Information As a Strategic Contingency: Applying the Strategic Contingencies Theory of Intraorganizational Power to Academic Libraries

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This research examines the changes that electronic information technologies have caused on power within organizations. Based on the strategic contingencies theory of intraorganizational power, a model of organizational power is developed and tested. Major features of the model include a technology index, subunit power variables, environmental variables, and bases of power variables (structure, coping with uncertainty, centrality, and substitutability). According to canonical correlation analyses, changes in library automation and changes in the environment are related to changes in both the bases of power variables and power itself. The bases of power, in turn, are related to changes in the power of the library as measured by the percent of the institutional budget allocated to the library, the number of library positions, and the perception of power.

Technology is having a major impact on academic libraries, causing librarians to rethink their positions on collections (e.g., access versus ownership), budgets (e.g., paying for computer hardware and software), buildings (e.g., space needs and wiring for telephone and data connections), staff (e.g., training for new technologies and changes in roles), and services (e.g., educating users about new technologies).[1] As a result, libraries and librarians must face financial issues, social and organizational issues, and issues involving the role of the library.[2]

Finding the money to pay for information technology (IT) is a great challenge for most libraries. The costs of purchasing, maintaining, and replacing computer equipment; hiring computer experts or consultants; training librarians and other library staff to use the technologies; and acquiring machine-readable records have stretched the budgets of libraries greatly.

Computing and electronic information technologies may cause changes in

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certain power payoffs or "power shifts" within organizations.[3] Often these shifts alter the political atmosphere of an organization, increasing the power of those who control the decision-making apparatus that distributes needed resources within the organization.

This study sought to understand the role that electronic information technologies have played in the distribution of power within organizations, specifically, the power of the library within the liberal arts college. The strategic contingencies theory of intraorganizational power provided the theoretical base for this research. Within this theory, power is considered a dependent variable that changes in response to a subunit's bases of power. The bases of power include the subunit's ability to cope with uncertainty, its substitutability, and its centrality to the organization.[4] A *strategic contingency* is defined as "a requirement of the activities of one subunit which is affected by the activities of another subunit."[5] Information is one such strategic contingency. As developed by D. J. Hickson et al., the strategic contingencies theory states that the control of contingencies needed by other subunits within the organization is related to the power of the controlling subunit. The more necessary these contingencies are for the work of other subunits, the more power accrues to the controlling subunit.

Within this study, the exercise of power is specifically concerned with marshaling resources for use within a subunit (the library) of an organization (the liberal arts college). Resources are defined as both monetary (as indicated by subunit budget allocations) and personnel (as indicated by the number of subunit staff). In addition, the perception of power on the part of the library director is included.

In addition to power variables, the proposed integrated model includes variables considered to be the bases of power. These include both structural variables and variables associated with the strategic contingencies theory of organizational power, namely uncertainty, centrality, and substitutability. Because power, according to Jeffrey Pfeffer, is first and foremost a structural phenomenon, various structural variables are measured to determine their changes in response to changes in technology.[6] Many previous studies confirm the importance of the existing organizational structure as a base of power.[7]

Uncertainty can be defined as "a lack of information about future events, so that alternatives and their outcomes are unpredictable."[8] Such uncertainties can involve the sources and composition of inputs, the work flow or production process, and the market for products.

Hickson et al. defined *centrality of a subunit* as "the degree to which its activities are interlinked into the system."[9] In her research on colleges and universities, Judith D. Hackman defined centrality as how closely a unit matches the central mission of its parent institution and found that a unit's centrality crucially affects the internal resources allocated to it by the institution.[10] Similarly, Richard H. Hall states that from his observations at a number of universities, "the centrality of the operation and the scarcity of personnel are major determinants of the power of a particular organizational unit."[11]

The final factor included in the contingency theory of power is that of *substitutability*. Hickson et al. defined this term as "the ability of the organization to obtain alternative performance for the activities of a subunit."[12] In other words, the functions of one subunit can be taken over by another subunit. Robert Dubin notes that power within a formal organization is based on the importance of the functions performed by the subunit and the exclusiveness with which it performs them.[13] The less the activities of one subunit can be taken over by another, the greater that subunit's power.

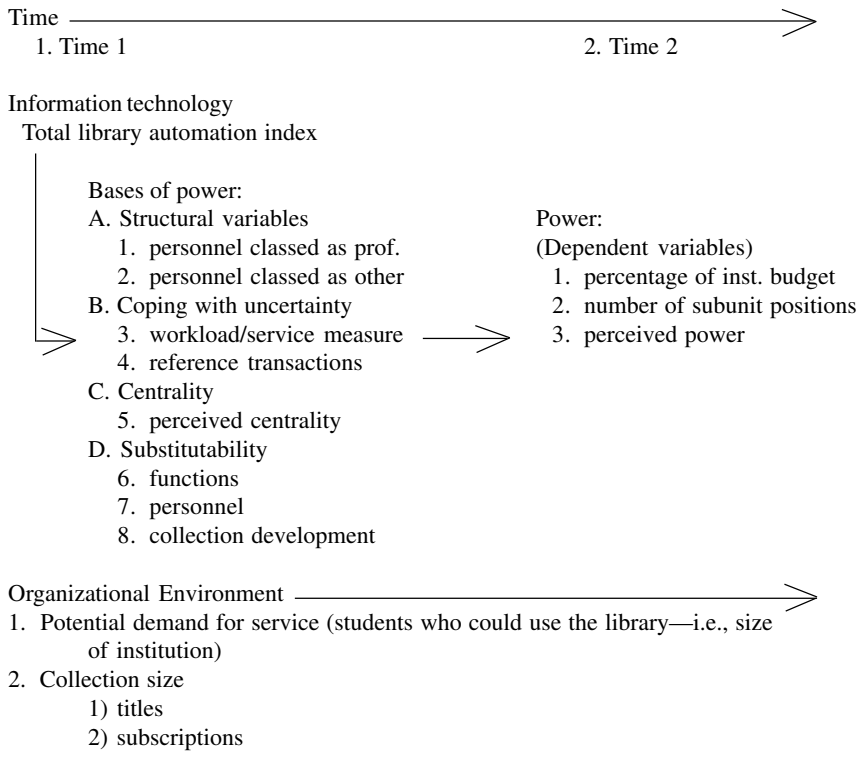
Integrated Model of Intraorganizational Power

The model of intraorganizational power proposed and tested in this study seeks to integrate the strategic contingencies model of intraorganizational power with concepts drawn from the literature of the effects of technology on organizations. Figure 1 presents the integrated model. The dependent variables are three aspects of subunit power; the major independent variables include a technology index and environmental variables; and the intervening variables are the bases of power.

For this research, technology—specifically, information technology—is the major independent variable. According to the model developed by Carol S. Saunders and Richard W. Scamell in their studies of management information systems (MIS), as MIS usage increases, the power of the subunit that controls the MIS also increases due to the increase in that unit's centrality, its ability to cope with uncertainty, and its nonsubstitutability.[14] Similarly, Andrew M. Pettigrew and Pfeffer and Huseyin Leblebici argue that information access and the control of information technologies are power resources.[15] Various authors within the library literature have also shown that automation is a change agent within libraries.[16]

The current integrated model also includes variables considered to be the bases of power. These include both structural variables and variables drawn from the strategic contingencies theory of or-

FIGURE 1
Integrated Model of Intraorganizational Power



ganizational power.[17] In keeping with the strategic contingencies theory, power is considered to be the main dependent variable.

Finally, the model posits that time is an important variable in its own right. The study is longitudinal so that the effects of technology may appear within both the bases of power and the power measures themselves.

The environmental variables provide a way to account for influences on the power of the library that lie outside the theories used to construct the integrated model. The size of the user population and the size of the collection are important environmental variables that must be considered.

In keeping with the strategic contingencies theory, power is considered to be the main dependent variable.

In brief, the model states that as technology within the subunit changes over time, the bases of power react to those changes, and that as the bases of power change, the power of the subunit changes. As a result, the manifestations of power as revealed by the power variables also change.

Research Question

One overarching research question guides this research: How has the control of ITs affected power within organizations? In particular, the research question can be made more focused by asking: How has the control of library-related ITs affected the library's power within the liberal arts college?

Methodology

The unit of analysis for this study was the library within the liberal arts college. The population frame consisted of all those colleges classified as Liberal Arts Colleges I or Liberal Arts Colleges II by the Carnegie Foundation for the Advancement of Teaching.[18] Only those colleges that completed both the 1982 HEGIS and the 1990 IPEDS surveys and that were not part of a multilibrary reporting group were included in the study. The final total population frame for the study was 487 institutions.

Variables in the Model

Most of the variables in the tested model used two measures (Time1 = 1981–82 academic year and Time2 = 1989–90 academic year) to examine changes occurring over this time span, although a few measured perceptions of change over the time period using only one. The time periods included in the study reflect the data available from the Higher Education General Information Survey (HEGIS) in 1982 and its 1990 replacement, the Integrated Post-Secondary Educational Data System (IPEDS). These two dates provided a basis for studying the changes in libraries during the 1980s, a period in which great strides were made in library automation.

The dependent variables were three measures of power: (1) percentage change in the institutional budget allocated to the library, (2) percentage change in the number of personnel in the library, and (3) perceived change in the power of the library.

Independent variables included the technology index and the environmental variables. Intervening variables included the structural variables, coping with uncertainty variables, centrality variables, and substitutability variables.

The technology index was developed recursively using existing measures and various data sources for library automation.[19] The library technology index was calculated simply by adding together the number of technologies incorporated into the library over the time span studied. These included automated acquisitions, automated serials, automated cataloging, automated circulation, online

public access catalog, network utility membership (OCLC, RLIN, WLN, etc.), network-based interlibrary loan, local area network within library, node on campus network, local/regional consortia or networks, telefacsimile, public computing workstations, CD-ROM indexes, reference database searching, and librarian/staff workstations.

The bases of power consisted of two major groups of variables: structural variables and contingency variables. The contingency variables included three subgroups: coping with uncertainty variables, centrality variables, and substitutability variables. These variables acted as dependent variables for analyses involving the technology indexes and environmental variables, as independent variables for analyses of the power variables, and as intervening variables in analyses of the entire model.

The structural variables examined the personnel of the subunit and consisted of two subvariables: percentage change in the number of personnel classed as professional and percentage change in the number of personnel classed as other. "Other" personnel included those individuals not classed as professional, such as support staff, nonprofessionals, and clerical workers.

Coping with uncertainty was defined as involvement within the work flow of the organization. Two coping with uncertainty measures were included: workload of the subunit (percentage change in the circulation per staff member) and instructional service of the subunit (percentage change in the number of reference transactions).

Centrality examined the ability of the library to support the primary mission of the college. This research used a single measure of centrality—perceived change in centrality.

Substitutability referred to the ability of other campus subunits to perform functions similar to those performed by the library. The three substitutability variables measured changes in the ability of other subunits to perform the library's information functions, the difficulty in hiring technologically qualified librarians, and the collection development responsibility of librarians.

The environmental variables examined changes within the subunit's environment and included change in potential demand for service (number of students) and change in collection size as measured by changes in the total title count and the number of periodical subscriptions.

Sources of Data

The sources of data included a mailed questionnaire and archival data. The questionnaire sought data for the following variables: amount of library automation; perceived change in power; perceived change in centrality; and perceived change in substitutability of functions, personnel, and collection development responsibility. Seven-point Likert scales were used for perceived change in power, centrality, and substitutability (three measures). A coin flip decided whether each question stressed an increase or a decrease in the variable under consideration. For the technology index, a list of technologies was presented and respondents indicated the year when each technology was made available in their libraries.

This research used a single measure of centrality—perceived change in centrality.

After pretesting, the questionnaire was sent to the directors of the 487 identified libraries, except those directors who participated in the pretest. If it was not returned within eight weeks of mailing, another copy was sent by mail. Usable responses were received from a total of 416 institutions (85.4%).

The HEGIS and the IPEDS surveys

provided data for the following variables for both Time1 and Time2: library budget as a percentage of the institutional general and educational budget, number of positions, potential demand for service (size), collection size (title and subscription counts), classification of personnel (professional and other), and workload/service of the library (circulation and reference transactions).

Methods of Analysis

Full and partial canonical correlation analyses were used to test the model which consisted of independent (automation indexes and environmental variables), intervening (bases of power), and dependent (power) variables. The significance level was set at $a = .05$.

In canonical correlation, each set of variables (i.e., the independent, intervening, and dependent variables) may be represented by at least one linear combination of variables, called a *canonical variate*. The correlation between these canonical variates is called the canonical correlation. Thus, *canonical correlation* analysis examines the relationship between two sets of variables and also can be used to partial out a third set of variables.

Table 1 provides descriptive statistics for the variables included in the study including the mean, standard deviation, maximum, minimum, and number of cases for which data were available.

Test of the Proposed Model

The proposed model was tested using a set of three canonical correlations. Table 2 provides the detailed statistics for all three steps of the analysis.

In the first step, the canonical correlation included the automation index and the environmental variables as independent variables and the bases of power variables as the dependent variables. The canonical correlation analysis yielded one significant canonical correlation between the automation index and the environmental variables and the bases of power (Wilks' Lambda = .77, F = 2.03, df = 32/901.4, $p < .001$). The amount of variance of the bases of power variables explained by automation and the environ-

TABLE 1
Summary Descriptive Statistics for Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
Automation Index					
Total automation	5.06	2.91	0	14	416
Bases of Power Variables					
Change in professionals	.23	.68	-1.00	9.00	487
Change in other staff	.34	1.31	-1.00	14.00	457
Change in circulation	5.78	129.20	-1.00	2830.40	480
Change in reference transactions	1.61	8.41	-1.00	141.86	444
Perceived centrality	4.74	1.47	1	7	375
Substitutability of functions	2.96	1.87	1	7	382
Substitutability of personnel	3.42	1.65	1	7	378
Substitutability of collection development	2.32	1.50	1	7	390
Environmental Variables					
Change in number of students	.29	.80	-.42	10.40	476
Change in number of titles	.31	2.09	-.85	41.24	405
Change in number of subscriptions	1.59	16.62	-1.00	306.69	463

TABLE 2
Canonical Correlation Analyses of Integrated Model: Standardized Structure Coefficients (Variate Loadings)

Step One

Canonical Variate:	1
Independent Variables (Automation Index & Environmental Variables)	
Total automation	.30
Change in students	.64
Change in titles	.67
Change in subscriptions	-.06
Dependent Variables (Bases of Power Variables)	
Change in professionals	.73
Change in other	.57
Change in circulation	.20
Change in ref. trans.	.35
Perceived centrality	.16
Subs. of functions	-.21
Subs. of personnel	-.16
Subs. of col. dev.	.47
Squared Canonical Correlation:	.12
Wilks' Lambda:	$F_{32,901.4} = 2.03$*

*p<.001

Step Two

Canonical Variates:	1	2	3
Independent Variables (Bases of Power Variables)			
Change in professionals	.60	.16	.70
Change in other	.92	.01	-.45
Change in circulation	-.01	.02	-.25
Change in ref. trans.	.01	-.04	-.13
Perceived centrality	-.07	.95	-.22
Subs. of functions	.06	.02	.05
Subs. of personnel	.01	.07	-.01
Subs. of col. dev.	.06	-.01	-.27
Dependent Variables (Power Variables)			
Change in budget	-.09	.04	1.05
Change in staff	1.02	.06	-.19
Perceived power	-.02	.99	-.21
Squared Canonical Correlation:	.76	.58	.04
Wilks' Lambda:	$F_{24,850.4} = 44.7$*	$F_{14,588} = 24.6$*	$F_{6,295} = 2.2$**

*p<.001, **p<.05

(continued)

TABLE 2, cont.
Canonical Correlation Analyses of Integrated Model: Standardized Structure Coefficients (Variate Loadings)

Step Three (Bases of Power Partialed Out) Canonical Variate:	1	2
Independent Variables (Automation Indexes and Environmental Variables)		
Total automation	.19	.99
Change in students	-.70	.27
Change in titles	.60	-.16
Change in subscriptions	-.23	.20
Dependent Variables (Power Variables)		
Change in budget	.46	.28
Change in staff	-.69	.75
Perceived power	.63	.48
Squared Canonical Correlation:	.10	.05
Wilks' Lambda:	$F_{12,627.3} = 3.5^*$	$F_{6,476} = 2.5^{**}$

*p<.001, **p<.05

ment was small (canonical correlation = .28, variance explained = 12%).

The canonical variate for the independent variables was characterized by the following significant loadings: total library automation index, .30; change in the number of students, .64; and change in the number of titles, .67. For the canonical variate of the dependent variables, the highest loadings were change in the number of professionals (.73), change in the number of other staff members (.57), change in reference transactions (.35), and change in collection development responsibility (.47).

In step two of the analysis, the bases of power were considered the independent variables and the power variables were the dependent variables. The analysis yielded three significant canonical correlations. The first canonical correlation (canonical correlation = .87, Wilks' Lambda = .09, F = 44.7, df = 24/850.4, p <. 001) explained the most variance (76%); the second explained 58 percent of the variance (canonical correlation = .76, Wilks' Lambda = .40, F = 24.6, df = 14/588, p <. 001); and the third explained 4 percent (canonical correlation = .21, Wilks' Lambda = .96, F = 2.2, df = 6/295, p <. 05).

The standardized canonical coefficients for the dependent variables (i.e., the power variables) showed that each variate had only one high loading: variate 1, change in the number of staff (1.02); variate 2, perceived power (.99); and variate 3, change in the budget allocation (-1.05). For the independent variables (i.e., the bases of power variables), the highest loadings for the first canonical variate were change in the number of professionals (.60) and change in the number of other staff members (.92), showing a strong relationship between the change in the number of professionals and the change in the number of other staff members variables with the overall change in staff power variable. For the second variate only perceived centrality loaded highly (.95), exhibiting a strong relationship with perceived power. Finally, for the third variate both change in the number of professionals (.70) and

change in the number of other staff members (-.45) exhibited high loadings and were significantly related to the change in budget variable.

The third step of the analysis used the automation indexes and the environmental variables as the independent variables and the power variables as the dependent variables with the bases of power variables being partialed out of the analysis.

Two canonical correlations were significant: canonical correlation = .32, Wilks' Lambda = .84, F = 3.5, df = 12/627.3, $p < .001$, 10 percent variance explained; and canonical correlation = .23, Wilks' Lambda = .93, F = 2.5, df = 6/476, $p < .05$, 5 percent variance explained. The variates representing the independent variables were characterized by high loadings of change in the number of students (-.70) and change in the number of titles (.60) for the first variate and total library automation (.99) for the second. All three power variables loaded highly on the first variate of the dependent variable: change in budget (.46), change in the number of staff (-.69), and perceived power (.63). For the second dependent variate, two of the power variables loaded highly: change in the number of staff (.75) and change in perceived power (.48). This step of the analysis showed that, although there is a significant relationship between automation and the environment and the power of the library, the effects are small.

Limitations

This research has several limitations. First, the study was conducted using data from only one broad classification group of academic institutions. As a result, the findings may not be generalizable to other types of academic libraries or to other types of libraries.

Second, the time span used as the basis of the study may not have provided a long enough time for changes caused by automation to have become apparent. The decade of the 1980s, however, was one of great changes in computers and library automation. Some differences due to automation may not have had time to manifest themselves over this time period.

Third, the underlying economic conditions of the institutions included in the study may have affected its results, especially the changes in budget percentage and staff power variables.

Fourth, the model proposes causality when the relationships between variables may merely be correlational.

Fifth, much of the research upon which the tested model was built was drawn from the administration and MIS literatures. The conclusions of such research that ITs have acted as change agents within organizations, especially businesses, may not be applicable to the academic library setting.

Finally, other exogenous variables not included in the model may have caused any changes that were identified. Such variables may include those that examine the economic condition of the colleges and the leadership styles of the college administrators and head librarians, both of which could affect the funding of the library significantly.

Conclusion

The driving question behind this research was: How has library automation affected the academic library and its position on college campuses, echoing the statement of Kenneth L. Kraemer and John L. King that "The fundamental question about computing and organizational politics is who gains and who loses from computing."[20] The present

The main idea expressed in the proposed model was that as automation within a library changed, the bases of power of that library also changed.

study developed and tested a model of intraorganizational power based largely upon the strategic contingencies theory of intraorganizational power. The strategic contingencies theory states that power within an organization can be viewed as a function of a subunit's ability to cope with uncertainty, its centrality to the organization, and the substitutability of its functions and personnel within the organization. The tested model also added automation, structural, and environmental variables to provide an integrated model of intraorganizational power.

The main idea expressed in the proposed model was that as automation within a library changed, the bases of power of that library also changed. Such changes in the bases of power would then cause changes in the power of the library on campus. The analyses showed that automation and the environment affected specific bases of power variables positively. In accordance with the strategic contingencies theory, the bases of power variables showed significant relationships with the power variables. The analyses also revealed a significant positive relationship between automation and the environment and power.

These results provide limited support for the major theory presented by this research, namely, that automation is a change agent within libraries. In the analyses presented in this study, the effect of automation, though significant, was weak. However, the core of the strategic contingencies theory was upheld with the bases of power accounting for 76 percent of the variance of the power variables.

Understanding the effects of library automation and obtaining a better view of the nature of power should prove to be beneficial to the directors of liberal arts college libraries. In various comments given by library directors in the course of this research, the directors believed that automation had been a major help in providing the library with increased power. Although automation was shown by the analyses to influence the bases of power, it had only a weak direct relationship to power itself.

This research provides one way to study the relationship between IT and power. The data presented and the results generated by them can help enlighten library directors as to the state of the field and provide insight into the effects that ITs have had on subunit power within the college.

As Pfeffer says, "Power and politics are often part of organizations, and need to be understood as fundamental and important processes."[21] This research is one step toward such an understanding within liberal arts college libraries.

Notes

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