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IT Penetration in the Government Workforce: A Resource-based Analysis Comparing the Fifty U.S. State Governments

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ABSTRACT

Information technology (IT) penetration in the workforce is an important measure of the extent of IT or e-Government¹ adoption in government organizations. Different state governments in the United States (U.S.) have achieved different levels of workforce IT penetration. This paper seeks to examine whether these differences may be explained as a result of disparities amongst state governments in the distribution of certain resources that enable workforce IT penetration. This research finds that disparities in the distribution and deployment of two key enabling resources, namely IT management capability and IT budget size, do not account for differences in workforce IT penetration. Some secondary contributions of this study are: it categorizes the fifty U.S. state governments according to 1) their relative positions along two dimensions of workforce IT penetration, and 2) relative levels of the two enabling resources mentioned above.

Keywords

Workforce information technology penetration, state governments.

INTRODUCTION

For the last three decades, federal, state and local government entities in the United States (U.S.) have actively sought, or have been actively encouraged, to increase their use of information technology (IT) in order to improve their functioning (see, for example, Caudle and Gorr, 1991; Danziger and Dutton, 1977; Kraemer and Perry, 1979). In the current time, this process is reflected in the heightened interest in e-Government¹ and in the efforts of government leadership to encourage the assimilation of e-Government within all levels and functions of government (see, for example, Forman, 2002).

An important measure of the extent of assimilation of IT within a government organization is the extent of IT penetration within the organization's workforce. This study first estimates relative levels of workforce IT penetration in the fifty U.S. state governments. Workforce IT penetration is estimated along two dimensions - namely IT usage *reach* and IT usage *richness* - and state governments are categorized according to relative levels of attainment along these two dimensions.

Next, this study explores some potential underlying reasons for the differences in levels of workforce IT penetration. In the context of IT or e-Government adoption, level of workforce IT penetration may be considered a performance outcome. According to the resource-based view in organizational theory (Barney, 1991; Wernerfelt, 1984), differences in performance outcomes, amongst organizations that have similar a *raison d'être*, may be a result of heterogeneity in the distribution and deployment of resources amongst these organizations. In keeping with this view, this study investigates whether differences in levels of workforce IT penetration amongst state governments may be explained as a result of disparities amongst state governments in the distribution and deployment of resources that enable workforce IT penetration. In this context, two key enabling resources are considered, namely *IT management capability* and *IT budget size*.

Finally, results of the analyses are discussed in the context of lessons from past research. Some alternative, possible, reasons for the differences in workforce IT penetration are discussed, and suggestions on what different state governments can learn from each other are offered.

¹ Note: e-Government has been variously defined, and this paper uses the following definition, put forward by the World Bank (<http://www1.worldbank.org/publicsector/egov/>): "E-Government refers to the use of information and communications technologies to improve the efficiency, effectiveness, transparency and accountability of government" and thus "transform relations with citizens, businesses, and other arms of government."

The rest of the paper is organized as follows: The next section contains a brief background discussion on workforce IT penetration, resource-based analysis, and the research model under consideration. The subsequent section describes the data used, methodology employed, and results obtained from this study. The penultimate section offers a discussion of the results. The final section offers concluding statements, including limitations of this study and suggestions for future research.

BACKGROUND

Workforce IT Penetration

A key aspect of IT usage in government organizations is the extent of IT penetration within the organization's workforce. Workforce IT penetration refers to the extent to which a reference workforce uses information technology. In the context of government organizations, workforce IT penetration is considered an important objective by both practitioners (i.e. government managers) (Caudle and Gorr, 1991; Forman, 2002; Kraemer and Perry, 1979) and researchers (Kraemer and Perry, 1979; Stevens and LaPlante, 1986; Stevens, Cahill and LaPlante, 1991). Government managers consider workforce IT penetration (e.g. through the development of end-user computing or distributed data-processing) important because information technology can aid their workforce to tackle ill-structured and dynamic problems in increasingly sophisticated ways (Caudle and Gorr, 1991; Forman, 2002). Researchers consider workforce IT penetration important because their research has shown that information system adoption is an incremental process, and previous IT experience is one of the key determinants of a workforce's success in adopting new information technologies, tools and processes (Danziger and Dutton, 1977; Kraemer and Perry, 1979; Nedovic-Budic and Godschalk, 1996; Stevens and LaPlante, 1986; Stevens et al., 1991). Thus, workforce IT penetration in government organizations may be considered an important measure - and predictor - of IT and e-Government adoption in such organizations.

In the research literature, the concept of workforce IT penetration has been dealt with from diverse perspectives and has been measured in various ways (e.g. Grover and Goslar, 1993). This research proposes to measure workforce IT penetration along two dimensions. The first dimension is termed '*reach*', which refers to the proportion of a workforce that uses IT in the workplace. The second dimension is termed '*richness*', which refers to the level of sophistication with which a workforce uses IT in the workplace.

Resource-Based Analysis

According to the resource-based view in organizational theory (Barney, 1991; Wernerfelt, 1984), various resources may be heterogeneously distributed and deployed across different organizations, and this heterogeneity can account for disparities in organizational outcomes among organizations that belong to the same industry sector, or that otherwise have the same *raison d'être* (as in the case of state governments).

Thus, resource-based analysis is a potentially useful technique for exploring the underlying reasons for differences in the levels of workforce IT penetration among state governments. Ideally, such analysis should consider a large variety of resources that enable - or otherwise influence - IT penetration. However, due to constraints of data availability across the fifty state governments, this study only considers two key resources. The resources considered are *IT management capability* and *IT budget size* of each state government. IT management capability is a key resource because state governments with better capability should be able to a better job of deploying IT within their organization, and should therefore be able to achieve higher levels of workforce IT penetration. IT budget size is also a key resource because it directly relates to - and serves as a proxy for - the overall resources that a state government is prepared to commit towards deploying IT within the organization. There are of course limitations to using a model as simple as this - i.e. one with only two kinds of resources under consideration. Nevertheless, this research imparts some important and relevant findings; and as a first foray into resource-based analysis in the given context, the limitations of using this simple model may be considered to have been compensated for, by the findings.

Research Model

Figure 1 corresponds to the research model under consideration. According to the figure, *IT management capability* and *IT budget size* of state governments are key enabling resources that are considered to have an impact on workforce IT penetration within the state governments. Further, workforce IT penetration is considered to have two dimensions, namely *reach* and *richness*. According to this model, disparities among state governments in terms of the distribution and deployment of enabling resources (i.e. in terms of *IT management capability* and *IT budget size*) should lead to differences in terms of workforce IT penetration (along the dimensions of *reach* and *richness*). Further, according to this model, state

governments that command or deploy higher levels of enabling resources, are expected to exhibit higher levels of workforce IT penetration; and vice versa.

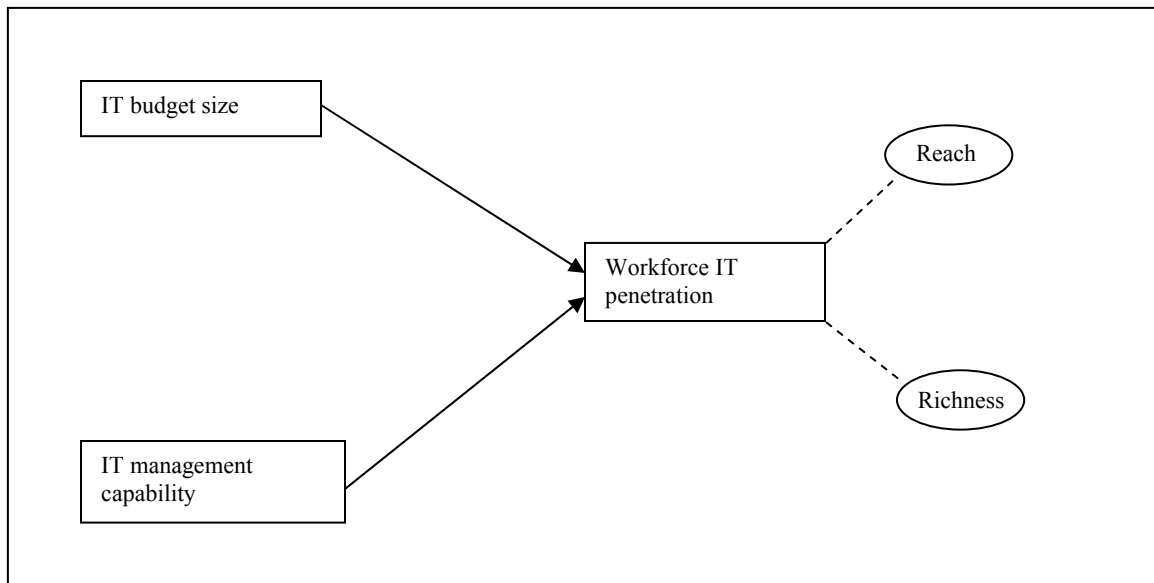


Figure 1. Research Model

METHODOLOGY AND RESULTS

This paper uses data on state government workforce IT penetration, *IT management capability* and *IT budget size* from the year 2001.

Workforce IT penetration *reach* and *richness*

Data on workforce IT penetration in the fifty state governments were calculated from the 2001 Current Population Survey (CPS). The survey yielded a sample of 3,209 state government employees across the fifty states. The *reach* dimension of IT penetration was estimated from questions that related to whether state government employees used computers in the workplace. The *richness* dimension of IT penetration was estimated from questions that related to the complexity with which state government employees used computers in the workplace (e.g. whether they used computers for e-mail, word-processing, spreadsheet applications, database applications etc.).

IT management capability

Data on *IT management capability* of the fifty state governments were obtained from the 2001 Government Performance Project (GPP) report produced by the Maxwell School of Citizenship and Public Affairs at Syracuse University and funded by the well-respected Pew Charitable Trusts (<http://www.maxwell.syr.edu/gpp/>). In 2001, the project rated the *IT management capability* of each of the fifty state governments. *IT management capability* was evaluated on the basis of aspects such as quality of IT systems, IT architecture and IT procurement efficiency. Each state government was rated on a twelve-point scale.

IT budget size

IT budget sizes of the fifty state governments in 2001 were estimated from 1999 and 2002 IT budget data, which in turn were obtained from the Center for Digital Government (www.centerdigitalgov.com), which describes itself as "a national research and advisory institute providing industry, government, and education leaders with decision support, research and services and an array of projects and publications covering the critical policy, executive leadership and technology applications surrounding electronic government" (from the Center's website). IT budget data so obtained related to totals of estimates of state government budgets for IT hardware, IT software, IT training, IT staffing and IT services. Since different U.S. state

governments have markedly different IT budgets, these data were standardized to make them comparable across states. To standardize these data, the IT budget of each state government was divided by the state's population in order to obtain a per-capita IT budget for each state government. This per-capita IT budget measure is referred to as *IT budget size* throughout this paper.

Cluster Analysis

The specific statistical technique used in this research is cluster analysis, which was performed using SPSS version 7.5. Cluster analysis was the preferred technique because the small sample size of fifty may prove problematic for techniques such as regression analysis.

Cluster analysis was performed in three phases. In the first phase state governments were clustered into four categories according to relatively high or low levels of workforce IT penetration *reach* and *richness*. This phase thus produces estimates of relative levels of workforce IT penetration in the fifty U.S. state governments along the dimensions of *reach* and *richness*.

In the second phase of cluster analysis, state governments were clustered into four categories according to relatively high or low levels of *IT management capability* and *IT budget size*. The results from this phase serve to identify the relative positions of different state governments with regard to the levels of resources commanded or deployed by them. Thus, state governments are differentiated according to whether they have higher or lower levels of resources that enable workforce IT penetration.

In the third phase of cluster analysis, the first two phases were combined and state governments were clustered according to relatively high or low levels of *reach*, *richness*, *IT management capability* and *IT budget size*. If disparities in the distribution and deployment of enabling resources indeed account for the differences in workforce IT penetration, then state governments with relatively higher levels of enabling resources should also demonstrate relatively higher levels of workforce IT penetration; and vice versa. If this association does not hold true, it should be reasonable to conclude that disparities in the enabling resources that have been considered in this study do not *directly* account for differences in levels of workforce IT penetration among state governments.

Cluster Analysis Phase 1

Clustering of state governments according to their relative positions along the *reach* and *richness* dimensions of workforce IT penetration.

The results of this cluster analysis procedure are presented in Table 1 (*refer to Table 1 at the end of this paper*).

According to the results in Table 1, state governments can be clustered into four categories in terms of their achievement in workforce IT penetration, as follows:

- High Overall IT Penetration (High *reach*, high *richness* quadrant)
- High Reach (High *reach*, low *richness* quadrant)
- High Richness (Low *reach*, high *richness* quadrant)
- Low Overall IT Penetration (Low *reach*, low *richness* quadrant)

Cluster Analysis Phase 2

Clustering of state governments according to their relative levels of *IT management capability* and *IT budget size*.

The results of this cluster analysis procedure are presented in Table 2 (*refer to Table 2 at the end of this paper*).

According to the results in Table 2, state governments can be clustered into four categories with regard to the levels of resources owned or deployed by them, as follows:

- High Overall Resources (High *IT management capability*, high *IT budget size* quadrant).
- Medium Overall Resources Case 1 (High *IT management capability*, low *IT budget size* quadrant).
- Medium Overall Resources Case 2 (Low *IT management capability*, high *IT budget size* quadrant).
- Low Overall Resources (Low *IT management capability*, low *IT budget size* quadrant).

Cluster Analysis Phase 3

Now, the state governments are clustered according to relatively high or low levels of all four variables considered so far, namely: *reach*, *richness*, *IT management capability*, and *IT budget size*.

The results of this cluster analysis procedure are presented in Table 3 (*refer to Table 3 at the end of this paper*).

Table 3 suggests that clear associations between levels of resources and levels of workforce IT penetration are not evident. And instead, it suggests that there is considerable diversity in the associations between levels of enabling resources and levels of workforce IT penetration achieved by state governments.

- High Yield State Governments: These have achieved either 1) high overall IT penetration despite low or medium overall resources (e.g. Iowa, Minnesota, Alaska); or 2) high *reach* or *richness* despite low overall resources (e.g. Alabama, Arizona).
- Fair Yield State Governments: These have achieved either 1) high overall IT penetration from high overall resources (e.g. Oregon); or 2) high *reach* or *richness* from medium overall resources (e.g. Montana, Delaware).
- Poor Yield State Governments: These have achieved either 1) low overall IT penetration, or high *reach* or *richness*, from high overall resources (e.g. Hawaii, Connecticut, Arkansas); or 2) low overall IT penetration from medium overall resources (e.g. North Carolina).
- Indifferent State Governments: These have achieved low overall IT penetration from low overall resources (e.g. Georgia).

DISCUSSION OF RESULTS

Clear associations between levels of resources and levels of workforce IT penetration are not evident. Instead, various combinations of levels of enabling resources and worker IT penetration are observed among different states. There are several states with worker IT penetration at the higher end of the spectrum, but with enabling resources at the lower end of the spectrum; and vice-versa.

There are several environmental and organizational factors that may explain why different government organizations have different experiences with the process of IT adoption and penetration. Among some such factors that have been identified by researchers are organizational and technical leadership, legislative and administrative mandates, strategic planning, size and complexity of IT projects, purpose and design of IT applications, systems design approaches, statutory constraints, financial support, level of centralization of decision making and the political economies and processes manifest in the organization (c.f. Danziger et al. 1977; Kling 1978; Kraemer et al. 1979; Shi 2002; Stevens et al. 1986; Stevens 1991).

Clearly, high yield state governments have something to teach the other states about how they should go about achieving higher workforce IT penetration. Considering the high costs involved in developing an IT infrastructure, state governments that have achieved high overall IT penetration despite a low intensity strategy may be able to offer valuable lessons on how to maximize efficiency and obtain optimal workforce IT penetration related outcomes.

The contribution of this research is that it allows stakeholders (government managers and politicians) in specific state governments to identify how their state government is faring - relative to other state governments - along two dimensions of workforce IT penetration. Further, since this research classifies the performance of various state governments according to their yield levels in achieving workforce IT penetration relative to certain resources, it allows lower performing states to determine which higher performing states they should choose to emulate. For instance, a state government that has achieved a high level of workforce IT penetration *reach*, but a low level of workforce IT penetration *richness*, may benefit from the study of the systems and procedures of high yield state governments that have achieved high workforce IT penetration *richness*.

The contribution of this research to researchers is that it identifies different yields that specific state governments have achieved in workforce IT penetration relative to certain enabling resources. This provides researchers with a reason and opportunity to delve deeper into the differences in how certain state governments operate and strategize; which should in turn aid researchers in understanding why some state governments are able to do more with less, even while others do less with more. Identification of the underlying reasons for such disparities can be immensely fruitful in terms of increasing the effectiveness and efficiency of the IT-related strategies of not only state governments, but also of other forms of government organizations and entities.

CONCLUDING STATEMENTS

This paper classifies state governments according to their relative achievements in workforce IT penetration according to two dimensions, namely *reach* and *richness*. Further, the paper categorizes state governments according to relative levels of their ownership or deployment of certain resources that enable workforce IT penetration. This research finds that disparities in enabling resources such as IT management capability and IT budget size do not account for differences in worker IT penetration amongst various state governments. Finally, this study categorizes state governments according to their yields in achieving in workforce IT penetration relative to certain enabling resources

A limitation of this research is its simplified research model, with a small number of variables considered. Nevertheless, this research imparts some important and relevant findings. In light of its contributions, and as a first foray into resource-based analysis in the given context, this model may be considered to have compensated to some extent for its limitations. Another limitation of this research is that it only considers *direct* associations between enabling resources and outcomes. It does not consider moderated associations (i.e. interactions). It may be that some moderating factor moderates the association between *IT management capability* - or *IT budget size* - with worker IT penetration. A further limitation of this research is that it has considered data from a single year. Such research would benefit from consideration of longitudinal data. Future research should address and remedy these limitations via consideration of more complex research models and through the use of longitudinal data.

It has been noted that while government entities at the federal and local level have received considerable attention from information systems researchers, state governments have received relatively less attention (Stevens et al., 1991). By addressing state governments, this paper contributes towards ameliorating this imbalance.

This research throws up many questions for future research. For example, what are high yield state governments doing right, and what are low yield state governments doing wrong? How can low and fair yield state governments emulate high yield state governments? Why are some state governments (i.e. the indifferent ones) apparently doing relatively little to increase workforce IT penetration? Future research should attempt to address such questions, because identification and understanding of the underlying issues and processes that influence workforce IT penetration in government organizations can be hugely beneficial to future efforts to increase the adoption of IT and e-Government in such organizations.

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| | | Workforce IT Penetration <i>richness</i> dimension | |
|---|------|--|--|
| | | Low <i>richness</i> | High <i>richness</i> |
| Workforce IT Penetration <i>reach</i> dimension | Low | Georgia Hawaii Kentucky Mississippi New Mexico New York North Carolina Ohio Wisconsin | Alabama California Connecticut Delaware Idaho Indiana Michigan Nebraska New Jersey Pennsylvania Rhode Island Texas Washington West Virginia |
| | High | Arizona Arkansas Colorado Florida Illinois Kansas Louisiana Maine Massachusetts Montana Nevada New Hampshire North Dakota Oklahoma South Carolina South Dakota Tennessee Virginia | Alaska Iowa Maryland Minnesota Missouri Oregon Utah Vermont Wyoming |

Table 1. Clustering state governments according to *reach* and *richness* dimensions of Workforce IT Penetration

| | | <i>IT management capability</i> | |
|-----------------------|-------------|---|---|
| | | Low | High |
| <i>IT budget size</i> | Low | Alabama Arizona California Colorado Florida Georgia Idaho Indiana Iowa Kansas Louisiana Maine Maryland Nebraska Nevada New Hampshire North Dakota Oklahoma | Delaware Michigan Minnesota Missouri Montana New Jersey North Carolina Ohio Pennsylvania South Carolina South Dakota Tennessee Texas Utah Virginia Washington Wisconsin |
| | High | Alaska | Arkansas Connecticut Hawaii Illinois Kentucky Massachusetts Mississippi New Mexico New York Oregon Rhode Island Vermont West Virginia Wyoming |

Table 2. Clustering state governments according to *IT management capability* and *IT budget size*

| | | Low Workforce IT Penetration reach | | High Workforce IT Penetration reach | |
|----------------------------|--------------------------------------|---|---|--|---|
| | | Low Workforce IT Penetration richness | High Workforce IT Penetration richness | Low Workforce IT Penetration richness | High Workforce IT Penetration richness |
| Low IT budget size | Low IT management capability | Georgia | Alabama California Idaho Indiana Nebraska | Arizona Colorado Florida Kansas Louisiana Maine | Iowa Maryland |
| | High IT management capability | North Carolina Ohio Wisconsin | Delaware Michigan New Jersey Pennsylvania Texas Washington | Montana South Carolina South Dakota Tennessee Virginia | Minnesota Missouri Utah |
| High IT budget size | Low IT management capability | | | | Alaska |
| | High IT management capability | Hawaii Kentucky Mississippi New Mexico New York | Connecticut Rhode Island West Virginia | Arkansas Illinois Massachusetts | Oregon Vermont Wyoming |

Table 3. Clustering state governments according to Worker IT penetration reach and richness, and IT management capability and IT budget size