

Organization Design: A Participative Mul- tivariate Approach

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This paper proposes a broader design objective based on recent concepts of purposefulness in organizational systems. A multivariate analysis was used, which allowed a wide variety of faculty members of a School of Management to participate in the design decision. Results of the analysis are compared with groupings of faculty members 20 months after the analysis.¹

THEORETICAL BACKGROUND

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Division of labor and coordination have been central to organization design theory ever since organizations became a subject of inquiry (Babbage, 1832, Gulick and Urwick, 1937; Mooney, 1947). Presently popular ideas (Koontz and O'Donnell, 1972; Litterer, 1973) about how division of labor and coordination are best designed and implemented follow the classical view closely. Implicit in all these approaches is the idea that design activities are prerogatives of top management which focus on the number of subunits, the links among them, and their internal characteristics; lower-management and nonmanagement personnel are not expected to participate in the process.¹

About 1967, two explicit design objectives were published (Thompson, 1967; Lawrence and Lorsch, 1967a,b). Thompson (1967) focused on types of interdependence and costs of coordination. He said that various costs arose as a result of the need for coordination of input and output transactions among organizational subunits and that the subunits in a complex organization first are formed to handle reciprocal interdependence, since it entails the most costly form of coordination, mutual adjustment. He also noted that homogeneity of processes within subsystems reduced coordination costs. Galbraith (1970) found some empirical support for Thompson's approach and Pondy (1970) presented a complementary theoretical discussion of the costs of interdepartmental interdependencies, what he called externalities, in the context of a broader theory of internal resource allocation.

Simply put, Thompson's design objective was: form subunits so as to maximize the homogeneity of activities within the subunits and minimize the transactions across subunit boundaries. This objective focused on differentiating the total organization into subunits and thus emphasizes the important problem of boundary formation. To attain this objective successfully, the designers must be fully cognizant of all employee activities required by the work-flow technology.

Lawrence and Lorsch (1967a,b) reported evidence showing that organization subunits were differentiated by factors in addition to worker skills—such as goals, interpersonal styles, time constraints, and structural orientations—depending on the kind of task environment each faced. But, they pointed out that the more the subunits accentuated their own differences the more difficult it was to integrate (coordinate) them into an optimally functioning whole. They found that differentiation led to high performance only when accompanied by the appropriate integrative mechanisms.

In essence, the Lawrence and Lorsch design objective was: form the internal characteristics (leadership style, personality styles, and so forth) of each subunit so as to make it compatible with its particular task environment, and then develop integrative mechanisms as needed to coordinate all subunits. This objective focused on differentiating the internal characteristics of subunits once they were formed. To attain this objective successfully the designers must have well-designed subunit boundaries in the first place and know enough about the task environment of a subunit to make the necessary internal differentiations.

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Thompson's design approach emerged from what Gouldner (1959) termed the rational model of organization, where the emphasis was on structures and procedures restraining the autonomy of the subunits. The Lawrence and Lorsch contingency theory advocated either the rational model or the natural system model (Gouldner, 1959), depending on the kind of task environment the organization faced. The natural system model recognized the employee motivation and the quality and quickness of decisions forthcoming when subunits were given authority to make important task related decisions. Lawrence and Lorsch offered an improvement over Thompson's approach in that their design recognized the existence of both models of organization. However, contingency theory may prove inadequate in organizations where elements of both models are present. A design approach based on a synthesis of both models may offer the possibility of still further improvement.

Even barring the possible deficiencies of their underlying theoretical models, the Thompson and Lawrence and Lorsch design objectives are of limited usefulness because they do not deal with the problem of implementation. Designs developed by managers and consultants at the top of an organization are often based on insufficient or biased information and typically are imposed on lower-status members of the organization by those at the top of the hierarchy. Consequently the structural design may not match groupings of interdependencies perceived by lower-status members, leading them to ignore it or, even worse, to undermine it. Much of the emphasis on organization development by means of improving interpersonal processes has evolved out of recognition of these consequences (Schein, 1969).

Despite the risk of this top-down approach, it may be used because: (1) methods are not available that allow the many lower-status members to participate in the decision successfully and efficiently; (2) members of subunits are not able to decide for themselves how they should be differentiated and what integrative mechanisms are necessary, either because they cannot make decisions or lack the proper perspective; (3) managers want to retain sole authority for design decisions for political expedience, personal security, pleasure, and so forth; or (4) managers and design consultants, holding "Theory X" assumptions about people (McGregor, 1960), simply assume that organization design is not within the capability of non-managerial employees. It is questionable whether these explanations apply to many organizations, especially those employing professionals and operating in changing environments. More participative design approaches may be effective under many circumstances.

Purposefulness in Organizational Subunits

The design objective developed in this paper is based on a concept of organizations recently developed by Ackoff (Ackoff, 1971; Ackoff and Emery, 1972) and elaborated by McKelvey (1973). Organizations are defined as purposeful systems containing one or more conditionally autonomous purposeful subsystems. Purposefulness is defined as the ability to exercise will or conscious choice. This definition highlights three essential characteristics of organizations: (1) their intent, if not actual ability, to pursue specified objectives; (2) their right, if not actual ability, to constrain the autonomy of their subunits to varying degrees; and, (3) the capability, if not actual ability, of their subunits to act purposefully. These characteristics set organizations apart from other social systems which do not have the right or power to decide on overall objectives or to condition the autonomy of their various subunits, and they set organizations apart from individual human beings who do not have purposeful subsystems. Each employee and each formal or informal grouping in an organization is capable of acting as a purposeful subunit. But each individual or group able to act purposefully may choose not to act purposefully in certain circumstances or for some length of time. It is

also possible that the formal structure or higher-status members of an organization may condition the autonomy of the subunits to such an extent they can no longer act purposefully in legitimate ways.

Several trends in the literature point toward the natural occurrence of purposefulness in organizations. Studies have shown that organizations are able to act purposefully to change their overall organizational objectives (Blau, 1955; Sills, 1958; Hage and Aiken, 1970; Zald, 1970). Theorists have given attention to the specific processes by which organizations choose their goals (Simon, 1965; Thompson, 1967; Silverman, 1971; McKelvey, 1973). The view of individuals as purposeful has been strongly supported by humanistic psychologists such as Frankl (1966), Maslow (1966), and Buhler (1967) among others, and many observers have argued that organizations ought to change structural elements pressuring employees away from purposefulness toward passive, dependent, submissive, and immature behavior (Merton, 1940; Argyris, 1957; McMurry, 1958; McGregor, 1960; Crozier, 1964). The purposeful behavior of informal work groups in reaction to management controls has been known for years (Homans, 1950; Trist and Bamforth, 1951). Burns and Stalker (1961) reported examples of organic organizations where subunits closest to the task environment or organizational boundary were given considerable decision-making authority. Lawrence and Lorsch (1967a) showed that subunits facing more changing and uncertain environments had more autonomy to exercise choice. A recent study by Duncan (1972) demonstrated that organizational subunits were able to design their own internal structure so as to remain effective in different kinds of environments.

The foregoing definition of organizations offers a synthesis of the natural system and rational models of organization. The rational model focuses attention on how and why top managers should condition the autonomy of their subordinate groups and individuals so as to orient them toward the overall objectives of the organization. Since purposeful subunits can exercise their will, they are able to deviate from the overall objectives of the organization, so their autonomy does need to be conditioned to some extent to avoid anarchy and loss of organization effectiveness resulting from unrestrained autonomy (Thompson, 1967: 58). The natural system model recognizes the forces and energies in organizations that flow from the natural tendencies of individuals and groups to meet their needs for social relations, influence, and psychological growth by seeking autonomy to exercise their own purposefulness. In addition to being more motivated, purposeful subunits are important in organizational effectiveness when the organization faces frequently changing and uncertain task environments (Burns and Stalker, 1961; Likert, 1967; Bennis, 1974), since they can more quickly and accurately respond to environmental changes. Changes involving the subunits are not delayed or misinformed because of the filtering affecting information flows up and down the managerial hierarchy (Simpson, 1959; Maier *et al.*, 1961; Reed, 1962).

Given this synthesis, a possible design approach is to find ways of developing purposeful subunits as links between overall organizational purposefulness and the individual purposefulness of lower-status employees. Structures and procedures may be set up to encourage individual or group subunits to exercise their purposefulness within the rational system rather than in opposition to it. The idea is to create a climate where it is legitimate to identify both organizational and subunit objectives and to negotiate a contract specifying which objectives the subunit is committed to achieve. If one thinks of subunits as represented by the entire group rather than a designated superior, the linking function is similar to Likert's (1961) linking pin idea and the negotiation process is similar to management by objectives (Odiorne, 1965).

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To be effective as linking pins and negotiators, the several members of a subunit need to be able to exercise their will as a group, not as disconnected individuals. For each member to retain a feeling of his individual purposefulness, the group will needs to be exercised through a group decision-making process that does not depend on one formal or informal leader or a minority clique to make decisions for the group. Of the several kinds of decisions typically made in groups, only decision by consensus (Schein, 1969) offers all members opportunities to express their will and to influence the final decision.²

Decision by consensus requires that members be congruent—that is, either agree or have complementary differences—in those values and attitudes that affect the development of group decision-making norms (Watson, 1966: 97), otherwise the subunit will not be able to make decisions. This is not to say that the members must be alike on all dimensions, only those supporting decision making. Indeed, subunits are more likely to successfully respond and adapt if they contain the requisite variety of values, attitudes, and skills necessary for coping with unpredictable environmental changes (Ashby, 1968). More extensive discussions of the homogeneity-heterogeneity issue are given by Arrow (1951) and Black (1958).

One way of fostering group decision making is to encourage participative leadership by the formally appointed subunit manager (Tannenbaum *et al.*, 1961; McGregor, 1960, 1967). Another approach is to avoid a formally designated manager and make decision making a function shared equally by all members, as in autonomous work groups (Herbst, 1962; Bucklow, 1966; Davis, 1971). Under either approach group decision making is facilitated if organizational subunits are designed so that the subunit members are congruent in those values and attitudes supportive of group decision-making norms.

Participative Design

A participative way of implementing an organization design can improve the effectiveness of the design for two important reasons. First, the lower-status members directly involved with the several task environments have a more up-to-date and complete understanding of their task-related interactions with other members. Second, involving many members in the decision assures their future commitment and cooperation. One of the advantages of the participative approach to organization change is that employees are more likely to be satisfied with and to implement decisions they have helped to make (Leavitt, 1965: 1165; Kilmann, 1974).

Why are participative design approaches not more widely used? Their absence could be due to a lack of suitable procedures. Consider the specter of 100 employees trying to make a design decision in a short length of time. However, a suitable method, multivariate analysis, is now available.

Multivariate analyses, such as factor or cluster analysis, have now developed to where they can be straightforward, objective, and replicable by others, as long as the specific techniques used are reported. These methods reduce a large mass of data to a manageable size, thereby allowing many individuals to participate in selecting from design alternatives. Furthermore, with the aid of large computers, the data can be analyzed rapidly and without bias toward any vested interest or response set. One possible source of bias, the kinds of questionnaire items used to elicit responses, can be minimized by using only those items suggested by the participants involved.

Multivariate analysts have some control over the outcome, though this can be monitored by other analysts, and top managers may still

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Groups may decide by consensus to allow more expedient kinds of decisions under certain conditions when it would be awkward to take the time necessary for consensus-based decisions (Schein, 1969).

insist on making the final decision after viewing the results of the analysis. The point is not that participative structural intervention is guaranteed, but that it is now feasible.

Design Objective Applied and Tested

The design objective we propose encompasses the two objectives suggested by Thompson and Lawrence and Lorsch, but it is: (1) based on a synthesis of both rational and natural system models of organization; (2) based on more valid information; and (3) directed toward gaining more commitment from organizational members other than top managers. A design objective is only as good as the methods supporting its implementation, therefore the statement of the theoretical objective is accompanied by a consideration of implementation.

The Design Objective

The design objective is: form subunits by maximizing member homogeneity with regard to values and attitudes supporting group decision-making norms and minimize task-related interdependencies among subunits. Use a method of implementation that allows a wide variety of employees to determine the design configuration with respect to their own information base.

Through fortuitous circumstances, the authors had an opportunity to apply the proposed design objective in an organization depending on the results for its redesign. We also had an opportunity to test the multivariate analysis by comparing its design configuration with the actual configuration 20 months later. The comparison is a unique test because during the 20 months the members of the organization were free to, and actually encouraged to, evolve towards whatever configuration suited them. Most organizations probably could not take 20 months to allow their members to slowly evolve toward a configuration they prefer.

METHOD

Setting

The organization studied was the management school of a large university. It was chosen because its dean and faculty members wanted to change its structure, not because it was especially representative of all management schools; nevertheless, it was not unlike other management schools and departments the authors were familiar with, except that it was larger than most, having 115 faculty members.

Before the change, the school consisted of one department, which in turn was made up of nine subunits called areas, such as accounting and operations research. Each area had responsibility for hiring new faculty members within its competence; deciding what courses its members would teach; advising, teaching, and evaluating Ph.D. students; and stimulating, sharing, and promoting the research interests of its faculty members and Ph.D. students.

Many faculty members felt that over the years the areas had become unresponsive to new curriculum possibilities and research problems. In consultation with the faculty members, the dean decided that a matrix organization (Cleland and King, 1968; Delbecq *et al.*, 1969; Kingdon, 1973) might offer the desired flexibility to respond to new teaching and research interests.

The new structure would consist of as many as 17 curriculum committees forming one axis of the matrix. The committee chairmen would report to the department chairman. Each committee would be responsible for hiring new faculty members, taking care of Ph.D. students, and staffing courses offered within its competence. The other axis of the new grid structure would consist of school-wide teaching programs such as the MBA program and research-oriented

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subunits—to be called study centers—the directors of which would report to the dean

This study was limited to redesigning the research-oriented subunits, the study centers. The design objective described here was suggested to the dean when the authors perceived that the faculty members wanted: (1) to maximize the homogeneity of member research interests within study centers, thereby increasing mutual support and collaborative research projects; and (2) to carry out the redesign so as to assure member control over the form of the new structure. The dean accepted the idea and encouraged the faculty to participate.

Variables

In accordance with the design objective, the multivariate analysis was based on a questionnaire containing operational measures of values and attitudes fostering decision-making norms and task-related interdependencies. Instead of actual value and attitude measures, part of the questionnaire contained the names of the faculty members, and the respondents were asked to indicate who they felt could contribute to their own research activities over the next five years, using a seven-point scale ranging from "not at all" to "none I'd like more." The authors felt that in this case "liking" would indicate congruency in values and attitudes. The important task-related interdependencies were those related to faculty collaboration on research interests. The dean asked the faculty members to distribute memos defining new research interests as possible subjects for collaborative investigations. In addition to the new interests, the central research interests of the old areas were also included in the questionnaire, and respondents were asked to indicate which were their most important interests, using a seven-point scale ranging from "not at all" to "of prime interest." Some interests, for example, were human systems development, operations research, information systems, urban problems. Altogether there were 115 faculty names and 31 research interests included in the questionnaire.

Questionnaire Administration

The questionnaire was sent to 99 active faculty members—emeritus professors, those on leave, and part-time lecturers not doing research were omitted—and 74 usable questionnaires were returned, amounting to 78 percent of the population. To preserve anonymity, code names were used. The initial coding and decoding for final presentation of the results was carried out by one faculty member having a widely trusted role in the evaluation of teaching.

Multivariate Analysis

The method used for this study was factor analysis, because it pursues the design objective of forming homogeneous groupings while minimizing interdependence among groupings and because the authors were most familiar with this method. An iterative process for estimating communalities—starting with the highest correlation in row estimate—produced the initial eigenvectors by the principal factor method (Harman, 1967: chap. 8), and used Kaiser's Varimax formula for orthogonal rotation (Harman, 1967: chap. 14).

Because factor solutions are indeterminate (Harman, 1967), the number of factors to rotate is unknown. Since the number of factors determined the number of subunits and the assignment of faculty members to subunits, an arbitrary criterion such as amount of variance explained was unacceptable; instead, 13 different rotation solutions of from 5 to 17 factors were considered.

Evaluating Factor Solutions

Predicted subunit affiliation. An objective method for selecting the best solution was developed. A *potency value* was calculated for each factor of a given solution in the following way. For the faculty

members included in a factor, the average score and standard deviation on all research interest variables were calculated. The variable having the highest standard score, Z , multiplied by the number of faculty members included in the factor, was used as an indicator of the group's potency, that is, its strength of agreement and size to deal with a particular research interest. The potency values for all the factors in a given solution, for example, five factors in the five-factor solution, were averaged together to give a potency value for the solution. All solutions were evaluated this way. The authors used the one with the highest potency value as the best solution for organizational design.

With most factor analyses, the respondents are used as referees to group variables into factors. In this study the data matrix was transposed so that faculty members were grouped on factors by using the variables as referees. In factoring a transposed matrix, more variables than respondents are required; we had 146 variables and 74 respondents.

Each factor would consist of several members having high factor loadings with a correct sign and one or two members having high loadings with the opposite sign. The members with the correct sign would show high scores on the same research interest variables and low within-group variance. Members having the opposite sign were in some way being rejected by the members having the correct sign. Upon analysis, the opposite-sign members would not show high scores on the same research interest variables and would show high within-group variance. Because of the rejection, their names were not included when the results were presented to the faculty.

In most cases each member could be readily assigned to a particular factor because he or she had one dominant loading. For this study, each member was assigned to only one factor, though for about 10 percent of the members this assignment was arbitrary, since they had loadings of almost the same size on two or more factors. Although second-choice factor assignments could have been made by using the second highest loadings, this additional complexity was avoided. The objective was to get each member into at least one suitable study center.

Actual Subunit Affiliation. To evaluate our approach, we needed a means of matching an individual's location in the factor solution with his location in the organizational structure 20 months later. A difficulty arose because many faculty members were official members of two or more subunits, yet the factor solutions predicted only one affiliation, so the directors of the several study centers were asked to name the most active members—those who had a 60 percent probability of coming to a meeting, barring a schedule conflict. None of the members was found to be active in more than one study center.

Matching. The operational procedure for defining a "match" between predicted affiliation and actual affiliation was to determine whether members having common interests were identified by positive or negative loadings on each factor, and to decide which factor groups were similar in research interests to each of the actual study-center subunits. The number accepted as eligible loadings on each factor—starting with the highest—was the number equal to the number of active members in the comparable study center. Then, if an active member had a loading of the correct sign within this number, he was counted as matched.

RESULTS

From factor analysis 13 solutions emerged, ranging from 5 to 17 factors; 3 solutions, of 5, 8, and 11 factors, adequately represented all the others. To minimize information overload, while still giving the faculty members the broadest range of alternatives, only the 5- and

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11-factor solutions were presented to the faculty in a memo from the dean.

The faculty members were asked, at their convenience, to group themselves together and make a formal proposal for a subunit including its principal research interest and members. These subunit proposals and membership listings did not have to conform to, or even be influenced by, the published factor solutions. The factor solutions were offered merely as an aid to forming the subunits. The authors did not hear any evidence suggesting that the faculty members felt obligated to follow either of the published solutions.

It was possible, 20 months later, to compare the best initial factor solution with the voluntarily chosen design and to test the predictive validity of the multivariate analysis. A listing of subunits and their members published by the dean at the end of 20 months was taken as an indication of a structural design voluntarily chosen by the members. To test the analysis, two questions were asked: (1) Did the factor solution predict the correct number of subunits with the correct principal research interest? and (2) Did the list of names on each factor of the solution match the list of faculty members actually in each subunit?

For the test, average potency values were computed for the 5-, 8-, and 11-factor solutions. The 5-factor solution had an average value of 17.2; the 8-factor solution 21.4; and the 11-factor solution 17.8. The 8-factor solution was taken as the best solution because it had the highest value, so test comparisons were made between it and the voluntary design.

Table 1

Comparison of Factor and Voluntary Subunit Design

Voluntary Subunits	Factor Subunits	Potency Value*
Human Resources, Manpower, and Industrial Relations	A. Human Resources, Manpower, and Industrial Relations	33
Organization Studies	B. Human Systems Development	30
Operations Research	C. Operations Research	30
Finance and Business Economics	D. Business Economics I	22
Accounting-Information Systems	E. Educational Innovation	19
	F. Marketing	15
Finance and Business Economics	G. Business Economics II	12
Managerial Studies	H. Management Theory and Policy	10
Urban Resources		

*Value is the product of Z score times the number of people in the cluster.

Predictions of Subunits

Table 1 shows the comparison between the best factor solution and the voluntary design as it had evolved 20 months later. Of the seven voluntary subunits, five were clearly predicted by the factor solution: organization studies (since renamed "human systems development"), operations research, finance and business economics (split between two factors), human resources, and so forth and managerial studies. Business economics I was the dominant one. Business economics II emerged separately because of some feelings against the organization studies faculty members; but it overlapped business economics I in membership. With respect to accounting-information systems, the factor solution came closer than it appears. The mean score on the research interest variable, information systems, was actually higher than the score on the variable, educational innovation, but the variance was also greater because two of the central accounting faculty members did not return questionnaires. Thus, while

their missing responses did not add focus to the factor subunit, they did play a strong role in skewing the voluntary subunit toward accounting. The urban resources voluntary subunit was not predicted by the factor solution because it did not explain enough common variance to be included in the eight factors; however, all but two of its members had higher loadings on other factors. A few faculty mem-

Table 2

Matching of Active Members in Voluntary Subunits with Members in Factor Subunits															
Factor		Loading and Memberships													
A.	Human Resources, Manpower and Industrial Relations	80	63	59	58	52	49								
	Loading [•]	<i>A1</i>	<i>A2</i>	<i>A3</i>	<i>A4</i>	<i>A5</i>	<i>A6</i>								
	Member ^{••}														
B.	Human Systems Development	68	55	54	51	47	45	44	43	39	37				
	Loading	<i>B1</i>	<i>B2</i>	<i>B3</i>	<i>B4</i>	<i>B5</i>	<i>B6</i>	<i>G5</i>	<i>B9</i>	<i>B11</i>	<i>G2</i>				
	Member														
C.	Operations Research	78	63	60	55	50	48	46	44	42	31	27	24		
	Loading	<i>C1</i>	<i>C2</i>	<i>C4</i>	<i>C5</i>	<i>C6</i>	<i>C7</i>	<i>C8</i>	<i>C9</i>	<i>C10</i>	<i>B10</i>	<i>H4</i>	<i>C12</i>		
	Member														
D.	Business Economics I	61	56	55	48	43	43	42	40	34	30	29	26	24	22
	Loading	<i>D1</i>	<i>D2</i>	<i>D3</i>	<i>D4</i>	<i>B6</i>	<i>B7</i>	<i>D5</i>	<i>D6</i>	<i>A12</i>	<i>G4</i>	<i>H3</i>	<i>G11</i>	<i>A4</i>	<i>G13</i>
	Member														
E.	Educational Innovation	59	53	44	44										
	Loading	<i>E1</i>	<i>E3</i>	<i>E6</i>	<i>C4</i>										
	Member														
F.	Marketing	64	59	30	26										
	Loading	<i>F1</i>	<i>F2</i>	<i>E4</i>	<i>H2</i>										
	Member														
G.	Business Economics II	71	52	48	36	35	32	31	31	30	29	22	22		
	Loading	<i>G1</i>	<i>G4</i>	<i>G6</i>	<i>G9</i>	<i>H3</i>	<i>D1</i>	<i>G10</i>	<i>D5</i>	<i>G11</i>	<i>E7</i>	<i>C3</i>	<i>B13</i>		
	Member														
H.	Management Theory and Policy	53	45	43	39	36	35	35							
	Loading	<i>H1</i>	<i>H2</i>	<i>H3</i>	<i>D4</i>	<i>H5</i>	<i>H6</i>	<i>C11</i>							
	Member														

[•] Decimals have been deleted in all loading columns. Correct-sign loadings are all listed as positive; opposite-sign loadings have been deleted.

^{••} Members having code letters differing from that of the factor had a higher negative loading on another factor. Italics indicate a member, active in the voluntary subunit indicated by the letter, whose loading on the factor under which he is listed had the correct sign and was high enough to be included in the top group of loadings and thus counted as a match.

bers had attempted to form a voluntary marketing subunit, but they had not been recognized officially by the dean, because they were too few in number.

The factor solution came very close to predicting the seven official and one unofficial voluntary subunits. The failure to predict voluntary subunits perfectly can be ascribed to the influence of nonrespondents, the fact that the authors did not include second choices (second highest loadings) in assigning members to factors, and the strong feelings against one subunit shown by members of another.

Matching of Individual Affiliation

How well the factor solution predicted the voluntary choice of subunits by each faculty member is shown in Table 2. The six active members of the voluntary subunit, human resources, and so forth, all loaded highly on the factors, such as human resources, giving a 100 percent match rate. The factor, human systems development, predicted 90 percent of the active members of the subunit, organization studies. Only 1 member out of 10 was not matched. Of the 12 active members of the operations research subunit, only 2 were not predicted by the respective factor, resulting in an 83 percent match rate.

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There were 14 active members of the finance and business economics subunit. The factor, business economics I, matched 10 of them correctly; business economics II recorded 9 matches. In the analysis, 4 of the 14 members loaded highly on both factors; the high loading members of both factors scored highest on the same research interest variable, business economics; and many individuals loading high on business economics II had high negative loadings on the organization-studies factor and vice versa. The two business economics factors taken together predicted 100 percent of the active members of the subunit, finance and business economics.

The educational innovation factor predicted only 50 percent of the active members of the accounting and information systems subunit for the reasons already presented.

The marketing subunit did get a subunit proposal together and did show some activity, and later marketing was officially recognized as a study center. The marketing factor predicted the active members of this later subunit with a 100 percent match rate. The managerial studies subunit had only two of the seven top loadings matched, giving a 29 percent match rate. The urban studies subunit was not predicted by the eight-factor solution, hence the match rate here was 0 percent.

The factor solution predicted 47 of the 58 faculty members active in at least one voluntary subunit. The total match rate was thus 81 percent, a high percentage, considering only first choices were used in the test procedure. A more complex method allowing second choices and multiple memberships in the subunits would have resulted in a higher percentage.

DISCUSSION

The objective of this study was the design of purposeful subunits through the use of multivariate, participative approaches based on a synthesis of the rational and natural system models of organization and on objectives of subunit formation discussed by Thompson (1967) and Lawrence and Lorsch (1967a,b).

The objective: (1) increases the ability of an organization to respond to uncertain and changing environments by forming subunits better able to make changes in their objectives and structure; (2) makes it possible for managers to condition the autonomy of their subunits through negotiation about objectives rather than through the use of rules and regulations; (3) allows subunits to make decisions about forming their own internal and external integrative devices; and (4) increases the ability of an organization to provide an internal environment where the motivation of individuals and groups is improved by encouraging their purposefulness. It also creates a better structural foundation upon which to begin one or more programs of organization development, a possibility discussed by Kilmann and McKelvey (1975).

Because of a unique opportunity, the authors were able to make a longitudinal test of the predictive validity of multivariate analysis. The test showed that the analysis used, factor analysis, had good predictive ability when compared to a structural design voluntarily chosen by the participants after a lapse of 20 months.

Although a number of incipient theoretical trends and supportive research lend support to the objective of designing toward purposeful subunits, this study did not test whether the resulting design led to improved overall organizational effectiveness. At this time, testing the effectiveness of designs is difficult because there are no test sites nor good measures of purposefulness. Such a test would be possible only after managers became interested enough in the objective to try it without prior supportive evidence. There could be an important role for laboratory studies here.

While this study was done in a management school, it in fact dealt only with restructuring the research function of the organization. Many other kinds of organizations and industrial laboratories also have research functions, and indeed, nonuniversity research organizations are better suited for multivariate design because in such organizations the notion of organization-wide research coordination is much more legitimate. Most researchers in industrial laboratories, for example, have to pursue their research activities in close coordination with others, an ideal situation for the design objective proposed here. In contrast, in a university, each individual traditionally is free to pursue his interests, without coordination or collaboration with colleagues.

The proposed design objective only creates conditions that make purposeful behavior possible. Most subunits cannot be expected to actually behave purposefully without additional process consultation or open-systems planning of the kind described by Schein (1969), McWhinney (1972), or Krone (1972). The design objective creates what Herbst (1970: 48–49) called "operational boundaries", that is, a grouping of employees to give them a chance to develop into purposeful subunits. The subunit is then able to negotiate its specific purpose with higher management and outline its specific functions and distinctive competencies. At this point the subunit creates and maintains what Herbst (1970) called its functional boundaries.

Not all organizations have the technological flexibility to design toward purposefulness. For some, the technology and environment can be the primary determinant of subunit configuration; but, for many organizations, this may not be so. In a recent paper on technology and organization, Davis (1971) argued that modern, sophisticated, automated technologies are less deterministic than traditional technologies because they possess an unrecognized flexibility in relation to the social systems accompanying them. The design objective is thus more applicable in organizations with highly developed technologies.

The proposed design objective is especially suited for redesigns stimulated either by the recognition that the current structure is not in accord with the environment or by the recognition that the present interdependencies are not well managed by the present subunit boundaries. In either of these cases, the organization's members are the best sources of relevant information. In cases where a change in the purposes of the organization means that it plans to go in entirely new directions, where the present experiences of the members would be irrelevant, one might not want to use multivariate analysis for the initial redesigning, but it might be well to check the initial design one or two years later by using such methods.

It is recognized that many managers would not be willing to turn over decisions on organization design to others. Nevertheless, managers could still use multivariate analysis for diagnostic or monitoring purposes. When the environment of an organization is changing, such a monitoring procedure could give early clues that the activities and interactions of the employees are shifting away from the existing design toward patterns more compatible with the environment. Use of multivariate analysis for monitoring may not be successful, unless one is sure that employees are still willing to share valid information.

Throughout this paper the authors have tried to remain sensitive to the interplay of organizational design, design technology and the underlying patterns of belief that managers and nonmanagers might have about what organizations are and how they might best be operated. It seems to us that the design ideas presently available in the literature are not sufficiently grounded in the day-to-day reality experienced by organizational members, nor are they based on very comprehensive theories of organization.

Organization Design

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