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TECHNOLOGICAL AND STRUCTURAL DETERMINANTS OF PERCEIVED JOB CHARACTERISTICS

by
Jeffrey Thomas Walsh

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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1978

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CHAPTER ONE

REVIEW OF THE LITERATURE

The purpose of this dissertation is to examine the impact of organizational structure and technology on the attitudes and perceptions of organizational members. In keeping with this general purpose, the following literature review is designed to:

1. acquaint the reader with the concepts of technology and organizational structure as they are commonly used in the sociological literature. Particular attention will be paid to the definition and use of interdependence, since it is the structural dimension to be examined in this dissertation.

2. demonstrate, through a selective review of the literature, that in dynamic situations, job and role characteristics at the individual level can substantially affect and are affected by the structure and technology of the organization.

3. describe several integrative models linking macro level variables, such as interdependence and technology, to individual level variables, such as perceived job characteristics and role variables, and summarize the relevant empirical work.

In the interest of brevity, those areas likely to be familiar to applied psychologists and characterized by general agreement among empirical studies have not been reviewed. In particular, the literature relevant to the dependent variables in this study will not be reviewed here. Instead, the reader is referred to Hackman and Lawler (1971), Hackman and Oldham (1975), and Walsh, Taber, and Beehr (1977) for discussions of perceived job characteristics. For discussions of role theory and, specifically, the use of the concepts of role ambiguity and role overload, the reader should consult Beehr (1976), Beehr, Walsh, and Taber (1976), House and Rizzo (1972),

Kahn, Wolfe, Quinn, Snoek, and Rosenthal (1964), and Sieber (1974). Finally, for discussions of individual outcome variables, Lawler (1973), Lawler and Hall (1970), and Porter, Lawler, and Hackman (1975) are more than adequate.

The Definition and Use of Technology as a Concept in Organizational Research

There are probably as many definitions of technology as there are empirical studies of the subject, multiplied by the number of disciplines engaged in the research. For the purposes of this review, however, Blauner's (1964) definition is suitable for defining technology as the complex of physical objects and processes (mental, manual, and mechanical) employed in turning out the goods and services produced by the organization. It should be noted that this definition is focused primarily on the production system (core technology) and omits the body of engineering and technical knowledge, as well as maintenance functions, that constitutes the support technologies of the organization.[1]

Early Case Studies

Interest in the measurement of technology along specified dimensions stems largely from a series of case studies done at the Tavistock Institute of Human Relations. In developing their theory of technical and social system interaction, Tavistock researchers studied the process of change associated with technological development in several diverse industries. Trist and Bamforth's (1951)

[1] This is not meant to be an arbitrary resolution of the crucial problem of determining the relative impact of the core vs. the support technologies on the structure of the organization and its members. It is merely a convenience, since only core technology subunits will be used in subsequent analyses.

British mines, Rice's (1953) study of job design in an Indian textile mill, and the Industrial Democracy Project studies in Norwegian industry (Engelstad, 1972) all stressed the emergence of the autonomous work group in conjunction with shifts to more sophisticated technology. Emphasis was placed on consciously giving the work group a central role in the production process. Unfortunately, the lack of quantitative attempts to measure technology along specified dimensions makes it difficult to generalize to more stable settings. Since the new technologies were dramatically and obviously different from the old (in terms of work methods, automation, arrangement of equipment, etc.) in all these studies, measuring technology may have seemed unnecessary.

In the United States, the first studies to emphasize the importance of technology were also case studies of the social changes associated with technological development. Walker (1957) studied the first seamless pipe mill in the United States to employ a process technology. Over four years of observation, he found that workers in the new plant became more interdependent, required less supervision, and expressed greater satisfaction. Walker also found that, over the years, workers became more autonomous as a group. In fact, Walker believed that increased emphasis on group activity was an integral part of the automation process.

As in the Tavistock studies, the increase in technological sophistication was obvious. However, Walker emphasized certain aspects of the technology, particularly: the uniform nature of the input, the automatic transfer equipment, the continuous nature of the process, the decreased physical effort required, and the functional

relationships among the men as well as between men and machines.

Faunce (1958) studied automation in the auto industry. His subjects, who had voluntarily transferred to the new plant from non-automated plants, reported closer supervision in the new plant and lower satisfaction than workers in older plants. Again, there was no quantitative assessment of the technology, but Faunce did stress the machine-controlled production line and the multi-purpose automatic machines as the important aspects of the new system.

In yet another study of the introduction of a process technology, Mann and Hoffman (1960) investigated social change in power plants. The usual increases in interdependence, work group autonomy, satisfaction, etc. were obtained. They did specify the characteristics distinguishing the more sophisticated technology. Specifically, they defined automation as "the application of control devices of a feedback nature, such as servomechanisms, to provide self-regulating production processes" (p. 87). Relative technological sophistication was discussed in terms of four characteristics: capacity and sophistication of basic plant equipment; degree of mechanization; degree of functional integration of the production system; and the use of feedback-control mechanisms.

Most of the research that followed was based on these early studies. With the exception of Faunce, all reported some degree of increased worker satisfaction, increased social interaction, greater emphasis on group process, and enhanced worker discretion and responsibility as a direct result of the shift to a more sophisticated technology. Faunce's data are discounted by noting that his study was of static design, with his attitudinal assessment roughly corresponding

to Walker's first round of interviews, which was also negative.

While this explanation may account for Faunce's data, it cannot account for the results of another case study of technological change reported by Chadwick-Jones (1969). In his documentation of the change from batch to continuous flow production in the British tin-plate industry, Chadwick-Jones obtained results directly contrary to those of previous case studies. He found that the technological change resulted in the dissolution of existing autonomous work groups as well as negative changes in all the usual individual attitudes and behaviors. Chadwick-Jones' results are difficult to interpret, since the technological change occurred in conjunction with significant changes in the social organization of the plant and the local community.

But his findings, when viewed along with those of Faunce, suggest two basic problems with these case studies. On the one hand, there seems to be an implicit assumption underlying studies of shifts to advanced technologies that somehow the adoption of highly sophisticated technologies will lead to desirable or acceptable individual attitudes and behaviors for the few remaining production employees. This utopian view of technological change coupled with the case study approach has led to a second problem: the absence of measures of the independent variable. Without actual measures of technology, these case studies' divergent results cannot be interpreted unambiguously, since the relationship between technology and individual outcomes cannot be specified clearly.

The Development of Typological Models

The first systematic attempt to study the relationship of tech-

nology to organizational structure was Woodward's (1965) analysis of the manufacturing firms of the Southeast Essex area of Great Britain. From a survey of 100 organizations, Woodward developed a nine-point scale of technical complexity based on the production system used. This scale was subsequently collapsed into three categories: unit or small batch production; large batch and mass production; and process production. Woodward noted that her nine-point scale was arranged in chronological order, the lower categories being the earliest forms of manufacture. Also, she found that the possibility of controlling the production process increased with the level of technical complexity.

Woodward observed that there was no one optimum level of technology; a given organization might find any particular level best, depending on the product. In fact, regressions to lower production categories occurred in two of the firms studied, with positive results in the marketplace. The level of technology "is dependent on the nature of the product, the range of products, the market served, and the techniques and hardware available to process the appropriate raw materials and components" (p. 75).

Woodward found that similar production systems seemed to have similar organizational structures. She found that technical complexity was related to characteristics of the hierarchical structure, top level span of control, and increased percentages of clerical, administrative, supervisory, and other indirect labor relative to production labor. In particular, the highest and lowest levels of the scale showed less development of line-staff organizations, fewer production control mechanisms, a smaller span of control for first-line supervisors, and a greater number of skilled workers, as compared

to the large batch and mass production categories. There was no relationship between technology and size of the organization.

Woodward (1970) suggested two alternative explanations for the relationship of technology to organizational structure. In the first, the degree of uncertainty and unpredictability in the production task was the causal link between the two. (This is similar to Perrow's [1967] number of exceptional cases.)

The other interpretation emphasized the role of the control system as the underlying variable. In a re-analysis of the South-east Essex data (1970), she categorized firms in terms of control processes. A very clear relationship was obtained between production process and control process. Woodward suggested that the similarities between the process and unit production processes were due to the fact that unitary control processes predominate in both, with the differences due to impersonal or mechanical controls dominating in the former and personal control in the latter. The heterogeneous structure associated with the large batch and mass production firms was linked to their distribution across the entire range of control processes, with most exhibiting fragmented control.

Since it was the first large-scale comparative study of organizations to stress the relationship of technology to organizational structure, Woodward's work served to legitimize the use of technology in comparative organizational analysis. Her study stimulated additional research as well as alternative approaches to operationalizing the concept of technology.

There were difficulties with Woodward's scale of technical complexity. In particular, 20 percent of her sample could not be

classified unambiguously into one or her nine categories, even though all were relatively small organizations (91 percent had 1,000 or fewer employees). Twelve percent of her sample was too diversified to be placed in any one of her nine categories and another eight percent did not fit at all. Also, the large batch and mass production categories became a catch-all category; such firms were frequently closer to the unit or process ends of the scale than to each other. The fact that one in five organizations in her original sample could not be readily classified in terms of her scale of technical complexity severely weakens its usefulness as a general purpose typology of technologies.

Starting from a different perspective, Perrow (1967) compared organizations on a measure of technology based on the complexity of the input. He distinguished two aspects of technology, the number of exceptions and the extent to which search is an analyzable procedure. Four technologies were derived: routine, engineering, craft, and nonroutine.

Perrow did not attempt to operationalize his technological variables; he did interpret an extensive body of research in terms of his framework. The importance of his approach lies in its shift from measuring technology in terms of output to emphasizing the impact of the nature of the input on the organization's arrangement of the production process. Also, by avoiding any assumptions about organizational structure, functions, or goals, Perrow's scheme lends itself to generalization beyond the blue-collar industrial setting.

Using Perrow's framework, Hage and Aiken (1969) studied 16 health and welfare agencies. A random sample from each agency,

stratified by level and department, received a questionnaire designed to measure the routineness of the work. Responses were aggregated by location in the organization and combined into an organizational score for each agency. As expected from Perrow, agencies with routine work were found to be higher on measures of centralization of power, formalization of work roles, and emphasis on product goals (large quantities of "service" at low cost).

Grimes, Klein, and Shull (1972) have also attempted to apply Perrow's model. Though hardly decisive, their results also supported the model; the autonomy of industrial task units did tend to be highest for the craft cell, intermediate for the engineering cell, and lowest for the routine cell. None of the units sampled fell into the nonroutine cell.

In yet another version of the Perrow model, Van de Ven and Delbecq (1974) presented results which strongly suggested the presence of an interaction effect between their equivalent of the search process (perceived task difficulty) and the exceptions dimension (perceived task variability). They chose to ignore the possibility in their own discussion of the results, however.

Finally, Lynch (1974) presented an "empirical assessment of Perrow's technology construct" in a library setting. Her results were interpreted as substantiating the model.

Thompson (1967) proposed a third typology of technologies. He identified three varieties of technologies, long-linked, mediating, and intensive, at a level sufficiently general to allow application to most complex organizations. The long-linked technology involved serially interdependent tasks in the sense that some act, A, must be

performed before some other act, B, and so on.

The mediating technology entailed the sorting of inputs or clients into groups for the application of standardized procedures. The intensive technology consisted of the selective application of procedures on the object in a manner governed by feedback from the object itself.

Thompson's examples and propositions were focused at the organizational level of analysis. However, empirical work involving the typology is available only at the intraorganizational level. Mahoney and Frost (1974) applied Thompson's typology to a sample of departments and divisions within a number of business and industrial firms. Their results were generally supportive of Thompson's theoretical analysis. They found that their criteria of organizational effectiveness did vary with the nature of the technology of the unit.

> The relevant criterion dimensions in units with long-linked technologies tend to relate to the efficiency, smoothness and reliability of operations, those in units with mediating technologies tend to relate to flexibility, smoothness, and efficiency of operations, and those in units with intensive technologies tend to relate more to relationships with other units and quality of staff as well as performance (p. 134).

Rousseau (1977) has used Thompson's typology to examine variations in job characteristics (Hackman & Lawler, 1971) and worker satisfaction across technologies. Rousseau asserted that the amount of discretion afforded to workers varies across the typology. Workers in situations involving a long-linked technology have little discretion, since activities can be programmed in advance. Workers in mediating technologies, however, must use discretion at least in the choice of which standardized procedure is appropriate to deal

with each of a number of possible inputs. Workers in intensive technologies exercise the greatest degree of discretion, since intensive technologies are characterized by a problem-solving orientation.

Rousseau found significant differences among the three technologies in terms of individual perceived job characteristics. When compared to mediating and intensive technologies, long-linked technologies were associated with few opportunities to interact with others, low skill variety, low autonomy, low significance of the tasks, and little opportunity to learn. Mediating technologies were distinguished from intensive technologies by higher task identity and feedback from agents, although the difference in task identity may have been a function of the sample; the intensive cell consisted primarily of hospital nursing staffs.

The Evidence from Job Redesign Studies

Data from both successful and unsuccessful job redesign experiments have also suggested that a significant relationship exists between the structure and technology of an organization and both actual and perceived characteristics of individuals' jobs within that organization. In his review of organizational change and development techniques, Beer (1976) suggested that the core technology of an organization may limit the possibilities for job redesign within existing facilities. Thus, Beer argued that participative techniques useful in service industries (for example, Weed, 1971) must give way to work modules designed around subassemblies (Briggane & Stewart, 1963) or the creation of semi-autonomous teams within the existing technology (Iman, 1975) in more capital-intensive industries.

Beer also speculated as to the possible direct impact of

technology on workers' perceptions of their jobs. He stated that

> Autonomy, variety, and task identity are not equally possible in all technologies. For example, task identity is difficult in a process technology where many thousands of pounds of a material are processed by a manufacturing line in one hour (i.e., chemicals, soap, fertilizer). On the other hand, conditions of autonomy and feedback may be easier to create in an automated process technology (Blauner, 1964; Shepard, 1967) than in heavy assembly technology (p. 976).

Davis and Taylor (1972) have expressed the relationship between technology and the characteristics of jobs more forcefully. As the technology becomes more sophisticated, they argued, the machine-product interaction comes to predominate in the production process. The man-product interaction (traditionally the "job" of the worker) declines in importance, resulting in simpler, smaller and more fractionated jobs. The alternatives are clear: either accept non-jobs involving minimal man-product interaction (Blauner's auto worker) or expand the worker's role to include more extensive man-machine interaction (maintenance and production supervision).

A Dimensional Model of Technology

Taking another tack, Hickson et al. (1969) classified technologies in terms of operations, knowledge, and materials, although empirically they have concerned themselves only with the first type. They divided operations technology into four subconcepts: automation of equipment; adaptability of workflow; evaluation of operations; and unit of throughput. The first three concepts were operationalized as one variable, workflow integration, which was defined as the degree of automated, continuous, fixed-sequence operation in the technology.

Five subscales constituted the workflow integration scale. The core of the scale was the workflow rigidity scale, based on Thompson

and Bates' (1957) definition of the adaptability of the technology as "the extent to which the appropriate mechanics, knowledge, skills and raw materials can be used for other products" (p. 331). Two additional scales were based on Amber and Amber's (1962) concept of automaticity, which they defined as the degree to which machines perform human attributes. The automaticity range score was the value assigned to the most sophisticated piece of equipment in the unit, while the automaticity mode was the value assigned to the most common type of equipment in the unit.

The fourth scale, interdependence of workflow segments, assessed the degree of linkage among the subunits of the organization. Interdependence varies from duplicate subunits in different parts of the organization producing the same final outputs to subunits having outputs that are the sole input for other organizational subunits. The final scale, specificity of criteria of quality evaluation, referred to the degree to which final outputs are compared to precise specifications in determining their acceptability.

Since a principal components analysis of all the scales yielded a first factor accounting for 59 percent of the variance and all scales loaded at least .6 on the factor (three loaded above .8), Hickson et al. decided that they were justified in combining the five scales into one. Their workflow integration scale, therefore, was constructed by adding together the scores on the five component scales.

However, their hypothesis, that technology and organizational structure are strongly related, was not supported. A comparison of their results with Woodward's (1965) led to a reformulation of the

role of technology. They concluded that

> Structural variables will be associated with operations technology only where they are centered on the workflow. The smaller the organization, the more its structure will be pervaded by such technological effects: the larger the organization, the more these effects will be confined to variables such as job counts of employees on activities linked with the workflow itself, and will not be detectable in variables of the more remote administrative and hierarchical structure (pp. 394-395).

In other words, in small organizations, everybody is closer to the production process; in larger organizations, managers and administrative personnel are separated from it by the administrative structure that comes with size, thus weakening the impact of technology on the organization as a whole. And, in general, the results of later studies by Inkson et al. (1970), Aldrich (1972), and Child (1973) have substantiated the notion that technology is of secondary importance as a determinant of organizational structure.

However, it may also be that their hypothesis failed not because there is little relationship between structure and technology, but because they totally neglected support technologies in their conceptual model. They simply assumed that the core technology was the only technology, which may well be the case in small organizations but is certainly not the case in larger, more diversified organizations. Had they measured support technologies, they might well have found the same result in large organizations that they found in small ones; namely, that the dominant technology in the subunit has a significant impact on that unit's structure.

Job-specific Studies of Technology

Finally, there have been a number of studies that have focused specifically on the nature of the tasks performed by individual

Finally, there have been a number of studies that have focused specifically on the nature of the tasks performed by individual workers. Bell (1967) examined the relationship between job complexity and span of control. Bell defined complexity in terms of four factors that bear a striking resemblance to several of Turner and Lawrence's (1965) Requisite Task Attributes. Bell's factors were: degree of predictability of work demands (knowledge); amount of discretion (autonomy); extent of responsibility (responsibility); and number of different tasks performed (variety). He found that both supervisor and subordinate job complexity were inversely related to span of control.

Others, such as Mohr (1972), have taken more of a shotgun approach, defining technology in terms of the manageability of inputs, noise level, and degree of task interdependence. In the same vein, Hrebiniak (1974) looked at technological (job) level, task predictability, interdependence, and manageability (operationalized as uncertainty). Both found weak relationships between their measures, which were all gathered by questionnaires, of technology and their measures of structure and supervisory style.

Attempts at Integration

Although definitions of technology abound in the literature, there is a definite shortage of integrative efforts. Hunt (1972) did provide an adequate summary of the theoretical work to date, but integration amounted to forcing everything to fit Perrow's model. What did not fit got lost.

Lynch (1974), besides providing an intelligible rendition of Perrow, has provided the best summary exposition of the existing

theoretical positions. She has erred, however, in assuming that everybody is actually talking about the same thing when they speak of technology. In fact, they are not, and there are two complementary reasons why. First, most work to date has adopted either a limited, almost unidimensional view of technology (Perrow; Taylor, 1971a, b; Thompson; Woodward) or a shotgun approach to the multivariate analysis of questionnaire data (Hrebiniak; Mohr). Whether or not these unidimensional, operational definitions bear any relationship to one another is an empirical question that has yet to be addressed.

Secondly, and compounding the first problem, is the tendency of researchers to speak not of the relationship of, say, workflow rigidity to the percentage of procedures that are specified in writing, but rather to speak of the impact of technology on structure. Stanfield (1976) has suggested that the major problem in the study of technology and structure is the confusion that arises from the common practice of generalizing, not across types of organizations but across types of variables. Not only has this resulted in apparently contradictory findings as a host of different variables, all labeled "technology," are related to structural variables, but it has also obscured the overlap between operationalizations of structure and technology.

Stanfield suggested that researchers "conceptually disaggregate" their measures and focus on the relationships between specific scales (as, for example, Bell has done) rather than rush to generalize from their nonrepresentative sampling of a few variables to a complex aggregate of variables labeled "technology." The use of multiple measures of technology would seem to be another possible solution to

the problem, since this would allow for an empirical comparison of the various measures. Once it is realized that the previous efforts to measure technology are not necessarily talking about the same thing and often drift from technology into the realm of organizational structure, some of the apparent discrepancies among various findings become less troublesome.

Lynch, for example, commits a fundamental error in lumping Woodward's work with the Aston studies, differentiating both from Perrow only in terms of level of analysis. Her conclusion that Woodward's effort was like that of Hickson et al., "in classifying industrial production in terms of its technology and according to the technical complexity of the overall productive process rather than in terms of its organization" (p. 339), is exactly backwards. Woodward was concerned with how whole organizations were set up to turn out a product, not solely with the characteristics of the production operations. Woodward was not trying to measure operations technology, as Lynch assumes. Woodward's measure of technical complexity (an unfortunate choice for a label) is a global measure of the organization's combination of operations, materials, and knowledge technologies in producing a product.

Hickson commits a similar error in his treatment of Thompson. He mistakenly equates Thompson's long-linked technology with his own operations technology; intensive technology with materials technology; and mediating technology with knowledge technology. Whether Hickson sees Thompson's categories as increasing workflow integration from intensive through mediating to long-linked or is merely indicating the type of technology most important in each of Thompson's

categories is unclear.

Thompson's concern was in categorizing complex organizations in terms of the way their production processes are organized. And while knowledge of input characteristics may be important in the mediating technology, that does not imply that knowledge technology, in Hickson's sense, is necessarily pre-eminent in that category of organizations. Whether or not Thompson's categories can be differentiated on the basis of workflow integration scores is an empirical question.

To summarize, students of technology have not been about the same task. There is very little agreement, even conceptually, as to what technology is. Thompson's typology has probably received the most attention of all the various approaches in terms of applications by others. Workflow integration, on the other hand, is probably the best empirical measure of technology. It has been subjected to the most thorough empirical evaluation and has the advantage of consisting of discrete, operational subscales. More critical evaluations of previous work, such as Stanfield's article, coupled with empirical cmparisons of the major approaches and the avoidance of generalizations across classes of variables constitute the parameters for further research in the area of "technology." On the positive side, it seems clear even in the early case studies that technology can exert a substantial influence over individual attitudes (Blauner; Chadwick-Jones; Faunce; Trist & Bamforth; Walker).

The technology of an organization is directly related to the characteristics, actual and perceived, of individuals' jobs. Changes in technology often result in profound changes in the nature of the

tasks may result in significant changes in the technology and even in the product. (Kalmar is a case in point [Walton, 1975].) Beer has implied that perceived job characteristics may exhibit systematic relationships to technology even in stable situations. However, these relationships have yet to be explored in detail. Later work by Rousseau has demonstrated that workers' perceptions of their jobs may be the intervening variable between the organization's technology and job satisfaction.

Finally, there appears to be some consensus that automaticity and workflow rigidity (to use the terminology of Hickson et al.) are useful dimenions of technology. Both Walker and Chadwick-Jones focused on automatic transfer equipment as an important aspect of technology, and Mann and Hoffman spoke of the degree of mechanization and sophistication. The concept of workflow rigidity is paralleled by Faunce's machine-controlled line and multipurpose machines, Woodward's discussion of machine control, and Mohr's concept of interdependence among tasks.

The Definition and Use of Structure as a Concept in Organizational Research

Organizational structure is usually defined as the relatively stable pattern of role relationships within an organization. Structure develops around three basic events within the organization, namely: input transactions, throughput, and output transactions. It is the occurrence of these events, and the interdependencies and relationships among them, that constitutes the structure of an organization (James & Jones, 1976; Katz & Kahn, 1966).

Two aspects of this definition merit special attention. First,

as is the case in all social systems, structure, that is, the pattern of role relationships, exists only so long as the organization is functioning (Allport, 1962). As Katz and Kahn point out, social systems differ from biological or physical systems in this regard, as the latter poses measurable structures whether they are functioning or not. To ignore this basic distinction between social and physical or biological systems is to obscure the contrived, loosely articulated and highly variable nature of social systems, such as organizations.

The second aspect of the definition that bears attention is the assertion that structure is a relatively enduring characteristic of an organization. Although dependencies and interrelationships among organizational subsystems may change over time (the job redesign literature mentioned earlier provides many examples), structure, in comparison to other organizational characteristics such as climate, is considered to be relatively enduring (Katz & Kahn; Pugh, Hickson, Hinings, & Turner, 1968).

Systematic theoretical and empirical attention to the concept of organizational structure developed in response to Weber's (1947) treatise on bureaucracy. Inital empirical efforts focused on the question of whether the concept called "bureaucratization" was unidimensional, as Weber seemed to suggest. Representative of the unidimensional approach are studies by Udy (1959) and, more recently, Blau (1967), Child (1972), and Mansfield (1973). All at least imply that bureaucracy may be a multifaceted concept but have opted to treat structure as unidimensional. A common variation on the unidimensional theme are the two-ideal-types models such as Burns and

Stalker's (1961) and Hage's (1965) organic and mechanistic styles of organizing.

Dimensions of Organizational Structure

Most researchers have chosen to think of organizational structure not in terms of degree of bureaucratization, but as separate dimensions characterizing the flow of organizational events. Although the issue has not been settled unequivocally by the research to date, the consensus seems to be that a multidimensional view affords a more flexible approach to the study of structure (Reimann, 1973; Scott, 1975) than does the unidimensional approach.

James and Jones have reviewed the major approaches to dimensionalizing structure and have identified seven proposed dimensions occurring in the literature. Stated briefly, their proposed dimensions are:

1. Total organizational size. Several researchers (Indik, 1968; Porter & Lawler, 1965; Sells, 1963) have treated size as a structural variable, and on that basis, James and Jones classified it as such. On the other hand, it should be noted that the Aston group (Pugh, Hickson, Hinings, & Turner, 1969), Aldrich (1972), Blau (1970), and many others (Kimberly [1976] provides a comprehensive listing) have consistently treated size as a contextual variable influencing or determining structure, rather than as a structural variable per se (Walsh, 1977).

2. Centralization of decision making and authority. Although terminology varies, most approaches to the definition of structure include some notion of centralization. Pugh et al. (1968) defined it as the locus of authority to make decisions; Hall, Hass, and

Johnson (1967) called it centralization of authority; Porter and Lawler (1965) called it shape, centralized or decentralized; and Indik (1968) labeled it the authority structure.

3. Configuration. Pugh et al. (1968) defined configuration as the "shape" of the role structure and operationalized the concept in terms of the number of levels in the line hierarchy and span of control. Others, such as Indik, Porter and Lawler, and Hall et al., have separated the two operational definitions into separate variables.

4. Formalization. Most definitions of the concept refer to the degree to which roles are clearly defined (usually in writing) and procedures specified in advance (Pugh et al., 1968). Other aspects of formalization include going through proper channels (Hall et al., 1967) and a reliance on written forms of communication.

5. Specialization. The degree to which the work is divided according to functional specialization (Pugh et al.) is the most common definition of specialization, although this concept is less clearly understood than the proceeding dimensions. Tyler (1973) has developed a measure of specialization called role variety that effectively removes much of the conceptual and empirical ambiguity that has characterized the use of the concept thusfar.

6. Standardization. Pugh et al. defined standardization as the extent to which the organization has rules to cover every contingency. In a similar vein, Indik focused on the degree of task specification. Both definitions are problematic in that they may overlap substantially with formalization in so far as formalization refers to the extent to which procedures and role definitions are committed to

writing.

7. Interdependence. The only concept listed by James and Jones not derived primarily from the Aston studies is interdependence. James and Jones defined the concept as "degree of task interdependence (Indik, 1968) and autonomy with respect to intraorganizational functions (Sells, 1963)" (p. 82). Critical to an understanding of interdependence is Rice and Mitchell's (1973) distinction between the dimension structure and the interaction structure of the organization. The dimension structure of an organization refers to the nature or characteristics of relationships among individuals and/or groups in the organization. Power (Emerson, 1962) and status were important aspects of the dimension structure for Rice and Mitchell. The six dimensions of organizational structure just discussed can be characterized as parts of the dimension structure, broadly defined (Moch & Feather, 1977).

The interaction structure, on the other hand, refers to the network of relationships among organizational members and subgroups, as reflected in communication patterns within the organization. The concept of interdependence may be viewed as representative of the interaction structure of the organization. Empirical studies which have focused on the dimension structure of organizations have tended to omit interdependence as a structural characteristic. Instead, interdependence has emerged in the interorganizational literature[1] and in studies focusing on relationships among organizational subunits.

[1] See Walsh (1976) for a concise summary of the concern with dependency relationships in the interorganizational literature.

Thompson (1967) has provided the most comprehensive treatment of interdependence among organizational subunits. Noting that both closed and open systems models of organization assume that subunits are interdependent, Thompson demonstrated that this assumption does not imply that each subunit is somehow dependent on all the others. Thompson suggested that interdependence can take one of three forms. Pooled interdependence is the most primitive form and characterizes situations in which each subsystem "renders a discrete contribution to the whole and each is supported by the whole" (p. 54).

The second form of interdependence is sequential interdependence. Again, each subsystem makes contributions to the whole and is, in turn, supported by the system; but, in addition, direct dependencies among subunits can be identified and the direction of the dependencies specified. Sequential interdependence is not symmetrical. In terms of exchange theories of power (Emerson; Jacobs, 1974), this constitutes a bilateral exchange imbalance, with one member of the relaionship enjoying a dominant position vis-a-vis the other.

The third form of interdependence Thompson called reciprocal interdependence. Reciprocal interdependence exists when the outputs of one subsystem become the inputs for another subsystem and vice versa. Under these conditions, each subsystem is dependent on the other. This constitutes the most complicated form of interdependence, since it involves pooled, sequential, and reciprocal interdependencies simultaneously. Thompson used the example of an airline to clarify this last point. The outputs of the maintenance subsystem are serviceable aircraft, which are one of the inputs for the operations subsystem. One output of the operations subsystem is an input for

the maintenance subsystem, namely, aircraft in need of service. Pooled interdependence exists, since each contributes to the success of the whole, and sequential interdependence exists since the same aircraft are passed first to one and then to the other. Reciprocity exists in the dependency relationships, however, because each subsystem poses critical contingencies for the other. Put in terms of exchange theories of power, reciprocal interdependence represents a balanced or two-way flow of influence.

Hickson, Hinings, Lee, Schneck, and Pennings (1971) have elaborated on Thompson's and Emerson's models. They view organizations as interdepartmental systems for which a major task is coping with uncertainty. Imbalances in dependence relationships, because of their impact on the participants' uncertainty, give rise to power relationships among departments. Since coping with uncertainty is a central problem for organizations, the power relationships resulting from dependency imbalances will be tempered by two related variables: the degree to which a department copes with uncertainty for other departments and the extent to which departments' coping activities are substitutable. Thus, a complete understanding of uncertainty requires not only the ability to specify the network of dependencies as it currently exists, but also the importance of each relationship to the participants (degree of coping for others) and the availability of other equivalent relationships (substitutability).

Hinings, Hickson, Pennings, and Schneck (1974) have attempted to operationalize these three aspects of interdependence. The basic measure of interdependence, workflow pervasiveness, reflects the number of links each department had with all other subunits in the

organization. Substitutability was ascertained by asking members of the organization how easy they thought it would be to subcontract work for which they were currently dependent on other sections. It was not clear how, if at all, the relative importance of dependency relationships was ascertained. A more extensive discussion of measures of interdependence will follow in Chapter Three.

There are many problems with these seven dimensions of organizational structure, both conceptually and operationally. Theoretical definitions are hardly independent, and the scales tend to be highly correlated. For the most part, scales are based on a priori definitions of structure and large-scale factor analyses. Cross-validation is rare. Original samples are hardly representative of work organizations in general, or of any subset thereof. In addition to these common problems, all the original studies contain their fair share of methodological problems. On the other hand, there does appear to be some convergence of results, and, to the credit of the researchers, there seems to be a conscious effort to build on and incorporate the work of earlier studies into later research. Finally, several studies have recently appeared which are focused specifically on sharpening the theoretical and operational definitions of specific dimensions. Tyler's (1973) article on role variety (specialization) and Kimberly's article (1976) on size are two excellent examples of this trend.

Integrative Models

Concurrent with the refinement of the concept of organizational structure has been the effort to bridge the gap between macro and micro approaches to the study of organizations through the develop-

ment of integrative theoretical models incorporating the salient variables from both domains. Pugh (1966, 1969; Payne & Pugh, 1976) has frequently stressed the need to break with traditional disciplinary compartmentalization and develop a unified science of individual, group, and organizational behavior. In fact, Pugh's own work reflects the development of this interdisciplinary trend. In concluding a 25 page discussion of hypothesized relationships among structural and contextual variables, Pugh, Hickson, Hinings, McDonald, Turner, and Lupton (1963) mentioned their intention to "relate the organizational structure and functioning to what we have tentatively called group composition and interaction, and individual personality and behavior. We would hope to generate hypotheses about the relationships between these three levels of analysis" (p. 314).

In a later review of six sub-areas in the organizational theory literature (management theorists, structural theorists, group theorists, individual theorists, technology theorists, and economic theorists), Pugh (1966) demonstrated the inadequacies of organizational research based on limited discipline-specific approaches to organizational phenomena. He concluded that the maintenance of artificial boundaries can not only lead to naive explanations or misinterpretations of empirical results, but can also constrain researchers in their choice of problems.

Still later, Pugh (1969) noted a substantial shift in the thinking of at least micro-level theorists. Citing the impact of Katz and Kahn's (1966) application of open systems theory to the study of organizations, Pugh suggested that psychologists were beginning to accept "the reality of the structured social

relationship" (p. 347).

Pugh seems to see the development of the concept of organizational climate as indicative of a growing awareness of the importance of structural variables in understanding individual behavior. Payne and Pugh (1976) cast climate in the role of a mediating variable between organizational structure and the individual. Different organizational structures result in different organizational climates. For Payne and Pugh, "climate describes the characteristic behavioral processes in a social system at one particular point in time" (pp. 1127-1128). This model (see Figure 1.1) is significantly different from what Pugh, at least, had proposed earlier. Initially, Pugh (1966; Pugh et al., 1963) had implied that group-level variables within an organization mediate between organizational-level and individual-level variables. Now, Payne and Pugh are arguing for a direct organizational-individual link mediated only by the climate (objective and/or perceived) of the organization.

Unfortunately, Payne and Pugh chose to omit several articles critical of the climate literature from their review (notably: Guion, 1973; James & Jones, 1974; Johannesson, 1973). This severely weakened their arguments, particularly with respect to climate-individual outcome relationships. Nonetheless, they did present data suggesting a structure-climate relationship, at least where objective structural measures were used. The objective measures of structure cited were reasonably stable and, like the reported contextual-structural relationships, they conformed to the standard Aston pattern. However, their objective and subjective indices of structure rarely correlated well with one another, and their perceived

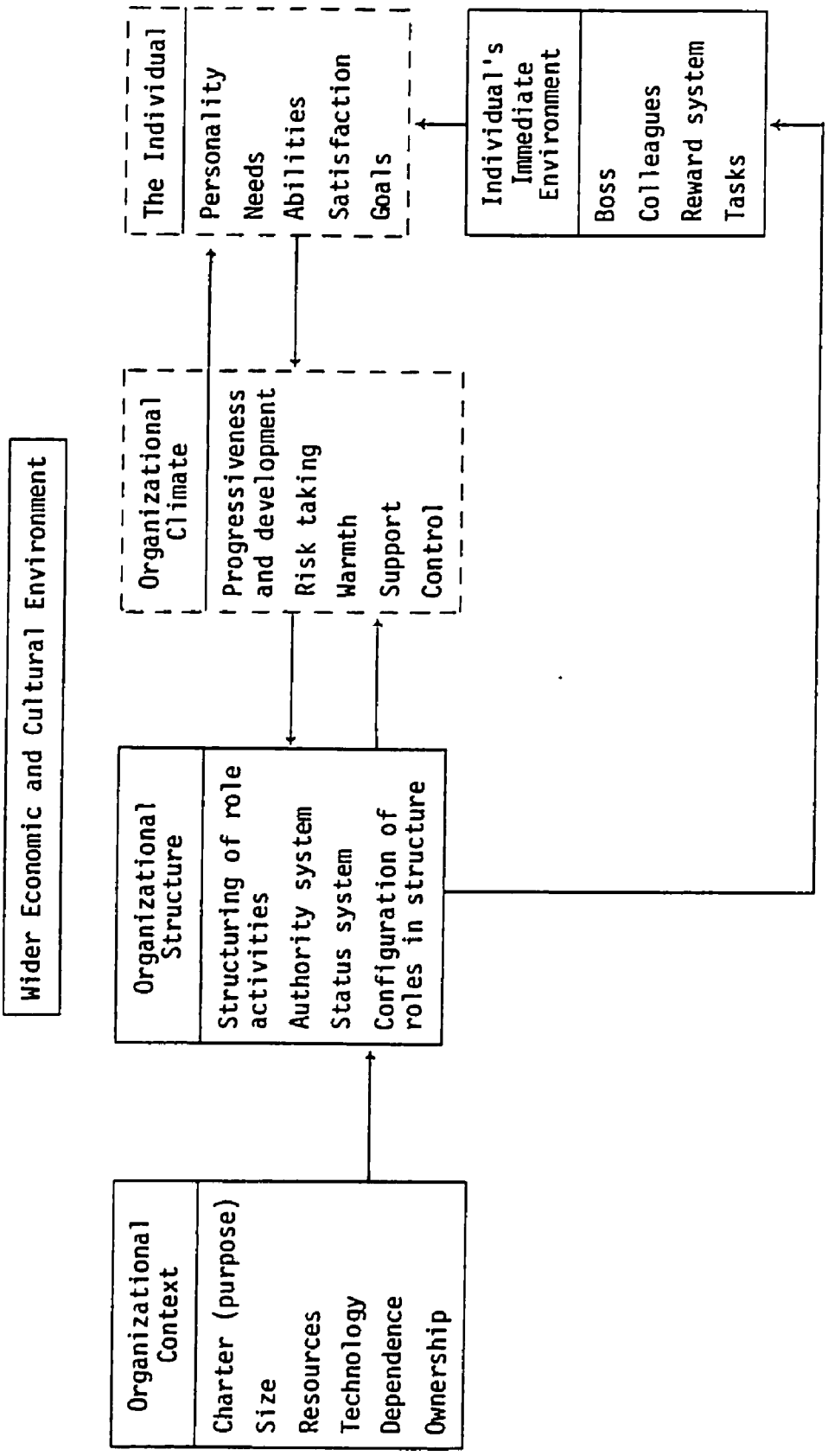


Figure 1.1. Major influences on organizational structure and climate. Adapted from Payne and Pugh (1976).

structure measures correlated erratically with perceived climate.

In their conclusions (they provided two, labeled "pessimistic" and "optimistic"), the authors suggested that "future research can ignore most of these studies and utilize a completely different approach" (p. 1168). However, Pugh's heroic optimism remains, as evidenced by the suggestion that "the potential benefits for exploring multimethod variance for a particular organizational concept" (p. 1169) warrant a continued faith in cross-level analysis, though perhaps that faith is best expressed in more focused studies.

Indik's (1968) integrative model maintained the group level as mediating relationships between organizational-level and individual-level phenomena. Indik's model consisted of seven panels of variables (Figure 1.2). These panels represented the variables relevant to the study of individuals, arranged in groups, embedded within organizations. Ultimately, Indik would like the variables in the seven panels to be mutually exclusive and exhaustive.

Panels One through Six were paired because Indik assumed that variables from panels at the same level of analysis would be more likely to be related to each other than to variables from other levels of analysis. Also, the closer two panels are, the stronger the expected relationship between variables in the panels. Finally, variables in, say, Panel Two were expected to have their relationships with variables in, say, Panel Five mediated by variables in Panels Three and Four.

James and Jones' (1976) review of the organizational literature was based on a theoretical model that combined the features of both Payne and Pugh's and Indik's models. In fact, James and Jones

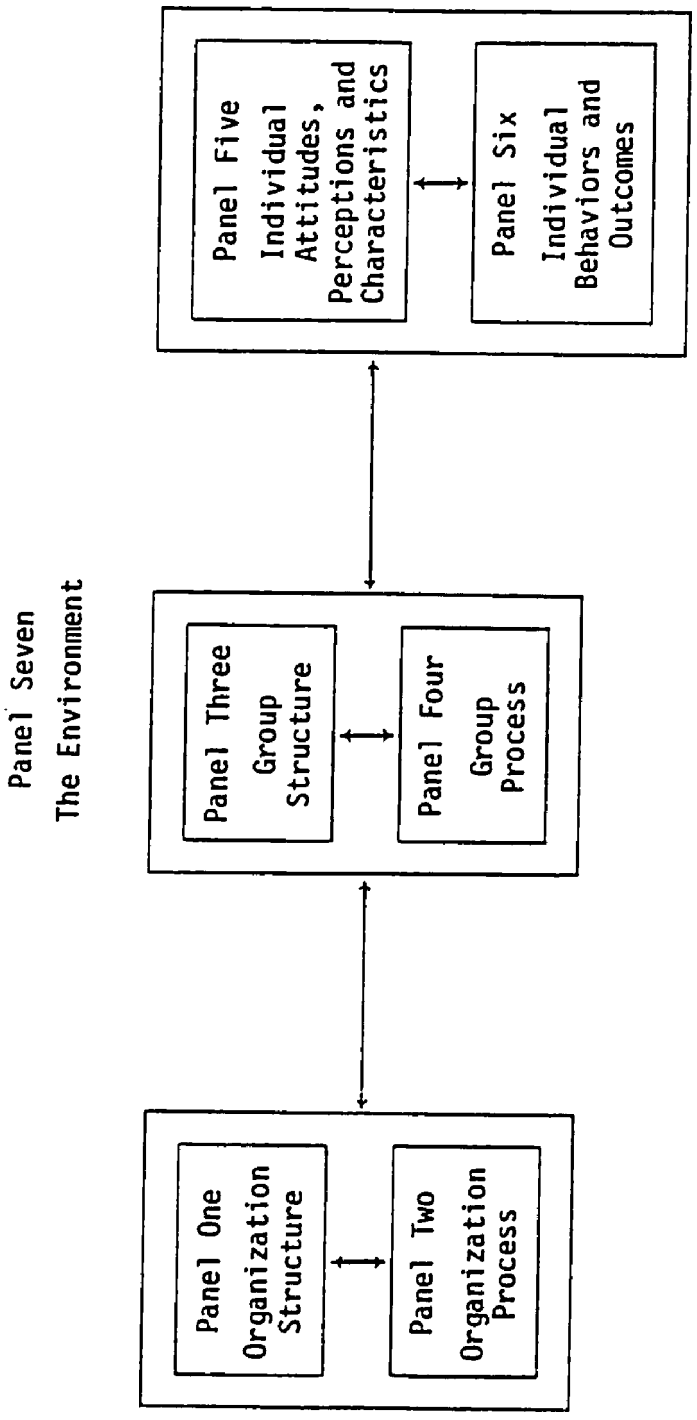


Figure 1.2. A modified version of Indik's (1968) model of organizations.

acknowledged their dependence on Indik for the basic form of their model. Their model was considerably more complex than either of the preceding models, containing 17 panels of variables (ranging from the sociocultural environment to job behaviors) grouped into four major categories (situational, intervening, individual characteristics, and individual behaviors and outcomes) and ranging across four levels of analysis (environment, organization, group, and individual).

James and Jones offered a number of substantive conclusions based on their review of the literature. Their perspective was congruent with that of Katz and Kahn: structure develops in order to accomplish the events of input, throughput, and output. Differences among events (production, adaptation, maintenance) result in differences in structures and give rise to the dynamic characteristics of the system. Structure is a multidimensional construct, and these dimensions are not orthogonal. When an organization consists of subsystems, James and Jones suggested that it may be more appropriate to consider subsystem structures separately rather than deriving a modal organizational structure.

When relationships between structural variables and individual attitudes, behaviors, and outcomes were examined, James and Jones concluded that simplistic assumptions about structure (for example, bureaucratic vs. nonbureaucratic "structures") characterizing many cross-level studies have weakened the generalizability of the conclusions derived. Clearly, relationships exist, but the use of simplistic dichotomies or atheoretical structural variables (for example, level, department, etc.) has made it difficult to specify the form and conditions of relationships precisely.

In keeping with their substantive conclusions, James and Jones advocated the use of integrative cross-level models that take advantage of conceptual advances at both the macro and micro levels. Of necessity, such studies would have to involve multiple methods of data collection and a large number of variables. Such studies must be based on integrative models (such as their own) in order to insure explicit recognition of the multi-level, multi-disciplinary characteristics of such research.

Taken together, these three models embody most of the problems of the cross-level, multi-disciplinary research they all advocate. Indik and Payne and Pugh represent the two basic options available and emphasize the problem of what to do with the group as a level of analysis. Payne and Pugh have dropped the group in favor or organizational climate as the critical intervening variable. Indik ignored climate (except as an individual-level perception) and postulated that all organizational effects are mediated by the structure and functioning of the primary work group. James and Jones have suggested that neither, either, or both may be the intervening variable in a given organizational setting. Their model allows for considerable variation in the pattern of relationships among organizational variables at all levels. However, this flexability carries a high price, for their model comes perilously close to simply saying that everything is related to everything else, without emphasizing what relationships are likely to be important across the broad range of organizations.

To summarize, these models provide a first approximation for the development of integrative cross-level studies of organizational

phenomena. Since they are based on previous work involving one or more levels, it is unclear how useful they will prove to be in facilitating the investigation of problems that have heretofore fallen through the cracks between disciplines (Pugh, 1966). They do succeed in emphasizing two possible mediating concepts, organizational climate and the primary work group, with the potential for linking structural and individual-level variables.

Empirical Attempts at Integration

Many researchers have attempted to link particular aspects of an organization's structure to individual-level variables. In surveying these efforts, it will be helpful to group studies in terms of their basic approach to the problem. It should be noted that these groupings do not represent programmatic research efforts but, rather, a convenient way of summarizing what are often radically different studies in terms of common orientations or themes. The first such group of studies are the direct approaches. These studies are characterized by simplistic or atheoretical operationalizations of organizational structure and tend to look for direct relationships between structural variables and individual attitudes or behaviors. The second group of studies share a reliance on organizational climate as the mediating variable between structure and the individual.

Direct approaches. The direct approach to the relationship between organizational structure and individual-level variables is characterized by two types of studies: those that dichotomize structure (Bennis' bureaucratic vs. nonbureaucratic organizations, for example) and those that focus on anatomical characteristics of organizational structure. James and Jones (1976) have summarized

the former, while Porter and Lawler (1965) have concentrated on the latter type of study.

In James and Jones' estimation, the first group of studies have contributed little to an understanding of structure and its impact on individuals.

> It is questionable that the relationships and interactions among the proposed dimensions of organizational structure would allow for such dichotomies as bureaucratic-nonbureaucratic, mechanistic-organic, and Theory X-Theory Y. The complexity of relationships among structural dimensions, even though far from understood, provides sufficient evidence to invalidate such oversimplified dichotomies (pp. 92-93).

They also pointed out that such studies frequently differentiate among organizations on the basis of structural characteristics, when no measurement of structure was ever undertaken.

Studies which focused on particular anatomical characteristics of organizational structure were generally atheoretical in nature and limited in their generalizability. Porter and Lawler (1965) succeeded in integrating this confusing body of research, however, and they offered several conclusions. They began by defining structure as "the positions and parts of organizations and their systematic and relatively enduring relationships to each other" (p. 303). For Porter and Lawler, structure was synonomous with the formal organization. Seven aspects of structure were singled out for close examination: level, line/staff, span of control, subunit size, organization size, shape, and centralization. They concluded that

> The following directional relationships seem to be well supported by the research evidence to date: (a) organizational level--positive relationship between height of level and degree of job and need satisfaction, positive relationship between height of level and perceived necessity for

> inner directed type of job behavior; (b) line/staff hierarchies--positive relationship between line type of position and degree of need satisfaction; (c) subunit size--negative relationship between size and degree of job satisfaction, positive relationship between size and absenteeism rates, positive relationship between size and turnover rates (p. 323).

In addition, Porter and Lawler concluded that two other characteristics of organizational structure, total organizational size and shape (tall-flat), bore some relationship to their dependent measures, although the direction of the relationship was unclear. They also pointed out that structure appeared to be more strongly related to indices of need satisfaction than to indices of need importance and more strongly related to attitudes than to behaviors such as absenteeism. Finally, Porter and Lawler made a strong plea for the consideration of possible interrelationships among structural characteristics in future research, rather than a continuation of single-minded studies focusing on specific anatomical characteristics of organizations.

Since Porter and Lawler's review, several studies similar to those summarized have been published, particularly in the areas of total organizational size and shape (tall or flat). The consensus (Herman & Hulin, 1972; James & Jones, 1976) is that these studies have contributed nothing over and above the Porter and Lawler review.

Herman and Hulin's study, along with two similar studies (Herman, Dunham, & Hulin, 1975; Newman, 1975) represent the "state of the art" in the investigation of organizational structure through the use of anatomical measures and direct relationships. Herman and Hulin and Herman et al. used sophisticated multivariate analysis techniques (discriminant function analysis and part canonical analyses, respec-

tively) to determine the degree of association of such variables as hierarchical level, functional division, and department in the first study and tenure, shift, job level, department, and participation in an apprentice program in the second study to various individual attitudes. Incredible as it may seem, all the independent variables listed were classified as structural variables in the analyses. Herman et al. concluded that individuals higher in the organization tended to be more satisfied with their work and pay than lower-level organizational members and that organizational members from some departments were more satisfied than members of other departments.

Two aspects of these studies are important. In the first place, both studies demonstrated that substantial differences exist between departments within the same organization on typical individual attitude measures. This result lends added weight to the argument that structural differences exist among subunits of the same organization, since attitudes thought to be associated with structural dimensions varied across units (Indik, 1968; James & Jones, 1976). Secondly, and more importantly, Herman et al. admitted that little additional information remained to be gained by the continued use of anatomical characteristics of structure:

> The process by which nonpyschological-variables, organizational-structure or demographic characteristics become psychologically meaningful is still speculation. . . . Useful directions of future research would be to identify the psychologically meaningful stimuli in the work environment which are indexed by organizational-structure characteristics and to determine how these psychologically meaningful stimuli function to control responses (p. 231).

Herman et al. are correct in recognizing that concepts such as department and shift have little psychological meaning in and of themselves.

Such concepts are surrogate variables, placeholders for other unmeasured variables. These variables do nothing to further our understanding of how organizational structure and individual attitudes and behaviors are related or what aspects of the organization's structure are the best predictors of individual-level variables. But the authors are not correct in concluding that what is needed is a set of psychological variables apart from (the meaning of "indexed by"?) organizational-structure variables. Rather, what would be most useful are ways of measuring structure (and technology) at the subunit level that would allow researchers to compare departments in terms of their structures and relate structural differences among departments to differences in individuals' perceptions of their work environment, their behaviors, and their attitudes.

Organizational climate as an intervening variable. One possible form that a relationship between organizational structure and individual attitudes and behaviors might take casts organizational climate in the role of an intervening variable between the organization's structure and the individual. Since the research on the relationship between climate and individual attitudes and behaviors is extensive, but not critical to what follows, only the literature relevant to the relationship between structure and climate will be reviewed here.[1]

Although Payne and Pugh postulated that climate mediates the relationship between the organization's structure and the individual, the evidence they marshalled in support of their position was weak.

[1]A number of excellent reviews of the organizational climate-individual behaviors and attitudes literature is available, including: Hellreigel & Slocum, 1974; James & Jones, 1974; and Schneider, 1975.

In studies using perceived measures of climate and perceived measures of structure, they found that perceived measures of structure were relatively stable across studies, while climate dimensions were not, and that organizations perceived as having decentralized decision making tended to be perceived as having climates that were warm, supportive, and encouraging of risk taking.

Where objective measures of structure were used in conjunction with perceived measures of climate, size emerged as most consistently related to climate, followed by centralization and task specialization. The pattern of results was far from clear, however. Relationships were not always in the hypothesized direction; relationships between structure and climate were weak; and different structural variables affected climate in different ways, often simultaneously. Payne and Pugh concluded that both concepts are complex and multidimensional and that research to date has barely scratched the surface.

Others have had difficulty establishing a clear link between structure and climate as well. Lawler, Hall, and Oldham (1974) collected structure and climate data from research directors and scientists working in research and development laboratories. They found virtually no relationship between their anatomical variables (span of control, size, levels, tall/flat, levels from director to top of parent organization) and their climate dimensions (competence/potence, responsible, practical, risk oriented, impulsive), other than significant correlations between both span of control and flatness (both possible surrogates for centralization) and the climate dimension of responsible. Several of the Lawler et al. (1974) process

dimensions bore a close resemblance to typical measures of organizational structure, however, and these dimensions were correlated with perceived climate. Dimensions of professional autonomy, assignment generality, and the presence of informal budget accounts could all be interpreted as indicators of centralization/decentralization and all were correlated significantly with the climate dimension of responsible. Finally, Lawler et al. suggested that low variance and substantial missing data on their structural measures may have contributed to the weakness of their results.

Newman (1975) has also attempted to link anatomical characteristics of the organization to perceptions of the work environment and, through these perceptions, to individual attitudes. Newman used multiple discriminant function analysis to confirm[1] that anatomical characteristics of the organization (functional divisions, department, work group, and level) were more strongly related to individual attitudes (the Job Description Index and job involvement) than personal demographic characteristics (age, sex, education, tenure [a structural dimension from Hulin et al.], and number of dependents).

Newman then used canonical correlation techniques to demonstrate that his anatomical characteristics of the organization could account for more of the variance in perceived climate than his individual demographic characteristics. Finally, Newman used predicted climate scores (constructed by applying the coefficients from the canonical variates derived in the previous analysis to the raw anatomical

[1]Both Herman and Hulin (1972) and Herman et al. (1975) came to the same conclusion.

characteristics) in another canonical correlation with individual attitudes (thus controlling methods variance but vastly increasing his ability to capitalize on chance). Newman was able to account for 30 percent of the variance in individual attitudes in this fashion.

Two aspects of Newman's study deserve attention. First, his overall analysis suggested that relationships exist between the structure of the organization and perceptions of organizational climate. Even with surrogate structural measures, Newman consistently found significant relationships between the two sets of variables. And, second, department and work group emerged as the most powerful predictors in Newman's analyses. When perceptions of the organization's climate were partitioned using each predictor separately, omega-squared statistics for department and work group were .45 and .65, respectively. Newman's results add further support to the argument that subunits of an organization differ appreciably in terms of their structure and technology and that these differences are reflected in the perceptions of individual subunit members.

James and Jones (1976) have examined the results of several earlier studies in order "to conceptualize processes whereby organizational or subsystem structure is operationalized into organizational and subsystem functioning and individual attitudes and behavior" (p. 102). Specifically, they focused on the potential impact of size, formalization, specialization, and standardization. With respect to size, they concluded that size by itself could not explain the differences in individual-level variables. Their conclusion is similar to Child's (1973) assessment of the impact of size. Child also concluded that an understanding of the impact of

organizational size required that other variables be taken into account as well.

James and Jones suggested that optimum levels may exist for standardization and formalization rather than linear relationships between these structural characteristics and individual attitudes. Low formalization and lack of standardized contingencies have been shown to lead to high role ambiguity and conflict, which, in turn, lead to low motivation, satisfaction, and performance. On the other hand, high role prescription, although associated with low ambiguity, has also been associated with low satisfaction and achievement. James and Jones suggested that high specialization may be associated with reduced autonomy, challenge, and satisfaction (Forehand & Gilmer, 1964), as moderated by individual preferences for constrained vs. free environments, if high specialization leads to job simplification (Hulin & Blood, 1968).

Although highly speculative, James and Jones' interpretations of previous research suggested that relationships among structural and individual variables do exist. Moreover, their review suggested two sets of individual variables that may prove to be the links between structure and individual attitudes and behaviors, namely, perceived job characteristics (which they classed as climate variables) and characteristics of the individual's role in the organization.

In general, the research reviewed here and by others, while not disconfirming the relationship, does not provide overwhelming support for a straightforward relationship between organizational structure and climate. Apparently, the relationship between structure and climate is a complex one; James and Jones, for example, spoke of

optimum levels of structural characteristics. What constitutes an optimum level for one organizational member, however, may not be optimum for another, suggesting that individual differences may moderate structure-perceived climate-outcome relationships. And the concept of organizational climate itself is still the subject of considerable debate, with no firm consensus as to what is and what is not climate.

It seems unlikely that broad dimensions of organizational climate will turn out to be consistently related to structural characteristics of the organization. Instead, specific aspects of climate are probably simultaneous functions of multiple structural dimensions, moderated by individual characteristics.

Summary

The results of job redesign efforts such as those summarized by Beer (1976), Walton (1975), and others have made it clear that a strong relationship exists between the organizational-level variables of structure and technology and individual perceptions, attitudes, and behaviors. With those results in mind, this review set out to survey the literature bearing on that set of relationships. The literature regarding both technology and structure was summarized, and a number of specific observations were made and conclusions drawn.

The technology literature suffers from a lack of agreed upon definitions and a tendency to generalize across classes of variables rather than classes of organizations. The nature of the technology-structure relationship is still unclear, possibly because researchers have tended to think in terms of a single organizational technology,

measured in a too limited fashion. Two aspects of technology seem to recur in the literature, namely, workflow rigidity and automaticity. And Rousseau, at least, has demonstrated that even broad typological classifications or organizational subunits are significantly related to individual-level perceived job characteristics.

The organizational structure literature demonstrates a greater degree of convergence than does the technology literature. Meaningful dimensions of structure have been isolated, with substantial agreement across studies as to their importance. An important distinction among structural characteristics is between what Rice and Mitchell have called the dimension structure and the interaction structure. Centralization and formalization are examples of the dimension structure, while interdependence is an example of the interaction structure.

The general models suggested by Indik, James and Jones, and Payne and Pugh provide a broad framework within which cross-level analyses can be undertaken. These models suggest two possible intervening variables between organizational structure and individual attitudes and behaviors, namely, organizational climate (Payne & Pugh) and the work group (Indik). James and Jones' model would allow for the simultaneous or complementary operation of climate and the work group as mediating variables. Their model also emphasizes the inherent complexity of cross-level analyses.

Attempts to link structure directly to individual attitudes and behaviors have indicated that differences among individual-level variables exist across both levels and subunits of organizations. But the dichotomous or surrogate measures of organizational structure

do not measure structure in terms of any meaningful dimensions; anatomical measures of structure do not indicate how subunits differ in terms of structure of why such differences should bear any relationship to individual attitudes. As Herman, Dunham, and Hulin themselves have concluded, this approach is unlikely to produce any additional insights into the relationship between organizational structure and individual-level variables.

Attempts to isolate intervening variables have usually relied on dimensional measures of structure and have concentrated on organizational climate as the appropriate mediating variable. Although several theorists have asserted that the work group mediates the relationship between structure and the individual, and the technology literature supports such an assertion (Taylor; Walker), the research to date has not addressed the question. Two sets of variables that the climate approach has indicated may prove useful in understanding structure-individual relationships are perceived job characteristics and role variables.

CHAPTER TWO

STATEMENT OF THE PROBLEM

This dissertation focuses on the relationships between the macro-level variables of organizational structure and technology and the micro-level variables of individual perceptions and attitudes. The job redesign literature (Beer, 1976; Walton, 1975) has demonstrated through case studies and anecdotal evidence that changes at the level of the individual job can have far reaching effects on the structure of the organization and even its technology. The early case studies of technological change have demonstrated that technology, in conjunction with organizational structure, can exert substantial influence over characteristics of the work role. And numerous studies have indicated that characteristics of the dimension structure of organizations as well as technology, broadly defined, are related, albeit weakly, to organizational climate and, ultimately, individual attitudes. These studies have identified perceived job characteristics and role perceptions as important micro-level variables in these cross-level analyses.

The present study pursues this line of inquiry more systematically. This study examines the impact, on individual-level variables, of two somewhat overlapping macro-level concepts: the structural dimension of interdependence and the technological dimension of workflow integration (mechanistic interdependence). Specifically, this study has five goals:

1. examination of the relationship between workflow integration and the individual-level variables of perceived job and role characteristics

2. examination of the relationship between workflow integration and individual outcome measures

3. examination of the relationship between interdependence and the individual-level variables of perceived job and role characteristics

4. examination of the relationship between interdependence and individual outcome measures

5. exploration of the joint relationship of technology (workflow integration) and structure (interdependence) to both perceived job and role characteristics, as well as individual outcome measures.

This chapter outlines 19 specific hypotheses addressing these five goals.

The Relationship of Technology to Individual Perceptions and Attitudes

As was noted in Chapter One, the literature concerned with the concept of technology has little theoretical and empirical convergence. Only recently have researchers begun to view technology as multidimensional and to be concerned with the differing technologies of organizational subunits rather than the determination of the organizational technology.

In spite of these problems, however, technology has usually been found to be related to individual-level attitudes and behaviors. These relationships have not always been in the same direction (Chadwick-Jones vs. Walker, for example), but relationships have been found with virtually every indicator of technology used. Unfortunately, these indicators have often been little more than gross dichotomies or global typologies, raising the possibility that such measures were actually surrogates for a host of other unmeasured

concepts. Moreover, in those early case studies technology was not the only thing that changed. Changes in technology were always accompanied by changes in the social structure of the organization as well. Thus, it is extremely difficult to determine the nature of the relationship between technology and individual attitudes on the basis of such studies. To do so requires a more detailed measure of technology.

As discussed in Chapter One, such a measure of technology is available from the Aston research: the workflow integration scale, composed of five subscales. This scale has two properties that make it especially useful for the purposes of this dissertation: it consists of discrete and relatively focused subscales and it taps aspects of technology which parallel the structural concept of interdependence.

With this more focused measure of technology (as opposed to general typologies such as Thompson's), it should be possible to specify clearly how certain aspects of technology are related to individual perceptions and attitudes and avoid the sometimes contradictory but uninterpretable results obtained with vague indicators of technology. This degree of specificity is not without its costs, however. Workflow integration, as operationalized, is not applicable across the full range of work organizations but, rather, is aimed primarily at manufacturing organizations.

The major advantage of using workflow integration as the measure of technology is its overlap with the concept of structural interdependence. Structural interdependence describes the interrelationships among roles within the social structure of the organization.

Workflow integration measures the degree to which the design and arrangement of production equipment in the organization (or its subunits) result in unalterable interdependencies among work stations (workflow rigidity subscale) and among organizational subunits (interdependence of workflow segments subscale).[1] Thus, workflow integration is a measure of mechanistic interdependence.

Technology and Perceived Job Characteristics

Since the dependencies among work stations that are reflected in high workflow integration scores for an oragnizational subunit are, by definition, unavoidable, it seems reasonable to expect such dependencies to be reflected in at least four perceived job characteristics (autonomy, variety, task identity, and challenge) of individuals working within the subunit.[2] In particular, perceived autonomy should be inversely related to workflow integration, since a high workflow integration score indicates that the production system affords little flexibility to the operator. In effect, required coordination and decisions have been designed into the equipment and not left to the operator. Greater workflow integration should also be reflected in lower perceived variety among subunit

[1] A third component, consisting of the two automaticity subscales, does not necessarily reflect the degree of mechanistic interdependence in the workflow, although automaticity may be expected to correlate highly with workflow rigidity (Hickson et al., 1969).

[2] On the basis of the high interrelationships among subscales of the workflow integration scale reported by Hickson et al., hypotheses are offered for the overall scale only. Prior to analysis, the degree of relationships among the subscales will be determined for this sample, with separate analyses performed for each subscale regardless of the results. In the interest of brevity, however, specific hypotheses for each subscale will not be provided here.

members, since both high workflow rigidity[1] and high automaticity[2] mean single purpose equipment which, in turn, implies single purpose operators, at least within the range of workflow integration scores expected for this sample of organizational subunits.

Across the broad range of possible workflow integration scores, the relationships between workflow integration and both autonomy and variety may well be curvilinear, with operators in subunits having maximum workflow integration scores responsible for more than the mere operation or monitoring of a single piece of equipment (Davis & Taylor, 1972). Unfortunately, the sample of organizational subunits from which data were collected for this dissertation is limited (no subunits scored near the maximum on degree of workflow integration) and this discussion and the hypotheses that follow reflect that limitation.

Workers in subunits characterized by high workflow integration should also tend to report lower perceived task identity, due to the nature of the equipment predominating in subunits with high workflow integration scores. Production systems relying on single-purpose, serially-linked, and highly automated equipment score high on

[1]The workflow rigidity subscale is scored on the basis of how equipment in the subunit is arranged. A maximum score would be obtained by a sequential production system, with no tolerance of delays, no ability to work around breakdowns, and equipment that can be used for only one purpose. A zero score would be obtained if the production system was not sequentially arranged, could absorb delays (either through rerouting or reliance on buffer stocks), and used equipment that could be adapted to serve more than one purpose.

[2]The automaticity subscales (mode and range) are scored along a continuum from hand tools at the low end to self-measuring and adjusting equipment at the high end. It reflects the degree to which first energy and then information are provided by the equipment rather than the operator.

workflow integration. In such production systems, man-product interaction is reduced (Davis, 1971), in comparison to production systems with lower workflow integration scores. Since task identity reflects workers' perceptions of the degree to which they do an entire piece of work and can clearly identify the results of their efforts (Hackman & Lawler, 1971), task identity should be lower in those subunits characterized by high workflow integration.

Challenge, too, should be reduced in subunits whose production systems show a high degree of workflow integration. Jordan (1963) has argued that "by designing man-machine systems for man to do least, we also eliminate all challenge from the job" (p. 165). It has been argued in the preceding paragraphs that a high degree of workflow integration implies that workers will experience reduced flexibility, make fewer decisions about fewer things, and have little interaction with the product. The greater the degree of workflow integration of a subunit's production system, then, the less there is for workers to do and, consequently, the lower the perceived challenge of subunit members.

In line with the previous discussion, the following four hypotheses are offered:

> Hypothesis 1A: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the perceived autonomy reported by subunit members.
>
> Hypothesis 1B: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the perceived variety reported by subunit members.
>
> Hypothesis 1C: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the perceived task identity reported by subunit members.

Hypothesis 1D: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the perceived challenge reported by subunit members.

Technology and Role Perceptions

While role overload is not necessarily a function of workflow integration, the preceding discussion of the impact of workflow integration on perceived job characteristics suggests that overload may be less likely in subunits characterized by high workflow integration than in subunits characterized by low workflow integration. The rationale is straightforward: workers in the latter subunits simply have more to do than workers in subunits with high workflow integration. Thus, the following highly speculative hypothesis is offered:

Hypothesis 1E: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the degree of role overload reported by subunit members.

Again, the possibility exists that the relationship may be curvilinear across the entire range of possible workflow integration scores.

However, there is no reason to expect workflow integration to be related to the degree of role clarity reported by subunit members. Workflow integration could affect role clarity in conjunction with other variables as, for example, a high degree of workflow integration could exacerbate conditions of role ambiguity resulting from inadequate training or supervisor feedback. However, a direct relationship between workflow integration and role clarity is not predicted.

Technology and Individual Outcomes

Finally, the relationships between workflow integration and individual outcomes must be addressed. Three outcomes will be considered: effort, intrinsic motivation, and global job satisfaction. All three outcomes have received considerable attention in the technology literature, though not with respect to the particular measure of technology used here. All three have been found to be low under conditions of assembly-line (high workflow rigidity) production (Blauner, 1964; Faunce, 1958; Walker & Guest, 1952) and in automated production systems (Davis & Taylor; Jordan), although the relationship between satisfaction and automaticity may (Taylor, 1971a; Mann & Hoffman, 1960; Walker, 1957) or may not (Chadwick-Jones, 1969) be curvilinear. Based on this evidence, the following hypotheses are offered:

> Hypothesis 1F: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the degree of effort reported by subunit members.
>
> Hypothesis 1G: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the degree of intrinsic motivation reported by subunit members.
>
> Hypothesis 1H: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the degree of global job satisfaction reported by subunit members.

Since these outcomes have been found to be related to perceived job characteristics (Hackman & Lawler; Hackman & Oldham, 1976; Lawler & Hall, 1970), these three hypotheses will be tested both with respect to zero-order relationships and with the effects of perceived job characteristics partialled out. Also, all hypotheses will be

tested using each of the component subscales in place of workflow integration in order to determine which are most strongly related to the dependent variables.

The Relationship of Interdependence to Individual Perceptions and Attitudes

As discussed in Chapter One, interdependence refers to the network of relationships among role incumbents and work units within the organization. As such, it is representative of the interaction structure (Rice & Mitchell) of the organization. Although a number of studies have concerned themselves with aspects of the dimension structure in relation to individual perceptions and attitudes, the impact of interdependence on individual-level variables has received virtually no attention.

Interdependence and Perceived Job Characteristics

At the organizational subunit level, interdependence has received some attention. Studies by Hickson et al. (1971), Hinings et al. (1974), and Jacobs (1974) were reviewed in Chapter One. These studies focused on various measures of interdependence as predictors of subunit power[1] or control within organizations. In general, these studies showed that subunits that enjoy a position of dominance in their dependency relationships with other subunits were seen as more powerful (Jacobs). Hinings et al. found that subunits that have the most links (pervasiveness) with other subunits or who are least replaceable (nonsubstitutability) tend to be seen as more powerful.

[1] Strictly speaking, both Jacobs and Hinings et al. are speaking of control rather than power (Wrong, 1968), since control, unlike power, need not be planned or deliberate and there need be no resistance on the part of the controlled.

Subunits in which dependency relationships were most critical to the workflow (immediacy) were seen as more powerful and as more centrally involved in organizational decision-making processes.

If, by virtue of their position in the interaction structure of the organization, some subunits are seen as exerting more control over organizational events than others, then this greater degree of control should be reflected in the perceived autonomy of subunit members involved in the inter-subunit dependencies. Whether it is simply the number and importance of the dependency relationships engaged in by a subunit that is related to perceptions of control and autonomy or the form of the dependency relationship (Jacobs; Thompson) is an empirical question. Consequently, the following hypotheses are offered:

> Hypothesis 2A: Members of subunits involved in sequential or reciprocal interdependencies with other organizational subunits will report higher autonomy if their subunit occupies a position of dominance in the interaction structure of the organization than if their subunit occupies a controlled position.
>
> Hypothesis 2B: The more dependent other subunits in the organization are on a given subunit, the greater will be the degree of autonomy reported by members of that subunit.

Since substitutability is not a relevant concept in the research site for this study (no outside contracting is done and all subunits perform different functions), no hypotheses are offered regarding that concept. Also, because of the way in which the data were originally collected as well as the nature of the workflow in the organization, the number of dependencies (pervasiveness) and their importance (immediacy) are combined into one measure, the degree of

dependence. These constraints will become clearer when the characteristics of the site and the data collection procedures are described in Chapter Three.

Interdependence and Role Perceptions

Another aspect of interdependence is its overlap with the concept of the role set. Interdependence, broadly defined, represents a macro-level summary of the role sets of the organization's members. For Katz and Kahn,

> Generically, role behavior refers to the recurring actions of an individual, appropriately interrelated with the repetitive activities of others so as to yield a predictable outcome. The set of interdependent behaviors comprise a social system or subsystem, a stable collective pattern in which people play their parts (p. 174).

The macro-level concept of interdependence, as used here, is a way of characterizing those role relationships among organizational members that span subunit boundaries. These boundary spanning dependencies arise from and reflect the flow of work through the organization.

If interdependence is, in fact, a way of characterizing the network of role relationships within the organization, the question arises as to how interdependence is related to individuals' affective reactions to their roles. Characteristics of the dimension structure of the organization have already been shown, in the literature reviewed in Chapter One, to be related to role ambiguity and to role overload. How, then, is interdependence related to these concepts? Two hypotheses are proposed:

> Hypothesis 2C: Other things being equal, the more dependent a given subunit is on other subunits in the organization, the lower will be the degree of role clarity reported by members of the subunit.

Role clarity is defined as the difference between the optimal

and the actual amount of information available regarding role expectations (Sarbin & Allen, 1968). There are many ways in which the dependence of a subunit on other units could contribute to reduced role clarity among subunit members. For example, such dependencies could involve a reliance on other units for relevant information and assistance regarding the subunit's work that is otherwise unavailable. Work procedures may vary unpredictably as a function of the input from other subunits. Scheduling may be impossible because the arrival of needed information cannot be specified exactly. Basically, reliance on other subunits for parts of the information and assistance, or even portions of throughput, introduces uncertainty into the procedures or performance criteria for members of dependent units. That uncertainty should be reflected in lower degrees of reported role clarity.

> Hypothesis 2D: Other things being equal, the more dependent other subunits are on a given subunit, the higher the degree of role overload reported by members of the subunit.

The more extensive the network of links between a given subunit and other subunits in the workflow, the more commitments the members of the subunit must meet and, hence, the more likely they will be to report conditions of overload.

There are two things about these last two hypotheses that should be mentioned. First, both are, admittedly, speculative. No data exist to confirm or deny either hypothesis. They are based on the premise that if interdependence among subunits is an aggregate of individual role sets, then individual role perceptions should be, on the average, related systematically to interdependence.

Second, the phrase "other things being equal" prefaces both

hypotheses. This means that dependencies within the subunit, since they, too, are potential sources of role perceptions, must be controlled in testing the hypotheses.

Interdependence and Individual Outcomes

Four different individual outcomes will be used in subsequent analyses: global job satisfaction (Quinn & Shepard, 1974), satisfaction of higher order needs (Porter, 1961, 1964), intrinsic motivation (Lawler, 1973), and effort (Beehr, Walsh, & Taber, 1976). Since previous studies have shown that these outcomes are related to one or more of the perceptual variables discussed above,[1] the concern here is with direct relationships between measures of interdependence and the outcome measures.

Evidence to support hypotheses linking interdependence to individual outcomes is not overwhelming. To the extent that members of controlled subunits (Hypothesis 2A) do, in fact, feel that they are in a situation where their freedom of action is constrained, then those feelings should show up in lower reported satisfaction of higher order needs, that is, autonomy and self-actualization needs. Hence, the following hypothesis is offered:

> Hypothesis 2E: Members of subunits involved in sequential or reciprocal interdependencies with other organizational subunits will report higher satisfaction of higher order needs if their subunit occupies a position of dominance in the interaction structure of the organization than if their subunit occupies a controlled position.

Paralleling Hypothesis 2B, the following hypothesis is also

[1] For example, House and Rizzo (1972) have shown that role clarity is related to job satisfaction; Margolis, Kroes, and Quinn (1974) found that role clarity is associated with effort; Beehr et al. have demonstrated relationships between role overload and both satisfaction (negative) and effort; and so on.

offered:

> Hypothesis 2F: The more dependent other subunits in the organization are on a given subunit, the greater will be the degree of satisfaction of higher order needs reported by subunit members. Conversely, the more dependent the subunit is on other subunits in the organization, the lower will be the degree of satisfaction of higher order needs.

With respect to the other outcome measures, Argyris' (1973) discussion of the relationship of personality to organizational theory is most relevant. Argyris argues that organizational structures that place employees in dependency relationships and frustrate individual growth (forcing individuals to seek expression of infantile needs) will result in frustration and conflict on the part of those employees. In his discussion of the organizational factors most likely to result in frustration and conflict, Argyris heavily emphasizes dependence on others as the critical dimension. Though Argyris focused on dependency relationships with superiors, his arguments can be generalized to encompass dependency and control relationships structured by the workflow, since it is the psychological impact of the dependency relationship rather than the source of the dependency that is critical.

Argyris argued that employees cope with the frustration and conflict arising from dependency in a number of ways, including psychological withdrawal, apathy, and reducing the intrinsic importance of the work. Based on this elaboration of Argyris' theory, the following hypotheses are offered:

> Hypothesis 2G: Members of subunits involved in sequential or reciprocal interdependencies with other organizational units will report a higher degree of effort if their subunit occupies a position of dominance in the interaction structure of the organization than if their subunit occupies a controlled position.

Hypothesis 2H: Members of subunits involved in sequential or reciprocal interdependencies with other organizational units will report a higher degree of intrinsic motivation if their subunit occupies a position of dominance in the interaction structure of the organization than if their subunit occupies a controlled position.

These hypotheses assert that, across employees, intrinsic motivation and effort will tend to be lower in subunits characterized by dependency on other subunits than in subunits not dependent on other subunits. While individual personality characteristics may moderate the micro-level relationships between dependency and frustration, as well as the way in which that frustration is expressed, consideration of these relationships is beyond the scope of this study. Moreover, the data at hand do not permit an examination of these moderating effects.

Since low autonomy (Hackman & Lawler), low effort (Beehr et al., and low intrinsic motivation (Lawler, 1973) tend to be associated with low job satisfaction, it seems likely that subunits characterized by one or more of the above will also be characterized by lower average job satisfaction as well. Hence, this final hypothesis is offered:

Hypothesis 2I: Members of subunits involved in sequential or reciprocal interdependencies with other organizational units will report a higher degree of global job satisfaction if their subunit occupies a position of dominance in the interaction structure of the organization than if their subunit occupies a controlled position.

Exploratory Analyses of the Joint Effects of Technology and Interdependence

Thus far, the concern has been with the separate effects of technology (operationalized as workflow integration) and interdependence on individual perceptions and outcomes. Ideally, the next step

would be an assessment of the joint effect of the two macro-level predictors on the micro-level dependent variables. Unfortunately, the limited data available here preclude all but an exploratory analysis.

It was assumed in the first portion of this chapter that mechanistic interdependence (high workflow integration) replaces structural interdependence, since production systems characterized by high workflow integration have coordination requirements pre-programmed or designed into the equipment itself. This inference can be tested, and to that end the following hypothesis is offered:

> Hypothesis 3A: The greater the degree of workflow integration characterizing the technology of the organizational subunit, the lower will be the degree of required coordination with others reported by subunit members, and vice versa.

Moreover, Davis and Taylor have argued that vertical loading (the allocation of supervisory and maintenance tasks to operators) of jobs is one way of overcoming the negative impact that reduced man-product interaction has on individual outcomes. Since vertical loading amounts to increasing the job's requirements for coordination with others (Walton, 1975) or, in other words, increasing structural interdependence, a comparison of members of subunits characterized by high and low workflow integration and high and low required coordination should shed some light on the general question of the relationship between structural and mechanistic interdependence while addressing the specific hypothesis raised by Davis and Taylor. To that end, the following hypothesis is offered:

> Hypothesis 3B: Among subunits characterized by a given level of workflow integration, those subunits that are characterized by higher degrees of required coordination (interdependence) should also be characterized by higher average perceived job

characteristics and individual outcome measures than subunits characterized by lower degrees of required coordination.

In other words, if increased required coordination is one alternative for ameliorating the adverse impact of high workflow integration on perceived job characteristics (Hypotheses 1A-1D), then members of subunits that are characterized by a higher degree of required coordination should report having more autonomy, variety, task identity, and challenge on their jobs than members of subunits characterized by a lower degree of required coordination, but the same level of workflow integration.

Since individual outcomes such as global job satisfaction and intrinsic motivation are known to be linked to perceived job characteristics (Hackman & Lawler) and may be linked directly to workflow integration as well (Hypotheses 1G-1H), a similar effect is expected for these individual outcome measures.

Hypothesis 3B will be tested for those perceived job characteristics and individual outcomes that show significant relationships to workflow integration. The lack of adequate measures of interdependence for Organization T, coupled with the absence of measures of technology for Organization S makes it impossible to pursue the joint effects of technology and structure any further than this.

CHAPTER THREE

METHOD

The hypotheses advanced in the preceding chapter were tested through secondary analyses of two existing data sets. These data sets will be discussed in detail below. Two data sets were used because no one data source contained both technology and structure variables in a form adequate to the purposes of this dissertation. Of course, this meant that it was not possible to investigate the joint effects of structural and mechanistic interdependence on individual perceptions and outcomes systematically. (Hypotheses 3A and 3B suggest exploratory analyses along such lines.)

Because the data were drawn from two sources, this chapter divides easily into two parallel sections, dealing with the two sites and data sets separately. Each section begins with a brief description of the site. The sample of questionnaire respondents is then described, along with the methods through which the questionnaire data were collected. The derivations and interpretations of the questionnaire-derived measures are discussed. Finally, the interview methods used to collect the structural or technological data are presented, and the interview-derived measures are described and explained.

In addition to these parallel components, the section concerned with Organization S also contains an extensive discussion of the measurement of interdependence. The Organization S section concludes with a brief description of several additional variables to be used in supplementary analyses contained in Chapter Four.

Organization T

Characteristics of the Site

Organization T is a manufacturer of engines and engine parts. Its major facilities, consisting of two large plants (4,860 and 2,185 employees at the time of the study) and several satellite plants, are located within a 30 mile radius of a small midwestern city. Organization T markets over 100 different standard engine designs with hundreds of options that allow them to build engines to meet virtually any specifications. Organization T engages in all aspects of engine production, from the burring of rough castings to the testing of the completed engines. The two large plants do virtually all the manufacturing, with the satellite facilities responsible for packaging and shipping, and some specialized machining of engine parts. All data used here were collected in the two large plants and one separate machining facility.

Organization T's management philosophy, in the view of top management, is solidly in the human relations style, while middle and lower-level company personnel view the organization as highly paternalistic. At the shop level, employees are represented by an independent union. Although there is a long history of union-management cooperation (for many years management financed the union), relationships of late have become less cordial, with talk of joining the United Auto Workers growing. In addition, the first strike in its history took place several years prior to this study, and talk of another strike was common during the author's contact with the organization.

Characteristics of the Sample

Data for the dependent measures reported here were collected during a larger survey of all divisions and levels of the organization's midwestern complex. A ten percent sample of employees was selected based on the company's randomly assigned employee payroll numbers. Surveys were administered on company time to groups of 10-20 employees at a time by the author or one of several associates from The University of Michigan. Administrations took place in July and August 1974. Participation was voluntary. The response rate for the entire sample was 79 percent.

In all, 248 shop-level employees were members of the subunits (departments) for which technology data were available. These respondents were mostly male (96 percent) and educated (80 percent held at least a high school diploma). Respondents ranged in age from 20 to 64, with an average age of 36. They reported working for Organization T for an average of 11 years, with a range of less than one year to 35 years. Respondents were drawn from all three shifts, with 49 percent of the sample working the first shift, 32 percent working the second shift, and 19 percent working the third.

Questionnaire Data

Data regarding a wide variety of aspects of their working life were collected from respondents in the course of the survey. Those portions of the survey relevant here are contained in Appendix B. In all, 11 scales were derived from the questionnaire data and used as dependent measures testing the first series (1A to 1H) of hypotheses. A twelfth scale (perceived need for coordination) was derived for use in testing Hypothesis 3A. Descriptions of the scales follow below.

Table 3.1 contains scale reliabilities computed for this subsample (on the diagonal) and intercorrelations among the 11 dependent measures.

Autonomy (mean = 4.30, S.D. = 1.27). This scale was formed by averaging responses to three items regarding the extent to which the respondent makes job-related decisions.[1] Its derivation, and the derivation of the following five scales, is reported in Walsh, Taber, and Beehr (1977). In general, the job characteristics scales were constructed from items drawn from or similar to those used in the Job Diagnostic Survey (Hackman & Oldham, 1976) or the Michigan Assessment of Organizations (1975).

Variety (mean = 3.57, S.D. = 1.62). This scale was formed by averaging responses to two items dealing with the number of different job-related activities engaged in by the respondent.

Task identity (mean = 3.57, S.D. = 1.62). This scale was formed by averaging responses to three items reflecting the respondent's evaluation of the importance of his/her contribution to the product.

Task feedback (mean = 5.70, S.D. = .99). This scale was formed by averaging responses to two items concerned with the degree to which the respondent can determine how well he/she is performing simply by doing the job.

Supervisor feedback (mean = 4.35, S.D. = 1.45). This scale was formed by averaging responses to two items measuring the extent to which the respondent's supervisor tells the respondent how his/her work is being evaluated.

[1] For this and all variables (except difference scores) used in this dissertation, a high score signifies "more" of the concept than a low score.

Table 3.1

Correlations among Dependent Variables for Organization T with Reliabilities (Spearman-Brown) on Diagonal (N = 209)

Autonomy	.53										
Variety	.32**	.55									
Task identity	.31**	.29**	.50								
Task feedback	.10	.06	.22**	.36							
Supervisor feedback	.14*	.04	.16*	.08	.40						
Challenge	.41**	.64**	.38**	.13	.11	.76					
Role overload	-.15*	-.11	-.15*	-.19**	-.21**	-.13	.61				
Role clarity	-.16*	-.01	-.21**	-.20**	-.53**	-.09	.30**	.57			
Effort	.20**	.16*	.07	-.03	.00	.09	.21**	.04	.64		
Intrinsic motivation	.28**	.21**	.28**	.15*	.20**	.37**	-.16*	-.20**	.09	.49	
Global job satisfaction	.30**	.29**	.25**	.22**	.16*	.37**	-.33	-.18**	-.02	.23**	.82

*$p \leq .05$.

**$p \leq .01$.

Challenge (mean = 4.37, S.D. = 1.90). This scale was formed by averaging responses to two items concerned with the extent to which the respondent is able to develop and use his/her skills and abilities.

Role overload (mean = 3.60, S.D. = 1.34). This scale was formed by averaging responses to three items refelcting the respondent's perception of having too much work to do in the time available. A principal axis factor analysis (reported in Beehr et al., 1976) confirmed that the measure is distinct from other role perception measures, including the following role clarity scale.

Role clarity (mean = 3.14, S.D. = 1.15). This scale was formed by averaging responses to four items concerned with the respondent's clarity with respect to his/her duties and with respect to the expectations of others.

Effort (mean = 4.14, S.D. = .88). This scale was formed on an a priori basis by averaging responses to three items and converting to a seven-point scale. It reflects the respondent's perception of how hard he/she works on the job.

Intrinsic motivation (mean = 4.85, S.D. = 1.89). This scale was formed on an a priori basis by averaging responses to three items concerned with the extent to which the respondent is motivated to perform well by feelings of personal satisfaction derived from good performance. Principal axes factor analysis confirmed the distinction between this scale and the effort scale.

Global job satisfaction (mean = 3.06, S.D. = .82). This scale was formed by averaging two items and converting to a four-point scale. It reflects the respondent's overall evaluation of his/her job. This scale was constructed from two items drawn from Quinn and

Shepard's (1974) facet-free measure of job satisfaction.

Perceived need for coordination (mean = 5.13, S.D. = 1.26, reliability = .61). This scale was formed by averaging responses to two items measuring the extent to which the respondent must interact with other employees in order to do his/her job properly. It was constructed to serve as a surrogate measure for interdependence in analyses conducted on data from Organization T.

Interview Data

Data for the independent variable, workflow integration, were collected in August 1974 from subunit (department) foremen in the two large plants and one of the smaller facilities. Interviews were conducted by the author and two associates from The University of Michigan. A department foreman was interviewed if at least one production worker (non-supervisory, non-inspection) from that subunit was included in the random sample of employees and had completed a questionnaire. This sample of subunits included all the major production departments across all three shifts. In all, 90 foremen were interviewed, representing assembly, machining, and test operations; shipping departments were deliberately excluded from the sample.

Appendix C contains the interview schedule used to collect the subunit-level data. Questions 5 and 6 contain the workflow integration subscales. Several modifications of the original Hickson et al. (1969) scales were necessitated by the characteristics of the subunits sampled here. In particular, the subscale concerned with the precision of evaluation was dropped. Preliminary interviews with general foremen and several department foremen indicated that all subunits would fall into the highest Hickson et al. category of precision,

"measurements used over virtually the whole output(s) to compare against precise specification (blueprint or equivalent)" (p. 383).

In addition, the original Hickson et al. interdependence subscale was broadened. Instead of a single interdependence subscale, two more detailed subscales were used to measure a given subunit's dependence on other production subunits as well as the dependence of other production subunits on the focal subunit. Both scales perserve the basic logic of the original subscale, that is, a high score should indicate a greater degree of interdependence within the organization than a low score. This change was also made on the basis of organizational-level factors. In this case, the overall arrangement of the production system in the organization (long-linked, in Thompson's terminology) led us to believe that the original Hickson et al. interdependence subscale would not adequately discriminate among subunits. Unfortunately, the use of two subscales resulted in only a modest increase in precision.

Thus, the five subscales, with modifications, are as follows:

Input interdependence. This subscale reflects the extent to which the focal subunit is dependent on other production subunits within the organization. It ranges from the absence of any dependence on other production subunits within the organization (all inputs come from outside Organization T) to complete dependence on another subunit within the same plant for at least one input.

Output interdependence. This subscale reflects the extent to which other subunits in the organization are dependent on the focal sununit for their inputs. It ranges from the absence of dependence on other subunits on the focal subunit (the subunit's output is

unique and final for the organization) to a maximum level of dependence on the focal subunit (the subunit's output is a unique input for other subunits in the same plant).

Automaticity range. Amber and Amber (1962) define automaticity in the following way. "The more human attributes performed by a machine, the higher its 'order' of automaticity. Automaticity is here considered to be the self-acting capability of a device" (p. 2). The automaticity range subscale measures the level of automaticity achieved by the most sophisticated equipment in the subunit. Hand tools and manual machines constitute the lowest level, and self-measuring and adjusting (feedback) machines the highest level of automaticity.

Automaticity mode. This subscale uses the same five-point scale as the automaticity range subscale. The difference is that the automaticity mode subscale is scored for the most common level of sophistication achieved by the equipment in the subunit.

Workflow rigidity. This subscale assesses the degree of flexibility built into the production system of the subunit. It consists of eight yes/no items. Subunits were scored for rigidity, that is, the extent to which the technology is non-adaptable, limited in use, and arranged in an invariable sequence. A rigid response received a score of "2" and a flexible response received a score of "1."[1] The rationale for combining the eight items into a single subscale is presented in Levy and Pugh (1969). For ease of interviewing, several of the items in this subscale were slightly reworded, although no

[1]The zero point in the original Aston subscale was eliminated by the addition of a constant (8) for convenience in analysis. The same holds for the two automaticity subscales.

substantive changes were made.

Scores of the five subscales were added together to form the workflow integration scale. Hickson et al. justified the combination of their five subscales on the basis of a principal components analysis. For comparability, the same analysis was performed on these five subscales, using the data from the 90 subunits in Organization T. Hickson et al. found that their first component accounted for 58 percent of the variance in their subscales; the first factor accounted for 55 percent of the variance in the subscales used here. Loadings for the five subscales (with comparable Hickson et al. loadings in parentheses) were: automaticity mode, .89 (.87); automaticity range, .89 (.80); workflow rigidity, .55 (.68); input interdependence, .77; and output interdependence, .51 (the Aston interdependence subscale loaded .61).

Table 3.2 contains frequency distributions for all subscales and individual workflow rigidity subscale items. The frequency distribution for the overall workflow integration scale is contained in Table 3.3.

Organization S

Characteristics of the Site

Organization S is one division of a large electrical power utility, whose many facilities are located in the eastern half of the United States. Organization S was a participant in a larger study from which the data reported here were drawn. Organization S is a white-collar division of the utility and is engaged in engineering work of a planning and design nature. The responsibilities of this division include planning and upgrading (but not operating or

Table 3.2

Frequency Distribution for Modified
Workflow Integration Subscales (N = 90)

Input Subscale

Excluding inspection, receiving and similar departments:	
Does one input come from only one department within the _____ plant?	45
Does one input come from more than one department within the same _____ plant?	0
Does one input come from another _____ plant?	1
Do all inputs come from outside _____?	44

Output Subscale

Excluding shipping, inspection and similar departments:	
Department output is a unique input for other department(s) in the same _____ plant.	81
Department output is unique and goes to another _____ plant.	9
Other departments in this plant have the same final outputs.	0
Department output is unique and final for _____.	0

Automaticity Subscale

Range: highest score possible for the department
Mode: score for the bulk of the department's equipment

Items	Range	Mode
Hand tools and manual machines	4	18
Powered machines and tools	21	15
Single-cycle automatics and self-feeding machines	33	49
Automatic: repeats cycle	27	8
Self-measuring and adjusting: feedback	5	0

Workflow Rigidity Subscale Items

	Yes	No
In the event of a breakdown does all workflow stop immediately?	(11)[1]	79
In the event of a breakdown does some workflow stop immediately?	(68)	22

[1]Rigid response in parentheses.

Table 3.2 (continued)

	Yes	No
Are buffer stocks present or delays possible?	83	(7)
Is any waiting time possible?	60	(30)
Does all input come from a single source and through one point?	(21)	69
Can equipment be used for more than one purpose?	74	(16)
Is the rerouting of work possible?	73	(17)
Is there a production (assembly) line?	(39)	51

Workflow Rigidity Subscale

Subscale Score	Frequency
8	17
9	12
10	19
11	18
12	15
13	9
14	0
15	0
16	0

Table 3.3

Bivariate Frequency Distribution of Workflow Integration Scores by Subunit Function (N = 90; Possible range: 12-34)

Workflow Integration Score	Subunit Function: Machining (N = 58)	Assembly (N = 14)	Mixed Assembly and Machining (N = 4)	Testing (N = 14)	Total Sample
18	0	1	0	0	1
19	0	0	0	11	11
20	6	2	0	0	8
21	18	3	0	0	21
22	6	0	0	3	9
23	6	3	1	0	10
24	8	5	0	0	13
25	7	0	0	0	7
26	2	0	3	0	5
27	2	0	0	0	2
28	3	0	0	0	3

maintaining) power transmission systems. This division is small (about 380 engineering and engineering support personnel) and relatively stable.

The division is arranged into five subdivisions corresponding to different areas of responsibility, although the type of work done is similar from subdivision to subdivision. Subdivisions, in turn, are broken down into work units (subunits) ranging in size from four to 28 engineering personnel. There are between six and eight subunits in each subdivision, with the exception of one subdivision which has only three subunits.

All non-management employees in the division are represented by one of two unions. The engineers have their own independent, but effective, association, while all other non-management employees belong to a branch of a large national union. Throughout its history, this utility, and the particular division of concern here, have enjoyed a cooperative pattern of union-management relations.

Characteristics of the Sample

Data for all the individual-level variables reported here were collected during a larger survey of all members of Organization S conducted during June 1976. Questionnaires were distributed on company time to small groups of employees. The purpose of the questionnaire was explained by personnel from The University of Michigan and respondents were instructed on how to fill out the questionnaire. Respondents then returned to their work places to complete the questionnaire on company time. Completed questionnaires were either left in drop boxes provided for that purpose or turned in to union stewards. Participation was voluntary, and the response rate was

approximately 87 percent.

In all, 272 respondents from Organization S were managers (13 percent), engineers (47 percent), or engineering assistants (40 percent)[1] and were members of subunits for which structural data were also available. (Structural data were gathered by interview; see below). These respondents were mostly male (94 percent) and highly educated (56 percent held at least a bachelor's degree). Respondents ranged in age from 21 to 64. The most common age groups were 46 to 55 (29 percent) and 26 to 30 (20 percent). Most respondents (57 percent) reported working in this particular division of Organization S for 11 or more years. Only nine percent of the sample said they had worked in the division less than a year.

Questionnaire Data

Data regarding a wide variety of aspects of their working life were collected from respondents in the course of the survey. Those portions of the survey relevant here are contained in Appendix D. In all, ten dependent measures were derived from the questionnaire data and used either in testing Hypotheses 2A through 2I or in further analyses. Descriptions of these scales follow. Table 3.4 contains individual-level correlations among the scales as well as scale reliabilities on the diagonal. Descriptions of questionnaire-derived measures of interdependence are discussed later in this chapter.

Autonomy (mean = 4.40, S.D. = 1.30). This scale was formed by averaging responses to five items regarding the extent to which the respondent makes job-related decisions. Derivation of the scale was

[1]All clerical and secretarial personnel were excluded from all analyses reported here.

Table 3.4

Correlations among Dependent Variables for Organization S with Reliabilities (Spearman-Brown) on Diagnonal (N = 263)

Autonomy	.89									
Variety	.57**	†								
Task identity	.56**	.41**	.62							
Challenge	.67**	.67**	.49**	.78						
Role overload	.20**	.34**	.15*	.31**	.73					
Role clarity	.35**	.22**	.37**	.30**	-.12*	.74				
Satisfaction with higher order needs	.55**	.52**	.36**	.71**	.13*	.43**	.93			
Effort	.30**	.36**	.38**	.45**	.19**	.26**	.36**	.61		
Intrinsic motivation	.32**	.24**	.23**	.33**	.09	.20**	.32**	.29**	.62	
Global job satisfaction	.45**	.49**	.28**	.62**	.09	.47**	.73**	.38**	.44**	.85

†Single item measure.

*$p \leq .05$.

**$p \leq .01$.

based on a cluster analysis (Bailey, 1975) of job characteristics items.

Variety (mean = 4.29, S.D. = 1.78). This scale was formed by a single item that asked respondents how much variety they experience in their job.

Task identity (mean = 4.65, S.D. = 1.10). This scale was formed by averaging responses to three items concerned with the respondent's evaluation of the importance of his/her contribution to the product. It was constructed to parallel the task identity measure used within Organization T, since two items overlapped exactly, and the third differed only in format.

Challenge (mean = 4.49, S.D. = 1.36). This scale was formed by averaging responses to three items designed to ascertain the extent to which the respondent feels challenged by his/her job.

Role overload (mean = 3.28, S.D. = 1.24). This scale was formed by averaging responses to two items reflecting the respondent's perception of having too much to do in the time available. This scale, and the role clarity scale, were based on a cluster analysis of role perception items.

Role clarity (mean = 4.83, S.D. = 1.03). This scale was formed by averaging responses to four items concerned with the respondent's clarity with respect to his/her duties and with respect to the expectations of others.

Satisfaction with higher order needs (mean = 4.42, S.D. = 1.45). This scale was formed by averaging responses to five facet-specific satisfaction items. Cluster analysis was used to select this item set from among a larger and more diverse set of facet-specific

satisfaction items. This scale reflects the respondent's satisfaction with the opportunities to grow and develop present in the job.

Effort (mean = 5.18, S.D. = 1.02). This scale was formed on an a priori basis by averaging responses to two items dealing with the amount of effort exerted by the respondent in doing his/her job. A cluster analysis confirmed that this scale is empirically distinct from the following two outcome measures.

Intrinsic motivation (mean = 5.92, S.D. = .73). This scale was also formed on an a priori basis by averaging responses to two items reflecting the respondent's likelihood of experiencing personal satisfaction from the proper accomplishment of his/her duties on the job.

Global job satisfaction (mean = 4.99, S.D. = 1.30). This scale was formed on an a priori basis by averaging responses to three facet-free job satisfaction items. Again, cluster analysis confirmed the empirical distinctiveness of this and the preceding two outcome measures.

The Measurement of Interdependence: Overview

Prior to actually testing the hypotheses concerned with the impact of structural interdependence on individual attitudes and perceptions, measures of interdependence drawn from the interview data were compared to various measures of interdependence derived from the questionnaire data. It was thought that this analysis would establish the validity of the interdependence measures used in later analyses and provide useful information on how workflow interdependencies are perceived by organizational members.

Although previous efforts along these lines have met with only

moderate success (for example, Hinings et al., 1974), the endeavor looked promising, since only production subunits were being examined and nearly complete information on dependence relationships was available from the interview. In addition, questionnaire data were available on several aspects of those same relationships, and, most importantly, comparability had been built into the two instruments deliberately.[1] Thus, this appeared to be an excellent opportunity to compare the objective approach to the measurement of structure (for example, Pugh et al., 1968) with the perceptual approach (for example, Hage & Aiken, 1967).

In all, 27 different measures of interdependence were developed and compared in the course of this study. Many of these measures overlapped considerably and were constructed with the idea of selecting only the most comprehensive yet parsimonious measures for use in subsequent analyses. The remainder of this chapter will describe the origin and interpretation of these various measures. The interview measures will be discussed first, with descriptions of the questionnaire-derived measures following. Finally, the interview measures will be compared to those derived from the questionnaire.

The Measurement of Interdependence: Interview Derived Measures

During early November 1976, personnel from The University of Michigan attempted to personally interview all work unit (subunit) supervisors in the division. In all, supervisors of 25 "production"[2]

[1] Rarely have investigators used both "objective" measures of structure (elite interviews, archival data, etc.) and perceptual measures (questionnaire responses) in the same study. Pennings (1973) is a rare and notable exception.

[2] "Production" work units means those work units actually doing engineering work of any kind. All administrative units were excluded from all analyses reported here.

subunits whose members had completed questionnaires were interviewed. Supervisors at the next two hierarchical levels (subdivision and division) were also interviewed, but the data from those interviews were not used in any of the analyses reported here. These structured interviews were rather lengthy, rarely lasting less than one hour, and covered a variety of topics. Of concern here were the sections of the interview schedule dealing with the interdependence of subunits.

A substantial portion of the structured interviews conducted with subunit supervisors was devoted to an assessment of the subunit's position in the organization's workflow. Supervisors were asked to rate the extent of their subunit's dependence on each of the other work units within their subdivision as well as the dependence of each of the subunits in the subdivision on their own subunit. A seven-point scale was used. The scale points were: (1) not at all dependent; (4) moderately dependent; and (7) very dependent. The specific questions asked were: "Please rate the extent to which your [subunit] is directly dependent upon each other [subunit] in order to get its work done" and "I'd like you to rate the extent to which these other [subunits] are directly dependent on your [subunit]." With each question, the supervisor was presented with the list of all subunits within the subdivision.[1]

In addition, this list contained the names of all other

[1]Since the actual interview schedule contained the names of all the subunits, presenting it in a separate appendix would have identified the organization. Hence, this interview schedule was only summarized here.

subdivisions within the division. Supervisors rated their subunit's dependence on these other subdivisions in the same manner as they did for subunits within their own subdivision. Likewise, supervisors rated the dependence of these other subdivisions on their subunit. Thus, complete sociograms were available within each subdivision, and partial sociograms were available for relationships across subdivision boundaries.

These sociograms were summarized by 14 different quantitative measures. These measures are described below. Correlations among the measures are presented in Table 3.5. Note that these are all subunit (macro) level variables.

DEPON[1] (average dependence on other subunits within the subdivision)(mean = 3.92, S.D. = 1.43). This variable was created by averaging the supervisors' responses to the first question described above regarding dependence of the subunit on other subunits within the subdivision. (The number of such responses averaged together to form this variable, as well as similar variables described below, varied as a function of the number of subunits in the subdivision.) It reflects the average degree of dependence of the subunit on other subunits in the same subdivision.

DEPOF (average dependence of other subunits in the subdivision on the focal subunit)(mean = 3.55, S.D. = 1.10). This variable was created by averaging the supervisors' responses to the second question described above regarding the dependence of other subunits on the focal subunit. It reflects the average dependence of other

[1]Unique shorthand variable names will be used throughout this chapter for greater clarity.

Table 3.5

Correlations among Interview-derived Measures of Interdependence (N = 25)

DEPON	1.00												
DEPOF	.54**	1.00											
VARDEPON	-.10	-.07	1.00										
VARDEPOF	.32	.35*	.03	1.00									
MAXDEPON	.46*	.28	.13	-.03	1.00								
MAXDEPOF	.24	.47*	.11	.45*	.21	1.00							
DEPONOTHERS	.25	.65**	.10	.30	.01	.08	1.00						
DEPOFOTHERS	.15	.57**	.06	.14	-.22	.11	.81**	1.00					
VARDEPONOTH	.30	.59**	.33	.30	.16	.64**	.46*	.45*	1.00				
VARDEPOFOTH	-.05	.44*	.40*	.03	.01	.34*	.46*	.49**	.85**	1.00			
MAXDEPONOTH	-.05	.38*	.19	.14	-.14	.41*	.46*	.46*	.78**	.75**	1.00		
MAXDEPOFOTH	-.02	.38*	.18	.14	-.13	.53**	.40*	.47*	.76**	.69**	.95**	1.00	
DIF	.67**	-.20	-.04	.07	.30	-.16	-.21	-.32	-.14	-.40*	-.32	-.32	1.00
OTHERDIF	.19	.13	.07	.25	.36*	-.05	.39*	-.21	.05	-.01	.05	-.06	.17

*p ≤ .05.

**p ≤ .01.

subunits in the subdivision on the focal subunit.

VARDEPON (variance of DEPON measure)(mean = 2.81, S.D. = 2.23). This variable is the variance across the supervisors' responses to the first question regarding the subunit's dependence on other subunits in the subdivision. It reflects the variability in the degree of dependence of the focal subunit on other subunits in the subdivision. This variable, and the three other variance measures described below, were constructed for use in the comparison of interview and questionnaire-derived interdependence variables. They will not be used in actually testing the hypotheses presented in the preceding chapter.

VARDEPOF (variance of DEPOF)(mean = 3.37, S.D. = 3.58). This variable is the variance across the supervisors' responses to the second question regarding the dependence of other subunits in the subdivision on the focal subunit. It reflects the variability in the degree of dependence of other subunits on the focal subunit.

MAXDEPON (maximum dependence on other subunits in the subdivision)(mean = .48, S.D. = .92). This variable represents the number of maximum dependencies on other subunits in the subdivision ("7" on the response scale) that were reported by the supervisor. This measure complements the DEPON measure, which can only summarize the general trend in the subunit's dependency relationships and could easily obscure instances of high dependence. The MAXDEPON measure, however, focuses only on cases of extreme dependence on other subunits.

MAXDEPOF (maximum dependence of other subunits in the subdivision on the focal subunit)(mean = .32, S.D. = .69). This variable

represents the number of maximum dependencies ("7" on the response scale) of other subunits in the subdivision on the focal subunit, as reported by the focal subunit's supervisor. Its purpose corresponds to that of the MAXDEPON measure.

DEPONOTHERS (average dependence on other subdivisions[1])(mean = 3.30, S.D. = 1.16). This variable was created by averaging the supervisors' responses to the first question described earlier regarding dependence of the subunit on other subdivsions in the division. It reflects the average dependence of the subunit on other subdivisions.

DEPOFOTHERS (average dependence of other subdivisions on the focal subunit)(mean = 2.95, S.D. = 1.09). This variable was formed by averaging the supervisors' responses to the second question regarding the dependence of other subdivisions on the focal subunit.

VARDEPONOTH (variance of DEPONOTHERS measure)(mean = 2.63, S.D. = 2.14). This variable is the variance across the supervisors' responses to the first question regarding the subunit's dependence on other subdivisons in the division. It reflects the variability in the degree of dependence of the focal subunit on other subdivisions.

VARDEPOFOTH (variance of DEPOFOTHERS measure)(mean = 2.71, S.D. = 2.11). This variable is the variance across the supervisors' responses to the second question regarding the dependence of other subdivisions on the focal subunit. It reflects the variability in the degree of dependence of other subdivisions on the focal subunit.

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[1]Supervisors were not asked about each specific subunit in the other subdivisions. Instead, they were asked about dependencies on and of the subdivisions only. No instructions were provided to the supervisors on how to arrive at a single answer for each of the other subdivisions.

MAXDEPONOTH (maximum dependence on other subdivisions in the division)(mean = .24, S.D. = .60). This variable represents the number of maximum dependencies ("7" on the response scale) on other subdivisions that were reported by the supervisor. This measure complements the DEPONOTHERS measure. While that measure summarizes the general trend in the subunit's dependency relationships, it could easily obscure instances of high dependence. The MAXDEPONOTH measure focuses specifically on the number of such extreme dependencies on other subdivisions experienced by the focal subunit.

MAXDEPOFOTH (maximum dependence of other subdivisions on the focal subunit)(mean = .20, S.D. = .50). This variable reflects the number of maximum dependencies ("7" on the response scale) of other subdivisions on the focal subunit that were reported by the focal subunit's supervisor. Its purpose corresponds to that of the MAXDEPONOTH measure.

DIF (difference between dependence on and dependence of other subunits in the subdivision)(mean = .40, S.D. = 1.20). This variable was formed by subtracting the DEPOF measure from the DEPON measure. It reflects the degree of reciprocity (Thompson, 1967) present in the subunit's dependency relationships. A negative score on this measure indicates that the subunit enjoys a position of dominance in the subdivision's network of interdependencies, since other subunits in the subdivision are more dependent on the focal subunit than it is on them. A positive score indicates just the opposite: the focal subunit is more dependent on the other subunits in the subdivision than they are on it. A score of zero indicates that the subunit's dependency relationships with other subunits in the subdivison are

reciprocal.

OTHERDIF (difference between dependence on and dependence of other subdivisions)(mean = .35, S.D. = .69). This variable was formed by subtracting the DEPOFOTHERS measure from the DEPONOTHERS measure. It reflects the degree of reciprocity present in the focal subunit's dependency relationships with other subdivisions in the organization. Its interpretation parallels that of the DIF measure discussed above.

The Measurement of Interdependence: Questionnaire-derived Variables

In addition to the interview-derived measures of interdependence, 13 measures of interdependence were developed from questionnaire data. These measures were all constructed at the individual-level. The first nine measures were based on a set of 12 questionnaire items. Cluster analysis disclosed that these 12 items could be grouped into six indices. These six indices were then used to compute three difference scores analogous to those derived from the interview data. In addition, other items contained in the questionnaire were used to construct four more measures of perceived interdependence. Items used in the construction of all these measures are contained in Appendix D. Table 4.6 contains the correlations among the indices (at the individual level) with reliabilities (Spearman-Brown) on the diagonal. Descriptions of the measures follow.

QDEPONUNIT (dependence on subunit)(mean = 3.83, S.D. = 1.40). This measure was formed by averaging responses to two interdependence items from section B of Appendix D, I.1a and I.2a. This measure reflects the respondent's dependence on others in his/her own subunit for information, advice, or assistance.

QDEPON (dependence on other subunits in the subdivision)(mean =

Table 3.6

Correlations among All Questionnaire-derived Measures of Interdependence with Reliabilities (Spearman-Brown) on Diagonal (N = 256)

QDEPONUNIT	.82												
QDEPON	.57**	.86											
QDEPONOTHERS	.37**	.68**	.84										
QDEPOFUNIT	.44**	.44**	.37**	.86									
QDEPOF	.34**	.56**	.58**	.63**	.88								
QDEPOFOTHERS	.25**	.46**	.75**	.48**	.78**	.88							
QUNITDIF	.55**	.14*	.02	-.50**	-.26**	-.21**							
QDIF	.22**	.43**	.07	-.24**	-.51**	-.37**	.43**						
QOTHERDIF	.15*	.26**	.28**	-.19**	-.33**	-.43**	.32**	.63**					
UNITCONTACT	.26**	.22**	.26**	.35**	.20**	.17**	-.07	.01	.11	†			
CONTACT	.21**	.44**	.46**	.36**	.50**	.45**	-.13*	-.08	-.03	.55**	†		
OTHERCONTACT	.15*	.27**	.54**	.33**	.43**	.63**	-.16**	-.19**	-.17**	.30**	.64**	†	
COORDINATION	.38**	.45**	.43**	.40**	.40**	.40**	.00	.03	.02	.27**	.39**	.42**	.78

†Single item index.

*$p \leq .05$.

**$p \leq .01$.

3.46, S.D. = 1.32). This measure was formed by averaging responses to two interdependence items from section B of Appendix D, I.1b and I.2b. This measure reflects the respondent's dependence on members of other subunits in the subdivision for information, assistance, or advice.

QDEPONOTHERS (dependence on other subdivisions)(mean = 3.11, S.D. = 1.40). This measure was formed by averaging responses to two interdependence items in section B of Appendix D, I.1c and I.2c. It reflects the respondent's dependence on others outside the subdivision for information, assistance, or advice.

QDEPOFUNIT (dependence of subunit)(mean = 3.83, S.D. = 1.33). This measure was formed by averaging responses to two interdependence items in section B of Appendix D, I.3a and I.4a. It reflects the dependence of others in the respondent's subunit on the respondent for information, advice, or assistance.

QDEPOF (dependence of other subunits in the subdivision)(mean = 3.47, S.D. = 1.37). This measure was formed by averaging responses to two interdependence items in section B of Appendix D, I.3b and I.4b. It reflects the dependence of members of other subunits in the subdivision on the respondent for information, advice, or assistance.

QDEPOFOTHERS (dependence of other subdivisions)(mean = 3.10, S.D. = 1.46). This measure was formed by averaging responses to two interdependence items in section B of Appendix D, I.3c and I.4c. It reflects the dependence of members of other subdivisions in the organization on the respondent for information, assistance, or advice.

QUNITDIF (difference between dependence on and dependence of others in the subunit)(mean = .03, S.D. = 1.46). This measure was

formed by subtracting the respondent's score on the QDEPOFUNIT variable from the score on the QDEPONUNIT variable. It is analogous to the difference measures computed on the interview data, only at the individual level.

QDIF (difference between dependence on and dependence of other subunits)(mean = -.01, S.D. = 1.29). This measure was formed by subtracting the respondent's score on the QDEPOF measure from the score on the QDEPON measure. It, too, is analogous to the DIF measure computed on the interview data, only at the individual level.

QOTHERDIF (difference between dependence on and dependence of other subdivisions)(mean = -.01, S.D. = 1.09). This measure was formed by subtracting the respondent's score on the QDEPOFOTHERS measure from the score on the QDEPONOTHERS variable. It is analogous to the OTHERDIF measure computed on the interview data, only at the individual level.

UNITCONTACT (contact within the subunit)(mean = 4.09, S.D. = .92). This variable is a single item measuring the amount of personal, written, and telephone contact between the respondent and other members of the same subunit that is necessary in order for the respondent to do his/her job.

CONTACT (contact within the subdivision)(mean = 3.35, S.D. = .94). This variable is a parallel item measuring the amount of contact between the respondent and persons in other subunits within subdivision.

OTHERCONTACT (contact outside the subdivision)(mean = 2.78, S.D. = 1.05). This variable is a parallel item measuring the amount of contact the respondent has with persons outside the subdivision.

COORDINATION (perceived need for coordination)(mean = 5.44, S.D. = 1.02). This measure was formed by averaging responses to three questions dealing with the extent to which the respondent must interact with other employees in order to do his/her job properly. It corresponds in orientation to the variable of the same name used in the Organization T analyses.

The Measurement of Interdependence: Comparison of the Two Approaches

When the questionnaire and interview measures were compared, the results were disappointing. Table 3.7 presents the correlations between the four average dependence measures derived from the interview and the three sets of questionnaire-derived variables. Clearly, there is little convergence between the two sets of measures. The top portion of the table contains the correlations between what had seemed to be the most directly comparable measures from the two media. Only one of the four correlations that might reasonably be expected to be significant (indicated by a ✓-mark) was, in fact, significant. The interview-derived DEPON measure did not correlate significantly with the corresponding questionnaire measure QDEPON, nor did DEPONOTHERS correlate significantly with QDEPONOTHERS, nor did DEPOF correlate with QDEPOF, although the last two correlations approached significance at the .10 level.

The correlations between the interview measures and the questionnaire-derived measures of amount of contact with others presented in the second portion of the table also failed to show the expected degree of discrimination. It had been expected that the CONTACT variable would be correlated with DEPON and DEPOF, and OTHERCONTACT would be correlated with DEPONOTHERS and DEPOFOTHERS. While three of

Table 3.7

Correlations between Interview-derived Measures of Interdependence and Aggregated Questionnaire-derived Measures (N = 25)

Questionnaire-derived Measures:	Interview-derived Measures			
	DEPON	DEPOF	DEPONOTHERS	DEPOFOTHERS
QDEPONUNIT	-.18	.06	.05	.07
QDEPOFUNIT	-.09	.10	-.11	.08
QDEPON	✓.18	.17	.00	.19
QDEPOF	-.03	✓.32	.27	.49**
QDEPONOTHERS	.37*	.44**	✓.32	.47**
QDEPOFOTHERS	.20	.47**	.52***	✓.64***
UNITCONTACT	.29	.25	.28	.13
CONTACT	✓.32	✓.50*	.40**	.59***
OTHERCONTACT	.38*	.49*	✓.50**	✓.59***
COORDINATION	✓.24	✓.43*	✓.27	✓.44**

*$p \leq .10$.
**$p \leq .05$.
***$p \leq .01$.
✓ = predicted significant correlation.

these four relationships proved to be significant, all four of the other possible relationships between these two sets of variables were significant. Moreover, the correlations between CONTACT and the interview measures of DEPONOTHERS and DEPOFOTHERS were higher than the correlations of CONTACT with DEPON and DEPOF, respectively.

The correlations between the interview measures and COORDINATION are presented in the final portion of the table. Conceivably, COORDINATION might have been correlated significantly with all four interview measures; the items used in the construction of the scale had no specific reference group (within subunit, within subdivision, outside subdivision) and did not necessarily imply dependence on others or dependence of others on the respondent. In fact, COORDINATION was significantly related only to DEPOF and DEPOFOTHERS.

When the variances of the interview measures were controlled, the pattern of results did not change. These analyses are summarized in Table 3.8. For each of the interview variables, the analysis described in the preceding paragraphs was repeated for the half of the sample (median split) with lower variance. Thus, DEPON was correlated with the questionnaire measures using only subunits falling in the lower half of the VARDEPON measure; DEPOF was correlated with the questionnaire measures using only the subunits falling in the lower half of the VARDEPOF measure, and so on for all four interview-derived measures. Because of the small number of cases, it was not possible to control for the variance of more than one of the measures in any given analysis.

Finally, the difference scores formed from these variables were compared. Table 3.9 presents these results. While the two interview

Table 3.8

Correlations between Interview-derived Measures of Interdependence and Aggregated Questionnaire-derived Measures, Controlling for the Variance of the Interview Measures

	Interview-derived Measures			
Questionnaire-derived Measures:	DEPON[a] (N = 12)	DEPOF[b] (N = 12)	DEPONOTHERS[c] (N = 12)	DEPOFOTHERS[d] (N = 13)
QDEPONUNIT	-.19[a]	.08	-.55[b]	-.34
QDEPOFUNIT	-.15	.15	-.02	.27
QDEPON	✓.13	.48	.13	.19
QDEPOF	-.07	✓.38	.59**	.62**
QDEPONOTHERS	.39	.60**	✓.86***	.69***
QDEPOFOTHERS	.28	.62**	.83***	✓.62**
UNITCONTACT	.32	.37	.25	.33
CONTACT	✓.34	✓.78***	.79***	.82***
OTHERCONTACT	.49	.70***	✓.88***	✓.72***
COORDINATION	.29	.44	.38	.54

[a]For lower half of VARDEPON.

[b]For lower half of VARDEPOF.

[c]For lower half of VARDEPONOTH.

[d]For lower half of VARDEPOFOTH.

*$p \leq .10$.

**$p \leq .05$.

***$p \leq .01$.

✓ = predicted significant correlation.

Table 3.9

Correlations among Interview-derived Difference Scores and Aggregated Questionnaire-derived Difference Scores (N = 25)

QUNITDIF	1.00				
QDIF	.44**	1.00			
QOTHERDIF	.24	.69***	1.00		
DIF	.00	✓.37*	.38*	1.00	
OTHERDIF	.11	.09	✓-.04	.17	1.00

*$p \leq .10$.
**$p \leq .05$.
***$p \leq .01$.
✓ = predicted significant correlation.

derived difference measures do not show any appreciable relationship to one another, the questionnaire-derived difference scores correlate much more strongly with each other than they do with the corresponding interview-derived measures.

It seems clear that supposedly comparable scales derived through two fairly standard techniques have failed to show even minimally acceptable convergence or discrimination. Variables were correlated more strongly within media than with the comparable variables across media, with the questionnaire measures particularly bad in this regard. The questionnaire measures failed to discriminate with respect to either the direction of the dependency relationships or the reference groups. Yet the pattern of relationships between variables from the two media was not random. None of the three questionnaire measures concerned with intra-subunit dependencies (QDEPONUNIT, QDEPOFUNIT, UNITCONTACT) were significantly correlated with any of the interview measures, in spite of the high correlations between these measures and the inter-subunit questionnaire measures.

In addition, there was a consistent pattern to the significant results that were obtained. Two trends in the data appear to have combined to produce consistently higher correlations between DEPOFOTHERS and the questionnaire measures than between any of the other interview measures and the questionnaire variables. These trends involve both the direction of the dependency relationship and the reference group. In particular, the questionnaire measures tended to correlate more strongly with the interview variables that measured the dependence <u>of</u> others on the subunit (DEPOF and DEPOFOTHERS) than those that measured the dependence of the subunit

on others. The reference group for the dependency relationship was also important. Questionnaire measures tended to correlate more strongly with interview variables pertaining to dependency relationships with other subdivisions (DEPONOTHERS and DEPOFOTHERS) than with those variables describing relationships with other subunits within the subdivsion.

Apparently, respondents were not as astute at discriminating among, or even recognizing, the various aspects of interdependence as were their supervisors. The results just described, coupled with the generally high correlations among the questionnaire-derived scales that were reported in Table 3.6, suggest a possible explanation for this rather surprising, and disappointing, finding.

While the interview measures relevant to dependency relationships among subunits within the subdivision were not consistently related to those pertaining to dependency relationships with other subdivisions, the questionnaire measures did demonstrate a systematic blurring of one reference group into the next. When correlations among subsets of the questionnaire variables were examined (the triangular submatrices along the diagonal in Table 3.6), all were found to posses simplex structures (Runkel & McGrath, 1972). Whatever the particular subset of measures, the intra-subunit variable always correlated more highly with the inter-subunit variable than with the inter-subdivision variable. Respondents were simply not making the same fine discriminations that the questions called for.

The pattern of correlations between the interview and questionnaire measures suggested that respondents may have been more likely to recognize some interactions as dependency relationships than

others. Respondents appear to have been more aware of their dependency relationships outside their own subdivision than those involving members of other subunits within the subdivision. Moreover, respondents seem to have been more conscious of the dependencies of others on them than the other way around. Perceived need for coordination with others, for example, was correlated only with DEPOF and DEPOFOTHERS, although the items did not imply a dependency relationship of either direction.

Whether this is the most persuasive explanation of these results or not is an empirical question that will be addressed later through a supplementary analysis at the individual level. At the moment, the more pressing question is what to use as the measure(s) of interdependence in testing Hypotheses 2A through 2I. Given the absence of convergent and discriminant validity among the measures, and the complexity of testing nine hypotheses with 27 different versions of the independent variable, some standard must be found for use in selecting from among the candidates. Face validity is a commonly used, albeit arbitrary, rule of thumb for making such choices and is the criterion that will be used here.

On that basis, the interview-derived measures seem to be the best choice. Although one could argue that interdependence is whatever interdependent respondents say it is, that argument assumes that the respondent's decision rules for classifying phenomena as dependency relationships are understood by the investigator and are also accurate. Neither assumption can be said to hold here, although later analyses will shed some light on the first assumption. While questionnaire respondents were asked to answer abstract questions

regarding their relationships with groups of other employees (members of the same subunit, members of the same subdivision, other organizational members), subunit supervisors were asked to estimate the degree and direction of dependence existing between their subunits and each specific and explicitly named subunit in their subdivision and other subdivisions in the organization. Thus, the interview variables appear to possess a greater degree of face validity as a measure of the subunit's place in the network of interdependencies within the organization than aggregated individual estimates of respondents' particular pattern of dependency relationships with other unnamed organizational members.

Variables Used in Supplementary Analyses

In addition to testing the hypotheses presented in Chapter Two, additional, supplementary analyses were undertaken at the individual level in order to gain additional insight into respondents' perceptions of dependency relationships. For the most part, these analyses entailed the use of previously described variables. The development of one additional variable from the questionnaire was necessary. The variable is described below. Appendix D contains the specific items used in the construction of this measure.

Perceived need for cooperation among subunits (mean = 5.45, S.D. = .61). This measure was formed on the basis of a factor analysis of 36 items describing the climate of relationships among subunits within the organization. Out of the original item set, nine items were dropped either because of low communalities (less than .25) or multiple loadings, and the item set was refactored. The same four factors emerge (Kaiser's criterion), accounting for 42 percent

of the variance in the reduced item pool. The factor matrix was rotated (varimax criterion) and the scales formed on the basis of the loadings obtained for the varimax solution. Only one of the scales developed was ultimately used in the supplementary analyses. This measure was formed by averaging responses to five items expressing the belief that cooperation among subunits is necessary for the effective performance of the respondent and his/her subunit.

CHAPTER FOUR

RESULTS

Chapter Four presents tests of the 19 hypotheses presented in Chapter Two, along with the supplementary analyses described briefly in the latter part of Chapter Three. This chapter is divided into four sections. The first section covers Hypotheses 1A through 1H, that is, those hypotheses dealing with the impact of technology on the individual-level variables of perceived job characteristics, role perceptions, and individual outcome measures. This section will use data drawn from Organization T only.

The second part of this chapter is devoted to testing Hypotheses 2A through 2I. These hypotheses cover the relationship of structural interdependence to the three categories of individual-level variables just mentioned. This part of the chapter will use data collected in Organization S only.

The third portion of this chapter covers the exploratory analyses suggested by Hpotheses 3A and 3B regarding the joint impact of mechanistic interdependence (technology) and structural interdependence on individual-level variables. Again, the same three groups of individual-level variables will be used as dependent variables. The analyses will be carried out with data from Organization T.

The fourth and final segment of this chapter summarizes the supplementary analyses suggested in the previous chapter. This section focuses on individual-level interpretation of dependency relationships. It should be noted that this is the only portion of

the chapter in which analyses are carried out at the level of the individual respondent. All analyses in the first three sections are performed using respondent data aggregated to the subunit level in conjunction with data relevant to global properties (Lazarsfeld & Menzel, 1969) of the subunit gathered through interviews with the subunit supervisors. Aggregation is discussed more fully in Appendix A.

Relationships between Technology and Individual-level Variables

Perceived Job Characteristics

Hypotheses 1A through 1D dealt with the relationship of workflow integration to the perceived job characteristics of autonomy (1A), variety (1B), task identity (1C), and challenge (1D). In all cases, it was predicted that the dependent variables would be inversely related to workflow integration.

Table 4.1 presents the results of separate one-way analyses of variance (Hayes, 1963) for aggregated perceived job characteristics as dependent variables and subunit workflow integration scores (bracketed) as the independent variable. Analysis of variance was selected as the method of analysis when a comparison of the correlation coefficients and correlation ratios obtained between workflow integration and the aggregated perceived job characteristics showed substantial gaps between the two measures of association. This indicated that the relationships between workflow integration and the aggregated perceived job characteristics measures were non-linear (Nunnally, 1967). Hence, it was appropriate to use analysis of variance rather than correlational techniques. Workflow integration scores were bracketed for these analyses to increase the stability

Table 4.1

Summary of One-way ANOVA's for Aggregated Perceived Job Characteristics by Bracketed Workflow Integration Scores

	Workflow Integration					
Job Characteristics	18-20 (N)	21-22 (N)	23-24 (N)	25-28 (N)	F-ratio	Eta
Autonomy	4.82 (20)	3.93 (29)	4.03 (23)	4.46 (15)	5.45***	.41
Variety	4.27 (20)	3.93 (29)	2.97 (23)	3.39 (16)	4.80***	.38
Task identity	5.84 (19)	4.76 (29)	4.76 (23)	5.13 (16)	6.05***	.42
Task feedback	5.84 (20)	5.41 (29)	5.69 (23)	5.55 (16)	1.29	--
Supervisor feedback	4.18 (20)	4.53 (29)	4.03 (23)	4.66 (16)	1.53	--
Challenge	5.37 (20)	4.12 (29)	3.86 (23)	4.39 (16)	4.38***	.37

* $p \leq .10$.
** $p \leq .05$.
*** $p \leq .01$.

of the results. Bracketing was accomplished by collapsing cells with less than ten subunits. Insuring stability seemed especially important since the aggregate data for subunits was based on responses from an average of three respondents per subunit, constituting about ten percent of the subunit's members.

Finally, aggregated data were used to test these (and the remaining) hypotheses because the rationale for aggregating the individual-level variables was more persuasive than the arguments in favor of disaggregating the technological and structural variables. The issue of aggregation is treated more fully in Appendix A.

As predicted, workflow integration was significantly related to autonomy, variety, task identity, and challenge and not related to two other job characteristics, task and supervisor feedback. However, the pattern of the relationships was not as predicted. These results are presented in Table 4.1.

Figure 4.1 presents the results for the four significant relationships graphically. In all four cases, the relationship was curvilinear with the highest values for the dependent variables (variety excepted) reported in the two extreme workflow integration categories. Although the discussion in Chapter Two suggested the possibility that these relationships might well be curvilinear across the broad range of workflow integration scores, it was not anticipated that this pattern would be observed within this limited sample of Organization T production subunits.

Role Perceptions

Table 4.2 presents the results of a one-way analysis of variance for the workflow integration-role overload relationship (Hypothesis

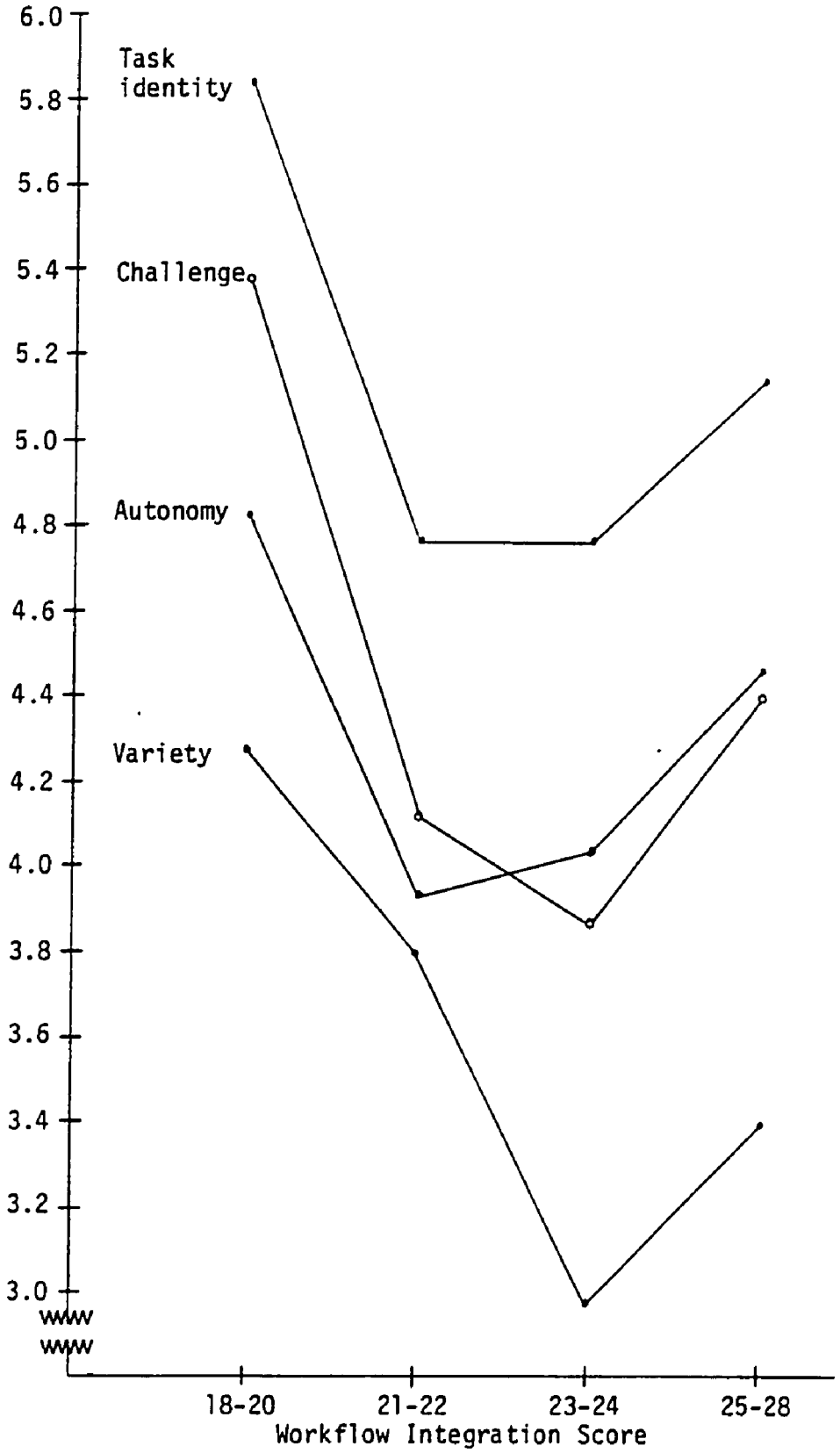


Figure 4.1. Relationships of aggregated perceived job characteristics to bracketed workflow integration scores.

Table 4.2

Summary of One-way ANOVA's for Aggregated Role Perceptions by Bracketed Workflow Integration Scores

	Workflow Integration					
Role Perceptions	18-20 (N)	21-22 (N)	23-24 (N)	25-28 (N)	F-ratio	Eta
Role overload	3.31 (20)	3.54 (29)	3.88 (23)	3.31 (15)	1.23	--
Role clarity	3.11 (20)	2.93 (29)	3.18 (23)	2.99 (16)	.475	--

1E). This hypothesis was not confirmed. No relationship was found between workflow integration and the average degree of role overload reported in the subunit, nor was a relationship found between workflow integration and role clarity.[1]

Individual Outcome Measures

Hypotheses 1F through 1H were concerned with the relationship between workflow integration and the individual outcome measures of effort (1F), intrinsic motivation (1G), and global job satisfaction (1H). Table 4.3 presents the results of separate one-way analyses of variance for aggregated individual outcome measures as the dependent variables and workflow integration as the independent variable.

Hypothesis 1F was fully confirmed by the data. A significant relationship was found between workflow integration and the average amount of effort exerted on the job. Moreover, the form of the relationship, while not perfectly linear, was monotonic and negative, as predicted.

Hypothesis 1F was not confirmed by the data. No relationship was found between aggregated intrinsic motivation and workflow integration.

Hypothesis 1H was partially confirmed by the data. A significant relationship was found to exist between workflow integration and aggregated global job satisfaction. However, this relationship was too curvilinear, with the highest average global job satisfaction found in the two extreme categories of workflow integration.

As indicated in Chapter Two, significant relationships between

[1]Although no hypothesis was offered regarding role clarity, this analysis is included here for the purpose of comparing the effects of structural interdependence and mechanistic interdependence.

Table 4.3

Summary of One-way ANOVA's for Aggregated Individual Outcome Measures by Bracketed Workflow Integration Scores

	Workflow Integration					
Individual Outcomes	18-20 (N)	21-22 (N)	23-24 (N)	25-28 (N)	F-ratio	Eta
Effort	4.47 (20)	4.07 (29)	3.99 (23)	3.82 (14)	5.17***	.40
Intrinsic motivation	5.27 (20)	4.78 (29)	4.70 (23)	4.54 (15)	.90	--
Global job satisfaction	3.33 (20)	2.88 (29)	3.02 (23)	2.08 (16)	2.18*	.27

*$p \leq .10$.
**$p \leq .05$.
***$p \leq .01$.

workflow integration and aggregated individual outcome measures could be due to the significant relationship between workflow integration and perceived job characteristics, since perceived job characteristics are known to be associated with individual outcomes. To determine whether or not workflow integration is directly related to individual outcomes, further analyses were performed.

First, each of the three outcome variables was regressed onto the perceived job characteristics of autonomy, variety, task identity, and challenge (the job characteristics found to be significantly related to workflow integration). These regressions were carried out at the individual level. Next, the residual scores for each of the outcome measures were aggregated to the subunit level, and separate one-way analyses of variance were performed, with the bracketed workflow integration scale as the independent variable. These results are presented in Table 4.4. Of the outcome measures, only effort was found to be significantly related to workflow integration when the effects of perceived job characteristics were controlled. The form of the workflow integration-effort relationship was monotonic and negative.

Additional Analyses

Thus far, only relationships between the overall workflow integration scale and the various dependent measures have been examined. One advantage of the workflow integration scale that was discussed in Chapter Two is that its subscales tap different aspects of the production system that contribute to the overall integration or interdependence of workflow segments. Consequently, separate one-way analyses of variance were performed on all the dependent measures

Table 4.4

Results of One-way ANOVA's for Aggregated Individual Outcome Measures by Bracketed Workflow Integration Scores with Perceived Job Characteristics Partialled Out (N = 85)

Individual Outcomes	F-statistic	Eta
Effort	3.087	.32
Intrinsic motivation	.3423	--
Global job satisfaction	.4044	--

discussed earlier, using each of the five subscales as predictors.

These results are presented in Table 4.5. In terms of significance, the results in Table 4.5 are virtually identical to those obtained with the overall workflow integration score, with two exceptions. None of the subscales were significantly related to autonomy, although workflow integration was significantly related to autonomy (eta = .41). In addition, both automaticity range and mode were significantly related to intrinsic motivation, although the overall workflow integration scale was not related to intrinsic motivation.

With respect to the form of the relationships, however, the results for specific subscales were somewhat erratic. The significant relationships between the input interdependence subscale and both task identity and global job satisfaction were monotonic but increasing. All significant relationships between the workflow rigidity subscale and the dependent measure were monotonic and decreasing over all but the upper portion of the workflow rigidity subscale, where scores on the dependent measures began to increase again. Both automaticity subscales showed monotonic and decreasing relationships with variety and effort, and erratic curvilinear relationships with the other dependent measures.

It seemed unwise to make too much of these differences in form of relationship. In general, the relationships between the subscales and the dependent variables mirrored the overall relationships between workflow integration and those same dependent measures. Moreover, subunits were not equally distributed across scale points, with small cell frequencies common for portions of all the subscales.

Table 4.5

Eta Statistics for All Dependent Measures
by All Workflow Integration Subscales

Dependent Variables	Input Scale	Output Scale	Automaticity Range	Automaticity Mode	Workflow Rigidity
Perceived job characteristics					
Autonomy	--	--	--	--	--
Variety	--	--	.36**	.33**	.44***
Task identity	.28*	--	.38**	.41***	.32*
Task feedback	--	--	--	--	--
Supervisor feedback	--	--	--	--	--
Challenge	--	.19*	.37**	.40***	.34*
Role perceptions					
Role overload	--	--	--	--	--
Role clarity	--	--	--	--	--
Individual outcomes					
Effort	--	--	.36**	.39***	.39**
Intrinsic motivation	--	--	.37**	.31**	--
Global job satisfaction	.26**	--	.31*	--	--

*$p \leq .10$.
**$p \leq .05$.
***$p \leq .01$.

This condition appears to have contributed to the instability of the results obtained.

Relationships between Structural Interdependence and Individual-level Variables

Perceived Job Characteristics

Hypotheses 2A and 2B dealt with the relationship of structural interdependence to the perceived job characteristic of autonomy. Specifically, Hypothesis 2A predicted that perceived autonomy would be higher in subunits occupying positions of dominance in the interaction structure of the organization than in other subunits in the organization. This hypothesis was tested by one-way analyses of variance, using the categorized difference scores (DIF and OTHERDIF) as the predictors. Subunit scores on the interview-derived DIF and OTHERDIF measures were grouped into three categories: dominance, that is, the subunit is less dependent on other subunits or subdivisions than they are on it; parity, the subunit is about as dependent on other subunits or subdivisions as they are on it; and controlled, the subunit is more dependent on others than they are on it.

Table 4.6 presents the results of these analyses. As the first line of the table shows, Hypothesis 2A was not supported by the data. Neither the categorized DIF nor OTHERDIF variable was significantly related to perceived autonomy. When the two variables were combined into a single pattern variable to test for possible joint or interaction effects, the results were again non-significant.

Table 4.6 also contains the results of identical analyses performed for three other aggregated job characteristics (variety,

Table 4.6

Summary of One-way ANOVA's for Aggregated Perceived Job Characteristics by Categorized Difference Scores

	Interdependence Measures											
	DIF					OTHERDIF					Pattern Variable	
Perceived Job Characteristics	Dominance (N = 8)	Parity (N = 7)	Controlled (N = 13)	F-statistic	Eta	Dominance (N = 3)	Parity (N = 10)	Controlled (N = 12)	F-statistic	Eta	F-statistic	Eta
Autonomy	4.72	4.34	4.51	.33	.17	4.84	4.68	4.40	.64	.23	.54	.36
Variety	4.41	4.46	4.48	--	.04	4.32	4.62	4.33	.36	.18	1.06	.48
Task identity	4.81	4.61	4.53	.85	.27	4.93	4.68	4.52	1.01	.29	1.27	.51
Challenge	4.72	4.56	4.55	.21	.14	4.51	4.90	4.43	1.36	.33	1.34	.52

task identity, and challenge). None of these analyses were significant. Although these analyses were not called for by any hypotheses offered in Chapter Two, they were performed and included here to parallel the analyses of the first section of this chapter.

Hypothesis 2B asserted that the more dependent other subunits in the organization are on a given subunit, the higher the average perceived autonomy reported by members of that subunit. This hypothesis was tested in two ways. First, the correlations between the interview-derived average interdependence measures, DEPOF and DEPOFOTHERS, and aggregated perceived autonomy scores were examined. These results, presented in Table 4.7, partially supported Hypothesis 2B. DEPOFOTHERS was significantly related to perceived autonomy while DEPOF was not.[1]

Table 4.7 also summarizes the results of a multiple regression analysis performed using both average interdependence measures as predictors of autonomy. Again, the results were significant, but there was no gain in ability to predict autonomy over and above the degree possible with DEPOFOTHERS alone.

When the results of the same analyses performed on the other three job characteristics were examined, only variety was significantly related to structural interdependence. Variety was significantly correlated with both DEPOF and DEPOFOTHERS, with a multiple R of .50.

Hypothesis 2B was tested in a second way, using the maximum dependency variables. While neither MAXDEPOF nor MAXDEPOFOTH was significantly related to aggregated perceived autonomy, MAXDEPON did

[1]Neither DEPON nor DEPONOTHERS was significantly related to autonomy.

Table 4.7

Correlations between Interview-derived Average Interdependence Measures and Aggregated Perceived Job Characteristics (N = 25)

	Interdependence Measures		
Perceived Job Characteristics	DEPOF	DEPOFOTHERS	Multiple R's
Autonomy	.28	.46*	.46*
Variety	.36*	.46*	.50**
Task identity	.06	.29	.32
Challenge	.21	.32	.30

*$p \leq .10$.
**$p \leq .05$.

prove to be significantly related to autonomy. Subunits with one or more maximum dependence relationships on other subunits are characterized by significantly lower aggregate autonomy than subunits with no maximum dependencies on other subunits. In fact, MAXDEPON was the only one of the maximum dependency variables to show a significant relationship to any of the job characteristics. Table 4.8 presents the results for MAXDEPON and MAXDEPONOTH, as well as a summary of the results achieved using a pattern variable formed from both the latter variables.

Thus, these analyses have indicated that Hypothesis 2A was clearly not supported by the data, while Hypothesis 2B was partially supported. Perceived autonomy did increase appreciably ($r = .46$) with the average degree to which other subdivisons were dependent on the focal subunit, but not with the degree of dependence of other subunits within the focal subunit's own subdivision. Moreover, there was no relationship between either of the maximum dependency of others variables (MAXDEPOF and MAXDEPOFOTH), while subunits with one or more maximum dependencies on other subunits within the subdivision showed significantly lower perceived autonomy than subunits without such dependencies.

Role Perceptions

Hypotheses 2C and 2D, dealing with the relationship of interdependence to aggregated role clarity and overload, respectively, were tested in the same fashion as Hypothesis 2B. Table 4.9 presents the results of these analyses. It was hypothesized that role clarity would decrease as the subunit's dependence on others increased. That hypothesis was not supported. DEPONOTHERS was significantly and

Table 4.8

Summary of One-way ANOVA's for Aggregated Perceived Job Characteristics by Maximum-dependency Interdependence Variables

	Interdependence Measures									
	MAXDEPON				MAXDEPONOTH				Pattern Variable	
Perceived Job Characteristics	No Maximum Dependencies (N = 17)	1 or More Dependencies (N = 8)	F-statistic	Eta	No Maximum Dependencies (N = 21)	1 or More Dependencies (N = 4)	F-statistic	Eta	F-statistic	Eta
Autonomy	4.81	4.04	7.64**	.50	4.59	4.40	.21	.10	3.08**	.55
Variety	4.55	4.23	.87	.19	4.41	4.65	.29	.11	.47	.25
Task Identity	4.77	4.34	5.36	.43	4.63	4.64	--	--	1.89	.46
Challenge	4.78	4.31	2.92*	.34	4.55	5.01	1.58	.25	1.60	.43

*p ≤ .10.

**p ≤ .05.

Table 4.9

Correlations between Interview-derived Average Interdependence Measures and Aggregated Role Perceptions (N = 25)

	Interdependence Measures			
Role Perceptions	DEPON	DEPONOTHERS	DEPOF	DEPOFOTHERS
Role overload	.33	.05	✓.33	✓.11
Role clarity	✓.02	✓.35*	.11	.32

*$p \leq .10$.

✓ = predicted significant correlation.

positively related to role clarity, while DEPON was not significantly related to role clarity. Moreover, neither of the maximum dependency variables (MAXDEPON and MAXDEPONOTH) was significantly related to role clarity.

Hypothesis 2D stated that role overload would increase with the degree of dependence of others on the subunit. This hypothesis received only partial support. Neither DEPOF nor DEPOFOTHERS was correlated significantly with role overload, although the relationship between DEPOF and role overload approached significance. Likewise, MAXDEPOFOTH was not significantly related to role overload, but MAXDEPOF was significantly related ($F = 5.42$, d.f. = 1,23, sig. = .03, eta = .44). Subunits with one or more other subunits maximally dependent on them showed significantly greater aggregate levels of role overload among members than subunits without such dependency relationships.[1] The results were again significant ($F = 3.47$, d.f. = 3,21, sig. = .03, eta = .58) when a pattern variable was formed using the two maximum dependency variables, and a one-way analysis of variance was performed using the pattern variable.

With respect to the two hypotheses concerning the impact of structural interdependence on role perceptions, the results may be summarized as follows. Hypothesis 2C was not confirmed; in fact, the results suggest a possible relationship in the opposite direction to what was predicted. Hypothesis 2D received partial confirmation. The dependence of other subunits within the subdivision on a given subunit (MAXDEPOF) was consistently related to higher average role

[1] For subunits without dependencies, mean = 3.13, N = 20; for subunits with maximum dependencies of others on the subunit, mean = 3.93, N = 5.

overload for the members of that subunit. The dependence of other subdivisions on the focal subunit (MAXDEPOFOTH) was not related significantly to role overload by itself, but appeared to affect role overload somewhat in conjunction with MAXDEPOF.

Individual Outcome Measures

Five hypotheses were concerned with the relationship of interdependence to individual outcome measures. Hypotheses 2E and 2F dealt with satisfaction of higher order needs and paralleled Hypotheses 2A and 2B. Hypothesis 2G asserted that members of subunits occupying positions of dominance in the interaction structure of the organization would report higher levels of effort than respondents in controlled subunits. Likewise, Hypotheses 2H and 2I stated that respondents in dominant subunits would report higher average intrinsic motivation and global job satisfaction, respectively, than respondents in controlled subunits. The last three hypotheses were based on Argyris' discussion of the impact of dependency relationships on the individual.

None of these five hypotheses were supported by the data. Table 4.10 presents the results of separate one-way analyses of variance using the difference scores (separately and together as a single pattern variable) as predictors and aggregated individual outcome measures as dependent variables. One of 12 possible relationships proved to be significant at the $p \leq .10$ level; exactly what would be expected by chance. Table 4.11 presents the correlations between the average interdependence measures and the same four aggregated individual outcome measures. None of the 12 correlations proved to be significant.

Table 4.10

Summary of One-way ANOVA's for Aggregated Individual Outcome Measures by Categorized Difference Scores

	Interdependence Measures											
	DIF					OTHERDIF					Pattern Variable	
Individual Outcomes	Dominance (N = 8)	Parity (N = 3)	Controlled (N = 13)	F-statistic	Eta	Dominance (N = 3)	Parity (N = 10)	Controlled (N = 12)	F-statistic	Eta	F-statistic	Eta
Satisfaction of higher order needs	4.77	4.45	4.51	.40	.19	4.69	4.89	4.38	1.66	.36	1.15	.49
Effort	5.21	5.46	5.11	.44	.20	5.18	5.36	5.05	.82	.26	1.93	.59
Intrinsic motivation	5.99	6.02	5.93	.17	.13	6.08	6.0[illegible]	5.87	1.22	.32	.88	.44
Global job satisfaction	5.06	5.05	5.05	--	--	4.51	5.40	4.95	3.07*	.47	1.59	.55

*p ≤ .10.

Table 4.11

Correlations between Average Interdependence Measures and Aggregated Individual Outcome Measures (N = 25)

	Interdependence Measures			
Individual Outcomes	DEPON	DEPONOTHERS	DEPOF	DEPOFOTHERS
Satisfaction of higher order needs	.05	.09	.12	.29
Effort	.06	-.19	.05	.00
Intrinsic motivation	-.09	-.20	-.14	-.01
Global job satisfaction	.12	.14	-.02	.16

Exploratory Analyses of the Joint Effects of Technology and Structural Interdependence

Relationship between Perceived Need for Coordination and Workflow Integration

Hypothesis 3A asserted that subunits characterized by high workflow integration would tend to be characterized by lower average need coordination with other people than subunits characterized by low workflow integration. This hypothesis was tested by a one-way analysis of variance using the bracketed workflow integration scales as the independent variable and aggregated perceived need for coordination with others as the dependent variable. A significant relationship was obtained ($F = 2.35$, d.f. = 3,82, sig. = .08, eta = 28) at the .10 level, confirming the hypothesis. Figure 4.2 presents these results graphically. Pairwise comparisons among the four levels of workflow integration indicated that the last bracketed category (25-28) was significantly different ($p \leq .05$) from all other bracketed categories, while there were no significant differences among the first three bracketed categories.

Table 4.12 summarizes the results of separate one-way analyses of variance performed with each of the workflow integration subscales as independent variables. (Correlation ratios are reported only for significant relationships.) The strongest relationship was between automaticity mode and aggregated perceived need for coordination. Relationships between both the automaticity variables and coordination were monotonic and negative.

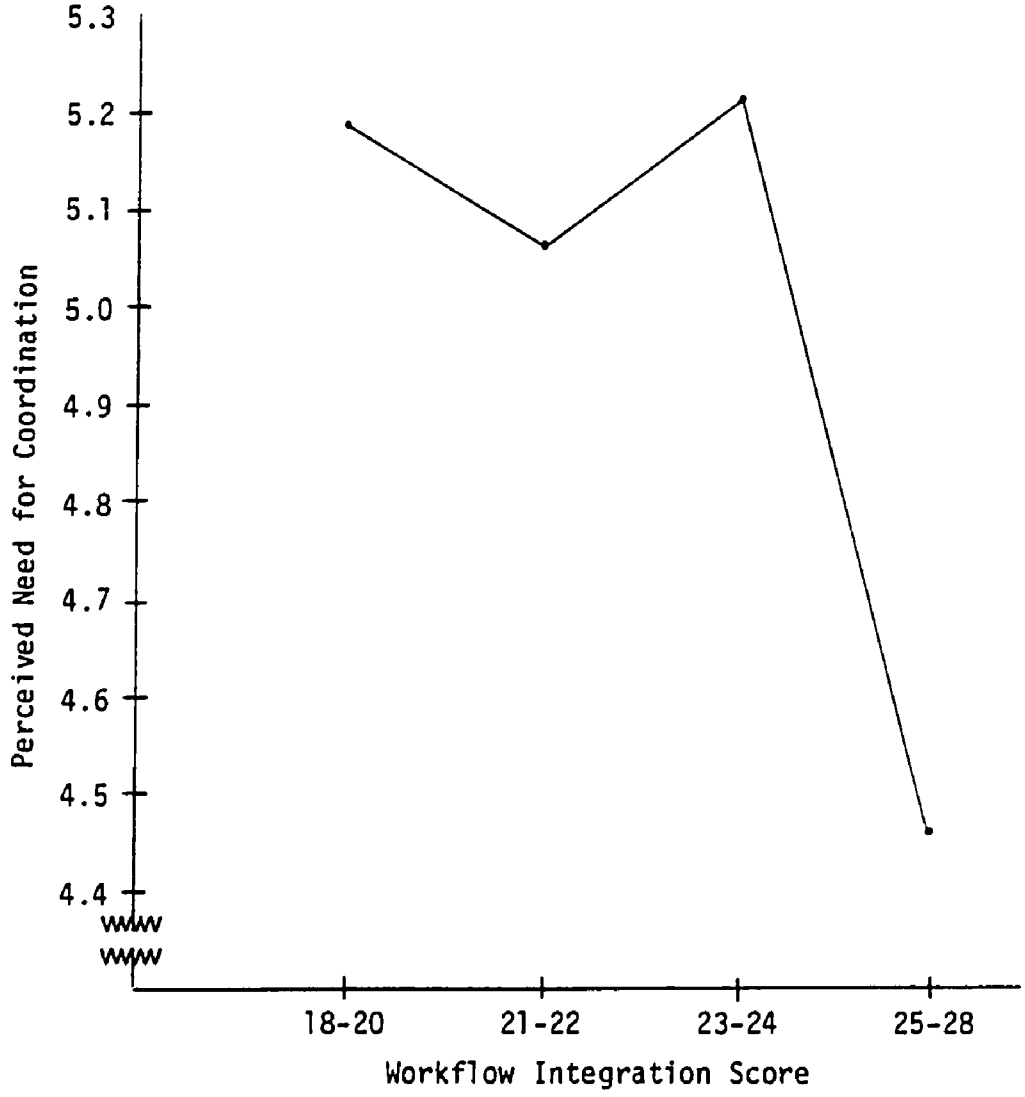


Figure 4.2. Relationship of aggregated perceived need for coordination to bracketed workflow integration scores.

Table 4.12

Eta Statistics for Significant ($p \leq .10$) Relationships between Coordination and the Workflow Integration Subscales (N = 86)

Workflow Integration Subscales	Eta
Input interdependence	.27
Output interdependence	--
Automaticity range	.31
Automaticity mode	.37***
Workflow rigidity	--

*** $p \leq .01$.

Relationships of Both Workflow Integration and Perceived Need for Coordination to Perceived Job Characteristics and Individual Outcome Measures

Hypothesis 3B stated that for a given level of workflow integration, subunits characterized by higher levels of required coordination should also be characterized by higher scores on perceived job characteristics and individual outcome measures. Since workflow integration and perceived need for coordination were not independent, a two-way analysis of variance (factorial design) was not appropriate for testing Hypothesis 3B. Instead, multiple regression techniques were used since they allowed for the presence of a relationship between the two independent variables. The specific analysis strategy used was suggested by McNemar (1969, p. 449).

First, dummy variable multiple regressions were performed on the four aggregated perceived job characteristics discussed in Hypotheses 1A through 1D (autonomy, variety, task identity, and challenge), the two role perception variables (role overload and role clarity), and the three aggregated individual outcome measures (effort, intrinsic motivation, and global job satisfaction), using workflow integration as the predictor. Bracketed workflow integration scores were converted to dummy variables for these regressions because earlier analyses had made it abundantly clear that the relationships between workflow integration and five of the seven dependent variables were curvilinear (only effort and intrinsic motivation showed monotonic relationships to workflow integration). For simplicity, the same analysis strategy was applied to all seven.

Second, these dummy variable multiple regressions were repeated,

but with the addition of aggregated perceived need for coordination as an independent variable. The significance of the Beta for the coordination variable was then determined by testing for the significance of the differences in the R^2's, with and without coordination as a predictor, for each of the dependent variables. The results of these analyses are presented in Table 4.13. A significant difference in the R^2 means that the addition of the coordination variable significantly increased the predictable variance of the dependent variable over and above that predicted by workflow integration alone. Thus, Hypothesis 3B appears to be supported only for task identity and intrinsic motivation.

Finally, the significant joint relationships were examined in greater detail. This was accomplished by dichotomizing both independent variables and computing cell means for each cell in the resultant two-by-two tables. These data are presented in Tables 4.14 (for task identity) and 4.15 (for intrinsic motivation). In both cases, t-tests indicated that the high coordination-low workflow integration cell was significantly different from all other cells in the table, with no significant differences among the other three cells.

Thus, the data provided very weak support for Hypothesis 3B. For only two of the seven dependent variables were significant joint effects found. Under conditions of low workflow integration, high perceived need for coordination with others was associated with significantly higher levels of task identity and intrinsic motivation than was low perceived need for coordination. However, under conditions of high workflow integration, there were no differences between high and low conditions of perceived need for coordination with others

Table 4.13

Summary of Multiple Regression Analyses
Testing for Significance of Aggregated Coordination
as a Predictor of Aggregated Dependent Measures (N = 85)

Dependent Variables	R^2 Workflow Integration Only	R^2 with Coordination In	F-ratio d.f. = (1,80)
Job characteristics			
Autonomy	.15	.15	--
Variety	.17	.20	2.818
Task identity	.18	.23	4.940**
Challenge	.13	.15	1.596
Role perceptions			
Role overload	.04	.07	2.073
Role clarity	.02	.03	1.062
Individual outcomes			
Effort	.16	.18	2.307
Intrinsic motivation	.02	.09	5.908***
Global job satisfaction	.06	.06	--

** $p \leq .05$, d.f. = (1,80)

*** $p \leq .01$, d.f. = (1,80)

Table 4.14

Aggregated Task Identity Scores as a Function of Aggregated Perceived Need for Coordination and Workflow Integration Scores

Workflow Integration	Perceived Need for Coordination: Low	Perceived Need for Coordination: High	
Low	4.86 (25)	5.59 (22)	5.19 (47)
High	4.90 (22)	4.89 (16)	4.89 (38)
	4.88 (47)	5.30 (38)	5.07 (85)

Table 4.15

Aggregated Intrinsic Motivation as a Function of Aggregated Perceived Need for Coordination and Workflow Integration Scores

Workflow Integration	Perceived Need for Coordination: Low	Perceived Need for Coordination: High	
Low	4.40 (25)	5.51 (23)	4.74 (48)
High	4.73 (21)	4.60 (16)	4.67 (37)
	4.55 (46)	4.90 (39)	4.82 (85)

for either task identity or intrinsic motivation.

Supplementary Analyses

In Chapter Three, the interview and questionnaire-derived measures of interdependence were compared. Those analyses made it clear that the two sets of measures showed little convergence; they hardly seemed to be comparable measures of the same phenomenon, differing only in their origins. At that point, it was speculated that respondents were not making the same distinctions among dependency relationships that the researchers had made and that respondents were differentially aware of their dependency relationships with others. Some evidence was presented that indicated respondents were more aware of the dependency of others on them than their own dependency on others and were more aware of dependency relationships involving more distant members of the organization than those involving organizational members close at hand.

This question of how interdependence is interpreted by individual organizational members was pursued further at the individual level. (Analyses presented in Chapter Three were all performed at the subunit level using aggregated data.) Two specific questions were addressed in these supplementary analyses. First, to what extent do individuals discriminate among the dependency relationships in which they are engaged? And, second, do individuals view their dependency relationships with other organizational members as characteristics of their own role set or as a reflection of the organization's workflow?

The first question was partially answered through the aggregate analyses discussed in Chapter Three, where it was noted that all triangular submatrices along the diagonal of Table 3.6 displayed

simplex structures. This was interpreted as indicating a systematic blurring of respondents' perceptions of their dependency relationships.

A factor analysis of the 12 dependency items used in the construction of the first six questionnaire-derived interdependence measures (QDEPON, QDEPOF, etc.) substantiated the speculations regarding respondents' ability to discriminate among dependency relationships and their referents. Three factors with eigenvalues greater than 1.0 emerged from the factor analysis. Together, these three factors accounted for 70 percent of the variance in the questionnaire items. Table 4.16 presents the results of a varimax rotation of the three factors.[1] An examination of the loadings on the second and third factors will show that respondents did discriminate between the dependence of others on them and their dependence on others, at least within the subunit and, to a lesser extent, within the subdivision. However, the fact that all items involving dependencies both on and of distant members of the organization (ninth through twelfth items) loaded primarily on the first factor suggested that this distinction was not maintained as the reference group grew

[1]Ostensibly, this factor analysis could have formed the basis for three interdependence scales instead of the six scales actually used (see pp. 88 - 91). This would have created more problems than it solved, however. If the typical strategy of forming scales from the items with the highest loadings and discarding the others had been used, the four within-subdivision items could not have been used, since they all load on two factors. Using factor scores would have solved both this problem and the problem of high correlations among the scales, but would have succeeded only in moving the attendant ambiguity into the construction and interpretation of the scales, rather than eliminating it. Plus, factor scores would have lost the parallelism between the measures derived from the two media that characterized the scales actually used.

Table 4.16

Simultaneous Varimax Rotation on Results of Principal Axes Factor Analysis of Questionnaire Dependence Items (N = 255)

Items	Communality	Dependencies Involving Distant Members	Dependencies on Subdivision Members	Dependencies of Subdivision Members
Within subunit[1]				
B I.1a (on)	.73282	.076140	.82254	.22462
B I.2a (on)	.51674	.054858	.66937	.25628
B I.3a (of)	.68620	.10562	.31239	.75991
B I.4a (of)	.68478	.18442	.24288	.76927
Within subdivison				
B I.1b (on)	.72916	.48032	.70015	.090835
B I.2b (on)	.56514	.43592	.57901	.19963
B I.3b (of)	.64449	.56467	.15392	.54950
B I.4b (of)	.77197	.53965	.15675	.67541
Outside subdivison				
B I.1c (on)	.81534	.76754	.47434	.035011
B I.2c (on)	.72363	.78628	.31312	.085750
B I.3c (of)	.76668	.77768	.050867	.399913
B I.4c (of)	.76410	.74033	.033176	.46359

[1]Labels refer to item tags in Appendix D.

more and more distant from the respondent.

The loadings for the within subdivision items (fifth through eighth items) also supported the assertion that reference groups were systematically blurred. While all four such items loaded on the appropriate "dependence on" or "dependence of" factor, they also loaded almost equally on the first, or "distant dependencies," factor, while the within subunit items did not. Thus, in answer to the first question raised above, the results of this factor analysis of individual responses confirmed and extended inferences drawn earlier from the aggregated data: respondents tended to systematically blur the distinctions between reference groups. Moreover, respondents appeared to be less and less able to distinguish between dependence on others and others' dependence on them (or, perhaps, found it less important to do so) the farther the referent was from their own subunit.

The second question to be addressed here concerns the way in which the respondent classified the dependency relationships of which he/she was a part. In order to determine whether respondents viewed their dependency relationships primarily as components of their own role set or as characteristic of the organization's workflow, two sets of multiple regressions were performed. The predictors were the six questionnaire-derived interdependence measures and the three contact variables. The dependent measures were perceived need for coordination and another variable not used in earlier analyses, perceived need for coordination among subunits. The former variable reflects the respondent's perception that he/she must coordinate his/her work with that of other organizational members in order to do

his/her job properly. The latter variable measures the extent to which the respondent believes that subunits must also cooperate if the respondent and the respondent's subunit are to perform effectively.

Table 4.17 presents the results of multiple regressions using each set of predictors separately and together. In all cases, the interdependence and contact variables were more strongly related to perceived need for coordination at the individual level than at the subunit level. It would appear that respondents viewed the dependency relationships in which they were engaged as a part of their own job, rather than a reflection of the subunit's place in the workflow. This makes any aggregation (averaging) of individual responses regarding dependency relationships outside the subunit suspect, unless every subunit member was involved in all the subunit's dependency relationships with other subunits or the number of subunit members involved in a particular inter-subunit dependency relationship was proportional to the importance of that relationship to the focal subunit. Both conditions seem highly unlikely.

Thus, a given subunit of, say, ten members could have been critically dependent on another subunit for certain information. This dependence would probably have been represented in the supervisor's ratings of the degree of dependence of his subunit on other subunits. But if only one member of the subunit (say, the supervisor, or a senior engineer, or, perhaps, even a clerk) was responsible for getting that information as a part of his/her job, while other subunit members obtained the information from that one person, then the aggregated questionnaire measure of dependence on other subunits would

Table 4.17

Results of Multiple Regressions for Individual and Unit Coordination with Dependence Measures as Predictors (N = 245)

Predictors	Multiple R*	
	Individual Coordination	Unit Coordination
Questionnaire-derived dependence measures (QDEPONUNIT through QDEPOFOTH)	.53	.31
Contact variables	.47	.23
Both sets of variables	.59	.32

*All R's significant beyond $p \leq .01$ level.

probably not have reflected that critical dependency. While this example is extreme, it is not atypical of the way in which critical information passed back and forth among subunits in Organization S.

If, in fact, the way in which a subunit's dependency relationships were apportioned among its members moderated the correlation between the interview and aggregated questionnaire measure of interdependence, then subunits for which the scores from the two media corresponded should be characterized by structures similar to the ideal models mentioned above, while subunits for which the scores were divergent should resemble the hypothetical subunit in the preceding example.

When the average interdependence measures from both media (those measures presented in Table 3.7) were examined for each subunit, six subunits were identified as being characterized by some degree of convergence in the scores from the two media and five other subunits were identified as showing considerable divergence in the scores from the two media. When the supervisors' descriptions of the work done by the subunits were examined, in conjunction with the extensive notes compiled by one of the sociologists collecting the interview data,[1] differences in the way the work was being done in these sections were noticeable. Subunits demonstrating convergence between the two sets of measures appeared to have been engaged in routine engineering work. Moreover, the distribution of that work appeared to have resulted in everyone at a particular level being engaged in parallel activities. That is, all the senior engineers were engaged in the same type of projects involving relationships with the same other subunits in the

[1]The author is deeply indebted to John Feather for this material.

organization. Likewise, the junior engineers and engineering assistants were engaged in parallel activities on very similar projects.

On the other hand, the most divergent subunits were engaged in engineering work that was not as routine, at least with respect to required interactions with other subunits. Members of the divergent subunits were all engaged in the same general type of engineering, but projects did not appear to have been as similar as in the convergent subunits. In particular, members of the divergent subunits may have been dependent on other subunits for information and assistance to varying degrees and may even have been dependent on different subunits. The same was true of the dependence of other subunits on the focal subunits. Thus, real differences may have existed in the type and degree of the dependency relationships engaged in by members of the most divergent subunits; differences that did not exist within subunits demonstrating the greatest degree of convergence between the questionnaire and interview-derived measures of interdependence.

It cannot be overemphasized that these results are interpretations of qualitative data collected for other purposes and drawn from only a few subunits. Hence, the greatest amount of caution must be used in evaluating these suggestive findings. But it is not unreasonable to expect the internal dimensional structure of the subunit to moderate the relationship between aggregated questionnaire responses and interview responses, and these data do not contradict such an assertion.

CHAPTER FIVE

DISCUSSION

Throughout the preceding chapters, care was taken to separate clearly discussions of mechanistic interdependence (or workflow integration) from those focusing on structural interdependence. From the sociologists' perspective, this is entirely proper. Only recently have sociologists begun to recognize the ambiguities in their definitions of technology and structure (Stanfield, 1976); no one has suggested, in the journals, that there may be substantial degrees of overlap not just among structural dimensions, but between those dimensions and technology.

From the perspective of the psychologist, however, these distinctions may be less critical. In this study, which focuses on the impact of interdependence on individuals' perceptions regarding their jobs and roles and their attitudes, the similarities between technology and structure become more important than the distinctions commonly made between the two concepts. Both can (and, as operationalized here, do) reflect the pattern of interactions among work roles within the organization.

The most developed measure of technology (for industrial organizations), workflow integration, has been defined as the means by which outputs are created (Hickson et al., 1969). In its original form the scale was composed of five subscales, one of which, interdependence of workflow segments, referred to the networks of relationships among subunits resulting from the flow of materials from one subunit to another. A second scale, workflow rigidity, measured the

nonadaptability and invariable sequencing of tasks within subunits; in other words, the degree to which interdependencies within the subunit are predetermined by the nature of the equipment used. As modified for use in this dissertation, workflow integration consisted of two highly correlated basic components: an automation component, measured by two subscales, and an interdependence component, measured by the workflow rigidity subscale and two interdependence of workflow segment subscales (Chapter Three, pp. 70-73).

Structural interdependence generally has referred to the network of relationships among organizational members and subgroups as reflected in communication patterns within the organization (Chapter One, p. 23). As it was operationalized here, structural interdependence represented the degree to which subunits were dependent upon one another in order to do their work. Put another way, the interview-derived measures of interdependence combined a determination of the pattern, or network, of relationships among subunits with a determination of how critical those relationships were to the focal subunit.

In the workflow integration scale, inflexibility within the subunit was determined directly through the workflow rigidity subscale and was implicit in the automaticity subscales. The two interdependence subscales (input interdependence and output interdependence) combined both aspects, since they ranged from no dependence on or of other organizational units to complete dependence with respect to one input/output.

Thus, the concept of structural interdependence, as used here, was analogous to mechanistic interdependence; both involved measuring

the extent to which the subunit was tied into the network of workflow-centered relationships among the organization's subunits, and both involved a measure of the rigidity or inflexibility of those relationships. It was hoped that results obtained using structural interdependence would converge with those obtained using mechanistic interdependence, thus demonstrating that the concepts are analogous. In fact, there was little convergence or complementarity to the results. This was particularly discouraging, since the problem appeared to stem from inadequate measures resulting from an incomplete understanding of the concept of structural interdependence.

Thus the implicit goal of this dissertation, that is, the development of a broad-based understanding of interdependence as expressed through both the mechanistic and the structural integration of work roles, could not be realized. Instead, the relationship of mechanistic interdependence to individual perceptions and attitudes was examined in some detail (Hypotheses 1A through 1H) and the joint effects of mechanistic and structural interdependence were explored (Hypotheses 3A and 3B) in a more tentative fashion. The hypotheses regarding structural interdependence (2A through 2I) were tested, using the interview-derived measures of interdependence. This was not an entirely satisfying arrangement, since the interview and questionnaire measures of interdependence showed little convergence or discrimination. But given the explicit focus on cross-level analysis, and the superior face validity of the interview measures, this was the only acceptable way to test the structural interdependence hypotheses.

Technology as a Determinant of Individual Perceptions and Attitudes

In all, eight different hypotheses were offered regarding the impact of technology on individual perceptions and attitudes. These hypotheses fell into three groups dealing with the relationship of technology to perceived job characteristics, role perceptions, and individual outcomes. The hypotheses concerned with perceived job characteristics were supported by the data; the role perceptions hypothesis was not supported; and mixed results were obtained for the individual outcome hypotheses.

Workflow integration, the measure of technology used in this study, was consistently related to perceived job characteristics, although not in the manner originally predicted. Workflow integration accounted for 17 percent of the variance (eta squared) in aggregated autonomy, 14 percent of the variance in variety, 18 percent in task identity, and 14 percent in challenge. Although the possibility of a curvilinear relationship between workflow integration and perceived job characteristics had been discussed during the development of Hypotheses 1A-1D, it seemed unlikely initially that the distribution of obtained workflow integration scores was broad enough to allow for the emergence of such a relationship. Consequently, linear relationships were hypothesized within the limited range of workflow integration scores available. In fact, the relationships between workflow integration and perceived job characteristics all proved to be curvilinear.

These results are consonant with and extend two long-standing views regarding the psychological impact of the structure of the work role on the job incumbent. On the one hand, there is the consistent

(Blauner, 1964; Davis & Taylor, 1972; Faunce, 1958) and currently accepted finding that modern automated assembly-line type technologies reduce the involvement of the worker in the production process (man-product interaction), with corresponding deleterious psychological effects on the workers. Contemporaneously, other studies have isolated several critical psychological dimensions of work (Hackman & Lawler, 1971; Hackman & Oldham, 1975, 1976; Turner & Lawrence, 1965), while a few studies have shown that these psychological dimensions are (to varying degrees) meaningful as objective descriptors of the job itself (Jenkins, Nadler, Lawler, & Cammann, 1975; Turner & Lawrence, 1965). The present study provides data regarding the missing link in this body of research by demonstrating that dimensions of the technology are systematically linked to the commonly accepted perceived job characteristics. Moreover, these results make it clear that differences in perceived job characteristics correspond to differences in the degree to which the technology of the work unit is automated or rigid. Rousseau has demonstrated that the three categories of Thompson's broad typology of technologies differ in terms of perceived job characteristics. The results of this study indicate that within at least the long-linked category, differences in the extent to which the workflow of a given subunit is integrated have an appreciable impact on the way in which the members of that subunit perceive their own jobs.

These results also lend support to the position advanced by Davis (1971; Davis & Taylor, 1972), among others, that increasing the collateral responsibilities of the worker can compensate for the adverse consequences of the reduced interaction of the worker with

the product. In the most highly integrated subunits, the downward trend in perceived job characteristics was reversed, resulting in a curvilinear relationship between workflow integration and the perceived job characteristics. Supervisors' responses to the question concerning the duties of subunit members (Appendix C, item 4b) indicated that respondents in most of these subunits[1] were responsible for quality control, monitoring activity, and some preventative maintenance functions in addition to the operation of the equipment.

While many others have also found that vertical loading can ameliorate the impact of reduced man-product interaction, these results have been obtained either through comparisons of entire factories (Walton, 1975) or their major divisions (Taylor, 1971b) or through before-and-after comparisons of the same site (Engelstad, 1972; Mann & Hoffman, 1960; Walker, 1957). The data presented here demonstrate that the same results can be obtained within a single manufacturing complex. Differences in the degree of workflow integration among similar subunits (similar in terms of broad typological classifications such as Thompson's or Woodward's) were associated with differences in the degree to which subunit members perceive their jobs as possessing autonomy, variety, task identity, and challenge. And within the limited range of workflow integration scores obtained within this predominantly long-linked technology, relatively small changes in the degree to which workers assumed additional tasks were found to counteract the aversive psychological impact of increasing automation and rigidity of the production

[1] These subunits were primarily machining departments, most of which were operating highly-automated equipment resembling that of a continuous-flow production system.

process.

When individual outcomes were examined, the same pattern persisted, although the magnitude of the results was somewhat attenuated. Global job satisfaction and effort were both significantly related to workflow integration, with global job satisfaction showing the same curvilinear effect that characterized the workflow integration-perceived job characteristics relationships. However, with perceived job characteristics partialled out, the workflow integration-global job satisfaction relationship was non-significant, suggesting that perceived job characteristics mediate the relationship between workflow integration and satisfaction.

The negative monotonic relationship between workflow integration and effort was exactly as expected. Moreover, the relationship did not disappear when job characteristics were partialled out (although the percent of variance in effort accounted for by workflow integration dropped from 16 to 9 percent). In fact, the overall pattern of relationships between effort and both workflow integration and its component subscales adds substantially to the author's confidence that these results are meaningful and not artifactual or the result of some unmeasured, confounding variable.

There are two reasons for this confidence. First, the relationship between effort and workflow integration persisted even when perceived job characteristics were partialled out. And second, the form of the relationship differed from that of the other dependent variables. Effort, per se, is not generally viewed as a component of any of the perceived job characteristics used here and need not covary with them. Instead, the theoretical as well as operational

definitions of automaticity as the degree to which the equipment, rather than the worker, provides first physical energy and, at higher levels, information clearly suggest a negative monotonic relationship between automaticity and effort. While workflow rigidity need not be related to effort, the strong correlations between the automaticity subscales and the workflow rigidity subscale suggest that the overall workflow integration score is likely to be negatively related to effort.

However, if the results obtained with these data were due to some bias introduced through the aggregation process or in the sampling procedures, then the aggregated dependent measures should share the same error variance, and partialling out the perceived job characteristics should have wiped out the relationship between workflow integration and effort. If the results were due to some systematic error in the measurement of workflow integration, then, to be consistent, reported effort should have shown the same form in its relationship to workflow integration as did the perceived job characteristics.

Interdependence as a Determinant of Individual Perceptions and Attitudes

Altogether, nine hypotheses were offered regarding the impact of structural interdependence on individual perceptions and attitudes. These hypotheses, like those of the preceding section, fell into three categories covering the relationship of structural interdependence to perceived job characteristics, role perceptions, and individual outcomes. In general, the hypotheses were not confirmed by the data. Of the competing hypotheses regarding autonomy, Hypothesis

2B, which specified direct and positive relationships between the dependency of others and perceived autonomy, received partial support. Hypothesis 2D, which predicted a direct and positive relationship between the dependence of others on the subunit and the degree of role overload reported by subunit members, also received partial support. All other hypotheses were not supported by the data.

Hypothesis 2A asserted that members of subunits involved in sequential or reciprocal interdependencies with other organizational subunits would, on the average, report higher autonomy if their subunit enjoyed a position of dominance in the interaction structure of the organization than if their subunit occupied a controlled position. This hypothesis was based on an Emersonian concept of power (Emerson, 1962; Jacobs, 1974). On the other hand, Hypothesis 2B (based on work by Hickson et al. [1971] and Hinings et al. [1974]) postulated a simpler direct relationship between the degree to which others are dependent on the subunit and the average degree of autonomy reported by subunit members. As was mentioned above, Hypothesis 2B received partial support while Hypothesis 2A was clearly rejected.

Interpretation of the significant results that were obtained in testing Hypothesis 2B becomes somewhat clearer when the problems encountered in the interpretation of interdependence at the individual level are taken into account. Respondents appeared to be more accurate in estimating (or more aware of) dependency relationships that involved subunits or subdivisions outside their own subdivision and more accurate in estimating (or, again, more aware of) dependencies of others on them than of their dependencies on others. In testing Hypothesis 2B, DEPOFOTHERS was found to be significantly

related to autonomy (eta = .46) while DEPOF itself was not. (The multiple correlation between both measures used together in a dummy variable multiple regression and autonomy was also significant.) If respondents do not view dependency relationships within the subdivision in the same light as they do dependency relationships involving other subdivisions, then it seems plausible that if autonomy is affected by the extent to which other organizational components are dependent on the subunit, those dependency relationships that are most clearly recognized as such by the respondents (that is, those involving the dependence of other subdivisions on their subunit) should be most strongly related to perceived autonomy.

At first glance, the results obtained with the maximum dependency variables would seem to contradict this argument, since only MAXDEPON was significantly related to autonomy (eta = .50). However, problems with cell frequencies may have led to instability in the results. Within a total sample size of 25, eight subunit supervisors reported one or more maximum dependencies of their subunits on other subunits in the subdivision (MAXDEPON). For the other three maximum dependency variable, only four or five subunit supervisors reported a maximum dependency relationship within the organization. Also, the obtained relationships between the other three maximum dependency variables and autonomy, while non-significant, were in the expected direction. Members of subunits with one or more other subunits (MAXDEPOF) or subdivision (MAXDEPOFOTH) maximally dependent on their subunit reported higher average autonomy than subunits without such relationships, while members of subunits with one or more maximum dependencies on other subdivisions (MAXDEPONOTH) reported lower

average autonomy than subunits without such dependencies, although, again, these results were not significant.

With regard to the two hypotheses concerned with the impact of interdependence on role perceptions, the results obtained were disappointing. Instead of the predicted negative relationship between role clarity and dependence on others (DEPON and DEPONOTHERS) a barely significant positive relationship ($p \leq .10$) was obtained with DEPONOTHERS.

Partial support for Hypothesis 2D was obtained; DEPOF and DEPOFOTHERS were not significantly correlated with aggregated role overload, but a pattern variable formed from MAXDEPOF and MAXDEPOFOTH did show a substantial relationship with role overload (eta = .58). The lowest average role overload was reported by subunits with no other subunits maximally dependent on them, and the highest role overload was reported by subunits with maximum dependencies from both other subdivisions and other subunits within the same subdivision.

Apparently, only the extreme dependence of other organizational units is reflected in the degree of role overload reported by members of the focal subunit. This seems reasonable for a relatively stable, yet highly interdependent, organization like Organization S. Subunits have had ample opportunity over the years to routinize dependency relationships within Organization S's relatively placid environment. Thus, it is not surprising that only extreme dependency relationships are reflected in higher reported role overload; less critical dependencies may be simply a part of the normal course of events for many, if not most, of the organization's members.

Routinization of dependency relationships may also account for

the lack of a relationship between role clarity and structural interdependence. Reliance on others for information, expertise, etc. need not lead to reduced role clarity if the dependency relationship is a routine or often repeated pattern of interaction. Under these conditions, members of the dependent subunit may have a fairly accurate picture of what to expect from the units on which their subunit is dependent.

Finally, it is difficult to interpret or understand why hypotheses in this section were not supported, since substantial doubt surrounds the appropriateness and meaning of the independent variable. This problem will be discussed in a later section of this chapter.

The Joint Effects of Technology and Structural Interdependence on Individual Perceptions and Attitudes

Two hypotheses suggested exploratory analyses regarding the joint effects of workflow integration and perceived need for coordination. Hypothesis 3A predicted a negative relationship between workflow integration and perceived need for coordination, while Hypothesis 3B asserted that, for a given level of workflow integration, high perceived need for coordination would be associated with higher degrees of autonomy, variety, task identity, and challenge than would low required coordination. Both hypotheses received partial confirmation.

The relationship between workflow integration and coordination was not linear, as predicted: the subunits in the highest bracketed category of workflow integration scores showed significantly lower perceived need for coordination than did the other three categories (among which there were no significant differences). For the most

part, the subunits in the highest workflow integration category were machining subunits with highly automated equipment almost like a continuous-flow process.[1] Although the author did not observe these subunits at length, it did appear that each employee was responsible for a discrete portion of the overall production process. And while work-related interaction with the supervisor did occur occasionally during the course of the interviews, little work-related interaction among employees was evident.

These are the same subunits that manifested the upturn in perceived job characteristics discussed earlier. The employees in these subunits were often responsible for monitoring quality control and performing some preventative maintenance functions in addition to their duties as operators. Apparently, vertical loading on these jobs did not include the addition of any activities requiring additional coordination with others.

When the data from Organization T were examined for joint effects (Hypothesis 3B), it was found that only two of the dependent variables demonstrated a significant increase in the R^2 statistic when coordination was added as a predictor (along with workflow integration). Task identity and intrinsic motivation were the dependent variables and in both cases the effect was the same. Under conditions of high workflow integration, no differences in either dependent variable were found between high and low coordination. But, under conditions of low workflow integration, subunits characterized by high coordination

[1] Unskilled employees placed, say, pistons on holding racks and the equipment then performed virtually all the machining operations, with most of the subunit's members monitoring various aspects of the process. At the end, other unskilled laborers removed the finished pistons.

showed significantly greater degrees of aggregate task identity (Table 4.14) and intrinsic motivation (Table 4.15) than the subunits characterized by low coordination.

Because of the nonlinear form of the relationship between workflow integration and coordination, the median split done on the workflow integration "concentrated" all the covariance between the two predictors in the high workflow integration category. Thus, the high workflow integration-low coordination cell actually is significantly lower in terms of workflow integration than the high workflow integration-high coordination cell. This makes it impossible to interpret any differences (or lack of a difference, to be more precise) between these two cells.

On the other hand, there are no differences in terms of workflow integration between the two low workflow integration cells. And between these two cells there are significant differences in both task identity and intrinsic motivation. These results do not lend much support to the position that vertical loading can negate the adverse psychological effects of highly integrated production systems because significant differences were obtained only for low workflow integration. Whether or not similar results would have been obtained for high workflow integration were workflow integration and coordination not hopelessly confounded is pure speculation.

These results do suggest that the interpersonal characteristics of the job may be more important than is generally acknowledged. Although Turner and Lawrence included both required and optional interaction among their perceived task attributes, other researchers have tended to overlook required interaction (need for coordination)

as an important characteristic of the job since Hackman and Lawler concluded that required interaction is not related to performance or important to motivation. Hackman and Lawler collected their data from telephone company employees; these data were from shop-floor employees of a manufacturer of engines and engine parts. Major differences exist between these two samples in terms of the nature of the work performed by the respondents, which may account for differences in the results obtained. Whether or not coordination is related to performance cannot be determined from the data available here. But, for this sample, when technology was controlled, high required coordination was associated with high task identity and high intrinsic motivation.

Problems in the Measurement of Structural Interdependence

Probably the most important findings of this study regarding structural interdependence involved the lack of convergence of the interview and questionnaire-derived measures of the concept. It was clear that interdependence, as defined by social scientists, did not correspond to interdependence as defined by the respondents in Organization S. Four trends seemed to characterize the questionnaire-derived measures of interdependence. First, respondents tended to blur distinctions among reference groups; measures of intra-unit dependence always correlated higher with measures of inter-subunit dependence than with measures of dependence on, or of, other subdivisions. Second, respondents viewed the dependency relationships of which they were a part more as characteristics of their own individual role than as manifestations of interdependence among subunits. Third, respondents appeared to be more accurate in

estimating[1] the dependence of others on them than they were in estimating their dependence on others. And fourth, respondents seemed to be more accurate in estimating the extent of their dependency relationships with members of other subdivisions than in estimating the extent of their dependency relationships involving members of their own subdivision, although respondents were apparently not discriminating too clearly between dependence on members of other subdivisions and the dependence of those members of other subdivisions on them.

The first trend may well be due to measurement problems. Two aspects of the construction of the items may have led respondents to blur distinctions among referents: the order of the items and the vagueness of the items.[2] Respondents were asked how dependent they were for information and advice from members of their own subunit, members of their subdivision, and members of other subdivisions in a block of three consecutive items. The same format was used for determining the degree of dependence on others for assistance and for determining the dependence of others on the respondent for both information and advice, as well as assistance.

Compounding the problem of item order was the vagueness of the items themselves. General references such as those used are highly

[1]Accurate in comparison to the supervisor's estimate of the subunit's dependency relationships. While the supervisor could be in error and the respondents from his/her subunit correct, or both could be correct in their estimates (from their own perspectives) and yet not agree, the supervisors' estimates were used as the standard because of their superior face validity in comparison to the questionnaire measures.

[2]Appendix D presents the items in their actual order in the questionnaires.

susceptible to errors stemming from selective recall and misclassification of relevant organizational members, particularly when the items are arranged as described above and presented in a format that encourages rapid response.

While the first trend may be due to inadequate design of the measurement instrument, the remaining trends are not so easily explained. The measurement problems just discussed cannot account for either the greater emphasis on the dependence of others or the tendency to view dependency relationships as characteristics of the individual role rather than as reflections of the patterns of work-flow within the organization. Clearly, systematic differences exist between respondents' estimations of the nature of their dependency relationships with other organizational members on the one hand and the typical social scientist's view of those dependency relationships on the other.

A theory of interpersonal perception would be useful in explaining these perceptual biases on the part of respondents. One such theory is attribution theory (Heider, 1958; Kelly, 1971). Basically, attribution theory argues that perceptual processes are ultimately subjective, but certain common rules characterize the information processing activities of individuals. One such rule concerns the systematic differences in perception that arise by virtue of the perceiver's position as either an actor or an observer. Attribution theory argues that "there is a pervasive tendency for actors to attribute their actions to situational requirements, whereas observers tend to attribute the same actions to stable personal dispositions" (Jones & Nisbett, 1971, p. 2). The respondents in Organization S may

be viewed as occupying both positions in answering the questions regarding their dependence on others within the organization and the dependence of others on them; that is, they respond as actors when describing their own dependence on others and as observers in responding to the questionnaire items regarding the dependence of others on them.

Since attribution theory is relevant only to perceptual biases with respect to the behavior of individuals, the second trend noted above is a necessary precondition for proceeding with this application of attribution theory. Respondents viewed their dependency relationships (both "on" and "of") as characteristics of their own role and not as reflections of the location of their subunit in the organization's workflow. Had the opposite result been obtained, then, strictly speaking, attribution theory would not have been applicable, since attribution theory only applies to perceptions regarding the actions of individual actors and not the abstract sociological entities into which they may be grouped.

The perceptual distortions noted in the third trend mentioned earlier can be interpreted in terms of an attribution model. According to attribution theory, actors are more likely to focus on environmental cues that shape behavior and evoke it than on their own behavior (Shaver, 1975). For the typical respondent in Organization S, dependence on others in the organization is an outgrowth of his/her own needs, while the dependence of others represents an environmental cue that evokes behavior on the part of the respondent. According to attribution theory, then, respondents should underestimate the extent of their dependence on others, since actors tend to

underestimate the degree to which their actions reflect internal needs or dispositions. On the other hand, respondents should overestimate the extent of the dependence of others on them, since observers tend to overestimate the dispositional nature of the actions of others. Moreover, respondents are likely to emphasize the dependence of others on them because such dependencies represent environmental cues to the respondents as actors. Since actors tend to attribute their actions to situational factors rather than personal characteristics, this should serve to further enhance, for the respondent, the salience of the dependence of others vis-à-vis the dependence of the respondent on other organizational members. Thus, the greater degree of convergence for the dependence of others measures that was noted in Chapter Three can be interpreted in terms of an attribution model.

Respondents' perceptions may be further distorted through the reporting process, i.e., completing the questionnaire. Jones and Nisbett point out that actors are more likely to give themselves credit than blame in order to maintain self-esteem. If respondents see the dependence of others on them as more desirable than their dependence on others, then respondents' self-reported dependencies may be biased in favor of the respondents. That is, respondents may underestimate the degree to which they are dependent on others as a way of maintaining self-esteem.

Finally, respondents appeared to be more accurate in their estimations of their dependency relationships with members of the organization from other subdivisions than with members of the same subdivision. Again, attribution theory suggests a possible explanation for this phenomenon. Within Organization S, contact among

subunits within the same subdivision are relatively common. Contacts with other subdivisions, however, are both less frequent (as a comparison of the means reported on p. 91 will show) and less routine. As a result, dependency relationships involving members of other subdivisions are likely to be more salient and to involve a greater number of environmental cues than other dependency relationships. Hence, they may be easier to recall (Shaver) for the respondent.

The fact that dependency relationships involving members of other subdivisions are less frequent may also account for the fact that both the dependence on and dependence of items loaded highest on the same (first) factor when all the questionnaire dependence items were factor analyzed (Table 4.16). Because they occur infrequently and have a number of similar environmental cues associated with them, dependency relationships involving members of other subdivisions may be more difficult for respondents to distinguish from one another than are dependency relationships within the subdivision; hence the moderate loadings on the appropriate dependence factor (dependence on or dependence of).[1]

Conclusions

Whether or not structural and mechanistic interdependence represent two variations or ways of conceptualizing the same basic concept of interdependence could not be determined, due to ambiguities in the meaning and measurement of structural interdependence. Substantial differences in the meaning of structural interdependence were found between data gathered through the typical objective approach to the

[1]The loadings on the first factor probably reflect the common variance among the items resulting from the blurring of reference groups as well and are somewhat inflated as a result.

measurement of structure (elite interviews) and the typical perceptual approach to measuring structure by aggregating the responses of individual organization members.

If interdependence is to be measured and the concept used in analyses at either the individual or the subunit (or organizational) level, then the systematic biases likely to affect respondents' self-reports of dependency relationships must be taken into account in designing the measures. If objective measures of interdependence are to be used, the radical differences between those measures and the meaning of interdependence to organizational members make it unlikely that interdependence so measured will be related to individual perceptions or attitudes any more strongly than was the case here.

No foolproof techniques exist for circumventing these problems. Interdependence is a theoretical concept whose meaning is not consistent across levels of analysis; interdependence among subunits is not equivalent to the interdependence of subunit members. Members' perceptions of their own dependency relationships are subject to systematic biases in interpretation and reporting. Moreover, members' perceptions of their own dependency relationships, when aggregated, do not necessarily correspond to global measures of interdependence obtained at the subunit level. For the researcher to weight members' responses appropriately in the aggregation process, he/she would have to have complete information on the individual level network of dependency relationships and complete information regarding the relative importance of those dependency relationships to the various subunits, as well as complete information on the workflow patterns within the subunits. In other words, a complete sociogram at the individual

level is needed. General questionnaire items are simply inadequate for the task.

The problems just discussed make interpretation of the results obtained in testing the hypotheses concerned with structural interdependence suspect. Moreover, what significant results were obtained were weak and sometimes inconsistent.

Structural interdependence did appear to be related only to autonomy and role overload. Autonomy tended to be negatively related to dependence of the subunit on other subunits and subdivisions and positively related to the degree of dependence of other subunits and subdivisions on the focal subunit. Role overload appeared to be associated only with the existence of maximum dependencies of other subunits on the focal subunit.

The results for autonomy seem straightforward enough, although it must be emphasized that even here results were inconsistent and weak. With respect to role overload, it appears that the organization has routinized dependency relationships among subunits to such a degree that only extreme cases of dependence of others on the focal subunit are associated with a significant increase in the degree of role overload perceived by the members of the focal subunit.

On the other hand, the results obtained regarding mechanistic interdependence were reasonably straightforward. Mechanistic interdependence was systematically related to perceived job characteristics in ways that are consistent with the results of other studies in the area. Autonomy, variety, task identity, and challenge were all negatively related to workflow integration, to a point. Within those subunits where technology was rigid, inflexible, and more automated,

perceived job characteristics were lower than in less highly integrated subunits. However, collateral responsibilities had been introduced in the most integrated subunits, and an upturn in perceived job characteristics was observed for those subunits.

Also, the more integrated the technology of a subunit, the lower the average reported effort exerted by the members of the subunit. This relationship was not curvilinear and is consonant with the definition of automaticity as the degree to which first physical energy and then information are provided by the equipment rather than the worker.

Global job satisfaction was significantly related to workflow integration and, as was the case with perceived job characteristics, the relationship was curvilinear. However, this relationship was non-significant with perceived job characteristics partialled out, suggesting that job characteristics mediate the relationship between workflow integration and job satisfaction.

Thus, it appears that even within a limited range of workflow integration scores obtained within a predominantly long-linked technology, differences in the degree to which the workflow is integrated correspond to systematic differences in workers' perceptions of their jobs. Workflow integration appears to be a relatively sensitive measure of technology that permits discrimination among degrees of automation and inflexibility and provides a direct link between the organization's technology and perceived job characteristics.

The data presented here suggest that vertical loading of maintenance and quality control tasks can ameliorate the negative impact of highly integrated technology <u>even</u> within a traditional

manufacturing setting, although the degree of improvement was modest in this case. The data also suggest that the importance of required coordination with others as a determinant of perceived job characteristics may have been underestimated. Required coordination with others may provide another means of reducing the aversive consequences of a high degree of integration in the production system.

APPENDIX A

PROBLEMS IN AGGREGATION

The fundamental decision in any research that involves concepts or variables drawn from both collectives and their members (Lazarsfeld & Menzel, 1969) is the selection of the appropriate level of analysis. In this study, hypotheses were advanced that postulated relationships between properties of organizational subunits (workflow integration and structural interdependence) on the one hand and the perceptions and attitudes of subunit members on the other. The choice, then, was whether to aggregate individual perceptions and attitudes to the subunit level or to disaggregate (impute) subunit properties to individual members of the subunit.

As is often the case (Dogan & Rokkan, 1969) the requirement to aggregate or disaggregate data to one level of analysis in this study was necessitated by missing data. Objective data regarding the technology of subunits were available only at the subunit level, while individual attitudes and perceptions existed only at the individual level. While structural interdependence measures were available at both levels, assessing the convergent and discriminant validity of the structural measures required either aggregation of the individual-level variables or disaggregation of the subunit-level interdependence measures.

Both aggregation and disaggregation represent the homology approach (Hannan, 1971) to changing levels of analysis. Basically, this approach "supports the free translation of theoretical propositions across levels of analysis" (Hannan, p. 477). This approach has been operationalized by economists as the consistency criterion. The consistency criterion provides a standard against which to evaluate the effects that changing levels with empirical data has on statistics

based on those data.

Before describing the consistency criterion more precisely, three sets of relationships must be defined: microrelationships, composed soley of micro-level variables; macrorelationships, composed entirely of macro-level variables; and aggregation relationships, which define macro-level variables in terms of corresponding micro-level variables[1] (Hannan).

The consistency criterion holds if knowledge of any two sets of relationships leads to a complete specification (prediction) of the third set of relationships. For example, if the values of the micro-level variables are known,as is the pattern of relationships at the micro level, and the aggregation relationships are specified, then the consistency criterion holds if the values of the aggregated macro-level independent variables lead to the same prediction for the value of the aggregated macro-level dependent variable as does an aggregation of the predicted micro-level dependent variable based on the micro-level relationships. If the results are not consistent, any differences can be attributed to the biasing effect of changing levels of analysis through, in this example, aggregation. Robinson's (1950) ecological fallacy represents the opposite source of bias, namely, disaggregation.

However, the consistency criterion has meaning only when variables at one level are all mathematical transformations of corresponding variables at another level (Alker, 1969). As Crozier (1973) has emphasized, the use of aggregation or extrapolation of

[1]Similarly, one could speak of disaggregation relationships, which would define micro-level variables in terms of corresponding macro-level variables.

micro-level data as a way of understanding macro-level phenomena has all too often resulted in the reification of abstract collectives by ascribing to them the characteristics of their members. Although the numbers can always be manipulated to obtain an aggregated, or disaggregated, score, the new variable is meaningful only when the definition or meaning of the concept remains constant across levels.

In order to preserve this theoretical correspondence across levels, it was necessary to aggregate the individual (or micro) level variables rather than to disaggregate the macro-level variables of workflow integration and interdependence. In this case, it did not seem possible to find individual-level equivalents for the subunit-level variables. Interdependence reflects the pattern of dependency relationships among organizational subunits.. And while those dependencies are expressed, ultimately, in terms of the role relationships among individual subunit members, a given individual's pattern of dependency relationships with other organizational members that arises from the requirements of his/her own particular job need not be equivalent to the subunit's pattern of dependency relationships arising from the subunit's place in the organization's workflow.[1]

Workflow integration is a macro-level concept with no corresponding concept at the micro level. In Lazarfeld and Menzel's terminology, workflow integration is a global property of a subunit; that is, a characterisitc of the collective that is not based on information about the properties of individual members. Subunit workflow integration scores cannot be imputed to individual subunit

[1]The comparisons between macro-level and aggregated macro-level interdependence variables that were reported in Chapter Three demonstrate the accuracy of this position.

members since workflow integration is not a characteristic of human beings; it has no meaning at the micro level.

On the other hand, individual perceptions and attitudes obtained by survey techniques are routinely aggregated in ecological research (Linz, 1969). For example, members of different organizations or organizational subunits are frequently compared in terms of their perceptions (of their supervisors, pay, organizational climate, etc.) or their satisfaction.[1] Such aggregations of micro-level variables do have meaning at the macro, or aggregate, level.

In the present study, the aggregated variables describe the average response of subunit members. For example, autonomy at the micro level refers to the extent to which the respondent makes job-related decisions. At the macro level, aggregated autonomy refers to the average amount of decision-making authority of subunit members. At the micro level, effort reflects how hard the respondent believes he/she is working, while, at the macro level, aggregated effort reflects how hard subunit members, on the average, believe they are working.

Because the micro-level variables available could be aggregated into meaningful macro-level variables, while the macro-level variables could not be disaggregated into meaningful micro-level variables, the decision was made to proceed with the development and testing of the hypotheses at the macro level.

Once the level of analysis had been determined, consideration returned to the possible sources of bias introduced by the aggregation

[1] Often, the aggregation process is implicit, as when department is treated as a predictor of, say, satisfaction (for example, Newman [1975]) in analyses performed at the individual level.

process. The most basic concern was the relationship of the aggregation variable (subunit membership) to the micro-level variables being aggregated. Blalock (1964), among others, has argued that aggregating in such a way as to maximize the variance on the independent variable will increase the correlation between independent and dependent variables while aggregating so as to maximize the variance on the dependent variable will hopelessly confound the effects of the independent variable with those of outside influences. Maximizing the variance on the independent variables used here (work-flow integration and interdependence) amounts to controlling for outside influences, and, so long as the results are not to be generalized to the individual level (Robinson's ecological fallacy), need not be considered a potential source of bias in this study.

On the other hand, aggregating so as to maximize the variance on the dependent variables could be a real threat to the integrity of this study. According to Alker (1969), the question of whether or not relationships among aggregated (or disaggregated) variables are spurious or not can only be determined with certainty within the context of a cross-level theory. For at least Hypotheses 1A-1H, 3A, and 3B, there appeared to be sufficient agreement between the proposed theoretical model, existing micro-level models (Hackman & Lawler, 1971; Walsh, Taber, & Beehr, 1977), and the data to conclude that aggregation bias was of little importance as a determinant of the obtained results.

This was confirmed by a comparison of correlations among the dependent variables at both the micro and macro levels. Perceived job characteristics are known to covary and are known to be related to

individual outcome measures (Hackman & Lawler; Hackman & Oldham, 1975, 1976; Walsh et al.). If the consistency criterion holds for the dependent variables, then there should be no differences in the patterns of correlations between the macro and micro versions of the same concepts. Table A.1 presents this data for Organization T. There are no substantial shifts in either the magnitude[1] or pattern of the relationships between the two levels of analysis. Although this does not "prove" that aggregation has not maximized the variance of the dependent variables (in other words, that the consistency criterion holds for these data), it does reduce the likelihood that the obtained results are biased in that manner.

Finally, there is the question of whether or not the results obtained here can have any meaning at the individual level. If, for example, the results obtained in testing Hypotheses 1A through 1D were to be used in the redesign of jobs, statements about individual responses to technological dimensions would have to be made, based on the results of an ecological analysis. The dangers of making such inferences were recognized early by Robinson and the statistical bases of those early warnings have been elaborated in the literature (Smith, 1977).

Others, however, have argued that using ecological data and correlations to make inferences about individuals may be a fruitful approach to understanding phenomena involving variables from more than one level of analysis. Allardt (1969) has argued that too much attention to ecological and other fallacies in cross-level research

[1] Hannan estimates that a 10 to 15 percent inflation factor should always be expected, since virtually any aggregation variable (any rule other than random aggregation) will be slightly related to the dependent variable.

has diverted attention from considering the informative value of deliberate uses of the ecological fallacy. Allardt asserts that:

> When the informative value of a statement is defined by the number of ways it can be proved false, it appears that generalizations containing variables dealing with entirely different subject matters or chosen from different theoretical systems are most likely to have high informative value. Generalizations containing variables from different levels of a social system (different aggregate levels) are likely to have high informative content and also likely to restrict arbitrariness in the selection of operational definitions.
> . . . .
> When generalizations are specified, the most fruitful specifications are those in which the specifying variable is chosen from a clearly different area from the generalization to be specified. Again, the selection of variables from different aggregate levels serves as a powerful safeguard against both triviality and arbitrariness with operational definitions (p. 51).

Allardt's argument is a philosophical rather than a statistical one and cannot obscure the very real and predictable effects that aggregation can have on the variance in the independent and dependent variables.

In the present study, it is possible to generalize to individual cases only indirectly, by speaking of the impact of a subunit's degree of workflow integration on the expected value of respondents' perceived job characteristics scores (merely a restatement of the hypotheses in more statistical terms). One could predict a lower perceived autonomy, on the average, if a subunit's workflow were redesigned in a more automated or rigid fashion. However, a direct relationship at the micro level could not be predicted, since the independent variable cannot be disaggregated and the dependent variables are all average responses.

Table A.1

Comparison of Individual Level (N = 209) and Aggregated (N = 85) Perceived Job Characteristics and Individual Outcomes for Organization T

Autonomy	*1.0* 1.0						
Variety	*.32*[*] .28	*1.0* 1.0					
Task identity	*.31* .55	*.29* .28	*1.0* 1.0				
Challenge	*.41* .53	*.64* .63	*.38* .54	*1.0* 1.0			
Effort	*.20* .21	*.16* .00	*.07* .20	*.09* .02	*1.0* 1.0		
Intrinsic motivation	*.28* .30	*.21* .11	*.28* .34	*.37* .27	*.09* .26	*1.0* 1.0	
Global job satisfaction	*.30* .34	*.29* .31	*.25* .37	*.37* .43	*-.02* -.07	*.23* .15	*1.0* 1.0

[*]Individual-level correlations are in italics.

APPENDIX B

ORGANIZATION T QUESTIONNAIRE ITEMS

I. Perceived Job Characteristics

1. Autonomy

On my job I make a lot of decisions on my own.*

I have a lot of say in decisions which affect my work.

My supervisor leaves it up to me to decide how to go about doing my job.

2. Variety

My job requires me to repeat the same activities over and over. (Reversed)

I do a large number of different things on my job.

3. Task Identity

I can see the results of my own work.

My work makes a visible impact on a product or service.

On my job I produce a whole product or perform a complete service.

4. Task Feedback

I can tell how well I am doing at my job without being told.

My job gives me very little idea about how well I am performing. (Reversed)

5. Supervisor Feedback

My supervisor meets with me regularly to discuss my performance.

How accurately does your supervisor evaluate or judge your performance? (Check one)

[1] Very inaccurately; he has no idea how I perform

[2] Fairly inaccurately

[3] Moderately accurately

[4] Fairly accurately

[5] Very accurately; he knows how I perform

*All items are scored on a seven-point agree-disagree scale (strongly disagree; disagree; slightly disagree; neither agree nor disagree; slightly agree; agree; strongly agree) unless otherwise indicated.

6. Challenge

On my job I get a chance to use by skills and abilities.

My job requires that I keep learning new things.

II. Role Perceptions

1. Role Overload

I am given enough time to do what is expected of me on my job. (Reversed)

It often seems like I have too much work for one person to do.

The performance standards on my job are too high.

2. Role Clarity

My supervisor makes sure his people have clear goals to achieve.

My supervisor makes it clear how I should do my work.

It is clear what is expected of me on my job.

I don't know what performance standards are expected of me. (Reversed)

III. Individual Outcome Measures

1. Effort

How hard do you usually have to work on your job? (Check one)

[1] Not hard at all

[2] Not very hard

[3] Fairly hard

[4] Very hard

[5] Extremely hard

On your job, how often do you do extra work beyond what is expected of you? (Check one)

[1] Almost never

[2] Occasionally

[3] Often

[4] Very often

[5] All the time

I try to do a lot of work.

2. Intrinsic Motivation

Here are some things that could happen to people when they do their jobs especially well. How much does doing your job especially well increase the chances of each of the following things happening to you?

Getting a feeling of accomplishment*

Getting a feeling of personal satisfaction*

How much does doing your job especially poorly increase the chances of each of the following things happening to you?

Being disappointed in yourself**

3. Global Job Satisfaction

All in all, how satisfied are you with your present job? (Check one)

[1] Not at all satisfied

[2] Not too satisfied

[3] Somewhat satisfied

[4] Very satisfied

Knowing what you now know, if you had to decide all over again whether to take the job you now have, what would you decide? (Check one)

[1] I would decide definitely not to take the job

[2] I would have some second thoughts

[3] I would decide without hesitation to take the same job

IV. Coordination

Many other jobs must be coordinated with mine if they are to be done properly.

In order for me to do my job properly, my activities must be closely coordinated with others.

---

*Scored on a seven-point scale with anchors: (1) doing well doesn't make any difference; (2) increases the chances a little; (3) increases the chances a lot.

**Scored on a seven-point scale with anchors: (1) doing poorly doesn't make any difference; (2) increases the chances a little; (3) increases the chances a lot.

V. Demographics

1. Personal Characteristics

How old are you? _____ years old

Are you? (Check one) [1] Female [2] Male

How much schooling have you had? (Check one)

[1] Some elementary school (grades 1-7)
[2] Completed elementary school (8 grades)
[3] Some high school (grades 9-11)
[4] Graduated from high school
[5] Some college or technical training beyond high school
[6] Graduated from college (Bachelor's degree)
[7] Some graduate school
[8] Graduate degree (Master's, Ph.D., M.D., etc.)

2. Work Related Characteristics

Which shift do you work? (Check one)

[1] First shift
[2] Second shift
[3] Third shift

How many years have you worked for _____?

_____ years

APPENDIX C

DEPARTMENT INTERVIEW SCHEDULE

1. Department number _____.

   Department name _____.

2. How many people (including supervisors) are in the department?

   _____

3. Are there subdivisions within the department? yes-1 no-2

   If yes, draw the hierarchy here:

4. Criteria for grouping departments

   a. Job class range:

      Highest job class _____.

      Lowest job class _____.

      What job class occurs most frequently? _____.

   b. Does everybody in the department do basically the same thing? yes no

      If no, what classes do what kinds of work?

      If yes, what kind of work does everybody do?

5. Interdependence with other departments

   a. Inputs

      How many different kinds of things that come from outside your department are used to turn out your department's product? (exclude permanent machinery, maintenance, etc.)

      _____

      Input Scale (stop when a yes is obtained)

      Excluding inspection, receiving and similar departments

      Does one input come from only one department within the same _____ plant? yes-4 no

      Does one input come from more than one department within the same _____ plant? yes-3 no

Does one input come from another _____ plant? yes-2 no

Do all inputs come from outside _____? yes-1 no

b. Outputs

How many different kinds of things does your department turn out? _____

Output Scale (stop when a yes is obtained)

Excluding shipping, inspection, and similar departments

Department output is a unique input for other department(s) in the same _____ plant. yes-4 no

Department output is unique and goes to another _____ plant. yes-3 no

Other departments in this plant have the same final outputs. yes-2 no

Department output is unique and final for _____. yes-1 no

c. Workflow Rigidity Scale (answer each item)

In the event of a breakdown, does all workflow stop immediately? yes no

In the event of a breakdown, does some workflow stop immediately? yes no

Are buffer stocks present, or delays possible? yes no

Is waiting time possible? yes no

Does all input come from a single source and through one point? yes no

Can equipment be used for more than one purpose? yes no

Is the rerouting of work possible? yes no

Is there a production (assembly) line? yes no

0 1 2 3 4 5 6 7 8 (total of underlined responses)

6. Technology--Automaticity Scale

Range: highest score possible for the department
Mode: score for the bulk of the department's equipment

Item	Range	Mode
Hand tools and manual machines	1	1
Powered machines and tools	2	2
Single-cycle automatic and self-feeding machines	3	3
Automatic: repeats cycle	4	4
Self-measuring and adjusting: feedback	5	5

APPENDIX D

ORGANIZATION S QUESTIONNAIRE ITEMS

A. Dependent Variables

I. Perceived Job Characteristics

1. Autonomy

How much <u>freedom</u> do you have to determine how you do your job?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Very little; I have no say about the procedures and equipment used to do my job.		Moderate freedome; I can make some of the decisions about how the work is done, but many of the decisions and procedures are specified for me.			Very much; I have almost complete responsibility for how I will do my job.	

How much <u>say</u> do you have over the things you do on your job?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Very little; I have almost no influence in deciding what I do.		Moderate influence; I have influence in some decisions but not in others.			A great deal: I have a lot of influence in most of the decisions about what I do.	

On my job I make a lot of decisions on my own.*

I have a great deal of say over what has to be done on my job.

I have no control over the decisions made about my job.

*All items are scored on a seven-point agree-disagree scale (strongly disagree; disagree; slightly disagree; neither agree nor disagree; slightly agree; agree; strongly agree) unless otherwise indicated.

2. Variety

How much variety is there in your job?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Very little; I do pretty much the same things over and over, using the same equipment and procedures almost all the time.			Moderate variety.			Very much; I do many things, using a variety of equipment and procedures.

3. Task Identity

How much does the work you do on your job make a visible impact on a product or service?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
None at all; it is hard to tell what impact my work makes on the product or service.			A moderate amount; the impact of my job is visible along with that of others.			A great amount; my work is clearly visible; it makes a noticeable difference in the final product or service.

I can see the results of my own work.

On my job I produce a whole product or perform a complete service.

4. Challenge

My job is very challenging.

On my job, I seldom get a chance to use my special skills and abilities. (Reversed)

How much challenge is there on your job?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
There is very little challenge on my job; I don't get a chance to use any special skills and abilities and I never have jobs which require all my abilities to complete them successfully.			Moderate challenge.			There is a great deal of challenge in my job; I get a chance to use my special skills and abilities and often have jobs which require all my abilities to complete them successfully.

II. Role Perceptions

1. Role Overload

I have too much to do to be able to do it well.

I never seem to have enough time to get things done.

2. Role Clarity

I always know what I should be doing on my job.

It is clear what others expect of me on my job.

Most of the time I know what I have to do on my job.

Most of the time people make it clear what they expect of me.

III. Outcome Measures

1. Satisfaction with Higher Order Needs

Please indicate how satisfied you are with the following aspects of your job.**

The chances you have to accomplish something worthwhile.

The chances you have to learn new things.

The chances you have to do something that makes you feel good about yourself as a person.

The chances you have to do the things you do best.

** Scored on a seven-point scale (very dissatisfied; dissatisfied; slightly dissatisfied; neither satisfied nor dissatisfied; satisfied; very satisfied.

The opportunity you have to do the things you do best.

2. Effort

I work hard on my job.

In general, do you do large quantities of work?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
No, I don't do a very large amount of work.						Yes, I do very large amounts of work.

3. Intrinsic Motivation

I get a feeling of personal satisfaction from doing my job well.

It's important to me that I do my job well.

4. Global Job Satisfaction

All in all, I am satisfied with my job.

In general, I like working here.

All in all, I am very satisfied with the kind of work I have to do on my job.

B. Interdependence Variables

I. Interdepence Items*

The following questions refer to different ways in which you may depend on others. For each question, think of what you need in order to do your job well, and indicate to what degree you may depend on others in the way mentioned.

1. To what degree do you need <u>assistance</u> in doing your work from each of the following?

   a. Other people in your section

   b. People in other sections of your branch

   c. Employees in other branches or divisions

2. To what degree do you need <u>information</u> or <u>advice</u> from each of the following?

   a. Other people in your section

   b. People in other sections of your branch

   c. Employees in other branches or divisions

*All interdependence items are scored on a seven-point scale (not at all; to some degree; to a large degree; to a very great degree).

These questions refer to different ways in which <u>others</u> may depend on <u>you</u> in order to do their job well.

3. To what degree do each of the following need your assistance in doing their work?

   a. Other people in your section

   b. People in other sections of your branch

   c. Employees in other branches or divisions

4. To what degree do each of the following need <u>information</u> or <u>advice</u> from you?

   a. Other people in your section

   b. People in other sections of your branch

   c. Employees in other branches or divisions

II. Contact Items

Please indicate how much contact you have with each of the following groups of people. Include both personal contact and written or telephone communications which you have with other employees as a result of your work.

1. How much contact do you have with . . .*

   Other people in your section?

   People in other sections of your branch?

   Employees of other branches or divisions?

III. Coordination

1. How much do you have to <u>cooperate</u> directly with other people in this organization in order to do your job?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Very little; I can do almost all my work by myself.			A moderate amount; some of my work requires co-operating with others.			Very much; all my work requires co-operating with others.

2. To do my job well, I have to work closely with other people.

*Scored on a six-point scale (no contact; little contact; moderate contact; a good deal of contact; a large amount of contact; does not apply.

3. How often does your job require that you meet or check with other people in this organization?

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Not at all; I never have to meet or check with others.			I sometimes need to meet or check with others.			Very often; I must constantly meet or check with others.

C. Interdependence-related Variables

I. Perceived Need for Cooperation among Subunits

People in other work sections really need to understand the problems and conditions we have to deal with on our jobs.

It is in my best interest for other work sections to perform well.

What other work sections do affects what my work section can do.

Despite conflict between sections, work seems to get done around here.

When conflict arises, a neutral person makes the final decision.*

D. Demographics

I. Personal Characteristics

1. What was your age on your last birthday?

[1] Under 20
[2] 21-25 years
[3] 26-30 years
[4] 31-35 years
[5] 36-40 years
[6] 41-45 years
[7] 46-55 years
[8] 56 years or older

2. Are you (check one)

[1] Female
[2] Male

*Scored on a seven-point scale (never; sometimes; often; almost always).

3. What is your educational level? (indicate highest completed)

   [1] Some elementary school (grades 1-7)

   [2] Completed elementary school (8 grades)

   [3] Some high school (9-11 years)

   [4] Graduated from high school or G.E.D.

   [5] Some college or technical training beyond high school (1-3 years)

   [6] Graduated from college (B.A., B.S., or other bachelor's degree)

   [7] Some graduate school

   [8] Graduate degree (master's, Ph.D., M.D., etc.)

II. Work-related Characteristics

1. How long have you worked for _____?

   [1] Less than 30 days

   [2] 1-3 months

   [3] 4-11 months

   [4] 1-3 years

   [5] 4-5 years

   [6] 6-10 years

   [7] 11 years or more

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