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An Examination of the Determinants of Organizational Structure[1]

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Multiple regression and path analysis were employed to explore the relationships among organizational context, organizational complexity, and bureaucratic control in a sample of 50 Japanese industrial manufacturing plants. Of three contextual variables, internal dependence is found to be the most powerful predictor of bureaucratic control; organizational size and technological automaticity show their influence on control by channeling through some intervening variables. The finding that structural differentiation has no important associations with centralization and formalization disconfirms part of our proposition, but each of the other two complexity variables (functional specialization and knowledge complexity) is a significant predictor of one of the two control variables. The magnitude of variance explained by all the variables examined suggests that the model used is more predictive of formalization than of centralization.

One of the most interesting research challenges facing social scientists today is investigation of the actual dynamics of complex organizations. The issue involved is largely an outgrowth of Weber's classic essay on bureaucracy. Weber was concerned mainly with distinguishing between the bureaucratic style of administration and other systems based on different types of authority. He stated that a strict hierarchical system of authority was a vital characteristic of a bureaucratic system of administration. However, at no point did he suggest that centralization of decision making in such a hierarchy was a characteristic of bureaucracy, nor did he even make explicit the relation between bureaucracy and centralization (Mansfield 1973). He indicated that the notion of authority within a bureaucratically administered organization does not mean "the 'higher' authority is simply authorized to take over the business of the

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'lower.' Instead, the opposite is the rule" (Weber 1946, p. 197). It is reasonable to interpret Weber as implying a moderate negative relationship between the bureaucratic variables and the centralization of decision making (Mansfield 1973).

Organization literature contains three distinct views of the relationship between bureaucratization and centralization. The first tends to characterize bureaucracies as centralized organizations administered by means of a large number of rules and marked by large quantities of paperwork. Hage (1965, p. 300), for example, advanced the proposition that the higher the centralization, the higher the formalization. His conception of formalization seems close to Weber's definition of a bureaucracy, that is, the regulation of organizational activities by formal rules. Hage and Aiken (1967) even argued that Weber implied a positive relationship between centralization and aspects of bureaucratization. They argued that "as power becomes more centralized . . . it becomes imperative to develop clear-cut rules because of the pressure of time. Leaders cannot spend all their time making decisions about work so they codify past decisions into rules specifying what job occupants are supposed to do. Rules are in this sense decisions for routine procedures or problems as well as the guidelines for the behavior of the job occupants" (Hage and Aiken 1967, p. 82).

This is the unidimensional view of bureaucracy. According to this construct, increasing degrees of specialization of labor, centralization of authority, formalization and standardization of activities, and impersonality of interpersonal relations mean increasing degrees of structure, or bureaucratization (Blau 1967; Hall 1972).

The second view is held by the Aston researchers. On the basis of a factor analysis of data gathered in 46 work organizations in the English Midlands, the Aston researchers concluded that organizational structure could best be described by four independent underlying dimensions. The first two orthogonal dimensions were structuring of activities (encompassing standardization, formalization, specialization, and vertical span) and concentration of authority (encompassing organizational autonomy, centralization, percentage of work-flow superordination, and standardization of procedures for selection and advancement) (Pugh et al. 1968, p. 89). Pugh et al. (1968) found that centralization of authority was not related to specialization and formalization, but they did find a strong positive correlation between specialization and formalization. They concluded that these patterns exhibited a consistent bureaucratic pattern: "An organization that scores higher in specialization, standardization and formalization would have gone a long way in structuring its activities" (1968, p. 84). On the other hand, centralization did not have any necessary relationships with structuring. Thus, "That one organization scores as

centralized, whereas another scores as decentralized, does not necessarily bear any relationship to how specific the allocation of authority is within the two" (1968, p. 84). The Aston group concluded that bureaucracy is not unidimensional but that "organization may be bureaucratic in any one of a number of ways" (Pugh et al. 1968, p. 88).

According to the third view, there is a general compensatory relationship between greater delegation of decision making and greater structuring through bureaucratic control. Child (1972) attempted to replicate the Aston study with a sample of 82 British business organizations but was unable to duplicate the Aston group's independent dimensions of structuring of activities and concentration of authority. Structuring, far from being unrelated to centralization as in the Aston interpretation, is in fact an alternative means of gaining administrative control in bureaucracy. As Child notes: "Within certain limits imposed by the organization's operating situation managers appear to have a choice between (a) maintaining control directly by confining decisions to fairly senior levels or (b) maintaining control indirectly by relying on the use of procedures, paper records, and on the employment of expert specialists to take decisions at lower levels" (1972, p. 174). Specifically, in contrast to the Aston study, Child concluded that the multiplicity of rules, procedures, and paperwork was negatively related to the centralization of decision making.

The contradictory perspectives about the dimensionality of bureaucracy in general and about the relationship between centralization and structuring of activities in particular have both theoretical and strategic importance. So far, most of the studies concerning these issues have been undertaken in Western organizations. The present article attempts to test their relevance in a different national context. Specifically, the objectives of the study are empirically and conceptually to examine: (1) the way that contextual variables influence the structural characteristics of organization; (2) the relationships among the structural characteristics of organization; (3) the relationships among organizational context, organizational complexity, and organizational control.

CONCEPTUAL FRAMEWORK

The overall framework used in the present study can be specified as shown in figure 1.

The model assumes that contextual variables, as the exogenous variables, not only have direct effects on the control variables but also have their indirect effects on control variables mediated through the complexity variables. Similarly, the complexity variables, as the intervening variables, have direct effects on the control variables. The actual

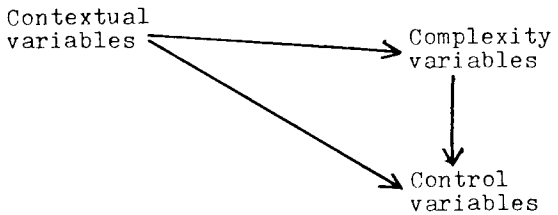

FIG. 1.—Causal model of relations among context, complexity, and control

relationships among the three sets of variables are far more complicated than the model shows. The reasons are quite obvious. First, each set of variables contains multiple variables. Second, although the model shows the directions of relationships, the actual relationships among variables are still not clear. To clarify the conceptual framework, the following subsections will focus on the relationships among (1) context and complexity; (2) complexity and control; and (3) context, complexity, and control.

Contextual Variables and Complexity Variables

Since the mid-1960s there has been a continuing debate over contextual factors thought to exert a pervasive influence on organizational structure. A number of studies provide strong empirical support for the importance of organizational size (Blau 1970; Blau and Schoenherr 1971; Pugh et al. 1969; Child 1972, 1973), but no less persuasive are those arguing for technology (Woodward 1965; Perrow 1967; Aldrich 1972; Dewar and Hage 1978) and organizational dependence (Pugh et al. 1969; Horvath et al. 1976; Mindlin and Aldrich 1975).

Blau and his associates have been the major proponents of size as the primary cause of complexity. A series of studies conducted by them found consistently strong and positive relationships between organizational size and various components of complexity (Blau and Schoenherr 1971; Blau 1970). Although substantial relationships between size and complexity have been found in many studies in many different samples of organizations (Meyer 1972; Pugh et al. 1968; Child 1972), the issue of causality remains controversial (Scott 1975; Kimberly 1976). For example, Hall (1972), after reviewing recent literature, takes a very different view of the role of size: "There are no 'laws' regarding size and other organizational characteristics. . . . Size, which related to some important characteristics, is not as important as other factors in understanding the form organizations take. When size (and growth) is taken in conjunction with technological and environmental factors, predictions regarding organizational structures and processes can be made" (p. 139).

Like the importance of organizational size, that of technology to the structure of organization continues to be an open issue. Such writers as Woodward (1965), Perrow (1967), and Thompson (1967) argued that differences in technology alone, not in other variables such as size or historical background, were related to structural difference. To view organizations as technological systems offers a better basis for comparing and comprehending them. This technologically deterministic view of organization, however, did not receive support in other empirical studies. Khandwalla (1974, p. 77), after a brief review of the extant literature, concluded: "There is no unanimity that technology affects organizational structure. . . . The impact of technology on organizational structure, if any, is likely to affect some, perhaps few dimensions." Pugh et al. (1969) and Hickson, Pugh, and Pheysey (1969) also suggested that the operations technology of an organization as such has little, if any, effect on structural features beyond those directly linked with the work flow.

As for the relative importance of size and technology, Child and Mansfield (1972) found that size has a much closer relationship to the aspects of structure measured than does technology. They indicate that technology is not strongly related to organizational structure, even to those structural variables logically (as opposed to empirically) most closely related to worker integration. Marsh and Mannari (1981), on the other hand, show the effects of technology, net of size, to be greater than the effects of size, net of technology, on several aspects of organizational structure.

Organizational dependence is also important in determining organizational structure. Pugh et al. (1969) conceptualized dependence as the relationship to a parent organization or owning group or to other organizations. They found that as an organization becomes more dependent on other organizations, it tends to be more centralized, to be less autonomous in relation to the parent organization, and to exhibit some increased standardization of procedures for selection and advancement but no apparent change in either formalization of procedures or specialization of activities. Inkson, Hickson, and Pugh (1970) reported similar findings.

The major problem in the Aston study was its failure to distinguish between internal and external dependence. Breaking down the operationalization of dependence into two scales, Horvath et al. (1976) found a strong positive relationship of internal dependence to centralization and formalization, but the influence of external dependence did not show a consistent pattern in organizations of different countries. Mindlin and Aldrich (1975), using Aston data, found that the higher the dependence on other organizations—excluding the parent organization—the lower the formalization and standardization of organizational structure.

In the present study, size (log size of employees and log fixed assets of the factory), technology (Aston automaticity scale and Khandwalla's

technology), and dependence (internal and external) are assumed to be the contextual variables. Their effects on complexity and control variables will be analyzed separately and together.

Organizational Complexity and Organizational Control

The conceptual distinction between complexity and control is well established in thinking about organization. Hage and Aiken (1967) have distinguished between complexity and centralization; Hall, Haas, and Johnson (1967) have distinguished between complexity and formalization; and Blau and Schoenherr (1971) have distinguished between differentiation and administration. More recently, Child has elaborated the distinction between complexity and control, indicating (1973, p. 177) that "differentiation, especially of functions and roles, is one major component of organizational complexity. Another is the level and range of specialized expertise applied to organizational activities. A bureaucratic mode of control is characterized by both formalization, that is, use of standard procedures and documentation, and also by the decentralization of decision making." Complexity is frequently regarded as a major characteristic of modern organization and also as an important determinant of other structural features. Complexity is likely to generate administrative problems of coordination and control. One way in which such problems may be met is increased formalization, that is, the elaboration of controls in the form of standard rules and procedures and the use of documentation and records. The alternative is the concentration of decision making, that is, use of personal leadership as a strategy of coordination and control (Child 1973, p. 169; Hage 1980).

Although the pattern of relationships between complexity variables and control variables is likely to be complex, there is strong evidence consistent with a positive relationship between complexity and formalization but a negative one between complexity and centralization (Khandwalla 1974; Child 1973).

In the analysis presented below, the degree of complexity within an organization is assessed by scores on measures of structural differentiation (horizontal and vertical), functional specialization, and knowledge complexity. The degree of bureaucratic control is assessed by scores on overall formalization and overall centralization.

Context, Complexity, and Control

The observation that bureaucratization is more evident and extensive in large organizations has always been a theme in the literature about organizations. However, large size in itself is not likely to be a direct

cause of the degree of bureaucratic control utilized. Child (1973) argued that it is the degree of complexity rather than size which forces management toward bureaucracy or some other elaborate system of coordination and control. He indicated: "A large number of low skilled employees in unspecialized activities can usually be managed through a simple system of direct command more readily than employees with greater expertise engaged in specialized activities. With specialization and expertise (that is, complexity) it is therefore predictable that managerial control tends to become indirect and impersonal" (1973, p. 181).

Decentralization is likely to be accompanied by an increase in standard procedures and documentation designed to maintain control and consistency of performance. In addition, the employment of qualified specialists is itself likely to generate more standardization of procedures and documentation. In short, we can postulate that organizational complexity is a somewhat stronger predictor of organizational control than is size.

Similarly, a number of studies indicate there is no direct relationship between technology and bureaucratic control. For example, Hickson et al. (1969, pp. 394-95) suggested the following hypothesis: "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 those 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."

The status of dependence variables in the causal ordering is not clear. The high correlation of dependence with concentration of authority led the Aston investigators to propose dependence as a predictor of centralization of decision making while positing no relation of dependence with the other structural dimension (Mindlin and Aldrich 1975).

In the present study, contextual variables are assumed to cause structural differentiation (horizontal and vertical). With a differentiated structure, organizations increase the number of functional specializations and increase many types of expertise (knowledge complexity). With greater specialization and expertise, it is predictable that organizations increase the degree of formalization and decrease the concentration of decision making on the top levels (Child 1973, pp. 77, 81).

DATA AND VARIABLE MEASUREMENT

The data used for this paper are part of the Okayama Organizations Project. The survey was conducted by two of the authors. Fieldwork was

done during the summer of 1976 in a city of 400,000 population in Okayama Prefecture in Japan. The sample included 50 industrial manufacturing plants within some 13 different industries.

Most of the instruments used to measure structural properties in this project are based on the Aston scales. Although developed for use in Britain, these measures have been applied to sets of organizations in several national contexts (Lincoln et al. 1978; Child 1972; Inkson et al. 1970; Horvath et al. 1976).

The variables used in the present study are as follows:

1. *Organizational size:* Total number of employees (X_1) and fixed assets (X_{1a}) are used as measures of organizational size.[2] Logarithmic transformations were performed on total number of employees and fixed assets to adjust for skewness in the relationship between size and other variables.

2. *Technological variables:* Two technological variables are employed in this study. Automaticity (X_2) is measured by a six-point scale going from "hand tools and manual machines" (scored 0) to "computer control: automatic cognition" (scored 5). Each factory is rated twice on this scale, once for the bulk of its equipment and again for the most automated piece of equipment, and its score is the sum of both. Khandwalla's technology scale (X_{2a}) uses the five categories of Woodward's technology scale—custom, small batch, large batch, mass production, and continuous process automated—but rates the use of each category on an anchored seven-point scale (from 1 = this technology is not applicable to this factory's principal products and 2 = it is used very slightly, through 6 = it is used to a great extent and 7 = it is almost exclusively used). The five categories of technology are weighted from 1 for custom technology to 5 for continuous process technology, and each is multiplied by the 1–7 extent of its use. The total is the Khandwalla technology score. The higher the score, the more the organization uses mass production and/or continuous process automated technologies (Khandwalla 1974).

3. *Dependence variables:* Dependence is conceptualized as (1) internal dependence (X_3)—the dependence of the focal organization (the factory studied) on its parent organization, and (2) external dependence (X_{3a})—the focal organization's dependence on suppliers and customers; the fewer the suppliers and customers, the more externally dependent the organization is.

[2] Some studies (e.g., Tracy and Azumi 1976) use sales volume, rather than fixed assets, as a measure of organizational size. In our data, sales volume and fixed assets are essentially uncorrelated ($r = .09$) but have similar relationships to the log of the number of employees ($r = .59$ and .62, respectively). Substituting sales volume for fixed assets in tables 2 and 5 does not alter the basic pattern of our findings in terms of either betas or variance explained in the dependent variables. Therefore, this paper uses fixed assets rather than sales volume as the second measure of size.

4. *Horizontal differentiation* (X_4): The number of departments is always treated as an indicator of structural differentiation. In this paper, it will represent horizontal differentiation.

5. *Vertical differentiation* (X_5): The number of levels from highest to rank and file will represent another aspect of structural differentiation—vertical differentiation.

6. *Functional specialization* (X_6): We use Azumi's scale, which added two items—"internal audit" and "computer specialist"—to the 16-item Aston scale. This scale is designed to measure the extent to which administrative organizational functions are assigned as specialized duties to individuals. This is not a measure of specialization on the production level.

7. *Knowledge complexity* (X_7): The number of professionals or specialists in an organization is often used as a measure of organizational complexity (Hage and Aiken 1967). The present study uses the percentage of university graduates a a measure of knowledge complexity.

8. *Centralization* (X_8): We use a 37-item scale designed to measure the extent to which the authority for decision making rests on the higher levels in the organization. Centralization refers to the distribution of authority within the focal organization, whereas internal dependence refers to the distribution of authority between the parent organization and the focal organization. Neither conceptually nor as measured by our Aston scales are centralization and internal dependence tautologous.

9. *Formalization* (X_9): The 13-item formalization scale denotes the extent to which rules, procedures, instructions, and communications are written in the organization and the extent of their application or distribution.

Table 1 shows the matrix of zero-order correlations for all the variables used in this study.

FINDINGS: ORGANIZATIONAL CONTEXT AND ORGANIZATIONAL STRUCTURES

Size and Structural Variables

Table 2 reports the results when complexity and control variables are regressed on log number of employees and log fixed assets. It indicates that log number of employees has significant positive effects on horizontal differentiation, vertical differentiation, specialization, and formalization. These four variables are conventionally regarded as the important elements of the structuring of activities. Thus, when organizations increase their number of employees, structural differentiation and functional specialization will increase, and organizations will also use rules, documents, and paperwork more widely than before as means of control. The present

TABLE 1

MATRIX OF ZERO-ORDER CORRELATION COEFFICIENTS

	1	2	3	4	5	6	7	8	9	10	11	12
1. Log number of employees (X_1)	1.00											
2. Log fixed assets (X_{1a})	.35	1.00										
3. Automaticity (X_2)	.39	.40	1.00									
4. Khandwalla's technological score (X_{2a})	.53	.26	.37	1.00								
5. Internal dependence (X_3)	.38	.46	.50	.33	1.00							
6. External dependence (X_{3a})	−.03	−.08	.28	.07	−.05	1.00						
7. Horizontal differentiation (X_4)	.63	.12	.18	.25	.02	−.16	1.00					
8. Vertical differentiation (X_5)	.15	−.29	.06	.16	−.33	.13	.07	1.00				
9. Functional specialization (X_6)	.51	.16	.07	.19	.12	−.07	.36	.20	1.00			
10. Knowledge complexity (X_7)	.14	.04	.34	.12	.14	−.07	.08	.21	.01	1.00		
11. Centralization (X_8)	−.07	.29	.01	.03	.22	.20	−.04	−.24	−.11	−.37	1.00	
12. Formalization (X_9)	.40	.38	.46	.33	.59	.08	.02	−.08	.26	.30	.13	1.00
M	5.70	7.46	5.12	27.12	2.90	3.85	4.28	7.10	11.10	5.94	133.43	14.04
SD	.98	3.19	2.05	8.20	2.43	1.67	3.89	1.89	4.59	4.71	29.40	4.31
N	50	50	50	50	50	47	50	50	48	49	49	49

findings are similar to those of previous research of Pugh et al. (1968), Child (1972, 1973), Blau (1970), and Blau and Schoenherr (1971). Their studies found that organizational size has a significant positive relationship to the variables of structuring of activities. However, unlike them, we do not find a significant negative relationship between size and centralization of decision making.

Table 2 also shows that log fixed assets has significant positive effects on vertical differentiation, centralization, and formalization. These findings imply that an organization with large fixed assets will increase the number of levels and use both of the control mechanisms. The relationship patterns shown in table 2 are consistent with Kimberly's (1976) proposition that alternative measures of organizational size may have different relationships to structure.

Finally, an examination of table 2 reveals that these two size variables combined are more important in explaining the variations of horizontal differentiation, functional specialization, and formalization (explained variance, 38.6%, 22.6%, and 19.2%, respectively) than in explaining other variables.

Technology and Structural Variables

Table 3 examines the relationships between technological variables and complexity and control variables. Of 12 beta weights, only two show significant effects. This finding indicates that when the organizations increase their technological automaticity, knowledge complexity and formalization will also increase. It is reasonable to speculate that an organization with highly automated technology would need more employees with high specialist qualifications and longer educational training. In the same organization, there would also be a need for rules, procedures, and documentation to familiarize the employees with the automated operating system and new social relationships.

Reading across the row of adjusted R^2, we find that the two technological variables have very little explanatory power for the variation in structural variables.[3]

Dependence and Structural Variables

Table 4 shows the results of the regression of complexity and control variables on dependence variables. The only two significant relationships

[3] The findings reported here, however, are not inconsistent with those in a previous article (Marsh and Mannari 1981) in which technological factors were found to have not only significant effects on formalization and knowledge complexity but also important linkages with other aspects of organizational structure which are not studied in the present article.

TABLE 2

MULTIPLE REGRESSION OF COMPLEXITY AND CONTROL VARIABLES ON ORGANIZATIONAL SIZE

	COMPLEXITY VARIABLES			CONTROL VARIABLES		
SIZE VARIABLES	Horizontal Differentiation	Vertical Differentiation	Functional Specialization	Knowledge Complexity	Centralization	Formalization
Log number of employees	.672***	.286*	.514***	.139	−.196	.309*
Log fixed assets	−.112	−.391**	−.019	−.006	.360**	.268*
$\bar{R}^2$	.386***	.121*	.226**	−.025	.080	.192**
N^a	50	50	50	48	49	49

[a] Using pairwise deletion, N varies in different analyses.
* Significant at .05 level.
** Significant at .01 level.
*** Significant at .001 level.

TABLE 3

MULTIPLE REGRESSION OF COMPLEXITY AND CONTROL VARIABLES ON TECHNOLOGICAL VARIABLES

	COMPLEXITY VARIABLES			CONTROL VARIABLES		
TECHNOLOGICAL VARIABLES	Horizontal Differentiation	Vertical Differentiation	Functional Specialization	Knowledge Complexity	Centralization	Formalization
Automaticity	.086	−.131	.004	.335*	−.000	.390***
Khandwalla's technological score	.222	.205	.188	−.001	.033	.185
$\bar{R}^2$	.031	−.001	.016	.093	−.020	.206**
N^a	48	50	50	48	49	49

[a] Using pairwise deletion, N varies in different analyses.
* Significant at .05 level.
** Significant at .01 level.
*** Significant at .001 level.

are those between internal dependence and vertical differentiation and formalization. Organizations that are highly dependent internally will not only need many hierarchical levels but also increase the need for the standardization of rules and procedures. The organization's external dependence—its dependence on suppliers and customers—has no significant effect on any of the complexity or control variables.

Generally, except for formalization, the two dependence variables combined do not explain much variation in structural variables.

Contextual Variables and Structural Variables

Table 5 puts the six contextual variables together in one equation to examine their combined effects on the structural variables. Comparing table 5 with tables 2, 3, and 4, we find the following interesting results:

1. Log number of employees is the most important determinant of horizontal differentiation. This indicator of organizational size alone explains a large percentage (39.6%) of the variance in horizontal differentiation. This finding is consistent with that of previous studies (Blau and Schoenherr 1971; Child 1972) that larger organizations differentiate into more departments and divisions.

2. When other variables are taken into account, both indicators of organizational size lose the importance they had in table 2 in explaining the variation of vertical differentiation (see table 5). Internal dependence is the only variable which has a significant effect on vertical differentiation. The coefficient between them increases from −.322 (table 4) to −.398 (table 5).

3. Although the important effect of log number of employees on functional specialization is still maintained, the explained variance decreases from 22.6% in table 2 to 17.4% in table 5 after other contextual variables are taken into account. This finding suggests that, except for the variable of log number of employees, the other contextual variables make no important contribution to the explanation of the variance in functional specialization.

4. Technological automaticity is still the single contextual variable that has a significant effect on knowledge complexity. All contextual variables combined do not explain a significant amount of the variation in this aspect of organizational complexity.

5. Log fixed assets and internal dependence have significant effects on centralization after other contextual variables are taken into consideration. But the variance in centralization explained by the six variables is negligible.

6. When we put all six contextual variables in one equation, the log number of employees and automaticity lose their previous significant

TABLE 4

Multiple Regression of Complexity and Control Variables on Dependence Variables

Dependence Variables	Complexity Variables: Horizontal Differentiation	Vertical Differentiation	Functional Specialization	Knowledge Complexity	Control Variables: Centralization	Formalization
Internal dependence	.017	−.322*	.115	.139	.226	.593***
External dependence	−.159	.114	−.069	−.058	.212	.014
$\bar{R}^2$	−.018	.080	−.026	−.022	.049	.327**
N^a	47	47	47	46	46	46

[a] Using pairwise deletion, N varies in different analyses.
* Significant at .05 level.
** Significant at .01 level.
*** Significant at .001 level.

TABLE 5

Multiple Regression of Complexity and Control Variables on Size, Technological, and Dependence Variables

Contextual Variables	Complexity Variables: Horizontal Differentiation	Vertical Differentiation	Functional Specialization	Knowledge Complexity	Control Variables: Centralization	Formalization
Log number of employees	.740***	.278	.597***	.012	−.199	.147
Log fixed assets	−.053	−.273	.038	−.151	.373*	.077
Automaticity	.118	.059	−.121	.469**	−.308	.121
Khandwalla's technological score	−.060	.187	−.077	.012	.039	.040
Internal dependence	−.283*	−.398**	−.043	−.043	.323*	.425**
External dependence	−.183	.067	−.015	−.212	.278	.070
$\bar{R}^2$	.412**	.179	.174	.032	.130	.322*
N^a	47	47	47	46	46	46

[a] Using pairwise deletion, N varies in different analyses.
* Significant at .05 level.
** Significant at .01 level.
*** Significant at .001 level.

effects on formalization. The only significant effect on formalization is from internal dependence ($b = .425$). The variance in formalization explained by the two dependence variables is similar to that explained by all six contextual variables (the explained variances are .327 in table 4 and .322 in table 5, respectively).

7. Table 5 can also be summarized according to the relative importance of variables in each different contextual group. First, log number of employees is more important than fixed assets, revealing its significant effects on horizontal differentiation and functional specialization. Second, among the categories of contextual variables, technological variables have the least importance in influencing and explaining the structural variables. The only significant relationship is between automaticity and knowledge complexity. Third, as in the findings of previous studies, internal dependence shows more significant effect on organizational structures than does external dependence.

FINDINGS: ORGANIZATIONAL COMPLEXITY AND BUREAUCRATIC CONTROL

The first purpose of table 6 is to examine the relationships between centralization and other structural variables. Previous studies have found contradictory results about these relationships. Hage and Aiken (1967) argued that there is a positive relationship between centralization and other structural variables. In contrast, Pugh et al. (1968) found that centralization was not related to specialization and formalization, but they did find a strong positive correlation beween specialization and formalization. Child, using the same methodology as Pugh and his asso-

TABLE 6

Multiple Regression of Control Variables on Complexity Variables

Complexity Variables	Control Variables: Centralization 1	Centralization 2[a]	Formalization
Horizontal differentiation	.031	.083	−.154
Vertical differentiation	−.152	−.073	−.229
Knowledge complexity	−.335*	−.455**	.349*
Functional specialization	−.088	−.244	.456**
Formalization	...	.343*	...
$\bar{R}^2$	.035	.161	.214*
N	47	47	47

[a] Formalization was included in the regression equation.
* Significant at .05 level.
** Significant at .01 level.

ciates at Aston, concluded: "In contrast to the Aston study, centralization of decision making is found to be related negatively to structuring" (1972, p. 174).

To compare our data with previous studies, we undertook two separate regression analyses on centralization: first, we examined the relationships between four complexity variables and centralization (step 1); second, we put formalization into the regression equation with complexity variables to examine further the relationship (step 2).

Table 6 shows more complicated findings than the previous studies. When centralization is regressed on four complexity variables, the result reveals that there is only one significant relationship between them, and the four complexity variables combined explain little variation in centralization. After formalization is put in the regression equation, the importance of knowledge complexity is increased (from —.335 to —.455). The negative relationship suggests that organizations with a high percentage of university graduates decentralize decision making.

The most interesting finding in table 6 is the significant positive relationship between formalization and centralization. This is opposite to Child's finding (1972) and supports the proposition that "the higher the centralization, the higher the formalization" (Hage 1965, p. 300). The finding that formalization and centralization go hand in hand in Japanese organizations is also found in other studies. Lincoln et al. (1978), after reviewing the literature on Japanese organizations, stated that Japanese organizations have high centralization and formalization but low functional specialization. Azumi and McMillan (1975) compared their Japanese sample with Aston's and Child's sample and found the scores of centralization and formalization higher in Japanese organizations than in British, but the score of functional specialization lower than in the British sample.

The second purpose of table 6 is to show the relationship between formalization and complexity variables. We find that functional specialization and knowledge complexity have a strong positive relationship to formalization. While the positive correlation linking specialization and formalization has been found in many other studies (Hage and Aiken 1967; Blau and Schoenherr 1971; Hinings and Lee 1971; Child 1973), a few words are needed to clarify the relationship between knowledge complexity and formalization. In his recent important book (1980), Hage indicated that there are various measures of formalization, and different measures have different patterns of findings. However, he recognized that "the concentration of specialists leads to the development of written documents that appear to emphasize procedures more than job descriptions, but in any case specialists, like bureaucrats, emphasize paper work" (Hage 1980, p. 366).

FINDINGS: PATH ANALYSIS OF CENTRALIZATION AND FORMALIZATION

In this study, the first step of analysis examined the relationships between contextual and structural variables (including both complexity and control variables). The second step analyzed the relationships among structural variables (our special focus was on the relationship between structuring of activities and centralization). Now comes the final step: What are the relationships among contextual variables, complexity variables, and control variables in the conceptual framework?

The following analyses employ path diagrams to examine the causal orderings of two bureaucratic control variables. In order to compare the results we used the same exogenous and intervening variables in the path models. Three contextual variables (log number of employees, automaticity, and internal dependence) were selected as the exogenous variables that affect the control variables directly as well as indirectly.[4] The four complexity variables were all included in the model as intervening variables: both aspects of structural differentiation (horizontal and vertical) are assumed to affect control variables not only indirectly (through functional specialization and knowledge complexity) but also directly. Functional specialization is presumed to affect control variables both directly and indirectly (via knowledge complexity). Knowledge complexity is presumed to affect the two control variables directly. Path analysis is used here to explore more fully the conceptual framework discussed earlier.

The path analyses of figures 2 and 3 show the following results:

1. Log number of employees has a significant positive effect on both aspects of structural differentiation and functional specialization. This finding indicates that when organizational size increases, differentiation and functional (administrative) specialization tend to increase. The only significant indirect effect of log size of employees is channeled through functional specialization and leads to a strong positive effect on the degree of formalization (fig. 3). This finding suggests that organizations with a large number of employees in unspecialized activities will not lead management toward formalization; it is only when an organization has many employees participating in specialized administrative work that managerial control tends to become indirect and impersonal[5] (Blau and Schoenherr 1971; Child 1973).

[4] We used two criteria in selecting these three from the set of six contextual variables: first, the earlier attention given to them as key determinants of organizational structure by Blau (1971), Aldrich (1972), Pugh et al. (1968), and Child (1972, 1973); second, their explanatory power in the present paper.

[5] An anonymous referee suggested that this positive relationship between knowledge complexity and formalization may be due to the fact that specialists make rules for others.

2. The insignificance of P_{82} and P_{92} shows that there is no important power of technological automaticity in predicting bureaucratic control. The importance of technological automaticity is revealed in its strong effect on knowledge complexity ($P_{72} = .335$) and through this variable to a strong negative effect on centralization ($P_{87} = -.404$). This finding suggests that when the automaticity of technology increases, the organization needs more employees with high education and specialist training; at the same time, when automaticity and knowledge complexity both increase, the decentralization of decision making will also increase. This finding confirms a number of previous studies (Hall 1968; Hage and

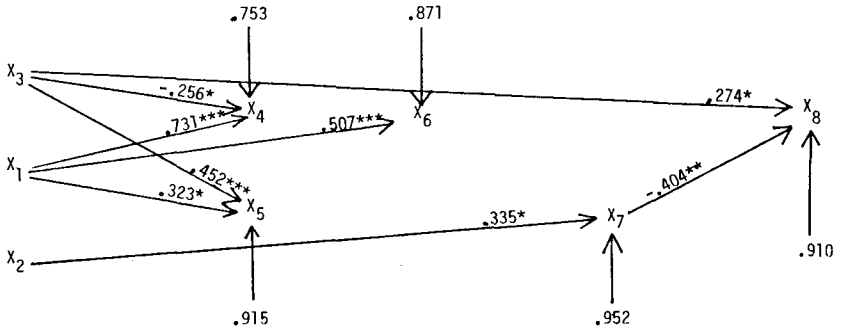

FIG. 2.—Simplified path diagram for centralization. Intercorrelations among exogenous variables and those path coefficients which did not reach the .05 significance level have been dropped from the figure (see table 1 and App. table). Variables: X_1, log number of employees; X_2, automaticity; X_3, internal dependence; X_4, horizontal differentiation; X_5, vertical differentiation; X_6, functional specialization; X_7, knowledge complexity; X_8, centralization.

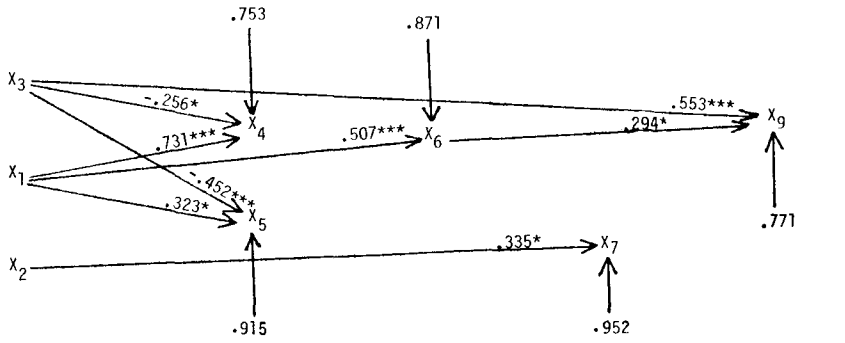

FIG. 3.—Simplified path diagram for formalization. Intercorrelations among exogenous variables and those path coefficients which did not reach the .05 significance level have been dropped from the figure (see table 1 and App. table). Variables: X_1–X_7 as in fig. 2; X_9, formalization.

Aiken 1967; Aldrich 1972; Child 1973). But, in general, the thesis that technological automaticity is an important predictor of organizational control does not receive support from our data.

3. Internal dependence is the only contextual variable which has significant direct effects on both control variables. This finding indicates that the more the focal organization depends on the parent organization, the higher the degree of centralization and formalization in the focal organization. Internal dependence also has strong negative influences on both aspects of structural differentiation. An organization that is highly dependent internally tends to decrease its horizontal and vertical differentiation.

4. Among the four complexity variables, only two have significant relationships with control variables. Knowledge complexity has a negative effect on the concentration of authority, although it shares some of its effect with technological automaticity. The administrative functional specialization has a positive influence on formalization, even though it shares some effect with log number of employees.

5. The most important determinants of organizational centralization of decision making are knowledge complexity and internal dependence. The finding that there is a significant negative relationship between knowledge complexity and centralization is not a new one. One of the dominant themes in organizational sociology is that as the labor force becomes more professionalized, there is an inevitable strain toward decentralization in organizations (Thompson 1961; Hage and Aiken 1967; Hall 1968). Thus, it is understandable that, when organizations increase the percentage of employees with high education, the level at which decisions are made will be substantially lowered. On the other hand, in organizations with high dependence on their parent organizations, the concentration of decision making will increase.

In the case of formalization, the two major predicting factors are internal dependence and functional specialization. With high dependence and specialization, it is predictable that managers will depend more on standardization of procedures and documentation to maintain control.

6. Combining three contextual variables and four complexity variables explains 44.4% of the variance in formalization but only 12.9% of the variance in centralization (see App.). This suggests that the causal model fits the explanation of formalization better than centralization.

SUMMARY AND DISCUSSION

The findings of this study can be summarized as follows:

1. Each of the three categories of contextual variables has its own effects on the two control variables. Internal dependence has a significant

direct effect on both centralization and formalization. The positive relationships between them suggest that the highly dependent organization will rely on both strategies to maintain administrative control. This finding is consistent with earlier research. For example, Pugh et al. (1968, 1969) indicated that membership in a larger organization imposes structural demands not only because of the need for standardization of rules and operating procedures but also because of the need for accountability—hence centralization (see Horvath et al. 1976).

The influence of organizational size on formalization is mediated through functional specialization, and the influence of technological automaticity on centralization is channeled through knowledge complexity. These findings support the proposition that some complexity variables are more important in predicting bureaucratic control than are organizational size and technological automaticity (Child 1973, p. 181).

2. Complexity variables were assumed to be intervening variables in our conceptual framework, but this was not fully borne out by our analyses. Functional specialization has an important effect on formalization but not on centralization; on the other hand, knowledge complexity is important in explaining centralization but not formalization. The results also indicate that neither aspect of structural differentiation has significant predictive power with regard to bureaucratic control after taking other variables into account. This disconfirms the hypothesis that structural differentiation has an intervening status between organizational context and bureaucratic control (see Dewar and Hage 1978, p. 132).

3. The significant relationship between formalization and centralization, with other structural variables controlled (see table 6), indicates that they are not independent dimensions of bureaucracy as argued by Pugh et al. (1969). The positive relationship between these two variables also contradicts the argument by Child (1972, 1973) and Mansfield (1973). For example, Mansfield argued that the only method by which the directorate in large organizations can retain overall control is by decentralizing much of the decision making within the framework of bureaucratic rules (1973, p. 478). In our Japanese cases, it seems reasonable to argue that both strategies of control can be used in the same organization. In other words, the Japanese managers can depend heavily on written procedures and rules for coordination and control but without decentralizing their decision making.

APPENDIX

REGRESSION COEFFICIENTS FOR STRUCTURAL VARIABLES

	X_4	X_5	X_6	X_7	X_8	X_9
X_1	.727***	.308*	.480**	−.089	−.197	.197
X_2	.018	.066	−.142	.321*	.038	.154
X_3	−.263*	−.479***	.047	.111	.339*	.355*
X_4	...	...	.070	.076	.139	−.261
X_5	...	...	.132	.279	.000	−.065
X_6	...	...	...	−.061	−.099	.311*
X_7	...	...	...	...	−.408**	.196
$\bar{R}^2$	.421***	.147	.210*	.052	.129	.444*
N	50	50	50	48	47	47

NOTE.—Using pairwise deletion, N varies in different analyses. X_1 = log number of employees; X_2 = automaticity; X_3 = internal dependence; X_4 = horizontal differentiation; X_5 = vertical differentiation; X_6 = functional specialization; X_7 = knowledge complexity; X_8 = centralization; and X_9 = formalization.

* Significant at .05 level.

** Significant at .01 level.

*** Significant at .001 level.

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