THE ROLE OF SPECIALISTS IN ORGANIZATIONS-- A CASE STUDY OF A PUBLIC AGENCY

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ABSTRACT

THE ROLE OF SPECIALISTS IN ORGANIZATIONS--
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By

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This dissertation examines the relationships between specialists and hierarchical authority and other specialists in a large public agency. A number of researchers have identified cleavages between specialists and the bureaucracy. This research explores the notion that as the degree of skill of the specialist increases, there is a decrease in respect for hierarchical authority, specialists in other substantive areas, and specialists with fewer skills. The research was also concerned with the idea that as specialists succeed hierarchically, there is a positive association with respect for hierarchical authority. Finally, the research explored the relationships between the specialists' respect for hierarchical authority and commitment to organizational goals.

The research methodology used in this study included a scaled response questionnaire and individual interviews as instruments for data collection. The questionnaire was distributed to 405 engineers in three divisions of a public agency. A smaller sample of engineers were interviewed, both respondents and non-respondents, to complement the information provided in the questionnaire.

Data presented in this research tends to support the observation that as the level of education increases, there is a decrease in respect for hierarchical authority and specialists in other substantive areas. Data testing the relationship between an increase in level of education and decrease in respect for specialists with lesser skills was not supported. As specialists become supervisors and managers, there tends to be a positive association with respect for hierarchical authority. Finally, specialists' respect for hierarchical authority is positively associated with commitment to organization goals.

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CHAPTER I

INTRODUCTION: SPECIFICATION OF THE PROBLEM

We live in a world of large scale organizations, a world in which organizations are becoming increasingly complex for the attainment of social, political, and economic goals. This complexity stems in part from the arrangement of people in patterns of working relationships so their efforts may be related more effectively to accomplishing the multiple purposes of the organizations. During the past few years, considerable emphasis has been given to the study of organizations by students from various disciplines such as psychology, social psychology, sociology, political science, economics, business administration, and so on. This emphasis is not unjustified. As Etzioni puts it, "we are born in organizations, educated by organizations, work for organizations."[1] Charles Perrow suggests that "No matter what you have to do with an organization--whether you are going to study it, work in it, consult for it, subvert it, or use it in the interest of another organization, you must have some view of the beast with which you are dealing. This constitutes a perspective on organizations."[2]

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[1]Amitai Etzioni, Modern Organization, (Englewood Cliffs, New Jersey: Prentice Hall, 1964) p. 1.

[2]Charles Perrow, Organizational Analysis: A Sociological Perspective, (Belmont, California: Wadsworth Publishing Company, Inc., 1970) p. 2.

The growing concern with organizations as a major new dimension of society has accelerated in recent years. There has been a widespread shift in systems of living from an individualistic, family existence where eighty percent of the workers were self employed enterprisers in the early nineteenth century to the present where it is calculated that 200 corporations own over half the industrial wealth of the nation.[3] In short, most of us are employees and we can expect to spend our working lives as members of large organizations.

Organizations then, are extremely complex systems. As one observes them, they seem to be composed of human activities on many different levels of analysis. Personalities, small groups, norms, values, attitudes, all appear to exist in extremely complex multi-dimensional patterns. The complexity may at times be almost beyond comprehension. Yet it is this very complexity that is, on the one hand, the basis for understanding organizational phenomena, and on the other, that makes life difficult for an administrator. In order, then, to appreciate how organizations behave, we must have some understanding of the large, faceless bureaucratic machines that surround us.

There have been a number of things said and written about organizations by those who have worked in and studied them. Many executives and administrators have written about their experiences in biographical form appearing in books and articles. The scientific management movement has been concerned with organization theory and

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[3]John M. Pfiffner and Frank P. Sherwood, Administrative Organization, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960) p. 441.

from this comes statements of good organization principles. Sociologists, many of them influenced by Max Weber's analyses of "bureaucracy", have theorized about organizations and carried out systematic observations. Social psychologists have been particularly interested in two aspects of organization behavior: in leadership and supervision on the one hand, and in morale and employee attitudes on the other. They have also undertaken studies of the effects of communication patterns upon organizational behavior. Political scientists have been interested in problems parallel to those of the scientific management group--the efficient operation of governmental organizations--and also the problem of securing effective control over governmental administration. Economists have been involved with the operation of markets and the pricing and allocative mechanisms of organization. And so it goes, each discipline looking at different aspects of organizational phenomena.

The scattered and diverse body of writing leaves one with the impression that not only is there a great body of knowledge yet to be acquired about organizations but there is a significant disparity between hypotheses and evidence. Much of what we know or believe about organizations has been distilled from common sense and from the practical experience of executives. The great bulk of this wisdom and lore has never been subjected to the rigorous scrutiny of scientific methods. In short, the literature contains many assertions but little evidence to determine whether these assertions really hold up in fact. There has been, however, in the past several years an increasingly large number of empirical studies exploring different elements found in organizations.

Organizations, then, are ubiquitous in our society; everyone is familiar with them. Despite this familiarity, the understanding of them is not sufficient to allow people in organizations to realize their own desires, to allow the organization to achieve its goals nor to allow organizations to accomplish all they could for society.

There are many different approaches to the study of organizations. The psychologist, for example, is concerned primarily with trying to change human behavior within an organizational context. The social psychologist is interested in small groups and their relationships with heavy emphasis on leadership problems and human relations. In working within a variety of organizations, it has been the writer's experience that manipulating the structure, analyzing the goals, and grasping the nature of the relationships within the system are more practical, efficient, and fruitful ways of dealing with an understanding of organizational phenomena than looking at processes.

If organizations are to be studied, rather than individuals or group processes then the emphasis on structure appears to be superior. Furthermore, this emphasis provides a more economical approach to organizational change, problem solving, and provides a convenient tool for analyzing differences among and within organizations.

This study then, will focus primarily on social structure, perhaps the best developed area in the sociology of organizations.[4] The study of social structure reflects the great influence of Max

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[4]Koya Ozmui and Jerald Hage, Organizational Systems, (Lexington, Massachusetts: D.C. Heath and Company, 1972), p. 213.

Weber, who, during the first World War in Vienna, came away from military service with a conception of what he called bureaucracy. This model of organization, which is discussed in greater detail in Chapter II, is based on a rational-legal system of authority arranged in a hierarchy of offices filled by technical experts. He felt his model would be the dominant form because of its superior efficiency. This was a new way of thinking about social structure.[5]

A necessary ingredient of social structure is the idea of patterned action, that is, diverse individuals performing diverse tasks while interacting with diverse individuals. These tasks are called jobs in an organization or positions in a more generic sense. The arrangement of these jobs or positions into some rational system is the essence of social structure.[6]

The models of organization structure contain a number of critical properties. As expressed in Weber's terms, they are the hierarchy of authority or the distribution of power; the utilization of rules; and the role of the technical expert within the division of labor. Although the bulk of the research on structure has focused on these properties, another one has been equally important; the problem of configuration or shape of the organization. Although not strictly a Weberian conceptualization, it articulates in various ways with other properties, because it is frequently seen as a way of inferring these other characteristics.[7]

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[5] Ibid.

[6] Ibid.

[7] Ibid., 214, 224-226.

This research will be concerned with one structural aspect of the organization, the role of the specialist and his relationship with other specialists and hierarchical authority.

In our well developed industrial society of today, the predominant form of organization is a highly rationalized and impersonal integration of a large number of specialists cooperating to achieve some announced specific objective. Superimposed upon the division of work in such organizations is also an elaborate hierarchy of authority. This form of organization is what Max Weber calls "bureaucracy."[8]

As the bureaucratic form has developed, associated as it is with the advance of specialization, one of the most difficult problems has proved to be the securing of cooperation among individual specialists and hierarchical authority. Increasingly large amounts of time, effort and thought are expended on securing cooperation.

In large organizations, most people spend much of their time as small cogs in the bureaucratic machinery. It is through these structures that the individual must find success and earn his livelihood. Being a cog in the machinery, the individual loses much of the control over his own destiny. Many people feel powerless, alienated, and respond with various kinds of behavior. Some are able to manipulate the organization sufficiently well to achieve important aims of their own. Others submit to bureaucratic standards of achievement and find bureaucracy comfortable. There are others, however, who deplore

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[8]Max Weber, The Theory of Social and Economic Organization, Trans. A. M. Henderson and Talcott Parsons, ed. Talcott Parson, (New York: Oxford University Press, Inc., 1947).

the loss of individual freedom and initiative, and perhaps more importantly, the bureaucratization of the organization with its attendant autocratic, steeply pyramidal structure. In short we find specialization, a relatively modern phenomenon, occuring with hierarchy which is characteristic of older organizational forms in an earlier age.

As organizations grow in size and complexity, hierarchical authority become less and less able to master the knowledge and techniques necessary to make decisions. A great structure of specialized competences has grown in order that organizations may achieve the multiple purposes of their existence. With the proliferation of science and technology, then, the superior loses to experts the ability to command in one field after another but he retains the right as part of his role.

Organizations, then, have had to depend upon highly trained specialists to accomplish their goals. Victor Thompson makes a very careful distinction between two dimensions of specialization, person and task. Person specialization is usually the product of extended education and training where individuals are employed for their technical expertise as it relates to the accomplishments of certain organization goals. Task specialization, on the other hand, involves the division of labor associated with the completion of a particular task.[9] This study is concerned with person specialization.

The specialization of persons, a social process, takes place under the guiding influence of certain personal and social needs.

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[9]Victor Thompson, Modern Organization, (New York: Alfred A. Knopf, 1961).

Durkheim said that the individual specializes in order to survive satisfactorily within altered conditions of existence.[10] One of the conditioning forces, therefore, is individual welfare. But person specialization also contributes to social cohesion by creating a feeling of mutual interdependence. In organizational terms we would say that these two sets of needs, personal and social, simply reflect the fact that organizational arrangements must meet the personal goals of the participants and the formal, objective, external goals of the organization. The organization in this context is viewed as a means to the participants' goals and the participants as means to the organizational goals.

Since specialization creates interdependence, it creates a need for coordination. At the higher levels of organizations, where both external and internal relations are highly varied, administrators can never hope to master all the details of the problems with which they deal. The responsibility of keeping track of what goes on in many fields makes it impossible for the administrator to become, or remain an up-to-date specialist in any field. If the rules and regulations, characteristic of modern bureaucracy, are consistent with the personal goals of the specialists, they may reduce tension because they meet an apparent operational need. On the other hand, the rules and regulations may increase tensions if they constitute an imposed division of work emphasizing jurisdictions or rights rather than abilities.

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[10] Emile Durkheim, Division of Labor in Society, translated by George Simpson, (Glencoe, Illinois: The Free Press, 1947).

The relationships between specialists and hierarchical roles in accomplishing organizational and personal goals provides a basis for analyzing tensions and strains. Research in this area suggests that there are built-in strains between organizational and professional values involving disagreement over goals, control over specialists work, kinds of incentives sought, and who has ultimate power in decision making. These pressure points provide severe constraints to effective cooperation between specialists on the one hand and occupants of hierarchical positions on the other.

With the movement toward specialization in modern organizations, then, it is becoming increasingly difficult to coordinate the various organizational interests into the older hierarchical framework which requires a bureaucratic authority structure.

As a result of this phenomenon, Thompson argues there is a growing gap between the right to decide, which is authority, and the power to do so which is specialized ability.[11] This gap is growing because technological change is bringing about a more rapid increase in specialization than the change in cultural definitions of hierarchical roles. This rapid growth produces not only tensions but strains the willingness of the specialist to cooperate with members of his peer group as well as hierarchical authority. In short, the most symptomatic characteristic of modern bureaucracy is the growing imbalance between technical specialists (ability) on the one hand and the incumbents of hierarchical positions (authority) on the other.[12] It is in

[11]Thompson, op. cit.

[12]Thompson, op. cit., p. 6.

the struggle between these elements that we find much that interests us in our analysis.

To understand fully the bureaucratic organization and behavior we find in it, this study deals with aspects of specialization, the hierarchy of authority, and the relationship between specialization and hierarchy. The tensions peculiar to the specialist role in large scale organizations frequently results in conflict. It should be noted, however, that all conflict should not be regarded as dysfunctional.[13] Yet much of it in large organizations seems to be the specialist relations with those in other professional fields and his authority relations with those in hierarchical positions are areas which produce strains between the assumptions and demands of organization logic and professional technical ethics of the specialist.

It will be argued then, that a proliferation of occupational specialties--person specialization--results in conflict not only with hierarchical authority but with other specialists as well. In addition, it will also be argued that the success of the specialist is positively associated with respect for hierarchical authority and his commitment to organization goals.

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[13]William G. Scott, The Management of Conflict, (Homewood, Illinois: The Dorsey Press, Inc. 1965); Theodore Caplow, Principles of Organization, (New York, Harcourt, Brace and World, Inc., 1964), pp. 317-355.

CHAPTER II

THE SPECIALIST, ORGANIZATIONAL GOALS, AND BUREAUCRATIC AUTHORITY

Considerable attention has recently been devoted to understanding behavior in large organizations. Although some of this work has been based on research, it has more typically been general theorizing with little support from research data.

Definition of Terms

Before reviewing the literature in the field, the writer feels it important to discuss some of the more basic concepts in order that there be some understanding of what we are talking about.

Organization

What is an organization? At first glance it would appear to be a rather clear cut question with a reasonably simple answer, and yet among students who have studied organizations, there has surfaced some very different statements of what constitutes and goes on in organizations. To some, organizations are arrangements of tasks and an authority structure; to others an organization is a set of relations in a face to face group. To some, it is a network of communications, to others, a network of interactions. Some points of view support one another, others are in direct conflict and yet all profess to be talking about organizations!

In defining organizations, Max Weber distinguishes the "corporate group" from other forms of social organizations--"a corporate group is a social relationship which is either closed or limits the admission of outsiders by rules . . . so far as its order is enforced by the actions of specific individuals whose regular function is of a chief or 'head' and usually an administrative staff."[1]

In addition to the social relationships, Weber also presents the notion that an organization has a boundary. The idea of order, a hierarchy of authority, and a division of labor are also component parts of the definition. Weber also argues that organizations carry out continuous purposive activities of a specific kind. In short, organizations are designed to do something.

Barnard, on the other hand, defines an organization as "a system of consciously coordinated activities or forces of two or more persons."[2] That is, activity accomplished through conscious, deliberate, and purposeful coordination. Organizations require communications, a willingness on the part of the members to contribute to the organization and a common purpose on the part of all the members. While Weber emphasizes the system, Barnard is concerned with members of the system.

Blau and Scott deplore the fact that some writers use the term "large scale" or "complex" organizations. They prefer the term

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[1]Max Weber, The Theory of Social and Economic Organization, translated by A. M. Henderson and Talcott Parsons, edited with an introduction by Talcott Parsons, (New York: Oxford University Press, 1947) pp. 145-146.

[2]Chester I. Barnard, The Functions of the Executive, (Cambridge, Massachusetts: Harvard University Press, 1966) p. 73.

formal as a defining concept.[3] It would appear the same criticism of the prefix "formal" can also be made since it means different things to different people.

Etzioni defines organizations as "social units or human groupings deliberately constructed and reconstructed to seek specific goals."[4]

Scott suggests that organizations be defined as "collectivities . . . that have been established for the pursuit of relatively specific objectives on more or less continuous basis."[5] He carefully points out, however, that organizations have distinctive features other than goal specificity and continuity. This includes relatively fixed boundaries, authority ranks, a communication system, and an incentive system which enables various types of participants to work together in the pursuit of common goals. This writer would accept Scott's definition as being the most comprehensive since it describes what it is that organizations are all about.

Bureaucracy

One of the early theories of organization which continues to be regarded as the classic on the subject almost half a century after it was written is Max Weber's theoretical analysis of the

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[3]Peter M. Blau and W. Richard Scott, Formal Organizations, (San Francisco: Chandler Publishing Company, 1962) p. 7.

[4]Amitai Etzioni, Modern Organizations, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964) p. 3.

[5]W. Richard Scott, "Theory of Organization" in Robert E. L. Faris, editor, Handbook of Modern Sociology, (Chicago, Illinois: Rand McNally and Company, 1964) p. 488.

principles of bureaucracy. These concepts, which have had a profound influence on almost all subsequent thinking and research in the field, provide a framework for a systematic theory of formal organization. The fact that Weber analyzes bureaucratic organization not empirically, but as an ideal type, does not detract from this important achievement. Weber's bureaucracy can be dimensionalized in the following way:

1. A division of labor based on functionalization
2. A well defined hierarchy of authority
3. A system of rules covering the rights and duties of employees
4. A system of procedures for dealing with work situations
5. Impersonality of interpersonal relations
6. Promotion and selection based on technical competence[6]

These six organizing principles describe the basic underpinnings of bureaucracy, the pyramidal organization which dominates so much of our thinking and planning related to organizational behavior. Weber, in effect, defines the concept of bureaucracy by pointing to those characteristics.

Bureaucracy, to the average person, some practitioners, and some students of organization, is a dirty word. It suggests rigid rules and regulations, a hierarchy of offices, narrow specialization of personnel, an abundance of offices or units which can constrain those who want to get things done, impersonality, and resistance to change. Yet every organization of any significant size is

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[6]Robert Hall, "The Concept of Bureaucracy: An Empirical Assessment" The American Journal of Sociology, 69:33, July, 1963.

bureaucratized to some degree or to put it differently, exhibits more or less stable patterns of behavior upon a structure of roles and specialized tasks. Bureaucracy, in this sense, is another word for structure.

Hierarchy

The term hierarchy in the Weberian sense, is viewed as a system of roles--the role of the superior and subordinate arranged in a chain so that role 1 is subordinate to role 2; 2 is superior to 1 but subordinate to 3; and so forth, until a role is reached that is subordinate to no other role, (but perhaps to a group of people such as a board of directors, commission, etc.)[7] The essence of hierarchy is the distinction between the role of "superior" (or superordinate) and "subordinate." The person or group in the superior role is expected to exercise authority over the subordinate. The subordinate in turn is expected to accept the authority of his superior and be responsible to him.

Authority

The concept of authority in the study of organizations has been elusive indeed. The conventional notion emphasized the formal rational, impersonal, control from the top aspects of authority. Authority was most characteristically defined as "an attribute of office as distinct from a relationship between the incumbents of formal

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[7]Maurice E. O'Donnell, editor, Readings in Public Administration, (New York: Houghton, Mifflin Company, 1966) pp. 52-65.

positions."[8] This approach emphasized the rationality and predictability of organizational activity and, for the most part, tended to ignore the motivations and attitudes of the human beings who were employed by the organizations. Max Weber's theoretical treatment of bureaucracy, Frederick W. Taylor's scientific management movement and the administrative management theory associated with Luther Gulick and L. F. Urwick typify the conventional approach to authority.[9]

The human relations movement drastically altered, if it did not reverse many of the implications of the older, more conventional approaches to authority. The literature of human relations research defines authority in rational terms, stressing its informal, non-rational and subjective aspects. Many writers contributed to this movement. It can best be characterized, however, by the writings of Mayo.

Elton Mayo views management's task as developing an environment in which employees willingly cooperate to accomplish certain goals. Worker satisfaction gained from allegiance to his own group and the larger organization is as important as material benefits. Acceptance of authority is generated by "spontaneous cooperation."[10]

Katz and Kahn view authority as "a legitimate power, power which is vested in a particular person or position, which is recognized as so vested, and which is accepted as appropriate not only by

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[8]Robert L. Peabody, Organizational Authority, (New York: Atherton Press, 1964) p. 18.

[9]Ibid.

[10]Elton Mayo, The Social Problems of an Industrial Civilization, (Boston: Harvard Graduate School of Business Administration, 1945.

the wielder of power but by those whom it is wielded and by the other members of the system."[11]

Converging theoretical approaches can be found in Barnard's authority-upward idea in which he argues that authority possessed by a leader is based upon the willingness of members to accept it,[12] Simon's motivations for the acceptance of authority,[13] and other empirical studies by Blau and Scott, Golembiewski, Harrison, Etzioni, James, Evan and Zelditch and others. It has been argued by some that attempts to define authority in a single phrase should be avoided since it is better to describe what it is that authority involves.[14]

Whatever terms we may choose to use to define authority, it is apparent to this writer that the key analytical question is: who sets the goals and allocates the resources for their accomplishment? If we dwell only on the official and prescribed it would appear that we would receive a myopic view of the organization. Since the important key here is the focus of analysis and not its label, it is suggested that "authority be regarded in the official hierarchical sense as the right to command."

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[11]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations, (New York, John Wiley and Sons, Inc., 1966) p. 203.

[12]Chester I. Barnard, The Functions of the Executive, (Cambridge: Harvard University Press 1938).

[13]Herbert A. Simon, Donald W. Smithburg, and Victor A. Thompson, Public Administration, (New York: Alfred A. Knopf, 1950).

[14]Peabody, op. cit.

Hierarchy of Authority

A typical hierarchy of authority is found in a monocratic organization where the person at the top gives orders that initiate all activity. His subordinates make the orders more specific and they in turn communicate the information to their subordinates. Eventually, specific individuals carry the orders out. Hierarchical authority implies not only an awareness of which position or person is superior and which is subordinate, but it also conveys a great deal of information about which way communications will flow, particularly instructions and orders as distinguished from reporting and information messages. As Miller puts it, "the defining characteristic of the authority relationship is that by virtue of occupying a given position in a patterned role relationship, one individual is empowered to direct the actions of another, and the other is obliged to accept that direction."[15] In addition, the occupant of the superior position is accorded greater prestige than the occupant of the subordinate position.

The basic concepts which have just been reviewed provide a point of departure for a discussion of the pertinent literature dealing with the role of the specialist within an organizational context.

Scientific Management Movement

The scientific management movement pioneered by Frederick W. Taylor, which emphasized efficiency as a value, came into prominence

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[15]Walter B. Miller, "Two Concepts of Authority", American Anthropologist, 57: 271-289, 1955.

toward the end of the nineteenth century. Taylor attempted to dissect manual tasks in the hope of improving output by training workers to eliminate all body movements that were not essential, and he searched for a set of basic activities to which all work behavior could be reduced.[16] While Taylor did not attempt to study the entire organization, he did concentrate on an intensive analysis of work processes at the level of the individual worker. His "one best way" of carrying out each operation is the fundamental contribution which he made to scientific management.

Taylor, reacting to the disorder he found in the typical factory of his day emphasized system and order. His own words best convey how he reacted to this situation:

> . . . . Now among the various methods and implements used in each element of each trade, there is always one method and one implement which is quicker and better than any of the rest. And this one best method and best implement can only be discovered or developed through a scientific study and analysis of all the methods and implements in use, together with accurate, minute, motion and time study . . . .
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> . . . . In almost all the mechanic arts the science which underlies each act of each workman is so great and amounts to so much that the workman who is best suited to actually doing the work is incapable of fully understanding this science, without the guidance and help of those who are working with him or over him, either through lack of education or through insufficient mental capacity. . . . Those in the management whose duty is to develop this science should also guide and help the workman in working under it, and should assume a much larger share of the responsibility for results that under usual conditions is assumed by the Management.[17]

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[16] Frederick W. Taylor, The Principles of Scientific Management, (New York: Norton, 1967).

[17] Ibid., pp. 25-26.

While Taylor did not ignore the human factor, he felt the system not the man should come first to correct the absence of order.[18] He felt the average worker simply did not know enough and that in his own interests he should follow the management system. Taylor's basic principle of "friendly cooperation" between management and the workers reflect his attitude toward the employee. He views them in a kindly, paternalistic way. Worker motivation according to Taylor consisted of high wages for employees and maximum output for the employer. Although he was concerned that the individual's health not be threatened in the work process, he felt employees should work to the limit of their physiological capacities.[19] In short, he believed that it was possible to analyze the functions performed by each individual in a work setting and determine not only the one best way for each work operation, but also to set compensation.

The implications of Taylorism can be seen in the statement that "the fundamental principles of scientific management are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations which call for the most elaborate cooperation."[20] In both the private and public sector, the "principles" of the machine model permeated the thinking of practitioners and students of organization alike during the first three decades of the present century. In the case of government, there

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[18] Ibid., p. 7.

[19] Felix A. Nigro, Modern Public Administration, (New York: Harper and ROW, Publishers, 1965) pp. 84-87.

[20] George, op. cit., 79-80.

was increasing concern over inefficiency and waste, and scientific management provided the intellectual apparatus for making government more businesslike.

The basic principles of the machine model include:

1. Division of labor and specialization. The functions of the organization are placed in separate departments and each department is subdivided into specialized parts (sections, units, individual positions), the more specialization in individual work assignments, the better. If an organization is not operating properly, there is not a proper division of labor, hence, some rearrangement of units is necessary.
2. Unity of command and centralization of decisionmaking. For the departments, sections, and units to function correctly, there must be a unified command at the apex of the organization. By the same token, the head of each organization subdivision must direct all activities in that subdivision. Superior officials, then, must direct and monitor operations. As Katz and Kahn state, although the organization was viewed as a machine, it was not considered "self-directing."[21]
3. Top-down authority. The second principle has developed the notion that authority flows down the chain of command from the top of the organization to the bottom. This concept reflects the highly centralized authoritarian type of structure which is popular in the classic organization theory literature.

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[21]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations, (New York: John Wiley and Sons, Inc., 1966) p. 72.

4. Span of control. The maximum number of subordinates that any one individual can supervise effectively should be limited to a relatively small number such as five or six. It is argued that this will permit the superior adequate time to give detailed supervision to each subordinate. This results in a steeply pyramidal type of organization where the importance of hierarchy is emphasized.[22]

The major criticism of the machine model is that it ignored the human element. Workers were viewed as automatons. The worker must adjust to the job and task; labor is a commodity which can be bought and disposed of at management's discretion. Organization is based upon jobs and tasks and the basic unit of the organization is the position, which is composed of the tasks that are to be performed by a single worker. In establishing or studying organizations, the orientation therefore is the job. The personalities in the jobs should be ignored. People should adapt themselves to organization needs; and those who are unable to meet job demands are to be discarded. Leaders are chosen competitively on the basis of merit and production workers take direction from such leaders. Orders go downward and reports of accomplishment constitute the sole upward communication. To sum it up, men are viewed as machines. It is clear, then, that Frederick Taylor, in the scientific management movement developed the division of labor and specialization, both task and person, as a crucial element of his model.

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[22]Nigro, op. cit., pp. 88-89.

Durkheim's Division of Labor

The idea of social differentiation as a factor in the development of organizations has gained widespread currency. Durkheim and others have repeatedly called attention to the importance of role specialization and the division of labor not only as an essential element in the rise of industrialism and modern forms of production, but also in science, government, and in all diverse manifestations of modern civilization. The most remarkable effect of the division of labor, according to Durkheim, is not that it accentuates the distinction of functions already divided, but that it makes them interdependent. Its role in every case is not simply to embellish or perfect existing societies but to make possible societies which, without it, would not exist. [23] Durkheim made the primacy of social structure his central doctrine. His classic analysis of the division of labor in society holds that increases in social density promote specialization, which in turn, changes the basis of social solidarity from common values--"mechanical solidarity"--to interdependence with a greater tolerance for differing value orientations--"organic solidarity."[24] Durkheim also said that specialization as an adjustment to achieve a more satisfactory life involves not only a function which reduces competition but also one suited to a person's constitution or

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[23]Robert E. Park and Ernest W. Burgess, Introduction to The Science of Sociology, (Chicago: University of Chicago Press, 1969) pp. 714-718.

[24]Emile Durkheim, The Division of Labor in Society, trans. George Simpson, (Glencoe, Illinois: The Free Press, 1947) pp. 70-132, 256-282.

tastes.[25] While theorizing on a relatively high level of abstraction, Durkheim utilizes the division of labor and specialization as important variables in his analysis of social systems. Some qualifications of Durkheim's assumption that specialization is beneficial, however, seems required. The literature will show that there is an inherent tension in organizations between those in hierarchical positions and those who play specialized roles.

Weber's Bureaucratic Organization

Large scale bureaucratic organizations arise primarily because they allow more effective specialization of functions than smaller structures. Within large organizations, bureaucratic patterns maximize efficiency.[26] This is true regardless of the purpose of the organization and bureaucratization occurs in business, voluntary associations, schools, hospitals, religious organizations as well as in government. The main feature of bureaucracy conceived as an ideal type are specialization, hierarchy, a system of rules and impersonal criteria for decisions.[27] Each organization member has specialized well defined responsibilities. Tasks are assigned and coordinated through a hierarchy of officials, with general policies translated into increasingly specific instructions as they pass down the chain

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[25] Ibid., pp. 374-375.

[26] Max Weber, From Max Weber: Essays in Sociology, translated and edited by H. H. Gerth and C. Wright Mills, (New York: Oxford University Press, 1946) p. 214.

[27] Peter M. Blau, Bureaucracy in Modern Society, (New York: Random House, 1956) pp. 17-19.

of command and bits of information being pieced together as a basis of future decisions as they pass up the chain. Formal rules applied impersonally give a basis for decisions, make for predictability since each person can know what rules will guide other people's decisions.

These ideal type bureaucratic features are not equally present in all organizations. Even though in general they make for efficiency, the most thoroughly bureaucraticized organization would not necessarily be the most efficient. For example, in an ideal bureaucratic organization, employees are appointed and promoted based on technical competence in a career system. After a trial period, officials gain tenure of position and are protected against arbitrary dismissal. Under this type of organization, does tenure promote efficiency? Under what conditions does it have this effect and under what conditions does it not? Given the premise that hierarchy of authority promotes discipline and makes possible coordination of activities, does it not discourage subordinates from accepting responsibility? Another criticism of the Weberian model is its preoccupation with the formal aspects of organization while ignoring the informal relations and unofficial patterns which develop. Frequently, in modern organizations, the informal structure is the heart of the decision-making process.

Perhaps the most significant limitation of the bureaucratic model and one in which this study is primarily concerned, involves the relationship between the expert qualifications of a professional staff and the bureaucratic authority vested in a hierarchy of offices. Professionalism and bureaucracy, as a theoretical issue, have much in

common such as impersonal detachment, specialized technical expertness, and rational decision making based on universalistic standards. There are also divergent elements, however, and professional principles often come into conflict with the requirements of bureaucratic authority. Weber implied that the professional authority rooted in expert technical knowledge and bureaucratic authority rooted in a hierarchy of offices tended to occur together. "The role of technical qualifications in bureaucratic organizations is continually increasing."[28] But in addition, "each lower office is under the control and supervision of a higher one." He implies that there is no conflict between these two principles: that is, he implicitly assumes that in every disagreement between superior and subordinate, the superior's judgment is also the better judgment in terms of technical expertise.[29] This is not a realistic assumption. Administrators and managers in large scale organizations are not merely occasionally but typically less qualified to make technical judgments than their professional subordinates, since they cannot possibly be the leading expert in each of the specialties under their jurisdiction. Frequently, top management are not expert in any of the specialties, but in administration. The judgment of superiors who are concerned with administrative problems will differ from the judgment of their professional subordinates, who are primarily concerned with technical problems.

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[28]Max Weber, The Theory of Social and Economic Organizations, translated by A. M. Henderson and Talcott Parsons, Edited with an Introduction by Talcott Parsons, (New York: Oxford University Press, 1947) p. 335.

[29]Alvin W. Gouldner, Patterns of Industrial Bureaucracy, (Glencoe, Illinois: The Free Press, 1954) p. 22.

Talcott Parsons also criticises Weber for confounding these two analytically distinct types of authority.[30] Professional authority rests on the certified superior competence of the expert, which prompts others voluntarily to follow his directives because they consider doing so to be in their own interest. Bureaucratic authority, in contrast rests on the legitimate power of command vested in an official position which obligates subordinates to follow directives under the threat of sanctions. Superior knowledge is not required for bureaucratic authority, whereas it is essential for professional control and mandatory compliance is enforced by coercive sanctions in the bureaucratic but not in the professional case. Gouldner similarly stresses the difference between the influence exerted on the basis of technical competence and the compelling authority in a bureaucratic hierarchy, and he derives from this distinction two contrasting forms of bureaucracy--"representative" and "punishment centered."

Specialists--Bureaucratic Authority Relationships

The various components of specialization must be distinguished in analyzing its implications for hierarchical authority in organizations. Full fledged specialization involves not only expert skills but also a body of abstract knowledge underlying them, a self-governing association of professional peers, professional standards of workmanship and ethical conduct, and an orientation toward service. Some of these factors may easily come into conflict with the discipline

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[30]Parsons, op. cit., pp. 59-60.

required by bureaucratic authority. Research indicates that a professional orientation toward service and a bureaucratic orientation toward disciplined compliance with procedures are opposite approaches toward work and often create conflict in organizations.[31] Besides the identification of specialists with an external reference group may well reduce their loyalty to the organization.[32] It is also reasonable to expect that conflicts arise or decisions made strictly on the basis of professional standards are recurrently set aside for the sake of administrative considerations by bureaucratic authorities. All these conflicts refer to fairly advanced aspects of professionalization. But Weber's concern was not so much with these components of professionalism as with technical expertness, which he held to be an integral part of hierarchically organized bureaucracies. The findings of Udy[33] imply, however, that even a moderate degree of technical expertness conflicts with bureaucratic authority.

An important segment of the research literature involving the specialist-hierarchical authority dichotomy deals with such

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[31]Ray G. Francies and Robert C. Stone, Service and Procedure in Bureaucracy, (Minneapolis, Minnesota, University of Minnesota Press, 1956.

[32]Alvin W. Gouldner, "Cosmopolitan and Locals," Administrative Science Quarterly 2:281-306, March, 1958; Theodore Caplow and Reece J. McGee, The Academic Marketplace, (New York: Basic Books, 1958) p. 85; Everett C. Hughes, Men and Their Work, (Glencoe, Illinois, The Free Press, 1958) p. 137; Peter Blau and W. Richard Scott, Formal Organizations, (San Francisco: Chandler Publishing Company, 1962) pp. 64-74.

[33]Stanley H. Udy, Jr. "Bureaucracy and Rationality in Weber's Organization Theory," American Sociological Review, 24: 791-795, December, 1959.

professional organizations as hospitals,[34] public welfare agencies,[35] and public schools.[36] Scott suggested that not only is there a basic incompatibility between expert orientation and bureaucratic orientation but that the profession and the bureaucracy rest on fundamentally different principles of organization, and these divergent principles generate conflict between professionals and their employers in certain specific areas.[37]

Corwin in his study of conflict in nursing roles surveyed 295 nurses in seven hospitals and junior and senior student nurses in four schools of nursing.[38] He argues that the professional conception of roles upheld by nursing schools is in principle opposed to crucial aspects of the hospital bureaucracy. Upon graduation, as the student's status merges with an administrative office, professional and bureaucratic principles converge producing conflict in roles. He insists that graduates of degree programs are especially vulnerable to the resulting conflict because of the program's independence of hospital administrators.[39]

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[34]Ronald G. Corwin, "The Professional Employee: A Study of Conflict in Nursing Roles," American Journal of Sociology, 66: 604-615; May, 1961; Mary E. Gross, "Influence and Authority Among Physicians in an Out-Patient Clinic," American Sociological Review, 26: 33-50, February, 1961.

[35]Blau and Scott, op. cit.

[36]Ronald G. Corwin, "Professional Persons in Public Organizations," Educational Administrator Quarterly, 1: 1-22, Autumn, 1965; "Patterns of Organizational Conflict," Administrative Science Quarterly, 14: 507-519, December, 1969.

[37]W. Richard Scott, "Reactions to Supervision in a Heteronomous Professional Organization," Administrative Science Quarterly, 10: 65-81, June, 1965.

[38]Corwin, the Professional Employee: a Study of Conflict in Nursing Roles, op. cit.

[39]Ibid.

In this study, Corwin addresses himself to the following questions:

1. Do bureaucratic and professional conceptions of role conflict?
2. Are there systematic differences in the organization of roles produced by diploma and degree programs?
3. Do discrepancies between ideal roles and perceptions of the reality increase after graduation?

Results of this study suggest that at graduation, inherent conflicts between professional and bureaucratic principles of organization are most seriously encountered. Those who express strong allegiance to bureaucratic and professional roles, simultaneously, also sense the greatest discrepancies between ideal conceptions and perceived opportunity to fulfill them--which is interpreted as evidence of their incompatibility. Because of the greater independence of degree programs from hospital administration, bureaucratic principles are stressed more than in the diploma programs. There is evidence that diploma and degree graduates organize the bureaucratic professional roles differently and adjust to conflict of roles in systematically different ways.

For example, while both degree and diploma nurses experience conflict in roles after graduation, the degree nurses maintain high professional conceptions more frequently than diploma nurses. Diploma nurses express lower professional and service conceptions of roles than diploma students do, suggesting that these are modified after graduation while bureaucratic conceptions are apparently maintained. On the other hand for the degree nurses, the professional conception seems to be maintained after graduation.

In another study by Corwin[40] several variables considered as potential causes of conflict suggest that conflict is endemic to large scale, complex organizations or at least to schools. He focuses mainly on the structural causes of conflict using a several stage cross section design. The earlier case studies because they observed organizations across time, had an opportunity to see conflict as a process.

Data on 28 high schools in Pennsylvania, Ohio, Michigan, and Indiana were collected between 1962-65. Over 1500 teachers and administrators representing a stratified sample of more than three fourths of the total number of employees returned questionnaires. Over 700 of the respondents, stratified by position and subject matter taught, were randomly selected for tape recorded interviews. The variables used by Corwin included structural differentiation, specialization, levels of authority, organizational complexity, participation in the authority system, regulating procedures, heterogeneity, and interpersonal structure. The hypotheses offered by Corwin suggest that:

1. Conflict will increase with the degree of differentiation in the organization.
2. Specialization will be positively associated with the incidence of conflict.
3. Organizational tension and conflict will increase with the number of levels of authority in an organization.
4. Organizational tension and conflict will be positively associated with organizational complexity.

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[40]Ronald G. Corwin, "Patterns of Organizational Conflict," Administrative Science Quarterly, 14: 507-520, December, 1969.

5. Organizational tension and conflict will be positively associated with the participation of subordinates in the authority system.

6. Organization tension and conflict are positively associated with emphasis on procedures for regulating organizational conflict.

7. The number of staff members added to the organization will be positively associated with organizational tension and conflict.

8. The rate of informal interaction among a faculty, the rate of interaction between a faculty and its administration, and the degree of participation in employee associations are positively associated with organizational tension and conflict.

In this study organization size, specialization, hierarchy, complexity, staff additions and heterogeneity seem to contribute to organizational strain; participation in decision making and cohesive peer relations seem to facilitate conflict if it is present. Close supervision, standardization, and rules also appear to be associated with strain.[41] In short, the hypotheses were supported by the data.

The significance of this research in terms of the present study identified not only the tensions which exist between specialists and hierarchical authority but with other specialists as well. For example, the number of officially recognized departments in a school, one aspect of organizational complexity, was associated with the number of moderate and severe disagreements among the faculty. The addition of teachers (specialists) increases the tension found in the school system. Finally, Corwin notes that in terms of interpersonal structure, the proportion of a faculty who lunch together "very

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[41] Ibid.

frequently" is significantly associated with the number of disputes. It is in the more experienced faculties that frequent lunching is associated with conflict. In less experienced faculties most conflict tends to decrease with interactions.

Blau and Scott in a survey of two welfare agencies explored the notion developed by Gouldner and others that professionals tend to assume a cosmopolitan orientation manifesting itself in a lack of loyalty to particular organizations and a willingness to move from one employer to another compared with those less committed to professional skills who usually have strong feelings of loyalty to their organization.[42]

The researchers developed the hypothesis that there is an inverse relationship between professional commitment and organizational loyalty. The index which was employed to measure the professional orientation among the social work staff consisted of (1) commitment to professional skills as indicated by some graduate training in social work, and (2) orientation to professional reference groups outside the agency.

Data was gathered using unstructured observation, interviewing, and analysis of records and documents. The subjects included 80 professional employees in the City Welfare agency and 103 professionals in the County agency. The results of the survey indicated there was a tendency for workers with graduate study to choose outside reference groups. In addition, professionals were in all cases most

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[42]Blau and Scott, op. cit., pp. 66-74, 254-257.

likely to exhibit professional characteristics such as attending conferences, being active in local welfare groups, and feeling that supervisors should have M.S.W. degrees. Finally, the professionals were somewhat more apt to be willing to leave their employing agency for another position than were the bureaucrats. These findings confirm the hypothesis derived from other studies that a professional orientation is inversely related to organizational loyalty.

In an analysis of specialists in an industrial setting, Kornhauser and Hagstrom found that there were built in strains between organizational and professional values.[43] These researchers suggest that there are four areas in which professional organizational values are in basic conflict:

1. The Nature of the Goals Sought. The professional seeks excellence and adherence to scientific standards. The organization also seeks excellence but wants its scientists to come up with profitable developments in a regular fashion. But the nature of science is such that the developments may not only fail to be profitable but also may not occur with any regularity. Both sets of goals are legitimate but both cannot always be realized at the same time.
2. Source of Control Over Scientists' Work.
   A) Recruitment of personnel. The organization wants to select persons it believes will benefit the organization

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[43]William Kornhauser and Warren O. Hagstrom, Scientists in Industry, (Berkley, California: University of California Press, 1962.

in the long run, personnel who have potential to move into management positions. The sciences on the other hand demand that selection be based on scientific ability and these skills are not necessarily the same.

B) Actual organization of work groups may present conflict. Scientists desire work groups to be organized around scientific specialites, since this facilitates intensive investigations into specific areas of interest. The organization on the other hand, prefers that work groups be organized around particular tasks, which involves mixing different types of scientists and engineers for the solution of a particular problem or the development of a particular product.

C) Supervision is another problem. Organizations rely upon legitimate hierarchical authority as the means of control; scientists and other specialists rely on expertise as the major control mechanism. As a scientist is placed in a supervisory position, his ability as a scientist is likely to suffer since he will have less time to spend on keeping up with his field.

3. Kinds of Incentives Sought. The scientist operates in a community that transcends organizational or geographic boundaries and is known by his contributions to this community. He is rewarded by the recognition that he has made a contribution to knowledge. The organization on the other hand uses advancement within it as its primary reward system. This creates

conflict with scientific advances. The organization expects its members to be local in orientation with loyalty to the organization and its purpose, but the scientist is cosmopolitan in that his reward and reference are in the wider scientific community. For the cosmopolitan, advancement in the local organization may not be an attractive incentive.

4. Matter of Influence--Who Has the Ultimate Power in Decision Making? Since the organization assumes the risks for its actions, it has the last word in deciding which course of action to pursue. In this sense, the hierarchy has ultimate power over professional expertise which puts the scientist in an awkward position. If he remains detached from the decision making process, he has little impact on organizational matters, he in reality becomes part of the organization and moves out of the scientist role.[44]

Kornhauser and Hagstrom conclude that these areas of value conflict, while probably inherent in the situation, need not result in conflict for the professional or the organization. They state:

> In sum, the strain between professional autonomy and bureaucratic control is accommodated by the creation of new roles for research administration. Administrative matters are controlled on the basis of hierarchical principles of authority while matters regarded by professionals as the primary responsibility of the individual are more subject to multilateral determination through colleague relations. Thus, organization controls are relied upon to a greater extent in the sphere of general policy, in research areas close to operations, and by the top research directors, whereas, professional controls are used more extensively in research assignment and procedures, in more basic research areas, and by first line research supervisors.[45]

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[44] Ibid., pp. 17-41.

[45] Ibid., pp. 201-2.

Specialist vs. Specialist

Specialization in large scale organizations has often resulted in strong attachment to subgoals of the enterprise.[46] Specialists are not immune to such ills as resistance to change that would decrease the importance of their specialty and status anxiety as they compete with other specialists in the formal arena of the organizational hierarchy. Presthus, in a study of organizations concluded that specialists can frequently be difficult. Rarely can they be persuaded that their own unit does not deserve the lion's share of the organization's resources. Their orientation makes it difficult for them to see someone else's point of view. They frequently disturb the equilibrium of the organization by fighting among themselves about resources and recognition. In large organizations such conflicts are less amenable to accommodation based upon personal association and friendship. Each department or division tends to become a world in itself. "Indeed, there are political and professional sanctions against collaborating with the enemy, because the internal discipline and unity of each subunit becomes so important in its competitive success. In this sense, size and attending specialization can become pathological."[47]

Shepard in his research observed that specialist groups tend to foster narrow interests and make it difficult to cross specialist

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[46]Edwin B. Flippo, Management: A Behavioral Approach, (Boston, Allyn and Bacon, 1970) Ch. 13.

[47]Robert Presthus, The Organizational Society, (New York, Vintage Books, 1962) p. 30.

lines and cooperate with other kinds of specialists. He indicated this may discourage creativity and the responsiveness to challenge, "the scientist becomes a specialist in knowing what cannot be done and is afraid to venture into unfamiliar fields."[48] Litterer, in his analysis of organizations, concluded that specialists may be more concerned with their specialty than with the end purpose of the organization. Because of the interest in their specialty, people may find it either difficult or not in their interest to communicate and associate with other organizational members.[49] Thompson argues that the introduction of new programs in organizations frequently is viewed with suspicion and even hostility by established specialists. The new may threaten the old with loss of functions or programs and, therefore, with loss of status. In order for new specialties to be accepted, they must be evaluated over a period of time and then the new functions must have a high social evaluation in order to have high status.[50] Communication difficulties between specialists with different frames of reference, then, can easily become great. The problems of communicating with or between specialties, each of which tends to have its own terminology, approach, and perhaps basic values as well poses a significant organizational dilemma.

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[48]Herbert A. Shepard, "Nine Dilemmas in Industrial Research," Administrative Science Quarterly, 1: 302, December, 1956.

[49]Joseph A. Litterer, The Analysis of Organizations, (New York: John Wiley and Sons, 1945) p. 181.

[50]Victor A. Thompson, Modern Organization, (New York: Alfred A. Knopf, 1963) pp. 38-39.

Specialists' Respect for Hierarchical Authority

In his research with organizations, Thompson also indicates that organizations face a growing problem of rewarding specialists. To be socially regarded as successful in Western Civilization is interpreted to mean possessing social prestige or status. The status system provides incumbents of hierarchical positions such important personal satisfactions as power, income, deference, interesting assignments and broader associations. It has generally been conceded that status or social prestige has become largely a monopoly of the hierarchy in modern bureaucracy. To be socially defined as successful, then, one must proceed up some hierarchy, that is, a person must give up his specialty and enter hierarchical competition.[51]

Employees of modern organizations are conditioned to expect promotions for good work. With few exceptions in professional specializations, promotions are defined as improvement in hierarchical rank. Specialists, then, to "succeed" must leave their field of specialization and enter management.[52] With the enormous expansion of knowledge flooding the organization with specialists of all kinds and with the organization increasingly dependent upon them, the organizations reward system is facing a crisis. With all his pre-entry training, the specialist finds he can succeed only by giving up work for which

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[51] Ibid., pp. 96-97

[52] Wilbert E. Moore, Industrial Relations and the Social Order, rev. ed., (New York, the MacMillan Company, 1951) Chapter 6; Alvin W. Gouldner, Patterns of Industrial Bureaucracy, (Glencoe, Illinois: The Free Press, 1954) p. 226.

he is trained and entering management--work for which he has no training.[53]

Administrators of technical programs generally are selected on the basis of their capacity to accommodate management. They are more than likely to be oriented toward the bureaucratic norms of the organization rather than the colleague norms of the professional group. The organizational orientation is likely to be strongest at the higher levels of management, as the following case study by Marcson illustrates.

In a national firm, engineers on the highest management levels are more company minded and less professionally minded than engineers on lower management levels. "At the same time, all engineering managers of whatever levels are more company oriented than professionally oriented."[54] This is the central conclusion of a study of 616 (83 percent) of the engineering managers in this company. The highest engineering executives, including the chief engineers, tend to see themselves as business leaders with executive authority and responsibility for "selling ideas and project results to upper levels of management or to customers." The group leaders who comprise the lowest management level gave greater emphasis to the norms of the colleague group and responsibility for "a technical and engineering type of job." These engineers are more apt to be defensive and protective about the professional aspects of their jobs.[55]

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[53]Lewis C. Mainzer, "The Scientist as Public Administrator," Western Political Quarterly, 16: 814-829, December, 1963.

[54]Simon Marcson, "Role Concept of Engineering Managers," Institute of Radio Engineers Transactions of the Professional Group on Engineering Management, EM-7: 33-33, March 1960.

[55]Ibid.

Anthony, in a survey of 405 industrial laboratories, reports that:

> The (research) director usually, but not always, has technical training experience. In rare instances, he has reached the top in the laboratory principally because of the brilliance of his technical work; more commonly, he has been given his job primarily because of his executive ability, rather than because he has had a record of outstanding technical accomplishments.[56]

Specialists' Commitment to Organizational Goals

Since organizations engage in activities of one sort or another and presumably these activities accomplish something, the issue of organizational goals plays an important role in much of the research.

Like other organizational concepts, there exists a plethora of definitions on what goals really are, according to Etzioni "an organizational goal is a desired state of affairs which the organization attempts to realize."[57] This desired state of affairs means many things to many people. In large organizations, top executives may see the organization seeking one kind of state while those in the middle and lower echelons may have drastically different goals for the organization and for themselves personally.

Parsons has pointed out that organizational goals are intimately intertwined with important and basic societal functions such

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[56]Robert A. Anthony, Management Control in Industrial Research Associations, (Cambridge, Massachusetts: Graduate School of Business Administration, Harvard University, 1952) p. 31.

[57]Amitai Etzioni, Modern Organizations, (Englewood Cliffs, New Jersey: 1964), p. 6.

as integration, pattern maintenance and so on.[58] From this point of view, organization goals are really an extension of what the society needs for its own survival. At the other extreme, it may be argued that strictly speaking, organizations do not have goals; only individuals do.[59]

Both positions leave something to be desired. If the level of analysis is kept in the broad societal-function framework, the variations in goals and activities among organizations performing the same basic functions are ignored. If the level of analysis focuses on just the variety of individual goals, there would be no point in organizing.

Organization goals are created by individuals singly and collectively. They represent the desires of its members along with pressures from the environment and the internal system. "While there is never 100 percent agreement among members as to what organizational goals are or should be, members can articulate a goal that is a desired state for the organization at some future point in time."[60]

This approach is similar to that of Herbert Simon whose major focus is on decision making within the organization. He notes that:

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[58]Talcott Parsons, Structure and Process in Modern Societies, (New York: Free Press, 1960) pp. 17-22, 44-47.

[59]Charles Perrow, Organizational Analysis: A Sociological Perspective, (Belmont, California: Woodsworth Publishing Company, Inc., 1970) pp. 133-134.

[60]Richard H. Hall, Organizations--Structures and Processes, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972) p. 82.

> When we are interested in the internal structure of an organization, however, the problem cannot be avoided . . . . Either we must explain organizational behavior in terms of the goals of the individual members of the organization, or we must postulate the existance of one or more organization goals, over and above the goals of the individuals.[61]

Simon then goes on to differentiate between the goals or value premises that serve as inputs to decisions and motives, and the causes that lead individuals to select some goals over others as the basis for their decision making. He keeps the goal idea at the individual's level but offers the important notion that the goals of an organization at any point in time are the result of interaction among the members of the organization.

To this, the writer would add that external conditions also affect the nature of the organization's goals. An example is the case of the Department of Highway and Transportation where the official goals are to design, construct, and maintain a state trunkline system. Members of the Legislature, Executive Office, Department of Highway and Transportation and other state agencies have placed responsibility for mass transit systems within the department significantly altering its original goals. In this example, the goals of individual organization members, particularly those in high positions, are crucial in goal setting. These goals are modified in the course of internal and external interactions.

Perrow argues that the type of goals most relevant to understanding organizational behavior are not the official goals but those

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[61] Herbert A. Simon, "On the Concept of Organizational Goal," Administrative Science Quarterly, 9: 2, June, 1964.

that are embedded in major operating policies and the daily decisions of the personnel.[62] These goals will be shaped by the particular problems or tasks an organization must emphasize, since these tasks determine the characteristics of those who will dominate the organization.

The factors that affect goals and the fact that the meaningful goals of an organization are not those officially pronounced, might lead us to reject the goal concept altogether. But there is still the simple but basic fact that the organization would not exist if it were not for some common purpose. With few exceptions, members come to the organization willingly, if not enthusiastically. In all cases, the organization engages in some activity. This activity is simply not random behavior, it is based on some notion of what the purpose of the action is.

The basis for organizational activities, then, is its purpose or goals. While it is true that means may be emphasized more heavily than the goal itself, that members of the organization may have no idea of why they are doing what they are doing, and that blind adherence to obsolete norms may become the norm; but these behaviors would be impossible without the presence of a goal. "Even when forgotten or ignored, the goal is still the basis for the organization, since the means would not have developed without it in the first place."[63]

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[62]Charles Perrow, "The Analysis of Goals in Complex Organizations," American Sociological Review, 26: 854-866, December, 1961.

[63]Hall, op. cit., p. 94.

Perrow focuses on the complex nature of goals in an organization. He develops five different kinds of goals which he feels must be carefully distinguished: societal, output, system, product, and derived. Societal goals produce goods and services. This category deals with large classes or organizations that fulfill societal needs. output goals are those which place the public in contact with the organization such as consumer goods, business services, health care, education, etc. System goals reflect the state or manner of functioning of the organization. Examples would place emphasis upon growth, stability, and profits. Product goals represent the characteristics of the goals or services produced. Examples would emphasize quality and quantity, variety, styling, and availability of products. Finally, derived goals are identified as the uses to which the organization puts the power it generates in pursuit of other goals. Examples are political aims, community service, employee development, etc.[64] He concludes that a person's point of view will in large measure determine what the goal is. For example, for a society, the justification of the Department of State Highway and Transportation's existance may be to produce an expressway system for the entire state; the goal of the Department may be to design, construct, and maintain a state trunkline system (not necessarily an expressway system); for roadbuilders and suppliers to accelerate the construction program; for top executives, to run a stable and secure organization where life is predictable and not too stressful; for a division head, to design the best

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[64]Perrow, op. cit., p. 135.

damned highway around; and for the specialist, to emphasize the design of fixed span bridges rather than movable structures.

Multiple goals do not necessarily create problems unless the pursuit of one goal interferes with the pursuit of another. In General Motors Corporation, two of its goals are to produce a large number of cars and at the same time to maintain a quality product. It becomes apparent, however, that a point is reached where one goal can be accomplished only at the expense of another. In organizations as large and as complex as those found in government such conflicts, then, are not uncommon.[65]

Research in three industrial plants showed conflict between the staff specialists and line groups that hindered the attainment of organization goals. The higher line executives opted for greater control of specialists or the elimination of these groups with the functions taken over by persons friendly to line personnel. The conflict between the two groups was attributed to differences in goals, fear in the line that staff personnel would undermine line authority, differences in ages (staff much younger than line), formal education, and potential occupational ceilings.[66]

Organizations are social units oriented toward the pursuit of specific goals according to Etzioni.[67] In this sense they can be

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[65]Melvin L. DeFleur, William V. D'Antonio, and Lois B. DeFleur, Sociology: Man in Society, (Glenview, Illinois: Scott, Foresman and Company, 1971.

[66]Melville Dalton, "Conflict Between Staff and Line Managerial Officers," American Sociological Review, 15: 342-351, June, 1950.

[67]Amitai Etzioni, A Sociological Reader on Complex Organizations, (New York: Holt, Rinehart and Winston, Inc., 1961) p. 155.

conceived as tools which gain meaning and direction from their functions. Students of organizations have observed that often the "tools" determine in part the goal to which they are applied. The process takes several forms: initial goals may prove to be "utopian," and organizational personnel may adjust these goals by making them more "realistic" or the organization's original goals may be neglected without being changed officially and the organization may develop alternative or competing goals which are more in line with the interests of its staff. The organization may also see its predominant task as maintaining and expanding itself.[68]

A study was conducted by Sheldon to test the hypothesis that investments and social involvements will lead to the development of commitment to the organization.[69] By investments, the author means participation in an organization to an extent that possible participation in another organization is decreased. Social involvement refers to interaction and identification with other members of the organization. The hypothesis that investments produce commitment to the organization regardless of other features of the relationship of the member to the organization was supported for professionals with long lengths of service in the organization, regardless of their position in the organization. Professional commitment appeared to increase with the work experience and professionals with high commitment to

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[68] Ibid.

[69] Mary E. Sheldon, "Investments and Involvements as Mechanisms Producing Commitment to the Organization," Administrative Science Quarterly, 16: 143-149, June, 1971.

the profession tended not to be committed to the organization, regardless of investments. The profession, thus increasingly provides a reference group that competes for loyalty with the organization. The organization is hard pressed to retain the loyalty of its professionally committed personnel particularly those with a medium length of service.

The literature which has just been reviewed is more often confusing than enlightening. The general theorizing has not been systematically supported by empirical research. Indeed, perhaps the most significant contributions have come from those students whose works do not have an empirical base. A great amount of the research has been conducted with industrial organizations. There has been a paucity of interest in typically large bureaucratic organizations especially in the public sector. In addition, the focus has been on the professional association competing with the organization for the loyalties of its members. While it is evident that some of the research involving professionals pertained to the relationship between the specialist and hierarchical authority, there were few studies which addressed themselves to the relationships between specialists in large bureaucratic organizations.

The commitment of the specialist to organization goals has generally involved competition with external forces, i.e., professional associations. There has been little effort to establish these relationships without reference to outside interest groups. The concepts specialist or professional have often been used as if they referred

to more or less undimensional, well understood phenomena, when in fact as some studies demonstrate they tend to mean some very different things.[70]

Hypotheses

This study will address itself not only to the relationships between specialists and hierarchical authority, but to the neglected relationships between specialists and their commitment to organizational goals.

Existing studies of specialists have included a variety of professional occupations. Included in the groups have been lawyers, doctors, accountants, teachers, social workers, stockbrokers, personnel managers, and advertising executives in a variety of organizational settings. The kinds of research concerning professionals in organizations has at least four dimensions:

1. Professionals engaged in private practice vs. those on salary.
2. Professionals in government vs. those in the private sector.
3. Professionals who are a part of a large bureaucracy vs. the specialist who has his own practice.
4. Professionals who deal with things rather than people.

The present research is concerned with a study of salaried engineering specialists in a large public bureaucracy who deal with things (highway design, construction, and maintenance) rather than people. The engineering specialist is viewed as the product of extended

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[70]Bertram M. Gross, Organizations and Their Managing, (New York: The Free Press, 1964) pp. 36-37; Flippo, op. cit.

education and training prior to entering the organization where he is employed for his technical expertise as it relates to the accomplishment of certain organizational goals. The proliferation of occupational specialties--person specialization--as we have seen appears to result in strains between the professional and the organization. It will be argued that not only are there strains between the engineers and hierarchical authority, but with other engineers as well. These tensions and strains arise where occupants of hierarchical positions and engineers in a particular area must consult appropriate engineers in other areas thus sharing decision making. This suggests the following hypotheses:

1. The greater the degree of skill required to perform the functions of a particular position, the less the respect for hierarchical authority.

2. The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists in other substantive areas.

3. The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists with fewer skills.

4. The extent to which specialists succeed hierarchically (assumes a generalist or managerial role) is positively associated with their respect for hierarchical authority.

5. The extent to which specialists respect hierarchical authority is positively associated with their commitment to organizational goals.

A large complex state bureaucracy which employes a substantial number of engineers in different professional specialties was selected for intensive study.

CHAPTER III

RESEARCH DESIGN AND OPERATIONALIZATION OF CONCEPTS

The hypotheses outlined in the previous chapter provides the framework for this research. This investigator will study the relationships between specialists and hierarchical authority, other specialists, and specialists' commitment to organization goals. These hypotheses are rooted in the literature in the field, are brief, and testable.

The independent variables used in the study include degree of skill, promotion to supervisory and managerial positions, and respect for hierarchical authority. The dependent variables are respect for hierarchical authority, attitude toward specialists in other substantive areas, attitude toward specialists with fewer skills, and commitment to organization goals. Respect for hierarchical authority is used in part of the analysis as a dependent variable and in another part of the study as an independent variable.

Operationalization of Concepts

In order to analyze the organizational phenomena, the following concepts will be operationalized in this research. Degree of skill refers to the amount of education or technical training required

for the accomplishment of certain non-repetitive tasks. These skills are generally acquired prior to joining an organization. Subsequent improvement in education, however, may also be required. The acquisition of years of experience and increases in Civil Service class level are surrogates for hierarchical competition. In short, as one ascends the hierarchy (increases his class level) and gains experience, he becomes a generalist resulting in increased respect for hierarchical authority and commitment to organizational goals.

Respect shall be defined to mean the evaluation of one's performance by others. To be held in high regard, generally means to be judged competent by superiors, subordinates and colleague group. Recognition as a superior employee provides satisfaction to most people. An individual likes to feel that he is important to his department or group; while he may not be indispensable, he likes to feel that his contribution is important enough so that group action will not be the same without him. Most men are responsive to the attitudes of others who are not members of the same organization. Working for a well regarded organization or individuals is a highly desirable goal.

> Respect, then, is a value which may be attributed unevenly; some men are given more deference than others . . . respect arises out of those informal norms of behavior or 'rules of the game' in terms of which members regulate each others' conduct and which are enforced by both positive and negative sanctions. Those who excel in playing by the rules are given respect and are rewarded.[1]

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[1]Heinz Eulau, "Basis of Authority in Legislative Bodies; A Comparative Analysis," Administrative Science Quarterly, 7: 309-332, December 1962.

Hierarchical authority refers to the relationships of boss and men. It shall be defined to mean the influence and sanctions (formal and informal) available to any incumbent of a position regardless of his personal characteristics. It is assumed that the superior, at any point in the hierarchy, is able to tell his subordinates what to do and to guide them in doing it. The managerial or supervisory role shall include those positions identified at the Engineer 12 level and higher according to the Civil Service class specifications.

The success of specialists hierarchically involves giving up their specialty to "enter hierarchical competition."[2] Success, then, means leaving a highly technical position for one which is usually identified as managerial to acquire social prestige, status, recognition and esteem, in addition to increased income. The higher rewards come from joining the administrative structure.

Commitment to organization goals is viewed as the extent to which specialists identify and agree with the stated objectives of an organization. Research which has attempted to measure this variable has been relatively rare in public bureaucracies. "Generalizations about . . . the loyalty that employees feel toward the organization have largely been based on research in industrial firms."[3] The research which has been conducted, however, suggests that specialists do not support organizational objectives as effectively as they might, given their own objectives.

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[2]Victor Thompson, Modern Organization, (New York: Alfred A. Knopf, 1961) p. 110.

[3]Robert L. Peabody and Francis E. Rourke, Public Bureaucracies, in Handbook of Organizations, James G. March, editor, (Chicago, Illinois: Rand McNally and Company, 1965) p. 810.

The terms specialists, technical expert, and professional have been used interchangeably in this study. The crucial elements include extended education or training to achieve a recognized occupational competence. The more professional training an individual has acquired, the greater the degree of skill he will possess to achieve personal and organizational objectives. Specialists shall be defined to mean those department employees who have civil service classifications of "engineer" who work at the 07 through the 11 level, and are assigned to the Design, Construction, and Maintenance Division, Bureau of Highways, Department of State Highways and Transportation. Engineers in class levels 12, 13, and 14 are defined to mean supervisory and middle management personnel. 15 level engineers and higher are defined as top management for purposes of this survey.

Context of Data: Description of the Organization

In order to measure the variables previously outlined, the writer has surveyed the Department of State Highways and Transportation. (See appendix A) This organization has been undergoing an organizational renewal resulting in significant changes in goals and direction.

The State Highway Department was originally established in 1905 reflecting a shift in emphasis from local responsibility for the construction and maintenance of roads to one of shared responsibility with the State. Since the passage of a tax on motor vehicles and fuel where the revenues were used for highway construction and maintenance and a subsequent constitutional amendment in 1938 earmarking the gas

and weight tax exclusively for "highway purposes," the Department has grown in size and complexity reflecting a typical large bureaucratic organization.

The department was administered by an appointed or an elected State Highway Commissioner up to 1964. The Constitution which became effective January 1, 1964 created a 4 man State Highway Commission responsible for administering the State Highway Department as well as having "jurisdiction and control over all state trunkline highways and appurtenant facilities and such other public works of State, as provided by law."[4]

Policy making for the state trunkline system is now vested in a four man commission. The Commission "shall appoint and remove a State Highway Director, who shall be a competent highway engineer and administrator."[5] The Department maintains a central office in Lansing. The field operations are assigned to ten districts (see appendix B) each administered by a district engineer whose specialty may be either construction or maintenance. The division chiefs in the central office and their assistants maintain functional control of each program in the district with coordination being provided by the district engineer.

The budget requests for fiscal year 1969-70 indicates "the department's primary program responsibility is to plan, design, construct, and maintain state trunkline highways to meet the needs of the

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[4]Constitution of the State of Michigan of 1963, Article V, Section 28.

[5]Ibid.

state within the limits of available funds."[6] Planning, design, construction and maintenance of state trunklines, then, are the obvious, formal commonly articulated goals of the department.

Less well known but of considerable importance are these additional goals of the organization:

1) Public relations and tourist information services provide for the preparation and dissemination of news releases, magazine articles, and other information to more than 500 newspapers and 150 radio stations. This operation also distributes from eight tourist information stations located throughout the state; literature, brochures, pamphlets, and other material on Michigan attractions and points of interest.
2) Roadside parks and rest areas have been provided throughout the state to accommodate the motoring public. These facilities include picnic tables, restrooms, telephones and other items for public convenience.

Within the past year, the department was assigned responsibility for two additional functions, i.e., the general supervision of all aeronautics within the state and urban mass transportation programs.

The department, in order to operate its multiple programs, is organized into the following bureaus: Aeronautics, Urban and Public Transportation, Administration, Transportation Planning, Finance, and Highways.

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[6]Estimated Revenue and Budget Requests for July, 1969-June 30, 1970, Michigan Department of State Highways, p. 2.

The Bureau of Highways, the largest in terms of numbers of employees provides the bulk of the engineering services for the department. The three divisions in the Bureau which are the focus of this study involves the Design, Construction, and Maintenance Division. These divisions provide the crucial engineering elements in a highway program. The Design Division (see appendix C) conducts surveys and prepares plans, specifications, estimates and other required documents for all programmed or emergency projects for bridges, roads, and related work required for the maintenance, improvement and additions to the State Trunkline System.

The Construction Division (see appendix D) supervises all highway construction activities in the State's trunkline system. The staff process engineering and technical data used to support changes in contract quantities and costs, inspects the fabrication and welding of structural steel used in highway construction, provides engineering, inspection, and documentation activities on all bridge and road construction projects. The construction staff provides contractors with the alignment and elevation of all State Highway facilities under construction, takes measurements used as a basis of payment to contractors, compiles and computes quantities of work as completed by contractors and prepares reports of tested materials used.

The Maintenance Division (see appendix E) maintains the state trunkline system and appurtenant facilities, supervise maintenance activities on state trunklines in municipalities and counties where the local units provide the services to the department, maintains roads and bridges on the rest of the trunkline system. The staff is

responsible for the acquisition, maintenance, assignment, and disposal of automotive and special equipment for the department including servicing and repairs, inspects all structures including fixed and movable bridges on the trunkline system and recommends maintenance repairs. In short, personnel of this division provide road, bridge, and forestry maintenance for direct maintenance counties and supervises these activities in contract counties.

The department employs approximately 4,600 persons, the majority of which are assigned to the Bureau of Highways. The largest percentage of these employees are found in the Design, Construction, and Maintenance Divisions. The department employs approximately 645 persons who are classified as "engineers" according to Civil Service specifications. Out of 645 engineers, 6 are women who are assigned to the various divisions. The Design Division employs 3 of the 6 with the remaining numbers working in other divisions. The Construction and Maintenance Divisions have no female engineers. The Design Division employs 201 engineers, Construction Division 169, and Maintenance Division 35 for a total of 405.[7] These 405 engineers in Civil Service class levels 07 through 18 constitute the survey sample.

In order to better understand the various degrees of specialization identified by the Civil Service class levels and their concomitant relationships, a detailed description of each class is found in appendix F. Table 3.1 provides a summary of this information.

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[7]Statement by Orville Emery, Personnel Officer, Department of Highways and Transportation, Personal interview, January 10, 1974.

Table 3.1. Summary--Design, Construction and Maintenance Division.

	Class Level	No. of Emp. in Class			Degree of Specialization	Educ. Requirements For Appt. to Class
		Design	Const.	Maint.		
Specialists	07	1	8	0	Trainee	BS--Engineering
	09	23	18	1	Junior Engineer	BS--Civil Engineering
	10	15	20	0	Intermediate Engineer	BS--Civil Engineering
	11	73	17	9	Journeyman Engineer	BS--Engineering
Middle Management	12	41	70	7	Senior Engineer	BS--Engineering
	13	28	18	5	1st Line Supervisor	Registration
	14	6	7	2	Dist. or Ass't. Dist. Engineer	Registration
Top Management	15	10	8	6	Superintendent	Registration
	16	3	1	4	Beginning Adm. Level	Registration
	17	0	1	0	Area Engineer	Registration
	18	1	1	1	Division Head	Registration

Research Design

There exists in the literature a wide range of techniques to evaluate organizations. Since there is no predetermined technique, a good research design is in large measure influenced by the particular setting in which it is used. It must address the problem under study and provide certain kinds of information under certain kinds of conditions.[8]

Perhaps the greatest challenge facing most social scientists is the common assumption that unless the ultimate form of research design is used--experimental--the results will be something less than satisfactory. The key problem in this approach is to establish suitable control so that any change in the dependent variable can be attributed only to the independent variable that was manipulated by the researcher. The laboratory approach accomplishes this by isolating the research in a physical situation apart from the routine of ordinary living and by manipulating one or more independent variables under vigorously specified, operationalized, and controlled conditions.[9]

Because it does provide relatively complete control over intervening variables that may affect experimental outcomes, this approach had the virtue of being replicable in other contexts. It

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[8]Kent J. Chabotar and Stephen H. Montgomery, Second Year Evaluation of an American Management Association Pilot Programs: Adopting and Testing Business Management Development Programs for Educational Administrations, (Washington: U.S. office of Education, 1972).

[9]Fred N. Kerlinger, Foundation of Behavioral Research (New York, Holt, Rinehart and Wilson, Inc., 1964) p. 379.

has considerable appeal then, to the researcher who wishes to make an objective and rigorous contribution to his discipline.

But people in organizations do not lend themselves easily and readily to certain types of investigation. Their actions and attitudes are not amenable to precise definition, external manipulation, or isolation from extraneous variables. In short, the order of the laboratory is exchanged for the disorder of the field study. The crucial difference, then, in these two approaches is that the survey takes the world as it comes, without trying to alter it, as opposed to the laboratory approach where some aspects of the world are systematically altered in order to see what changes follow.[10]

The organizational evaluations used in the present study are designed to produce data that is useful and valid for an explanation of relationship among variables. Field studies have three distinct advantages for purposes of this research: to decide on significant variables in the research situation, to discover relations among variables, and to suggest guidelines for further research.[11] In short, while laboratory results are precise and "clean", they usually have to be "translated" for purposes of use in the "real world" while field studies try to take into account important "real world" variables.

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[10]Julian L. Simon, Basic Research Methods in Social Science: The Art of Empirical Investigation (New York: Random House, 1969) p. 229.

[11]Daniel Katz, "Field Studies", in Leon Festinger and Daniel Katz, Research Methods in the Behavioral Sciences, (New York: Holt, Rinehart and Winston, Inc., 1953) pp. 75-83.

The discussion thus far does not suggest that laboratory research is necessarily an inferior model, however, for our purposes, a field study would provide more useful information.

The research methodology used in this study included a scaled-response questionnaire and individual interviews as instruments for data collection. The survey explores relationships between the independent variables in the hypotheses, i.e., degree of skill, success of specialist, and respect for hierarchical authority and the dependent variables, respect for hierarchical authority, respect for specialists in other substantive areas, respect for specialists with fewer skills, and commitment to organizational goals.

Questionnaire

Questionnaires were used in this research because a larger sample can be surveyed in a relatively short period of time, and at a reasonable cost. Questionnaires produce large amounts of data while requiring a minimum amount of time for completion. The primary disadvantage of structured questions is that they sacrifice much of the color and intensity of the respondents answers.[12] Questionnaires also may induce a compliance process on the respondent's part--people may say what they think they should say. This is one form of the problem of reactive measurement and is a significant issue in social science

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[12]Charles H. Backstrom and Gerald D. Hursh, Survey Research, (Evanston, Illinois: Northwestern University Press, 1963) p. 75.

research.[13] The author might also add that other methodologies induce compliance, i.e., interviews.

The problem of measuring the intensity of the respondent's opinions is partially overcome by using a rating scale which allows the respondent to indicate the direction and intensity of his feelings. The questionnaire employed in the present research used a seven-point scale discussed below. To control and check for the problem of reactive measurement, the author attempted to allow major areas of overlap in the questionnaire and structured interviews.

The questionnaire was developed to include two categories of questions. The first seven items elicited demographic information concerning each respondent. The balance of the questionnaire contained 13 items designed to measure respect for hierarchical authority, attitude toward specialists in other substantive areas, attitude toward specialists with fewer skills, and commitment to organization goals. Four items, which were included, will be used for further research. (See Questionnaire in appendix G)

A seven point scale was the basis for responses to the items in the instrument.

1	2	3	4	5	6	7
Not at all			Fairly often			Very often

The scaled response questionnaire was pretested on a group comparable to the sample in another State agency. The pretest group consisted of engineers in the same Civil Service class levels as those

[13] Larry Kirkhart and W. Lynn Tanner, "Evaluation for Center for Planning and Development of the American Management Association," (Syracuse, New York, Syracuse University, October 1971) p. 38.

in the Department of Highways and Transportation. (N = 50) Each was given the questionnaire on two separate occasions (3 weeks apart). Questionnaires were coded to facilitate comparisons. Correlations were then computed using Spearman's Rho. The rank difference correlations ranged from a low of .57 to a high of .84 and significant beyond .0001 level of confidence with most of the correlations being in the .75+ range. The pretest provided evidence of the reliability of the items. The author, then, proceeded with the instrument as written.

The scaled response questionnaire was the common instrument used in the Design, Construction, and Maintenance divisions, Bureau of Highways. The questionnaires were mailed to all engineers (405) in each of the divisions with a self addressed and stamped envelope enclosed including a cover letter (see appendix H). The respondents were asked to return the questionnaire by a specified date. As a result, 245 questionnaires were returned.

The major problem in statistical analysis of the questionnaire data was to select a statistic that was both comprehensive and powerful. It was concluded that computing the arithmetic mean and standard deviation would be a fruitful way to measure the dependent variables in the first four hypotheses. The data tables 4.6, 4.7, 4.8, and 4.9 found in Chapter IV contain this information. The writer anticipated that as levels of education increased, there would be a decrease in respect for hierarchical authority, specialists in other substantive areas, and specialists with fewer skills. In other words, as the amount of education increased, there would be a decrease in the size of the mean response for each item, controlling for class

levels, except for items 17 and 18. In this case, the means should increase in size if the hypothesis is supported.

Chi-square (X^2) tests and contingency coefficients were computed to determine whether the differences between means were significant. It was also determined that the consistency of direction of the date would also suggest whether the differences in means are random and due to chance or whether the differences are, in fact, real.

The fifth hypothesis concerning the relationship between the specialists' respect for hierarchical authority and their commitment to organizational goals will be tested by computing correlations for the three items which measure the independent variable, respect for hierarchical authority with three items representing the dependent variable commitment to organizational goals. Correlations for each of nine cells will be computed using the Spearman Rank Difference Correlation.

In order to determine whether the sample size was adequate for research purposes three criteria were used, i.e., confidence level, degree of accuracy, and standard deviation. It was decided that a 95% confidence level is desirable, and that the acceptable level of precision would be .125 on a seven point scale. Given the standard deviation of 1.000 derived from the pretest questionnaire, the formula for determining the adequacy of the sample size is shown on the following page.

$$\bar{X} \pm 1.96 \frac{\sigma}{\sqrt{N}} \qquad N = 1.96 \frac{(1.000)}{.125} = 15.7$$

$$.125 = 1.96 \times \frac{\sigma}{\sqrt{N}} \qquad N = 246$$

$$.125 = 1.96 \times \frac{1.000}{\sqrt{N}}$$

(Distribution of two tailed test)[14]

These results suggest that the number of questionnaires returned appear to be an adequate size given the parameters that had been established.

Interview

Unlike questionnaires, interviews require a tremendous investment of time by researchers and respondents. The interview as a research tool has been used extensively especially in social science research. Advantages outweigh the disadvantages in using the interview technique to reinforce the questionnaire. The interview is a much more flexible instrument than the questionnaire since the interviewer has an opportunity to explain to the respondent any ambiguities that may emerge. The interview has the added advantage of permitting the interviewer to follow up leads and thus obtain more data and greater clarity.[15] The interview situation, thus, usually permits much greater depth than the other methods of collecting research data.

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[14]Hubert Blalock, Social Statistics, (New York: McGraw-Hill, 1972).

[15]Bernard S. Phillips, Social Research Strategy and Tactics, (New York: the MacMillan Company, 1966) pp. 120-121.

The free response interview technique has comparative advantages. The interviewer can provide the overall framework for the interview by asking a set number of basic questions. But any follow up questions are based on the responses of the interviewer. The semi-structured interview enables the respondent to describe circumstances and events with a minimal amount of definitional structure provided by the researcher. Theoretically, material produced through this method will be more "reality oriented"; more as the interviewee sees and defines things.

> There is also reason to believe that data gathered through this technique will be more conservative, i.e., less likely to show training effects and that when effects are produced they are more likely to be of meaning and value to the respondent and, hence, the organization . . . the semi-structured interview process is more likely to reveal internalized beliefs held by the respondent.[16]

The writer determined that 10% of the respondents would be an adequate N size for the interviews. All engineers, both respondents and non-respondents were divided in three broad groups, top management (level 15, 16, 18), middle management (12, 13, 14) and non-supervisory specialists (07, 09, 10, 11) by organizational unit. A table of random numbers was used to select by code number the interviewees keeping in mind the general distribution of specialists in the three divisions.

The interviewees consisted of central office as well as district personnel. Each respondent was asked 14 questions. They were assured of their anonymity and urged to be as open and candid as

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[16]Kirkhart and Tanner, op. cit., pp. 37-38.

possible. The author worked from a set of forms which contained the questions and insured that the order of items was always the same. (See appendix I) The questions were structured so that the author could immediately assign their responses to a seven point scale parallel to that used in the questionnaire. After the initial responses, non-directive probes were used to draw out the respondent and insure that he had responded to the question as fully as he could or wished to do. Feedback techniques were used, i.e., "I hear you saying that . . ." or "the major points you are making are . . ." this technique served to elicit additional information and also to correct and clarify impressions the respondent was making.

Because the number of subjects in this analysis is small, it was necessary to compare the results of the scale scores of the interviews with the responses of those engineers who returned the questionnaire. Since the interview is designed to enable the respondent to project his or her own feelings of the situation concerning each of the questions asked, it was anticipated that it would be possible not only to measure the intensity of responses but to elicit additional information which would improve the quality of the data. In order to test for differences in intensity of reaction, a mean was computed for each item used in the interview and was applied to the scale scores. This test even though applied to a small number of respondents still provides a meaningful analysis of the probability of differences between groups.

It should be pointed out that interpretation of these statistics for the interviews should be regarded as somewhat less powerful than the data from the questionnaires. However, with carefully conducted interviews rich data can be obtained from the subject which probably would not be revealed under any other circumstances. This is especially true concerning negative aspects of himself or negative feeling toward others. In a study by Jackson and Rothney[17] and supported by Walsh[18] it was concluded that under favorable conditions the interview tends to yield more complete data and also more data regarding negative aspects of the individual.

In summary, the data collection tools used in this research included a questionnaire supported by individual interviews. The information thus obtained was standardized and quantified, for the most part, at the time it was collected. The statistical methods used facilitated the study of relationships and comparisons between groups.

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[17]Robert M. Jackson and J.W.M. Rothney, "A Comparative Study of the Mailed Questionnaire and the Interview in Follow-Up Studies," Personnel and Guidance Journal, 39: 569-571, March 1961.

[18]W. B. Walsh, "Validity of Self-Report: Another Look," Journal of Counseling Psychology, 15: 180-186, March 1968.

CHAPTER IV

ANALYSIS OF RESULTS

In the last chapter, the variables under investigation were operationalized and the sampling procedure and design of the research were discussed. In this chapter the hypotheses will be tested and the findings discussed. However, before discussing the data as it relates to the hypotheses being tested, some of the preliminary analysis undertaken and its significance for the research will be made clear.

Background of Specialists

The dependent variables used in this research--respect for hierarchical authority, respect for specialists in other substantive areas, respect for specialists with lesser skills, and commitment to organizational goals were measured by means of a questionnaire administered to engineers in the design, construction, and maintenance divisions, Department of State Highways and Transportation. In addition to the questionnaires, interviews were conducted with 30 engineers selected by using a table of random numbers. A sample was drawn from each division in proportion to the total number of engineers employed in that division and representing the various class levels. The interviews lasted approximately 45 minutes and provided a useful supplement to the questionnaire data.

Table 4.1 indicates class level, number of employees in each class and respondents by division. Four hundred and five questionnaires were mailed to engineers in the three divisions with a total response of 245 representing a return rate of 60%. In addition to the statistical technique used to determine adequacy of the sample size i.e., confidence level, degree of accuracy, and standard deviation outlined in Chapter III, three additional variables: age, class level, and geographic location were employed to determine the representativeness of the respondents. It is clear from a sampling of non-respondents that the characteristics are essentially the same between groups as determined by the three variables. A breakdown of employees by class level, explained later in this chapter, indicates the following:

Class Level	% or total employees	% of total respondents
07-09-10-11 (specialists)	45.7	39.2
12-13-14 (middle mgt.)	45.7	51.0
15-16-18 (top mgt.)	8.6	9.8
	100%	100%

A comparison of the percentages of total employees with total respondents shows general similarity in the proportions in each level.

To provide a context for the data to be presented, it seems useful to present information on the backgrounds of the respondents. Table 4.2 provides a comparison of respondents by age, experience, education, and division. The median age category in the three divisions is 41-50 years and median experience category 16-20 years. The educational backgrounds of the engineers reveals that there are a substantially greater proportion of graduate degrees in the design

Table 4.1. Sample size by class level and division.

Class Level	Total No. of Employees in Class		Number of Respondents by Division			Total Respondents	
	No. of Employees in Class	% of Total	Construction	Design	Maintenance	No. of Respondents	% or Total
07	9	2.2	1	2	0	3	1.2
09	42	10.4	10	4	1	15	6.1
10	35	8.6	14	8	0	22	9.0
11	99	24.4	6	44	6	56	22.9
12	118	29.2	48	24	4	76	31.0
13	51	12.6	12	20	4	36	14.7
14	16	4.0	6	6	1	13	5.3
15	23	5.7	5	6	3	14	5.7
16	8	2.0	1	3	3	7	2.9
17	1	.2	0	0	0	0	0
18	3	.7	1	1	1	3	1.2
Total	405	100.0	104	118	23	245	100.0

Table 4.2. Comparison of respondents by age, experience, education and division.

AGE	Construction		Design		Maintenance	
	No. of Resp.	%	No. of Resp.	%	No. of Respondents	%
30 years and less	19	63.3	9	30.0	2	6.7
31-40 years	23	39.0	32	54.2	4	6.8
41-50 years	35	39.4	44	49.4	10	11.2
51-60 years	20	43.7	22	47.7	4	8.6
61-70 years	7	33.3	11	52.4	3	14.3
EXPERIENCE						
0-5 years	11	14.0	12	48.0	2	8.0
6-10 years	15	46.9	15	46.9	2	6.2
11-15 years	12	26.0	32	69.6	2	4.4
16-20 years	23	40.4	24	42.1	10	17.5
21-25 years	24	52.2	19	41.3	3	6.5
26 years and over	19	48.7	16	41.1	4	10.2
EDUCATION						
Less than BS degree	17	50.0	13	38.2	4	11.8
BS degree--Engineering	80	45.5	78	44.3	18	10.2
MA degree--Engineering	1	25.0	3	75.0	0	0
MS degree--Engineering	6	20.0	24	80.0	0	0

division than in either the construction or maintenance divisions. There are also proportionately fewer engineers with something less than a baccalaureate degree in engineering also in that division. The design division is the only organizational unit of the three which contains engineers possessing Ph.D. degrees.[1]

The composition of engineers by sex is not an important variable in this research.[2]

It can be seen from charts found in the preceeding chapter and the detailed class specifications found in appendix F that those specialists in class levels 07 through 11 include engineers from the Engineer Trainee through the journeyman level. Employees in these classes can work at their specialty unencumbered with supervisory, managerial, or administrative responsibilities. Engineers classified at the 12-13-14 levels serve in a supervisory or managerial capacity where a significant amount of their time is devoted to administrative detail. In the design division the 12 level engineer is an assistant squad leader and the squad leader is classified at the 13 level. In

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[1]Statement by Orville Emery, Personnel Officer, Department of Highway and Transportation, Personal interview April 2, 1974.

[2]There are six female engineers in the department, three of whom are assigned to divisions in the sample. The Design division employs two women and the Construction division employs one female office engineer. The Maintenance division has an all male engineering staff. There are no female engineers in supervisory positions. Four women were hired during the past year and two of these employees have since left the department. The department, as a part of their affirmative action program, has made numerous attempts to attract qualified women in the engineering classes without much success. There appears to be keen competition among employers for those few females enrolled in engineering curriculums.

the construction division, the project engineer at the 12 level, who is responsible for the more complex construction projects, supervises junior project engineers. The maintenance engineers at the same level whether in the central office or the district also function in a supervisory capacity. The higher level engineers, 15 through 18 levels, are considered top management in each of the divisions. The division directors have traditionally been viewed as part of top management on a department wide basis. It was necessary, then, to control for class level in order to measure in some reasonable way the variables under consideration. With this in mind, and for purposes of this study the 10 class levels will be collapsed in the following three major categories:

1. Class Levels 07-09-10-11--Specialists
2. Class Levels 12-13-14--Middle Management
3. Class Levels 15-16-18--Top Management

Table 4.3 provides a comparison of respondents engineering specialties in addition to work stations. The engineering specialists in the design division are evenly divided with road engineers predominating in the construction and maintenance divisions. The distribution of the respondents by work station reveals that the construction engineers are fairly evenly divided over the 10 districts which make up the state. The vast majority of construction engineers are assigned to the districts rather than the central office. Conversely, the design engineers are primarily located in the central office although there are a few design squads located in two districts. The maintenance engineers are evenly divided between the districts and the central office.

Table 4.3. Comparison of respondents by engineering specialty and work station.

Engineering Specialty	Construction		Design		Maintenance	
	No. of Resp.	%	No. of Resp.	%	No. of Respondents	%
Bridge	39	37.5	58	49.0	9	42.8
Road	65	62.5	60	51.0	12	57.2
Work Station						
Lansing	7	6.7	110	93.2	11	47.9
District	97	93.3	8	6.8	12	52.1

Table 4.4 compares respondents by age and education while controlling for class level. An inspection indicates class levels 07 through 11 contain the same percentage (16.6%) of advanced degrees as the top administrative engineers (16.6%). For all engineers 72% have bachelors degrees and 14% have advanced degrees. If we were to stop here, there would be a significant void in reviewing the educational backgrounds or degree of skill as defined in this study. How do we explain the 34 engineers or 14% of our sample who possess less than a bachelors degree in engineering? How is this possible when the Civil Service class specifications require either a degree in engineering or registration as a professional engineer?

There are three possible reasons why an employee may be classified as an engineer and not possess a bachelors degree in engineering. Prior to 1951 a great many positions including draftsman were classified as engineers. As a result of upgrading the class

Table 4.4. Comparison of respondents by age, education and class level.

AGE	N	EDUCATION							
		Less Than B.S. Degree		B.S. Degree in Engr.		M.A. Degree		M.S. Degree in Engr.	
		No. of Resp.	%	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%
				SPECIALISTS					
30 yrs. & less	29	0	0	27	93.1	0	0	2	6.9
31-40 yrs. old	30	3	10.0	18	60.0	1	3.4	8	26.7
41-50 yrs. old	19	4	21.1	14	73.6	0	0	1	5.3
51-60 yrs. old	10	5	50.0	5	50.0	0	0	0	0
61-70 yrs. old	8	1	12.5	3	37.5	2	25.0	2	25.0
Total	96	13	13.5	67	69.7	3	3.2	13	13.6
				MIDDLE MANAGEMENT					
30 yrs. & less	0	0	0	0	0	0	0	0	0
31-40 yrs. old	30	0	0	26	86.7	0	0	4	13.3
41-50 yrs. old	61	9	14.8	41	67.2	1	1.6	4	6.4
51-60 yrs. old	26	6	23.1	16	61.5	0	0	4	15.4
61-70 yrs. old	8	5	62.5	2	25.0	0	0	1	12.5
Total	125	20	16.0	91	72.8	1	.8	13	10.4
				TOP MANAGEMENT					
30 yrs. & less	0	0	0	0	0	0	0	0	0
31-40 yrs. old	0	0	0	0	0	0	0	0	0
41-50 yrs. old	9	0	0	8	88.9	0	0	1	11.1
51-60 yrs. old	10	1	10.0	7	70.0	0	0	2	20.0
61-70 yrs. old	5	0	0	4	80.0	0	0	1	20.0
Total	24	1	4.2	19	79.2	0	0	4	16.6

specifications for many of these positions, individuals were "grandfathered" into the system, i.e., continued in engineering classifications even though they did not meet the new educational requirements for the class (BS degree in engineering). Practically all the engineers over 50 years of age fit into this category. Until 10 years ago, the department accepted the passing of the Princeton Graduate Record Examination as a substitute for an engineering degree. A number of employees met the educational requirements in this manner. Finally, registration as a professional engineer has been viewed by the department and Civil Service as meeting the educational requirements even though a bachelors degree is not a mandatory requirement for registration. A number of respondents are registered professional engineers but have not completed a regular 4 year degree program in engineering.[3] A review of the educational backgrounds of these respondents indicate the group is evenly divided between those with a high school education and those with two years of college.

While Table 4.4 compared age and education by class level, it did not indicate the educational backgrounds of respondents in the three divisions. The education summary in Table 4.2 suggests that the design function attracts the vast majority of advanced degrees with construction second and maintenance a distant third.[4]

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[3]Statement by Orville Emery, Personnel Officer, Department of Highway and Transportation, Personal interview April 9, 1974.

[4]How does one explain this phenomena by comparison with the other two divisions? The design of highways and structures is considerably more theoretical and involves the application of engineering principles to a much greater extent. In addition to the functions of

Table 4.5 compares age with experience while controlling for class level. In class levels 07 throuth 11 the concentration of engineers appears in the first two experience intervals 0-5 and 6-10 years with the majority of employees 40 years of age and younger as one might expect. As one ascends the hierarchy, however, employees in the 12 through 14 levels tend to concentrate in the 11 through 25 year experience intervals and the 41 through 60 age groups. For the 15 through 18 levels, 50% of the engineers possess 26 years or more of experience in the department and tend to cluster in the upper age intervals again as one might expect. The respondents, then, for the lower class levels, tend to be younger and with fewer years of experience. Engineers in the supervisory classes 12 through 14 tend to be middle aged with 15 years of experience or more in the department and the administrative engineers in classes 15 through 18 tend to cluster at the upper ends of both the age and experience scales.

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this division, the recruiting practices have played a role. Approximately 15 years ago, the department experienced a severe shortage of engineers at a time when the construction program was accelerating at a rapid pace. To meet this manpower crisis, the residence and citizenship requirements were waived by the Civil Service Commission in order that the department be permitted to appoint foreign students majoring in engineering. As a result of these recruiting efforts, a substantial number of foreign born engineers from India, China, and the Near East were appointed to positions primarily in the design division. With few exceptions, practically all the foreign born students who were appointed possessed masters degrees. At least two of this group had their doctorate in engineering at the time of original appointment. The foreign born engineers tended to concentrate in the design division for two reasons. Since most of the students had their masters degree there seemed to be a trend toward specializing in structural engineering with emphasis on design. Secondly, the nature of the design functions is such that there is little if any public contact as compared to the construction and maintenance operation. Potential communications or language problems were not viewed as a

Table 4.5. Comparison of respondents by age, experience and class level.

AGE	N	EXPERIENCE--YEARS 0-5		6-10		11-15		16-20		21-25		26 +	
		No. of Resp.	%	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%
						SPECIALISTS							
30 yrs. & less	29	18	6.2	11	38.0	0	0	0	0	0	0	0	0
31-40 yrs. old	29	5	17.2	10	34.5	10	34.5	4	13.8	0	0	0	0
41-50 yrs. old	19	0	0	5	26.3	3	15.8	5	26.3	4	21.0	2	10.6
51-60 yrs. old	12	1	8.4	0	0	3	25.0	3	25.0	1	8.4	4	33.4
61-70 yrs. old	7	0	0	4	57.1	1	14.3	1	14.3	0	0	1	14.3
Total	96	24	25.0	30	31.3	17	17.7	13	13.5	5	5.2	7	7.3
						MIDDLE MANAGEMENT							
30 yrs. & less	0	0	0	0	0	0	0	0	0	0	0	0	0
31-40 yrs. old	30	0	0	2	6.7	18	60.0	10	33.3	0	0	0	0
41-50 yrs. old	62	0	0	0	0	7	11.3	24	38.7	28	45.2	3	4.8
51-60 yrs. old	25	0	0	0	0	3	12.0	4	16.0	8	32.0	10	40.0
61-70 yrs. old	8	0	0	0	0	1	12.5	0	0	0	0	7	87.5
Total	125	0	0	2	1.6	29	23.2	38	30.4	36	28.8	20	16.0
						TOP MANAGEMENT							
30 yrs. & less	0	0	0	0	0	0	0	0	0	0	0	0	0
31-40 yrs. old	0	0	0	0	0	0	0	0	0	0	0	0	0
41-50 yrs. old	9	0	0	0	0	1	11.2	4	44.4	4	44.4	0	0
51-60 yrs. old	10	0	0	0	0	0	0	2	20.0	1	10.0	7	70.0
61-70 yrs. old	5	0	0	0	0	0	0	0	0	0	0	5	100.0
Total	24	0	0	0	0	1	4.1	6	25.0	5	20.9	12	50.0

The demographic data outlined above provides the reader with background information in order to better understand the relationships between variables used to test the hypotheses in this research.

In order to determine whether there was a relationship between the dependent and independent variables, an arithmetic mean and standard deviation was computed controlling class levels for those engineers responding to the items designed to measure the independent variable in the first three hypotheses. In other words, the writer was interested in knowing whether an increase in levels of education and training would be reflected in a decrease in the respect for hierarchical authority, engineers in other specialites, and engineers with lesser skills. The mean, as a central value, is used as a basis for comparison of dissimilar universes, i.e., educational backgrounds and class levels.

Results of Survey

Table 4.6 sets forth the responses concerning respect for hierarchical authority. The seven point scale used by the respondents in answering the items and the four educational categories (4x7 matrix) were collapsed to a 3 point scale and 2 educational categories (2x3 matrix). The collapsing was done not to maximize differences but to secure reasonably sized marginals in all cases. In the original 4x7 matrix there was a large number of cells which contained 0 or at best only a few cases. Chi-square tests and contingency coefficients were

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constraint since there would be minimal contact with contractors, suppliers, and others in the industry. In short, interest in structural engineering and language problems were primarily responsible for the foreign born engineers in the design division.

Table 4.6. Arithmetic means and standard deviations for items measuring respect for hierarchical authority.

EDUCATION	N	Item 8		Item 9		Item 10	
				SPECIALISTS			
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	80	1.67	.47	1.40	.49	1.38	.49
Masters Degree	16	1.50	.52	1.25	.45	1.31	.48

EDUCATION	N	Item 8		Item 9		Item 10	
				MIDDLE MANAGEMENT			
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	111	1.86	.36	1.44	.50	1.41	.49
Masters Degree	14	1.78	.41	1.43	.51	1.29	.47

EDUCATION	N	Item 8		Item 9		Item 10	
				TOP MANAGEMENT			
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	20	1.90	.31	1.50	.58	1.65	.49
Masters Degree	4	1.75	.50	1.45	.51	1.50	.58

Item 8. I carry out the directives established by the State Highway Commission and the Director.

Item 9. Higher managements' authority is respected throughout the department.

Item 10. I have confidence and trust in higher management.

Hypothesis: The greater the degree of skill required to perform the functions of a particular position, the less the respect for hierarchical authority.

computed for data in the first four hypotheses. The differences in means were significant with some of the items, however, what is important is the consistency of direction of the data. Without exception, there is a decrease in the size of the means as educational level increases. This is true not only for the "true specialists," i.e., the lower level engineers but surprisingly for the supervisory and administrative engineers as well. The consistency of direction of the data then would suggest that the differences in means are not random and due to chance but that there appear to be real differences between means as level of education increases.

The similarity of the magnitude of the standard deviations in Tables 4.6, 4.7, 4.8, and 4.9 indicates comparable response variance among the several categories of respondents.

In short, as educational levels increase there is a decrease in respect for hierarchical authority, with position in the hierarchy held roughly constant. These conclusions are generally supported by data from the interviews. Typical of the comments from those engineers with advanced degrees are the following: "Policies are not and will not be as effective until engineers are appointed to the Commission to give it proper balance and provide technical input into engineering decisions" or "top management does not wield their authority in a manner designed to generate respect." A final observation suggests that "as political pressures increase in the decision making process there is a natural resistance from engineers especially where engineering decisions are concerned."

The questionnaire and interview data, then, concerning the relationship between levels of education and respect for hierarchical authority appears to support the hypothesis. The higher the level of education the lower the respect for hierarchical authority. The relationships between engineers with different specialties are measured by the four items which appear in Table 4.7. As educational level increases, respect for engineers in other specialties decreases. Again, the significance of the data is the consistency of direction. For items 11 and 12 the means decrease as educational levels increase. For items 17 and 18 the direction is just reversed. As educational levels increase the means should increase. Data in Table 4.7 supports this position. The consistency of direction is uniform for all class levels. The wording of questions 11 and 12 are such that means should decrease as educational levels increase. Conversely for items 17 and 18, the means should increase as educational levels increase if the hypothesis is supported.

Results of the interviews coincide with the questionnaire data. Engineers with advanced degrees felt their specialty required greater skill than other engineering positions in the department. As one engineer put it "we tend to be more theoretical in performing our engineering functions than other engineers." Another suggests "design engineers have to know and apply more basic engineering principles than construction engineers and a whale of a lot more than those 'roadside farmers' in maintenance division." Finally, a project engineer observes that he needed "a broader overall knowledge of basic engineering skills since I must review design plans and occasionally redesign a plan sheet when problems arise."

Table 4.7. Arithmetic mean and standard deviation for items measuring respect for engineers in other specialties.

EDUCATION		Item 11		Item 12		Item 17		Item 18	
					SPECIALISTS				
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	80	1.69	.47	1.46	.50	1.24	.43	1.19	.39
Masters Degree	16	1.63	.50	1.44	.51	1.31	.48	1.63	.50
EDUCATION		Item 11		Item 12		Item 17		Item 18	
					MIDDLE MANAGEMENT				
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	111	1.71	.47	1.45	.50	1.26	.44	1.24	.43
Masters Degree	14	1.67	.47	1.36	.50	1.43	.51	1.29	.47
EDUCATION		Item 11		Item 12		Item 17		Item 18	
					TOP MANAGEMENT				
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	20	1.90	.31	1.70	.47	1.20	.41	1.20	.41
Masters Degree	4	1.75	.50	1.50	.58	1.25	.50	1.25	.50

Item 11. Engineers with specializations different than my own contribute to the effectiveness of the State Highway Program.

Item 12. I really feel that engineers with specializations different than my own are getting things done.

Item 17. I really feel that engineers in my division make a greater contribution to the State Highway Program than engineers in other divisions.

Item 18. I believe my engineering specialty requires greater technical skills than others in the department.

Hypothesis: The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists in other substantive areas.

The data just reviewed tends to support the hypothesis that as educational levels increase there is a decrease in respect for engineers in other specialty areas. Data involving respect for specialists with lesser skills is reported in Table 4.8. The means are inconsistent. While the higher level engineers, supervisory and administrative, indicate lesser respect for engineers with fewer skills among those with advanced degrees, the lower level engineers 07 through 11 report just the opposite. It is difficult to explain these differences in light of the information developed in the survey. In any event, the crucial group are the lower level engineers who represent the "true specialists" in this study.

The interview data also reflects the inconsistencies found in the questionnaire data. When asked whether engineers with a lower class level than the interviewee made a contribution to the effectiveness of the highway program one 11 level engineer with a masters degree responded "very definitely--they are the backbone of the Highway program." Another indicated "you are only as good as the people under you--so they must contribute something to the program." And still another indicated "I feel I make a greater contribution to the program since the lower level engineers are in a learning capacity."

Neither the questionnaire nor interview data support the hypothesis that as educational levels increase there is a decrease in respect for engineers with less skills.

In order for specialists to succeed, they must give up their specialization and enter hierarchical competition according to

Table 4.8. Arithmetic mean and standard deviation for items measuring respect for engineers with fewer skills.

EDUCATION	N	Item 13		Item 14	
		SPECIALISTS			
		$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	80	1.42	.50	1.35	.48
Masters Degree	16	1.63	.50	1.44	.51
EDUCATION	N	Item 13		Item 14	
		MIDDLE MANAGEMENT			
		$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	111	1.72	.45	1.57	.50
Masters Degree	14	1.43	.51	1.43	.51
EDUCATION	N	Item 13		Item 14	
		TOP MANAGEMENT			
		$\bar{X}$	σ	$\bar{X}$	σ
B.S. Degree and Less	20	1.75	.44	1.55	.51
Masters Degree	4	1.50	.58	1.50	.58

Item 13. Engineers with Civil Service class levels lower than my own contribute to the effectiveness of the State Highway Program.

Item 14. I really feel that engineers with Civil Service class levels lower than my own are getting things done.

Hypothesis: The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists with fewer skills.

Thompson.[5] In other words, engineers to succeed must be willing to accept supervisory or managerial positions in which administrative (non-engineering) functions play an increasingly important role. The movement of engineers up the hierarchical ladder is viewed by this writer, then, as being positively associated with engineer's respect for hierarchical authority.

The data in Table 4.9 consists of responses to the three items designed to measure respect for hierarchical authority. The three major groups have been used to differentiate between the true specialist and those who are identified as supervisory or managerial. The seven point scale was employed since the cell size and marginals were acceptable in developing the means for each experience interval. Again, what is important concerning the data in this table is the consistency of direction. Without exception, the means increase in size as one moves up the bureaucratic ladder. The uniformity and consistency of the data suggests that the differences are not random and due to chance but are, in fact, meaningful. As one improves his hierarchical position, then, there appears to be increased respect for hierarchical authority.

Typical of the interview comments made by engineers in the supervisory or managerial classes are the following: "Yes, I feel the policies of the State Highway Commission and Director are effective because policies are generally written by engineers and recommended to the Commission for approval." "Top management has the support of

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[5]Victor Thompson, op. cit.

Table 4.9. Average arithmetic mean and standard deviation for items measuring respect for hierarchical authority.

Hierarchical Success Class Levels	N	Respect for Hierarchical Authority					
		Item 8		Item 9		Item 10	
		$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
07-09-10-11	96	5.51	1.70	4.80	1.51	4.85	1.52
12-13-14	125	6.03	1.18	4.99	1.33	5.00	1.37
15-16-18	24	6.08	1.28	5.21	1.28	5.29	1.65

Item 8. I carry out the directives established by the State Highway Commission and the Director.

Item 9. Higher management's authority is respected throughout the department.

Item 10. I have confidence and trust in higher management.

Hypothesis: The extent to which specialists succeed hierarchically (assumes a generalist or managerial role) is positively associated with their respect for hierarchical authority.

the rank and file engineers since the Director is an engineer as well as the majority of his Bureau Chiefs." Finally a top civil engineer observed "I believe the goals and objectives are reasonable and certainly attainable if there is no raid on restricted highway funds." This individual was obviously referring to the potential threat posed by the mass transit and aeronautics programs in the possible use of restricted gas and weight taxes.

The data appear to indicate a direct and positive relationship between hierarchical success and respect for hierarchical authority.

Finally, it has been hypothesized that the engineer's respect for hierarchical authority is positively associated with his

commitment to organizational goals. In order to determine the relationship, if any, which exists between these two variables, Spearman's Rank Correlation Coefficient was computed for items 8, 9, and 10 representing respect for authority with items 16, 23, and 24 representing organizational goals. Table 4.10 involves a 3x3 matrix which contains nine correlations. The correlations which varied from .44 to .73 were significant beyond the .0001 level of confidence. The correlations also reveal a systematic closeness of degree of relationship between items 8, 9, and 10 with items 16. 23, and 24. This suggests a positive relationship between two conceptually independent variables, in this case respect for authority and commitment to organizational goals. The interview data also suggest a positive relationship between respect for hierarchical authority and commitment to organizational goals. Several engineers who indicated the policies of the State Highway Commission and the Director were very effective suggested that "the goals established by top management are reasonable and attainable providing federal funds are made available for the construction program." Another engineer felt one of the primary goals of the department was "to provide a safe method of transportation for the motoring public." "The department has enjoyed considerable success in this area." A third engineer observed "since we have 'good leaders', the goals and objectives are certainly reasonable."

It would appear, then, from the questionnaire and interview data a positive relationship exists between respect for hierarchical authority and commitment to organizational goals.

Table 4.10. Spearman rank correlation coefficients respect for authority and organizational goals.

RESPECT FOR AUTHORITY		ORGANIZATIONAL GOALS		
	N	Item 16	Item 23	Item 24
Item 8	245	.48	.46	.44
Item 9	245	.57	.57	.52
Item 10	245	.73	.67	.64

Average Correlation = .57
Significant beyond the .0001 level of confidence.

Item 8. I carry out the directives established by the State Highway Commission and the Director.

Item 9. Higher management's authority is respected throughout the department.

Item 10. I have confidence and trust in higher management.

Item 16. I feel loyal to the department and agree with its goals and objectives.

Item 23. I agree with the goals and objectives of the department.

Item 24. I believe the department has realistic goals and objectives and that they are attainable.

Hypothesis: The extent to which specialists respect hierarchical authority is positively associated with their commitment to organizational goals.

Summary

After an attempt to provide the reader with background information on the respondents concerning such variables as age, education, experience, class levels, location of work station, and engineering specialty, attention was given to testing the major hypotheses. It is argued that as the level of education increases there is a decrease in respect for hierarchical authority and specialists in other

substantive areas. It is also argued that as specialists become supervisors and managers there is a positive association with respect for hierarchical authority. Finally, specialists' respect for hierarchical authority is positively associated with commitment to organizational goals.

The data reported in this chapter tend to support these conclusions. The data however, did not support the argument that as the level of education increases there is a decrease in respect for specialists with fewer skills. What is significant within the data for the first four hypotheses is the consistency of direction of the means. It is unlikely that the difference in means is due to chance, rather it would appear that there are significant differences between the variables. The implications of these observations and their plausibility are discussed in the final chapter.

CHAPTER V

DILEMMAS OF FORMAL ORGANIZATION

In this chapter the significance of the findings from the research must be fitted into the larger body of evidence from which it emerged. Hopefully this involves modifying as well as extending some of the prevailing assumptions and ideas which have grown out of the literature in the field. It is, then, the intent of the author to review and interpret the findings of this research and its significance for the larger body of evidence concerned with one aspect of organization theory.

The Role of Specialists in Organizations

There have been few general theoretical statements regarding technology in large scale organizations. The two which have the most relevance for the material discussed in this research are found in the works of Thompson, Kornhauser, and Hagstrom.[1] The research conducted by these authors, has been very influential in stimulating interest in this area. The authors discuss the impact of specialization on large scale organizations with special emphasis on the relations between specialists and the bureaucracy. Thompson argues there

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[1]Victor Thompson, op. cit.; William Kornhauser and Warren Hagstrom, op. cit.

is a growing gap between the right to decide, which is authority, and the power to decide which is specialized ability. He insists the gap is growing because technological change, with a resulting increase in specialization, occurs at a faster rate than the change in cultural definitions of hierarchical roles. This situation produces what he views as tensions, and strains the willingness to cooperate. In short, "the most symptomatic characteristic of modern bureaucracy is the growing imbalance between ability and authority."[2] Unfortunately, the general theorizing by Thompson is not supported with empirical findings. Kornhauser and Hagstrom agree basically with Thompson and identify the strains between professions and organizations in four areas: goals, controls, incentives, and influence.[3] Herbert Shepard adding to their research suggests that specialist groups tend to foster narrow interests which make it difficult to cross specialist lines and cooperate with other kinds of specialists.[4] The work of Thompson, Kornhauser and Hagstrom has been previously concerned with the relationships between specialists and the bureaucracy. The conflict between specialization and hierarchy and potential solutions to this dilemma have occupied their attention. Thompson would argue that while authority is necessary, it must be disciplined by reason and reality. By reason and reality he means accommodating the basic concerns of the specialist. In organizing, in dividing up the work and

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[2]Victor Thompson, op. cit.

[3]William Kornhauser and Warren Hagstrom, op. cit.

[4]Herbert Shepard, op. cit.

delegating jurisdictions, authority must submit to the needs of specialization. "Then men will become adults, and the grown up kindergartens through which we now conduct our affairs will pass unregretted from the scene."[5] Kornhauser and Hagstrom observe that the introduction of former specialists into managerial posts leads to a better relationship between those with authority and ability.[6]

In order to determine the relationship between specialists and the hierarchy, this research project involved a study of design, construction, and maintenance engineers, on the educational backgrounds of the respondents and their attitude regarding hierarchical authority, other specialists, and specialists with lesser skills. The following five hypotheses provided the framework for this study:

1. The greater the degree of skill required to perform the functions of a particular position, the less the respect for hierarchical authority.

2. The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists in other substantive areas.

3. The greater the degree of skill required to perform the functions of a particular position, the less the respect for specialists with fewer skills.

4. The extent to which specialists succeed hierarchically, (assumes a generalist or managerial role) is positively associated with his respect for hierarchical authority.

5. The extent to which specialists respect hierarchical authority is positively associated with their commitment to organizational goals.

The questionnaire and interview data reviewed in the preceeding chapter

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[5]Victor Thompson, op. cit.

[6]William Kornhauser and Warren O. Hagstrom, op. cit.

tends to support the notion that as educational levels increase there is a decrease in respect for hierarchical authority and specialists in other substantive areas. This was true not only for those engineers in class levels 07 through 11 but for the supervisory and managerial levels as well. Class levels were controlled for in this research since it was felt that supervisory and administrative engineers would respond differently than the "true specialist." This was not the case however, as indicated by the data tables in Chapter IV. The relationship between degree of skill and respect for specialists with lesser skills was not clearly established by the data. For engineers in the lower class levels, respect increased as educational levels increased. The reverse was true for the supervisory and managerial engineers. A partial explanation may be found in the nature of the work groups. In the design division for example, engineers are assigned to squads or as Kornhauser suggests, task groups. The task group exists to solve particular problems. The groups are heterogeneous and may include different levels of specialists. Because each of the specialists is concerned with only a part of the total problem, cooperative relations are necessary. As a case in point, senior design engineers will determine the basic design of a bridge. Once the basic design has been developed, there are many subsidiary designs which have to be produced to make a final product. These are of lesser importance requiring less engineering competence. In designing a bridge, initial design considerations may involve determining the length of the basic structure, whether it is to be a suspension or cantilever bridge, and other overall design characteristics. Once this is done, designs on

many subparts of the bridge must be carried out: girders, plates used to hold beams and girders together, the form and number of rivets and bolts, etc. There is a succession of engineering tasks, each subsequent one constrained by the preceding one, while allowing for less originality and competence, are essential to the proper completion of a set of plans. The engineer trainees and junior engineers perform those functions which do not require a high degree of skill. In spite of the various skills usually found in task groups, there appears to be an esprit de corps and camaraderie which is not found in other specialist groups.[7]

For this reason, there is the possibility that journeymen engineers may look favorably on lower level engineers because of the role they play in the task groups.

Thompson, Kornhauser, Moore, Marcson, Mainzer and others agree that specialists in order to "succeed" must leave their field of specialization and enter management. In other words, success, which is defined as an improvement in hierarchical rank, is awarded to those who can perform well as a manager. Generally, those specialists who are selected for administrative jobs are likely to be oriented toward the bureaucratic norms of the organization rather than colleague norms of the professional group. Marcson, in his study of a nationwide firm confirms this view that engineers at the management level are more "company oriented than professionally oriented."[8]

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[7]Herbert A. Shephard, op. cit.

[8]Simon Marcson, op. cit., pp. 30-33.

This research which controlled for class level in order to distinguish between supervisory and non-supervisory engineers supports the premise that specialists who are promoted to supervisory or managerial positions have a greater degree of respect for hierarchical authority than specialists or those at the lower levels. Again, the data indicates that as the specialist moves up the hierarchical ladder, there is a corresponding increase in respect for hierarchical authority. It has been suggested that the goals of an organization and the objectives it sets for the professional group are not the same as those for a profession.[9] Management's orientation in developing a product or providing a service may be expected to clash with the specialists' goals of the pursuit of technical knowledge. Not only may the goals differ significantly but the way of achieving them may also differ. Specialists would seek structural autonomy whereas managers would emphasize an integrated structure for better communications and coordination. While this may be true in some organizational contexts, there are other organizational environments which tend to reduce tension and possible conflict. La Porte in his research on industrial organizations concludes:

> The dependence of managers on scientists for achieving technical goals leads to a modification of traditional bureaucratic devices in operating large organizations. Introduction of many former scientists into managerial posts leads to a high degree of managerial understanding of the motives, goals, and rewards of scientists.[10]

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[9]William Kornhauser and Warren Hagstrom, op. cit., p. 12.

[10]Todd R. LaPorte, "Conditions of Strain and Accommodation in Industrial Research Organizations," Administrative Science Quarterly, June, 1965, 10: 21-38.

Organizational responses to professional values according to LaPorte, would tend to change the organization in such a way as to enable specialists to satisfy many important professional values; not simply by increasing traditional rewards, but by a movement away from relatively strict control of subordinates toward freedom of operation and protection from organizational uncertainties.

The Director, Department of Highways and Transportation, as well as the majority of bureau chiefs are former specialists within the organization. The administrative engineers may be better able to understand some of the needs of the engineers ~~than a non-engineer~~. The data in Table 4.10 in Chapter IV supports the argument that as the specialist's respect for hierarchical authority increases there is a positive association with his commitment to organizational goals.

To summarize, the results of this research tend to support the observation that the hypotheses have a directness as well as a relationship between the dependent variables, i.e., respect for hierarchical authority, and specialists in other substantive areas, with the independent variable, degree of skill. These conclusions generally agree with the research efforts of Kornhauser, Corwin, Shephard and others who have conducted empirical studies in this area. It may also be concluded that a positive relationship exists between the success of the specialist as the independent variable with his respect for hierarchical authority as the dependent variable. At this point, a critical question may be raised: In actual operation, which is the antecedent or "causal" variable, respect for hierarchical authority or commitment to organizational goals? This is reminiscent of the

chicken and the egg argument--one which does not lend itself to an easy answer. It has been the writer's experience in large scale organizations that both may be the causal variable under different circumstances. Finally, the specialist's respect for hierarchical authority, the independent variable, tends to be positively associated with his commitment to organizational goals, the dependent variable.

Comments on Methodology

This research would not be complete without some comment on the methodology employed in this study. Because of this author's interest in gathering demographic data as well as responses to the substantive questions from as large a group as possible, the questionnaire was selected as the primary tool for data collection with the interview used to provide complementary information. Questionnaires were distributed to 405 engineers in three divisions of the department. Responses were received from 245 employees or 60% of the total universe. Even though the instrument was carefully pretested in another state agency utilizing engineers employed at the same class levels, questions surfaced during the interviews which suggests that the wording of some questions may have influenced the respondent in a direction different from that which was intended. Two terms used in the questionnaire, i.e., directives and goals, were not well understood by some of the lower level engineers even though the majority of them were college graduates!

The cover letter which accompanied the questionnaire requested that the instrument be returned by January. Five weeks later the

documents were still trickling in. The question immediately arose whether the non-respondents came randomly from the population or represented a biased sampling, that is, are those people who did not respond to the questionnaire in some measureable way different from those who did respond. As statistics reported in the previous chapter suggested, the number of questionnaires returned appeared to be satisfactory. Three additional variables were employed, however, to support these findings. Age, class level and geographic location were determined for the non-respondents and compared with data in the questionnaire. After a laborious process of developing this information for the non-respondent, a comparison of the results indicated the characteristics were essentially the same for the two groups. In short, a substantial effort was expended to insure the representiveness of the respondents.

Finally, the author was faced with a dilemma--to increase the number of items and consequently the length of the questionnaire or to keep it brief hoping for a greater return rate. A decision was made to use a brief instrument. Experience with the interviews indicates the author did not get a completely true picture, in certain instances, of opinions and feelings on certain items in the questionnaire. Again, those questions dealing with the directives established by the Commission and Director and those questions dealing with department goals caused some difficulty.

Interviews were conducted with 30 engineers in the three divisions selected by using a table of random numbers keeping in mind the proportion of engineers in each division and their class levels.

The sample included both those engineers who returned the questionnaire and those who did not. Without exception, every engineer contacted was cooperative and helpful in providing the requested information. The interviews were successful from another point of view. It was possible, for example, to make full use of the responses of the subject to alter the interview situation. The interviewees provided more data with greater clarity than would have been otherwise possible. In addition, information was provided this researcher that would simply not have been available under any other circumstance. The reason why such information may be difficult to obtain is that it usually concerns negative aspects of the self or negative feelings toward others. Respondents are not likely to reveal this type of information about themselves on a questionnaire and will only reveal it in an interview situation if they have been made to feel comfortable by the interviewer.

This author recognizes some of the disadvantages of interviews as a data collection device: subjectivity and possible bias, training required to conduct interviews, time constraints in conducting interivews, and potential costs. In spite of these constraints, however, the author considers the interview an excellent tool to complement the primary selection instrument--the questionnaire. The strength of one method tends to reinforce the area of weakness of the other. This discussion suggests, then, that positive experiences with certain techniques tends to focus attention on these techniques for use in similar research efforts.

Suggestions for Future Research

The conclusions, based on the sizeable literature in the field in addition to this modest effort, has established the fact that strains and tensions do exist between the specialist, with his own set of values and the bureaucrat who more than likely will have a different set of values. The organization pressures on specialists' values has manifested itself at a number of different pressure points including goals, controls, incentives and influence. The values of the specialist, for example, suggest that he must have a degree of freedom to work on problems that interest him and to follow leads as they emerge from his work, if he is to make a maximum contribution to his profession. Bureaucracies, on the other hand, have generally curtailed this freedom in work in order to increase the production of a good or service, or for the efficient coordination of diverse activities. It is suggested that research be conducted with a pilot project exploring the possibilities of the organization accommodating specialists by inviting them to develop projects, present them to management for approval and allot a small amount of free time for research of the specialists' own choosing. It is also suggested that the specialists be encouraged to publish the results of their research efforts, again, in order to achieve recognition and contribute, in a scholarly way, to the literature in the field. This research effort, if successful, may contribute in a small way toward mitigating the strain not only between specialist and organizational requirements but between other specialists as well. Since specialists tend to compete with one another for professional achievement and recognition, this approach

may prove fruitful. It has been suggested that the introduction of former specialists into managerial ranks leads to a high degree of managerial understanding of the motives, goals, and rewards of specialists. This may be the case in the subject agency. Further research is recommended in this area to determine whether professional values may be more nearly realized and whether the specialist-turned-manager would provide the stabilizing elements and modification of the organization to respond to the requirements of technical innovation.

At least one student of organization has developed a description of the principles of organizational self-renewal, the Sponsorship Theory of Organization Change, and an experimental Research and Development methodology for producing more effective organizations.[11] One vehicle which has been proposed to bring about organizational renewal is a Learning and Knowledge Building Station. Through this mechanism, organizational actors and university representatives can come together to share their expertise in resolving organizational problems. This author would suggest exploring the possibility of bringing together the university community and the organization specialists to develop research and development projects within the framework of this model aimed at ameliorating the tensions and strains which have been identified in this study.

During the course of this research, it was indicated by one of the respondents that policy in the subject department was really not developed by top management or the Commission but was instead

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[11]Christopher Sower, A Michigan State Proposal for Funding by the Research and Development Incentives Program of the National Science Foundation, April, 1973, p. 1.

approved by them. He insisted that engineers develop policy and recommend them to higher authority for approval. Without verifying the accuracy of this observation, it does suggest the following questions:

1. Should the specialist influence policy?
2. If the specialist should influence policy, how should he communicate his ideas organizationally?
3. How much and through what means should the specialists influence policy?
4. Despite the best of intentions on all sides, how is the operating ethic of any specialty to be somehow accommodated to the ethics of other specialties and/or to the ethics of hierarchical authority?

Most of the empirical work conducted with the specialist--hierarchical authority dichotomy have implications for practitioners concerned with administration of complex organizational systems. Increasingly, modern organizations are being expected to cope with heterogeneous environments that are both highly dynamic and quite stable under different circumstances. While the advances of science are increasing the tempo of change in some subsystems, the requirements for regularity and predictability in peoples' relationship with each other remain in others. This continually increases the needs for specialization in organizations; yet the requirements for integration by the hierarchy to achieve a unified effort are at least as great as ever. The findings of this and other research indicate that, other things being equal, specialization and integration are essentially antagonistic, and that one can be obtained only at the expense of the other. Most administrators are very familiar with this issue. They are constantly struggling with the difficulty of reconciling the need for specialization with the need for coordination of effort. Some clues have been provided which

suggest conditions that seem able to make it possible to achieve a high degree of specialization and a high degree of coordination simultaneously. These clues, in combination with an emerging methodological capacity to quantify the variables under consideration may provide concrete direction for the deliberate design of organizations that can cope more effectively with the turbulent environment that science and technology are creating.

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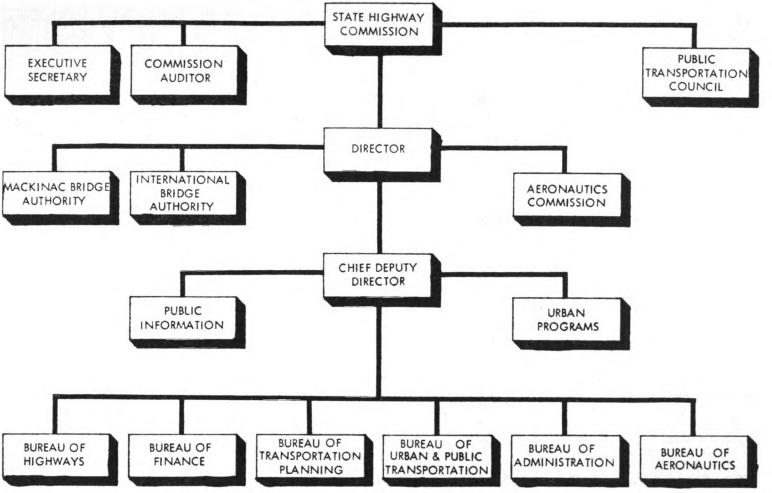
APPENDIX A

ORGANIZATION CHART--DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION



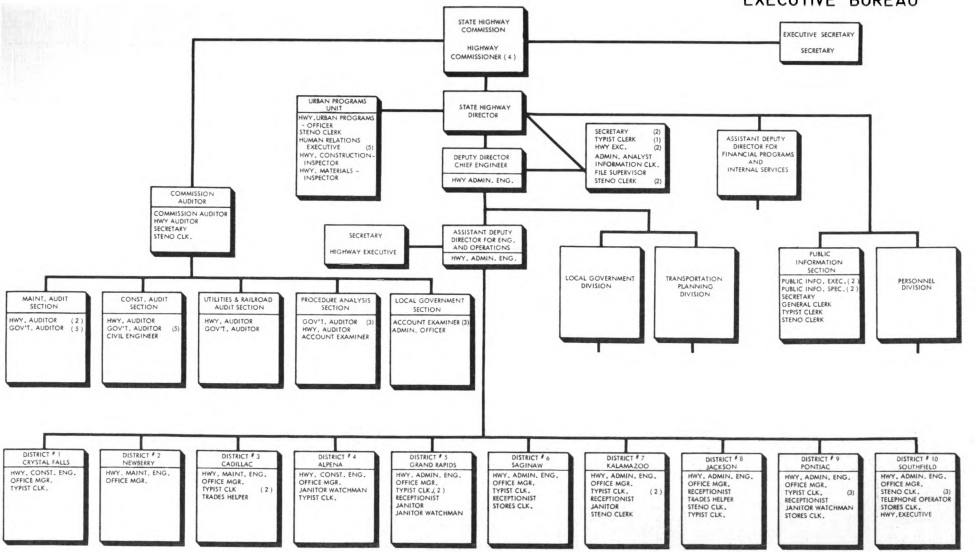
MICHIGAN DEPARTMENT OF STATE HIGHWAYS & TRANSPORTATION

MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION
ORGANIZATION MANUAL
EFFECTIVE DATE JULY 1973
REVISED NOV. 2, 1973

APPENDIX B

DISTRICT ORGANIZATION CHART

EXECUTIVE BUREAU



MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
EXECUTIVE BUREAU ORGANIZATION CHART
EFFECTIVE DATE : JANUARY , 1971

APPENDIX C

ORGANIZATION CHART--DESIGN DIVISION

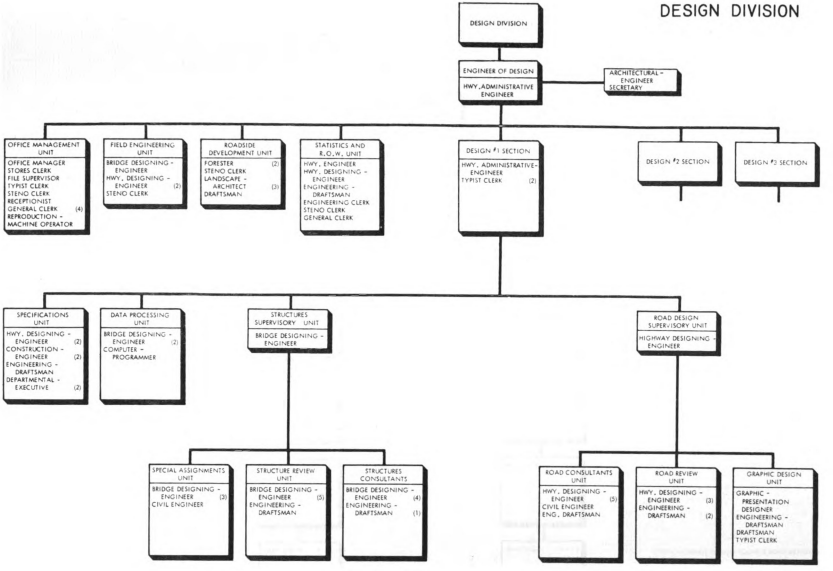
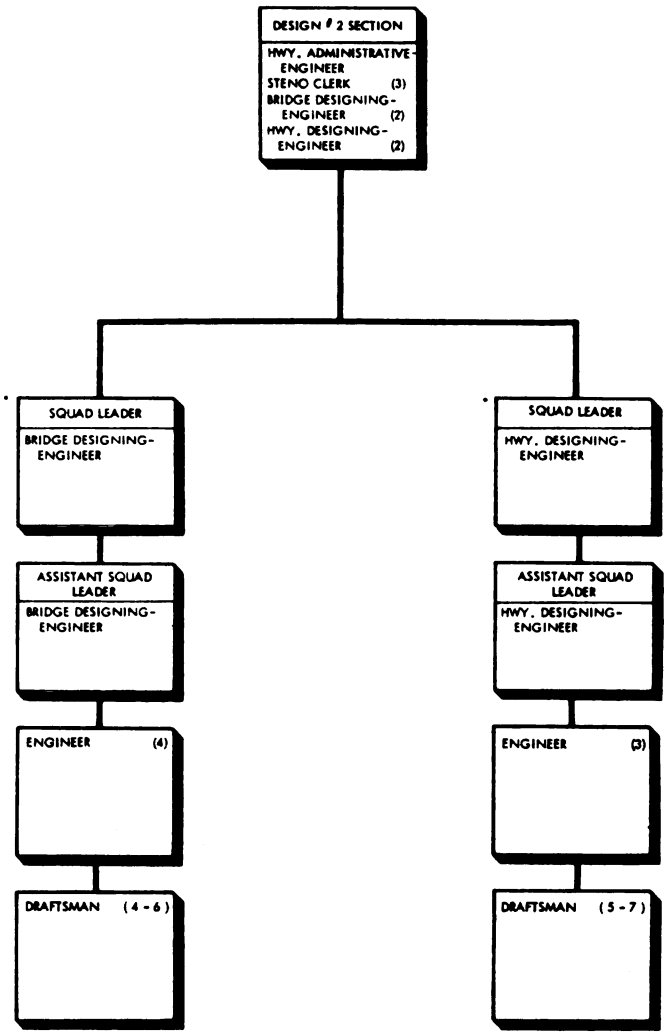


Chart 15

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
DESIGN DIVISION ORGANIZATION CHART
EFFECTIVE DATE : JANUARY, 1971

DESIGN DIVISION

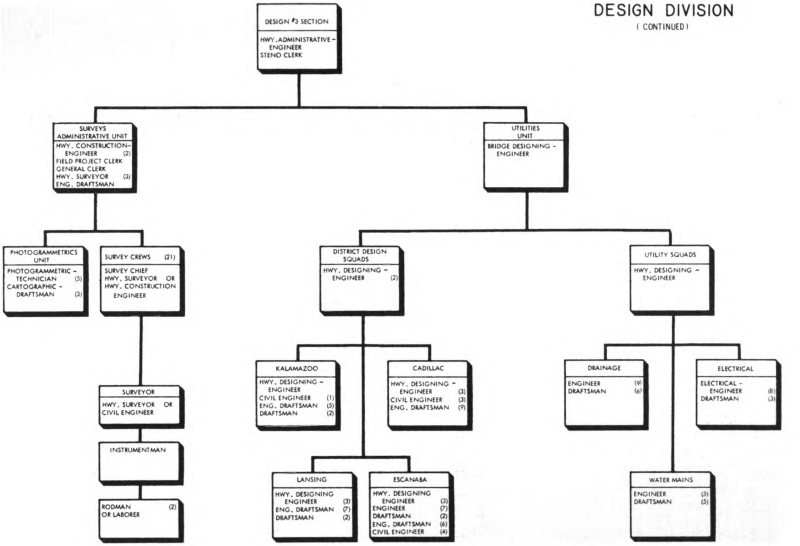
(CONTINUED)



* TYPICAL BRIDGE DESIGN SQUAD & ROAD DESIGN SQUAD

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATIONAL MANUAL
DESIGN DIVISION ORGANIZATION CHART
EFFECTIVE DATE : JANUARY , 1971

Chart 17



MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
DESIGN DIVISION ORGANIZATION CHART
EFFECTIVE DATE : JANUARY , 1971

Chart 19

APPENDIX D

ORGANIZATION CHART--CONSTRUCTION DIVISION

CONSTRUCTION DIVISION

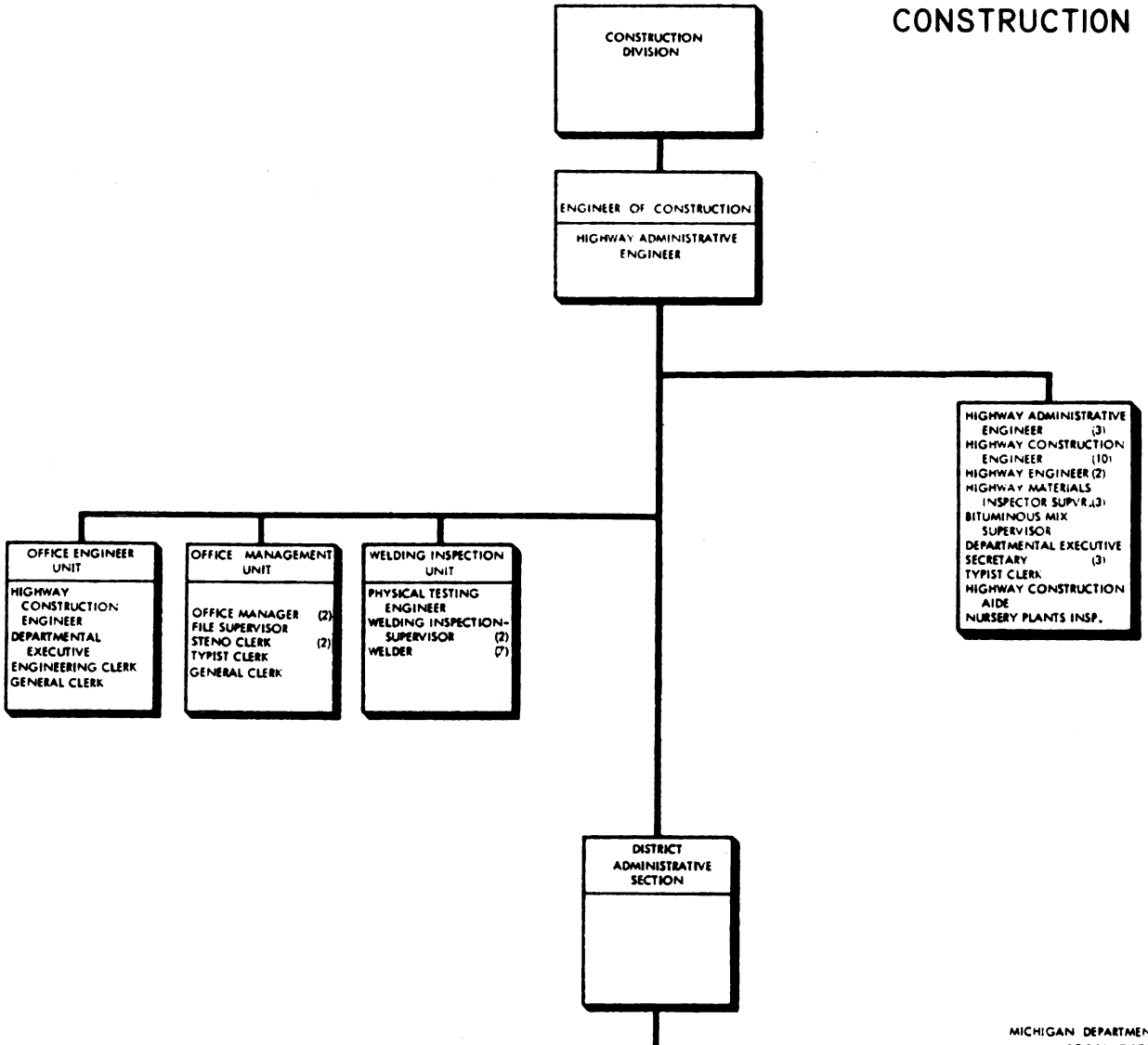


Chart 31

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
CONSTRUCTION DIVISION ORGANIZATION CHART
EFFECTIVE DATE: JANUARY, 1971

CONSTRUCTION DIVISION

CONTINUED

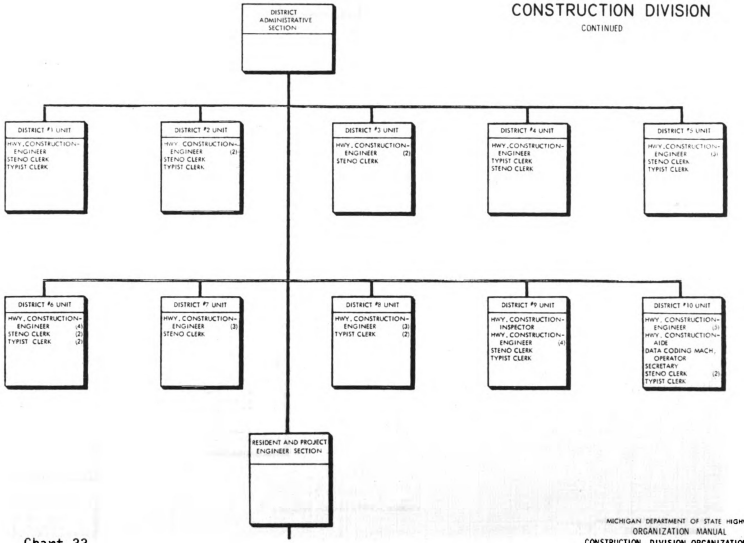


Chart 33

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
CONSTRUCTION DIVISION ORGANIZATION
EFFECTIVE DATE: JANUARY, 1971

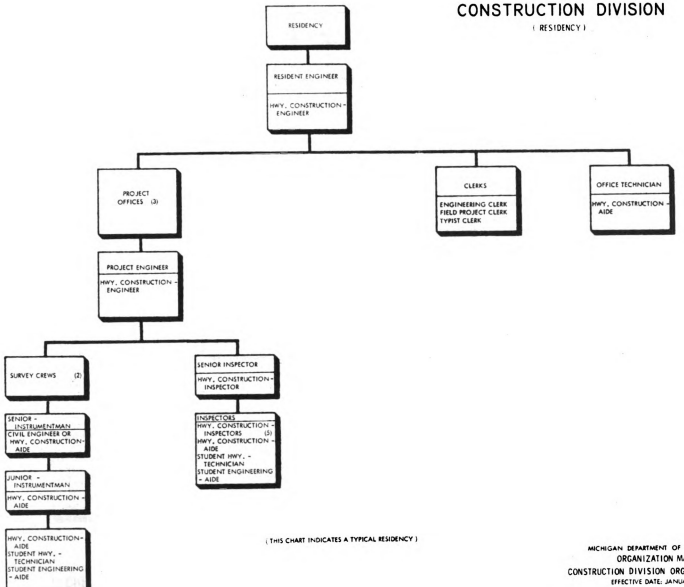
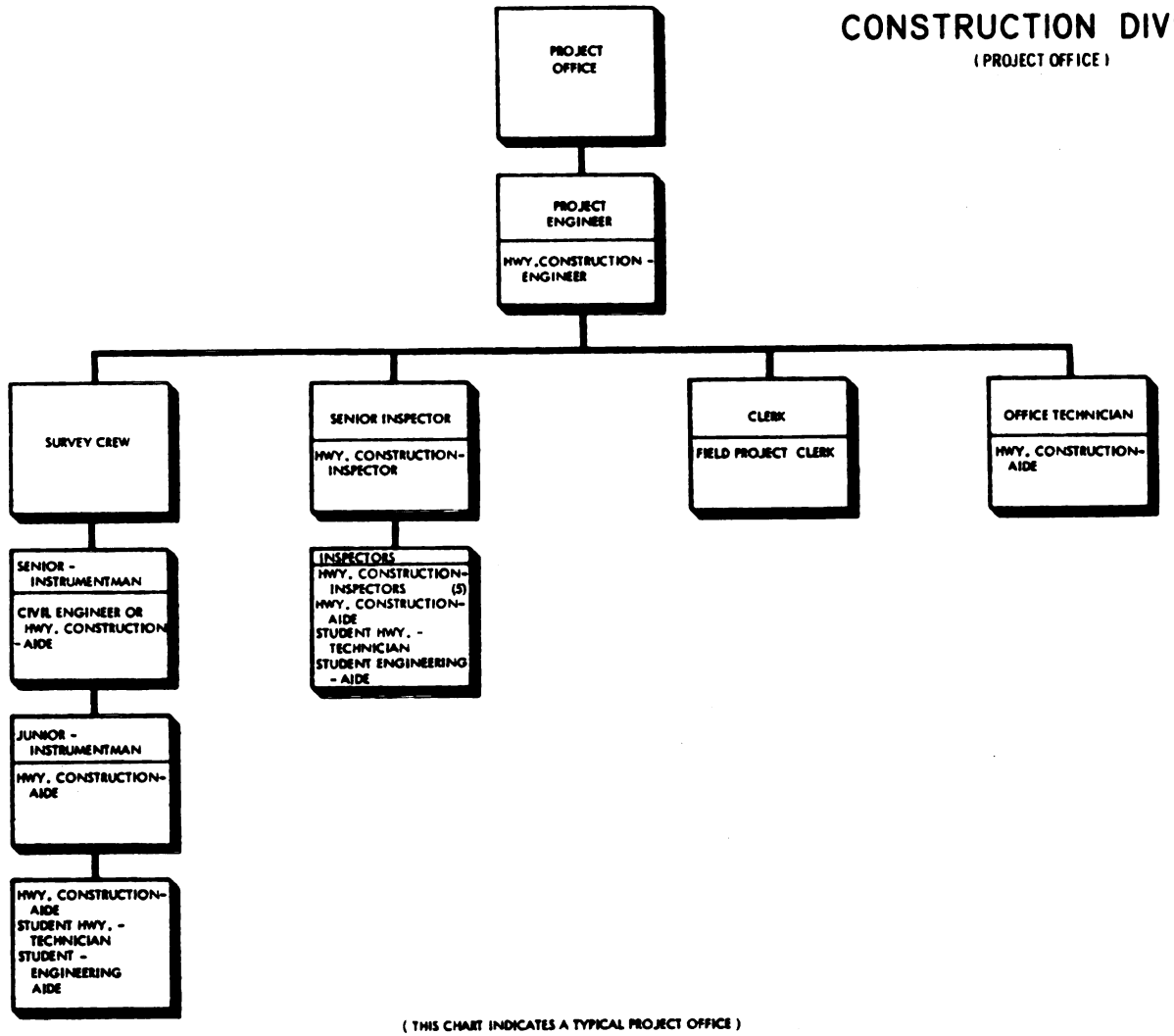

CONSTRUCTION DIVISION
(RESIDENCY)
RESIDENCY
RESIDENT ENGINEER
HWY. CONSTRUCTION - ENGINEER
PROJECT OFFICES (3)
CLERKS
ENGINEERING CLERK
FIELD PROJECT CLERK
TYPIST CLERK
OFFICE TECHNICIAN
HWY. CONSTRUCTION - AIDE
PROJECT ENGINEER
HWY. CONSTRUCTION - ENGINEER
SURVEY CREWS (2)
SENIOR - INSTRUMENTMAN
CIVIL ENGINEER OR HWY. CONSTRUCTION - AIDE
JUNIOR - INSTRUMENTMAN
HWY. CONSTRUCTION - AIDE
HWY. CONSTRUCTION - AIDE
STUDENT HWY. - TECHNICIAN
STUDENT ENGINEERING - AIDE
SENIOR INSPECTOR
HWY. CONSTRUCTION - INSPECTOR
INSPECTORS
HWY. CONSTRUCTION - INSPECTORS (3)
HWY. CONSTRUCTION - AIDE
STUDENT HWY. - TECHNICIAN
STUDENT ENGINEERING - AIDE
(THIS CHART INDICATES A TYPICAL RESIDENCY)
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
CONSTRUCTION DIVISION ORGANIZATION CHART
EFFECTIVE DATE: JANUARY, 1971

Chart 35

CONSTRUCTION DIVISION

(PROJECT OFFICE)



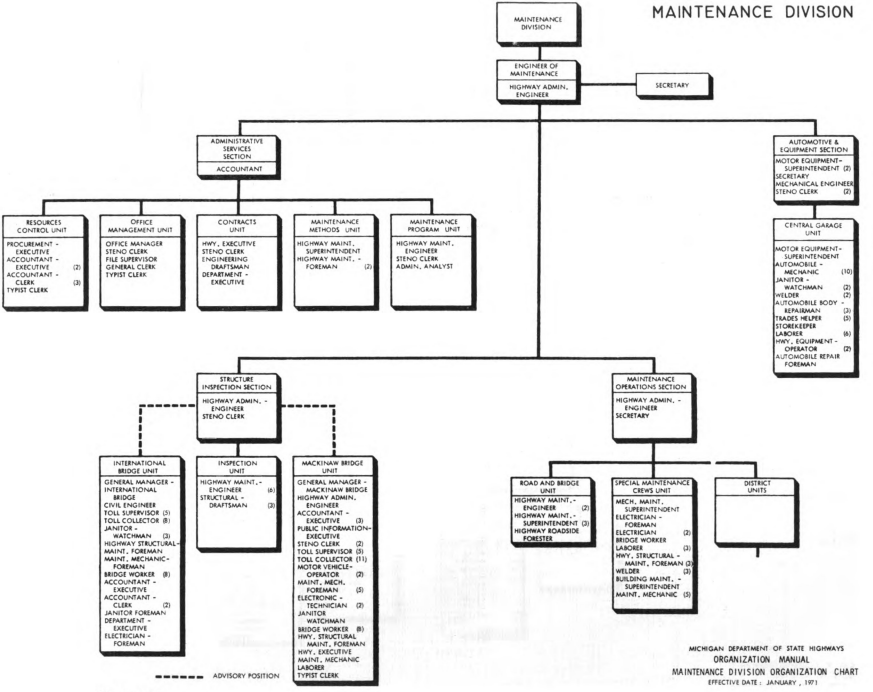
(THIS CHART INDICATES A TYPICAL PROJECT OFFICE)

Chart 37

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
CONSTRUCTION DIVISION ORGANIZATION CHART
EFFECTIVE DATE : JANUARY , 1971

APPENDIX E

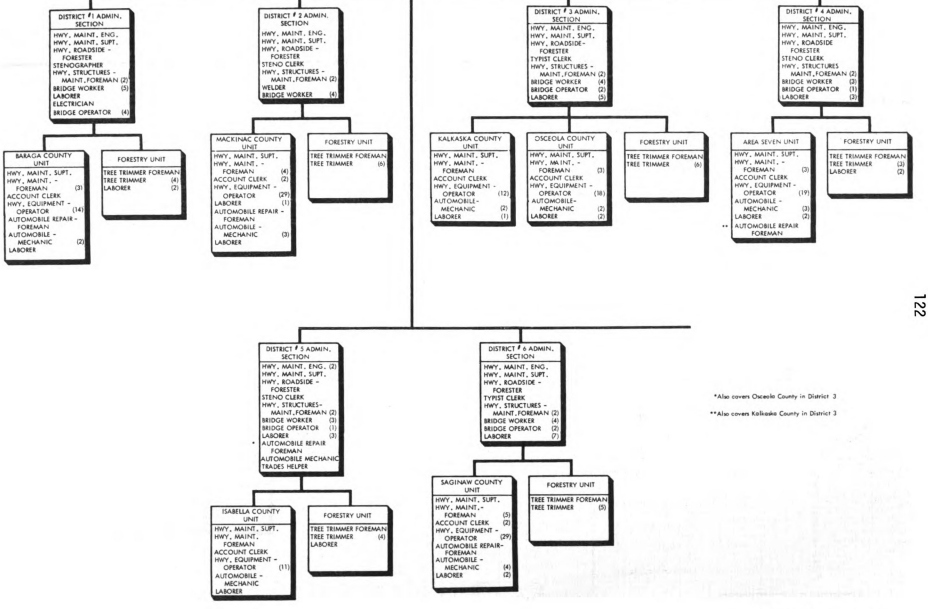
ORGANIZATION CHART--MAINTENANCE DIVISION



MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
MAINTENANCE DIVISION ORGANIZATION CHART
EFFECTIVE DATE: JANUARY, 1971

Chart 39

MAINTENANCE DIVISION
CONTINUED



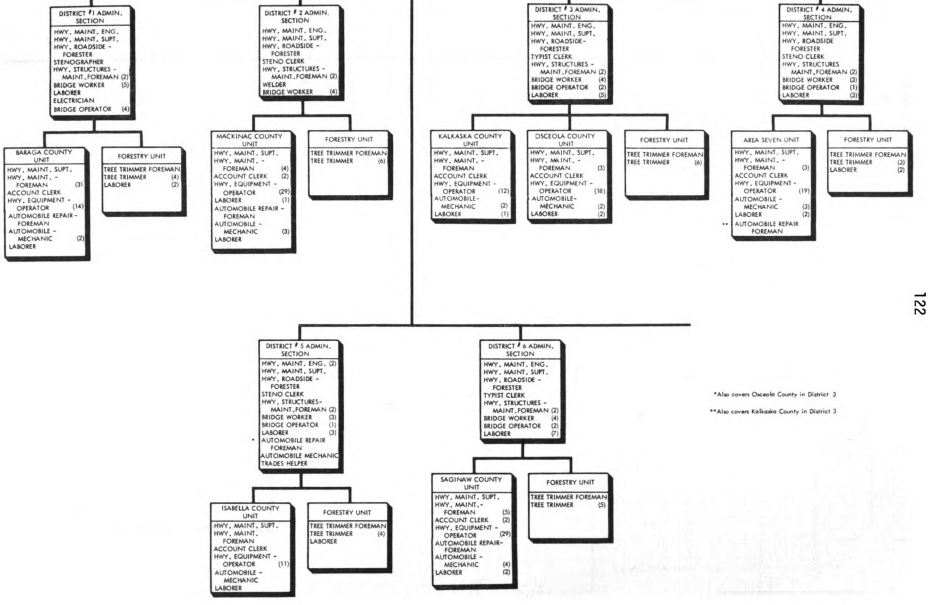
*Also covers Osceola County in District 3

**Also covers Kalkaska County in District 3

Chart 41

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
MAINTENANCE DIVISION ORGANIZATION CHART
EFFECTIVE DATE: JANUARY, 1971

MAINTENANCE DIVISION
CONTINUED



*Also covers Osceola County in District 3

**Also covers Kalkaska County in District 3

Chart 41

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
MAINTENANCE DIVISION ORGANIZATION CHART
EFFECTIVE DATE: JANUARY, 1971

MAINTENANCE DIVISION

CONTINUED

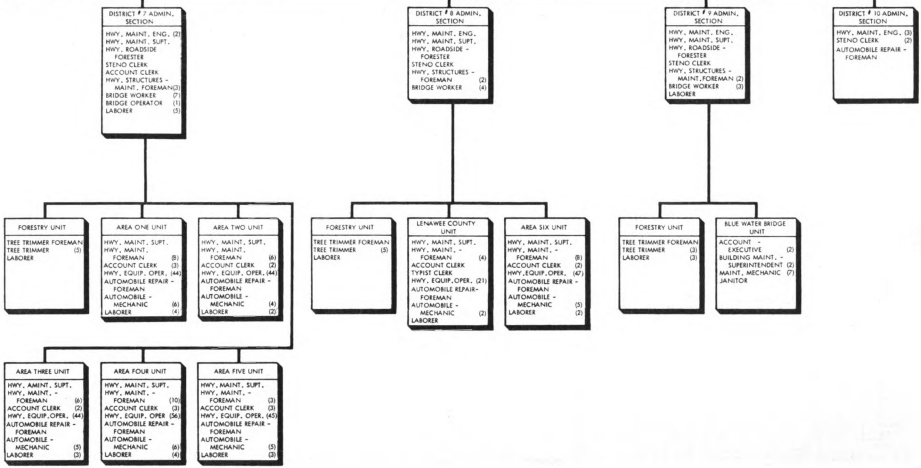


Chart 42

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
ORGANIZATION MANUAL
MAINTENANCE DIVISION ORGANIZATION CHART
EFFECTIVE DATE : JANUARY , 1971

APPENDIX F

DEPARTMENT OF CIVIL SERVICE--

CLASS SPECIFICATIONS

MICHIGAN DEPARTMENT OF CIVIL SERVICE

CIVIL ENGINEER 07

112107 Rev. 4/73

NATURE OF WORK

This is the beginning level, professional trainee in engineering, in such areas as survey, construction, design, maintenance, planning, route location, traffic testing or research. Technical work is performed under close supervision. Field and laboratory work is reviewed by professional supervisors who confer with the employee on problems and review conclusions and reports. The employee exercises limited judgement in carrying out his duties. Possible errors in judgement or performance of work would have some consequence. The employee is not responsible for the supervision of other employees.

After a period of satisfactory training and experience in this class, the employee will be promoted to the class, Civil Engineer 09. Should he fail to meet the requirements for promotion, he will be separated.

EXAMPLES OF WORK

In a training capacity with increasing responsibility for independent work, observes and/or performs the following:

Serves as a senior instrumentman on construction projects of average to complex with immediate responsibility for the less difficult projects; inspects the work of contractors, interprets contracts, specifications and plans; checks and supervises the work of staking parties and inspectors.

Serves as chief of a survey, in the absence of supervisor, or as senior instrumentman on complex construction or survey projects.

Assists a project engineer in supervising the construction of more complex bridges and grade separations; checks forms and structural parts and inspects methods; appraises the progress and workmanship of contractors and prepares construction progress reports.

Designs and prepares preliminary and final plans for highways, bridges, drainage structures, watermains, and miscellaneous highway facilities.

Makes investigations, analyses and summaries of traffic information and economic facts for the completion of studies for highway planning.

Makes studies and analyses for the selection of highway routes.

Assists a highway traffic engineer in an area of the state in investigating routes for traffic adequacy or safety; or in the central office, analyzes traffic data and formulates traffic estimates for the operational improvement of the highway system.

Serves as a materials inspector in the field; visits plants and inspects the work and reports of aggregate and gravel plant inspectors and the samples and processes of the plants; advises inspectors as to mix problems and proper performance of plant tests.

Analyzes soils visually and by testing to determine suitability of highway construction.

Performs physical experiments on highway materials; assists in developing laboratory tests and apparatus to complete studies; conducts field investigations and laboratory experiments, in the laboratory.

Prepares land descriptions on the basis of maps, blueprints, survey notes, title searches, abstracts, and field inspections.

KNOWLEDGES, SKILLS AND ABILITIES

Some knowledge of mathematics and mathematical tables used in engineering work.

Some knowledge of the principles of chemistry, physics and electricity.

Some knowledge of engineering design and related drafting practices.

Some knowledge of strength and characteristics of construction materials.

Some knowledge of the principles of mechanics, hydraulics and structures.

Some knowledge of the types and uses of surveying instruments.

Ability to use surveying instruments.

Ability to perform engineering computations.

Ability to prepare sketches, maps and engineering drawings

Ability to read and interpret engineering plans and specifications.

EDUCATION AND EXPERIENCE

Knowledges and skills typically acquired through completion of a bachelor's degree in civil engineering.

SP:cs

MICHIGAN DEPARTMENT OF CIVIL SERVICE

CIVIL ENGINEER 09

7112109 Rev. 4/73

NATURE OF WORK

This is the intermediate level of professional engineering work. The employee operates with increasing responsibility in such areas as survey, construction, design, maintenance, planning, route location, traffic testing or research. Technical work is performed under close supervision. Work is reviewed by professional supervisors who confer with the employee on problems and review conclusions and reports. The employee exercises limited judgement in carrying out his duties. Possible errors in judgement or performance of work would have some consequence. The employee may be responsible for the supervision of aides.

EXAMPLES OF WORK

Performs as a developing engineer in one or more of the following areas:

Serves as a senior instrumentman on construction projects of average to complex with immediate responsibility for the less difficult projects; inspects the work of contractors; interprets contracts, specifications and plans; checks and supervises the work of staking parties and inspectors.

Serves as chief of a survey party, in the absence of supervisor, or as senior instrumentman on complex construction or survey projects.

Assists a project engineer in supervising the construction of more complex bridges, and grade separations; checks forms and structural parts and inspects methods; appraises the progress and workmanship of contractors and prepares construction progress reports.

Designs and prepares preliminary and final plans for highways, bridges, drainage structures, watermains, and miscellaneous highway facilities.

Makes investigations, analyses and summaries of traffic information and economic facts for the completion of studies for highway planning.

Makes studies and analyses for the selection of highway routes.

Assists a highway traffic engineer in an area of the state in investigating routes for traffic adequacy or safety; or in the central office, analyzes traffic data and formulates traffic estimates for the operational improvement of the highway system.

Serves as a materials inspector in the field; visits plants and inspects the work and reports of aggregate and gravel plant inspectors and the samples and processes of the plants; advises inspectors as to mix problems and proper performance of plant tests.

Analyzes soils visually and by testing to determine suitability for highway construction.

Performs physical experiments on highway materials; assists in developing laboratory tests and apparatus of complete studies; conducts field investigations and laboratory experiments, in the laboratory.

Prepares land descriptions on the basis of maps, blueprints, survey notes, title searches, abstracts, and field inspections.

Performs related work as assigned.

KNOWLEDGES, SKILLS AND ABILITIES

Some knowledge of the principles and practices of civil engineering.

Some knowledge of mathematics and mathematical tables used in engineering work.

Some knowledge of the principles of chemistry, physics and electricity.

Some knowledge of engineering design and related drafting practices.

Some knowledge of strength and characteristics of construction materials.

Some knowledge of the principles of mechanics, hydraulics and structures.

Some knowledge of the types and uses of surveying instruments.

Ability to use surveying instruments.

Ability to perform engineering computations.

Ability to prepare sketches, maps and engineering drawings.

Ability to read and interpret engineering plans and specifications.

EDUCATION AND EXPERIENCE

Education

Knowledges and skills typically acquired through completion of a bachelor's degree in civil engineering.

Experience

Some experience as a civil engineer.

SP:cs

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7112110 CIVIL ENGINEER 10

Rev. 2/72

GENERAL DESCRIPTION

Employees in this class do professional field and office engineering work in survey, design, traffic, research, construction, and/or maintenance; and perform related work.

EXAMPLES OF WORK

As an experienced engineer, serves independently in any of the following capacities:

As a designer in a design squad, responsible for the preparation of preliminary and final plans for highways, highway structures or other structures.

As supervisor over instrument work and/or primary assistant to a project engineer in construction.

As an office engineer working on history sheets, mass diagram and final estimates in road construction; prepares computations balancing authorizations.

Performs mathematical computations required in the construction of structures and makes minor changes in design on the job.

Conducts minor research studies and participates in major research studies in such areas as pavement performance, stress analysis, soil mechanics, soil and aggregate properties, material testing and structural design of pavements and structures.

Supervises and conducts traffic studies and makes recommendations to improve traffic flow and safety.

Assists in field review and preparation of comprehensive reports related to highway sufficiency rating.

EXPERIENCE AND EDUCATION REQUIREMENTS

Education

Possession of a bachelor's degree in civil engineering.

Experience

Two years of experience as a civil engineer subsequent to obtaining the bachelor's degree.

Note: Possession of a master's degree in civil engineering may be substituted for six months of experience.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Intelligence quotient equal to college average.

Willingness to work in any assigned area of the state.

Knowledge of mathematics and mathematical tables used in engineering work.

Knowledge of the principles of chemistry, physics and electricity.

Knowledge of engineering design and related drafting practices.

Knowledge of strength and characteristics of construction materials.

Knowledge of the principles of mechanics, hydraulics and structures.

Knowledge of the types and uses of surveying instruments.

Knowledge of the engineering principles and practices involved in road and bridge design and construction, surveying, maintenance, planning, testing and research.

Ability to apply engineering skills and knowledges.

Ability to do instrument work in surveying.

Ability to make engineering computations.

Ability to make sketches, maps and engineering drawings.

Ability to read and interpret engineering plans and specifications.

Ability to supervise.

LR:ct

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7112111 *CIVIL ENGINEER 11
7112112 *CIVIL ENGINEER 12

Rev. 2/71

GENERAL DESCRIPTION

Employees in these classes do professional field and office engineering work in survey, design, construction and/or maintenance; and perform related work.

EXAMPLES OF WORK

Civil Engineer 11

As a supervisor in the office, or in the field,
Plans and supervises the work of a group of professional and technical assistants in the development and improvement of facilities.

Assigns and reviews projects with engineers.

Discusses plans, specifications, and work schedules with contractors.

Estimates cost of projects, and writes contracts and specifications for labor, materials and equipment for construction projects.

Makes design computations and prepares complete plans for engineering projects, or directs such work; prepares engineering reports.

Makes preliminary and final surveys and inspections, and supervises the building of engineering or architectural projects.

Keeps records of progress, quantities, changes, delays, and other pertinent factors.

Compiles and analyzes data and prepares conclusions and recommendations.

Civil Engineer 12

On the larger or more complex projects, and/or, on a more independent basis, performs the work described for Civil Engineer 11.

EXPERIENCE AND EDUCATION REQUIREMENTS

Education

*Possession of a bachelor's degree in civil engineering

*Minimum Requirements--Education, Experience

Experience

Civil Engineer 11

*Three years of experience as a civil engineer subsequent to obtaining the bachelor's degree.

Civil Engineer 12

*Four years of experience as a civil engineer subsequent to obtaining the bachelor's degree, one year of which shall have been as a Civil Engineer 11, or equivalent supervisory engineering experience.

Note: At other level, possession of a master's degree in civil engineering may be substituted for six months of experience.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to travel about the state as required.

Willingness to participate in inservice training.

Knowledge of the principles and practices of civil engineering.

Knowledge of survey, design and construction methods.

Knowledge of nomenclature and symbols used in civil engineering, drafting and design.

Knowledge of field and office procedures relating to civil engineering.

Ability to determine compliance of structures with specifications.

Ability to make engineering designs and to prepare complete plans for projects.

Ability to make engineering cost estimates.

Ability to prepare contracts and specifications.

*Minimum Requirements--Education, Experience

Ability to prepare engineering reports.

Ability to supervise the work of a group of professional and technical assistants.

Additional Requirements for Civil Engineer 12

Greater skill in the application of knowledges and abilities described at the lower level.

Ability to plan, organize and supervise civil engineering work.

LR:ct

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7112113 CIVIL ENGINEER 13
7112114 CIVIL ENGINEER 14
7112115 CIVIL ENGINEER 15

Rev. 1/73

GENERAL DESCRIPTION

Employees in these classes do professional field and office engineering work in survey, design, construction and/or maintenance; and perform related work.

EXAMPLES OF WORK

Civil Engineer 13

In a central or regional office, plans and supervises the work of a group of professional and technical engineering assistants.

Designs and computes engineering structures.

Assigns such problems as the preparation of reconnaisance and topographical survey maps; design of water and sewage systems, parks, roads and bridges; designs for water control projects; design, construction and inspection of buildings; and recommendation for building sites.

Reviews projects with engineers assigned to the work.

May be responsible for the implementation of various public acts as required.

Supervises the estimating of costs on approved plans for allocation of funds and appraisal of bids.

Analyzes proposed projects for the protection of conservation interests.

Writes contracts and specifications for labor, materials, and equipment for construction projects; prepares and authorizes partial and final payment to contractors.

Makes preliminary surveys, and supervises and inspects periodically, building projects in the field.

May conduct special engineering projects involving consulting engineers, attorneys, and municipal or other governmental officials.

Compiles work progress summaries.

Supervises land surveys for acquisition.

Participates in preliminary reconnaisance of projects so that feasibility may be determined.

Participates in project discussions with other division representatives.

Coordinates scheduling of construction projects.

Reviews projects with engineers assigned to the work.

Conducts interviews and correspondence relative to the work.

Civil Engineer 14

Directs or coordinates field construction supervisors in executing plans prepared by architects, engineers, and landscape architects.

Coordinates construction scheduling.

Prepares partial and final payments to contractors.

Assigns lineal, topographic and construction surveys as requested by land-administering divisions.

Supervises design engineers on conservation projects.

Confers on design problems; as required, recommends changes in plans.

Civil Engineer 15

Plans, organizes and directs the work of an engineering section, or serves as assistant in a large engineering division.

Supervises the staff responsible for survey, design, estimates, specifications, contracts and construction.

Supervises the establishment of cost records, charges and accounting for such projects.

Consults with department officials on costs and economic feasibility of proposed construction projects.

Supervises the preparation of the budget.

Determines standards of workmanship and accomplishment.

Directs the preparation of detail drawings, specifications, and cost estimates of projects.

Reviews and approves engineering reports, designs and plans.

Supervises requisitions for equipment, materials and supplies.

Conducts interviews and correspondence relative to the work.

EXPERIENCE AND EDUCATION REQUIREMENTS

Registration as a professional engineer in Michigan.

Civil Engineer 13

Two years of experience as a civil engineer with project responsibility, or civil engineering experience at an equivalent level of responsibility.

Civil Engineer 14

Three years of experience as a civil engineer with project responsibility, or civil engineering experience at an equivalent level of responsibility.

Civil Engineer 15

Four years of experience as a civil engineer with project responsibility, or civil engineering experience at an equivalent level of responsibility.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to travel about the state as required.

Willingness to participate in inservice training.

Knowledge of the principles and practices of civil engineering.

Knowledge of survey, design, and construction methods.

Knowledge of nomenclature and symbols used in civil engineering, drafting and design.

Knowledge of field and office procedures relating to civil engineering.

Knowledge of the technical phases of estimates, contracts, specifications and engineering reports.

Knowledge of administrative practices related to the work.

Ability to plan, organize and supervise civil engineering work.

Ability to determine compliance of structures with specifications.

Ability to make engineering cost estimates.

Ability to prepare contracts and specifications.

Ability to organize and evaluate information for special reports.

Additional Requirements for Civil Engineer 14

Greater skill in the application of the knowledges and abilities required for the next lower level.

Additional Requirements for Civil Engineer 15

Greater skill in the application of the knowledges and abilities required for the next lower level.

Ability to supervise and administer the engineering activities of a general engineering section.

LR:tj

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7142111 HIGHWAY DESIGNING ENGINEER 11
7142112 HIGHWAY DESIGNING ENGINEER 12

Rev. 11/72

GENERAL DESCRIPTION

Employees in these classes do responsible engineering work in the preparation of plans for highway construction; and perform related work.

EXAMPLES OF WORK

Highway Designing Engineer 11

As an experienced design engineer in a squad, independently prepares designs and computations for all types of highway projects.

Prepares engineering studies and details comparative cost estimates.

Highway Designing Engineer 12

Serves as assistant squad leader; assists in the supervision of a group of design engineers and technicians with personal responsibility for the more difficult or complex aspects of highway design.

Assists in assigning and reviewing progress of work and in supervision of the training of lower level engineers and technicians.

Develops special highway layouts to solve complex or unusual highway design problems.

Prepares and supervises preparation of reports related to the work.

Makes field inspections, as necessary, related to the design of the project.

In a design review squad, serves as a senior review engineer.

Reviews work prepared by contract consultants and/or other highway design squads and consults with them as necessary.

EXPERIENCE AND EDUCATION REQUIREMENTS

Education

Possession of a bachelor's degree in engineering.

Experience

Highway Designing Engineer 11

Three years of highway engineering experience, two years of which shall have been in highway design.

Highway Designing Engineer 12

Four years of highway engineering experience, one year of which shall have been as an experienced design engineer in a design squad.

Note:

At both levels proportionate credit will be given for experience of equivalent responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to participate in inservice training courses.

Knowledge of the principles and practices of highway construction and use of highway materials.

Knowledge of highway design principles, practices and methods.

Knowledge of drafting, projections and geometrical design.

Knowledge of the nomenclature and conventional symbols of drafting.

Knowledge of methods and practices followed in the preparation of highway plans.

Knowledge of the more important sources of engineering information.

Knowledge of highway cost estimates and specifications.

Ability to interpret field notes in preparing highway plans.

Ability to make and check difficult and complex engineering computations.

Ability to do the more difficult and complicated work of highway design such as preparation of intersections, grade separation approaches and special details of highway plans.

Ability to train others in the work.

Ability to plan, supervise and review the work of engineers and draftsmen.

Ability to prepare clear statements of engineering requirements.

Additional Requirements for Highway Designing Engineer 12

Greater skill in the application of knowledges and abilities rerequied at the lower level.

Ability to make preliminary field inspections.

Ability to meet time and production requirements and to maintain quality of design work.

Ability to assist in training and supervision of a design squad in the preparation of highway construction engineering plans.

LR:sc

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7142113 HIGHWAY DESIGNING ENGINEER 13

Rev. 10/71

GENERAL DESCRIPTION

An employee in this class supervises a squad of engineers and technicians in the design of highways; and performs related work.

EXAMPLES OF WORK

Supervises the preparation of contract plans based on engineering reports; occasionally prepares plans for bridge or grade separation projects.

Makes engineering and economic studies to recommend the best type of design.

Makes field inspections for adaptability of design to actual field conditions.

Supervises the preparation of preliminary and final right of way plans.

Supervises the design of complex urban and rural type interchanges and rest areas.

Makes recommendations for stage construction details for the maintenance of traffic in critical areas.

Assists in preparing critical path studies for construction of projects.

Supervises the preparation of studies to determine necessity for retaining walls, drainage structures, bridges, etc., to be designed by other design units.

Supervises the preparation of specifications and estimates.

Supervises the preparation of special cost estimates for the Transportation Planning Division and for federal highway administration justification.

Supervises the training and conduct of engineers and technicians assigned to the squad.

Recommends promotions and advises on service ratings of personnel in the squad.

EXPERIENCE AND EDUCATION REQUIREMENTS

Registration as a Professional Engineer in Michigan

Experience

Two years of experience as a senior design engineer in a design squad.

Note:

Proportionate credit will be given for experience of equivalent responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical and mental condition adequate for performance of work of the class.

Tact and similar qualities necessary in dealing effectively with others.

Willingness to participate in inservice training.

Knowledge of highway engineering principles, practices, and methods.

Knowledge of highway design principles, practices and methods.

Knowledge of highway location, survey, traffic, and construction.

Knowledge of highway construction materials.

Knowledge of highway specifications and cost estimating.

Knowledge of highway organization and division functions.

Knowledge of field conditions and factors affecting highway design.

Knowledge of methods of design used to aid construction work.

Knowledge of electronic computer methods and critical path applications.

Knowledge of basic training principles and technique.

Ability to make and check difficult and complex engineering computations.

Ability to make "plan in hand" inspections in the field.

Ability to prepare specifications and engineering requirements.

Ability to organize and coordinate the activities of the personnel for maximum efficiency to meet rigid time and production schedules.

Ability to train and supervise design engineers and draftsmen.

Ability to communicate effectively in the written and spoken media.

LR:rr

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7142114 HIGHWAY DESIGNING ENGINEER 14
7142115 HIGHWAY DESIGNING ENGINEER 15

Rev. 10/71

GENERAL DESCRIPTION

Employees in these classes supervise the design of plans for highways; and perform related work.

EXAMPLES OF WORK

Highway Designing Engineer 14

Serves as a bituminous specialist.

Makes field inspections of proposed projects, recommending design and construction procedures. Supplies information to designers for working up the plans to obtain uniformity and proper use of various bituminous materials on projects.

Reviews existing road surfaces to determine future bituminous surfacing and reconstruction projects.

Serves as a member of a committee meeting with local officials to determine details of reconstruction of roads which are to be returned to local jurisdiction.

Schedules and directs grade inspections for projects involving resurfacing of existing pavements, widening of existing pavements and resurfacing to modern standards, and upgrading of institutional roads.

or, Supervises the Specifications and Estimates Unit.

Highway Designing Engineer 15

Serves as a highway design supervising engineer.

Supervises a group of design squads.

Plans work schedules and reviews progress of subordinate units.

Reviews route location and other reports; makes suggestions for possible changes or additional studies.

Performs an administrative review of preliminary and final design plans.

Coordinates and participates in field inspections with the federal highway commission, local governmental officials and other departmental personnel.

Conducts meetings with departmental and outside agencies regarding highway designs problems.

Prepares and directs the preparation of special reports.

May represent the department on drainage committee work throughout the state; checks drain cost apportionments; reviews proposed drain laws.

Initiates and prepares correspondence.

Directs the section in the Design Engineer's absence.

or, Serves as the design field engineer.

Traverses proposed routes with district engineers and squad leaders.

Makes recommendations on design changes.

or, Supervises a group of design review squads.

Supervises design squads engaged in reviewing, expediting, and coordinating work performed by departmental design sections and outside consultants.

Writes informational memoranda on highway design procedure to assure more uniform and better quality highway plans.

Makes special studies on various aspects of highway design.

Coordinates plans with the federal highway administration and the construction division.

Reviews preliminary plans being prepared by consultants; recommends changes as necessary; approves line and grades on plans.

Makes inspections with the federal highway administration, as necessary.

Works with specification personnel in obtaining supplemental specifications for items not covered in the current standards.

Answers inquiries and conducts correspondence on plans and specifications.

EXPERIENCE AND EDUCATION REQUIREMENTS

Registration as a professional engineer in Michigan is required at both levels.

Highway Designing Engineer 14

One year of experience as a Highway Desinging Engineer 13.

Highway Designing Engineer 15

Two years of experience as a Highway Designing Engineer 13.

Note:

At either level, proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in dealing with others.

Knowledge of highway engineering principles, practices and methods.

Knowledge of problems of traffic operation and right-of-way acquisitions.

Knowledge of highway design.

Knowledge of highway location and construction.

Knowledge of highway construction materials.

Knowledge of highway cost estimating and specifications.

Knowledge of supervisory and basic training principles and techniques.

Knowledge of field conditions and factors affecting highway design.

Knowledge of methods of design used to aid construction work.

Ability to prepare specifications and engineering requirements.

Ability to supervise the training of designers and draftsmen.

Ability to coordinate and review the work of several design squads.

Ability to make technical decisions.

Additional Requirements for Highway Designing Engineer 15

Knowledge of highway location and design principles, practices and methods.

Knowledge of traffic, landscape, right-of-way problems, architectural and bridge engineering factors and their effect on highway design and construction.

Knowledge of contractual agreements and related legal requirements affecting the work.

Ability to plan and assign the work of several design squads.

Ability to analyze road and bridge plans from the standpoint of design and cost of right-of-way.

LR:tc

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7142214 *HIGHWAY DESIGN SUPERVISOR 14

Rev. 8/69

GENERAL DESCRIPTION

Employees in this class supervise the design of plans for highways; and perform related work.

EXAMPLES OF WORK

In the central office, serves as a supervisor of a group of design squads located in the district offices.

Schedules and expedites the work of district design squads.

Makes personal and telephone contacts with design squads to advise on design problems.

Reviews plans and makes decisions on design changes when such changes do not alter original intent.

Makes recommendations to supervisor on design determination and line changes to avoid excessive right-of-way costs or soils problems.

Makes field inspections as necessary to correlate design with topographic features.

Coordinates the district design work with other divisions, municipalities and Bureau of Public Roads.

Reviews control authorizations to determine necessity for changes in plans.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Six years of responsible engineering design experience, three years of which shall have been as a Highway Designing Engineer 12.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in dealing with others.

Knowledge of highway engineering principles, practices and methods.

Knowledge of problems of traffic operation and right-of-way acquisitions.

*Minimum Requirement--Experience

Knowledge of highway design.

Knowledge of highway location and construction.

Knowledge of highway construction materials.

Knowledge of highway cost estimating and specifications.

Knowledge of supervisory and basic training principles and techniques.

Knowledge of field conditions and factors affecting highway design.

Knowledge of methods of design used to aid construction work.

Ability to make and check difficult and complex engineering computations.

Ability to prepare specifications and engineering requirements.

Ability to supervise the training of designers and draftsmen.

Ability to coordinate and review the work of several design squads.

Ability to make technical decisions.

LR:ds

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7143111 BRIDGE DESIGNING ENGINEER 11
7143112 BRIDGE DESIGNING ENGINEER 12

Rev. 10/72

GENERAL DESCRIPTION

Employees in these classes do responsible engineering work in the preparation of plans for highway bridges and similar structures; and perform related work.

EXAMPLES OF WORK

Bridge Designing Engineer 11

As an experienced design engineer in a squad, independently prepares studies and complete designs of highway structures of all classifications. In the course of such work, studies water area, drainage and foundation requirements, and determines clearances.

Prepares final layout drawings and stress calculations.

Reviews preliminary plans for coordination with proposed or existing road approaches.

Prepares and checks detail plans, design calculations, cost estimates and recommendations prepared by other engineers for completeness, mathematical accuracy and conformity to good engineering practices, office specifications, standards and design theory.

Rerates existing bridges for load limit postings.

Bridge Designing Engineer 12

Serves as assistant squad leader in charge of the work of a group of design engineers and technicians with personal responsibility for the more difficult or complex aspects of the work.

Assists in assigning and checking progress of the work and in the training of squad members.

Checks plans, computations and estimates.

Assembles and analyzes available engineering and project data.

Determines the effect of proposed changes on designs, and recommends changes in plans.

Coordinates the work of highway structure design with that of other aspects of the work of the department.

On specialized assignment: prepares plans for maintenance work on various structures.

Prepares and submits specifications and standards.

Or, in a design review squad, serves as a senior review engineer.

Reviews work prepared by contract consultants and/or other highway design squads and consults with them as necessary.

EXPERIENCE AND EDUCATION REQUIREMENTS

Education

Possession of a bachelor's degree in engineering.

Experience

Bridge Designing Engineer 11

Three years of highway engineering experience, two years of which shall have been in bridge design.

Bridge Designing Engineer 12

Four years of highway engineering experience, one year of which shall have been as a senior bridge designing engineer.

Note:

At both levels, proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to participate in inservice training courses as required.

Knowledge of drafting, projections and geometrical design.

Knowledge of the nomenclature and conventional symbols used in structural drafting.

Knowledge of the principles and practices of structural engineering design.

Knowledge of cost estimates.

Ability to prepare plans from field notes.

Ability to prepare plans for railroad structures.

Ability to make the most difficult types of structural engineering calculations and computations and to check others in such work for accuracy, completeness and conformity to design standards.

Ability to prepare clear statements of structural engineering requirements.

Additional Requirements for Bridge Designing Engineer 12

Greater skill in the application of knowledges and abilities required at the lower level.

Ability to act in the capacity of squad leader, on occasion, in the absence of the squad leader.

Ability to make "plan-in-hand" inspections in the field.

Ability to meet time and production requirements and to maintain quality of design work.

Ability to train and supervise a design squad in the preparation of highway structural engineering plans.

LR:cy

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7143113 *BRIDGE DESIGNING ENGINEER 13

Rev. 8/69

GENERAL DESCRIPTION

An employee in this class, supervises a squad of engineers and technicians in the design of structures; and performs related work.

EXAMPLES OF WORK

Supervises the preparation of contract plans for bridge and grade separation structures and related work based on an engineering report; occasionally prepares plans for road projects.

Makes engineering and economic studies to recommend the best type of design.

Makes field inspections for adaptability of design to actual field conditions.

Supervises the preparation of preliminary and final right of way plans.

Makes drainage studies and cost analyses for special drainage problems.

Makes recommendations for the disposition of private and public utilities.

Supervises the design of complex urban and rural type interchanges.

Makes recommendations for stage construction details for the maintenance of traffic in critical areas.

Assists in preparing critical path studies for construction of projects.

Supervises the preparation of studies to determine necessity for retaining walls, drainage structures, bridges, etc., to be designed by other design units.

Supervises the preparation of specifications and estimates.

Supervises the preparation of special cost estimates for the Programming Division and for Bureau of Public Roads justification.

Supervises the training and conduct of engineers and technicians assigned to the squad.

Recommends promotions and advises on service ratings of personnel in the squad.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Registration as a Professional Engineer in Michigan.

Experience

*Two years of experience as a Bridge Designing Engineer 11, or equivalent experience outside the state service.

Note:

Proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical and mental condition adequate for performance of work of the class.

Tact and similar qualities necessary in dealing effectively with others.

Willingness to participate in inservice training.

Knowledge of highway engineering principles, practices and methods.

Knowledge of highway design principles, practices and methods.

Knowledge of highway location, survey, traffic, and construction.

Knowledge of highway construction materials.

Knowledge of highway specifications and cost estimating.

Knowledge of highway organization and division functions.

Knowledge of field conditions and factors affecting highway design.

Knowledge of methods of design used to aid construction work.

Knowledge of electronic computer methods and critical path applications.

Knowledge of basic training principles and technique.

Ability to make and check difficult and complex engineering computations.

Ability to make "plan-in-hand" inspections in the field.

*Minimum Requirements--Registration, experience

Ability to prepare specifications and engineering requirements.

Ability to organize and coordinate the activities of the personnel for maximum efficiency to meet rigid time and production schedules.

Ability to train and supervise design engineers and draftsmen.

Ability to communicate effectively in the written and spoken media.

LR:eic

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7143114 *BRIDGE DESIGNING ENGINEER 14
7143115 *BRIDGE DESIGNING ENGINEER 15

Rev. 5/71

GENERAL DESCRIPTION

Employees in these classes do professional engineering work in specialized functions, or in supervising the preparation of plans for highway bridges and similar structures; and perform related work.

EXAMPLES OF WORK

Bridge Designing Engineer 14

Serves as a staff specialist, with responsibility for a specialized function of bridge design engineering, in a complex or highly technical area.

Supervises a team of engineers in the analysis of structural problems and preparation of plans for repair and strengthening of bridges and other structures, including emergency situations and structural analysis of existing bridges to determine capacities, load limits and other problems.

or, Supervises the review of plans and specifications for bridges and other structures prepared by consulting engineers; coordinates the design review functions and problems with consultants, utility companies, railroads, government units, suppliers and fabricators; supervises preparation of agreements with consultants.

or, Has responsibility for research and development work on structural designs, development and revision of bridge design standards and design notes, and the review and coordination of bridge plans and specifications; conducts special investigations and reviews as required.

or, Maintains liaison with county road commissions relative to federal-state aid policies, programs and plans with emphasis on bridges, and assists the commissions and their consultants in preparation of their bridge plans and inspection during construction.

In any case, makes technical recommendations and decisions, subject only to general administrative direction.

May supervise a group of engineers in the work.

Determines priorities and conformance with policies, procedures and standards.

*Minimum Requirements--Registration, experience

Bridge Designing Engineer 15

Serves as a bridge design supervising engineer in the central office of the design division.

Plans work schedules and reviews progress of subordinate design units.

Reviews initial material submitted to originate bridge design studies; makes suggestions for alternate studies to be conducted.

Performs review of preliminary and final bridge design plans.

Meets and corresponds with municipalities, bureau of public roads and other governmental agencies on design matters.

May make field inspections.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Registration as a professional engineer in Michigan will be required at both levels.

Bridge Designing Engineer 14

*Two years of experience as a Bridge Designing Engineer 12.

Bridge Designing Engineer 15

*Two years of experience as a Bridge Designing Engineer 13.

Note:

At both levels, proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in dealing effectively with others.

Knowledge of highway engineering principles, practices, and methods.

Knowledge of problems of traffic operations and right-of-way acquisition.

Knowledge of the principles and practices of highway structural engineering design.

*Minimum Requirements--Registration, experience

Knowledge of structural engineering drafting.

Knowledge of cost estimates and the use of structural engineering materials.

Knowledge of structural engineering specifications and standards.

Knowledge of basic training principles and supervisory techniques.

Knowledge of the sources of structural engineering information.

Ability to apply technical knowledge in a specialized area of bridge design.

Ability to check engineering calculations and designs for accuracy, completeness and conformity to prescribed standards.

Ability to use independent judgment and make decisions.

Ability to organize, coordinate and supervise the work of engineers in specialized areas of bridge design.

Ability to prepare design requirements, specifications and standards.

Ability to maintain favorable public contacts.

Additional Requirements for Bridge Designing Engineer 15

Knowledge of location and construction problems affecting bridge design.

Knowledge of the interrelation of highway structure design and other aspects of highway construction and maintenance.

Knowledge of the operations and responsibilities of other divisions of the Highway Department.

Knowledge of contractual agreements and related legal requirements affecting the work.

Ability to plan for, coordinate and direct the work of engineers and draftsmen in highway structural engineering location and design.

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7123111 HIGHWAY CONSTRUCTION ENGINEER 11
7123112 HIGHWAY CONSTRUCTION ENGINEER 12

Rev. 10/72

GENERAL DESCRIPTION

Employees in these classes do professional engineering work in road and bridge construction; and perform related work.

EXAMPLES OF WORK

Highway Construction Engineer 11

As a project engineer, under general supervision of a resident or district engineer, has responsibility for supervising highway and bridge construction work of contractors.

Coordinates the work of contractors, public utilities and local governments.

Inspects the work of contractors for compliance with contracts, plans and specifications.

Makes suggestions regarding design after preliminary field surveys.

Interprets contents of contracts, specifications and plans to contractors.

Settles differences between contractors and inspectors.

Examines construction materials to be used on the project and sends samples to the laboratory for testing.

Ascertains that authorized plan and specification revisions are followed.

Checks and supervises the work of staking parties and inspectors.

Estimates and reports on work completed to determine money due contractors at stipulated intervals.

or, Serves as chief of one or more highway survey parties on the more difficult surveys or acts as a survey supervisor when so directed.

Lays out the work for the survey crew in running lines and taking cross sections.

Supervises the establishment of bench marks and control points for alignment.

Supervises the recording of data showing cultural features and typing in property lines and government corners.

Directs the preparation of preliminary field maps.

Supervises the taking of soundings in swamps.

or, Serves as the district office engineer for both highway and bridge construction.

or, Serves as the assistant project engineer on the largest and most complex projects.

Highway Construction Engineer 12

As a senior project engineer, has responsibility for a greater number and more complex construction projects on a continuing basis.

Supervises junior project engineers.

Performs the work described for project engineers at the lower level.

EXPERIENCE AND EDUCATION REQUIREMENTS

Possession of a bachelor's degree in engineering.

Highway Construction Engineer 11

Three years of engineering experience, two years of which shall have been in bridge or road construction.

Highway Construction Engineer 12

Two years of experience as a project engineer on both road and bridge construction projects.

or, Two years of experience as a project engineer in either road or bridge construction and current assignment to a "package" project.

Note:

In either alternative, the following will be required:

Completion of at least one highway construction project demonstrating engineering and supervisory competence.

Current responsibility for projects valued at $1.5 million.

Note:

At both levels, proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to participate in inservice training courses.

Willingness to travel about the state as assigned.

Knowledge of road and bridge engineering principles, practices, standards and specifications.

Knowledge of nomenclature and conventional symbols of structural drafting

Knowledge of mathematics, mathematical tables and computations applicable to the work.

Knowledge of topographic survey work.

Knowledge of road and bridge construction materials and equipment.

Elementary knowledge of road and bridge construction specifications and contracts.

Knowledge of cost estimates.

Ability to inspect construction details and materials for quality and conformity with plans, specifications and contracts.

Ability to measure and compute construction work and prepare estimates of percentage of contracts completed.

Ability to use surveying instruments.

Ability to supervise project and survey crews.

Ability to interpret and explain plans and specifications and settle differences which arise during construction.

Ability to plan, lay out and supervise the work of a number of engineers and their assistants.

Ability to meet the public.

Additional Requirements for Highway Construction Engineer 12

Greater skill in the application of knowledges and abilities described for the lower level.

Ability to train and supervise junior project engineers and survey chiefs.

Ability to supervise a number of survey parties and construction projects in an assigned area.

LR:sc

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7123113 HIGHWAY CONSTRUCTION ENGINEER 13
7123114 HIGHWAY CONSTRUCTION ENGINEER 14
7123115 HIGHWAY CONSTRUCTION ENGINEER 15

Rev. 10/72

GENERAL DESCRIPTION

Employees in these classes do professional engineering in the supervision of road and bridge construction; and perform related work.

EXAMPLES OF WORK

Highway Construction Engineer 13

Serves as a resident engineer; supervises three or more project engineers.

Directs road and bridge construction engineering and inspection activities on a series of complex construction projects.

Supervises and coordinates the engineering and inspection activities of several project engineers assigned to various construction activities.

Makes recommendations regarding designs and contracts prior to construction.

Assigns, transfers and requisitions personnel, equipment, supplies and materials for the stakeout and inspection of the construction projects.

Maintains liaison between the district construction engineer and the project engineers.

or, Assists in the work described below for the district construction engineer in a more active district.

Serves as project engineer on the largest and most complex projects valued at $10.0 million on a continuing basis.

Directs road and bridge construction activities on a series of complex construction projects; these are usually found in urban or suburban areas of the state, and have complicated design, numerous utilities, frequent traffic problems inherent with high volume traffic flow, a greater number of contractual work items, and are being constructed within confined construction limits.

Coordinates stage construction operations of utilities, tunnels, service roads, structures, grading, drainage, paving, signing, lighting, and landscaping.

Highway Construction Engineer 14

Serves as district construction engineer in one, or a combination of, less active districts.

or, Serves as the assistant district construction engineer in a more active district having an anticipated five year program averaging $20 million a year.

Performs the work described below for district construction engineer.

Or, Serves as the assistant district construction engineer in a more active district in which the district construction engineer is also serving as district engineer.

Performs the work described below for district construction engineer.

Highway Construction Engineer 15

Serves as district construction engineer in a more active district.

Coordinates the work of the construction division with that of other divisions in the district.

Inspects road and bridge construction projects in the district to determine progress, methods employed, quality of work, need for plan change, authorization and final acceptance.

Answers questions from resident and project engineers and contractors with respect to plans, specifications, contracts and construction work.

Makes plan-in-hand grade and field inspection prior to and during construction.

Assigns construction personnel to various projects in the district as the work requires.

Makes recommendations concerning construction personnel for the district.

Gives testimony at condemnation necessity hearings.

Confers with officials of public utilities and governmental agencies, both federal and local, on such problems as the removal and location of utility lines, land acquisition and the cooperative construction of highway structures in the district.

or, In a less active district, serves as construction engineer and district engineer.

Coordinates and provides administrative direction to engineering personnel assigned to the district.

Directs and supervises the work of non-engineering and clerical personnel assigned to the district office.

Performs the work described above for the district construction engineer.

or, Serves as a staff specialist in bridge and road construction.

Reviews preliminary and final plans and specifications for accuracy, completeness and practibility of construction.

Reviews recommendations for "changes in" and "extras to" construction contracts and field construction reports from engineers.

Performs liaison work between the central office of construction and design in regard to field construction difficulties or errors in plans.

EXPERIENCE AND EDUCATION REQUIREMENTS

Registration as a professional engineer in Michigan will be required at all levels.

Experience

Highway Construction Engineer 13

One year of engineering experience in bridge and road construction as a senior project engineer.

Highway Construction Engineer 14

One year of engineering experience in bridge and road construction equivalent in level of responsibility to a resident engineer.

Highway Construction Engineer 15

Two years of engineering experience in bridge and road construction equivalent in level of responsibility to a resident engineer.

Note:

At all levels, proportionate credit will be given for experience at an equivalent level of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Knowledge of the principles, practices and methods of road and bridge engineering.

Knowledge of problems of traffic operation and right-of-way acquisition.

Knowledge of laws, rules and regulations pertaining to highway structural construction.

Knowledge of the problems involved in highway location and construction.

Knowledge of estimates, contracts, plans and specifications.

Knowledge of field and office procedures related to road and bridge construction.

Ability to apply technical engineering knowledge to specific problems.

Ability to make preliminary studies, design and detail plans and estimates, and to prepare reports and recommendations.

Ability to determine conformity of work to construction plans and specifications and to recommend changes as necessary.

Additional Requirements for Highway Construction Engineer 14 and 15

Greater skill in the application of knowledges and abilities required at the lower level.

Ability to plan, supervise and coordinate construction projects within an assigned district.

Ability to determine appropriate methods of solving complex structural problems.

LR:cly

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7131112 *HIGHWAY MAINTENANCE ENGINEER 12

Rev. 8/69

GENERAL DESCRIPTION

Employees in this class, in the central office of the Department of State Highways, do professional engineering work in supervising the maintenance of state highways and structures; and perform related work.

EXAMPLES OF WORK

In the central office, has responsibility for road maintenance contracts in counties and municipalities.

Visits municipalities to prepare the annual maintenance budget in cooperation with district maintenance engineers.

Reviews and approves for payment monthly and quarterly financial reports.

Prepares annually, in cooperation with the county road commission association, the equipment rental schedule.

Investigates and makes recommendations on new applications and amendments to municipal contracts.

Supervises the paper processing of annual contracts and amendments to contracts for counties and cities.

Prepares annual unit cost and analysis charts for counties and cities.

Supervises the preparation of county and municipal maintenance maps and other mapping projects.

or, Has responsibility for the inspection of bridges and culverts on state trunklines and county roads in an area of the state.

Prepares inspection reports stating the conditions of the structures and estimating cost of needed repairs.

Assists the district maintenance engineer in establishing priorities for recommended work, and in preparing the budget for bridge maintenance.

Inspects work performed by district bridge maintenance crews.

Performs work on special projects as assigned, such as the updating of the Maintenance Manual and the conduct of studies.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Applicants will be required to possess a degree in engineering or civil service status in a professional engineering class.

Experience

*Three years of highway engineering experience at the 09 level or above in road or bridge construction or maintenance or soils; one year of which shall have been at the 11 level or equivalent experience outside the state service.

Proportionate credit will be given for experience at equivalent levels of responsibility in other phases of highway engineering.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Willingness to travel about the state.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to work irregular hours when necessary under varied weather conditions.

Knowledge of highway engineering principles, practices and methods.

Knowledge of mathematics, mathematical tables and computations applicable to the work.

Knowledge of highway construction principles and practices as they affect highway maintenance.

Knowledge of highway maintenance equipment and procedures.

Knowledge of road and bridge maintenance budgeting.

Knowledge of hazards commonly encountered in the work and of effective safety precautions.

Ability to plan work schedules for skilled, semiskilled and unskilled crews of workmen.

Ability to conduct maintenance inspections and to determine that quality of work conforms to prescribed standards.

*Minimum Requirements--Degree or status, experience

Ability to evaluate the adequacy of municipal maintenance facilities.

Ability to meet the public and to deal effectively with county and municipal highway engineers.

LR:ae

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7131113 *HIGHWAY MAINTENANCE ENGINEER 13
7131114 *HIGHWAY MAINTENANCE ENGINEER 14
7131115 *HIGHWAY MAINTENANCE ENGINEER 15

Rev. 11/69

GENERAL DESCRIPTION

Employees in these classes do professional engineering work in supervising the maintenance of state highways and structures in districts; and perform related work.

EXAMPLES OF WORK

Highway Maintenance Engineer 13

In an assigned district of the state, serves as assistant to a maintenance engineer; acts for the maintenance engineer in his absence.

Supervises the work of bridge maintenance crews and bridge operators; coordinates activities with county and municipal activities; approves payroll, expense accounts and reports relative to operations.

May administer municipal and county maintenance contracts, including budget preparation, approval of expenditures and inspection.

May supervise the district maintenance superintendent and district forester, and the work of forestry and county maintenance crews.

Participates in the approval of permit applications for activities within the right of way.

Participates in the inspection of railroad grade crossings; coordinates repair operations.

Investigates complaints of road conditions.

Prepares maintenance recommendations for resurfacing and special maintenance.

Instructs superintendents and foremen in new maintenance techniques and procedures.

Instructs new superintendents in the performance of the work.

Assists in standardizing operations and procedures, and recommends improved maintenance techniques.

Acts as an investigator in troublesome situations caused by difficulties in county management or labor relations.

Maintains records, prepares reports and conducts correspondence related to the work.

Highway Maintenance Engineer 14

In a less populated district, supervises maintenance activities on highways and structures.

Inspects state roads for such factors as pavement surface condition, snow, ice and dust control, pavement markings and adjacent right of way; issues instructions concerning repairs.

Supervises and instructs city and county engineers performing highway maintenance in standard methods as applied to specific areas of activities.

Makes recommendations and reviews preliminary draft of the maintenance field budget for the district.

Reviews and makes recommendations concerning applications for construction permits with and adjacent to right of way.

Reviews problems concerning above- and below-ground public utility services when located in highway right of way.

Supervises the activities of the bridge maintenance superintendents while on assignment in the district.

When necessary, represents the highway department in public relations matters.

Investigates accidents and complaints involving road conditions.

or, Serves as a staff assistant to the Engineer of Maintenance Operations, with responsibility for coordinating activities in the district.

Highway Maintenance Engineer 15

In a highly populated district, has responsibility for supervising maintenance activities on highways and structures.

Performs the work described above for Highway Maintenance Engineer 14.

In a less populated district, serves as maintenance engineer and district engineer.

Coordinates and provides administrative direction to engineering personnel assigned to the district.

Supervises the non-engineering and clerical personnel in the district office.

Performs the work described for district maintenance engineer.

or, Serves as assistant to the engineer of maintenance operations with responsibility for coordinating activities in districts.

Assists in standardizing maintenance operations and procedures through field inspections and instructions.

Recommends new and improved maintenance methods, operations and techniques for use in revising procedures.

Gives advice to district maintenance engineers in solving difficult technical problems.

Supervises the activities of bridge maintenance superintendents.

Serves on committees with other divisions relative to improvement of designs, materials and specification.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Registration as a professional engineer in Michigan will be required at all levels.

Highway Maintenance Engineer 13

*Two years of highway engineering experience at the 11 level in highway construction or maintenance or soils.

Highway Maintenance Engineer 14

*Two years of highway engineering experience at the 12 level in maintenance.

Highway Maintenance Engineer 15

*Two years of highway engineering experience at the 13 level in maintenance.

Note:

At all levels, proportionate credit will be given for experience of equivalent responsibility in other phases of highway engineering.

*Minimum Requirements--Registration, experience

OTHER REQUIREMENTS

Physical condition adequate for performance of the work of the class.

Willingness to travel about the state.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Willingness to accept assignments in any area of the state.

Willingness to work irregular hours when necessary under varied weather conditions.

Knowledge of highway engineering principles, practices and methods.

Knowledge of problems of traffic operation and right-of-way acquisition.

Knowledge of mathematics, mathematical tables and computations applicable to the work.

Knowledge of highway construction principles and practices as they affect highway and structures maintenance.

Knowledge of highway and structures maintenance, equipment and procedures.

Knowledge of hazards commonly encountered in the work and of effective safety precautions.

Knowledge of supervisory principles.

Ability to interpret and explain plans and specifications.

Ability to plan work schedules for skilled, semi-skilled and unskilled crews or workmen, and to supervise and coordinate their work.

Ability to conduct maintenance inspections and to determine that quality of work conforms to prescribed standards.

Ability to meet the public.

Additional Requirements for Highway Maintenance Engineer 14

Knowledge of modern highway and structures maintenance principles, practices, and schedules.

Knowledge of methods and materials adaptable to the maintenance of road surfaces, shoulders, drains, signs, special roadside areas, and the removal and control of ice and snow.

Knowledge of materials, methods and cost factors involved in highway and structures maintenance.

Ability to organize work to meet emergency road maintenance problems.

Ability to plan and coordinate maintenance work for an assigned district.

Ability to inspect highways and structures to determine the maintenance work required.

Additional Requirements for Highway Maintenance Engineer 15

Greater skill in the application of knowledges and abilities listed above.

Knowledge of problems affecting highway and structures maintenance.

Knowledge of the operations and responsibilities of other divisions of the Highway Department.

Knowledge of the administrative problems involved in highway and structures maintenance work.

Knowledge of the legal factors involved in highway and structures maintenance work.

Ability to review reports and budgets for contract cities and to make recommendations concerning need.

LR:md

MICHIGAN DEPARTMENT OF CIVIL SERVICE

7121116	*HIGHWAY ADMINISTRATIVE ENGINEER 16	Rev. 1/69
7121117	*HIGHWAY ADMINISTRATIVE ENGINEER 17	Rev. 1/69
7121118	*HIGHWAY ADMINISTRATIVE ENGINEER 18	Rev. 1/69
7121119	*HIGHWAY ADMINISTRATIVE ENGINEER 19	Rev. 1/69
7121120	*HIGHWAY ADMINISTRATIVE ENGINEER 20	Rev. 1/69
7121121	*HIGHWAY ADMINISTRATIVE ENGINEER 21	New 1/69

GENERAL DESCRIPTION

Employees in these classes administer major programs in the planning, engineering, construction and maintenance of the state's highway system; and perform related work.

EXAMPLES OF WORK

Highway Administrative Engineer 16

Serves as chief of a major section, or as assistant chief of a division.

Makes recommendations concerning proposed budgets.

Assigns and transfers personnel.

Assists in the preparation of uniform procedures, standards and methods.

Prepares manuals of instruction.

Reviews field reports and makes field inspections to determine progress of work and conformance to contracts, plans and specifications.

Conducts conferences with public officials, contractors, project engineers and district engineers.

Reviews, revises and prepares technical papers and reports.

Attends meetings and conferences.

Assists in the work of the division chief and acts for the chief in his absence.

or, Serves as district engineer in a larger district.

Directs and coordinates the administrative activities of maintenance, testing, soils, traffic and safety, and right of way acquisition operations in the district.

Directs the administrative and technical activities of road and bridge construction operations in the district.

Has responsibility for outside business and public relations contacts involving district operations or district personnel.

Consults with the design division on project design.

Makes recommendations on highway needs and conditions.

Contacts municipal and county officials regarding construction programs in the district.

Highway Administrative Engineer 17

Serves as chief of a division, or as assistant chief of a major division.

Directs and coordinates the work of a staff of engineers in the office and in the field.

Directs state and inter-state trunkline and secondary road construction or bridge construction work; consults with district construction engineers, project engineers, and contractors; inspects construction work in the field.

Coordinates a technical staff of engineers in collecting, analyzing and utilizing traffic and engineering data.

Meets with municipal officials concerning local road construction and maintenance projects and the allocation of highway funds.

Formulates programs, policies and procedures for the operation of the division.

Anticipates equipment, supply and personnel requirements.

Directs the selection and training of personnel.

Has responsibility for the maintenance of records and conduct of correspondence.

Prepares reports and documents for approval by the director.

Represents the department at meetings and conferences.

or, Serves in a staff capacity to the department deputy director as coordinator of district engineering operations.

Advises the department director on field problems requiring commission action.

Advises central divisions of methods and procedures to provide smoother work flow between divisions in the field.

Keeps district staff informed of policy changes affecting field activities.

Reviews district work programs to determine effective utilization of manpower and equipment.

Highway Administrative Engineer 18

Serves as chief of a major division, such as construction, design, maintenance, testing and research or transportation planning.

Coordinates the work between sections and with other divisions and jurisdictions.

Reviews and approves road and bridge plans, contracts and final estimates.

Directs work operations involved in road and bridge construction.

Directs maintenance operations on roads and bridges.

Has responsibility for work operations involved in design of roads and bridges.

Directs the conduct of studies for use in transportation planning; provides criteria to assist the director in establishing administrative policies.

Has responsibility for the testing and research of highway construction and maintenance materials; initiates new techniques.

Directs the preparation of annual division budgets.

Supervises the preparation of reports to the governor, legislature and federal bureau of public roads.

Keeps informed of current developments in the field; initiates new practices and procedures.

Represents the director at meetings and conferences.

Highway Administrative Engineer 19

Under the direction of the Assistant Deputy Director, serves as head of the Bureau of Engineering, or as head of the Bureau of Operations.

Directs, supervises and coordinates the engineering and administrative activities of the Divisions of Transportation, Planning, Design, Right of Way, and Testing and Research.

Plans, directs and coordinates programs to meet the needs of the state.

Schedules activities in accordance with the requirements of the long-range highway planning program.

Reviews progress of pre-construction activities for staff and line action.

or, Directs the activities of the Divisions of Construction, Maintenance, Traffic and Safety, and Local Government.

In the field, studies and resolves specific problems relating to the construction, maintenance and operation of the state trunkline system.

Reviews specifications for inclusion in contracts.

Formulates policies relating to departmental engineering and operations activities.

Reviews and revises budgets of the various divisions.

Edits technical reports and conducts correspondence.

Highway Administrative Engineer 20

Directs, supervises and coordinates the engineering and administrative activities of the Bureau of Engineering and the Bureau of Operations which are composed of the following Divisions: Transportation, Planning, Design, Right of Way, Testing and Research, Local Government, Construction, Traffic and Safety, and Maintenance.

Plans, directs, and coordinates construction and maintenance programs to meet state needs.

Reviews progress of scheduled projects for staff and line action.

Represents Commission, Director, or Deputy Director, at meetings with various individuals and groups to discuss and implement highway policies and procedures.

As determined by the Director, or Deputy Director, attends local and national meetings and conferences of a technical nature, prepares technical papers, talks and discussions with technical and non-technical groups.

Highway Administrative Engineer 21

As the Deputy Director assists the Director in the control and management of the department.

Supervises the operations of the Assistant Deputy Director, Engineering and Operations; the Bureau of Internal Services; the offices of Controller, Personnel, Public Information and Scheduling and Financial Forecasting; and the District Coordinator.

Represents the director, as assigned.

Attends meetings and conferences on highway matters.

Represents the director in contacts inside and outside the agency.

Acts as director when the director is out of state.

EXPERIENCE AND EDUCATION REQUIREMENTS

*Registration as a professional engineer in Michigan will be required at all levels.

Highway Administrative Engineer 16

*Two years of supervisory or administrative experience in highway engineering equivalent to the 14 level in state service.

*Minimum Requirement--Registration, experience

Highway Administrative Engineer 17

*Three years of supervisory or administrative experience in highway engineering equivalent to the 14 level in state service.

Highway Administrative Engineer 18

*Three years of administrative experience in highway engineering equivalent to the 15 level in the state service.

Highway Administrative Engineer 19

*Five years of administrative experience in highway engineering equivalent to the 15 level in the state service.

Highway Administrative Engineer 20

*Five years of administrative experience in highway engineering equivalent to the 16 level in the state service.

High Administrative Engineer 21

*Four years of administrative experience in highway engineering equivalent to the 17 level in state service.

OTHER REQUIREMENTS

Physical condition adequate for performance of the work.

Administrative ability.

Tact and similar qualities necessary in meeting and dealing effectively with others.

Knowledge of administrative techniques.

Thorough knowledge of the principles and practices of highway engineering.

Knowledge of the program, organization, policies, procedures, and rules and regulations of the Department of State Highways.

Knowledge of field and office procedures in highway engineering.

Knowledge of highway financing.

Knowledge of estimates, contracts, plans and specifications.

Knowledge of the methods and materials of highway construction and maintenance.

*Minimum Requirement--Registration, experience

Knowledge of highway structural design and construction.

Knowledge of the methods and problems of highway design.

Knowledge of the techniques of testing construction materials in the laboratory and the field.

Knowledge of the analysis of highway traffic studies.

Knowledge of the economic aspects of highway planning and route location.

Ability to plan and direct field and office operations.

Ability to interpret and explain plans and specifications.

Ability to deal effectively and diplomatically with other agencies and officials.

Ability to prepare and present reports, articles and speeches.

Additional Requirements for Highway Administrative Engineer 17 and 18

Greater skill in the application of knowledges and abilities required for the lower level.

Thorough knowledge of the techniques and problems of administering statewide highway programs in road and bridge construction and maintenance, road and bridge design, planning, traffic, and materials testing and research.

Knowledge of staffing, budgeting and reporting.

Knowledge of the relationship between federal, state and local highway agencies as to planning financing.

Knowledge of current highway engineering practices and trends.

Ability to direct and coordinate programs on a statewide basis.

Ability to schedule and follow up on work projects to meet priority and progress requirements.

Additional Requirements for Highway Administrative Engineer 19

Greater skill in the application of knowledges and abilities required for the lower level.

Ability to coordinate the work of several divisions.

Ability to make recommendations concerning legislation.

Additional Requirements for Highway Administrative Engineer 20

Greater skill in the application of knowledges and abilities required for the lower level.

Ability to coordinate the activities of two engineering bureaus.

Additional Requirements for Highway Administrative Engineer 21

Greater skill in the application of knowledges and abilities required for the lower levels.

Ability to develop and supervise the internal operations of the departments.

Ability to coordinate all activities of the department.

REH:nam

APPENDIX G

QUESTIONNAIRE

Code 1____

2____

3____

APPENDIX G

QUESTIONNAIRE

For each item (1-7) indicate in the appropriate space on the right, the item number corresponding to the correct answer. For example, if you are 35 years old, place a 2 opposite the item in the right hand column. You will note the numbers in the right hand column do not necessarily correspond with the item numbers at the left. This is for tabulating purposes only. Please place your answers in the appropriate spaces to the right of each item.

1. AGE (4) _____

    1. 30 and less
    2. 31-40
    3. 41-50
    4. 51-60
    5. 61-70

2. EXPERIENCE (Years of Engineering experience in the Department) (5) _____

    1. 0-5
    2. 6-10
    3. 11-15
    4. 16-20
    5. 21-25
    6. 26 and over

3. EDUCATION (6) _____

    1. Less than BS Degree
    2. BS Degree in Engineering
    3. MA Degree
    4. MS Degree in Engineering

4. What is your Civil Service Class Level: (7) _____
   e.g. If you are a Bridge Design Engineer 12 (8) _____
   put a 1 in space 7 and a 2 in space 8.

5. What division do you presently work in? (9) _____

    1. Design
    2. Construction
    3. Maintenance
    4. Other

6. If your Civil Service Class Level is 15 or below, please indicate which of these specialities is most applicable to you. (If your Civil Service Level is 16 or above, skip this question) (10) _____

   1. Bridge
   2. Road

7. Where is your work station? (11) _____

   1. Lansing
   2. District

Read each statement carefully then decide to what extent the statement accurately describes your work situation at the present time.

Choose a number value on the scale which best shows how you feel and write your choice on the right side of the page.

SCALE

1 2 3 4 5 6 7

NOT AT ALL FAIRLY OFTEN VERY OFTEN

8. I carry out the directives established by the State Highway Commission and the Director. (12) _____
9. Higher management's authority is respected throughout the department (13) _____
10. I have confidence and trust in higher management. (14) _____
11. Engineers with specializations different than my own contribute to the effectiveness of the State Highway Program. (15) _____
12. I really feel that engineers with specializations different than my own are getting things done. (16) _____
13. Engineers with Civil Service class levels lower than my own contribute to the effectiveness of the State Highway Program. (17) _____
14. I really feel that engineers with Civil Service class levels lower than my own are getting things done. (18) _____
15. I have confidence that the goals of the department established by higher management are realistic and attainable. (19) _____

16. I feel loyal to the department and agree with its goals and objectives. (20) _____

17. I really feel that engineers in my division make a greater contribution to the State Highway Program than engineers in other divisions. (21) _____

18. I believe my engineering specialty requires greater technical skills than others in the department. (22) _____

19. I feel that district engineers who are closer to the problem or work project are better able to make the correct decisions than others in the department. (23) _____

20. I believe that my division receives greater recognition than others in the department. (24) _____

21. I believe that my engineering specialty receives greater recognition than others in the department. (25) _____

22. I believe I have more visibility and prestige by working in the district. (26) _____

23. I agree with the goals and objectives of the department. (27) _____

24. I believe the department has realistic goals and objectives and that they are attainable. (28) _____

APPENDIX H

COVER LETTER FOR QUESTIONNAIRE

APPENDIX H

December 26, 1973

Dear Mr.

The attached questionnaire has been developed to test abstract theories concerning behavior in large scale organizations. The data gathered in this research project will provide the basis for my doctoral dissertation. This research effort has been approved by Mr. John Woodford, State Highway Director.

I have been a state employee for the past 24 years working in four separate agencies. I have, in addition, been doing graduate work, parttime in the evenings, at Michigan State University for the past twelve years. I hope to receive the PhD degree in June.

The major thrust of this research is concerned with the relationships between technical specialists (Highway Engineers) on the one hand and generalists on the other. The results of this study will provide a broader understanding of relationships in large scale organizations.

I would appreciate your filling out the questionnaire and returning it to me in the enclosed self-addressed and stamped envelope by January 11, 1974. The questionnaire has been coded to insure your anonymity. In short, your response will be completely confidential.

Thank you for your cooperation and assistance in aiding me in this research effort.

Sincerely,

Donald J. Willis

APPENDIX I

INTERVIEW SCHEDULE

APPENDIX I

INTERVIEW SCHEDULE

Code 1_____

2_____

3_____

1. AGE 4_____

2. EXPERIENCE 5_____
(years of engineering experience in the Department)

3. EDUCATION 6_____

4. CIVIL SERVICE CLASS LEVEL 7_____

8_____

5. What Division Do You Presently Work In? 9_____

6. Specialty 10_____

7. Work Station 11_____

8. Policies of the Department are established by the State Highway Commission and Director. In general, do you feel these policies are effective? 12_____

0 Uncodable--no response

1 Never effective

2

3

4 Sometimes effective

5

6

7 Highly effective

9. Do you feel top management has the support of the typical staff member in the department? 13_____

0 Uncodable--no response
1 No support
2
3
4 Average support
5
6
7 Maximum support

10. Do you feel the decisions made by top management have contributed to the overall effectiveness of the highway program? 14_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

11. Do you feel programs established by top management respond to the needs of the motoring public and are reasonable? 15_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

12. Do you think that engineers in the (two divisions other than respondents) contribute to the effectiveness of the department programs? 16_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

13. Do you feel that engineers with lower class levels than your own make a contribution to the effectiveness of the highway program?

17_____

0 Uncodable--no response
1 No contribution
2
3
4 Some contribution
5
6
7 Crucial contribution

14. Do you feel your position is properly classified compared with lower level engineering positions?

18_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

15. Do you feel the goals established by top management are reasonable? 19_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

16. How do you feel about the direction the department is moving? 20_____

0 Uncodable--no response
1 Not satisfied at all
2
3
4 Fairly satisfied
5
6
7 Completely satisfied

17. Do you feel that your engineering specialty requires greater skill than others in the department? 21_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

18. Do you agree that the goals and objectives of the department are reasonable and that they are attainable? 22_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

19. Do you feel that district engineers are in a better position to make correct decisions than others in the department? 23 _____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

20. Do you feel that your division receives greater recognition than others in the department? 24 _____

0 Uncodable--no response
1 Not at all
2
3
4 Receives some recognition
5
6
7 Receives great recognition

21. Do you feel your engineering specialty is more prestigious than others? 25_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

22. Do you think district engineers have more prestige by working in the district? 26_____

0 Uncodable--no response
1 Not at all
2
3
4 To some extent
5
6
7 Definitely

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