

**ORGANIZING MODES:
AN INFORMATION
PROCESSING MODEL**

CHAPTER

3

The task of this chapter is to present the framework for choices of organizing modes. Recall that Chapter 1 identified organization design as a continuous choice process covering choices of strategy, organizing modes, and techniques for integrating individual and organizational interests. Chapter 2 elaborated on each area of choice showing that organizing modes consisted of a choice of structure and information and decision process. The choice of integrating scheme consisted of choices of reward system and types of individuals. The short-run goals of the organization, resulting from choices of domain and objectives, constitute the organization's conception of its task. This task is the link between choices of strategy and organization. Recent research suggests that structure, decision process, and individual personality vary systematically with the uncertainty of that task. The objective of this chapter is to explain what is meant by task uncertainty and why it is associated with variations in organizing modes. Subsequent chapters will elaborate on these alternative modes. Finally, the link between task uncertainty and reward systems will be presented in Chapter 16 with an elaboration in following chapters.

TASK UNCERTAINTY AND ORGANIZATION DESIGN

The organization design problem is one of achieving coherence among strategy, organizing mode, and integration of individuals. This conception defines a rich choice of alternative actions to bring about a coherence but leaves one a little confused about where to start. To eliminate some of the confusion we will begin with the task and let it vary. In so doing we will be able to follow how organizing modes can be adjusted so as to maintain

coherence. However, the reader should regard this as a teaching device, not as a theoretical necessity. We could equally well see how tasks and structures vary as individual personalities vary. We choose to make use of recent research and start with the task and specifically with task uncertainty. Following this beginning, one is led to ask why task uncertainty is related to variation in organizing modes.

The basic proposition is that the greater the uncertainty of the task, the greater the amount of information that has to be processed between decision makers during the execution of the task. If the task is well understood prior to its performance, much of the activity can be preplanned. If it is not understood, then during the actual task execution more knowledge is acquired which leads to changes in resource allocations, schedules, and priorities. All these changes require information processing *during* task performance. Therefore *the greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to achieve a given level of performance*. The basic effect of uncertainty is to limit the ability of the organization to preplan or to make decisions about activities in advance of their execution. Therefore, it is hypothesized that the observed variations in organizational forms are actually variations in the alternative organizing modes to (1) increase their ability to preplan, (2) increase their flexibility to adapt to their inability to preplan, or (3) decrease the level of performance required for continued viability. Which mode is chosen depends on the type of uncertainty and the relative costs of the alternative modes. The function of the information processing framework is to identify these modes and their costs. Before articulating the framework, the concepts of uncertainty and information need clarification.

Uncertainty and Information

Uncertainty is the core concept upon which the organization design frameworks are based. This is unfortunate because there is a great deal of uncertainty about the concept of uncertainty. On a general level, everyone understands what uncertainty is. It is the inability to predict future outcomes or states of the world. But when it comes to specifically measuring uncertainty and comparing different tasks, the concept is not understood. No two research studies have defined, labeled, and measured the concept in the same way. The concept of uncertainty has been discussed under the labels of technology, complexity, uncertainty, etc.

First, it can be stated that uncertainty is not inherent in the task and therefore cannot be determined by an analysis of the task alone. *Uncertainty is the difference between the amount of information required to perform*

the task and the amount of information already possessed by the organization. Thus, the amount of task uncertainty is the result of the combination of the specific task and the specific organization performing the task. In order to determine uncertainty, the required task information must be defined.

The amount of information required to perform a task is a function of the nature of the task itself and the level of performance. The aspects of the task that are of interest are those that determine the number of variables about which the organization must collect information. The first aspect is the *diversity of goals* associated with output categories such as the number of different products, different markets, different clients, different diseases treated, etc. Each goal represents a factor in the environment about which knowledge and information must be obtained and processed in decision making. What these goals are and how many are relevant for decision making is determined by the choice of domain. The second aspect is the amount of internal diversity which is determined primarily by the *division of labor*. For example, the organization that employs electronic and electro-mechanical engineering specialists must process more information than the organization that employs electrical engineering generalists. The former must balance work loads among the specialties, sequence the movement of work between them, use two salary categories, etc. Thus, the division of labor determines the number of internal factors about which information must be processed.

The other determinant of required task information is the *level of goal performance* needed to remain viable in the organization's chosen domain. The higher the level of performance, the larger the number of variables that must be considered simultaneously when allocating resources, setting priorities, or determining schedules. For example, when funds are not scarce, universities respond to requests by professors for sabbaticals and trips by considering the merits of the professor's case. When funds are tight, however, professor A's case must be considered simultaneously with the cases of professors B, C, and D. Similarly, a capital shortage may force a job shop to increase its capacity utilization from 60 to 75 percent. At a 60 percent utilization rate, there are few bottlenecks, and scheduling consists of decisions about start dates and completion dates. Follow-up effort is a simple monitoring of progress against those dates. At 75 percent, however, many bottlenecks will arise. Decision making consists of the exploration of many more alternatives such as subcontracting, overtime, split orders, alternate sequences, etc. for the purpose of working around or eliminating bottleneck operations. The higher performance level necessitates considering more alternatives, more variables, and more variables simultaneously. Information must be collected and utilized for all these variables. Thus performance levels, similar to diversity and division of labor, increase the number of

variables to be considered when making decisions and the number of decisions to be made. In addition, performance levels affect the number of factors that must be considered simultaneously when making those decisions.

Task uncertainty is the difference between the required information as defined above and the amount already possessed by the organization. The amount of information possessed by an organization is largely a function of its prior experience with the service, product, type of client or customer, or the technology used in its operations. Thus, a technology may be well within the state of the art but still be new to an organization. Generalizations about new technology must be made in reference to the focal organization and its experience.

The discussion above is summarized by Fig. 3.1. If information could be measured on a scale, which it cannot be, then the amount of information possessed by the organization and the amount of information needed for task performance could be placed on the scale as shown. The difference between these amounts is the relative uncertainty that the organization faces and the amount of information that must be acquired and processed by the decision makers. Uncertainty here means simply the absence of information.

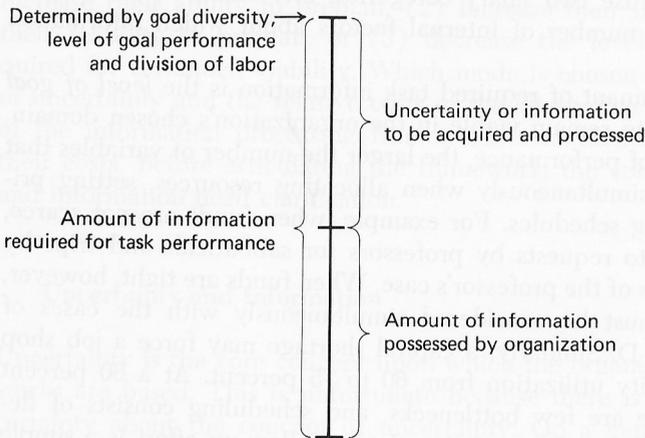


Fig. 3.1 Determinants of information and task uncertainty.

At the moment the information-processing load of a task and the information-processing capacity of an organization cannot be measured accurately. There exist measures for types of diversity¹ and for the division of labor² but no method for combining them into a measure of required information. This is due partially to the difficulty of operationalizing the measuring level of goal performance. Several researchers have developed measures of

overall perceived task uncertainty.³ Rather than measuring each of the components discussed here, they aggregate them and measure the uncertainty as perceived by the managers who must make the decisions. These researchers have been criticized by others trying to replicate their work. At the moment, the best measure is the combination of the validated task variability and task difficulty scales of Van de Ven and Lynch.⁴

These techniques do not permit the measurement of requirements and capacity so that adjustments can be made in the manner that organizations measure and match supply and demand. However, organizations can detect changes in variables affecting information. Organizations know when they adopt strategies of product or market diversification, they know when the division of labor increases, and they know when they increase performance levels by pursuing shorter schedules, tighter quality tolerances, lower costs, higher productivity, etc. Thus, when the task changes, the organization must change. The organization should be planned and designed concurrently with the strategy formulation and planned resource allocations. What the design choices are will be discussed in the remainder of the book.

In summary, the complexity of a task in terms of the amount of information to be processed in decision making is a function of the division of labor, the goal diversity, and the level of goal performance required. When the organization does not have the necessary information, it must acquire the information and make and remake decisions during the actual task execution. Task uncertainty is the relative amount of information that must be acquired. The greater the uncertainty, the greater the amount of decision making and information processing. It is hypothesized that organizations have limited capacities to process information and adopt different organizing modes to deal with task uncertainty. Therefore, variations in organizing modes are actually variations in the capacity of organizations to process information and make decisions about events which cannot be anticipated in advance. In order to see how information is related to structure, let us create a model organization and follow its development when it is faced with increasing task uncertainty.

THE MECHANISTIC MODEL

In this section, the basic model is created and the overall structure of the framework is outlined. Subsequent chapters will expand upon the organizing modes put forth in the framework. Of necessity, the remainder of the chapter is fairly abstract. The purpose is to conceive of organizations as information-processing networks and to explain why and through what mechanisms uncertainty and information relate to structure. In order to accomplish this explanation, a basic mechanical model is created. The value

of the model is not that it describes reality but that it creates a basis from which various organizing modes are followed to adapt the mechanistic structure to handle greater complexity.

In order to develop the model and the design strategies, assume we have a task which requires several thousand employees divided among many subtasks. For example, the task of designing and manufacturing an aircraft or space capsule requires a group to design the capsule, a group to design the manufacturing methods, a group to fabricate parts and components, a group to assemble the parts, and a group to test the completed unit. The creation of specialized subtasks shown in Fig. 3.2 has all the benefits that the classical theorists claimed. On the other hand, it creates new problems which are nicely illustrated by Bavelas.⁵

When a job is made up of separate parts, and parts fit together, small errors accumulating in different parts may easily ruin the final product. Any beginner in woodworking will attest to that. He learns early, and often sadly, to study his plans and consult them frequently, to work slowly, and to check his measurements.

When the interdependent parts of a job are distributed among many different persons, all of the usual problems remain and new ones appear. The new problems stem from the nature of distributed work.

A single workman who finds that the interlocking faces of a joint that he is building do not quite match will decide which face to modify or will scrap them both and began again. When two men are involved, questions may arise as to which one of them will make the adjustment, and which of the two of them was in error. When work is distributed such problems are always latent in the relationship among men and functions. And the more a job is fragmented, the more numerous and the more difficult these problems may become!

This little scenario gives a good feeling for the *interdependence* that arises when work is divided. The problems are more difficult when the product is intangible such as a curriculum or a therapy policy.

In order to coordinate interdependent roles, organizations have invented mechanisms for collecting information, deciding, and disseminating information to resolve conflicts and guide interdependent actions. The collection of mechanisms used constitutes the organizing mode of the organization. A number of theorists have proposed schemes for choosing mechanisms. Child suggests that there are two strategies of control, a personal centralized one and a decentralized bureaucratic one, and that size determines which is more appropriate.⁶ When organizations are small, decisions are centralized at the top and personally communicated to the implementers. Large

organizations decentralize decisions but control choices through rules, procedures, and performance measurements created by specialists. Thompson proposed that there are qualitatively different types of interdependence for which a different coordination mechanism is appropriate.⁷ Pooled interdependence is coordinated by rules and standards; sequential interdependence, by planning; and reciprocal interdependence, by mutual adjustment. March and Simon and more recently Hage, Aiken, and Marrett have identified programming, planning, and feedback (transmission of new information) as the basic mechanisms and one chooses the mechanisms based on routineness of task situations.⁸ The less routine and more diverse the situations, the more one chooses feedback as opposed to programming and planning. In the following sections, parts of all of these schemes are used. Each of the mechanisms will be discussed by returning to a fictitious organization and using the information-processing model as the vehicle.



Fig. 3.2 Horizontal work flow across a functional division of labor.

In order to complete the task in Fig. 3.2 at a high level of performance, the activities that take place in these various groups must be coordinated. The behavior of the product design engineer must be coordinated with process design engineers, etc. While the behavior of the several thousand people must be coordinated, it is impossible for them to communicate with each other. The organization is simply too large to permit face-to-face communication to be the mechanism for coordination. The organization design problem is to create mechanisms by which an integrated pattern of behavior is obtained across all the interdependent groups. In order to see what these mechanisms are and the conditions under which they are appropriate, let us start with a very predictable task and slowly increase the degree of task uncertainty.

Thus, we have a task, like the one represented in Fig. 3.2, in which there is a high degree of division of labor, a high level of performance, and relatively large size. A good deal of information must be processed to coordinate the interdependent subtasks. Then as the degree of uncertainty increases, the amount of information processed during task execution increases. Organizations must evolve mechanisms to process the greater amount of information necessary to maintain the level of performance. Let us follow the history of a fictitious organization performing the task represented in Fig. 3.2 and observe the mechanisms that are created to deal with increasing information loads caused by increasing task uncertainty.

Hierarchy of Authority

Every organization in every society selects some of its members to play coordinating or managerial roles and arranges these roles in a hierarchical form. The primary variable is the selection mechanism. In most of our organizations, managers are selected by the owners, legislators, or boards of trustees/directors on the basis of demonstrated performance. In the Civil Service, competitive examination is used. In still other organizations, seniority acts as the selection mechanism. In traditional societies, family connections are the bases for selection. In egalitarian cultures, workers vote for the managers. In an Israeli kibbutz or in Red China, steps are taken to prevent status differences from developing between managers and workers. Rules are that managers are elected for two or three years and cannot succeed themselves or that they spend half their time managing and half their time working. But in each case, the selection produces a representative with legitimate authority who can influence other members' behavior in resolving conflicts and coordinating interdependence. (The concepts of authority and legitimacy will be treated in depth in Chapter 16.)

Once managers are selected, they are invariably arranged in a hierarchical form as shown in Fig. 3.3. This form clearly identifies the person or group (if a committee or council is used) to whom an appeal must be made in resolving a conflict and thereby preserves legitimacy. In Fig. 3.3, a problem between assembly and fabrication is handled by Manager 2 while a problem between assembly and process design goes to the general manager. The hierarchy form is chosen because it is also an efficient information-processing mechanism.⁹ If communication to coordinate interdependence takes place through direct communication channels, then

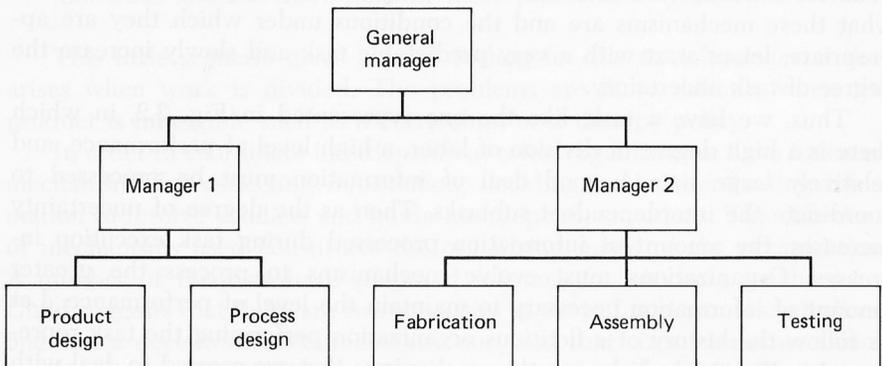


Fig. 3.3 Hierarchical organization structure.

$1/2n(n-1)$ communication channels are needed, where n is the number of subunits. This number grows with the square of n and gets very large even for moderate values of n . However, hierarchical channels reduce the number of channels that each subunit must maintain and yet ties together all interdependent units. If the structure has a uniform span of controls equal to s , then there are $(n-1)(s/s-1)$ communication channels. This number increases with n rather than the square of n ; a result which permits the linkage of larger numbers of subunits. Thus, hierarchies preserve legitimacy by identifying clearly who has authority over whom and by economizing on the information-processing capacity.

There is a price for the economy on information-processing capacity, however. Each channel has a limited capacity for processing information and each position can communicate directly only with those above and below. Other contacts must take place through one or more intervening nodes. An increase in task uncertainty overloads these channels and introduces delays and distortions. In order to overcome this disadvantage, organizations have invented other mechanisms which achieve coordination, preserve legitimacy, and economize on information-processing capacity.

Rules, Programs, or Procedures

All organizations employ rules or procedures which are simply decisions made in advance of their execution. That is, to the extent that decisions are repetitive, a procedure is worked out in advance of encountering the situation. The virtue of rules is that they eliminate the need for communication between interdependent parties and between superior and subordinate. In order to make effective use of programs, the organization's employees are taught the job-related situations with which they will be faced and the behaviors appropriate to those situations. Then, as situations arise daily, the employees act out the behaviors appropriate to the situations. If everyone adopts the appropriate behavior, the resultant aggregate response is an integrated or coordinated pattern of behavior. Thereby decisions for those situations that can be anticipated in advance are decentralized to the lowest levels and the vulnerable hierarchical channels are reserved only for those decisions that cannot be anticipated in advance.

A couple of points need to be emphasized concerning the use of rules and procedures. First, the overall effect is to move repetitive decisions to lower levels of the organization. This movement to lower levels has been described as decentralization. However, it should be noted that there is little decentralization of discretion. Whether workers are guided by a superior's directive made in real-time or in advance, they are still guided by a directive from a superior. The primary effect is an information-

processing one—the elimination from hierarchical channels of communications concerning routine events. Rules serve the same function as habits for individuals. They preserve the scarce information-processing, decision-making capacity for novel, consequential events.

Second, it is important to point out that rules are employed in addition to the use of the hierarchy, not instead of it. The uniform repetitive events are handled by rules while the new and unique events are treated as exceptions and referred to the hierarchical position where a shared superior exists for all affected subordinates. This combination guarantees an integrated coordinated response from the organization both for routine and nonroutine situations. While there exist trade-offs between mechanisms as we shall see, they are added to existing mechanisms to expand information-processing capacity.

The combination of rules and hierarchy, like hierarchy alone, is vulnerable to task uncertainty. As the organization's subtasks increase in uncertainty, fewer situations can be programmed in advance and more exceptions arise which must be referred upward in the hierarchy. As more exceptions are referred upward, the hierarchy will become overloaded. Serious delays will develop between the transmission of information about new situations upward and a response to that information downward. In this situation, the organization must develop new processes to supplement rules and hierarchy.

Discretion Guided by Planning or Professionalism

As the task uncertainty increases, the volume of information from the points of action to points of decision making overload the hierarchy. In this situation, it becomes more efficient to bring the points of decision down to the points of action where the information exists. This can be accomplished by increasing the amount of discretion exercised by employees at lower levels of the organization. However, as the amount of discretion exercised at lower levels of the organization is increased, the organization faces a potential behavior control problem. That is, how can the organization be sure that the employees will consistently choose the appropriate response to the job-related situations with which they will be faced?

The increase in discretion is significant for both the choice of organizing mode which is concerned with information needed to coordinate interdependent activities and for devices to integrate individual and organizational goals. Later chapters will discuss the choice of reward systems to integrate these goals. Here we shall continue with the cognitive portion.

In order to increase the probability that employees will select the appropriate behavior, organizations make two responses to deal with the

cognitive portion of the behavior control problem. The first change involves the substitution of craft or professional training of the work force for the detailed centralized programming of the work processes.¹⁰ This is illustrated by a comparison between manufacturing industries and construction. In mass production, the work processes that are planned in advance are:

1. . . . the location at which a particular task will be done,
2. the movement of tools, materials, and people to this workplace and the most efficient arrangements of these workplace characteristics,
3. sometimes the particular movements to be performed in getting the task done,
4. the schedules and time allotments for particular operations, and
5. inspection criteria for particular operations.

In construction these characteristics of the work process are governed by the worker in accordance with the empirical lore that makes up craft principles.¹¹

The shift to craft or professional workers represents a shift from control based on supervision and surveillance to control based on selection of responsible workers. Workers who have the appropriate skills and attitudes are selected.

Professionalization by itself may not be sufficient to shift decision making to lower levels of the organization. The reason is that, in the presence of interdependence, an alternative which is based on professional or craft standards may not be best for the whole organization. Thus, alternatives which are preferred from a local or departmental perspective may not be preferred from a global perspective. The product design that is technically preferred may not be preferred by the customer, may be too costly to be produced, or may require a schedule which takes too long to complete. In order to deal with this problem, organizations undertake planning processes to set goals or targets to cover the primary interdependencies.

An example of the way goals are used can be demonstrated by considering the design group responsible for an aircraft wing structure. The group's interdependence with other design groups is handled by technical specifications elaborating the points of attachment of the wing to the body, forces transmitted at these points, centers of gravity, etc. The group also has a set of targets (not to be exceeded) for weight, design man-hours to be used, and a completion date. They are given minimum stress specifications below which they cannot design. The group then designs the structures and assemblies which combine to form the wing. They need not communi-

cate with any other design group on work-related matters if they and the interdependent groups are able to operate within the planned targets.

Thus goal setting allows coordination to be maintained between interdependent subtasks and yet allows discretion at the local subtask level. Instead of specifying specific behaviors through rules and programs, the organization undertakes processes to determine targets to be achieved and allows the employees to select behaviors appropriate to the target.

The ability of the design groups to operate within the planned targets, however, depends upon the degree of task uncertainty. If the task is one that has been performed before, the estimates of man-hours, weight, due date, etc. will probably be realized. If it is a new design involving new materials, the estimates will probably be wrong. The targets will have to be set and reset throughout the design effort.

The violation of planned targets usually requires additional decision making and hence additional information processing. The additional information processing takes place through the hierarchy in the same manner as rule exceptions were handled. Problems are handled on an exception basis. They are raised to higher levels of the hierarchy for resolution. The problem rises to the first level where a shared superior exists for all affected subunits. A decision is made and the new targets are communicated to the subunits. In this manner the behavior of the interdependent subunits remains integrated.

Thus our fictitious organization operates by delegating routine decisions guided by rules to lower levels, by delegating local discretion guided by planned targets and goals, and by the use of the hierarchy when goals are not met and rules do not apply. While organizations use all three (and others to be added shortly), some choice of mix is made by organization designers. Holding task uncertainty constant, increases in size increase the amount of programming, planning, and decentralization.¹² In addition, organizations begin to create staff or nonwork-flow specialties such as accounting and personnel who maintain the planning and programming systems. As size increases, the addition of staff specialists is an efficient design choice. Let us follow the addition of administrative services to an organization.

Our fictitious organization is assumed to be growing. At an intermediate size, each of the first-line managers spend some fraction of their time on administrative matters such as budgeting and personnel. After the organization increases in size, there exists enough work for a full-time administrative service manager. The immediate effect of the added manager is better administrative decisions by a specialized full-time manager. The secondary effect is the freeing of other managers from some administrative tasks leaving them more time for supervision. The effects are shown in Fig. 3.4.

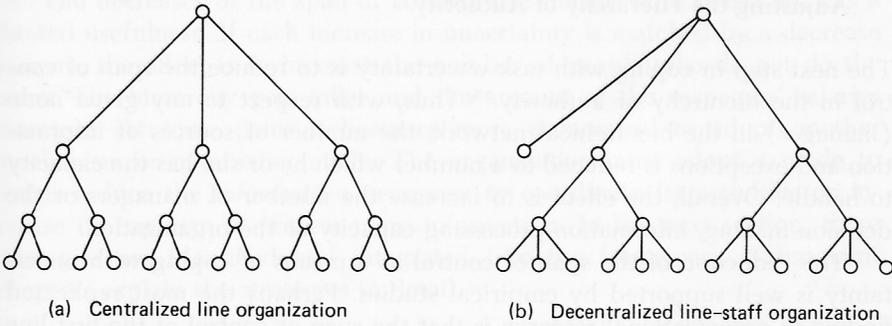


Fig. 3.4 Effects of a staff specialist with uncertainty held constant.

Organization A represents a line organization in which managers make all types of decisions. Organization B has added a specialist in a particular area which frees the line managers to supervise additional personnel. Thus, the same number of personnel can be managed by fewer supervisors. Organization A has ten managers while B has seven managers and a staff specialist. If the total of the three managers' salaries is greater than that of the staff specialist, this is an efficient design even if there is no difference in administrative decision quality.

This explanation is consistent with the empirical results. Increasing size is associated with increasing staff specialization, standardization, the recording of role performance, and decentralization.¹³ Increases in staff specialists and the recording of role performance is associated with proportionally fewer line managers.¹⁴ Similarly, studies on span of control show that the span increases with increasing size of organizations and with the supervision provided by others. Thus, other things being equal, increases in size permit the hiring of staff specialists and the reduction in proportion of managers thereby exploiting economies of scale of large organizations. The problem is that other things are rarely equal.

Two features change along with the changes in size which reduce the economies cited above. First, the expansion brings in new customers or clients whose needs are not exactly the same as the needs of old clients. Usually new services or products are introduced to satisfy these new consumers. Thus, diversity increases simultaneously with size. Second, the increased volume of activity permits greater specialization within the work organization itself. This increased division of labor increases interdependence. Thus, changes in size occur with changes in diversity and division of labor which increase the degree of task uncertainty. As uncertainty increases, we encounter the overloaded hierarchy.

Adjusting the Hierarchy of Authority

The next step in coping with task uncertainty is to reduce the span of control in the hierarchy of authority.¹⁵ Thus, with respect to any given node (manager) in the hierarchical network, the number of sources of information and exceptions is reduced to a number which he or she has the capacity to handle. Overall, the effect is to increase the number of managers or the decision-making, information-processing capacity of the organization.

The reduction of the span of control as a means of coping with uncertainty is well supported by empirical studies. Perhaps the most replicated finding in organizational research is that the span of control of the first-line manager, be it foreman, registered nurse, or finance supervisor, decreases with increases in task complexity, uncertainty, or professionalization and skill of the workers.¹⁶ Thus, uncertainty decreases and size increases the span of control. This relationship is demonstrated by data collected by the author from United States and Canadian oil refineries. Spans of control of first-line supervisors were correlated with size (number of workers in the department) for the production, maintenance, and engineering departments. It is assumed that the engineering task is more uncertain than maintenance which in turn is more uncertain than production. The results are shown graphically in Fig. 3.5. At any given size, the span of control in engineering is less than that in the other two departments. The same phenomenon occurs as one moves up in the hierarchy. As the number of subordinates increases at a particular level, the span of control of the superior increases.

But at each higher level, the span decreases. The effect is shown for the production department in Fig. 3.6. Thus, if we assume that uncertainty increases as we move up the hierarchy, the greater the uncertainty, the smaller the span for a given number of subordinates.

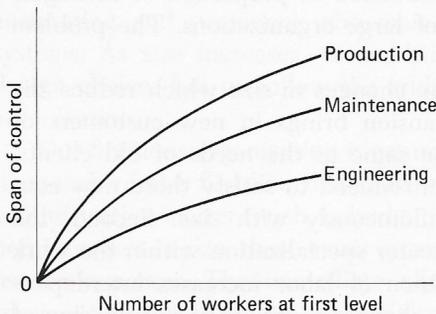


Fig. 3.5 Effects of size and uncertainty on span of control.

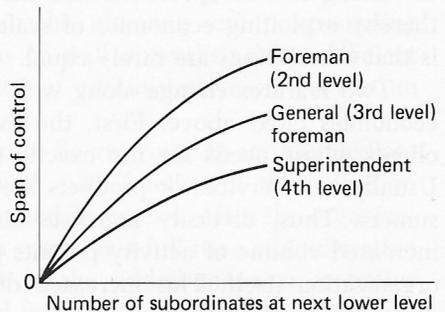


Fig. 3.6 Effects of size and level of uncertainty on span of control.

The decreases of the span of control, like the previous measures, has a limited usefulness. If each increase in uncertainty is matched by a decrease in span, the effect is to increase the number of people who do not do the work. The hierarchy gets taller and the amount of the managers' salaries increases. At some point it becomes more economical to adopt another mechanism or organizing mode. The organization must adopt a mode to either reduce the information necessary to coordinate its activities or increase its capacity to process more information. In the next section, these strategies are identified and integrated into the framework. Subsequent chapters explain the strategies in detail.

Alternative Organizing Modes

The ability of an organization to successfully utilize coordination by goal setting, hierarchy, and rules depends on the combination of the frequency of exceptions and the capacity of the hierarchy to handle them. As the task uncertainty increases, the number of exceptions increases until the hierarchy is overloaded. Therefore, the organization must again take organization design action. This action constitutes the strategic choice taken by the organization. As suggested above, it can proceed in either of two general ways. First, it can act in three ways to reduce the amount of information that is processed. And second, the organization can act in two ways to increase its capacity to handle more information. The three ways for reducing the need for information and the two ways for increasing processing capacity are shown in Fig. 3.7. The effect of all these actions is to reduce the number of exceptional cases referred upward into the organization through hierarchical channels.

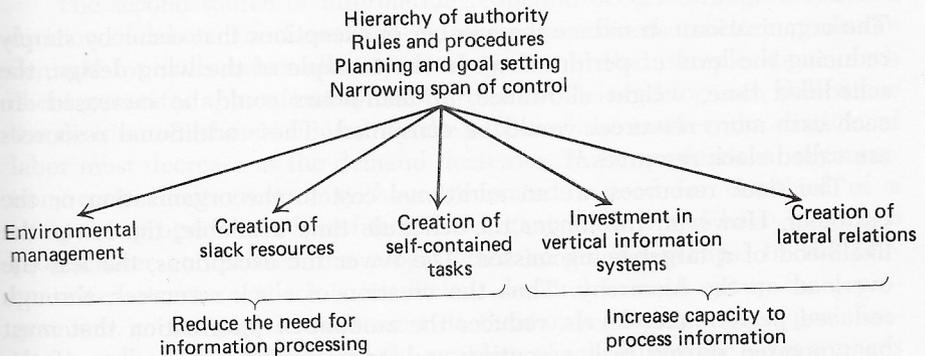


Fig. 3.7 Organization design strategies.

Environmental Management

Instead of modifying its own structure and processes, the organization can attempt to modify the environment. The attempts are to reduce uncertainty about critical events. If demand is very uncertain and fluctuating demand causes problems for highly mechanized facilities requiring 24-hours utilization, the organization can buy the prior or demanding stage in the product flow. Thus, through vertical integration the organization can reduce the potentially disruptive uncertainty.

There are a number of mechanisms by which an organization can relate to its environment. First, there are a number of voluntary responses to environmental demands. These are the (1) competitive response, i.e., being efficient in order to guarantee continual access to scarce resources; (2) public relations response, i.e., influencing the environment through the mass media; and (3) voluntarism, i.e., the voluntary management in the public interest of market imperfections and externalities. If these do not reduce the uncertainty of the environment, the organization can enter various cooperative schemes such as implicit cooperation, contracting, coopting, and coalescing. Finally, if the organization cannot manage a given environment, it can search for a new one through various forms of environmental maneuvering.

This environmental maneuvering consists of adjustments to strategy. That is, the organization modifies its domain and relations with elements in its domain. All of these responses have costs for the organization. Whether it chooses one depends on the amount of uncertainty and costliness of the other four strategies.

Creation of Slack Resources

The organization can reduce the number of exceptions that occur by simply reducing the level of performance. In the example of the wing design, the scheduled time, weight allowance, or man-hours could be increased. In each case more resources would be consumed. These additional resources are called slack resources.¹⁷

The slack resources are an additional cost to the organization or the customer. However, the longer the schedule time available, the lower the likelihood of a target being missed. The fewer the exceptions, the less the overload on the hierarchy. Thus the creation of slack resources, through reduced performance levels, reduces the amount of information that must be processed during task execution and prevents the overloading of the hierarchical channels. Whether the organization chooses this strategy or

not depends on the relative costs of the other four strategies for handling the overload.

Creation of Self-contained Tasks

The next method for reducing the amount of information processed is to change from the functional task design to one in which each group has all the resources it needs to perform its task; that is, change the way the task is decomposed into subtasks. For the example, self-contained units could be created around major sections of the aircraft—wing, cabin, tail, body, etc. Each group would have its own product engineers, process engineers, fabricating and assembly operations, and testing facilities. In other situations, groups can be created around product lines, geographical areas, projects, client groups, markets, etc., each of which would contain the input resources necessary for the task.

The strategy of self-containment shifts the basis of the authority structure from one based on input, resource, skill, or occupational categories to one based on output or geographical categories. The shift reduces the amount of information processing through several mechanisms—two are described here. First, it reduces the amount of output diversity faced by a single collection of resources. For example, a professional organization with multiple skill specialties providing service to three different client groups must schedule the use of these specialties across three demands for their services and determine priorities when conflicts occur. But, if the organization changed to three groups, one for each client category, each with its own full complement of specialties, the schedule conflicts across client groups disappear and there is no need to process information to determine priorities.

The second source of information reduction occurs through a reduced division of labor. The functional or source-specialized structure pools the demand for skills across all output categories. In the example above, each client generates approximately one-third of the demand for each skill. Since the division of labor is limited by the extent of the market, the division of labor must decrease as the demand decreases. In the professional organization, each client group may have generated a need for one-third of a computer programmer. The functional organization would have hired one programmer and shared the programmer across the groups. In the self-contained structure, there is insufficient demand in each group for a programmer, so the professionals must do their own programming. Specialization is reduced but there is not the problem of scheduling the programmer's time across the three possible uses for it.

Thus the first organizing modes reduce overloads on the hierarchy by reducing the number of exceptions that occur. The reduction occurs by reducing the level of performance, diversity of output, division of labor or by increasing the amount of information available to the organization prior to task execution. According to the theory put forth earlier, reducing the level of performance, etc., reduces the amount of information required to coordinate resources in creating the organization's services or products. Thereby the amount of information to be acquired and processed during task execution is reduced. The second class of modes takes the level of information as given, and creates processes and mechanisms to acquire and process information during task execution.

Investment in Vertical Information Systems

The organization can invest in mechanisms which allow it to process information acquired during task performance without overloading the hierarchical communication channels. The investment occurs according to the following logic. After the organization has created its plan or set of targets for weight, stress, budget, and schedule, unanticipated events occur which generate exceptions requiring adjustments to the original plan. At some point when the number of exceptions becomes substantial, it is preferable to generate a new plan rather than make incremental changes with each exception. The issue is then how frequently should plans be revised—yearly, quarterly, or monthly? The greater the uncertainty, the greater the frequency of replanning. The greater the frequency of replanning, the greater the resources, such as clerks, computer time, input-output devices required to process information about relevant factors.

Providing more information more often may simply overload the decision maker. Investment may be required to increase the capacity of the decision maker by employing computers, various man-machine combinations, assistants-to, etc. The cost of this strategy is the cost of the information-processing resources.

The investment strategy is to collect information at the points of origination and direct it to the appropriate places in the hierarchy. The strategy increases the information processing at planning time while reducing the number of exceptions which have overloaded the hierarchy.

Creation of Lateral Relations

The last mode is to selectively employ lateral decision processes which cut across lines of authority. This mode moves the level of decision making

down to where the information exists rather than bringing the information up to the points of decision. It decentralizes decisions but without creating self-contained groups. Several mechanisms are employed. The number and types depend upon the level of uncertainty.

The simplest form of lateral relation is direct contact between two people who share a problem. If a problem arises in testing in Fig. 3.3, the manager of testing may contact the manager of assembly and secure the necessary change. Direct contact avoids the upward referral to another manager and removes overloads from the hierarchy.

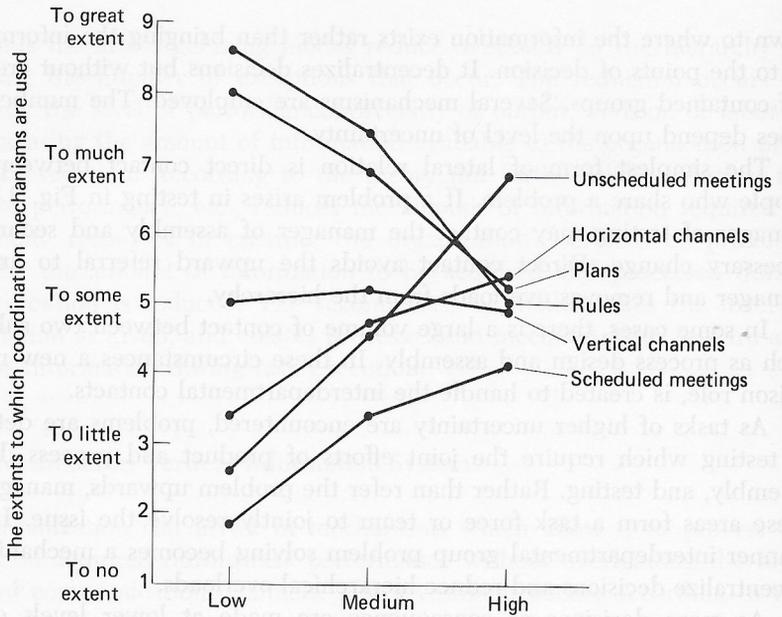
In some cases, there is a large volume of contact between two subtasks such as process design and assembly. In these circumstances a new role, a liaison role, is created to handle the interdepartmental contacts.

As tasks of higher uncertainty are encountered, problems are detected in testing which require the joint efforts of product and process design, assembly, and testing. Rather than refer the problem upwards, managers of these areas form a task force or team to jointly resolve the issue. In this manner interdepartmental group problem solving becomes a mechanism to decentralize decisions and reduce hierarchical overloads.

As more decisions of consequence are made at lower levels of the organization through interdepartmental groups, problems of leadership arise. The response is the creation of a new role, an integrating role.¹⁸ The function of the role is to represent the general manager in the interdepartmental decisions for a particular brand, product line, project, country, or geographical unit. These roles are called product managers in commercial firms, project managers in aerospace, and unit managers in hospitals.

After the role is created, the issue is how much and what kind of influence does the role occupant need in order to achieve integration for the project, unit, or product. Mechanisms from supporting information and budget control all the way to dual reporting relations and the matrix design are employed in various circumstances described in later chapters.

The empirical study by Van de Ven, Delbecq, and Koenig reveals a number of the characteristics of the coordination mechanisms described in this chapter.¹⁹ They measured the extent to which departments in an organization used the various mechanisms described above—rules, planning, hierarchy, horizontal channels, unscheduled meetings, and formal scheduled meetings. The results are shown graphically in Fig. 3.8. The graph shows that the use of horizontal channels and meetings increase with increases in task uncertainty. Second, the use of rules and planning declines with increases in uncertainty. Thus, there is a trade-off between the various modes. Third, the use of the hierarchy remains constant at all levels. This channel is used to its maximum and is supplemented by other mechanisms as needed. Fourth, an organization uses all mechanisms of coordination. They are added to the organization's repertoire rather than substituted for other



	Classified task uncertainty					
	n = 43		n = 125		n = 29	
	\bar{X}	Γ	\bar{X}	Γ	\bar{X}	Γ
Total coordination (Grand mean)	4.4	0.9	4.9	0.9	4.7	0.8
A. Impersonal coordination mode	8.4	1.7	7.2	1.4	5.1	1.2
1. Rules, policies, procedures	8.6	1.5	7.4	1.8	5.0	1.8
2. Plans, schedules, forecast	8.0	2.0	6.9	1.8	5.2	1.8
B. Personal coordination mode	4.2	0.9	5.0	1.1	5.1	1.2
3. Vertical channels (hierarchical)	5.0	1.2	5.2	1.6	4.9	1.5
4. Horizontal channels	3.4	1.4	4.7	1.3	5.3	1.7
C. Group coordination mode	2.1	1.0	3.7	1.8	4.9	1.8
5. Scheduled meetings	1.8	0.9	3.4	1.8	4.1	1.8
6. Unscheduled meetings	2.6	1.6	4.5	2.3	6.7	2.7

Fig. 3.8 Profile of coordination mechanisms on classified task uncertainty showing the extent to which coordination mechanisms are used.

mechanisms although some substitution takes place between using decisions made in advance (rules and plans) and decisions made on an as-needed basis (horizontal channels and meetings). Every organization maintains a repertoire as indicated by the profile, and the profile is a function of task uncertainty.²⁰

In summary, lateral relations permit the moving of decisions to lower levels of the organization and yet guarantee that all information is included in the process. The cost of the strategy is greater amounts of managerial time spent in group processes and the overhead expense of liaison and integrating roles.

Choice of Organizing Mode

Each of the five organizing modes has been briefly presented. The organization can choose to follow one or some combination of several if it chooses. It will choose that mode which has the least cost in its environmental context. However, what may be lost in all of the explanations is that the five strategies are hypothesized to be an exhaustive set of alternatives. That is, if the organization is faced with greater uncertainty due to technological change, higher performance standards, increased competition, or if it diversifies its product line to reduce environmental dependence, the amount of information processing will be increased. *The organization must adopt at least one of the five strategies when faced with greater uncertainty.* If it does not consciously choose one of the five, then slack, reduced performance standards will happen automatically. The task information requirements and the capacity of the organization to process information are always matched. If the organization does not consciously match them, reduced performance through budget overruns, schedule overruns, etc. will occur in order to bring about equality. Thus, the organization should be planned and designed simultaneously with the planning of the strategy and resource allocations. But if the strategy involves introducing new products, entering new markets, etc., then some provision for increased information must be made. Not to decide is to decide, and it is to decide upon slack resources as the strategy to remove hierarchical overload.

SUMMARY

This chapter introduced the basic theory upon which the remainder of the book will build. Starting from the observation that uncertainty appears to make a difference in type of organization structures, it was postulated that uncertainty increased the amount of information that must be processed during task execution. Therefore, perceived variation in organization form was hypothesized to be variation in the capability of the organization to process information about events that could not be anticipated in advance.

Uncertainty was conceived as the relative difference in the amount of information required and the amount possessed by the organization. The

amount required was a function of the output diversity, division of labor, and level of performance. In combination the organization's current knowledge, division of labor, diversity of output, and level of performance determine the amount of information that must be processed.

Next the basic mechanistic, bureaucratic model was introduced along with explanations of its information-processing capabilities. It was shown that hierarchical communication channels can coordinate large numbers of interdependent subtasks but have a limited capacity to remake decisions. In response, five organizing modes were articulated which either reduced the amount of information or increased the capacity of the organization to process more information. The way to decrease information was to reduce the determinants of the amount of information. Thus, reduction of performance levels, diversity, and division of labor were indicated. The modes to increase capacity were to invest in the formal, hierarchical information process and to introduce lateral decision processes. Each of these modes has its effects and costs. The subsequent chapters will discuss each mode in more detail. In addition, case studies will be presented which highlight the choice.

NOTES

1. M. Gort 1962. *Diversification and integration in American industry*. Princeton: Princeton University Press.
2. L. Pondy 1959. Effects of size, complexity, and ownership on administrative intensity. *Administrative Science Quarterly*, (March): p. 52.
3. R. Duncan 1972. Characteristics of organizational environments and perceived environmental uncertainty, *Administrative Science Quarterly*, (September), pp. 313-327.
4. A. H. Van de Ven and A. L. Delbecq 1974. A task contingent model of work unit structure. *Administrative Science Quarterly*, (June): 183-197. B. P. Lynch 1974. An empirical assessment of Perrow's technology construct. *Administrative Science Quarterly*, (September): 338-356.
5. A. Bavelas 1960. Communication and organization. In G. P. Schultz and T. L. Whisler (eds.), *Management organization and the computer*. Chicago: Free Press, p. 319.
6. J. Child 1972. Organization structure and strategies of control. *Administrative Science Quarterly* 17: 163-177.
7. J. D. Thompson 1967. *Organizations in action*. New York: McGraw-Hill, Chapter 5.
8. J. March and H. Simon 1958. *Organizations*. New York: Wiley, pp. 158-169. J. Hage, M. Aiken, and C. B. Marrett 1971. Organization structure and communication. *American Sociological Review*, (Oct.): pp. 860-871.
9. J. Emery 1969. *Organization planning and control systems*. New York: Macmillan, pp. 5-16.
10. A. Stinchcombe 1959. Bureaucratic and craft administration of production: a comparative study. *Administrative Science Quarterly*, (September): 168-187.
11. *Ibid.*, p. 170.

12. J. Child 1973. Predicting and understanding organization structure. *Administrative Science Quarterly*, (June): pp. 168–185.
13. *Ibid.*
14. D. Pugh, D. J. Hickson, C. R. Hinings, and C. Turner 1968. Dimensions of organization structure. *Administrative Science Quarterly* 13: 65–105. P. Blau and R. A. Schoenherr 1971. *The structure of organizations*. New York: Basic Books.
15. Blau and Schoenherr. J. Udell 1967. An empirical test of hypotheses relating to span of control. *Administrative Science Quarterly*, (Dec.): 420–439.
16. J. Woodward 1965. *Industrial organization: theory and practice*. London: Oxford University Press. P. Blau, W. V. Heydebrand and R. A. Stouffer 1966. The structure of small bureaucracies. *American Sociological Review*, (April): 179–191. P. Blau 1968. The hierarchy of authority in organizations. *American Journal of Sociology*, (Jan.): 453–467. G. Bell 1967. Determinants of the span of control. *American Journal of Sociology*, (July): 100–109. M. Meyer 1968. Expertness and span of control. *American Sociological Review*, (Dec.): 947–950.
17. J. G. March and H. A. Simon 1958. *Organizations*. New York: Wiley. R. Cyert and J. G. March 1963. *A behavioral theory of the firm*. Englewood Cliffs, N.J.: Prentice-Hall.
18. P. Lawrence and J. Lorsch 1967. *Organization and environment*. Boston: Harvard Business School Division of Research, Chapter 3.
19. A. H. Van de Ven, A. L. Delbecq, and R. Koenig 1976. Determinants of coordination modes within organizations. *American Sociological Review*, (April): pp. 332–338.
20. R. Duncan 1973. Multiple decision-making structures in adapting to environmental uncertainty. *Human Relations* 26: 273–291.

QUESTIONS

1. Why does structural form vary with task uncertainty?
2. What is the relation between uncertainty and information? Isn't uncertainty simply the absence of information?
3. How does a change in a performance level increase or decrease information processing in an organization? Give an example.
4. Are manufacturing operations always less uncertain than research tasks? Why or why not?
5. Why are hierarchies efficient information-processing instruments? Why are they inefficient information processors?
6. Some recent research findings suggest that greater use of rules, programs, and plans result in greater delegation and perceived control on the part of subordinates. How can this result be explained?
7. Why do (a) environmental management (b) slack resources, and (c) self-contained tasks reduce information processing?
8. Explain how vertical information systems and lateral relations expand information processing capacity.