Social Impacts of Computing

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Environmental and Institutional Models of System Development: A National Criminal History System

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ABSTRACT: This article tests two competing theories of system development referred to here as environmental and institutional models. These models form the basis for most explanations of why systems are developed and utilized. We will examine both models in detail and apply them to a single set of data concerned with the emerging national computerized criminal history system (CCH). A hybrid model, which combines elements of environmental and institutional approaches, is also developed and tested. A substantive result of this new model will alter our understanding of why a national CCH system is being developed. At the theoretical level, we conclude that a hybrid model is more powerful than either an environmental or an institutional model taken separately and that future research must take this into account.

1. MODELS OF SYSTEM DEVELOPMENT

Environmental or institutional models of organizational change are generally used to explain why systems are developed and utilized. Environmental models point to exogenous uncertainties and opportunities that organizations must either cope with or take advantage of in order to survive. Growing competition from other organizations, changing client or customer preferences, and population growth are examples of environmental uncertainties. These uncertainties are often simply referred to as "complexity." Environmental opportunities, though less frequently cited, are exemplified by such factors as declining hardware costs, market growth, external funding, and declining monetary costs. Uncertainties and opportunities are environmental insofar as they are not directly controlled by the organization.

Institutional models of system development focus on endogenous factors which are partially under organizational control or are the result of past organizational actions. The values, norms, and social structure of an organization are examples of institutional factors. Organizations, in this view, develop systems because they are believed to embody and reflect desirable values ("modernity" or "professional management") [6], because senior executives want to achieve high levels of organizational control, or because the organization possesses the required human and technical resources.

According to institutional models, systems may be developed in the absence of any environmental uncertainty or opportunity, and without any demonstrable contribution to the underlying "business" of the organization—whatever that may be [7]. This is not to say that systems development is unnecessary or undesirable. Although systems may not, in the institutional view, contribute to making better widgets, they contribute to the legitimacy and survival of the organization by garnering public support and stockholder confidence [3–5]. These two models—institutional and environmental—are explored below by examining factors which account for the adoption, utilization, and management of computerized criminal history systems.

2. DEVELOPMENT OF THE NATIONAL COMPUTERIZED CRIMINAL HISTORY SYSTEM

In a few years, the Federal Bureau of Investigation (FBI) will begin operating a national computerized criminal history system (CCH). This system will centralize at the federal level one of the largest public sector databases in the United States. A criminal history record contains information on police arrest charges, and, if it is complete, court findings (guilt, innocence, dismissal), and where the sentence, if any, was carried out.

There are about 195 million criminal history records in the United States concerning 36 million individuals active in the labor force [47, 55, 63]. The key to the national system is the on-going development of state computerized criminal history repositories which aggregate the criminal records generated by more than 60,000 local and state agencies, from police to courts and correctional institutions. At present, 33 states have a computerized criminal history system capability.

This article explores the power of environmental and institutional models to explain the patterns of adoption, utilization, and management of the state computerized criminal history systems which are the building blocks of the future national system.

2.1 Methods and Data

The research strategy employed in this article is to develop a measure of computer innovation composed of three distinct elements: adoption, utilization, and management of state CCH systems. In previous research, there has been a tendency to lump these analytically distinct facets of computer innovation into a single index [17]. Use of a single index as the dependent variable may mask interesting dynamics involved in computer innovation. Indeed, the working hypothesis of this article is that factors which cause variation in adoption are different from those which cause variation in utilization and management [65].

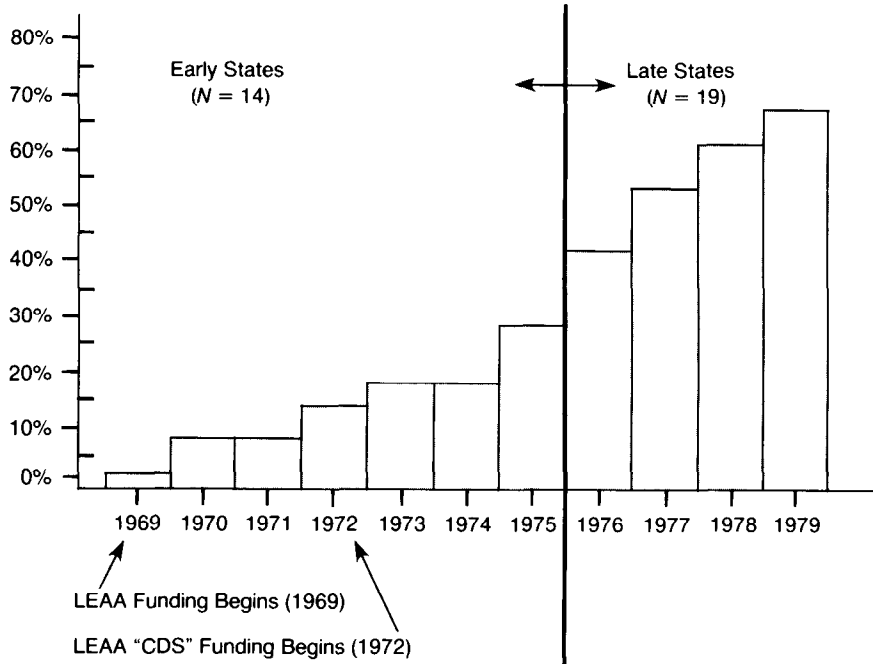
Once the dependent variables are properly conceptualized, we develop environmental and institutional explanations of system development in the form of two sets of hypotheses. A third hybrid model is then tested against empirical observations.

The data used to test the model were gathered in a 56 item survey completed by senior members of state criminal record systems in 1979 as part of a larger evaluation of the status of criminal records in the United States [47]. Forty-eight states responded with complete information.

2.2 Adoption of State CCH Systems

Table I presents a cumulative distribution of the adoption process, and divides the states into three groups: early, late, and nonadopting states.

TABLE I. Cumulative Frequency Distribution: CCH System Adoption



The following states correspond to the years on the graph: 1969: New York; 1970: California, Florida, Massachusetts; 1972: Delaware, Illinois, Texas; 1973: Oregon; 1975: Arizona, Georgia, Michigan, Utah, Virginia, Washington.

The following states correspond to the years on the graph: 1976: Alabama, Colorado, Connecticut, Missouri, Nevada, North Carolina, Ohio; 1977: Kansas, Louisiana, Minnesota, New Jersey, South Carolina; 1978: Alaska, Arkansas, Maryland, Nebraska; 1979: Hawaii, Oklahoma, Wisconsin.

As of 1980, the following states had not adopted CCH systems: Indiana, Iowa, Kentucky, Maine, Mississippi, Montana, New Hampshire, New Mexico, North Dakota, Pennsylvania, South Dakota, Tennessee, Vermont, West Virginia, Wyoming.

TABLE II. Extent of Management Controls over CCH Systems

	Number of states	
	Yes	No
Area:		
1. Institutional arrangements:		
Mandatory court reporting of dispositions	20	13
Criminal sanctions for abuse	28	5
2. Implementation of rights:		
Statute basis for rights	26	7
Statutes apply to all agencies	27	6
3. Information controls:		
Automatic disposition review	17	16
Systematic review of logs	10	23

The initiation of special federal funding programs such as the Law Enforcement Assistance Administration's (LEAA) Comprehensive Data Systems Program (CDS) is noted in Table I and their role in explaining the rapid growth of CCH systems after 1976 is explored below. We are interested in answering two questions about the adoption of CCH systems. First, in what ways do adopting states differ from nonadopting states? Second, what factors distinguish the early adopting states from those which adopted later?

2.3 Utilization of State CCH Systems

In this research, we define utilization as the number of criminal justice requests for criminal history information per capita. This measure is highly correlated ($r = 0.98$) with the per crime utilization of state CCH systems. There is considerable variation in utilization: the range is from 3 requests per capita to 260, with a mean of 47. The factors which cause this variation are discussed below.

2.4 Extent of Management Controls

In May 1975, LEAA published regulations which required states to develop specific management policies in five broad areas: completeness and accuracy of records, audit, individual access and review, limits on dissemination of records, and security [49]. Despite these regulations, LEAA permitted the states considerable latitude in implementing these regulations, provided no additional resources, and provided for no sanctions in the event states failed to comply with the regulations. Several studies conducted since 1976 have concluded that there is considerable variability among states in the implementation of these regulations, and considerable laxity in the management of state CCH systems [36, 44, 47].

Our survey included twenty items concerned with the extent of management controls in three areas: institutional arrangements, implementation of legal rights, and information controls. A factor analysis of these items produced a smaller set of six items which account for most of the variation in the three broad areas.

Table II illustrates the distribution of the states over these six measures of management. Most states have developed a statutory basis for individual rights which applies to all agencies. There is more variation in other areas, most notably in the area of information controls. A large number of states do not automatically review their files to assure that a court disposition is obtained for each arrest (16), even more states do not conduct systematic reviews of transaction logs (23), and a large number of states do not require that courts report dispositions to their files (13). What is the explanation for this variation in the extent of management control over CCH systems?

3. EXPLANATORY MODELS

The literature on system development, as well as the broader literature on organizational innovation, identifies two broad factors which account for organizational innovation: exogenous environmental factors and endogenous institutional factors [56, 68]. We will refer to these streams of explanatory factors as 'models' even though this may lend an aura of precision not warranted by previous work. First, we will explore the plausibility of environmental explanations of CCH systems and then discuss institutional explanations.

3.1 Environmental Models

In environmental explanations, the environment is seen as presenting organizations with both uncertainties and opportunities [2, 16, 60]. Objective uncertainties created by the environment are, in turn, perceived as organizational needs, and organizations respond rationally to these uncertainties by developing policies and programs to reduce or eliminate the uncertainties. The computer literature, in particular, emphasizes the role of computers in fulfilling organizational needs created by an ever changing and more complex environment [17, 38, 53, 57, 64].

3.1.1 Environmental Uncertainty

Officials responsible for the development of state CCH systems typically identify the need for these systems as a result of a growing crime rate, increases in criminal mobility, population growth, and expanding prison populations [23]. In this view, CCH systems are a rational response to clearly identifiable environmental changes and resulting organizational needs.

From 1967 to 1979, the period during which the state systems were developed, states and localities experienced an astounding increase in the incidence of serious crime. In some cities, the crime rate increased 20 percent per annum, while the overall U.S. crime rate increased approximately 10 percent per annum [61]. Between 1967 and 1972, the rising crime rate was coupled with the growth of civil rights and antiwar movements which provided the occasion for demonstrations and riots in highly visible urban areas. These developments, in turn, led to rapidly growing arrest rates and corresponding burdens on the administrative record-keeping functions in local and state criminal justice agencies. Knowledgeable observers at the time claimed that the administration of criminal justice was in a state of virtual breakdown caused by the enormous numbers of arrested persons and the fragmentation of

information among thousands of criminal justice agencies [33, 55]. As one commentator [36] noted: "It was impossible to figure out if the guy you arrested was wanted in a town down the highway, or some other place in the state, or even if he had a history of arrests and should be held for further investigation."

We identify environmental uncertainties using three indicators: state population (log 10), crime rate per 100,000 residents (known FBI index crimes), and prisoners per 100,000 population [61]. The first two environmental hypotheses are:

H1: Adoption of CCH systems is positively related to environmental uncertainties.

H2: Utilization of CCH systems is positively related to environmental uncertainties.

Environmental explanations of system development are often silent on questions of management. However, implicit in the work of Blauner and Woodward, authors who utilize environmental explanations of organizational change, is the notion that organizations facing similar needs ineluctably adopt a similar social organization in accordance with some efficiency criterion [9, 11, 60, 66]. In this view, organizations are structurally similar, and hence management is similar, because similar environments create similar exigencies and interdependencies, and only certain structural arrangements are capable of managing these interdependencies [1, 26].

In the case of CCH systems, this suggests that management patterns should be similar across all states because each state is responding to similar environmental uncertainties. A third environmental hypothesis is:

H3: There is no variation across states in the extent of management controls over CCH systems.

3.1.2 Environmental Opportunity

While a changing environment may have produced uncertainties and provided a necessary condition for the development of CCH systems, the same environment provided significant opportunities for states to develop CCH systems. A growing national awareness of crime coupled with an activist president who believed that the federal government should play a larger role in criminal justice affairs, produced an unprecedented series of reforms in the direction of criminal justice policy and a marked change in the relationship between federal and state criminal justice agencies. The creation of the President's Commission on Law Enforcement and the Administration of Justice in 1965 reflected the fact that crime and social disorder had come to the top of the national domestic agenda. The Commission specifically suggested that "criminal justice could benefit dramatically from computer-based information systems" and strengthened the belief that computer and communications technology could significantly reduce the incidence of new crime and assist in the arrest, prosecution, and punishment of criminal offenders [55].

In 1968 Congress passed the Omnibus Crime Control and Safe Streets Act which established the Law Enforcement Assistance Administration (LEAA). The LEAA represented the federal government's first comprehensive aid program for the reform and modernization of the criminal justice process. From 1969 to its end in 1979, LEAA distributed approximately $4.6 billion. Fifteen percent of its total budget (slightly over $700 million) was distributed by LEAA's Comprehensive Data Systems Program (CDS) which began, in 1972, to distribute funds to the states for the exclusive purpose of developing information and statistical reporting programs and computerized criminal history systems [37]. This federal funding was matched by state and local contributions of more than $1 billion to CCH systems from 1967 to 1979 [20]. Thus, whatever the "objective" needs for state CCH systems produced by rising crime rates, it is plausible that federal funding per se significantly influenced the development of state CCH systems (as in other state and local computer innovations) [30, 32].

In addition to federal funding, a state's location may also have provided an important environmental opportunity for the development of CCH systems. Previous research on system development has found, for instance, that the proximity of computer innovations in surrounding localities and states has an important effect on system development in a state [17, 31]. Innovations adopted in nearby states and localities provide models and practical experience for other states to draw upon and spur the innovation process [67, 68].

In our research, we measure environmental opportunities by the level of LEAA and CDS funding, both total and per capita, which were received by a state in the period 1969–1979. We define regions with a four-way classification: south, west, midwest, and northeast, using the same classification scheme as the Bureau of the Census [61].

Environmental hypotheses regarding opportunities are:

H4: Adoption of CCH systems is positively related to environmental opportunities.

H5: Utilization of CCH systems is positively related to environmental opportunities.

Once again, environmental models generally do not specify how opportunities are related to the management of innovations. In this case, however, there is a plausible link. As noted above, LEAA "required" states to adopt certain broadly stated goals and to accept specific management practices to assure individual rights and to maximize the completeness and accuracy of records. The regulations called for systematic audits of user agencies, transaction logs to trace information, and reviews of files to prevent dissemination of incomplete records (see Table II). States were under pressure to adopt certain management practices to the extent that they accepted LEAA funds. An environmental hypothesis here is:

H6: The extent of management controls is positively related to environmental opportunities, specifically, LEAA funding.

3.2 Institutional Models of System Development

In environmental models, organizations play merely an intermediary role insofar as they appear at all. The environment presents organizations with uncertainties and opportunities. The organization is able to reduce uncertainties through adoption of innovations to the extent that it is appropriately structured and technically endowed. The chain of reasoning proceeds from environment, to organization, to innovation [17, 19, 31 (p. 25), 60]. Such environmental models are inherently conservative because they suggest that whatever organizations do is an intended response to an environmental uncertainty [51].

This leaves out the fact that organizations can act without anyone intending them to act and without any precipitating environmental pressures [2, 21, 28].

In contrast to environmental models, a different tradition in sociological theory and research argues that organizational behavior is a function of widely shared values and interests rather than any "objective" environmental pressures. In these "institutional models," organizations may adopt computers because they are culturally approved by society and other organizations, and because they further the interests of subgroups and individuals in organizations.

The term 'institution' is used here in its traditional sociological sense as a set of widely shared values and interests pertaining to areas of strategic social importance. These values and interests are served by specific organizations through the allocation of statuses and roles, and they are internalized by individuals through lengthy socialization carried out by organizations. Behavior is "institutionalized" insofar as it conforms with these widely shared interests and values. 'Institutional' models are, therefore, those models which explain organizational behavior in terms of internalized values, interests, and structures [25].

Persons familiar with actual organizational decision processes will easily recognize the role of values and interests in decisions about information systems technology. Recently, in a faculty meeting, one person argued that "We [the university] must obtain a high speed digital network primarily because other universities of distinction have them." As Meyer and Rowen [42] note: " . . . organizations are driven to incorporate the practices and procedures defined by prevailing rationalized concepts of organizational work and institutionalized in society. Organizations that do so increase their legitimacy and their survival prospects, independent of the immediate efficacy of the acquired practices and procedures. Institutionalized products, services, techniques, policies and programs function as powerful myths, and many organizations adopt them ceremonially."

Even this formulation is environmentally driven: organizations adopt innovations because an environment pressures them to seek legitimacy and external support. A more radical departure from conventional thinking can be found in sociological studies of organizational underlife. Schrag's study of the Boston School System found that educational innovation can be fun and profitable for the participants because it creates new specialties, and hence organizational (if not occupational) mobility, and it often uses external funding sources which enhance internal budgets [10, 27, 58]. Several detailed studies of computer system development in large organizations and institutions, beginning with Laudon's study of welfare and criminal justice institutions [33], to Kling's study of a single welfare agency [29], to Danziger et al. [18] study of computer innovation in hundreds of counties and cities, have found that fundamental causes of their being are the internal payoffs [41]. In these studies, computer innovation reflects the desires, values, and interests of specific organizational actors rather than some reified environmental pressure to be efficient or look good. If one or several powerful actors in an organization believe in computer innovation (for whatever reason ranging from a calculation of personal benefits to a simple positive attitude), then they will put forth computer systems as a solution to a host of organizational problems whether or not such systems in fact provide a "solution" to any particular problem. Cohen et al. [13] have summarized this view: "Organizations can be viewed for some purposes as collections of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be an answer, and decision makers looking for work."

In previous research, the institutional model identifies those institutional and organizational features which predispose an organization to adopt innovations. If these are correlated with the adoption of an innovation, then institutional factors play at least an influencing role, or, in some cases, a decisive role. Three institutional factors are discussed and illustrated below: sociopolitical culture, specific organizational structure, and technical resources.

3.2.1 Sociopolitical Culture

Several studies have found that computer system development is encouraged by a supportive sociopolitical culture. Values that encourage innovation and a powerful executive capable of carrying out the innovation are important elements of a supportive culture [31, 33, 39]. Measuring 'supportive culture' can be difficult, but few would deny that some organizations have stronger value commitments to change and more powerful implementing structures than other organizations [67]. In the public sector, for example, computer innovation is encouraged by the presence of a strong central executive and a "reform" orientation to politics. The reform orientation, briefly, supports the development of professional, executive, and legislative branches isolated from parochial political interests and the application of modern management techniques to public policy, among which computers are seen as a leading element [18, 33]. Also, spare resources, wealth per se, can facilitate the realization of such values and permit the exercise of powerful implementing structures [19].

In the case of state CCH systems, the importance of a supportive sociopolitical culture cannot be overemphasized. State CCH systems are multiorganizational systems that require the cooperation of hundreds of police agencies, district attorneys, and court magistrates to provide record segments to a centralized state file. Each of these agencies is strongly rooted in local politics by tradition and constitutional design. A state CCH system inherently imposes new patterns of behavior and additional costs on these local agencies, and implies a new political relationship in which state interests, to some extent, supercede local interests. A judge, for instance, may not have the staff to inform the state of every court disposition but may be required to do so by CCH system rules. Similarly, local police have freely cooperated with local banks by supplying criminal information on potential bank employees in return for financial information on bank clients of interest to the police. This freedom of action can be constrained by state CCH systems prohibiting such behavior.

By supplying funds to assist compliance, a supportive state political culture can be crucial in persuading local agencies to cooperate. An institutional model suggests the following hypotheses:

H7: Adoption.

H8: Utilization.

H9: The extent of management controls is positively related to the presence of a supportive sociopolitical culture.

We use several measures of the reform orientation as indicators of the cultural support for systems development. Executive and legislative branch reform indices are used to characterize the general institutional features of state government. The executive branch reform index is an additive index measuring three items: governor's tenure in years, veto power, and appointive power [15]. The legislative reform index reflects five items: legislative branch functionality, accountability, level of information, independence, and representativeness [12]. In addition, per capita income is included as a measure found in previous research to be related to a strong, centralized political structure in the states [22].

3.2.2 Organizational Structure

While the general sociopolitical culture may influence the propensity and capability to innovate, it is also important to consider the features of the specific organization and functional area which may contribute to the adoption, use, and management of computer innovations [52]. While a private firm may, in general, be highly supportive of innovations, its warehousing operation may be archaic. Likewise in the public sector, a state may be, in general, supportive and capable of innovation, but its criminal justice organization may have remained unchanged since the 19th century. Indeed, in American politics, the criminal justice area is often the last to come under the control of central state authorities and in many states remains dominated by local interests. Previous research has found that CCH systems were more readily adopted, more likely to be utilized, and more closely managed where states had a strong control over local criminal justice budgets (through a state department of justice, for instance) [33].

The adoption of CCH systems may be more likely, and their utilization may be higher, where the criminal justice culture is particularly "strong" or "severe" [48]. For instance, there are behavioral differences among states in terms of the certainty and severity of punishment, the relative size of the police force, and the development of special programs which are specifically designed to ensure the use of criminal history data on arrested persons, for example, special prosecutor programs to assure maximum bail and sentencing for repeat felons [50]. These behavioral differences reflect different historical traditions which have been strengthened by contemporary politcal forces seeking harsher treatment of criminal offenders. Where these conditions exist, an institutional model suggests that the adoption of CCH systems will be more rapid and their utilization more intense:

H10: Adoption.

H11: Utilization.

H12: The extent of management controls over CCH systems is positively related to the presence of a supportive organizational structure.

The extent to which state authorities influence local agencies is defined as the percentage of the state's total criminal justice budget contributed by the state government. The "strength" of the criminal justice culture is defined as the number of law enforcement officers per 100,000 population. The "severity" of the criminal justice culture is defined as the median number of months served by convicted murderers [50].

3.2.3 Technical Resources

A last organizational factor to consider is technical endowment. States which possess significant human and technical computer resources may adopt systems faster, and utilize and manage them more intensively than other states. State and local governments are among the largest users of computer resources in the United States, spending over $1 billion annually [32]. Prior research in the institutional tradition has found technical experience to be related to successful implementation of systems [33, 39, 67]. The following institutional hypotheses are appropriate:

H13: Adoption.

H14: Utilization.

H15: The extent of management controls over CCH systems is positively related to the level of technical resources in a state.

We evaluate technical endowment using two indicators: the megabyte capacity of state government computing facilities (derived by totaling the capacity of all

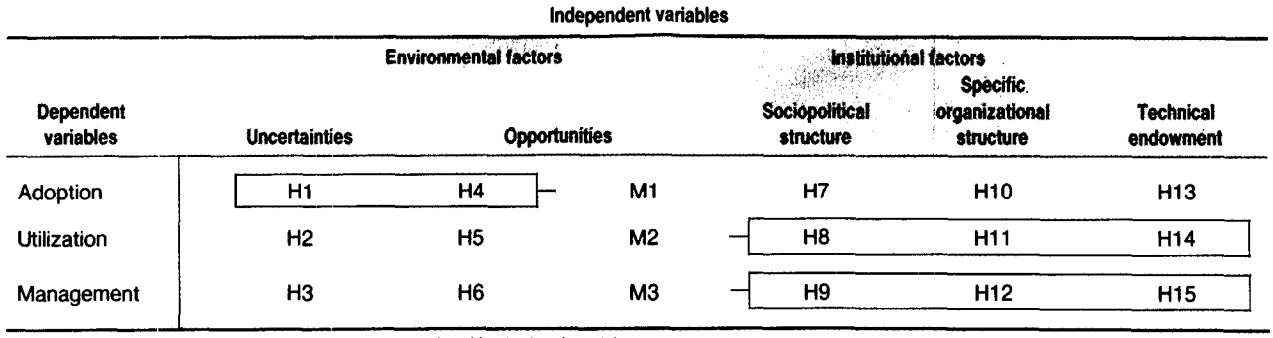


FIGURE 1. Summary of Hypotheses

state data processing mainframes) and the number of computer and information science graduates from all state institutions of higher education (B.A. level and above) [46, 62].

A better measure of a state government's human resources clearly would be the number of computer employees or the total number of computer personnel in a state labor force. Unfortunately, these data are not available.

4. RELATIONSHIP BETWEEN ENVIRONMENTAL AND INSTITUTIONAL MODELS

Theories are supposed to predict the relationships among variables and the changes in these relationships over time or under different circumstances [59]. Now that we have developed environmental and institutional explanations for CCH system adoption, use, and management, it is appropriate to consider how these different explanations might relate to one another. We do not believe these explanations are mutually exclusive. Both point to important factors in system development. However, their importance changes over time as a system develops from early adoption, to implementation and use, and finally to day-to-day management [24]. We will refer to hypotheses about the relationship between environmental and institutional models as "meta hypotheses" and suggest that:

M1: Adoption of CCH systems is primarily determined by environmental factors.

Rationale: Organizations are at least "half rational" [60]. In systems of the magnitude of CCH systems, organizations are constrained to demonstrate a need for the system and a financial capability to develop it. Internal organizational pressures to adopt an innovation such as a CCH system are of themselves insufficient to lead to adoption. Whether or not the adoption of the innovation will truly reduce environmental uncertainties is irrelevant. At least, however, the innovation must be perceived as relevant to a highly visible need by both the organization and the public.

M2: Utilization is primarily determined by institutional factors.

Rationale: Utilization is a far more complex process than mere adoption of a system. Prior research has found utilization to be a function of a "successful" implementation, which, in turn, depends on a number of internal social and political factors [38].

M3: The extent of management controls over CCH systems is primarily determined by institutional factors.

Rationale: In most of the research concerned with implementation, the actual management of a system is heavily dependent on the structure, values, and technical capabilities of the support staff of the organization in which the system resides [40].

Figure 1 summarizes the hypotheses and illustrates the expected relationships between environmental and institutional factors.

5. FINDINGS

5.1 Adoption

Table III presents an analysis of the consistency of the factors related to the states' adoption of CCH systems. We will consider a factor to be "important" insofar as it is able to discriminate consistently among cases in three comparisons. We use a T-test among subsample means assuming a common variance unless dictated otherwise by an F-test of subsample variances [8]. Given that the number of cases is quite small, a statistically significant difference at the .05 level indicates a substantial difference among groups.

Environmental uncertainties (crime, population, and, to a lesser extent, the size of the prison population) appear in Table III to be the factors most consistently related to CCH adoption. They are followed closely by environmental opportunities (LEAA and CDS total funding). In addition, one institutional factor, technical resources (total megabytes and computer graduates), is powerfully and consistently related to adoption.

Organizational structure and value factors (police officers per 100,000 population and severity of punishment) substantially discriminate current CCH states from those which have not yet adopted, but they fail to discriminate in other comparisons. The general sociopolitical culture variables are the least important factors in adoption.

Characterizing the adoption process, both adopting and early adopting states were high crime, populous states. This confirms M1 which argued that adoption is largely a result of environmental uncertainties and opportunities. An unexpected finding is that an institutional factor, technical resources, also plays an important role in adoption. The question is: did having a lot of computer resources per se, independent of environmental factors, lead to adoption of CCH systems? A closer examination of these factors and their intercorrelations points out the difficulties of separating environmental and institutional factors in an unambiguous fashion.

Table IV presents the intercorrelations of all variables used in this analysis. Here it is clear that states with either a large population or a higher crime rate attracted federal funding. And, a large population is also strongly related to high levels of computer resources ($r = +.72$).

Therefore, high levels of computer resources per se did not lead states to develop CCH systems. The argument most consistent with these data is that populous states have, over the years, developed significant technical and human resource capabilities to cope with environmental uncertainties. These resources, which are the result of prior investments, can be parlayed into the development of new systems such as the CCH.

Environmental explanations appear to be most plausible in the case of adoption, and M1 is supported. Insofar as institutional factors are important at all, they turn out to depend on environmental factors.

5.2 Utilization

We suggested (M2) that a system is utilized to the extent that it is successfully implemented. Following previous research, we expected that utilization would primarily be determined by institutional factors: general sociopolitical culture, organizational structure, and technical resources.

To a large extent, these expectations are borne out by the data (see Table V). Because we are examining only states which have adopted CCH systems ($n = 33$), we have expanded the technical resources variable to include measures of experience (measured by age of the CCH system), size of file, and sophistication of applications (an additive index of the total number of different applications supported by the system). Of the six factors related to utilization in Table V, four (state control of

TABLE III. Factors in the Adoption of CCH Systems: Differences Between Sample Means[1]

	Earliest versus all other states ($n = 14$ versus $n = 34$)	Early versus late computer states ($n = 14$ versus $n = 19$)	Computerized versus noncomputerized states ($n = 33$ versus $n = 15$)
Environmental factors			
1. Uncertainties:			
Crime rate	(+)***	(+)**	(+)***
Population	(+)***	(+)*	(+)***
Prisoners/per 100,000	(+)*		(+)***
2. Opportunities:			
LEAA funds (Total 1969–1979)	(+)***	(+)**	(+)*
CDS funds (Total 1969–1979)	(+)***	(+)	(+)***
LEAA funds/per capita***	(−)*		(−)***
CDS funds/per capita			
Region			
Institutional factors			
1. Sociopolitical structure:			
Executive branch reform index			(+)
Legislative reform index			
Income/per capita (1979)	(+)		(+)***
2. Organizational structure:			
State control of criminal justice			(+)
Police officers/per 100,000	(+)*		(+)***
Severity of punishment index			(−)*
3. Technical resources:			
Total state megabytes (1979)	(+)***	(+)***	(+)*
Total computer graduates (1979)	(+)**	(+)***	(+)**
Megabytes/per capita			(+)
Computer graduates/per capita	(+)**	(+)	

Key: ±: Direction of relationship.
*: Significant at .1.
**: Significant at .05.
***: Significant at .01.
[1] A T-Test was used to determine if the difference between subsample means was significant.

TABLE IV. Correlation Matrix (All States $n = 48$)

VAR	CDS$/ CAP	LEAA $	CDS $	CRIM	POP	INC$/ CAP	EXE REF	LEG REF	STAT CJ$	PRIS	SEV PUN	POLI	MEGA CAP	GRAD CAP	MEGA	GRAD	AGE	SIZ	SOPH	USE CAP	USE CRIME
LEAA/CAP	.07	−.20	−.14	−.33	−.45	.09	.20	−.08	.17	−.40	−.07	.08	.14	−.13	−.23	−.19	−.34	−.07	−.27	.18	.13
CDS$/CAP		−.33	.24	.48	−.49	.30	.06	−.13	.33	.11	−.23	.44	.39	−.02	−.34	−.24	.19	−.19	−.16	.31	.19
LEAA$			.68	.21	.86	.24	.30	.35	−.21	.11	.04	.27	−.46	.04	.83	.87	.22	.86	.32	.09	−.04
CDS$				.42	.53	.31	.49	.26	−.14	.03	−.03	.52	−.32	.10	.48	.64	.41	.74	.23	.17	.03
CRIM					.11	.58	.00	.24	.44	.34	−.19	.69	.03	.15	.13	.27	.62	.24	.22	.23	−.02
POP						.04	.22	.23	−.36	.23	.06	.10	−.60	.03	.75	.73	.29	.70	.47	−.01	−.07
INC$/CAP							.33	.45	.48	−.06	−.08	.56	.00	.06	.19	.27	.35	.26	.29	.17	−.05
EXE REF								.29	−.12	−.33	−.04	.11	−.16	−.02	.20	.23	.18	.36	.00	.12	.11
LEG REF									.04	−.26	.14	.20	−.17	.05	.31	.35	.11	.33	.09	−.14	−.15
STAT CJ$										.38	−.36	.44	.19	−.10	−.22	−.18	.23	−.21	.04	.23	.05
PRIS											−.32	.26	.01	−.06	.15	.07	.41	.03	.20	.13	.01
SEV PUN												−.27	−.03	−.10	.03	−.01	−.23	.02	.00	−.39	−.26
POLI													.02	.10	.40	.41	.45	.37	.19	.12	−.08
MEGA CAP														.00	−.15	−.31	−.13	−.41	−.39	.09	.13
GRAD CAP															.13	.48	.14	.08	.09	.30	.23
MEGA																.79	.23	.63	.25	.01	−.06
GRAD																	.25	.81	.27	.20	.05
AGE																		.20	.38	.48	.27
SIZE																			.14	.12	−.02
SOPH																				.19	.14
USE CAP																					.86

VAR = Variable
LEAA/CAP = LEAA per capita funding
CDS$/CAP = LEAA Comprehensive Data System (CDS) per capita funding
LEAA$ = LEAA total funding
CDS$ = Comprehensive Data System (CDS) total funding
CRIM = Crime rate per 100,000
POP = Total population size
INC$/CAP = Income per capita
EXE REF = Executive reform index
LEG REF = Legislative reform index
STAT CJ$ = State criminal justice expenditure/Total criminal justice expenditure (or state proportion of total criminal justice expenditure)
PRIS = Prisoners per 100,000
SEV PUN = Severity of punishment index
POLI = Police officers per 100,000
MEGA CAP = Megabyte capacity of state computers per capita
GRAD CAP = Information systems graduates per capita
MEGA = Total megabyte state capacity
GRAD = Total number of graduates in information systems or related fields
AGE = Age of state criminal justice system
SIZ = Size of state criminal justice system (number of records)
SOPH = Sophistication of state criminal justice system index
USE CAP = Utilization per capita of state criminal justice system

criminal justice budgets, severity of punishment, computer graduates per capita, and age of the system) are institutional factors. Two of the related factors are, unexpectedly, environmental factors (LEAA and CDS funds per capita).

The institutional explanation (M2) receives broad support in Table V, but there are two anomalies: the most powerful factor is severity of punishment ($r = -.50$, $p < .001$), but the direction of the relationship is opposite to that of our prediction. Second, utilization is, in part, associated with two environmental factors, LEAA and CDS funding, which we did not expect.

An examination of the correlation matrix for computer states ($n = 33$) provides a plausible explanation of the negative relation between severity of punishment and utilization. States with severe punishment patterns have little state control of criminal justice budgets ($r = -.41$, $p < .01$), have small police forces relative to population ($r = -.32$, $p < .05$), have low CDS federal funding ($r = -.27$, $p < .10$), and have little hardware capacity ($r = -.21$ n.s.).

The pattern that emerges reveals that utilization is low in those states with a relatively weak state criminal justice bureaucracy, a correspondingly greater degree of local autonomy, and much higher levels of punishment severity. Utilization is high in those states which have experienced a reform of criminal justice which usually entails a greater state role in criminal justice affairs including the sentencing behavior of judges. Indeed, one thrust of criminal justice reform programs is the reduction of judicial sentencing disparity and severity [14].

Looking next at the unexpected role of LEAA funding in the utilization of CCH systems, we can extend the previous argument. We would expect reform-oriented criminal justice bureaucracies to emphasize modern management tools and to specifically seek out federal funding to support CCH systems. This is precisely what we find: state control of criminal justice budgets is related to both LEAA and CDS funding per capita ($r = +.29$ and $+.34$ $p < .05$).

CCH system utilization is primarily determined by hypothesized institutional factors (M2). Environmental factors are linked to institutional arrangements and have little independent affect on utilization insofar as they are important at all.

5.3 Extent of Management Controls

In M3, we hypothesized that the extent of management controls over CCH systems, the presence of institutional controls, the level of implementation of legal rights, and the strength of information controls, would be determined by institutional factors and would be essentially unrelated to environmental factors. The management features that we focus on in this research require both a value commitment from executive authorities as well as a compliant legislature willing to impose and fund the statutory controls.

TABLE V. Factors in the Utilization of CCH Systems[1]

	Per capita utilization
Environmental factors	
1. Uncertainties:	
Crime rate	
Population	
Prisoners/per 100,000	
2. Opportunities:	
LEAA funds (Total 1969–1979)	
CDS funds (Total 1969–1979)	
LEAA funds/per capita	+.37**
CDS funds/per capita	+.30*
Region	
Institutional factors	
1. Sociopolitical structure:	
Executive branch reform index	
Legislative reform index	
Income/per capita	
2. Organizational structure:	
State control of criminal justice	+.20
Police officers/per 100,000	
Severity of punishment index	−.50***
3. Technical resources:	
Total state megabytes (1979)	
Total computer graduates (1979)	
Megabytes/per capita	
Computer graduates/per capita	+.28*
Age of system	+.47***
Size of file	
Sophistication index	

Key: *: Significant at .10.
**: Significant at .05.
***: Significant at .01.
xx: Significant at .20.
[1] Table reports Pearson correlation coefficients.

We expected sociopolitical culture to be closely related to management. In addition, we expected that some of the management controls such as mandatory court reporting of dispositions and systematic review of transaction logs would require additional computer resources.

To a large extent, these expectations are borne out by the data although the relationships are weaker than expected. Table VI illustrates the factors that account for variation in CCH systems management. The most significant determinant of variation in the extent management controls of CCH systems is a general sociopolitical factor, executive branch reform, which is related to criminal sanctions for abuse of information, a statutory basis for legal rights, and systematic review of transaction logs (all at $p < .05$). Technical resources (megabytes per capita, experience, and sophistication) are also related to several management controls.

Environmental factors are virtually unrelated to the management variables. However, LEAA and CDS funds per capita are weakly related to mandatory court reporting, a statutory basis for rights, and systematic review of logs. The most powerful determinant of the

extent of management controls over CCH systems is the broadly gauged sociopolitical culture in which the system is embedded, and to a lesser degree, the technical resources available.

6. CONCLUSION

This research examined both theoretical and substantive questions. The theoretical question explored two commonly used models for explaining why and how systems are adopted, used, and managed with the same data set. The substantive question asked why the states adopted CCH systems.

On the theoretical question, the findings clearly support the idea that both environmental and institutional factors play important roles in the adoption, utilization, and management of computer systems. More important, we have demonstrated a sequence in which these factors operate: environmental factors play a dominant role in adoption while institutional factors play a dominant role in utilization and management. The system development process is composed of distinct stages shaped by different factors. Several questions remain: why might this sequencing of factors occur, and how generalizable are the results to other system development projects?

In the specific case of large scale computer systems, the sequencing of factors appears to be the result of both high organizational costs and the scope of innovation which involves large numbers of organizational subunits. Because of high organizational costs (both monetary and other), organizations are not likely to adopt systems unless they can be shown to contribute in some demonstrable fashion to satisfying some visible and legitimate "need." Once adopted, however, implementation, utilization, and management are highly dependent on an array of institutional and organizational factors. Variation in these aspects of systems development can be expected to be related to the social and institutional features of organizations and to have little or nothing to do with the factors which led to adoption.

Our findings parallel and extend previous research. Straightforward environmental explanations of system

TABLE VI. Factors in the Management of CCH Systems

Independent variables	Institutional controls		Implementation of legal rights		Management controls	
	Mandatory court reporting	Criminal sanctions for abuse	Statute basis for rights	Applies to all agencies	Auto disposition review	Systematic review of logs
Environmental factors						
1. Uncertainties:						
Crime rate				(+)		
Population						
Prisoners/per 100,000		(−)				
2. Opportunities:						
LEAA funds (Total 1969–1979)						
CDS funds (Total 1969–1979)						
LEAA funds/per capita					(+)	
CDS funds/per capita	(+)		(+)			
Region						
Institutional factors						
1. Sociopolitical structure:						
Executive branch reform index		(+)**	(+)***			(+)**
Legislative reform index				(+)*		
Income/per capita (1979)				(+)*		
2. Organizational structure:						
State control of criminal justice						
Police officers/per 100,000				(+)		
Severity of punishment index				(−)		
3. Technical resources:						
Total state megabytes (1979)						
Total computer graduates (1979)						
Megabytes per capita	(+)					
Computer graduates per capita						(+)
Age of system			(+)***			
Size of file						
Sophistication index						(+)**

Key: *: Significant at .10.
**: Significant at .05.
***: Significant at .01.
±: Significant at .20.
[1] A T-test was used to test for the statistical significance of the difference among subsample means.

adoption are common in the literature [17]. Other researchers have mixed environmental and institutional factors in the same model of computer use [19]. Others have focused solely on the role of endogenous values and political interests—institutional factors—in explaining adoption, use, and management [18]. We explicated both environmental and institutional models and deployed them against the same data set to provide a critical test of both theories. Our findings provide an integrative framework for previous divergent streams of research, and lead to a more sophisticated understanding of the development process.

The results reported here may not be generalizable to all cases of system development. Environmental and institutional factors will vary in importance according to the nature of the technology and scope of innovation. Some technologies permit little or no degrees of freedom in utilization or management. This would seem to be true of certain industrial technologies described by Blauner [9], such as oil refineries or textile machines. Industrial engineering design decisions often preempt local variation in use or management. However, certain technologies, such as information systems, are highly malleable, afford many degrees of freedom in use and management, and can therefore be "fitted" to unique local situations. In these instances, one can expect considerable local variation in use and management.

Second, the scope of innovation will most likely affect the role of environmental and institutional factors. The systems described here were multiorganizational systems necessarily involving changes in the behavior of hundreds of organizations and thousands of individuals. Where the scope of change is large, one can expect institutional factors to play an important role in technological change. Where conditions are opposite, institutional factors will be less important.

On the substantive question of why states are developing CCH systems, our research clearly rejects the notion, put forth by many supporters of these systems, that they are simply a response to rising crime rates. To be sure, adoption of these systems is largely determined by environmental factors among which crime, population, and prison population are important, but, in addition, other environmental opportunities such as federal funding for these systems, and technical resources in the form of computer capacity and skilled employees are also important. A mixture of environmental constraints and opportunities which cannot be separated by analytic methods are at work here.

The rejection of simple environmental response explanations for state CCH system development is further strengthened by the finding that the actual use of these systems is not related to crime rates at all. Here, institutional factors such as organizational structure and technical resources predominate.

The natural history of systems, from inception to operation and management, turns out to be more complex than any single theory can explain. Management scientists and students of MIS who see systems primarily as responses to environmental "needs" of an organization, and social scientists who see systems primarily resulting from the working out of internal organizational forces, are both over-simplifying. Recognizing both environmental and institutional factors, observing where they complement or oppose one another, appears to provide more powerful explanations.

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