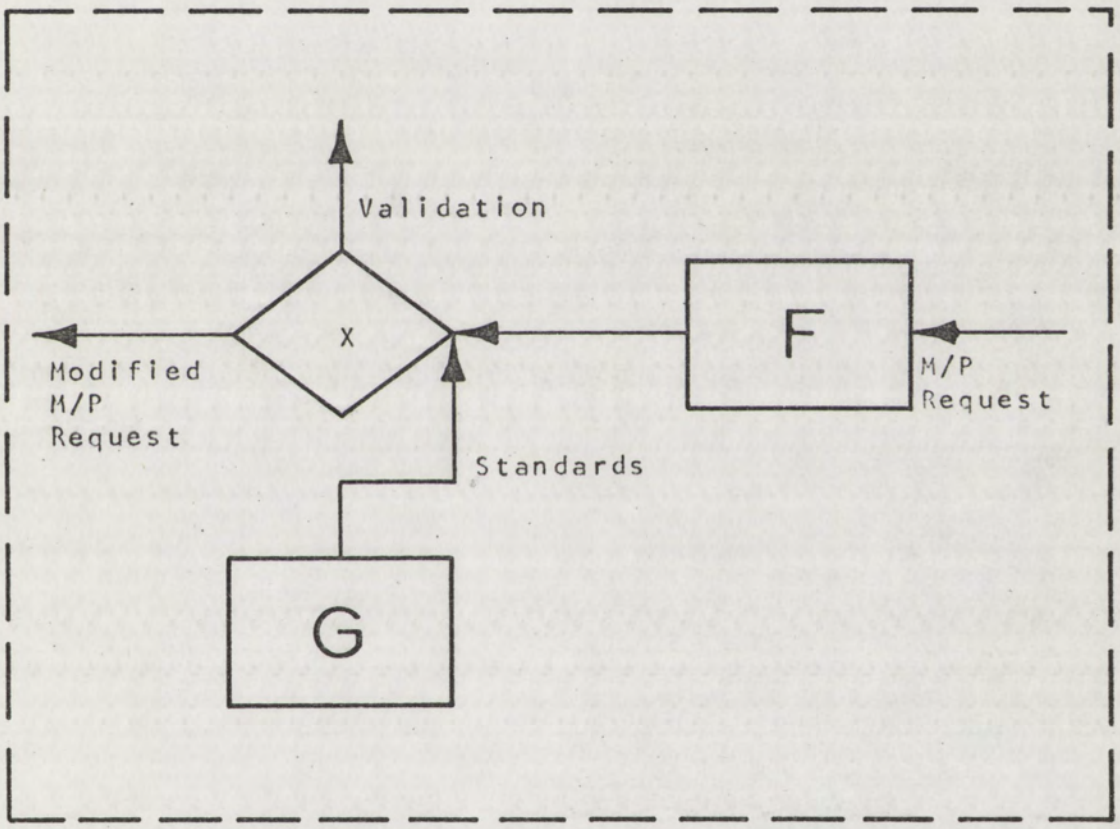
Figure 7.--Managements decision Block E of the D decision model shown in Figure 2. Additional detail has been added for clarity.



Effected by

1. Organizational constraints
2. Management knowledge

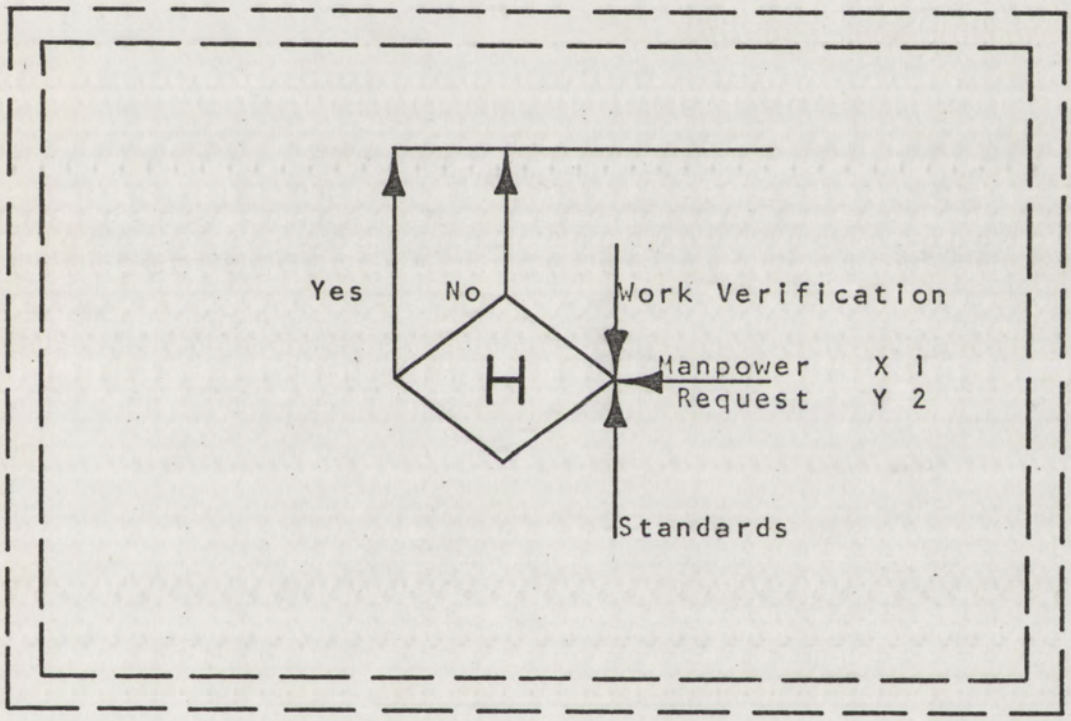
Figure 8.--The manpower management decision center and additional factors affecting this process.



Effected by

1. Manpower standards
2. Validation of needs
   a. Measurements
   b. Workload verification
   c. Manpower model
   d. Productivity level
3. Duration of need

Figure 9.--Air Force Systems Command Manpower decision with details of input and output that were eliminated from Figure 2 for clarity.



AFSC Manpower Management Decision

Effected by

1. Verification assignment
2. Availability
3. Environment
4. Priorities

In formulating the Air Force Manpower Model for the Directorate for Test and Engineering, the attempt was to find programmable factors which influence manpower requirements and produce a program equation that relates these factors. Historical statistical data at AFSWC from 1965 to 1969 by quarter were used where available.[4]

The following general factors were utilized as selection criteria:

1. Rationality
2. Availability of reliable historical data over an extended period of time
3. Sufficient information from which to program for at least 1 1/2 years
4. A statistical analysis be performed within the constraints of regulations.

Statistical correlation of approved procurement dollars was tested against the manpower base and statistically it provided an acceptable result. It appeared that the variables could be readily used in the development of a programming estimating equation (P. E. E.) for the organization. Correlation was based on the assumptions that manpower would be available to meet the workload when hardware was delivered and that AFSC procurement dollars dictate the complexity and level of effort. The programming estimating equation or final factors selected on acceptable statistical results was AFSC Procurement Program Dollars for the Directorate for Test and Engineering VS Manpower.[5]

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[4]Lt. Donaldson, Letter: SCOM-24 "PEE Development for Development and Test," 26 May 1969.

[5]Air Force Manual (AFM 25-1).

The purpose of the manpower management team as established by regulation is to achieve organizational improvements. This is to be done through maximum standardization by performing studies to increase efficiency and eliminate unnecessary functions through work simplification.[6]

After planning and coordinating their proposed study with the organization selected, the manpower team identifies the basic work units and establishes potential workload factors. This is done through work sampling from which work standards are computed using a correlation and regression analysis. From this analysis the establishment of a manpower model is then made.[7]

The purpose of the studies and the measurements is to help determine manpower authorization and to assure that existing manpower authorizations are effectively used. The Air Force model established for the Directorate for Test and Engineering related manpower to AFSC procurement dollars expended. Continuous performance evaluation or review is required by regulation for management to be able to guarantee that there is a valid relationship between paramaters. This basically is the complete process of establishing norms.[8]

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[6]Air Force Manual (AFM 25-5), pp. 1-11.

[7]Ibid.

[8]Air Force Manual (AFM 25-1).

In the identification of potential workload factors the importance of reliability and predictability is emphasized by regulations. This means that any change in the value of the output factors should be accurately reflected in a corresponding change in the manning requirement. The value of the factors must be predictable for future time periods in order to make the standards a useful tool.[9] This can only result from feedback through continuous examination of organization being studied.

Even though a linear model was chosen as the basis for the program equation, a parabolic model with even better correlation than the linear model was rejected because it reflected an unacceptable trend of decreasing manpower with increased workload. This raised some doubts as to the validity of the correlation and the extent of feedback being used.

The decision to use the program factors derived for the establishment of manpower may also be somewhat tenuous for although there is mathematical correlation there appears to be no real relationship to workload. Since none of the funds are allocated to the Directorate it appears that the workload is not directly sensitive to AFSC procurement dollars. A significant portion of the work in the Directorate is performed by contracts which if terminated would result in

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[9]Air Force Manual (AFM 25-5), pp. 5-7.

increasing the manpower required for the Directorate while the program estimating equation (P. E.) would then actually show a decreased requirement for manpower. This would tend to demonstrate the insensitivity of the equation to Directorate workload. In addition, assuming stable economic conditions within AFSC, additional workload could be accepted for the Directorate with no accommodating increase in manpower. This would also tend to illustrate the insensitivity between actual workload and AFSC procurement dollars.

In studying the P. E. it also appears that the maintenance cost with no AFSC money represents the current manning level a figure which is extremely high for zero expenditure of AFSC funds. Actually manpower and money should be interchangeable, and one could generate a curve for decreases in manpower if increasing AFSWC dollars were available.

In this model the requirement for continuous observations of performance appear to be abrogated, for once the standard is established regardless of performance, manning would be related only to the magnitude of procurement monies expended by AFSC. Since AFSC procurement dollars are not directly controllable by the Directorate and since the Directorate receives other funds for its operations as previously mentioned, this again shows little relationship of manpower requirements to funds or to productivity. This relationship appears to be an arbitrary standard which removes the supervisor and manpower management team from the decision center and responsibility for productivity and allocation of manpower.

Rationality is only possible if there is a positive correlation between the inputs and outputs, and precision can be established. However in the Air Force Model there appears to be no relationship of the Model to the output of the organization.

Positive correlation of the paramaters in this model would therefore appear not to be possible because of the insensitivity of the variables to manpower within the Directorate and as demonstrated the difficulty in identifying the outputs in units which makes the determination of an index expressive of manpower difficult or perhaps impossible.

The Descriptive Model

The Descriptive Model for Manpower Determinations is illustrated in Figure 2. Additional detail has been eliminated for clarity.

A modified questionnaire and interview technique was used as the basis for formulating the descriptive model. Initially it was intended that a questionnarie be used exclusively; however, the first interview set the pattern which made it necessary to use a combination of the two. The limitations of this approach for gathering information is recognized; however, useful information and a better understanding of the process in use do result.

The original descriptive model was reduced to give a primary focus to the major decision areas and are shown in Figures 2-9. After work is initiated by the outside agency,

it is assigned to a supervisor who may use a flow chart or establish a matrix to assist in defining the details of the work. Conferences, studies and investigations help to thoroughly understand the work and assist the supervisor in breaking it down into as much detail as possible. The constraints, alternative solutions, probability of additional resources and schedule help the decision maker to arrive at the final technical approach. These then are the major factors that are considered in Blcok A.

Through identification of the basic work element, a comparison is made with past experience for similar or equivalent work. This decision in Box B on the size of the work element is affected by the following factors:

1. The experience level of the proposed manpower.
2. The experience level of the existing manpower.
3. Past experience and capability of engineering judgment.
4. Environment of performance for each element.
5. Productivity level of proposed or existing manpower.
6. Required level of performance.
7. Time and other constraints.

Once individual element estimates are made, the total feeds into Block C where workload becomes the sum of the individual elements. This is done for existing as well as for future work. The factors affecting the total work are existing work, performance factors, new work elements and the time required for completion.

The decision on the sufficiency of manpower is made from Block D and its decision center. Manpower is related to work magnitude by the individual talent as well as the performance and productivity of the individual worker. The

magnitude of the workload is related to the capacity of avialable manpower selected to perform work. Within limits, the size of the job as viewed by the different workers will differ based on their experience and innovative capability. Projections or estimates are best performed by the supervisor because he has knowledge of each worker's performance and best understands the work elements. Participation in the establishment of commitments also adds to the validity of the estimate because of the personal desire to be correct in estimating. Factors that affect this decision are

1. The magnitude of work
2. The productivity level of manpower
3. The environment of the decision maker
4. The aspiration levels of the decision maker for:
   a. Time or possible extensions
   b. Technical requirements
   c. Possibility of releasing manpower from existing jobs or from support organizations
   d. Possibility of contracting support
5. The feedback on approval or disapproval of additional manpower

This review of work also considers the possibility of performing work in parallel, overlapping or in a serial fashion. The review is also used to establish the minimum, maximum and optimum manpower levels required for specific tasks. Critical path methods are also used occasionally as a guide on how to staff and run a given task.

The request for manpower is forwarded from the individual supervisor through the administration where a broader perspective of organizational constraints are imposed as illustrated in Block E. This provides management with the opportunity to integrate the additional knowledge they possess.

(See Figures 3-7)

From the administration, the single dashed decision box, the request is forwarded to manpower management organization on the local level where their decisions are made within the single dashed box. From Block F it can be seen that this organization then validates needs by comparing the request with performance and manpower standards. This comparison is only possible if manpower standards have been established by previous measurements. Modification of this request is then made based on a manpower model and the duration of need.

This entire decision node presently is incomplete because of the intangible nature of the output being measured. The local manpower organization has not at this time been able to measure the productivity of the RD&T organizations. Since no standards have been established for productivity in this area the modification or acceptance of the request and the decision as to the level of manpower funding must therefore be emperical.

Once the request for manpower is validated by the local MET, it is forwarded to AFSC where verification of assignment, priorities and availabilities are made. The triple dashed box represents the decisions made at AFSC. Information as to approvals are then fed back to the requesting organization where the decision is then made to start or terminate work.

In the descriptive model the intangible nature of the research productivity seems to remove the manpower management team from the requirement of formulating standards. Since this is prohibited by regulations it would appear that this would apply only until identification of measures of productivity are possible.

The Normative Model

In effect the descriptive model which is shown in Figure 10 becomes the normative model with a few changes in the area of the manpower organization. Blocks A through E remain essentially the same, with F in the RD&T case becoming subordinate to the commander and providing him with a staff service of auditing and recommending as shown in Figure 11.

The requirements for additional manpower are received at Block E and given consideration in relation to priorities, organizational constraints and possible reorganizational potentialities received from Block F, which is the local manpower organization. The audit performed by the manpower management organization is the feedback to the engineering manager to assist him in performing the best estimate. In addition the knowledge gained places the manpower management team in a better position to recommend to the commander areas for organizational change and release of resources.

The major change of the normative model from the descriptive model is in making the manpower team a support for the manager and not a tool of central control from above.

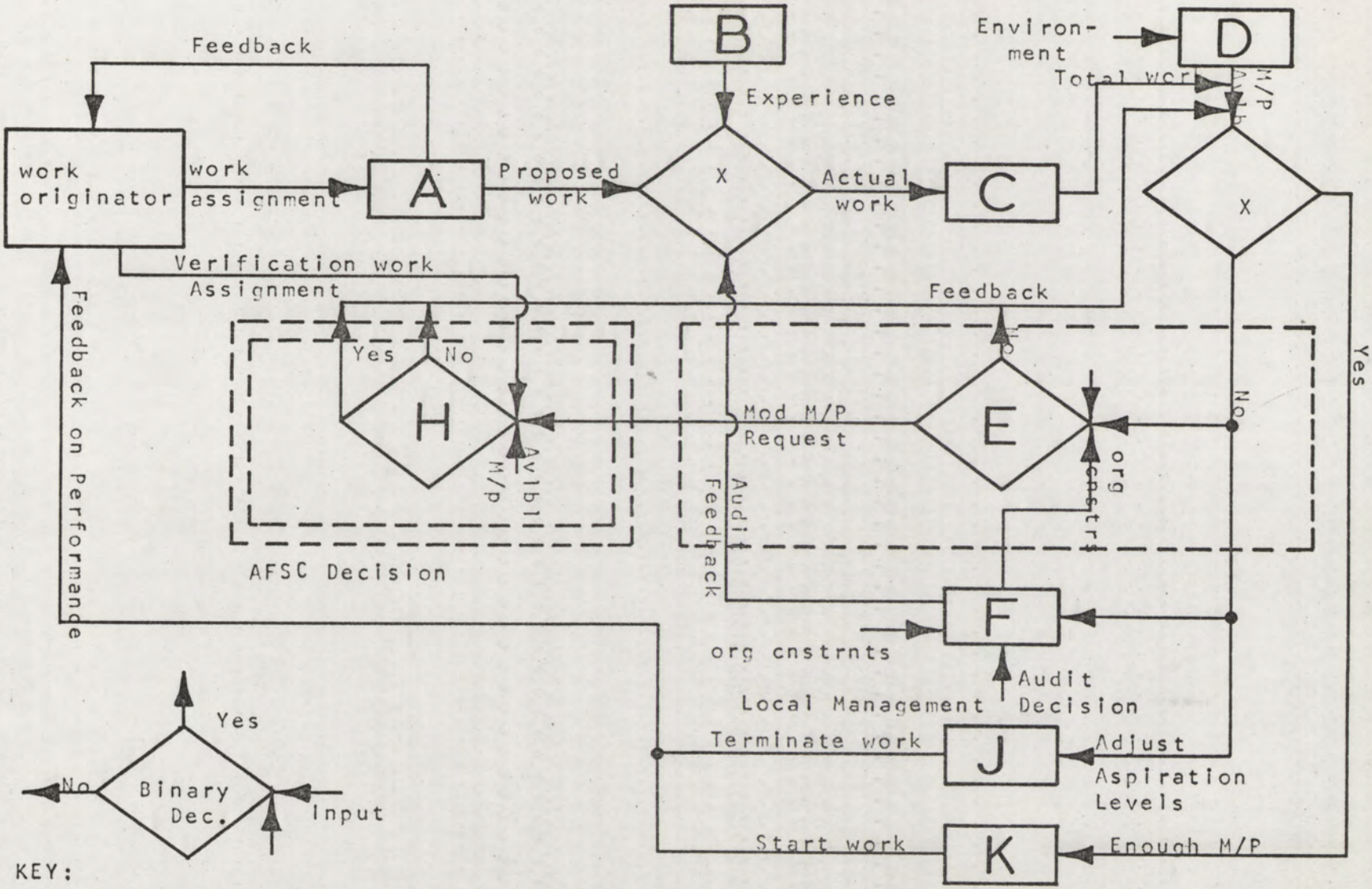
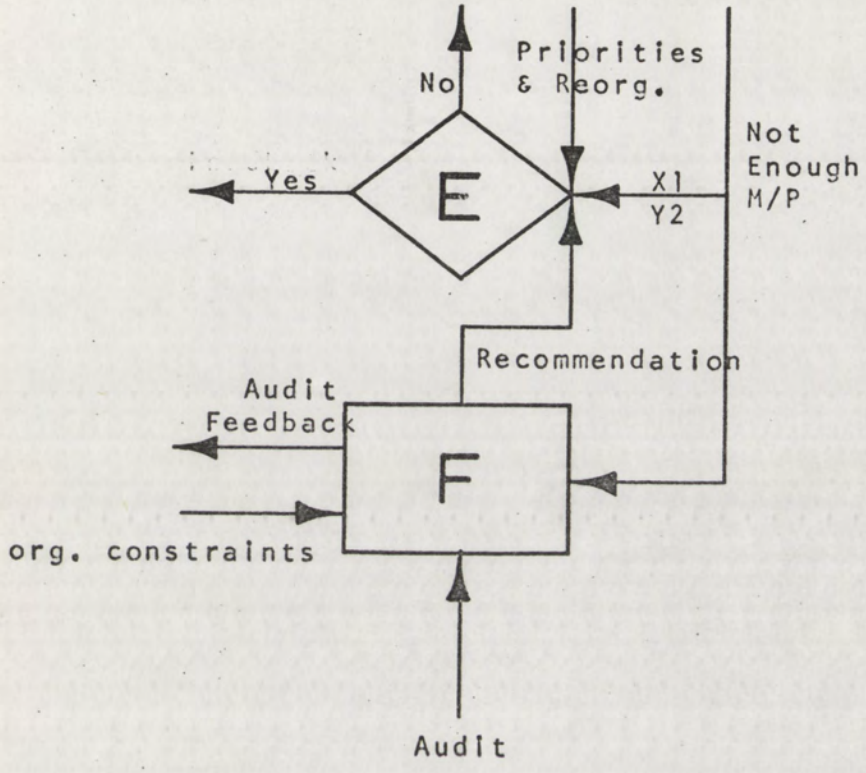


Figure 10.--The Decision Process of the Normative Model

Figure 11.--Illustration of the change in Block F to that of a staff function for the manager.



Effects on E & F

1. Requirement for additional manpower
2. Priorities of work
3. Organizational constraints
4. Audit of procedures used for Engr. Estimate
5. The feedback to the Engineering supervision regarding organizational constraints

This in effect substitutes self-control and objective management for control from outside. This permits the manager to be held responsible and accountable for the results of his performance within the limitations of the constraints provided.

The normative model, as do the previous two models, depends on a supervisory determination and identification of new work elements. In effect the determination of total workload factors must be provided by the supervisor. The magnitude of the problem and the identification of manpower requirements are best provided by the supervisor who can relate magnitudes to past experience and who can make sound scientific judgments. This estimation of magnitude of work and manpower would be required even if productivity factors were available for RD&T organizations.

The supervisor can best estimate work if he views his job as a science rather than an art and if he in fact follows detailed procedures to ensure a measure of rationality in his estimates. This rationality is assured by the staff service provided the supervisor by the manpower team. Their service to the supervisor making the estimates would include:

1. Maximum assurance that rationality is approached in the decision process by following of logical procedures.
2. That available resources within the center are also considered in the supervisor's decision and recommendation.
3. Assurance of compliance with priorities and manpower regulations.
4. The use of scientific methodology.

The manpower team is in an excellent and knowledgeable position after providing the service to the supervisor to advise the

manager as to the adequacy of the request. This in effect would consider reallocation of potential resources available to the manager.

Since manpower standards in the R&D area appear too difficult to determine at this time the procedures described above would provide maximum involvement of the manpower team with management in the formulation of the manpower decision. These procedures are recommended until sufficient research is performed to support the proposition that manpower standards can be established in the R&D area. Reliance on the supervisor for the workload and the manpower factors will therefore be necessary until standards can be developed.

Analysis

The decision process for determining manpower requirements is based on measures of productivity. This process does not presently function well for the RD&T organizations because of the intangible nature of the products and because the decision models tend to foster the idea that if progress towards goals can be measured efforts and resources can more rationally be managed. This has led to measures of performance for all levels of the organization. These measures and decision models are useful; however, one must be aware of their possible side effects.

Peter Blau[10] and Chris Argyris[11] in reviewing agencies

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[10]Peter M. Blau, The Dynamics of Bureaucracy (Chicago: 1955).

[11]Chris Argyris, The Impact of Budgets on People (N.Y.: 1952).

or organizations with a single measurable criterion found that the motivation for performance was towards the unit used as a measure of performance and that original goals were displaced and that an accounting period adversely affected overall goal accomplishment.

In his study of the Soviet manager, David Granick found that high production for one month caused neglect of repairs and maintenance; so in the following months there was a drop in production.[12] This helps to emphasize the dysfunctional aspects of a single measurable criterion for performance.

Even though the Air Force model uses a single criterion for decisions, the use of multiple criteria may not be a panacea either, because in the attempt to satisfy contradictory objectives the individual is forced to rely upon his judgment for application of his efforts to one criterion over another. The question must be raised as to the validity of the method used in the selection of criterion for the results of the O. R. Model indicated poor validity.

Single, multiple or composite criteria without an improvement in the knowledge of organizational behavior and actual relationship of the variables may still cause adverse performance. Behavioral consequences of performance would therefore seem to be the key, and if properly understood and applied through changed policies may provide an optimum

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[12]David Granick, Management of the Industrial Firm in the USSR (New York: 1954).

approach to increases in organization effectiveness.

One of the objectives of this analysis is to recommend a process that is functional based on sound engineering procedures, which gives maximum rationality to the formulation of manpower needs within the constraints imposed, and also to recommend organizational modifications that will stimulate efficiency. The decision process appearing from our model comparison is nearer the behavioralists end of the continuum than to the rational end; however, a move towards rationality is recommended through the manpower audit.

This analysis of this single sample might normally have limited the confidence in the conclusions drawn except that this decision process is typical of those utilized throughout the Air Force Systems Command where similar results which support this same conclusion are claimed. This conclusion is also supported by the USCSC report of survey of Air Force Laboratories and Test Centers conducted in 1965-1969.[13]

In examination of the three models, i.e., the Air Force, the descriptive, and the normative models, it can be seen that there is comparability for the initial step taken in the formulation of the decision regarding the magnitude of work. After determination of workload in this manner by supervision, the Air Force O. R. Model required the manpower management team to base their decision of staffing levels on an equation

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[13]Bureau of Inspections, Problems in the Management of Department of Defense In-House Laboratories (Washington, D. C.: U. S. Civil Service Commission, December 27, 1967).

which in this case is a relation of AFSC procurement monies to manpower. It has been shown that this is not a valid relationship, which illustrates the difficulty of establishing manpower factors in RD&T organizations and is typical of the intangible nature of the R&D product. Since continuous measurements of productivity of the organization have little or no relationship to the manpower and AFSC funds, one can easily see that the factors for predictability have not been identified. In order to continue use of this model, extensive research work would be required to identify the potential output factors.

The O. R. Model which is based on regulations identifies scientific management as the key to improvements in efficiency.[14] Once procedures have been initiated based on regulations, they particularly prohibit innovation which is limited because of the repetitious nature of the model. This in turn eliminates innovation which is responsible for major decreases in productivity. This major factor appears to have escaped detection in the formulation of the regulations.[15] Continuous improvements in productivity would therefore in this case be restricted by the initiation of a rigid standard.

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[14] Air Force Manual (AFM 25-5).

[15] Robert Solow, "Technological Change and Aggregate Production Progress and Economic Change," Review of Economics and Statistics, XXXIX (August 1957); Benton F. Massell, "Capital Formation and Technological Change in U. S. Manufacturing," Review of Economics and Statistics, XLII (May 1960); Solomon Fabricant, "Economic Progress and Economic Change," American Economic Review, Vol. 46 (May 1956).

It seems most desirable to progress past the Taylor period in the changing of regulations which require close supervision and tight controls for, as mentioned by Hampton, this often is met with a counter force resulting in a restriction of output.[16] It also appears desirable to consider more of the human relations aspects of management decisions.

The change in tasks to their highest form of specialization is suggested in scientific management by Taylor which is only possible if the output can be quantified. Today however we know that the maximum level of production is not achieved through the highest specialization of work but is set, according to Etzioni, through social norms. Noneconomic rewards and sanctions significantly affect the economic incentive and the loss of respect or affection of co-workers and friends is responsible in large for restrictions in output.[17] The loss of respect or affection is a motivator for, as we have seen in the hierarchy of human needs espoused by Maslow, the loss of love would result in a return to the safety levels and the motivation towards satisfaction of the higher needs is intensified.[18]

Taylor's approach has been that people are basically

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[16]David R. Hampton, Behavioral Concepts in Management (Belmont, California: Dickenson Pub. Co., Inc., 1968), p. 282.

[17]Amitai Etzioni, Modern Organizations (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964), pp. 58-67.

[18]A. H. Maslow, "A Theory of Human Motivation," Psychological Review, Vol. 50 (1943), pp. 370-396.

lazy and resist work and that management must counteract these tendencies. The inadequacies of these principles are explained partially by understanding that human needs are organized in a series of levels. Man lives by bread alone--when there is no bread. But when the physiological needs are satisfied, the higher needs emerge. The physiological needs are satisifed by employemnt and working conditions. The "carrot-stick" approach is not a motivator above the subsistence level.

Management cannot provide a man with self-respect or with the respect of his fellow workers. This can only come by creating the environment that encourages him to seek satisfaction. On the other hand failure to create these conditions can thwart attainment of these objectives and thus reduce productivity.[19]

The Air Force Model is inconsistent because of a use of subjective supervisory decisions of work load magnitude with a rational O. R. model for determining the numbers of people required. This combination cannot produce objective rationality for it will be no more rational than the initial subjective decision.

The O. R. model and the associated regulations are means/ends oriented and can be criticized as can all attempts at efficiency because of the assumption that the ends justify the means. The use of man as a means to another's organizational

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[19]Douglas McGregor, The Human Side of Enterprise (McGraw Hill, Inc., 1960), pp. 33-48.

ends, according to Kant, is immoral. The current approach to efficiency can be ruthless and may have a tendency to eliminate all ethical parts of the decision. It must be concluded that there cannot be rationality in the O. R. model because there is no real relationship of the paramaters to reality. We must at this time therefore depend upon people and their values for estimates until rationality through objective measures is possible. If it can be recognized that the normative approach can produce results, consistency, desired performance, while maintaining values then adoption would not become a problem. The first step in this process is the recognition that the Air Force Model is not currently functional.

Currently the requirement for conformance within the organizational constraints demands attempted implementation of the O. R. model. This is producing a transfer of goals to the products of the model as well as a distraction from research efforts.

In spite of the difficulties already mentioned, the value of the products is another item not coped with in any of the models and will not be treated in this analysis except to be mentioned. Herbert Simon has indicated that an index may be substituted for the profit motive of the private sector and measures taken to determine the degree of attainment of the objectives. These objectives in the public sector, however, must be stated in terms of values and these values are seldom expressible in sufficiently concrete terms to be applied to specific decisional problems. This means that even if our

decision was based on productivity that was quantifiable, we also require a measure of the value of our public goods to be able to complete the decision. If the value is not in itself quantifiable then it would be impossible to justify or favor the transfer of manpower from one government job to another. The scope of this implication is too great to be given full consideration in this analysis but is mentioned so it can be given consideration as a research item at a later time.

The descriptive model provides a pseudo-manpower standard generated by the supervisor in the form of estimates for workload and manpower. It is this standard that is currently utilized by default in the RD&T case. The manpower management organization in this case is not performing the function called for by regulation other than forwarding of the request to higher headquarters (AFSC). In fact it appears that the decision has been delegated to the lowest action center. In this case the supervisory decisions of workload and manpower requirements are accepted because an Air Force Model cannot be applied and the support to the decision generated in this way by the manpower office is primarily intuitive.

The failure of the Air Force Model is providing a form of democratic participation by the lower supervisors which tends to produce good side effects by making those participating feel that they are a part of a team and are respected.[20] This respect becomes a motivator and tends to create higher production.

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[20]Argyris, pp. 27-157.

Since there are no correlatable measures of productivity available in the RD&T area and since the Air Force Regulations have dysfunctional effects as written, they cannot be directly applied to this decision process. It is necessary to seek an alternate approach. In effect the descriptive model has been substituted for the Air Force Model and becomes a stepping stone to the normative or more desirable condition for manpower determinations.

The normative model accepts the supervisory appraisal of workload as does the descriptive but adds rationality through adherence to procedures making the decision more acceptable to management. The individual performing the decision because of the limits or available information and knowledge cannot be totally rational because he does not have all the alternatives or know all consequences affecting his decision. This decision maker forms his decision in this open model in a suboptimal manner or, as Herbert Simon indicates, in a "satisfizing" way.

The use of the manpower team in a staff capacity assists in decentralization so coordination can take place where information is actually exchanged. Delegation to experts brings greater knowledge to the solution of the problem therefore adds additional rationality. The use of the manpower team in a staff capacity to the supervisor also ensures that the scientific approach to decision is followed at that level. Thus a systematic approach through order adds rationality to that decision as well as the stimulation of innovation with its corresponding increases.

Sequential consideration of work elements, their magnitude, comparison with past experience and the integration into a total workload represents an incremental approach to the formulation of this decision. This approach is also maintained in the assignment of personnel and as such minimizes the impact of reassignment and adjustment of personnel resources. This incremental approach also permits the most rapid method or organizational learning and adjustment of aspiration levels.

The normative model is internally consistent because it uses the open or subjective model approach in each decision node which adds some measures of rationality. In our subjective model, decisions are reached when considerations fall within the limits of values and ethics of the individual, and they are brought into reconciliation with the organization and job requirements. This permits bargaining and the opportunity is supplied the individual to bring personal goals into resolution with organizational goals and become something more than a means to organizational goals.

In the normative model, creative tensions are retained. There is no complete autonomy or isolation for the supervisor, manager, peers, or the originator of the work. Because all share in formulating decisions, they have added incentive to see that commitments are met. This participation aids in the maintenance of purpose and goals.

The next step gained from this analysis is the understanding of the need for firm participative management to maintain a necessary creative environment from the top. The use of the

supervisor to establish requirements and to direct work in a decentralized fashion maintains participation; however, the use of the manager here ensures a firm and fair approach bridging the gap between Taylor and the neo-Humanists.

This model implies decentralization by placing the Air Force Manpower organization in a support role to the manager. This is the first step in organizational changes recommended for maximizing efficiency and productivity. Decentralized control of manpower to the manager or commander would achieve the goal stated in AFM 25-5 of greater flexibility in shifting resources to high priority jobs. Decentralization is a primary factor in effecting productivity of professionally oriented people and decentralizing manpower decisions to the manager level with participation by the subordinate supervisors should improve this process.[21]

Authority for control by the manager is essential for efficient utilization of all resources including manpower. This decentralized control from higher headquarters (AFSC) to the manager level would permit greater initiative and innovation in the accomplishment of overall goals. Since there is no completely rational decision approach open, it is necessary to maintain an environment conducive to maximum productivity which may be achieved by implementing the changes recommended by the analysis.

Management by objective through target setting by higher

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[21]Etzioni, pp. 68-74.

headquarters (AFSC) and the manager would be a beginning for the development of sound ground rules; this is supported by the research conducted by McGregor and Drucker. The next steps involve self-control within the bounds established by higher headquarters (AFSC) and the transfer of the manpower team to the staff of the commander which permits him to exercise responsibility in self-control.

Finally, it is recommended that a research effort be initiated by manpower and management to identify productivity estimates for the RD&T organization and individuals. This is recommended because our examination of the manpower organization and the related models clearly demonstrates that tangible measures are elusive and that a change in regulations and the decision process is in order. There is no completely rational process open to us at this time; however maximum rationality is approached by assistance through use of the scientific approach and help from the MET as a member of the commanders staff. The normative approach requires a reliance on the decision maker who by use of the normative approach makes the most rational choice possible.

Summary

This survey first examined three models. The first was established by an Air Force Unit. Regulations were quoted and conclusions drawn by the author that the correlation between the paramaters selected by the Air Force Systems Command (AFSC) monies and the Directorate manpower were not relatable. The

unreliability of the data implies that a modified procedure is necessary. Next a descriptive model of actual practices was obtained by interview and questionnaire. A tentative conclusion was drawn that decisions regarding workload and manpower needs for the descriptive model were somewhat intuitive; however they are based on experience and scientific judgment and are used in the formulation of workload estimates in the Air Force and normative models. This implies that the manpower team has been restricted from providing a full service in the RD&T area. Finally a normative model developed considered combinations of Air Force requirements and actual practices. The normative model suggested that management by objectives and self-control through an indirect approach may produce the highest productivity and may become the example of a process for decisions regarding manpower requirements.

CHAPTER IV

THE ADMINISTRATION OF AIR FORCE R&D MANPOWER PROGRAMS: POLICY EFFECTS AND MANPOWER STANDARDS

The case study approach was chosen as a tool for objectively looking at the historical events, their interrelationships and effects of policy on the AFSC R&D organization. In particular the study of the policy in the application of manpower standards provides a tool for projecting analysis into the policy formulation process.

The case of policy effects: A typical application was chosen primarily because it emphasizes policy development through the application of efficiency standards to an USAF R&D organization. Unfortunately a historical development does not yield general principles for future administrative action nor does it focus on such factors as motivation, leadership or communications. There is an insight gained, however, by a review of procedures and events as they show a softening of the decision against full implementation of the policy of applied manpower standards to the R&D organization.

The final analysis of the problem is interwoven with the events and their relationship to the final policy. A common ground is developed while exploring conflict relating to the issues. Case studies in general and this one in particular

lack guidance but show the general character of the problem faced in the organization. This case supports the proposition that manpower standards are having an adverse effect on the USAF R&D mission and are generating an impressive list of problems which is typical of over-reliance on efficiency controls.[1]

The Air Force Manpower Engineering Team (MET)

The Air Force Manpower Engineering Team (MET) is composed of efficiency experts appointed to review specific organizations and to establish manpower or efficiency standards. They have been directed by Regulations to state numerically as many variables as possible that can be used for manpower decisions. This was done assuming that if progress can be measured then rationality is assured. The MET completed preliminary measurements for the AFSWC Technical Facilities Directorate and Systems Engineering Directorate in April of 1965 and it will be shown that the application of the standards had adverse effects on the organizations.

These Directorates are the mission elements of the Air Force Special Weapons Center (AFSWC), an organization within the research arm of the Air Force Systems Command (AFSC). Their work of advanced development and state-of-the-art requirements places this organization as well as other AFSC centers well within the research and development area.

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[1]Frank J. Jasinski, "Use and Misuse of Efficiency Controls," Harvard Business Review, 34:4 (July-Aug, 1956), pp. 105-112.

The manpower survey was geared to the measuring the output of the organization to establish a relationship to manpower requirements. From the items counted, workload factors for manpower were developed. The construction of the relationship of the output to manpower is only an approximation of reality and does not consider all variables nor is it able to measure true output. It is necessary that the products lend themselves to quantification and have a real relationship to manpower or their value is lost and this may be the case for the R&D area.

On the 19th of August 1966, after the preliminary studies were completed, workload data were submitted. These data combined with the decision criteria established were used to justify a reduction of 12 manpower spaces in the Systems Engineering Directorate and a reduction of 11 spaces in the Technical Facilities Directorate.[2]

There are dangers in the formulation and application of efficiency standards. If the output being measured is somewhat intangible, the standards may be an abstraction of reality. If there is no follow up and feedback the quality of the relationship cannot be improved. No observable tests were performed and the benefits of utilizing the scientific approach were lost. Conflict was generated because there appeared a substitution of standards for organizational goals.

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[2]Plans Office, "Review of Manpower Validation of AFSWC R&D Mission Organizations," (Headquarters AFSWC: Plans and Requirements Office, 14 September 1966), p. 1.

Procedures

Technological War Plan (TWP)

Manpower expenditures records and manpower requirements using AFSC Form 59 (a form used to summarize manpower needs) and the Technological War Plan (TWP) or, score submission, for forecasting technological requirements, are the key elements used for approving, controlling and changing manpower within the AFSWC prior to the application of manpower standards. Manpower expenditure recording procedure is the only item listed not established by Regulations.[3]

When new work requirements were received they were checked by the Center staff for completeness and essentiality, then forwarded to the appropriate Directorate for a determination of manpower and other resource requirements. Estimates were developed by work center supervisors involved and a member of the Technical Operation Directorate. These estimates were formed by a comparison of work elements with past experience; where no comparison was available, an estimate was made using judgment based on scientific principles.

Manpower estimates were stated in great detail on AFSC Forms 59 and 59A which were reviewed by all levels of the administrative and supervisory staffs. Once it was determined that these resources should or could be made available these forms with a complete outline or job plan of the work were approved. The job plan and estimates then become a contract

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[3] Ibid., p. 2.

for performing work.[4]

All data were processed periodically by computer for a summary of manpower requirements. Printouts of monthly summaries were made for each job and division with estimates by fiscal quarters. This permited an overview of documented requirements and an excellent understanding of the dynamics and shifts anticipated for manpower.[5]

This procedure therefore not only became the management tool for checking on the planned versus actual use of R&D manpower, but became a control method also and forced change where priorities dictated. This procedure therefore permitted reprogramming of manpower to meet changing requirements. Because of the involvement and participation of the staff the TWP approach appears to be theory Y oriented.

The TWP emphasized decisions through management by direction and control in a decentralized manner. The TWP also provided for the management and planning for integrated requirements. Specifically each job was planned on the basis of merit. Jobs were then integrated into a whole, calling for changes in manpower from job to job and from work center to work center emphasizing the importance of particular jobs and changes received through the TWP. This system basically relied on the evaluation and judgment of the supervisors and managers to control the resources within their jurisdiction, with guidance from AFSC through the TWP.

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[4] Ibid. [5] Ibid., p. 4.

New Management System

The system was designed to simplify the administration of manpower and to make the procedures more equitable and more objective throughout the Air Force. This was an attempt to add rationality to manpower allocation and assure distribution of manpower to critical areas as viewed by the Air Force central office. This effort has been entitled "Management Engineering Program (MEP)" and given the mission outlined in AFM 25-5 of:

> Systematically increasing work center effectiveness.
> Developing and maintaining adequate work center standards which relate to approved workload.
> Recommend solutions to management problems.

Although eventually to be applied throughout the Air Force, MEP was new to the R&D area. The manpower team observed work in progress, arrived at work definitions, and delineated the work centers which generate identifiable output. Random observations were then made and tentative work standards relating manpower to production are then forwarded to the Air Force command for coordination and approval.[6] Somewhat arbitrary application of standards because of poor coordination with the commander and the lack of his involvement caused antagonism and resentment.

The MET manpower procedures decided on the manpower needed in areas based on the number of projects, work orders, drawings, and pages published without regard to the magnitude of effort

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[6]United States Civil Service Commission, Management of Human Resources in the Air Force Research and Development Establishment (USCSC, 1966), pp. 33-34.

or complexity of the job. The primary question asked by management was whether there was a relevance of the measures to productivity. Probably the greatest difference between the new approach and the MET is that the MET looks at the historical base while the TWP approach uses a continuous evaluation and shifting for future requirements based on new conditions that may exist.[7]

The following workload relationships were established by the MET with standard time factors based on 12 months of historical data:

a. Number of Personnel Authorized

The size of the administrative function was dependent upon the total number of people authorized for the organization.

b. Number of Work Orders

The average number of work orders in progress or completed per month was the workload factor used for the engineering organizations. Each work order was counted equally with no regard to the magnitude of effort required to accomplish each. It became obvious that the MET had no appreciation for the complexity of the work in progress.

c. Number of Projects

For some organizations, the average number of R&D projects worked on each month became the workload standard regardless of complexity or size.

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[7]"Review of Manpower Validation," p. 6.

d. Numbers of Pages Published

For the Space Vehicle Division the average number of pages published became the workload standard. The primary mission of this organization was making space radiation measurements not the incidental product of range documentation.

e. Capability

The telemetry station and the seismic impulse facilities were validated solely on the capability to maintain and operate the facility without regard to the magnitude or volume of work that was required.

f. Drawings Completed

The production unit for drafting was the number of drawings completed per month regardless of their size or complexity.

Problems and Effects

The MET approach is primarily theory X oriented and would appear to assume people are lazy and must be stimulated by the establishment of work-output standards. Data utilized are primarily historical and do not allow for change. Management claimed that the standards established could not be supported by history, the present, or future workload because of the changing magnitude, character, and complexity of work. Production standards caused dysfunctional effects on efficiency and morale similar to that observed by the USCSC.[8]

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[8] Ibid., pp. 4-5.

The manager had no authority over the MET team who reported directly to command headquarters. After initial coordination the next encounter would be when the manager received changes to his manning document resulting from application of the standards.[9]

The manager's dilemma occurred because the MEP reported to one staff element in command while another staff element administers authorizations. He may receive instructions to undertake a new project "within current resources," without authority to drop existing projects. He also runs the risk of losing the spaces of those transferred from existing projects.[10]

The current problem in establishing standards is the intangible nature of the research productivity. The scientist believes that the output of the researcher is either not predictable, measurable, or repetitive. The manpower utilized depends upon a number of variables like priorities, inventiveness, experience, the state-of-the-art, and the exercising of creative professional judgment. From this information it would appear that there may be extensive difficulty in establishing standards utilizing a single criterion or even multiple criteria without following the advice of the United States Civil Service Commission that the establishment of standards be made a research project itself.[11]

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[9] Ibid., pp. 33-34. [10] Ibid., pp. 34-35.

[11] Ibid., pp. 35-36.

Can standards be applied without extensive verification or research? Can it be assumed that the mission is not dynamic and everchanging? Can manpower standards be based solely on history and will the acceptance of the MET system result in the displacement of the real mission goals with the efficiency criteria of the number of pages published, work orders processed, etc.? Should the MET approach or the TWP approach to manpower be used?

Systems Engineering Directorate

Changes took place in the nature of work after the initial validation study was performed. A number of projects have been larger than those considered to be the average at the time of the study. With a change in the nature of the work can the standards be applied?

The complexity of the jobs increased, and with this increase the time and manpower required for each project also increased. This caused the workload count to fall.

A detailed evaluation indicates that for the period in question approximately 50 percent of all engineering time available was expended on a single project. The overload in the Engineering Division was so high that it was necessary to extend its work hours 20 percent, borrow approximately 16 percent more manpower, use extensive overtime, cancel vacations and low priority work; yet the manpower (job) count continued to go down.

The changing requirements were foreseen at the time of

the preliminary validation study and the following comments were made by the Director:[12]

> Within the Project Engineering Division there is some concern whether "Programs in Progress" will be a tangible workload factor over an extended period of time. It is recommended that the suggested workload factors be used on a trial basis for a period of one year without making manpower adjustments on the validation analysis during that time. At the end of this trial period, a determination can be made by the Manpower Team and the office of primary responsibility as to the effectiveness and desirability of applying manpower standards to mission elements in the field of Research and Development.[13]

The Space Vehicle Division

In the Space Vehicle Division similar results were obtained because the work goals in this Division were changed from paper to hardware. This change was made in accordance with plans forecasted by direction in the TWP. The analysis of AFSWC's future requirements dictated a change from space research to instrumentation. This change deleted the requirement for long range documentation and therefore deleted the requirement for publishing large numbers of pages. In short it was claimed that the real relationship of manpower to organizational output had not been identified and that the standard was also invalid because of the changed mission. The workload did not decrease; it simply changed character.[14]

In the Technical Facilities Directorate, standards were

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[12] Ibid., pp. 10-11. [13] Ibid., p. 11.

[14] Ibid., p. 19.

applied to nine work centers with similar results. It was also claimed that a change in the nature of the workload within these functional areas by fewer larger projects could cause a great distortion of needs and that the standard also appeared invalid for this organization.[15]

Technical Management Council (TMC) Involvement

The Technical Management Council of the Air Force Systems Command is composed of eminent scientists from organizations within the command. The scientists bring knowledge and current problems to the TMC. Their individual exposure to examples of manpower standards typical of those presented led them to forming opinions and action recommendations. After studying the procedures and techniques being used to apply standards, the concensus was that the application of standards was causing considerable consternation throughout the Command. They could see that the subject needed additional study. To emphasize their concern they presented a paper on 23 May 1967 to General Ferguson, the chief of AFSC, recommending that he sign their attached letter to General Houston which recommended a change in the implementation of the standards within AFSC.[16]

The TMC called attention to the vigorous pursuit of the

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[15] Ibid., p. 27.

[16] Arthur G. Wimer, Jr., Chief Scientist, letter re Application of the Management Engineering Program (MEP) in AFSC (M-120) to Gen. Ferguson, 23 May 1967.

MET in application of the standards throughout the Command. It was pointed out that these standards, as called for in Air Force Manual AFM 25-5, entitled "USAF Management Engineering Program," 10 August 1965, were for "routinized" non-R&D activities and the manual's content and example implied:

a. Uniformity and repetition of operations so that quantitative measures are meaningful. Qualitative means of evaluation are prescribed where operations are not uniform or repetitive.

b. Continuity of operation so that work observed is representative of that predicted as well as the historical data base used;

c. Duration of observation so that a high level of confidence is established that adequate samples have been obtained for use in standards development in the particular work area being assessed.[17]

It was not clear to the TMC that the standards were adequately founded in essentials for application to R&D activities. They also stated that in their opinion efficiency standards for other governmental agencies and industry pursuing R&D have been abandoned.

The TMC did not doubt the aims and objectives of the application of efficiency standards. They felt that conditions and attitudes created by the MEP could not only impair new programs but would also affect the ability to attract and retain

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[17] Ibid., p. 1.

competent technical personnel in the future. They also felt that morale of the present work force was being adversely affected.[18]

Management of Human Resources in the Air Force Research and Development Establishment, U. S. Civil Service Bureau of Inspection findings and conclusions, supplies additional support to the position of the TMC relating to manpower and personnel policies.

USCSC Involvement

The USCSC Bureau of Inspections performed an independent survey of the Air Force R&D facilities within the Systems Command organization initially in 1965 to determine implications of the Manpower Engineering Program. This was done to establish "whether manpower control systems are helping to accomplish the positive objectives of frugal and efficient management," and "whether the administration of controls is actually affecting the R&D capability adversely, either on an immediate or long range basis."[19]

The first survey in 1965 produced sufficient questions regarding the efficacy of the Manpower Engineering Program that they decided to make this a major focus in a later inspection conducted in 1966. The final survey covered seven Air Force laboratories, four test centers, the aero-medical

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[18] Ibid., p. 3.

[19] Management of Human Resources, pp. 1-2.

school, and the Wilford Hall hospital. The term R&D is applied to test centers as well as laboratories.[20]

It was noted that there was resentment among professional staffs because of standards being applied peremptorily rather than experimentally and without a prior determination that engineered standards could be developed for R&D. Inadequate communications and poor coordination with laboratory directors appeared to be having the opposite of its intended effects, and the professional staff was being diverted from its main effort.[21]

The recommendation of the USCSC on extension of the manpower program into these laboratories and facilities was that this program be considered a research effort itself with cooperation and participation by the laboratories. The use of research in the commission report included exploratory development, advanced development and engineering development as R&D. In this they are referring to both the laboratories and the test centers.[22]

In its detailed assessment in support of findings the survey team report contains a critical review of policies, procedures and evaluation of management practices in R&D laboratories, and draws attention to the uniqueness of the R&D mission. Decentralization of manpower authority to the commander

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[20] Ibid., p. 2 and appendix II.

[21] Ibid., p. 8.

[22] Ibid.

was recommended. The report recognizes the requirements of the DOD for objective standards but suggests "the need for another look" as the R&D work is farther removed from the operational activities than is non R&D organization.[23] The Commission also recognized that the application of standards was having an adverse effect on the R&D activities.

The survey team addressed the Air Force extension of the Management Engineering into AFSC with the acknowledged success in other commands. In particular they recognize the successful use of this method in standardizing the work procedures in SAC and AFLC. Since these organizations were not inspected, we might question the statement of successful application of these standards. A review of performance standards applied to Air Force Wings was reported by R. C. Wagner.[24] He found that a complex rating scheme utilizing multiple criteria covering a wide range of activities was used. When the organizations were placed under pressure to raise performance without increases in resources unanticipated consequences resulted. Individuals were subject to tensions, role and value conflicts, and there were occurrences of reduced morale. Air crews suffered intercrew antagonism and apathy. The power structure underwent changes. Communication distortions and blockages occurred. The integration decreased, cultural

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[23] Ibid., p. 22.

[24] R. C. Wagner, "Latent Functions of an Executive Control: A Sociological Analysis of a Social System under Stress," Research Previews, Vol. 2 (March 1954), pp. 11-15.

patterns changed, and norms were violated. Some of these consequences may have been desirable and some undesirable. One may therefore raise the question of overall performance and the effects of manpower standards even in areas other than R&D. The question might be asked, "Did the multiple criteria cause the conflict or do manpower standards have adverse effects on repetitive tasks in non R&D areas?"

USAF Direction to Office of Aerospace Research (OAR)

On 6 March 1967 the Air Staff terminated the OAR exemption from the provisions of AFM 25-5. This imposed a series of actions intended to implement the Manpower Engineering Program within OAR. This plan anticipated the use of the AFSC manpower teams where OAR laboratories are colocated with AFSC organizations.[25]

Ordinarily AFSC would not be involved but is vitally concerned because of two key points in air staff action:

a. The citing of AFSC expertise in the successful application of manpower standards to the R&D area since 1962.

b. The proposed use of AFSC MET to establish OAR standards which may cause serious conflicts through the application of techniques which have brought unrest within AFSC.

The terms "application" and "successful use" are not synonomous, and the technical leaders within AFSC strongly protested to the chief scientist that the application of MEP

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[25]Air Staff Letter, "A Management Engineering Program for Office of Aerospace Research (OAR)," dated 6 March 1967.

to the R&D area be re-examined.

Finally the Technical Management Council of AFSC suggested that it was inadvisable to ask OAR to withstand such imposition by sighting their observations as well as those of the USCSC and suggested delays until there was acceptance by scientists and the doubt as to the feasibility of application of engineered standards to scientific positions was removed.[26]

Redirection

In July 1967 the Department of the Air Force issued a memorandum re-directing the Management Engineering Programs within laboratories. In recognition of the needs to promote efficient productive management and utilization of resources and to be able to defend these needs the following re-direction statement was issued.

> Because of the recognized technological limitations of AFM 25-5 we have established capability for methodology development appropriate to the laboratory environment. It has also been recognized that this development should be performed in the "real world" of R&D and direction has been given for the MEP to be conducted as a joint undertaking of both laboratory and MEP personnel.[27]

It was also stated that solutions to problems would be found prior to implementation.

Finally the application of MEP as applied to laboratories was considered a research effort to develop and test techniques most appropriate for the environment prior to their implementation. The application of standards in the R&D area was therefore

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[26]Wimer, Appendix II, p. 2. [27]Ibid., Appendix III, pp. 1-4.

delayed until research into the problem could demonstrate scientific acceptance.

Follow up

As a joint effort of the USCSC and the Department of Defense a follow up program was initiated 8 February 1968. A status report was presented to the commission on 28 May 1969 which confirms that changes in the direction being proposed may eventually materialize.

In the problem area of coordinating workloads and funds, the DOD working with the military departments indicated that changes which should be considered were the following:

A. Increased delegation of authority for manpower, organization, and personnel management to laboratory directors.

B. Delegation to laboratory directors of authority to make exceptions in particular circumstances to manpower ceilings, grade and organizational procedures.

C. Substitution of fiscal budgets (for in-house work) for present manpower ceiling controls.

D. Use of man year accounting during the fiscal year.

E. Common DOD manpower control procedures for RDT&E activities.[28]

Regarding manpower controls it was stated that

The Department of the Air Force should improve the timeliness and responsiveness of the Systems Command manpower and organizational control system. Care should be exercised in applying engineered manpower

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[28]Joint Program of the Civil Service Commission and the Department of Defense to Resolve Problems in the Management of Defense In-House Laboratories, MAM 69-2 (Washington, D. C.: Office of Laboratory Management Office of DDR&E, Management Analysis Memorandum 69-2), p. 4.

standards to RDT&E activities. Initial application of the standard should be treated as a research project with laboratory management participating in their study.[29]

Summary

The final claim by management for the case study was in effect that workload factors based on the number of tasks and shop instructions were not an adequate measure for the R&D organization's output. The key problem was that of the size of the element of work varies widely in magnitude, time and difficulty. The rate of change was also a factor that was suggested as prohibiting the use of historical data. The selection of single variable and the lack of testing and verifying of the decision model prior to application was claimed as another key to the selection of poor standards. Management also claimed the intangible nature of research productivity and the nature of application of standards prohibited selection of tangible measures at that time.

Organizational change is not unusual and is occasionally necessary for maximum efficiency and survival. If applied incrementally, dysfunctional consequences and psychic costs, however, are minimized.[30]

Change in this case could have best been accomplished through involvement of those affected by providing opportunities for participation in the formulation of the standards. This

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[29] Ibid., p. 4.

[30] R. T. Golembiewski, Perspectives on Public Management: Cases in Learning Designs (Ill.: F. E. Peacock, 1968), p. 33.

involvement could have provided a sense of legitimacy and acceptability by the scientists and supervisors. This would also give them a pre-notice of impending changes so they could make adjustments necessary for accommodation and provide an opportunity for management to counter hostilities.[31] Neither formal or informal participation however was sought.

Informal participation and support from the scientists had not been secured. This was evidenced by the statement in the USCSC survey which noted none of the engineers or scientists interviewed was convinced that engineering standards were applicable to research efforts.[32] Formal participation was also missing as evidenced by the laboratory directors statements that they had no control over the manpower team and no voice in the determination of standards.[33]

Probably the most important person overlooked in this change is the commander or laboratory director who, by position held, could mediate as a change agent between the organization and the individuals. Delegation of responsibilities to this level is at the heart of our problem. The manpower team reports directly to command headquarters and in a sense makes the decisions regarding manpower utilization, by-passing the commander.

The commander can receive direction to perform a new

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[31] Ibid., pp. 33-37.

[32] Management of Human Resources, p. 8.

[33] Ibid., p. 34.

job from within existing resources without authority to terminate work in other areas. He cannot transfer personnel assigned to existing work without the risk of losing the manpower spaces.[34]

Centralization of decisions on manpower at the headquarters is a tendency towards centralization of the planning process and the desire to make sure there are the right numbers of people in the right places for mission accomplishment. However, this approach assumes sufficient knowledge and expertise in the headquarters, an assumption that frequently cannot be supported because of the dynamic and changing nature of the research effort. It is therefore most desirable to utilize the field specialist by joining the scientist/engineer and manager into a team at the source of the problem.

Delegation of authority to the commander is also necessary to be able to enforce accountability. This practice encourages rather than destroys initiative and enterprise, a factor responsible for increases in productivity in the past. A clear line of control with strong staff services at the commander's level with freedom to reorganize within existing resources at his discretion would appear necessary to clarify lines of responsibility and authority. By giving the commander authority and bounds he becomes responsibly involved. The strong executive structure as discussed is typical of that recommended in the Hoover Commission study of the executive

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[34] Ibid., p. 35.

office and departments.[35]

The intangible nature of the output makes measures by single or multiple criteria questionable and lends support to making manpower standards a research effort. The adverse effects on the R&D organization also support discontinuance of standards as being impractical until after validation through research is completed.

One can recognize the conflict created within the organization by the displacement of the goals of the organization by the manpower goals and between the manpower team and the manager and scientists. Conflict is also apparent when the organization attempts to be responsible for demonstrating efficiency in the R&D organization by the adoption of manpower standards. Efficiency through the use of manpower standards in an area where the output is intangible results in a decrease in the responsiveness of the organization to its primary objectives. This, therefore, supports the proposition that there is an adverse effect on the R&D activities in the Air Force.

CHAPTER V

STRENGTHENING OF AIR FORCE MANPOWER STANDARDS FOR R&D PROGRAMS

There are management principles that if applied may have equal or greater influence on efficiency in the Air Force R&D organization than those of scientific management. This chpater considers a few of these factors and their influence. We begin first by re-emphasis of the need for effective utilization of resources. Then we raise the quesiton; Can R&D productivity be identified and quantified or is it still intangible? Finally consideration is given factors of organization and management that are considered important to improvements in R&D productivity. These are decentralization, innovation and human relations.

Skepticism and the Need for Effective Utilization of Resources

Even with the emphasis on leadership and management improvements, the close of the 1960s has been characterized by a growing skepticism about the potentials of science and technology in solving the rising and pressing social problems of our society. Even with improvements in efficiency and productivity, the federal laboratories have not been directed towards solutions of our major social problems. Our federal

laboratories have been primarily concerned with providing support to other national needs. Because the social problems are not being resolved, there is a gradual erosion of the political foundation of support to basic R&D.

Because of the rising question of priorities, a new chapter in the history of science began in 1966 with the rate of annual funding slowed and a decline in federal support apparent. This new phase brings with it requirements for existing laboratories to be utilized more effectively. This effective use in broad terms may include creation of new laboratories or the shifting of interests and work from existing laboratories or from one national problem to another and might force the closing of some laboratories that have little prospect of serving current requirements.[1]

The extremely high investment in plant and laboratory equipment in federal laboratories were reduced in 1969. The magnitude of the investment and the impact of budget restrictions make it mandatory that facilities be utilized as efficiently as possible.[2]

The current rise in interest for the efficient utilization of laboratory facilities began with the appointment of a Senate subcommittee on Government Research, created in March 1966, to oversee federally sponsored research and development programs.

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[1] U. S., Congress, House, Subcommittee on Science, Research and Development of the Committee on Science and Astronautics, Utilization of Federal Laboratories, 90th Cong., 2d Sess., 1968, p. 7.

[2] Ibid., p. 1.

Increased responsibility for inquiring into the efficiency and economy of these programs was given by the Second Session of the 90th Congress. Both the Reuss Subcommittee on Research and Technical Programs (Committee on Government Operations) and the Daddario Subcommittee on Science, Research and Development (Committee on Science and Astronautics) recommended greater attention be given to effective laboratory utilization.[3]

Six days of hearings were held by the Daddario Subcommittee early in 1968 on federal laboratory utilization, with testimony from many of the federal laboratory directors. One of the recommendations of the Daddario Subcommittee was that ways of appraising laboratories be found for performance and productivity. Because there were no agreed upon methods for measuring performance the committee recommended that experimentation be conducted that will ultimately permit appraisal of laboratory capabilities.[4]

Donald Horning, at that time scientific advisor to the President, described various ways of appraising laboratories. However, he recognized that a great deal of qualitative judgment based on experience was still required. Allen Astin, the Director of the National Bureau of Standards, felt that it was essential to find some mechanism for rating laboratories.

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[3]U. S., Congress, An Inventory of Congressional Concern with Research and Development, 90th Cong., 2d Sess., 1969, Part 4.

[4]U. S., Congress, House, Subcommittee on Science, Research and Development of the Committee on Science and Astronautics, Hearings on Utilization of Federal Laboratories, 90th Cong., 2d Sess., 1968, pp. 1-2.

William McLean, Technical Director of the Navy Underwater Laboratories, indicated that the only nonsubjective measures of effectiveness in R&D must result from a comparison of laboratories. Dr. Harold Finger, then the Associate Administrator of NASA's Office of Organization and Management, said evaluations of capabilities and performance were not easily performed.[5]

The Subcommittee concluded that the principles and procedures for laboratory appraisal are not yet commonly agreed upon. Nor was there common agreement that performance measurement was feasible. It was also indicated that laboratories could not wait until a final utilization assessment method is found. The Committee therefore fostered the acceptance of available standards with the possibility of adding changes and improvements as they materialize.[6]

The large investment in facilities within the Department of Defense laboratories and their utilization approximate 60 percent of the federal laboratory resources. These facilities represent a major investment in national resources which demands judicious and effective management.[7] Perhaps this management can begin on an appraisal system for efficiency for both the laboratory and the scientist.

Can R&D Performance be Measured

Many different types of appraisals are utilized within the Department of Defense, including supervisory evaluations,

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[5] Ibid., pp. 4-126.

[6] Ibid., pp. 1-2.

[7] Glass, pp. 23-27.

program evaluations, special appraisals, visiting committees, and natural competitions. These techniques appear to be quite subjective.[8]

Since waiting for the ideal system of measuring productivity would delay action for a long period of time, it would appear desirable to follow the Daddario Committee's recommendations and take some kind of positive action expeditiously. Recommendations would include moving forward experimentally by establishing research projects within laboratories to facilitiate management participation in the formulation of standards and to permit ultimate development of performance and productivity appraisal systems for the individual scientist in the laboratories.[9]

The review of current literature on performance evaluation should provide an insight into the current status of evaluation. Highly professional persons look to colleagues' opinions as sometimes the only basis for evaluation of individual performance. Those outside the profession are not considered competent by training, experience and colleague certification to judge individual performance.[10]

Dr. Wayne Dennis has shown that there is a definite relationship between productivity and eminence in science. The correlation may be better understood if one understands that the greater the number of pieces of scientific work done

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[8] Ibid., pp. 23-27.

[9] The Bureau of Inspections, pp. 1-3.

[10] Vollmer, p. 41.

by a given man the greater the likelihood that one or more of them will prove to be of scientific value. The chance of achieving a degree of eminence increases with the number of publications. The quality and quantity of scientific output are correlated although they are not identical.[11]

Shockley in his work has shown that individual contributors vary greatly, and on the basis of this he proposes that the logarithm of this rate be used. This logarithm has a normal distribution over the population of typical research laboratories. The use of this appraoch may require justification because there are a few who publish a large number of findings as rapidly as possible, and conversely a few outstanding contributors publish very little. This wide variation would tend to raise doubts about the validity of using papers published as a measure of productivity. There is however a close correlation between quantity of scientific production and the achievement of eminence.[12]

Many European scientists apparently come to essentially the same conclusion as Shockley, that relatively high numbers of publications are characteristic of men of eminence. The chief conclusion of Shockley's work is that in the research staff of any large and reasonably homogeneous laboratory,

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[11]Wayne Dennis, "Bibliographies of Eminent Scientists," The Scientific Monthly, Vol. 79 (September 1954), pp. 18-183.

[12]William Shockley, "On the Statistics of Individual Variations of Productivity in Research Laboratories," Proceedings of the IRE, March 1957, p. 279.

such as the Los Alamos Scientific Laboratory and the Brookhaven National Laboratory, even though there are great variations from one individual to another, there is a normal distribution of the logarithm of the rate of publications which is characteristic of the scientific creative process.[13]

Shockley concluded that patent activity is also a measure of creativity even though the logarithmic scale for the patent distribution is markedly steeper.[14] From Shockley's conclusions, it would appear that there may be indicators of creativity that if used would be useful in measuring individual or combined organizational productivity.

Apstein in his doctoral study developed an extension to Pelz's work to arrive at a rank order of competence for rating of government laboratories. Through the use of peer ratings, this study concludes the following:[15]

1. A system of peer ratings and paired comparisons appears to permit the ranking of selected R&D laboratories in order of technical competence.

2. There is a discernible relationship between technical competence and the size of the contract effort administered by the laboratory.

3. A contract program greater than 60 percent of the total laboratory budget appears as an administrative burden which impairs the competence of the technical staff.

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[13] Ibid., p. 280.

[14] Ibid., pp. 284-285.

[15] Maurice Apstein, "Effectiveness of Military Laboratories as a faction of Contract Activities," IEEE Trans. on Engr. Management, Vol. EM-12, No. 2 (June 1965), pp. 44-50.

4. A laboratory that does an insignificant amount of contract supervision should take special care to insure interaction with the rest of the scientific community.

Glass indicates that current studies are being extended to permit examination and rating of laboratories from many different perspectives. Of special interest are the customer attitudes and the relation of such output indicators as patents, papers, and reports. The ultimate goal is to provide DOD managers with greater insight into research management and productivity.[16]

Since there are extensive variations between laboratories and even greater variations between individual scientists, it is difficult to recommend specific or multiple factors or criteria that should be measured for performance evaluation. It may however appear desirable to form a technical staff of RD&T personnel to initiate observations, studies and experiments in productivity measures. Since there is no immediate measure of productivity at hand, the establishment of goals and measures in an experimental way may be not only productive of data but also may provide a stimulus for achievement of the final goals.

The Importance of Decentralization for R&D Productivity

Decentralization particularly affects research and development organizations. The university research group with

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[16]Glass, p. 25.

its centers and institutes is the common prototype for decentralized organizations followed in industry and government. This partly decentralized federated form of organization does not provide close program management; all that is really provided is central administration. In support of this approach organizational theorists have said that this decentralized form of management is required for effective organization of professionally oriented people.[17]

High output productivity for well known organizations such as Bell Telephone Laboratories and General Research Laboratories results from using the university decentralized organization approach. A survey in 1957 found that research publication output in these two decentralized laboratories exceeded the combined research output for fifteen other research laboratories.[18] Other studies have also shown that where scientists are allowed a high degree of freedom or decentralization in managing their own work, their productivity based on scientific publications was highest.[19]

Complete autonomy from management and their influence and pressures, on the other hand, is also undesirable. This influence from managers and other scientists does tend to

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[17]Vollmer.

[18]Arthur D. Little, Inc., Basic Research in the Navy, Vol. II (Washington, D. C.: U. S. Dept. of Commerce, Office of Technical Services, 1959), p. 75.

[19]L. Meltzer, "Scientific Productivity in Organizational Sellings," Journal of Social Issues, XII (1956), pp. 542-549.

increase productivity.[20] Pelz in his "creative tension" approach provides a condition that R&D administration should meet along with a supportive relationship from management and fellow scientists.[21] Through interaction creative tensions arise from supervision and fellow scientists. A participative or consultive type of management appears to be more effective than either a completely centralized or completely decentralized form of management.

To evaluate the effectiveness of a research organization, management must consider such items as funding, personnel, and policy that contribute to innovation and creativity. One of the major influencing factors in creativity is scientific freedom or independence that results from decentralization.[22]

The Air Force policy in the early 1960s was that of decentralization. Specifically in the 1964 Air Force Manual 25-1, the commanders were held directly responsible for the utilization of all resources, for successful completion of assigned missions. Decentralization of operations was seen as essential. In this same document it states, however, that decentralized operations will be centrally controlled by higher authority to maintain priorities, allocation of critical

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[20] D. C. Pelz, "Freedom in Research," International Science and Technology, Feb. 1964, pp. 54-66.

[21] D. C. Pelz, "Creative Tensions in the Research and Development Climate," Science, Vol. 157, No. 3785 (July 14, 1967), pp. 160-165.

[22] Vollmer, pp. 35-45.

resources, and for correcting of deficiencies.[23] This central control seems to be opposing the desired management technique initially stated.

The nature of research creativity and its development lead to decentralization, which can be encouraged by management's rewards for individual creativity and productivity. Creativity is also fostered by providing opportunity to work with other creative people and by providing personal freedom in selecting research projects as well as research techniques.[24]

If decentralization provides more authority, responsibility, and accountability for the scientist, then he should be able to perform his work more efficiently and productively from his point of view and be able to substantially reduce management costs.

Prior to decentralization administrative power must first be centralized.[25] This would be consistent with the vertical continuum of Appleby and with Simon's vertical structuring of decisions.[26] Concentration of power at the top is consistent with the concept of decentralization and delegation. Even though power to make decisions resides at the top of the hierarchy those who have such power have delegated a portion

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[23]Air Force Manual, (AFM 25-1), p. 1.

[24]J. E. Walters, Research Management: Principles and Practices (Washington, D. C.: Spartan Books, 1965), p. 197.

[25]Dean Paul Appleby, Policy and Administration (Univ. of Alabama Press, 1949), Chapter 2.

[26]Simon, pp. 20-44.

of it to subordinates at all levels.

Delegation to commanders, as a subordinate, may be done in such a way as to permit retention of the principle of the strong central administrator. The use of the post audits is an efficient tool in assuring compliance within the constraints established. The relationship of the Commander to the scientist is also very important.[27]

The freedom of scientists in the management of their own research programs is a major factor affecting their productivity. Decentralization is only possible to the scientist if the commander has a measure of authority. The relationship between productivity and management principles becomes sharper as efficiency measurements become more accurate.[28] The Bureau of Inspections of the USCSC report of 1967 emphasized the importance of decentralization of management in the research, development and engineering area.

The Bureau of Inspections not only advised the Department of Defense to improve coordination of workload, funds and manpower, but also to increase delegation of authority for manpower, organization, and personnel management to research, development, and engineering laboratory directors. In this area of manpower control, the Bureau indicated that care in the application of engineered manpower standards to research

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[27] Pfiffner, pp. 177-197.

[28] R. Likert, New Patterns of Management (New York: McGraw-Hill, 1961), p. 13.

activities should be exercised, and the initiation or application of standards should be treated as a research project with laboratory management participating in forming the standards.[29] Coordination of manpower and funds has also been reviewed by the Navy in their survey of some 400 manpower studies.

In the survey of manpower practices in industry and other services, it became apparent to the Navy that productivity was directly related to management philosophy. Organizational structure, functions and policies were primary factors chosen for consideration.

A few of the Navy's major findings in industries that support decentralization were: first, manpower was not considered as a separate functional element in the attainment of objectives or goals but was regarded as just one more resource; second, industry was very strongly decentralized, including control over specific policies for hiring, firing, advancement and utilization. Divisions were held accountable for operational performance with the function of the corporate headquarters that of setting goals, establishing broad policies, and assessing performance. The corporate headquarters requires measurements of performance from divisions and may direct reductions of manpower based on this performance. The headquarters also requires reports on past performance as well as measurements of profit, volume, sales per employee and total compensation as a percent of sales. This provides industry

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[29]Bureau of Inspections, pp. 1-3.

with useful measures, combining cost and effectiveness. Third, industry has short-notice hiring with reasonable notice for firing which eliminates the need for long term manpower projections. This response provides a rapid self adjustment within industry.[30]

There are other applicable industrial practices such as: (a) personnel decisions made on the basis of individual capability, potential, and desire; (b) planning accomplished by using professional personnel specialists as well as business management specialists; (c) no long term periods of obligatory service for industry; (d) any level of technical specialist including executives can be hired in the open market; (e) a variety of fringe benefits in industry.[31]

A number of policy differences exist between the services and industry that affect the comparison of manpower. First, and the most important constraint over federal manpower and funds, is that control exercised by the legislative and executive branches of government. Second is that manpower users cannot determine who will be assigned to them. And third is that validation of manpower in the federal government attempts to impose a degree of accountability but does not measure performance effectiveness of the activity as a whole

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[30]Martin A. Tolcott, Manpower Control, Utilization and Requirements Vol. I: Summary (Institute of Naval Studies of the Center for Naval Analyses, Study 17, Jan 19, 1968), pp. 15-17.

[31]Ibid., p. 19.

and does not include cost measures.[32] In short there appears to be no incentive similar to the private sector's profit motive. To force accountability at the manager level this must be found and applied.

In the industrial survey there was a high degree of decentralization authority for policy-making. In the area of manpower, divisions can usually increase or decrease their staffs within broad limits as long as performance remains satisfactory. The Air Force policy of decentralizing authority for establishing billets within limits would permit, if delegated to the commander, the coordination of manpower with total resource planning.[33]

Tradeoffs between manpower and other resources could be realized and the objection of the Bureau of Inspection could also be overcome if workload, funds and manpower were furnished as a combined resource. To be able to achieve a measure of efficiency, it appears necessary that accountability for manpower costs and effectiveness on operating levels, and the establishment of output goals or standards of effectiveness in terms other than manpower be imposed.[34] These must also weight the value of the product being produced.

The incentive to allocate funds between capital and labor is provided by the desire to maximize resource effectiveness.

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[32] Ibid., pp. 20-23.

[33] Ibid., pp. 24-25.

[34] Bureau of Inspections, p. 4.

This is difficult in the federal system because of compartmentalization. Once funds are allocated at the beginning of the year to a specific input such as personnel, these funds can rarely be shifted to another input. This discourages efficiency for unused funds which will probably result in a reduction of such funds the next year with no increases to the area originating the savings.[35]

Recognizing Innovation to Increase R&D Productivity

Organizations have the fundamental knowhow to utilize the physical sciences for solutions to complex problems. Now our challenge is to make our human R&D organizations truly effective by providing a good environment for creativity and innovation.

Innovation is probably the greatest single contributor to increases in productivity. Education, skill and inventiveness are necessary parts of innovation for implementation of technologies. Forms of organizations quite often require more skill to handle the more complex systems inspired by innovation.[36]

Technological changes fostered by innovation according to B. F. Massell of Rand, Robert Solow of MIT, and S. Fabricant of the National Bureau of Economics, have been responsible for approximately 90 percent of the rise in output per manhour from

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[35] Ibid., pp. 1-3.

[36] Measuring Productivity, p. 9.

the early 1900s to the middle 1950s. This is contrasted with only a 10-12 percent rise in output due to capital investments.[37]

Human Relations and its Contribution to Increased R&D Productivity

Technological changes are characterized by the rise of scientific management which begins with Max Weber in his formal description and concepts of the large-scale organization. He completely depersonalized the formal organizational structure. Writing at about the same time Fredrick W. Taylor would mediate between the individual and the organization. Weber would stress the legal domination of the position while Taylor would emphasize the impersonal rationality of measurements. This basis for the classical organizational theory settles conflicts between the individual and the organization in favor of the organization. Through this approach efficiency and productivity surrenders man's needs to the service of the machine.[38]

Since norms are being alternated for the R&D area in the same way as they have been for laborers and craftsmen, a review of the impact of human relations in this area may shed some light on R&D problems. In giving attention to the improvement of the human organization, the "human relations" movement considers the individual as distinct from the organization. Elton Mayo, the father of the humanistic school, recognized, however, that people could not be studied outside their

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[37]Walters, p. 53.

[38]Warren G. Bennis, Changing Organizations (McGraw-Hill), pp. 66-67.

organizational context without structuring their behavior. In the human relations period it was also recognized that there existed a social group that has daily contact and that as part of its subset the informal group, where the values of individuals form norms or ways that the group looks at reality. The social group sets roles or ways the group expects each member to act and also sets the status or value of the role assigned.

One of the major discoveries of this human relations period was the importance of the social organization in the motivation of the worker.[39] Etzioni concluded in his study of the social group that (1) the amount of work carried out by a worker was determined by group norms and not by management; (2) that the highest specialization is not the most efficient form of division of labor; and (3) that workers do not react to management as individuals but as members of groups.[40]

In general it is recognized from the human relations period that the organization must take into account such factors as purpose, goals, status and power, and that the organization and management are responsible for creativity and innovation. The approach to management by being "hard" and following the structuralists approach of Weber and Taylor will in the long run not produce maximum efficiency for the RD&T organization.

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[39]Fred E. Katz, "Explaining Informal Groups in Complex Organizations: The Case for Autonomy in Structure," Administrative Science Quarterly, 10:2 (September 1965), pp. 204-221.

[40]Etzioni, p. 34.

"Hard" management directs behavior by the use of coercion and threats with close supervision and tight controls. This approach often produces a counter force resulting in restrictions of output and sabotage to management's objectives.[41]

On the other hand the "soft" management approach recommended by the behavioralists school requires satisfying people's demands in turn for their acceptance of management's direction. This approach achieves the highest morale, but to date there is little correlation between high morale and high creativity or productivity. The "soft" approach appears to be a partial abdication of management and may create harmony, but people continue to demand more participation in management while giving less in performance.[42]

Even though some needs are satisifed, management may continue to ask why productivity is low even though good working conditions and wages prevail. Management by direction and control whether implemented with the hard, soft, or firm approach fails to provide the motivation towards organizational objectives. It fails because direction and control are not motivators of people even though in the hierarchy of human needs as espoused by Maslow the basic needs of physiology and safety are reasonably satisifed.[43]

Argyris postulates that healthy people develop along a

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[41] Hampton, p. 5.

[42] Ibid., pp. 6-9.

[43] Maslow, pp. 370-396; Bennis, p. 78.

continuum from passivity to activity, dependence to independence, behavioral inflexibility to flexibility, subordinate to superordinate positions and that this is opposite to the demands of the formal organization. The formal organization tends to keep the individual dependent through task specialization, chain of command, unit of direction, span of control and other restrictive factors which minimize the individual's opportunities for growth towards self actualization.[44]

Contributing Management and Leadership Principles to Increased R&D Productivity

Using Drucker's "management by objective" McGregor restates several principles which would appear appropriate for increasing productivity of RD&T management: (1) Authority is central and indispensable for managerial control, and management by objective is accomplished through "target setting" by the supervisor and subordinate developing the ground rules together; (2) There must be interdependence or collaboration between superior and subordinate, which is necessary for agreement on satisfactory goals; (3) Subordinates are capable of learning self-control in their development towards maturity; (4) These principles imply the bringing together of the individual and organizational needs.[45] This would appear to replace the coercive or "hard" management

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[44] Chris Argyris, Personality and Organizations (Harper and Row Publishers, 1957), pp. 27-157.

[45] McGregor, p. 18.

approach by objective stress for organizational purpose and attainment.[46]

Good research leadership results from maximum productivity, according to Likert, when the following statements can be answered in the affirmative.[47]

1. Are subordinate ideas sought?
2. Is confidence shown subordinates?
3. Do subordinates feel free to talk to supervisors regarding the job?
4. Is motivation through reward and involvement?
5. Is organizational responsibility for achieving goals felt at all levels?
6. Is there adequate and accurate communications in all directions?
7. Is the character of interaction extensive with a high degree of confidence and trust?
8. Is cooperative teamwork high throughout the organization?

The fulcrum of organization and individual demands is good leadership and management, and since high output is more frequently associated with loose supervision than with close, it would seem desirable to attempt to gain the advantages of both the "hard" and the "soft" approaches. This may be accomplished by the adoption of the current popular theme of firm but fair management. The firm management approach may result in optimization of organizational demands while providing the individual with maximum opportunity for expression thus increasing RD&T productivity.[48]

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[46] Bennis, p. 77.

[47] Rensis Likert, "Organizational Dynamics: Building Effective R&D Departments" in Issues in Public Science Policy and Administration: A Symposium (Albuquerque: University of New Mexico, 1969), pp. 10-16.

[48] Bennis, pp. 77-78.

Even though we recognize leadership as being important, we also recognize that there is extensive evidence to show that informal organizations and leadership also cause costly reductions in organizational performance because of the social group limits and restrictions on output. Peer leadership, however, can contribute to high performance and should be used in a positive way through consultive and participative management to maximize productivity.[49]

Leadership and organizational structure are important to provide the necessary environment for maximum productivity. Vollmer recognized that to be effective, research also requires: continuous management consulting and evaluation of different research programs; a degree of freedom for the scientist in conducting his work; grouping of scientists for stimulating contact; and appropriate mixture of in-house and contract work; and an organization that couples research and nonresearch while maintaining organizational integrity.[50]

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[49]Rensis Likert, The Human Organization: Its Management and Value (New York: McGraw-Hill Book Co., 1957), p. 73.

[50]Vollmer, p. 25.

CHAPTER VI

SUMMARY

In summary and in contrast to "Scientific Management" there are important organizational factors as well as management principles and policies that can if implemented contribute to individual and organizational efficiency and productivity. The investment in R&D resources is high and the application of these principles can add a measure of assurance that they are being effectively utilized. It may not be possible to quantify the output of the scientist for some time; however added rationality in the utilization of manpower can perhaps be achieved through application of these principles and policies. The advance of the application of "Scientific Management" on the other hand must wait the results of research efforts to see if the present intangible nature of R&D productivity can be first identified then quantified.

The historical development of this study of measurements of production in the United States spotlights the use of efficiency measures and their use as a fairly new tool for management. Initially these measurements were taken to provide an understanding of the impact of automation on industry. The growth of these measurements has been towards evaluating hte productivity of industry as a whole.

The development of the Air Force manpower system has increased from basic accounting, training, and skill projection to include establishment of manpower standards. When the Air Force adopted the use of F. W. Taylor's principles of scientific management, they paused at a point in history, failing to recognize new management policies and the effects of the social groups in controlling productivity.

The recognition of the need for efficiency in the R&D area of the public sector grew as the Bureau of the Budget was charged with initiation of a positive program for improved efficiency within the executive branch.

In the application of manpower standards the organizational setting is emphasized along with the historical development of efficiency measurements in the Air Force. The setting stresses the changing management that is supportive of efficient R&D. Decentralization of management decisions with central planning and positive interaction for creative tension is also seen as supportive of efficient R&D. As an example of decentralization, the federated organization in many American universities exhibits the form of supportive management required for R&D effort. Central planning and decentralized management combine to create an efficient total organization for R&D.

The analysis of relevant manpower policies was conducted through the development of an operations research (OR) decision model by the Air Force manpower organization. The

foundation and compliance with Regulations illustrates the intangible nature of research productivity as well as the difficulty of establishing criteria relating to manpower. Analysis was continued through study of a description of techniques utilized for manpower prior to the implementation of the OR model. This model demonstrates the difficulty in adhering to regulation in identification and quantification of the output of an R&D organization and suggests modified procedures are in order.

The detrimental effects of the Air Force OR approach are illustrated by reviewing the application of standards to an R&D organization. The standards were responsible for decreasing manpower while workload increased. This example illustrates the detrimental effect of manpower standards on the R&D mission, and the effects of policy on manpower support the proposition that they tend to be a distraction to the primary science mission through goal replacement.

The descriptive model provides a review of the practices used prior to implementation of standards and suggests this process is better than those requiring standards. This model demonstrated greater benefits and consistency than the OR model and was finally expanded and changed to become a desired or "ought" condition for a normative model. The analysis of the normative model suggests decentralization, management by objective and self control as an approach to maximum productivity and that the application of standards are causing adverse effects on the Air Force R&D organization.

The decentralized controls may be assured by reassignment of the manpower team to the commander's staff and by regulation changes. Organization and management policies by the recognition of contemporary organizational theory if applied might produce greater research effectiveness than expected for "Scientific Management."

A modified case study approach is used to help become more objective in looking at the historical events and their effects on Air Force policy. The Technical Management Council of AFSC and the U. S. Civil Service Commission also supported the claim that the application of manpower standards to the R&D area were having other than its intended effects and that R&D does not lend itself to direct measures of productivity. A change in the policies appears necessary for efficient utilization of the critical manpower resources.

Finally the following recommendations are made for improved organizational policy that if applied might produce an environment for increased productivity. This is done effectively through recognition of the importance of human relations and individual contributions through innovation and decentralization. This might well be implemented by action in the following areas:

1. Provide instructions to the commanders that manpower resources allocated to them are intended to support all programs and activities and they must in turn organize to support the approved programs and activities within their assigned resources.

2. Decentralize Management Policy

   a. Manpower controls within assigned resources to be delegated to the commander.
   b. Project or activity management to be delegated

to the supervisor or scientist.

c. Management Engineering Team should be reassigned in a staff capacity to the commander.
d. Planning to be centrally controlled by the commander in conjunction with headquarters AFSC and the scientific staff.

3. Improve current procedures for correlating mission, manpower and funds.

a. Projects should not receive approval without approval of manpower or funds.
b. Improve controls of workload to the same level as manpower so work will not be approved without resources.

4. Extend Manpower Engineering Program into research and consider it a research effort while continuing utilization of supervisor estimates for manpower determinations until completion of research effort.

5. Change organizational policies to include

a. Participative management which is to be firm but fair.
b. Increase managements understanding of the individual in the areas of human behavior, the social group, motivation, the individual in the organization context, organizational factors that foster maximum efficiency and innovation in the R&D organization.
c. Management by objective rather than by domination.

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