

WILEY



Span of Control and Public Organizations: Implementing Luther Gulick's Research Design

Author(s): Kenneth J. Meier and John Bohte

Source: *Public Administration Review*, Vol. 63, No. 1 (Jan. - Feb., 2003), pp. 61-70

Published by: [Wiley](#) on behalf of the [American Society for Public Administration](#)

Stable URL: <http://www.jstor.org/stable/977521>

Accessed: 22/12/2014 15:48

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Wiley and American Society for Public Administration are collaborating with JSTOR to digitize, preserve and extend access to *Public Administration Review*.

<http://www.jstor.org>

Kenneth J. Meier
Texas A&M University

John Bohte
Oakland University

Span of Control and Public Organizations: Implementing Luther Gulick's Research Design*

In Luther Gulick's classic essay "Notes on the Theory of Organization," he argued that span of control structures relationships between leaders and subordinates in organizations. Commenting on the state of knowledge about span of control, Gulick lamented the lack of systematic research on what he viewed as three key determinants of span of control: diversification of function, time, and space. This study adopts Gulick's approach to studying span of control by examining the effects of diversity of function, time, and space in structuring relationships among personnel in a sample of 678 Texas public school districts. We then investigate Joan Woodward's link between span of control and organizational performance. Our results reveal that although Gulick was correct in asserting that diversity of function, time, and space play a role in determining how spans of control are structured, these variables have different meanings that depend on the level of organizational hierarchy analyzed.

"Span of control" refers to the way relations are structured between leaders and subordinates in an organization. A wide span of control exists when a manager oversees many subordinates; a narrow span of control exists when a manager oversees few subordinates. Although it is a simple concept, span of control has widespread implications for the study of organizations. For example, span of control is at the foundation of two different approaches to studying organizations. The concept is a key element in economic theories of organization that focus on hierarchical design (Alchian and Demsetz 1972; Fama 1980; Williamson 1975) because spans of control ultimately determine the number of levels—and thus transaction costs—in an organization (Perrow 1986, 30). The concept is also relevant to the human relations approach to organizations (McGregor 1960; Tannenbaum 1968; Worthy 1950) because span of control is a tool that orders relationships between leaders and subordinates in organizations and influences management styles. Thus, span of control not only has implications for

understanding organizational design, but also for understanding behavior within organizations.

Although span of control has virtually disappeared from academic work, it remains an interest among practical managers who must establish reporting relationships. President Nixon's proposal to create a set of supercabinet administrators, for example, was grounded in the notion that a limited span of control was a positive feature. The National Performance Review includes limiting spans as one aspect of its efforts (Kettl and DiIulio 1995). Our examination of span of control proceeds in four steps: First, a brief review of the literature will show that almost no re-

Kenneth J. Meier is the Charles Puryear Professor of Liberal Arts in the Department of Political Science and the Sara Lindsey Chair in Government in the Bush School at Texas A&M University. His current research interests include developing methods more suited to public administration, assessing the impact of structural factors on public organizations, modeling the management dimension of organizations, exploring questions of representative bureaucracy and gender, and introducing humor to the profession. **Email:** kmeier@polisci.tamu.edu.

John Bohte is an assistant professor of political science at Oakland University in Rochester, Michigan. His current research interests include educational finance reform and the relationship between school bureaucracy and student performance. His research has appeared in *Public Administration Review*, *Administration and Society*, *American Journal of Political Science*, and *Journal of Politics*. **Email:** bohte@oakland.edu.

*Financial support for this project was provided by the Department of Political Science at Texas A&M University. All data and documentation necessary to replicate this analysis are available from the senior author.

search has addressed how organizations determine spans of control or what difference it makes. Second, by returning to classic works by Luther Gulick (1937) and Joan Woodward (1980), we generate some hypotheses about how organizations determine their spans of control and how those spans affect organizational outputs. Third, we test these hypotheses using a large data set of public organizations. Our findings show that spans of control in organizations reflect the way organizations manage environmental challenges and affect organizational performance, though not in the way that Woodward proposes. Finally, we discuss the implications of our findings for the management of public organizations.

The Literature on Span of Control

The literature on span of control is sparse, a fact that may be attributed to a devastating critique of the principles of management literature (including span of control) by Herbert Simon (1946). Simon argued that various principles of management were ambiguous and provided contradictory advice to managers. Lost in the aftermath of the Simon critique was the recognition that empirical studies of span of control were essentially nonexistent (for a critical view of Simon's position, see Hammond 1990; on the lack of such knowledge relevant to the National Performance Review, see Kettl 1998). Gulick (1937, 90) himself concludes, "when we seek to determine how many immediate subordinates the director of an enterprise can effectively supervise, we enter a realm of experience which has not been brought under sufficient scientific study to furnish a final answer." As for studies, the best Gulick could point to was a series of recommendations based on European cabinets and V.A. Gracunius' (1937, 185) argument in the same papers that the optimal span of control was four. With few exceptions, the work that followed Simon on span of control was essentially descriptive (Bell 1967; Blau 1968; Meier and Bohte 2000). Urwick (1956, 41) argued that six was the optimal span. Woodward (1980) found a median span for chief executives of six, but values as high as 12. At the first-line supervision level of mass-production firms, however, spans of control averaged 50 and ranged as high as 90.

The irony of this sparse and often conflicting body of knowledge on span of control is that Gulick actually answered the question of which variables are crucial determinants of spans of control in his essay, essentially handing the scholarly community a clear plan of research for studying span of control relationships in organizations. Curiously, scholars have not taken advantage of Gulick's suggestions about how to design a course of research on span of control, which is one reason why our knowledge about this concept remains muddled. Gulick argued that spans of control reflect individual preferences and abilities and, more

importantly, three key organizational variables: (1) diversification of function, (2) the element of time, and (3) the element of space. In criticizing the small amount of research on span of control that did exist when he wrote his essay, Gulick (1937, 91) stated that "the failure to attach sufficient importance to these variables has served to limit the scientific validity of statements which have been made that one man can supervise but three, or five, or eight, or twelve immediate subordinates." In this study, we implement Gulick's research approach and systematically examine the role these variables play in structuring spans of control in a modern organizational setting.

The Determinants of Span of Control—Three Key Variables

Gulick viewed three variables as crucial determinants of span-of-control relationships in organizations: diversification of function, time, and space.

Diversification of Function

An organization that combines diverse functions (Gulick contrasts an Army general and a director of public works) will need to reduce the size of its spans of control simply because the supervisor must interact with many different types of individuals. If subordinates are all performing the same task with the same set of inputs, jobs can be routinized. This similarity of jobs should permit a single individual to supervise more subordinates. Although Gulick's discussion of diversity is terse, the concept applies quite clearly to the diversity of functions that individuals perform (or the diversity of workplace technologies), the diversity of occupations, and the diversity of inputs that workers use.

Time and Stability

In Gulick's view, the element of time focuses essentially on stability. In stable organizations, managers do not have to train and oversee new workers. Individual workers need less supervision simply because they are more familiar with their jobs. Stability might include not only the stability of workers, but also the stability of the organization's other inputs. A stable environment that provides similar inputs to an organization over a long period of time should permit greater routinization, and thus larger spans of control.

Size and Space

For Gulick, the element of space involves the number of buildings that house the organization: The more buildings there are, the less face-to-face contact and, in Gulick's mind, the more closely individuals would need supervision. Because space increases the transaction costs of supervision (Williamson 1975), it generally can be thought



of as an element of size. Although Gulick did not discuss size, larger organizations have larger transaction costs, all other things being equal. An alternative hypothesis could be specified for size and span of control (Blau et al. 1976, 25). Larger organizations can specialize to a greater degree, and thus are less likely to use generalists at the production level. The use of highly trained specialists with minimal supervision might generate wider spans of control. In short, there may be some economies of scale in larger organizations that permit fewer administrative oversight personnel.

Gulick hypothesized that these three variables condition spans of control. Studying the effects of these variables is important because span-of-control relationships ultimately can shape organizational performance. For example, Joan Woodward's (1980) classic study of British industrial firms revealed that span of control varied a great deal across organizational settings. Examining more than 200 industrial firms, Woodward classified firms according to three functional objectives. Unit production firms use small teams of workers to produce products that meet the varying specifications of individual customers (for example, shipbuilding). Large-batch production firms use more advanced technologies, such as assembly lines and techniques of mass production, in their work. Continuous-process organizations employ the most technologically advanced techniques of production to create products over a series of stages, such as the production of chemical compounds. In looking for commonalities among exemplary firms in each category, Woodward found that structure, including span of control, was an important determinant of organizational performance. Variations in spans of control were present *across* the three organizational categories; however, *within* each organizational category, successful firms used similar spans of control to structure relationships between executives and employees.

Woodward's study remains one of the few systematic studies of span of control and organizational performance. It provides a precise, testable hypothesis that organizations with spans of control similar to the average span for a type of organization will perform best. The implication of her findings in regard to different organizations suggests that one needs to control for the type of organization to get a clear picture of how span of control operates in an organization.

Practical Applications

The practical management aspect of span-of-control studies should be obvious. First, **larger spans of control allow organizations to operate with fewer administrative personnel**. To illustrate, assume an organization with 600 production-level personnel. If the span of control for this organization is four, a total of 202 supervisory personnel

(in five layers) are needed for the entire organization. Increasing the span of control to five reduces the number of supervisory personnel to 150 and eliminates one entire level in the organization. Effective management of spans of control, therefore, can produce significant savings for organizations.

Second, manipulating spans of control may affect managerial relations and management styles. Narrow spans of control imply close supervision, while wider spans of control require more autonomy on the part of the subordinate. This structural factor is consistent with management philosophies based on psychological theories of motivation (McGregor 1960) and with the philosophical work on ethics in public administration (Frederickson 1996; Wamsley et al. 1992).

Third, Mintzberg's (1979) work on organizations contends that spans of control are not uniform within most organizations (see also Blau et al. 1976, 28). The regular pyramid shape rarely occurs in real-world organizations. Organizations often have broad spans of control at one point in the organization and relatively narrow spans of control at other points. In education, the concept of site-based management attempts to move decision-making authority from central administration to the school level. The result of this strategy is that a large number of principals report to a relatively small number of central office administrators. This wide span of control compensates for a narrower span of control below the principal as he coordinates tasks that previously were the domain of central administration.

Methods

An ideal data set for examining spans of control would contain many organizations performing the same general function. That data set would need measures of span of control, performance measures, and measures of diversity, organizational size, and instability. One data set that meets these criteria is the Texas school district data set. The 678 Texas school districts with enrollment over 500 students have usable data for 1994–97, and pooling them generated 2,712 cases over the time frame of the study.¹ Schools are ideal organizations for examining how variations in spans of control affect relationships among organizational personnel. Schools—and school districts more generally—are highly professionalized, hierarchical structures. Working relationships exist between teachers and school administrators, between campus administrators and administrators at the district level, and between teachers and students. Variations in spans of control affect how each of these relationships is structured, and such variations ultimately have implications for how schools perform in educating students.

A second reason to examine schools is that they share similar functions, and thus permit studying how span-of-

control relationships affect organizational performance because they have common measures of outputs. Woodward's (1980) study examined a diverse grouping of more than 200 industrial firms in Britain. Casting a wide net over different types of firms makes it difficult to come to any solid conclusions about how span of control matters in any *one* particular type of organization. Our strategy is to study a set of organizations that all perform the *same* function. Put another way, Woodward revealed that spans of control vary across organizations that have different modes of production. Our goal in this research is to find what determines the span of control for a set of organizations that all use the same mode of production to achieve the same goal (for instance, educating students). In this sense, our work complements Woodward's and extends an important hypothesis about span of control from her research.

Using school districts as the focus of our study raises questions about how generalizable the findings will be to other public organizations. Texas school districts are extremely heterogeneous in terms of size, racial composition, and resources. This heterogeneity, along with the fact that Texas contains approximately 8 percent of all school districts in the United States, implies that generalizations to other school districts should not be a problem. Other generalizations need to be qualified. Schools are, in fact, the most common type of public organization; more public employees work for school districts than any other type of bureaucracy. At the same time, schools are highly professionalized organizations and vest a great deal of discretion in their street-level personnel (teachers); they tend to be flat organizations comprising individuals with a common educational background. Therefore, the findings here are more likely to apply to public organizations with these characteristics; the actual ability to generalize, however, requires additional studies (such as this one) that examine other types of organizations.

The pooled nature of the data require one additional adjustment. Autocorrelation is often a problem in pooled data. Accordingly, all models include a set of three dummy variables representing individual years to control for serial correlation.²

Dependent Variables: Span of Control

Span of control, in general terms, can be viewed as a set of ratios that link sets of managers and subordinates. Mintzberg's (1979) examination of structures suggests that span of control will vary at different levels within an organization. Two different span-of-control variables are relevant for this study—first-line supervision and middle-management level. The *first-line supervision* in school systems is administrators supervising teachers; the administrative–teacher span of control is measured directly as

the ratio of teachers to administrators in a district. The mean administrator–teacher span is 13.8 and varies substantially (standard deviation = 3.3, range = 3.0 to 30.5). This variation reflects large differences in the way schools structure reporting relationships.

Central office administrators supervise school-level administrators, a *mid-level management span of control*. This span can be measured as the ratio of the number of school-level administrators to the number of central office administrators. The broad span of control for teachers contrasts with a relatively narrow middle-manager span of control that averages 2.4, with a range of 0.2 to 11.3.³ The measure shows a great deal of variation relative to the smaller mean, with a standard deviation of 1.3. As these averages show, school systems are generally flat organizations with wide spans of control at the lower levels and narrow spans at the levels where administrators supervise other administrators.

Independent Variables

Diversity. Three sets of variables are likely to influence the spans of control in an organization's diversity, size, and instability. Diversity creates heterogeneous demands on an organization that prevent the use of wide spans of control, which are common in large-batch processing organizations. Three distinct types of diversity can affect organizational structure—task-demand diversity, production diversity, and role diversity.

The diversity of task demands implies that inputs to the organization vary. The greater the diversity of inputs, the more likely the organization will need to treat each input as a unique case (or that more distinct categories of production will be needed). A good indicator for task-demand diversity for schools is the racial composition of the student body. All schools educate students, but educational needs vary by race and ethnicity (Jencks and Phillips 1998; Meier and Stewart 1991), simply because race and ethnicity are correlated with poverty and other factors that make the educational process more difficult. To create a single measure of task diversity, the percentages of Anglo, Latino, and black students in the district were squared and summed together, then subtracted from 10,000. The result is the equivalent of the Herfindahl index, which is used to measure the degree of concentration and diversity in markets and a wide variety of other areas (Cohen and Sullivan 1983; Dickson 1994; Baumgartner, Jones, and MacLeod 2000; Hardin 1998). A single race school will have a value of 0, and the measure will increase as the student body becomes more diverse. The theoretical upper limit of the index depends on the number of groups. With three groups, the upper limit is 6,667.

Production diversity involves the distribution of production technologies. In the case of education, this is the dis-

tribution of teachers across distinct educational programs: regular education, special education, compensatory education, bilingual education, vocational education, and gifted education. The specific measure is a Herfindahl index constructed using these six categories. Because all six productions are teaching, production diversity in schools is clearly relatively narrow. At the same time, there is substantial variation in the diversity or homogeneity of the curriculum across school districts.

Role diversity attempts to tap the different occupations and roles within the organization. Six different occupational categories are used: central administration, campus administration, teachers, support staff, teachers aides, and auxiliary staff. Again, the specific measure is a Herfindahl index based on these categories. Larger numbers indicate greater diversity.

By using only one type of organization, we have restricted the variation on task demands and on role and production diversity relative to the diversity one might find among all organizations. Even within such restrictions, however, our measures tap the differences among schools in terms of what Gulick terms "diversity."

Organization Size and Space. Two dimensions of organizational size are relevant to span of control as Gulick discusses it. Total staff indicates the total number of employees to be coordinated. Because this variable is skewed by a few extremely large school districts, a log transformation of total staff was used. The other measure of size is spatial. Gulick stresses the problems that arise with organization members spread out across different buildings. As a measure of spatial size, we use the total number of campuses (buildings) in the school district.

Instability. Stable organizations allow standard operating procedures as well as the development of informal norms that facilitate work. Two aspect of change are likely to be key—changes in the inputs of the organization, and changes in production personnel. Change in the inputs of the organization is measured as the percent change in total student enrollment from the previous year. Although schools are accustomed to some changes in enrollment, large changes require shifting work assignment, hiring (or firing) personnel, and adjusting physical facilities. Change in production personnel, a variable specifically noted by Gulick, is measured as the percentage of teachers who leave the district.⁴ Compared to other public organizations, schools have high levels of turnover, averaging approximately 10 percent per year. Districts with high turnover in one year often have high turnover in subsequent years; this means they must add more administrative capacity to recruit, train, and evaluate new teachers. Over time, such changes will affect the spans of control in the organization. Teacher turnover is related to another dimension of stability. Experienced employees are likely to know their

jobs better and, therefore, need less supervision, allowing larger spans of control. Our measure of experience is the average number of years of teaching experience on the part of the faculty.

Findings

The model for first-line supervision (the ratio of teachers to campus administrators) span of control is reported in table 1.⁵ At the first-line supervisory level, role diversity matters a great deal, with more diversity leading to narrower spans of control. For these first-line administrators, the more varied the mix of teachers, aides, support staff and counselors, the fewer individuals they supervise. Task (that is, student) diversity has a similar negative impact on span of control, generating smaller spans of control at the supervisor level. Production diversity, in contrast, has a positive relationship. The different types of classes are associated with broader spans of control. Such a relationship makes sense within an organization if production diversity is handled by the production level of the organization; this means that the mix of students is dealt with through teacher specialization. Because teachers specialize and are likely to gain autonomy as specialists, administrators can supervise more teachers in a looser management style. Because the production level buffers the diverse inputs and technologies, the supervisory level does not need to do so.

Organizational size is consistent with our hypotheses, although the relationship for locations does not meet traditional levels of statistical significance. Larger organizations have larger spans of control at the first-line supervisory level. This relationship is consistent with size, which permits specialization in an effort to overcome diversity in

Table 1 The Determinants of First-Line Supervision

Span of Control			
Dependent variable = Teacher/administrator ratio			
Independent variables	Slope	Standard error	t-score
Diversity			
Task-demand diversity	-.1113	.0309	3.60
Production diversity	.1155	.0564	2.05
Role diversity	-2.0715	.1476	14.04
Organization size			
Staff (logged)	1.6657	.0561	29.70
Locations	-.0393	.0230	1.71
Instability			
Teacher turnover	-.0273	.0104	2.63
Enrollment change	.0062	.0041	1.52
Experience	.0718	.0344	2.09
R-square	.32		
Adjusted R-square	.31		
Standard error	2.65		
F	113.38		
N	2,718		
Coefficients for year dummies to correct for serial correlation not reported.			
Diversity coefficients multiplied by 1,000 to facilitate comparison.			

inputs and production.

Organizational stability also affects span of control. Teacher turnover results in a narrower span of control, as would be expected given the closer supervision needed for employees with less expertise. Administrators supervise these new teachers. Similarly, teacher experience is positively correlated with larger spans of control. Enrollment change does not meet traditional levels of statistical significance. Structure responds to employee turnover and experiences, but not to changes in workload.

Table 2 reports the results of our analysis for middle-management-level spans of control. Starting first with teacher turnover and enrollment changes, neither relationship is statistically distinguishable from zero. This is consistent with our conclusion that uncertainty is buffered at lower organizational levels. At the middle-management levels, changes in enrollment and teacher turnover have no impact on span of control. Teacher experience is negatively linked to middle-management spans of control, an unexpected finding that our theory did not predict.

We have argued that table 1 shows how organizations buffer diversity. If we are correct, then mid-level management should be less affected by diversity. Although the relationships for diversity are statistically significant, they are smaller in absolute terms than for the other levels in the organization. Role diversity—one aspect of diversity that is most likely to penetrate to middle-management levels—has a negative relationship, indicating that more distinct roles in the organization will narrow the span of supervision. The relationships for task diversity and production diversity are positive, but, as we have noted, the bulk of the adjustment to these factors occurs at lower levels in the organization.

Table 2 The Determinants of Middle Management

Span of Control			
Dependent variable = Campus administrator/central administrator ratio			
Independent variables	Slope	Standard error	t-score
Diversity			
Task-demand diversity	.0424	.0133	3.18
Production diversity	.1014	.0243	4.18
Role diversity	-.3501	.0635	5.51
Organization size			
Staff (logged)	.5658	.0242	23.41
Locations	.0176	.0099	1.77
Instability			
Teacher turnover	.0011	.0045	.23
Enrollment change	-.0004	.0018	.19
Experience	-.0676	.0148	4.56
R-square	.25		
Adjusted R-square	.24		
Standard error	1.14		
F	80.06		
N	2,712		
Coefficients for year dummies to correct for serial correlation not reported.			
Diversity coefficients multiplied by 1,000 to facilitate comparison.			

Overall, organization size continues to matter. Just as there are economies of scale at the production level, there should also be economies of scale at management levels. Specialization allows individuals to supervise more people, so long as their tasks are relatively similar.

Does Span of Control Matter?

The view that is implicit in this research and endorsed by Woodward is that span of control is an important organizational variable because it affects how well the organization functions. Woodward (1980) contends that organizations that come closest to the average structure for organizations of a given type will be the most productive. The school district data set permits us to assess this question. Students in Texas are required to take standardized tests of basic skills in several grades. Although basic skills are not the sum of all education, they are an important aspect of how schools are evaluated. If span of control is an important variable for these school districts, it should be associated with how well the districts' students perform on these standardized tests.

It is likely that many factors other than span of control affect how well students perform on these tests. Controls for these factors need to be introduced so that the results of our test are not spurious. Performance—including performance on these exams—should be a function of the inputs that organizations receive, the resources they apply to the process, and the quality of the technology applied to the process (Rainey 1997). We have measures for both the inputs that the organizations receive and the resources they apply to the process. Because these organizations all perform the same function (and because we limit the study to those over a certain size), we can assume they use relatively similar technologies.

Inputs to these organizations means that students—and the makeup of student populations—vary widely across school districts in Texas. Urban school districts tend to have larger numbers of African American, Latino, and low-income students than suburban school districts. Each of these types of students is likely to have learning disadvantages. Minority students come from disadvantaged circumstances and generally score lower on standardized tests than Anglo students (Rong and Grant 1992; Jencks and Phillips 1998). The probability of low-income students having difficulties performing well on standardized tests is also high (Coleman et al. 1966). Three variables were used to control for district student makeup: the percentages of African American, Latino, and low-income students per district. The variable for low-income students is the percentage of students who are eligible for free or reduced-price meals through school lunch programs. All relationships with performance should be negative.

Resources are divided into two categories: money and experience. While the relationship of money to educational performance is controversial (Hanushek 1996; Hedges and Greenwald 1996), financial resources do provide organizations with more opportunities to deal with a turbulent environment and should be linked to production. Our three measures of resources are the average teacher salary, class size, and per-student spending on education. The first recognizes that educational systems are personnel-intensive organizations; some scholars even argue that teacher salaries indicate how well school systems can compete in the market for scarce skills (Hanushek and Pace 1995). Class size and per-student instructional costs are reasonable measures of resources applied to actually educating students because they do not include administrative expenses and extracurricular activities. Teacher experience should be linked to learning on the job and the ability to perform at higher levels. Our measure is the average number of years of teacher experience for the district. All measures except class size should be positively related to organizational performance.

Woodward's finding on span of control is very precise: Effective spans of control approximate the average for the industry group. Because our first two tables show that similar organizations adjust their spans of control in predictable ways to environmental and internal factors, the best way to estimate the average span of control is with the regression equations found in these tables. Using the equations, we can predict the spans of control expected for each organization for each of these two levels (these are merely the predicted values for the regression). Comparing these predicted (or average values) to actual values, one can assess how close individual school districts come to these averages. We measure this convergence as the geometric distance of the actual spans of control from the predicted average spans of control on all dimensions simultaneously.⁶ This measure is the distance that a school district is from the average spans of control. Because it measures distance rather than nearness, it should be *negatively* related to performance, based on Woodward's work.

Table 3 adds this span-of-control distance measure to a production function that predicts overall organization performance. The results are inconsistent with Woodward's argument. The relationship is positive and significant. Schools with average spans of control are less productive. Before rejecting Woodward, however, we need to recall that her work relied on less precise measures and methods. A general pattern observed at the bivariate level, as in her case, often does not hold with appropriate controls.

To further probe Woodward's hypothesis, we simply substituted the actual span of control measures for the distance measure in the production function in table 3 (see table 4). The results confirm Woodward's intuition: Both

Table 3 Are Mean Spans Most Effective? A Test of the Woodward Finding

Dependent variable = Average student test scores			
Independent variables	Slope	Standard error	t-score
Distance from mean span of control	.4205	.1657	2.54
Control variables			
Teachers' salaries (K)	.7095	.1002	7.08
Teacher experience	.3700	.0922	4.01
Instructional funding	.0005	.0004	1.17
Class size	-.8583	.1175	7.30
Percentage of black students	-.2598	.0138	18.78
Percentage of Latino students	-.1154	.0104	11.09
Percent of poor students	-.2630	.0145	18.18
R-square	.71		
Adjusted R-square	.71		
Standard error	6.89		
F	595.81		
N	2,709		
Coefficients for year dummies to correct for serial correlation not reported.			

Table 4 Spans of Control and Organizational Production

Dependent variable = Average student test scores			
Independent variables	Slope	Standard error	t-score
Span of control measure			
Teacher-administrator	.1087	.0460	2.36
Mid-level management	.3084	.1108	2.78
Control variables			
Teachers' salaries (K)	.6480	.1016	6.38
Teacher experience	.3958	.0924	4.29
Instructional funding	.0006	.0004	1.38
Class size	-.9340	.1186	7.88
Percentage of black students	-.2654	.0139	19.06
Percentage of Latino students	-.1173	.0104	11.29
Percentage of poor students	-.2584	.0145	17.84
R-square	.71		
Adjusted R-square	.71		
Standard error	6.87		
F	549.69		
N	2,711		
Coefficients for year dummies to correct for serial correlation not reported.			

spans of control have a direct impact on organizational performance. Greater performance is associated with greater administrator-teacher spans of control and larger middle-management spans of control. Span of control does affect the outputs of the organization, but not in exactly the way that Woodward surmised.

Conclusion

Luther Gulick argued that diversity, stability, and space were three key explanatory variables that determine span-of-control relationships in organizations. In this study, we developed various indicators of these concepts and measured their effects at two different organizational levels in Texas public school districts.

Our general conclusion is that Gulick was correct in labeling these three variables as important determinants of span-of-control relationships in organizations. We also found that these variables appear in different forms at different organizational levels. Although task-demand diversity is a key factor that structures spans of control for first-line supervisors, role diversity, rather than task-demand diversity, is of central importance in structuring middle-management spans of control. Instability, measured in terms of teacher turnover, is an important explanatory variable at the first-line supervision level, but not at the middle-management level.

These findings suggest that diversity, stability, and space must be defined within the context of organizational hierarchies. Hierarchical organizational designs dictate that employees across different levels are responsible for managing different problems. Diversification of function means that actors throughout an organization define their key tasks based on the specific responsibilities they are charged with addressing. Thus, one set of factors that influence span-of-control relationships in a lower level of an organization may be totally irrelevant to how spans of control are structured at a higher level of that organization. Put another way, if personnel at each level of an organization are concentrating on their key tasks, the definitions of diversity, stability, and space should be level specific. As we have noted, teacher turnover is a major issue that affects the way first-line supervisors structure spans of control; however, teacher turnover has no influence in determining spans of control at the middle-management level. In short, diversity, stability, and space are relevant at all organizational levels. Yet as tasks vary across organizational levels, these variables will have precise meanings that depend on the levels in the organization that are analyzed.

We then tested Woodward's (1980) contention that organizations that approach average structures (including spans of control) will be most productive. Her hypothesis was not supported. Span of control did matter, however, with larger spans of control at the first-line supervision and middle-management levels associated with better performance.

This study examined educational organizations, but we are confident that our findings apply to other public organizations with similar characteristics—that is, highly professionalized organizations with discretion vested in street-level bureaucrats. Because we limited the study to one type of organization in order to get comparable performance measures, we also limited the variance on many of the variables. Although the result may not apply to all other public organizations, we feel this study provides credibility to Gulick's hypotheses and a rationale for more studies of this type using different types of public organizations.

The assessment of organizational structures, we feel, should be an essential component of management analysis. Studies such as this one not only reveal a great deal about how organizations operate, they also can be used to provide specific guidance to public managers about how to organize employees (see table 5). Table 5 can also be interpreted as our set of hypotheses about how span of control operates in other public organizations. Span of control is only one structural component among many; systematic study of other structural aspects of organizations is likely to provide additional benefits. In the contemporary environment in which public organizations are being challenged by the New Public Management, any factors—including spans of control—that affect organizational productivity should not be ignored.

Table 5 Span of Control Relationships—Guidelines for Organizing Employees

Narrow versus Wide Spans of Control

Wide spans of control are the default in many organizational settings because such designs maximize resource flows to production and minimize resource flows to supervisory tasks. In other words, wide spans of control are desirable from an efficiency standpoint. This table describes conditions under which *narrow* spans of control are preferable to wide spans of control.

First-Line Supervision

When production technologies in an organization are diverse, spans of control at the first-line supervision level should be narrow.

When role diversity among production level employees is high, spans of control at the first-line supervisor level should be narrow.

When there is great instability or high turnover of production level personnel, spans of control at the first-line supervisor level should be narrow.

Middle-Management Supervision

When role diversity throughout an organization is high, spans of control at the middle-management level should be narrow.

Notes

1. There are an additional 300-plus school districts in Texas with fewer than 500 students. Districts of this size often do not distinguish between middle-level and upper-level management (that is, the superintendent frequently is also the principal). Given the small number of professional employees in these organizations, they tend to be organizations with little structure. For these reasons, these smaller districts were not included in the analysis.
2. The inclusion of individual-year dummy variables is also the traditional way to correct for serial correlation in panels such as this one with few years and many cross-sections. The other statistical threat to panel analysis is heteroskedasticity (Stimson 1985). The panel contained a modest amount of heteroskedasticity, but this problem was not severe and did not affect the results of the analysis.
3. Spans of control can be fractional because districts report personnel figures in full-time equivalents. In this case, a full-time superintendent might be supervising a part-time principal. Individuals who split time among two or more schools are also counted in fractional full-time employees.
4. Turnover measures are not available for administrators or other personnel.
5. To make sure the relationships we found were not spurious, we also estimated these models with a measure of wealth (revenues per pupil), a measure of size (total school enrollment), and a measure of resources linked to special needs (funds for compensatory education). Enrollment was highly collinear with staff size, and thus created some problems. These three control variables were modestly related to spans of control, although not always in the predicted direction (revenues were negatively related to spans). In general, with these controls, the results were similar to those presented here.
6. This is merely the euclidian distance. To calculate this distance, the residuals of each equation are standardized to give each span an equal weight. The distance is then the square root of the sum of the two squared residuals for each district.

References

- Alchian, Armen A., and Harold Demsetz. 1972. Production, Information Costs, and Economic Organization. *American Economic Review* 62(5): 777–95.
- Baumgartner, Frank R., Bryan D. Jones, and Michael C. MacLeod. 2000. The Evolution of Legislative Jurisdiction. *Journal of Politics* 62(2): 321–49.
- Bell, Gerald. 1967. Determinants of Span of Control. *American Journal of Sociology* 73(3): 90–101.
- Blau, Peter M. 1968. The Hierarchy of Authority in Organizations. *American Journal of Sociology* 73(1): 453–57.
- Blau, Peter M., Cecilia McHugh Falbe, William McKinley, and Phelps K. Tracy. 1976. Technology and Organization in Manufacturing. *Administrative Science Quarterly* 21(1): 20–40.
- Cohen, Neil B., and Charles A. Sullivan. 1983. The Herfindahl-Hirschman Index and the New Antitrust Merger Guidelines. *Texas Law Review* 62(4): 453–510.
- Coleman, James S., et al. 1966. *Equality of Educational Opportunity*. Washington, DC: Government Printing Office.
- Dickson, Vaughn. 1994. Aggregate Industry Cost Functions and the Herfindahl Index. *Southern Journal of Economic Behavior* 61(2): 445–52.
- Fama, Eugene F. 1980. Agency Problems and the Theory of the Firm. *Journal of Political Economy* 88(2): 288–305.
- Frederickson, H. George. 1996. *The Spirit of Public Administration*. San Francisco, CA: Jossey-Bass.
- Gracunius, V.A. 1937. Relationship in Organization. In *Papers on the Science of Administration*, edited by Luther Gulick and Lyndall Urwick, 183–87. New York: Institute of Public Administration, Columbia University.
- Gulick, Luther. 1937. Notes on the Theory of Organization. In *Papers on the Science of Administration*, edited by Luther Gulick and Lyndall Urwick, 191–95. New York: Institute of Public Administration, Columbia University.
- Hammond, Thomas. 1990. In Defence of Luther Gulick's "Notes on the Theory of Organization." *Public Administration* 68(2): 143–73.
- Hanushek, Erik. 1996. School Resources and Student Performance. In *Does Money Matter?* edited by Gary Burtless, 43–73. Washington, DC: Brookings Institution.
- Hanushek, Erik, and Richard R. Pace. 1995. Who Chooses to Teach (and Why)? *Economics of Education Review* 14(1): 107–17.
- Hardin, John. 1998. Advocacy versus Certainty: The Dynamics of Committee Jurisdiction Concentration. *Journal of Politics* 60(2): 374–97.
- Hedges, Larry V., and Rob Greenwald. 1996. Have Times Changed? The Relation between School Resources and Student Performance. In *Does Money Matter?* edited by Gary Burtless, 74–92. Washington, DC: Brookings Institution.
- Jencks, Christopher, and Meredith Phillips. 1998. *The Black-White Test Score Gap*. Washington, DC: Brookings Institution.
- Kettl, Donald F. 1998. *Reinventing Government: A Fifth Year Report Card*. Washington, DC: Brookings Institution.
- Kettl, Donald F., and John DiIulio. 1995. *Inside the Reinvention Machine: Appraising Governmental Reform*. Washington, DC: Brookings Institution.
- McGregor, Douglas. 1960. *The Human Side of Enterprise*. New York: McGraw-Hill.
- Meier, Kenneth J., and John Bohte. 2000. Ode to Luther Gulick: Span of Control and Organizational Performance. *Administration and Society* 32(2): 115–37.

- Meier, Kenneth J., and Joseph Stewart, Jr. 1991. *The Politics of Hispanic Education*. Albany, NY: State University of New York Press.
- Mintzberg, Henry. 1979. *The Structuring of Organizations*. Englewood Cliffs, NJ: Prentice Hall.
- Perrow, Charles. 1986. *Complex Organizations: A Critical Essay*. 3rd ed. New York: McGraw-Hill.
- Rainey, Hal G. 1997. *Understanding and Managing Public Organizations*. 2nd ed. San Francisco, CA: Jossey-Bass.
- Rong, Xue Lan, and Linda Grant. 1992. Ethnicity, Generation, and School Attainment of Asians, Hispanics, and Non-Hispanic Whites. *Sociological Quarterly* 33(4): 625–35.
- Simon, Herbert. 1946. The Proverbs of Administration. *Public Administration Review* 4(1): 16–30.
- Stimson, James. 1985. Regression in Time and Space: A Statistical Essay. *American Journal of Political Science* 29(4): 914–47.
- Tannenbaum, Arnold S. 1968. *Control in Organizations*. New York: McGraw-Hill.
- Urwick, Lyndall F. 1956. The Manager's Span of Control. *Harvard Business Review* 55(3): 39–47.
- Wamsley, Gary L., Charles T. Goodsell, John A. Rohr, Orion White, and James Wolf. 1992. A Legitimate Role for Bureaucracy in Democratic Governance. In *The State of Public Bureaucracy*, edited by Larry B. Hill, 59–86. Armonk, NY: M.E. Sharpe.
- Williamson, Oliver. 1975. *Markets and Hierarchy: Analysis and Antitrust Implications*. New York: Free Press.
- Woodward, Joan. 1980. *Industrial Organization: Theory and Practice*. 2nd ed. New York: Oxford University Press.
- Worthy, James C. 1950. Organizational Structure and Employee Morale. *American Sociological Review* 15(2): 169–79.