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An Examination of the Reliability and Validity of the Aiken and Hage Scales of Centralization, Formalization and Task Routineness

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Abstract

This paper examines the reliability and several forms of the validity of six indices developed by Hall, Aiken and Hage to operationalize technology, centralization and formalization. The discussion of the definitions of these constructs and the empirical results lead to suggested revisions in the content of the indices of job codification and task routineness, to the elimination of the job specificity index, and to a relabeling of all indices except that of participation in decision making. Furthermore, it is suggested that none of these indices adequately operationalize the construct formalization and that the index of task routineness operationalizes a more limited part of the technology construct than some of these authors originally suggested.

Research on the properties of complex organizations has progressed to the point at which one can profitably conduct research on the constructs (Lynch, 1974) and indicators (Pennings, 1973; Downey, et al. 1975) used by pioneering studies. These constructs are not always defined with care and the measures used for their indicators are numberous to say the least (cf. Hall, 1972; Price, 1972). These are common problems during the development of any new approach, and the application of sociological survey methods to the study of complex organizations was no exception. We feel, however, that it is imperative for the accumulation of systematic knowledge about organizations that we periodically pause and take stock of the methodology of past studies which have been widely cited in the literature. Otherwise we run the risk of building new research on shakey foundations since researchers often rely on the criteria of precedent in selecting measures of constructs for their own use.

In this paper we focus on three constructs, formalization, centralization, and routineness of technology and their indicators developed by Aiken, Hage, and Hall. Our examination of the works of these individuals is prompted by the significant impact they had on subsequent research on these constructs. Their work has also been singled out since they developed items for survey analysis in which large numbers of informants report on organizational properties, an approach shown to be a more reliable procedure for this purpose than that relying on a few key informants (Seidler, 1974) as, for example, the Aston group has done (Pugh, et al. 1968). Our purpose will be to discuss the indicators they

propose for these constructs, to assess the reliability as well as the content, construct and predictive validity of their measures of indicators of centralization, formalization, and routineness of technology, and to critique the measurement indices used in several of these earlier studies. The ultimate aim is to contribute towards some clarity in the definition and operationalization of the constructs.

We begin with a critical discussion of the definitions of centralization, formalization, and task routineness in order to arrive at a clear understanding of the meanings these authors intended for these constructs. Then we shall proceed to examine the content validity of the items developed by these authors as measures of these constructs. Although we shall then use factor analysis to assess the construct validity of these indices, the definitions we will develop are an important set of complimentary criteria for determining whether a given item belongs in the index purporting to measure some construct.

The decision whether or not to use some set of items is also contingent on the reliability of the index. Consequently, we shall assess the reliability of these indices and discuss the possible impact on our estimates of reliability introduced by aggregation effects. At this time there is extensive theoretical disagreement concerning the interrelationships of centralization, formalization and routineness of technology. Consequently there are no clear cut theoretical criteria available for the assessment of predictive validity. As an alternative, after suggesting some modifications of the labels of these measures we

will assess their predictive validity through comparisons of observed associations with several competing theories.

We begin then with the definitions of these constructs. Nunnally states that "any measure can be said to have construct validity to the degree (that) results obtained from using this measure would have been the same if some other measure (or hypothetically all measures) in the domain had been employed," (1967: 86). Unfortunately, the domains of formalization and centralization were not always clearly defined in these early works. None of the early writings of Hage (1965), Hall (1963 and 1967), Hage and Aiken (1967) and Aiken and Hage (1968) define either construct. Instead, Hall discusses "bureacratization," which encompasses hierarchy of authority, the presence of rules, and procedural specifications (Hall, 1963:35; Hall, 1967:465). Similarly, Aiken and Hage provide us with no explicit definitions of formalization or centralization; instead, we are told only what their indicators are. "Centralization is measured by the proportion of occupations or jobs whose occupants participate in decision-making and the number of areas in which they participate." "Formalization, or standardization, is measured by the proportion of codified jobs and range of variation that is tolerated within the rules defining the jobs" (Hage, 1965; Aiken and Hage, 1966; Hage and Aiken, 1967a; Aiken and Hage, 1968).

In his later work, Hall, with Haas and Johnson, (1967) defines formalization as the degree to which rules define roles, authority relations, communications, norms and sanctions, and procedures. This is similar to his most recent definition which is the extent to which rules and proced-

ures are present in an organization. He also notes that these vary in terms of their stringency (1972: 173). Hall does not, however, provide a definition of centralization until 1972 (p. 228) where he defines it as the "power given to organizational subunits that could be retained by the central organization hierarchy." This emphasis on delegation probably reflects the influence of the Aston groups whose authors define centralization in a similar fashion (e.g., Pugh, 1968; Hickson, et al. 1969).

The later writings of Aiken and Hage begin to include definitions of both formalization and centralization. Generally, they define centralization as the extent to which "power is distributed among social positions," (1967b: 77; 1970: 38). Formalization is defined as "the use of rules in an organization," and is considered to have two separate dimensions: job codification, "the degree to which the job descriptions are specified," and rule observation, "the degree to which job occupants are supervised in conforming to the standards established in job codification" (Hage and Aiken, 1967b:79). However, in Hage and Aiken (1970:43) formalization refers to "the degree of codification of jobs," and the strictness with which rules are enforced. These definitions of formalization are similar but obviously not identical. For example, one might argue whether the degree of supervision to conform to standards is synonomous with the strictness of rule enforcement.

There are almost as many different conceptualizations of organizational technology in the literature as there are authors who have written on the subject. Hage and Aiken (1969) had no intention of exhausting all of the possible dimensions of this construct but instead decided to concentrate on the dimensions of perceived routineness, a dimension

Perrow described as referring to the kind of "search procedures" one uses depending on the degree to which he understands his task and the variability of the task (cf. Perrow, 1967:195-196, 204 and 1970:77-79). These two subdimensions are subsummable under what Hickson et al. 1969 have referred to as materials and knowledge technology. The former refers to characteristics of the object transformed while the latter refers to characteristics of knowledge used in diagnosing what is to be transformed and in determining which methods are to be used to carry out the transformation. While they give no definition nor description of routineness other than Perrow's, Hage and Aiken (1969:368) actually measure routineness by a series of items tapping only the variety in work.

While these authors are not always careful in providing formal definitions, they do exhibit consistency with respect to their indicators. Hall considered an organization more formalized to the extent to which it had more rules in five specific areas (Hall, Haas and Johnson, 1967: 906-907). This operationalization in similar fashion to that of the Aston groups (e.g., Pugh, et al. 1968) stresses the sheer number of rules. Hage and Aiken (1967a) attempted to use Hall's scale but the results of a principle components analysis influenced their conclusion that there were really two indicators, the codification of jobs and strictness with which rules are enforced. Later Aiken and Hage (1968) added a third indicator, the specificity of jobs, or the degree to which procedures defining jobs are spelled out. Aiken and Hage in each of their articles consistently state that centralization has two sets of

indicators, the concentration of decisions referring to resource distribution or policy formulation and the concentration of decisions referring to the performance of tasks. Power acts can occur in either of these distinct areas.

For routineness of technology Hage and Aiken concentrate only on the variety of work dimension as their indicator and they neglect the notion of analyzability of search procedures, although Perrow (1970) argues that while they are conceptually distinct they would be expected to be empirically related. Van de Ven, et al. grouped both kinds of items and report a reliability coefficient of .92 for the entire index of "perceived task uncertainty" (1976:334). Lynch, on the other hand found that items describing the repetitive nature of the task loaded on different factors than those describing the degree to which one understood the task in both her first and second order factor analysis (1974: 343 and 354-355). Although neither study presents correlations between the two kinds of items, we feel Lynch's results indicate that one should exercise caution in treating these as an empirically unidimensional construct. Consequently, we shall assume that Aiken and Hage's measures refer only to the task variability dimension and not to that of analyzability of search procedures.

The Content Validity of the Indices

Before proceeding with a mathematical assessment of reliability and validity of these indices, we feel it is most important to examine their content validity. Bohrnstedt (1970:91) defines this form of validity as "the degree that the score or scale being used represents the concept

about which generalizations are to be made." Furthermore he suggests that authors carefully search the literature to determine how various authors have used a concept before jumping to the conclusion that his measures are indicators of it. Because consensus on definitions and on the use of indices in the study of complex organizations occur with a frequency best described as "almost never," we feel it is imperative that we assess the degree to which the items in these scales are logically consistent with at least the definitions these authors have developed. The alternative, a strictly mathematical analysis of the clustering properties of these items, appears to us to be uninterpretable until some consensus has been achieved or criteria established with which one might judge why some measures should or should not be expected to cluster together. The extensive debate over the content of some of the Aston group's original factors is ample evidence that other authors feel as we do on this point (cf., Aldrich, 1972; Child, 1972; Donaldson, et al. 1975).

The measures to be discussed are listed in Figure 1. These are drawn from those reported by Hage and Aiken (1967b and 1969) and Aiken and Hage (1968). Most were originally designed by Hall (1963), although Aiken and Hage slightly altered the phrasing and added several new questions. In their adaptation and reordering of Hall's scales Hage and Aiken appear to have relied heavily on the outcomes of their principle components analysis and do not seem to have used content validity as a criteria for screening out items from their factors. An examination of the items used as indicators of the three constructs highlights the problem of relying on an empirical approach to index construction.

Aiken and Hage propose an organization's concentration of power, centralization, is indicated by the concentration of certain kinds of decision making acts. While one may question whether making a decision indicates power unless a check is built in as to whether the decision was carried out, at least the measures of these indicators should deal with some sort of decisions. An inspection of the questions in Figure 1 under Centralization indicates that they do refer to one or other type of decision making. The items under Participation in Decision Making (items CP1 through CP4) all appear to refer to decisions concerning the implementation of policy and the distribution of resources and so logically are good operationalizations of this indicator. Centralization also refers to the concentration of work-related decisions, presumably in the hands of supervisors. Unfortunately, none of the items in the Hierarchy of Authority scale (items CH1 through CH5) refer specifically to the task. One might claim, however, that most of a person's activities in an organization revolve around his job or task and so when he refers decisions upward, these are usually task related decisions. While the inclusion of specific references to the job would improve this index, it does appear that all items in it refer to the degree to which one must allow someone higher in the hierarchy to make decisions.

Formalization is defined as the degree to which jobs are codified (and later "specified," Aiken and Hage, 1968) and the strictness with which these rules are observed. The index of job codification has major problems of content validity, if these are the indicators. Question FJC2 in Figure 1 does not refer explicitly to the respondent's job or to rules about it. Instead it appears to refer to who can and cannot

make decisions. We would have included it in the hierarchy index except that it says nothing about the direction in which the decision is to be referred. We feel it should be dropped from the index of job codification. Questions FJC1, FJC3 and FJC4 again do not refer to rules or standards for performing one's job and again should be dropped from the index on the grounds of ambiguity. Item FJC5, if scored in reverse, may indicate the degree of job codification. It is the only item apparently tapping the content of this subconstruct of formalization as defined. The index could easily be improved of course by the simple addition of references to the task and to rules and procedures describing what one is to do in it.

In their 1968 article Aiken and Hage added the notion of job specificity as an indicator of formalization. However, the items used to measure this construct have definite problems of content validity. Questions FJS1 and FJS5 seem to be better measures of job codification and FJS3 and FJS6 appear to refer more to the loci of decision making; although they do suggest that some positions specialize in decision making. Further, the logical relationship between keeping a written record of job performance (FJS4) and job specificity assumes that it may be easier to keep such records for jobs which are relatively specific and that the written records themselves reflect specificity. This leaves FJS2 as the only item which appears to be an unambiguous indicator of job specificity.

The third indicator of formalization, the degree of rule observation, is measured with two questions tapping whether persons are watched to see that they obey rules. One does not know directly from these

questions whether people are actually sanctioned if they disobey rules, but the questions appear to measure well whether or not their behavior vis-a-vis rules are observed. We note that we have no indicator here of the "stringency" of rules which is part of Hall's (1972) definition of formalization, unless the rule observation index is considered a substitute. Furthermore, the existence of rules in the five areas specified by Hall, Haas and Johnson (1967:465) has not been measured directly.

Perrow (1967) claimed that the overall routineness of work subsumed some, but not all, of the many dimensions of technology. Inspection of the components of this index in Figure 1 indicates that all questions actually refer to the variability of the work (these questions were developed by Hall, 1963). Consequently, none of the questions in this index have particularly questionable content validity if we limit our attention to the notion of task variability. They obviously do not refer to the analyzability dimension of Perrow's concept of routineness as discussed above.

The Sample and Methods of Analysis

We have placed question marks in Figure 1 next to those items we feel have questionable content validity. The next step is to empirically test our reservations about these items. If they indeed have ambiguous meanings they should not cluster with those which appear to be clearer or more valid indicators of our constructs. This will be done by factor analyzing these items using three waves of data collected by Hage and Aiken as well as data from a study on a different set of

organizations. We feel that the use of multiples waves and samples provides a very sound test of the empirical validity of these measures.

We are fortunate to have been generously provided with the original data from the Aiken and Hage study. These data were collected in sixteen social service organizations which are described in Aiken and Hage (1967). Their surveys were conducted in 1964, 1967 and 1970. The number of respondents in each wave was 317, 510 and 481 respectively. The second set of data was collected by Whetten in 1973 from 69 manpower organizations (see Whetten, 1974); the number of respondents in this study was 306. While the organizations in the two samples are not identical they have many similarities. Most were public and all were non-profit; they were all small (none had more than 1,000 persons and most were less than 200) relative to the large corporations studied by the Aston group; they were all people changing or people processing (Hasenfeld, 1975); and their technology was service rather than product based. These characteristics of the sample should indicate to the reader the extent to which our findings are generalizable. The set of survey items we intend to examine were included in most of the waves and in both samples, as shown in Figure 1. There were a few variations in wording but overall these were very slight.

To assess their construct validity and reliability we will follow the procedures outlined by Heise and Bohrnstedt (1970). We will then construct measures of indicators both as suggested by the factor loadings of the items and by the definitions of these constructs and indicators. Once the scales have been established, their reliability and discriminant and convergent validity will be assessed. The associa-

tions of the resultant scales will then be compared with those predicted for them by various theories.

The diverse kinds of analysis performed on this data raise several complicated issues of the proper unit of analysis and aggregation procedures to be used which must be addressed before the analysis is described. Both data sets contain responses from individuals to questions or statements about their perceptions of characteristics of organizations. But, these individuals are members of social systems, and the unit of analysis is this system whether the issue is the discovery of underlying patterns in members perceptions or the reliability or validity of these indices. The number of cases, especially in Aiken and Hage's data is not sufficiently large for some multivariate analysis techniques, viz, factor analysis, to be performed. To do the analysis, then, we must assume that the constructs discovered using unaggregated individual responses are the same as those which would have been discovered had organizational scores (i.e., aggregated responses) been entered into the analysis.

The use of individual scores in the factor analysis is not without its advantages. First, for organizational properties which must be measured through aggregating individual perceptual responses, it is of some interest to know whether or not stable constructs can be found irrespective of the particular organizational context. For example, irrespective of whether or not one's organization has high degrees of formalization, does an individual answer all questions referring to this dimension consistently? If so, we may presume there is some commonality of meaning perceived in these questions by any set of organization members answering them from the types of organizations we have

in our sample. If there is, and if a stable factor structure is seen to emerge as a result of this, then one may assume that if stable structures were found using organizational scores they are not merely artifacts of aggregation procedures. The same argument may be made for the assessment of reliability of these indices. While reliabilities of aggregated scores should be somewhat higher since measuring errors and capricious responses would be averaged out, reliabilities of indices at the individual levels should be at least acceptable or the aggregation may be questioned. The argument does not extend to the issue of convergent or discriminant validity since theories have not been developed stating that individuals who perceive their organizations as characterized by certain degrees of any of these variables (formalization, centralization, or task routineness) should also perceive their organization as characterized by a particular degree of any of the rest of them.

In view of these considerations we have performed the factor analysis on the individual level only, although we would have wished to perform it also on the organizational level except that the small number of cases prevents this. The assessment of reliability is carried out on both levels of analysis. The examination of convergent and discriminant validity is done only on the organizational level since there are theories here predicting relationships among the variables.

The aggregation technique used is that of taking a simple mean of all respondents to create organizational scores. This issue is most complex and there are widely divergent practices used by different authors (contrast the simple mean scheme of Hall, et al. 1967; Aldrich, 1974; or Van de Ven, et al. 1976 with that of Hage and Aiken, 1967

utilizing means of "social positions" described as intersections of levels and specialties or with Hage and Aiken, 1969, where social positions are intersections of levels and departments). For now we shall use the simple mean of all responses to represent organizational scores since most authors employing survey methodology also use this procedure. We note that our failure to replicate Aiken and Hage's aggregation procedure will lead to different coefficients from those previously published by these authors.

The factor analysis will be performed separately on the data from the manpower organizations and on each wave of the Aiken and Hage data rather than on all data grouped together. We feel this provides a much better test of the clustering of these items since we will be able to examine whether the same clusters hold up across waves and samples. Questions which have different meaning depending on the time at which they were asked or depending on the sample in which they were asked should not load well on the same factors or should exhibit large shifts in load and can therefore be excluded. Furthermore, the factor analysis will not include the items referring to the centralization of policy or resource distribution decisions. We have omitted these items from the analysis since they were not part of the original set of items designed by Hall to measure bureaucracy and adapted by Aiken and Hage to measure centralization, since their response sets were composed of frequencies (always to never) and not true false continua as in the other items, since their response sets had a different number of items (five for the participation items as opposed to four for all others), and since the results of preliminary factor analyses (not shown here) indicated that

all participation items loaded on the same factor and did not affect the loads of any other items.

There are several different factoring techniques and the choice depends on certain assumptions about data and the purpose for which factoring techniques are utilized. We will use a factoring technique with iterations to estimate common variance and a varimax rotation. Oblique rotations were not used since factor loads are difficult to interpret. The advantages of oblique rotations is that they indicate even more clearly than varimax rotations the clustering of items. Preliminary analysis (not shown here) however, did not indicate any improvements with this data and consequently we shall use only varimax rotations.

Our objective is to determine which items should and should not be included with others as measures of these indices. Consequently criteria were developed concerning the size of load and stability of loads of items or factors. These rules are somewhat arbitrary and are used for lack of well developed alternative criteria. If an item load at .4 on only one factor after varimax rotation (Lynch, 1974, uses this as her exclusion level), it may be included in the index pending several other considerations. If an item loads on two factors, the item will not be included on either factor unless the percent of total common variance explained by one load after varimax rotation is two times that explained by all other loads. Hence, we not only consider the relative size of different loads but also the proportion of variance explained by a given factor. Loads of .5 on two factors indicate a bad split only if the proportion of variance explained by these factors is similar.

Finally, we limited the number of factors extracted to those with eigen values greater than .8. Although most authors disregard factors with eigen values less than 1, we have lowered this criterion to make it clear to the reader exactly to what extent some clearly interpretable factors fall short of this criteria.

Results

Table 1 presents the results of our factor analysis of 22 items which supposedly represent indicators of formalization (job specificity, job codification and rule observation), centralization (hierarchy of authority) and task routineness. These items were common to all waves and both samples with the exception that the task routineness and job specificity items were not used in the 1964 waves. Table 1 shows a fairly consistent set of factors across the different samples and waves of data. The heirarchy of authority items load consistently and very strongly on the same factor and this is always the first factor extracted. The only exception in the pattern is the weak load of item CH2 in 1970. Job codification items FJC3, FJC4 and FJC5 also consistently load on a factor, as do the rule observation items FR01 and FR02. These results suggest that the factor structure of these items is stable across samples and waves.

The task routineness factor is somewhat less stable. While all four items loaded on the same factor in the 1967 wave, item TTR1 drops off in 1970 and in the manpower organizations sample it loads with the rule observation items. These findings suggest TTR1 should not be included in this index. Furthermore, the eigen value of this factor

drops below the commonly acceptable level of 1 in the manpower data. We believe this is because this data was collected on a more technologically homogeneous sample of organizations than the Aiken and Hage data which contained five different types of social service organizations (mental hospitals, a department of special education, case work agencies, family service organizations, and sheltered workshops). Consequently, in the manpower data the variance on the technology items was probably constrained and their intercorrelations lower. This would have resulted in the generally smaller loads they have on their factor than in the Aiken and Hage data and in the smaller eigen value and percent of common variance explained. Because of the peculiar characteristics of the manpower organization sample, we do not feel the poor showing of the task routineness index there justifies a conclusion that it is an unimportant set of measures. It is simply less useful as would be any measure of technology in a technologically homogeneous sample of organizations.

Items FJC1 and FJC2 are not included in the job codification factor in any of the four data sets. In the 1964 wave they combined to form a separate factor and in the manpower sample they loaded with the centralization items. The relationship with centralization is also suggested in the 1967 wave but since it is not borne out in all the waves these two items will not be included in any of the factors. Surprisingly items FJC3 and FJC4 did load together with FJC5 even though our consideration of their content validity led us to expect otherwise. We will include them pending considerations of the reliability of this index.

A job specificity factor did not emerge in any of the four analyses (even when we extracted up to six factors). In fact only one of these

items loaded on any of the factors. In the manpower sample FJS5 loaded on the job codification factor and, although the wording of this question is very similar to others in this index, because this relationship did not emerge in any of the other analyses we will not add it to this index.[1]

(Table 1 about here)

Our concerns regarding the content validity of several of these 22 survey items are borne out by these results. The job specificity items are clearly not measuring that or any other unique construct and two of the job codification items (FJC1 and FJC2) showed more relationship with the centralization questions than with job codification.

While our factor analyses has produced four rather stable factors it is possible that these items clustered because of their very low correlations with other items in the survey and that they do not have sufficiently high correlations with one another to justify treating them as an index. As a check for this possibility the reliability of these indices was calculated following a domain sampling model (Nunnally: 1967:175). Since we do not have parallel forms of these indices alternative techniques for assessing reliability, such as that of split halves or test retests, would have been inappropriate (cf. Bohrnstedt, 1970: 85-89). The appropriate statistic for the domain model is Chronbach's alpha, which is defined as the expected correlation of one test with another of the same length when the two tests purport to measure the same thing (Nunnally, 1967: 196-197). The coefficient alpha gives a good estimation as to whether one has adequately sampled items from the domain and of the amount of error due to variation in performance

(e.g., guessing or random response). The difficulty with the use of alpha is that it is influenced not only by the amount of error in a test but also by the number of items. As this number increases alpha tends to be larger (Bohrnsted, 1970). This works to our disadvantage and therefore provides a more stringent test of the reliabilities of these indices since some items have been dropped because of the results of the factor analysis and some of the coefficients are consequently reduced. The small number of items also precludes the use of item to total techniques for the assessment of reliabilities.

We have computed alphas both for the scores of all individuals and for the scores of organizations, as shown in Table 2. This was done because the data on these constructs was gathered from individuals but is typically analyzed only in an aggregated form. Hammond (1973) and Hannon and Burstein (1974) have noted that sociologists frequently must work with aggregated data because the theories they are testing are formulated at this level of analysis. This is clearly the case with the constructs of centralization, formalization, and task routineness (cf. Child, 1972; Hage, 1974). Consequently both the reliability of the survey items as they were administered and the reliability of the aggregated indices are important considerations in our assessment of the quality of these measures.

(Table 2 about here)

Part A of Table 2 indicates that at the individual level of analysis the reliabilities are in ranges Heise (1970) would describe as mediocre (α = .50 to .64) to good (α = .65 to .84).[2] There is one

exception, the task routineness index in the manpower sample. The latter may be an additional indicator of the problems of detecting variation in technology in a sample of technologically homogeneous organizations.

In general we would have wanted these reliabilities to be somewhat higher and suspect that part of the reason for the mediocre levels may be the ambiguity of the phrasing we pointed out in the previous section on content validity. There is an additional problem with these questions that should be noted, namely, their inconsistent use of referents. These include: "I", "we", "a person", "people" in general, "the employees", "most people", "everyone", and "the organization." In addition, seven of the items do not specify a referent. Because of these inconsistencies the questions could have been interpreted to refer to a single person, a work group, a department, or the entire organization. It is impossible to determine how much of the unreliability of these scales is the result of the ambiguity of the questions, however, it would appear substantive enough to require referent modifications in the instrument if it is to be used in future research.

Part B of Table 2 presents the reliability scores for the scales at the organizational level of analysis.[3] In most cases there are noticeable improvements. The index of job codification has lower reliabilities than most of the other indices and we feel this is even more evidence for revisions in it so that its items tap the extent to which tasks must be carried out in accord with rules and procedures. As further confirmation of the problems with this index we note that Bacharach and Aiken (1976:691) who used items FJC2, FJC3, FJC4, and

FJC5 report a reliability of .66 in a study of Belgian city governments. Again this index had the poorest reliability of the ones they used.

The other very noticeable differences between the parts of this table are the relatively smaller improvements in reliabilities in the manpower agency data compared with the Aiken and Hage data when one moves from the individual to the organizational level of analysis. We feel these differences are probably effects of aggregation. Hannon (1971) and others have demonstrated that correlations between variables are generally increased by the process of aggregation. This is because aggregating scores diminishes the impact of error on the correlation coefficient. Reliabilities are improved in a similar fashion. The formula for Chronbach's alpha indicates that reliability will increase as scale variance becomes greater relative to the sum of the item variance.[4] When aggregation procedures involve the repsentation of the scores of individuals of some unit by a measure of central tendency, then the sum of the item variance declines from unaggregated to aggregated data more quickly than the variance of the total scale since item variance is more susceptible to capricious and extreme responses. As the sum of the item variance decreases relative to the total variance the reliability coefficient increases. The increase is exacerbated the greater the number of individual scores relative to the number of aggregate scores. Consequently, in the manpower data where the average number of respondents per unit score was 4.4 the improvement in reliability from the individual to the organizational level should be far less than that in the Aiken and Hage data where the averages were 20, 32 and 30 in 1964, 1967 and 1970 respectively. A comparison of the predicted rel-

ative size of improvements in Table 2 indicates only two exceptions, the hierarchy index in 1964 and the job codification index in 1969 decline slightly in reliability. Other than these the aggregation effects are much stronger in the Aiken and Hage data than in the manpower data.

The increase in reliability through aggregation is not necessarily a problem. If one assumes that capricious or extreme responses do not represent some organizational characteristic, then aggregation effects on reliabilities are of some advantage. Hence, the more individuals one selects as informants for each case, the more reliable will be his scores (see Seidler, 1974, for another example of this). This is especially true when members of organizations are used as informants (reporting widely observable objective organizational properties) rather than respondents (reporting subjective feelings or perceptions related to their unique personal positions in the organization (Seidler, 1974). When data has been collected from informants the increase in the reliability of an index using aggregated data is legitimate because the average of the reports from multiple observers is likely to more closely approximate the true score than the report from a single informant. This point makes the ambiguity of the referents in the Hage and Aiken scales a particularly salient criticism because it is difficult to determine whether the organization's members were treated as respondents or informants. Consequently we can not state conclusively whether the differences between the increase in the reliabilities at the organizational level should be treated as a useful reduction of individual error variation, or the unfortunate loss of diversity of individual opinion.

Convergent, Discriminant and Predictive Validity

Our discussion of the content validity of these indices as well as the results of the factor analysis and assessment of reliability have shown both indicators of centralization (participation and hierarchy), the indicator of technology (routineness), and one indicator of formalization (rule observation) have stable factor structures across waves and samples and good (α = .65 - .84) to excellent (α > .84) reliabilities at the organizational level of analysis. We suggest on the grounds of its content validity as well as the results of the factor analysis that the job specificity index be completely revised and we will not use this index in any of the subsequent analysis. The other indicator of formalization, job codification, has serious problems of content validity and lower reliabilities than the other indices. We feel some of its items should be rephrased. The next step in the evaluation of these indices involves examination of their empirical associations with one another to determine whether they are associated in ways which various theories would predict they should be.

The first set of criteria with which to judge the associations are those of convergent and discriminant validity. Campbell and Fisk (1959) suggest one assess these kinds of validity through the presentation of a multitrait-multimethod matrix. We cannot address the multimethod issue since all measures were taken through survey analysis. Convergent validity is indicated if measures supposedly of the same construct have higher intercorrelations than they have with indicators of different constructs while discriminant validity is indicated if measures supposedly of different constructs are not as highly intercorrelated as they are with indicators of the same constructs (Campbell

and Fisk, 1959). We have three general constructs, centralization, formalization, and routineness of technology with two indicators of the first and second and one for the third. Table 3 presents the intercorrelations of these scales on the organizational level of analysis.

(Table 3 about here)

There are some notable differences between the expected and observed correlations between measures of our constructs. Each box of this table contains four coefficients representing the relationship in our four samples. The participation index should correlate more with the hierarchy scale (the other indicator of centralization) than with all others. Instead the coefficients indicate consistently larger relationships with the task routineness and rule observation scales. Similarly, the correlations between rule observation and job codification, both of which are purported to be indicators of formalization, are on the average lower than those between rule observation and participation or hierarchy and between job codification and hierarchy. The conclusion appears inescapable that these findings do not support the convergent or discriminant validity of any of these scales as indicators of similar constructs. Instead we feel some modification of the labels of these scales is in order as well as of their linkages with the construct they were purported to measure.

All items in the hierarchy index (CH1, CH2, CH3, CH4 and CH5) refer to the degree to which one must refer decisions concerning his task to someone higher up for resolution. We feel it could be relabeled as the index of centralization of task decisions. In any case it is clearly a type of centralization of decisions regarding tasks while the partici-

pation index refers to large scale decisions such as those involving the distribution of critical resources (promoting and hiring professional personnel) or the determination of large scale policy (policy and new programs). We feel our results support the contention that there are two constructs of centralization as Hage and Aiken (1967) and the Aston group has previously recognized.[5] One could probably specify additional subconstructs under the broad rubric of centralization depending on the number of different decision categories which could be developed. While one may argue that policies of centralization should be uniform across types of decisions, and while three of our four associations between participation and hierarchy (centralization of task decisions) in Table 3 indicate that this is often the case, it is conceivable that policy makers may design systems with varying degrees of centralization across decision categories. This may explain the variation we observe in the size of these associations. When one considers the generally excellent reliabilities of both indices it would be difficult to raise the alternative possibility, viz., that the fluctuations are due to error.

The indices we feel most in need of both relabeling and reassessment of the construct they indicate are those of job codification and rule observation. In the former, only one item (FJC5) actually refers to rules dealing with the task. Furthermore, the other two items (FJC3 and FJC4) actually refer to the absence of rules, not their presence. While one might conservatively title this index the lack of rules, we feel the term autonomy (Bacharach and Aiken, 1976:631)

better captures its meaning. We are at a loss, however, as to what construct it refers since one can be autonomous in many ways. The questions (except perhaps FJ05) do not seem to tap the Aston group's definition of formalization: "the extent to which rules, procedures, instructions and communications are written," (Pugh, et al. 1968:75), Blau and Schoenherr's similar definition: "the extent of written regulations," (1971:58 and 104), or that cited earlier developed by Hall, et al. (1967): "the degree to which rules define roles, authority relations, communications, norms and sanctions, and procedures." Whether one wishes to develop questions which assess the sheer number of written rules or the proportion of activities specified by them (see Dewar, 1976, for further elaboration of this distinction), we suggest the index would be improved by explicit references to the task and to rules and procedures defining it. Since the index has no clear referent it is difficult to state a priori that it is an indicator of formalization and that as such it should be strongly associated with rule observation.

Both items in the rule observation scale (FR01 and FR02) do refer to conformity with regulations but the activity focused on is that of checking for deviations and not the extent to which rules are observed or even Aiken, Hage and Hall's dimension of the stringency of enforcement. People may be watched to see that they observe rules and regulations but this is no guarantee that they actually will do so or that the rules are even enforced. The more appropriate scale name would seem to be "Surveillance." Furthermore, we feel that the degree of surveillance may actually indicate part of the process of control, or

the maintenance of structural arrangements, in this case the rules (see Newman, 1975) and not necessarily formalization unless one adopts Child's (1972) point of view that formalization is a stategy of control. Bacharach and Aiken (1976:632) present an index for actually tapping the degree to which respondents feel they must observe rules rather than the extent to which they themselves are observed.

Finally, task routineness should be relabeled as the index of task variability since none of its items refer to the notion of analyzability of search procedures, the second component of routineness developed by Perrow (1970). Since there are no other indicators of technology, we cannot assess the convergent and discriminant validity of this index.

On the basis of our discussion of the content, convergent and discriminant validity of these indices, it appears we have scales tapping two distinct subconstructs of centralization (the participation index and the hierarchy or centralization of task decisions index), one scale measuring technology, task routineness (task variability), and one scale tapping formalization or control depending on where one feels comfortable placing the index of rule observation, i.e., surveillance. We feel the index of job codification (lack of autonomy) taps no construct as yet well recognized in the literature. What remains at this point is to assess the predictive validity of these scales, in short, do they behave in their associations with one another in ways predicted by theories of organizations?

Because of the large number of theories specifying the interrelationships of these variables, it is difficult to state unambiguously just what their associations should be. The underdeveloped state

of organizational theory necessitates a strategy of examination of the associations reported in Table 3 in the light of predictions various authors would make of them.

Perrow (1970) suggested that routineness of technology should be associated with the presence of bureaucratic structure and control, viz., high levels of centralization, formalization, and close supervision through monitoring subordinate's activities and correcting departures from pre-established standards. Hickson, et al. (1969) have also suggested that the effects of work line technology would be strongest on the structure and control of the work units and the results of Lynch (1974) and Van de Ven, et al. (1976) would appear to confirm this. Consequently, one would predict that the routineness index should be associated more with hierarchy (centralization of task decisions), rule observation (surveillance), and perhaps with job codification (lack of autonomy) than it would be with participation in large scale decision making (the participation index) since this last index should be less influenced than the others by what occurs at the work line.

Even if we disregard the results of the manpower agency data in which the variance on the task routineness index may be constrained, the results in Table 3 are exactly opposite to what we would have anticipated. Associations with the degree of participation are generally large, all significant, and in the correct direction from this theoretical perspective while those with the other three variables are with one exception, smaller, and with two exceptions, insignificant. We feel the real problem may be with the routineness index insofar as

it taps only the variability dimension of Perrow's construct and not that of analyzability or intelligibility. Because of this we cannot rule out the possibility that it is the lack of understanding of the task more than its simple variability which precludes rigid structure and control as a viable design. We also note that our units of analysis here are whole organizations and not technologically homogeneous work units. It is possible that this scale tapping only task variability may have more predictive validity in the latter setting.

There are two well known alternative theories concerning the relationship between centralization and formalization, Hage's (1965) and Child's (1972) as well as an earlier version in Blau and Schoenherr (1971). Hage (1965) would predict a positive association. The others would predict a negative one since centralization and formalization are assumed to be alternative strategies of control, i.e., alternative methods for minimizing variation in subordinate's behavior (Child, 1972).

The results in Table 3 support Hage's axiomatic theory better than the others, although the associations exhibit considerable fluctuation. If participation in large scale decisions increases, job codification (lack of autonomy), rule observation (surveillance) and hierarchy (centralization of task decisions) all decrease. These associations, however, are not consistently large. In contrast, hierarchy, rule observation and job codification are all significantly and positively associated except in the first wave of the Aiken-Hage data. It would appear that permission for role occupants to make their own task decisions coupled with a lack of surveillance may be causing them to

report generally autonomous conditions in their work, a finding quite consistent with the perceptions of working conditions reported by executives in Child (1973). Of course one might argue that none of these indices tap formalization and given our discussion above this possibility cannot be ruled out. Consequently, it would be difficult to refute Child's or Blau and Schoenherr's hypotheses of a negative link between centralization and formalization on the basis of these results.

The third alternative theoretical prediction is that organizations develop styles of structure and control depending on the conditions with which they have to cope in their environment or technology (Burns and Stalker, 1961). If we presume the rule observation scale (surveillance) actually indicates part of the process of control, then the consistency in the correlations of these three indices may actually indicate that organizations adopt organic or mechanistic styles of structure and control as would be predicted by Burns and Stalker (1961). In order to use this data as supporting evidence for the existence of such styles, however, three points should be kept in mind. Participation in large scale decisions does not appear to be closely associated with these styles; routineness of tasks (the variability dimension only) does not predict the occurrence of one or other style; and job codification (lack of autonomy) may indicate the simple inverse of freedom from close surveillance and freedom to make decisions about one's task. While there is some evidence then for the existence of organic or mechanistic styles of structure and control, it is not overwhelming.

Summary and Conclusion

In this paper we have attempted to add some clarity to the organizational structure literature by evaluating how the constructs of centralization, formalization and task routineness have been defined and operationalized by authors of some of the early empirical studies in this field. We have shown that one of the aspects of formalization, job specificity, does not emerge as a distinct dimension in our factor analyses. We did find four fairly stable factors in this battery of survey items, however, we have noted the ambiguity in the wording of the questions and have argued that their reliability and validity would be increased if these problems could be reduced. We have also noted that in terms of their validity the items used as measures of formalization and routineness of technology are tapping only marginally the domains of these constructs.

These problems are characteristic of research studies which develop a set of items, administer them, factor analyze the results and then label the factors which emerge. The name attached to a factor may be the best possible label but that does not mean that the scale is the best possible measure of the construct which has been used to label it. This is a fairly obvious but important point because of the tendency of many researchers to perpetuate the use of these measures simply because they have the appropriate label. From this perspective we are quite sure that these scales are not the best possible measures of two of the three constructs under consideration. We have suggested that the index of task routineness be amplified to contain items referring to the intelligibility or analyzability dimension originally suggested by Perrow (1967). Indices developed by Lynch (1974) and Van de Ven, et

al. 1976) should be preferred to the task routineness scale assessed here unless one wishes to tap only the dimension of task variability. It is the construct of formalization, however, which needs the most attention as far as measurement development is concerned. The rule observation index (surveillance) assessed here appears to reliably measure the surveillance aspect of control. Since there is as yet no agreement as to whether formalization and control are distinct constructs, we feel the surveillance index should not be used but instead that measures of formalization should be developed which focus more directly on the issue of rules. If one prefers to use a survey approach, then it should not be difficult to develop questions which ask informants either how many written rules there are, if one prefers a definition similar to that of Pugh, et al. (1968), or what proportion of the informant's activities are specified by rules, if one prefers definitions similar to that of Price (1972) or of Hall, et al. (1967).

Footnotes

[1] It should be noted that each of the four surveys had some additional items in this battery of questions besides the 22 items we have focused on. Because it is possible that adding these idiosyncratic items might have changed the pattern of responses across the 22 items in each survey, we factor analyzed each sample with all its items and compared the results to those in Table 1. These results were highly similar and for the sake of brevity they are not reported here but are available upon request.

[2] Index scores were computed from raw scores on the items, not from item scores transformed through factor weights. We have not used the factor loads because it is an uncommon procedure and because we wished our readers to know what the reliabilities and intercorrelations of these indices were without the use of weighted scores. Weighting would have improved both the reliabilities and correlations, although Featherman (1972) claims such improvements are usually quite small.

[3] The reliabilities of the task routineness scale if item TTR1 is included in the Aiken and Hage data are .87 and .90. Ordinarily one would expect substantial improvements in reliability if an item is added because of the sensitivity of the coefficient to the number of items in the scale. Since there was so little improvement we conclude the contribution of item TTR1 is primarily one of error and consequently have omitted it from further calculations involving this index.

[4] $\alpha = \frac{n}{n-1}\left(1 - \frac{\Sigma \sigma^2_{y_i}}{\sigma^2_x}\right)$ where n is the number of scale items, y_i represents the items and x represents the scale.

[5] Pugh, et al. (1968) labeled the one referring to large scale decisions, centralization, and the other referring to task decisions, line control of work flow.

Figure 1. Reported Indices of Centralization and Formalization from Hage and Aiken, 1967, 1969 and Aiken and Hage 1968 By Sample and By Wave within Aiken and Hage Sample

Manpower Organization Data	Aiken & Hage 1964	1967	Data 1970	
				1. Centralization
				a) Participation in Decision Making
*	*	*	*	CP1 How frequently do you usually participate in the decision on the adoption of new programs?
*	*	*	*	CP2 How frequently do you usually participate in decisions on the adoption of new policies?
*	*	*	*	CP3 How frequently do you usually participate in the decision to hire new staff?
*	*	*	*	CP4 How frequently do you usually participate in the decisions on the promotions of any of the professional staff?
				Response set: 5, always through 1, never
				b) Hierarchy of Authority
*	*	*	*	-CH1 There can be little action taken here until a supervisor approves a decision.
*	*	*	*	-CH2 A person who wants to make his own decisions would be quickly discouraged.
*	*	*	*	-CH3 Even small matters have to be referred to someone higher up for a final answer.
*	*	*	*	-CH4 I have to ask my boss before I do almost anything.
*	*	*	*	-CH5 Any decision I make has to have my boss' approval.
				Response set: 4, definitely true, 3, more true than false, 2, more false than true, 1, definitely false.

Figure 1 (continued)

Manpower Organization Data	Aiken & Hage 1964	Aiken & Hage 1967	Data 1970	2. Formalization
				a) Job Codification
*	*	*	*	? FJC1+ I feel I am my own boss in most matters.
*	*	*	*	? FJC2 A person can make his own decisions without checking with anybody else.
*	*	*	*	? FJC3 How things are done here is left up to persons doing the work.
*	*	*	*	? FJC4 People here are allowed to do almost as they please.
*	*	*	*	FJC5 Most people here make their own rules on the job.
				Response set: 4, definitely true through 1, definitely false.
				b) Rule Observation
*	*	*	*	FRO1 The employees here are constantly being checked for rule violations.
*	*	*	*	-FRO2 People here feel they are constantly being watched to see that they obey all the rules.
				Response set: 4, definitely true through 1, definitely false.
				c) Job Specificity++
*		*	*	? -FJS1 Whatever situation arises we have procedures to follow in dealing with it.
*		*	*	? -FJS2 Everyone has a specific job to do.
*		*	*	?-FJS3 Going through proper channels is constantly stressed.
*		*	*	?-FJS4 This organization keeps written records of everyone's job performance.
*		*	*	?-FJS5 We are to follow strict operating procedures at all times.
*		*	*	?-FJS6 Whenever we have a problem we are supposed to go to the same person for an answer.
				Response set: 4, difinitely true through 1, definitely false.

Figure 1 (continued)

Manpower Organization Data	Aiken & Hage 1964	Aiken & Hage 1967	Data 1970		
				3.	Technology (the Degree of Task Routineness) +++
*		*	*	-TTR1	People here do the same job in the same way everyday.
*		*	*	-TTR2	One thing people like around here is the variety of work.
*		*	*	-TTR3	Most jobs have something new happening everyday.
*		*	*	-TTR4	There is something different to do everyday.

\+ This question not used Aiken & Hage, 1968
++ This index not used Hage & Aiken, 1967
+++ This index used only in Hage & Aiken, 1969
? Indicates inclusion in index is questionable on grounds of content validity
* Denotes that this item was included in wave of data and in sample indicated
\- Indicates item scored in reverse to facilitate interpretation of tables

Table I. Factor Analysis of Centralization, Formalization and Task Routineness Items on Three Waves of Aiken & Hage Data and on Manpower Organizations Data (Loads less than .3 are omitted to facilitate reading of the Table.)

		1964 Wave N = 317				1967 Wave N = 510				1970 Wave N = 481				Manpower Data N = 306			
	Factors →	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. Centralization	Items																
a) Hierarchy of authority	CH1	.52				.48				.50				.42			
	CH2	.56				.45				.37				.55			
	CH3	.76				.68				.60				.66			
	CH4	.57				.76				.75				.68			
	CH5	.73				.80				.74				.61			
2. Formalization																	
a) Job Codification	FJC1			.59		.30								.56			
	FJC2			.53		.37								.56			
	FJC3		.41				.54				.46				.59		
	FJC4		.70				.66				.70				.56		
	FJC5		.60				.65				.70				.64		
b) Rule Observation	FRO1			.64				.65				.75				.55	
	FRO2			.68				.66				.72				.58	
c) Job Specificity	FJS1																
	FJS2		These														
	FJS3																
	FJS4		items														
	FJS5														.60		
	FJS6		omitted														
3. Technology			in this														
a) Task Routineness	TTR1						.45				.36					.46	
	TTR2		wave				.52				.71						.49
	TTR3						.75				.80						.60
	TTR4						.71				.75						.75
Eigen Value		3.87	1.70	1.25	1.01	4.89	1.51	1.41	1.25	5.0	1.79	1.59	1.25	3.98	1.75	1.27	.88
Percent Variance Explained		30	13	10	8	41	13	12	10	40	14	13	10	50	22	16	11

Table 2 Reliability of Multiple Item Scales: Values of Chronbach's Alpha

Part A. Individual Level of Analysis

	Aiken-Hage Data			Manpower Agencies
	1964 N=317	1967 N=509	1970 N=481	N=331
(1) Centralization				
(a) Hierarchy of Authority Items: CH1, CH2, CH3, CH4, CH5	.80	.83	.81	.78
(b) Participation in Decision Making Items: CP1, CP2, CP3, CP4	.88	.87	.89	.86
(2) Formalization				
(a) Rule Observation Items: FRO1, FRO2	.61	.64	.74	.69
(b) Job Codification Items: FJC3, FJC4, FJC5	.62	.64	.70	.60
(3) Task Routineness				
Items: TTR2, TTR3, TTR4	-	.67	.81	.43

Part B. Organizational Level of Analysis

	Aiken-Hage Data			Manpower Agencies
	1964 N=16	1967 N=16	1970 N=16	N=72
(1) Centralization				
(a) Hierarchy of Authority Items: CH1, CH2, CH3, CH4, CH5	.79	.96	.93	.70
(b) Participation in Decision Making Items: CP1, CP2, CP3, CP4	.95	.92	.93	.81
(2) Formalization				
(a) Rule Observation Items: FRO1, FRO2	.88	.93	.92	.73
(b) Job Codification Items: FJC3, FJC4, FJC5	.72	.62	.78	.67
(3) Task Routineness				
Items: TTR2, TTR3, TTR4	-	.82	.94	.74

1 Formation of organization scores was done by simply summing scores of all respondents and taking their mean. Aiken & Hage did not use this kind of aggregation procedure and consequently our results may differ slightly from their published results.

Table 3 - Intercorrelations of Scales for Indicators of Centralization, Formalization and Task Routineness at the Organizational Level of Analysis

		Participation				Hierarchy				Job Codification				Rule Observation			
		1964	1967	1970	MP	1964	1967	1970	MP	1964	1967	1970	MP	1964	1967	1970	MP
Hierarchy	1964	-.59**															
	1967		.10														
	1970			-.33													
	MP				-.29**												
Job Codification	1964	-.10				.05											
	1967		-.22				.56**										
	1970			-.32				.62***									
	MP				-.06				.29**								
Rule Observation	1964	-.55**				.02				.28							
	1967		-.33				.48**				.66***						
	1970			-.46*				.50**				.20					
	MP				-.22**				.63**				.36***				
Task Routineness	1964	-				-				-				-			
	1967		-.52**				-.22				-.27				.06		
	1970			-.67***				.30				.10				.76***	
	MP				-.32***				.27**				.09				.10

Aiken and Hage Data (1964, 1967 and 1970) n = 16
Manpower Organizations Data (1973) n = 69

*** = > $p \leq .01$
** = > $p \leq .05$
* = > $p \leq .1$

all are 2 tail tests

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