

# The Role of Organizational Structural Properties on ICT Use in Public Academic Institutions

Suyuang Wang, Hoi In Fong, Xiaoyu Wu and Ip Kin Wong

**Abstract**— Following the suggestion of social technology research stream for the need to incorporate measures of organizational structural properties in the information system, we examined the influence of these properties on organization members' ICT use empirically in a significant scale. We investigate the relationship of ICT use and organizational structural properties, such as institutional resources, funding, size, and culture among scholars in public academic institutions in North America. The results indicate that institutional size, resource, and competitive culture have positive effects on members' ICT use, while the effect of institutional funding is reversed as hypothesized. These findings suggest actors who belong to large institutions with abundance of supportive resources and a highly competitive working environment would employ more technologies than those who are situated in smaller institutions with fewer resources and/or less demanding working environment.

**Index Terms**—ICT, informational system, organizational structural properties

## I. INTRODUCTION

THE advent of the Internet and the ubiquitous use of computer have bought a new era of information and communication technology (ICT) use in organizations [1]. Although a considerable amount of effort has been devoted to the understanding of technology usage behaviors among individuals in private organizations [2-4], little research has investigated the use of ICT within public sectors such as government-funded research centers, colleges, and libraries.

The picture looks dim in regard to empirical studies of ICT use in organizations, especially public academic institutions. For example, much of the e-government research efforts and initiatives focus on the public domain where citizens and businesses are the center of interest [e.g., 5]; few empirical studies have focused on how institutions impact members' usage behaviors [6-8]. However, the organization and the social environment are the context in which adoption and use of ICT are given shape [9-10]. In fact, users are often constrained by organizational structural properties, such as norms and resources [11-12]. Although research from the

social technology research stream has consistently suggested a need to incorporate measures of organizational structural properties (i.e., the organizational context) in any information system (IS) research agenda of interest [10, 13-14], few if any studies has successfully examined the influence of these properties on organization members' ICT use empirically in a significant scale.

The editor's comments from the 2000 issue of MIS Quarterly suggest a great need to investigate social and organizational contexts in the IS research domain. Studies that are both rigorous and relevant are deemed necessary in the highest level of IS as well as organization research as they could help scholars to bridge the void in the literature and appeal immediately to practitioners [15]. The call from Orlikowski and Barley [16] elaborate the need to bridge this gap in IS literature by learning from organization studies (OS) as they note: "Because [IS] research focuses on information systems in organizations, understanding how organizational phenomena affect the development and use of technologies and how technologies shape organizations are central to the field's agenda" (p. 146). Other scholars have shown strong support for putting more attention to the organizational aspect in IS studies [14, 17-20].

Given the importance of technology on individual performance and organizational success, it is imperative to explore the role of organizational structural properties on members' technology usage [11, 21]. Knowing the extent to which these properties shape end-user behaviors could help policy makers to better formulate their e-government strategy [22]. Managers could be able to monitor users' behaviors and then adjust information policies to better suit their needs. Results could also extend the social technology literature by offering means of theoretical implications that are grounded by empirical evidence. The objective of this article is to investigate ICT use among scholars in public academic institutions in North America. The relationship of ICT use and organizational structural properties, such as institutional resources, funding, size, and culture are explored.

## II. THEORETICAL BACKGROUND

The call from Kling in the 1980s [14, 23] has invited numerous theoretical developments in social informatics [11, 18, 24]. The extent literature pertaining to this stream of research commonly suggest that organizational structural properties, such as organization's size, culture, resources, and financial support (e.g., funding), are related to members' use of technology [13, 25-30]. One major source of structural influences is the organizational competitive cultural environment. Studies reveal that organizations have been utilizing ICTs to leverage organization expertise and resources in order to sustain competitive advantage over

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other industry players [19, 31]. Such a competitive culture also shapes organization members to utilize more computer applications at work. For example, Lamb and Kling [10] find that actors voluntarily adopt certain technologies in an effort to present their professional competence online [32-33].

Another organizational structural influence comes from the size of the context. Much research finds that the utility of an ICT depends on the size of a community using the technology [34]. Oliver, Marwell, and Teixeira [35] point out that a sufficient number of people need to participate in a social network in order to allow the collective action in the system to be valuable. Van de Hooff [36] reveals that the size, the structure, the culture, and the environment of an organization influence members' ICT use. Galbraith [37] suggests that large organizations are the driving force for technological innovation because of their financial resources and abundant expertise. Rogers [28] points out that organization size has a positive effect on the diffusion process [1]. Bouwman et al. [13] elaborates that small- and medium-sized firms lag behind in ICT use due to their lack of resources and strategic vision as well as their primary interest in immediate profits and problems.

From the structuration theory perspective, scholars commonly refer to social structure as rules and resources that govern actors' behaviors such as modes of interaction and technology use [11, 38]. Volti [1] notes that organizations can influence ICT use and its effects by means of supply and demand of the technology. John and Pouder [39] reveal that technology innovation is a function of financial, expertise, and information system resources available to a firm or an industry. The authors find that technologically advanced organizations tend to cluster in regions that can provide the needed resources. For example, the development of the high-tech districts in Silicon Valley and central Texas is attributed to the resources available in the vicinity. Therefore, firms and individuals can take advantages of the resource availability and proximity in the environment. These firms can then leverage the organizational processes, for example, by using locally available database systems to ease organization members' research efforts [40]. Further, Bouwman et al. [13] explain that implementation of a technology is impacted by its accessibility. One kind of accessibility issue concerns the physical aspects of a technology, including its availability and reliability (p. 17). Wellman et al. [41] argue that the way employees communicate depends on the support of the organization management and its available resources. In regard to the education industry, Erickson [42] and Marshal [43] note that technology resources encourage teachers to utilize computer-mediated methods for their class instructions only if these resources are easily accessible to the users. Students also benefit from technology resources by means of active involvement.

Although ICTs have been consistently found to increase organizational process efficiency and effectiveness [40, 44-47], financial burden on IS spending has been a major challenge the management often faced [48]. Indeed, IS expenditure in U.S. organizations has increased over the years. For example, U.S. firms were expected to spend about \$811 billion on information systems infrastructure in 2003 [49]. McKinsey & Company finds that the total spending on network storage continues to grow 15% annually despite cost of storage declines 30% per year [50]. System acquisition,

development, and maintenance are expensive. A database management system, for example, can easily cost several millions or even more [51]. In fact, U.S. firms spent about \$70 billion on database systems and another \$155 billion on networking and telecommunication infrastructure in 2005 [49]. Funding has been a crucial driving force in technology innovation and use in the education industry. Academia also recorded a substantial information systems budget increase in 2003. In fact, IS spending in 2003 was more than double that in 1998. However, small colleges' IS spending continues to lag behind the industry average. For example, while the IS budget for two-year colleges suffered a six percent decline, four-year colleges had an eight percent increase in their IS budgets. And whereas institutions with enrollment greater than 25,000 enjoyed an average IS spending of \$16 million in 2003, colleges with under 2,500 enrollment only afforded an average budget of half a million dollars in the same year [52]. Studies have also found that technology use within institutional units (e.g., library and departments) is a function of the allocated funds [43, 53].

The aforementioned literature has consistently found that contemporary organizational structural properties such as organizational size, funding, culture, and resource have a direct relationship with use of technology, as Figure 1 shows. Base on the extent lecture discussed above, we propose the following hypotheses:

- H1: A public institutions' size has a positive effect on its members' ICT use
- H2: A public institutions' funding has a positive effect on its members' ICT use
- H3: A public institutions' competitive culture has a positive effect on its members' ICT use
- H4: A public institutions' resource has a positive effect on its members' ICT use

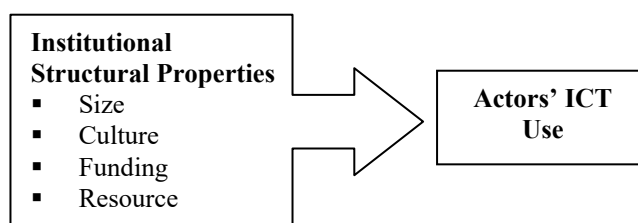


Figure 1. Theoretical Framework

### III. METHODOLOGY

This study utilizes a secondary dataset from a national survey of Japan Directory. The sample includes 564 specialists in the field of Japanese studies among 161 public colleges in the U.S. and Canada. Most of the respondents received the highest degree in their perspective field and were actively involved in teaching, research, or both. The questionnaire was originally developed by the funding organization of the project (i.e., Japan Foundation) and a team of experts in domain of inquiry. The project spanned across both Canadian and US institutions. The questionnaire was modified based on the development of the field. The data were collected in two consecutive years primarily through online survey, but were later supplemented with other means,

such as paper-based forms sent via fax, email, or regular mail. The data consist of four unit of analysis: institution, library, program, and individual members. The organizational-level independent variables were collected from the participating institutions, libraries, and the U.S. News. These variables were then disaggregated to incorporate into individual-level analysis [54-55]. In addition, individuals' socio-demographic factors were controlled in order to guard against spurious interpretation [56]. The hypothesize regression model was tested through multivariate regression analysis.

#### IV. RESULTS

Individual respondents were asked to report their socio-demographic information, such as gender, age, profession, and academic rank. A total of 65.9% of the respondents were male. The mean age of the sample is 52.23 year; the youngest was 27 and the oldest was 87. Whereas 69% of the respondents were considered to have a purely western background, about 11% of the others were considered purely eastern. Most of the sample have received their PhDs and were working as academic faculty (87.2%), while the rest of them either held positions as administrative staff (e.g., academic coordinator, librarian, and researcher) or retired. A great majority of the faculty members were serving their respective institutions as assistant professor or better, and the rest (5.7%) were doctoral candidates or instructors.

A total of 37 ICT use criterion variables were operationalized as a seven-dimension measure, which represents a gamut of commonly used technologies (e.g., communication, news and journals, word processing, multimedia, data management, presentation and analysis, and information portal) in professional organizations such as universities [57]. The operational definition of the ICT measurement model was validated through confirmatory factor analysis. The fit indices (RMSEA = 0.07, SRMR = 0.07, CFI = 0.90) suggest that the solution was plausible.

Results of the multivariate regression analysis provide partial support to the postulated research model, as Table 1 shows. The resulting parameter estimates for H<sub>1</sub> suggest that institutional size has a positive impact on actors' use of word processing ( $\beta = .15, p < .01$ ), information portal ( $\beta = .14, p < .01$ ), data management ( $\beta = .11, p < .10$ ), and information presentation ( $\beta = .12, p < .05$ ). Parameters for H<sub>3</sub>, however, reveal that organizational competitive culture is only significant for the use of communication ( $\beta = .12, p < .10$ ), news ( $\beta = .14, p < .05$ ), and information portal ( $\beta = .15, p < .05$ ). In addition, the effects of organizational resources, as H<sub>4</sub> proposes, suggest that the relationships were only present on the use of news ( $\beta = .16, p < .05$ ), information portal ( $\beta = .28, p < .001$ ), and data management ( $\beta = .19, p < .01$ ). Contrary to what H<sub>3</sub> hypothesized, the effect of institutional funding has a negative impact on actors' use of communication ( $\beta = -.20, p < .05$ ), news ( $\beta = -.35, p < .001$ ), information portal ( $\beta = -.51, p < .001$ ), and data management ( $\beta = -.23, p < .01$ ). The results on H<sub>3</sub> further suggest institutions' funding situations play the most important role among the four postulated institutional properties on technology usage behaviors in the context of academic institutions. Furthermore, the explained variances for the seven ICT constructs were between .14 and .33. However, a

two-step regression analysis (not shown here) identifies that the socio-demographic variables were able to explain a greater extent of variances of the criterion ICT variables than the institutional variables do.

#### V. DISCUSSIONS

**Table 1. Parameter Estimates and Percentage of Variance Explained**

	Institution Size	Institution Funding	Institution Competitive Culture	Institution Resource	R <sup>2</sup>
Communication	.00	-.20*	.12 <sup>†</sup>	.09	.14
News	.08	-.35**	.14*	.16*	.24
Word Processing	.15* *	-.06	-.02	.03	.33
Information Portal	.14**	-.51**	.15*	.28* **	.30
Data Management	.11 <sup>†</sup>	-.23* *	.08	.19* *	.25
Multimedia	.08	-.07	.07	.00	.23
Information Presentation and Analysis	.12*	-.11	.04	.09	.27

Note: The parameters presented are standardized. Socio-demographic characteristics are included in the model as control variables. R<sup>2</sup> represents the percentage of variance accounted for by both the socio-demographic and institutional variables.

<sup>†</sup> < 0.10; \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

The results indicate that institutional size, resource, and competitive culture have positive effects on members' ICT use, while the effect of institutional funding is reversed as hypothesized. These findings suggest actors who belong to large institutions with abundance of supportive resources and a highly competitive working environment would employ more technologies than those who are situated in smaller institutions with fewer resources and/or less demanding working environment. However, incumbents of poorly-funded public institutions seem to utilize technologies less than those in well-endowed public colleges. This situation might be attributed to the fact that most well-funded institution make resources readily available to users, while members of poorly-funded organizations have to rely on means of technology (e.g., communication tools, internet

portals, public databases, and other online information resources). An elaboration analysis (not shown here), however, reveals that the negative effect is more salient for poorly-supported institutions than their counterparts (Wong, 2007).

The results also indicate that users' socio-demographic characteristics play a more important role in explaining technology use in the context of inquiry. The findings suggest that ICT usage is more an individual phenomenon in academic institutions where members enjoy a great deal of work flexibility and job autonomy. These results shed light to public administration practitioners as they could help decision makers to better formulate information technology policies and strategies for government initiatives. For example, understand the impacts of institutional factors on individual members' technology usage behaviors could give a vantage point to policy makers and potential e-government initiative to predict how organization policies and structures might shape how potential users adopt and incorporate ICTs at work. This could help public administrators and managers to identify why certain e-government efforts and public technology infrastructures have succeed and others have failed beyond their scope of control. System engineer could benefit from the study as they could gain a better understand of how potential end-users could be influenced by certain organizational structural properties.

Results of the present study also shed light the literature. For example, evocations from Orlikowski and Barley [16] and Lee [15] have reputedly evinced a continue need to integrate both IS and OS efforts into hybrid studies. The current research responds to this call by fusing both streams of work into a single comprehensive study of ICT use in academic institutions. By so doing, this research offers "new syntheses" that fuse accounts of actors' technology usage behaviors and institutional structures "into richer explanations of techno-social change" [16, p. 159].

One such theoretical contribution germane to the works from organization research, which suggests that different types of technology are associated with different organizational structures and management approaches. However, empirical evidence, at least in a significant scale in terms of both the sample and technology covered, from these studies are largely lacking. In addition, prior studies also conceptualize ICT as an abstract and unidimensional object [16]. The present research fills this gap by first offering a typology of ICT use and then investigating the extent to which some of the postulated organizational structural properties impact the use of these technologies in the context of academic institutions. Furthermore, as the OS literature notes that different types of institutions have different organizational behaviors and therefore exert different influences on members, this study helps researchers to gain a better understand on professional institutions where members have a great degree of job independence and flexibility. More research is needed in order to understand how the current results could be applied in other forms of organizations. In addition, the present study updates the social informatics literature [10-11] by providing scholars empirical evidence that could be support their theoretical developments.

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