GOVERNANCE AND ICT INITIATIVE SUCCESS: A LONGITUDINAL FIELD STUDY OF TEN VILLAGES IN RURAL INDIA

Viswanath Venkatesh

University of Arkansas

Arun Rai

Georgia State University

Tracy Ann Sykes

University of Arkansas

Pankaj Setia

University of Arkansas

MIS Quarterly (in press)

***** pending copyediting *****

ABSTRACT

Initiatives to leverage information and communication technologies for development (ICT4D) have attracted huge investments, especially in less developed countries. However, the success rate of such initiatives has been low. Prior research on this topic has argued for various individual and network characteristics as predictors of information and communication technology (ICT) use and consequent benefits. We argue that, in order to garner potential benefits of the local information and knowledge resources embedded in citizens' advice networks, hybrid governance from a combination of the local government and the technology sponsor is required. We further theorize that leadership by the local government or the technology sponsor for different stages of the ICT4D initiative affects the effectiveness of the pathways through which benefits of citizens' advice networks accrue. We found support, in a longitudinal field study in ten villages in India (2,980 heads of households), for our theory that hybrid governance outperforms homogeneous governance models. Leadership by the local government for the pre-launch stage and by the technology sponsor for the post-launch stage was the most effective in promoting the behavioral pathway for economic benefits—that is, leveraging advice networks for ICT use and consequent gains in income. In contrast, leadership by the technology sponsor for the pre-launch stage and by the local government for the post-launch stage was the most effective in promoting the informational pathway—that is, leveraging information and knowledge from advice networks to directly generate gains in income. Adjacent villages that did not have a similar ICT4D intervention did not experience a comparable growth in farmer income.

INTRODUCTION

The use of information and communication technologies for development (ICT4D) has become a key focus for governments and non-government organizations that seek to improve the life and well-being of citizens in underprivileged communities, especially in rural communities of less developed countries. Consequently, ICT4D initiatives are attracting large investments (Heeks 2009; Venkatesh et al. 2016a). At the heart of such initiatives is tackling key goals identified by the United Nations as part of its Millennium Development Goals (MDGs; United Nations 2015), which have been more recently reformulated into the Sustainable Development Goals (SDGs; United Nations 2016). One widely used type of ICT4D initiative involves the setting up of kiosks to offer the community access to information via the Internet (see Venkatesh and Sykes 2013; Venkatesh et al. 2016a). Unfortunately, the success of ICT4D initiatives has been strikingly limited, with 85% of all initiatives failing to realize expected use by, or benefits

for, citizens (Avgerou and Walsham 2000; Venkatesh and Sykes 2013). In a developing country, especially in rural India, the limited success of ICT4D initiatives is particularly problematic as urban areas have seen a great deal of development in the past two decades, whereas more people in India (> 400 million people) are living in poverty and that is more than the number of people living in such conditions in all of the 26 sub-Saharan African countries combined (Alkire et al. 2013). The limited success of ICT4D initiatives coupled with the rapid growth of development of urban areas has created an even greater gap between rural and urban areas, thus increasing the urban-rural disparity in income and quality of life (Garg and Karan 2009).

Although there are huge investments directed at ICT4D initiatives, especially in a variety of ICTs to support various aspects of day-to-day life, ICT resources alone are not sufficient for the success of ICT4D initiatives. Several examples of ICT4D initiatives and efforts to improve the conditions of the poorest abound in the trade press (e.g., OPHI 2013; Rao 2009). As is well known in the broader IS literature, ICT investments do not necessarily or directly lead to successful outcomes and achieving ICT *use* is crucial to accrue benefits (Brynjolfsson 1993; Devaraj and Kohli 2003; Zhu et al. 2006).

There has also been significant recent attention to how ICT use can address or exacerbate societal problems that included a special issue in *MIS Quarterly*. Topics related ICT4D included ICT use to achieve identity verification (McGrath 2016), alleviate poverty (Jha et al. 2016), address corruption (Srivastava et al. 2016), and combat infant mortality (Venkatesh et al. 2016a). Consistent with the broader IS research, the recent ICT4D research reveals that providing citizens with access to ICT is not sufficient for the success of a ICT4D initiative, and shows that both ICT use by citizens and their social networks affect citizen well-being (Hsieh et al. 2011; van Dijk 1999; Venkatesh and Sykes 2013). When it comes to promoting citizens' use of ICT to

access government services, it is important to build trust amongst citizens regarding the e-government initiatives (for examples, see Srivastava and Teo 2009; Warkentin et al. 2002). Further, in a developing country context, where literacy rates are low, there are fairly low levels of direct use, with most use being proxy use (see Parikh and Ghosh 2006; Venkatesh and Sykes 2013).[1] The recent study by Venkatesh and Sykes (2013) of a ICT4D initiative in a village in India revealed the vital role of information resources situated in the social networks of individuals in driving both direct and proxy ICT use and realizing benefits. Venkatesh and Sykes (2013) concluded that advice networks, which are key local resources for citizens to access information and knowledge,[2] play an important role in determining *use* of Internet information kiosks and in generating spillover benefits for citizens not using the kiosks (either directly or by proxy) through diffusion of information in the social system. Specifically, they found that the advice networks of heads of households—i.e., the network of social relationships through which they seek advice—acted as vital informational resources that promoted economic outcomes by: (i) fostering the direct/proxy use of ICT: *behavioral pathway*; and (ii) providing the heads of household with access to superior information from the advice network resulting from ICT use by others in the advice network: *informational pathway.*

Extending this line of research, we propose that governance mode influences interactions in citizen networks, thereby shaping the patterns of ICT use and the consequences of an ICT4D initiative. The activities for this type of project differ markedly in the pre-launch stage that

[1] Due to the low literacy in rural India, Parikh and Ghosh argued that technology use is often facilitated by someone, thus resulting in proxy use (see Venkatesh and Sykes 2013; Venkatesh et al. 2016a). Indeed, in studies in villages in India, prior work found very little direct use of the Internet kiosk, with much of the use being proxy use—so much so that they did not have enough of a sample to conduct a model test using direct use. Based on this, when we refer to use, we mean either direct or proxy use and do not differentiate across the two—our expectation being very little direct use.

[2] The treatment of advice networks as resources is consistent with prior research on social networks in general (see Borgatti and Foster 2003) and IS research using social networks in particular (e.g., Sykes et al. 2014; Venkatesh and Sykes 2013).

involves planning, implementation, and training activities leading to and including the go-live, and the post-launch stage that involves continued evolution and maintenance post go-live stage. We conceptualize governance mode as the allocation of leadership responsibilities for the different phases of a project to a party, consistent with previous IS research that has contrasted governance choices based on the allocation of a leadership role—for example, user-led vs. developer-led development of activities in systems development (von Hippel and Katz 2002; von Hippel 2005) and IT vs. business leadership of activities in business process reengineering (Sambamurthy and Zmud 1999). We argue that different governance modes will play differential roles in mobilizing and leveraging resources that are resident in an individual's advice network. Specifically, we build on the work by Venkatesh and Sykes (2013) by assessing how governance modes of an ICT4D initiative affect the salience of the pathway—i.e., behavioral or informational—through which advice networks affect citizens' benefits from an ICT. We argue that because a focus on ICT investments alone is not sufficient, the leadership of an ICT4D initiative is critical to establishing effective governance that will enhance ICT use and increase the odds of realizing benefits from the initiative.

There is limited understanding of the alternative governance modes for ICT4D initiatives and the relative effectiveness of governance modes. On the one hand, because of the close relationships between local governments (LGs) and citizens, LGs often lead ICT4D initiatives. On the other hand, technology sponsor (TS) firms (e.g., Microsoft) are increasingly leading ICT4D initiatives, as they contribute the ICT resources and expertise in accordance with their corporate social responsibility charters (e.g., Gates Foundation 2012; McWilliams et al. 2006; OECD 2000; Pentland et al. 2004). The two prospective leaders of an ICT4D initiative, i.e., an LG and a TS, have different motivations and capabilities. LGs have contextual knowledge of the

needs and resources of their communities, responsibility for citizen well-being and economic development of their communities, and positional authority in their communities, whereas TSs possess ICT expertise and knowledge of ways to leverage ICTs. The leadership, either by an LG or a TS, may significantly influence how citizens perceive and use ICTs and consequently, garner [or do not garner] benefits.

Given that LGs and TSs possess unique—non-substitutable—competencies, there is growing appreciation for the need for LGs and TSs to not "lead alone" but to collaborate in order to promote effective ICT implementation and use in a local context. For example, the Gates Foundation has undertaken many collaborative ICT4D initiatives in partnership with local governments (Gates Foundation 2012). In such initiatives, the TS provides ICT resources and expertise to complement the LG's community organization and development motivations and capabilities. One such initiative is the One Laptop per Child (OLPC) that collaborates with the United Nations Development Programme (UNDP) offering local communities access to smart ICTs for the education of children. Such a collaboration between LGs and TSs has the potential to enhance citizens' quality of life through greater access to education, health care, and government services (UN Millennium Project 2005; Waage et al. 2010). Although such collaborative governance modes are designed to leverage the unique competencies of the two different types of leaders, ICT4D initiatives are complex projects and managing collaborative governance for these projects can be challenging. Specifically, as LGs and TSs differ significantly in their motivations and capabilities, it is important to understand, define, and compare the effectiveness of ICT4D initiative governance choices that emerge from each party, i.e., LS or TS, playing the leadership role for specific activities.

Given the different choices in governance modes that result from LGs and TSs assuming leadership for the activities in an ICT4D initiative, it is important to examine how the different governance modes influence ICT use and outcomes. Although prior research has assessed how individual use in an ICT4D initiative is influenced by individual disposition and attitudes, perceived behavioral control, economic capital, income and age, and household dynamics (Agarwal et al. 2009; Hsieh et al. 2008; Rice and Katz 2003; Selwyn et al. 2005), the role of governance modes on ICT use and outcomes has not been examined. We seek to address this gap. Besides focusing on governance by either an LG or a TS, we examine hybrid governance modes that involve collaborative efforts between an LG and a TS. Hybrid and homogenous governance modes on an ICT4D initiative differ based on the leadership of activities in the pre- and post-launch stages of an initiative.

Our first research question is: *in comparison to the homogenous governance modes in an ICT4D initiative, how do hybrid governance modes influence ICT use and outcomes?* As governance establishes the processes to utilize different resources for an initiative (Rai et al. 2012), the choice of a governance mode can create more or less favorable conditions for how citizens use information and knowledge resources situated in the local community following the rollout of an ICT4D initiative. Specifically, an ICT4D initiative's governance mode can change the effectiveness with which citizens can leverage advice from fellow citizens in developing their ICT use and generating economic benefits. This motivates our second research question: *how do the alternative governance modes in an ICT4D initiative affect the influence of local information and knowledge resources, specifically advice from advice networks, on ICT use and economic outcomes?*

This work makes several key contributions. Prior ICT4D research has focused on an individual's network or ICT factors influencing the penetration and use of ICTs (Agarwal et al. 2009; Dewan and Riggins 2005; Hsieh et al. 2008; Rice and Katz 2003; Selwyn et al. 2005; Venkatesh and Sykes 2013). We extend this research by integrating the role of governance modes to better understand the success of ICT4D initiatives. By identifying the governance modes based on leadership by an LG and/or a TS across the pre- and post-launch stages of an ICT4D initiative, we extend prior IS research studying governance modes on IS development projects (Sambamurthy and Zmud 1999; Xue et al. 2008; Xue et al. 2011). Further, our research advances knowledge in the domain of ICT governance as we contextualize governance within the broader ICT governance literature (see Alvesson and Karreman 2007; Johns 2006). This work also expands our knowledge on ICT4D initiative success, especially in a less developed country. Recent literature shows the role of advice networks in facilitating ICT use and farmer income in the context of an ICT4D initiative (Venkatesh and Sykes 2013). Using a new governance perspective, our work advances this literature by showing how the choice of a governance mode can mobilize these local resources more effectively. Specifically, our work extends this research by showing the interactions between advice networks and governance modes in facilitating key outcomes. Our findings are likely to aid in the management of ICT4D initiatives by showing how the choice of a governance mode shapes the specific ICT use pattern—i.e., through behavioral or informational pathways.

BACKGROUND

In this section, we present our conceptualization of governance modes and review past work on the pathways through which advice networks influence ICT use. These background elements establish the foundations for our model development.

Governance

Governance is the process of managing the social and economic activities, including contracting and enactment of controls,[3] to achieve the objectives of an organized initiative (Fama and Jensen 1983a; Tiwana 2009). A key aspect of governance involves assigning authority to a controller to execute the social and economic activities and attain outcomes (Kirsch 1997; Keil et al. 2013). The controller has the rights to decide about contracting, allocating resources, defining process and outcome standards, and establishing and enforcing punishments and rewards. The controller can apply a mix of contractual and relational mechanisms to manage controlees so as to effectively execute activities and attain outcomes (Dyer and Singh 1998; Fama and Jensen 1983a; Rai et al. 2012; Srivastava and Teo 2012; Williamson 1979). Alternative governance modes represent the choices to assign control to different stakeholders for the management of activities to achieve outcomes (Fama and Jensen 1983b, 1985).

As stakeholders who can be assigned decision rights can differ in their motivations and capabilities to manage activities and achieve outcomes (Ho et al. 2011), IS research has contrasted governance modes and compared their effectiveness in different contexts (Xue et al. 2008). For example, Sambamurthy and Zmud (1999) contrasted the effectiveness of organizational IS projects when the leadership for governing IT activities (e.g., IT infrastructure, IT use, project management) is assigned to corporate IS, divisional IS or line management. Similarly, Tiwana (2009) contrasted the effectiveness of IS development projects when the decision rights are allocated to IT and client departments. Given the importance of understanding

[3] Fama and Jensen (1983a) note that decision rights include decision management processes and decision control processes. Decision management processes comprise (a) initiation processes for seeking proposals for resource utilization and structuring of contracts and (b) ratification processes for choosing contracts. Decision control processes comprise (a) implementation processes to enact the chosen contracts and (b) monitoring processes to measure performance of decision agents and implement reward mechanisms.

how the allocation of decision rights to stakeholders with different motivations and capabilities affects outcomes, we differentiate between an LG-led and a TS-led governance of activities in an ICT4D initiative.

Governance Modes in an ICT4D Initiative

In the ICT4D context, governance modes can be defined by the role played by an LG or a TS, individually or collaboratively, to lead the activities in the initiative. We consider the roles played by an LG or a TS in the pre- and post-launch stages of the initiative. We differentiate between these stages based on the rationale that a project diffusing ICT through a population of potential adopters—be it employees in an organization or citizens in a defined social context—goes through stages that differ in objectives, challenges, and resource requirements (Cool et al. 1997; Fichman and Kemerer 1997; Grover and Goslar 1993; Zhu et al. 2006; Zmud and Apple 1992). For example, Cooper and Zmud (1990) differentiate between the adoption and infusion stages for diffusion of manufacturing resource planning technologies in manufacturing firms. Similarly, Xue et al. (2008) define seven archetypes of governance modes for IS projects based on the lead actors in three stages: initiation, development, and approval. Although researchers vary in their delineation of project stages, it is generally agreed that there are distinctions in the objectives, challenges, and resource requirements of the pre- and post-launch stages for both simple and more complex systems (Karahanna et al. 1999; Morris and Venkatesh 2010). A two-stage model, differentiating between the pre- and post-launch stages, has also been used in ICT4D research (e.g., Venkatesh and Sykes 2013) as well as ICT implementation research (e.g., Morris and Venkatesh 2010). Such a two-stage characterization is justified because of the differences in the types of activities and decisions in an ICT project across the two stages, before launch or immediately following it.

The pre-launch stage involves planning, organizing, staffing, installing, configuring, testing, go-live/actual deployment, and training activities, whereas the post-launch stage—or the post go-live period—is when ICT use by the target users commences and is developed and typically involves ICT adjustment and maintenance issues. The go-live stage falls within the scope of the pre-launch stage as it includes installation and training. Past ICT implementation research has referred to the time immediately following the launch as the shakedown stage and has suggested that it is the most critical as systems are most often abandoned in this stage as users fail to adjust to the "new normal" (Markus and Tanis 2000; Morris and Venkatesh 2010; Sykes et al. 2014). We argue that the type of leader managing the activities across pre- and post-launch stages plays an important role in defining the governance mode of an ICT4D initiative.

Conceptualizing the ICT4D Governance Modes

In ICT4D initiatives, an LG or a TS may be allocated the decision rights in either or both the pre- or post-launch stages. Because of the differences in their motivations and capabilities, LGs and TSs can be expected to enact the activities across the two stages differently. For example, although an LG is motivated to enhance local growth while preserving local customs, processes, social norms and cultures, a TS views ICT and its effective utilization as the mechanisms by which economic well-being and prosperity are enhanced (see Table 1). Based on the governance mode at the pre- and post-launch stages, we identify homogenous (LG-LG or TS-TS) or hybrid (LG-TS or TS-LG) governance modes in ICT4D initiatives (see Table 2).

Table 1: Motivations and Capabilities of Local Governments and Technology Sponsors

Local Government		Technology Sponsor	
Motivation	**Capabilities**	**Motivation**	**Capabilities**
✓ Increase local access to new ICT ✓ Increase communication between project and local communities ✓ Enhance participation of local communities ✓ Enhance local economic development ✓ Increase quality of life for citizens ✓ Ensure ICT implementation within a regulative framework ✓ Authorize local funds and contributions to the project ✓ Ensure timely project delivery	✓ Local outreach ✓ Explicit and tacit knowledge of local customs ✓ Familiarity and trusting relationships with citizens ✓ Knowledge of local rules and regulations ✓ Relationships with local financial organizations ✓ Project management experience in local context	✓ Foster ICT adoption and use ✓ Establish robust ICT architectures ✓ Manage ICT budgets ✓ Foster expedient ICT rollout ✓ Manage timely ICT rollouts	✓ Knowledge of ICT platforms ✓ Select and scout ICT talent ✓ Relationships with ICT vendors ✓ Design of ICT contracts and licenses ✓ Project management experience

Table 2. Governance Modes Based on Leadership for ICT Initiative Stages

Pre-launch / **Post-launch**	Local Government	Technology Sponsor
Local Government	Local Government *Only* Leadership (LG-LG)	Technology Sponsor-Local Government Sequential Leadership (TS-LG)
Technology Sponsor	Local Government-Technology Sponsor Sequential Leadership (LG-TS)	Technology Sponsor *Only* Leadership (TS-TS)

Homogenous governance modes: We conceptualize two homogenous governance modes: (1) local government *only* leadership mode (LG-LG) indicates local governance in both the pre- and

post-launch stages, and (2) technology sponsor *only* leadership mode (TS-TS) indicates governance by the TS in both stages.

Hybrid governance modes: An ICT4D initiative has different goals in the pre- and post-launch stages. Although it is necessary to obtain initial buy-in for use from stakeholders in the pre-launch stage, promoting ICT use is the key goal in the post-launch stage (e.g., Jasperson et al. 2005; Zhu et al. 2006). Obtaining initial buy-in for use and promoting use require overcoming different barriers, both in an ICT4D context (Hsieh and Wang 2007; Hsieh et al. 2011; van Dijk 1999) and in broader ICT adoption contexts (Karahanna et al. 1999; Venkatesh et al. 2003; Zhu et al. 2006). Considering the differences in motivations and capabilities of LGs and TSs, we propose the notion of a hybrid governance mode that involves sequencing leadership by two different entities, i.e., the LG and the TS, across the pre- and post-launch stages of an ICT4D initiative. Accordingly, we consider two hybrid governance modes: (1) local government-technology sponsor sequential leadership (LG-TS) and (2) technology sponsor-local government sequential leadership (TS-LG).

Focusing on these homogeneous and hybrid governance modes, we highlight how the choice of a governance mode for an ICT4D initiative influences citizens' ICT use and the economic impacts from an initiative. We also examine how hybrid governance modes, as compared to homogenous governance modes, influence the causal pathways by which individuals benefit from an initiative.

Outcomes: ICT Use and Economic Benefits

Research on ICT use has a rich tradition in IS research, dating back to the 1980s, with use seen as a critical mediating variable to realize performance benefits from ICT in a variety of settings (see Venkatesh et al. 2003, 2007, 2012, 2016b for reviews). Over the years, much

attention has been devoted to enriching our conceptualization of use and understanding the differences in the outcomes and predictors of different types of use (see Burton-Jones and Straub 2006; Robert and Sykes in press; Sykes and Venkatesh in press; Venkatesh et al. 2008). In much of this research, the focus has been on what Parikh and Ghosh (2006) term direct use where the user of an ICT is typically the person who would use the information obtained and benefit from the consequent actions/decisions based on the information obtained. However, in a rural context in a less developed country, such as India, such a conceptualization may be too limited (see Parikh and Ghosh 2006; Venkatesh et al. 2016a; Venkatesh and Sykes 2013), with proxies (e.g., Internet information kiosk attendants) aiding citizens by using the ICT on their behalf and providing the citizens with information on which the citizens can act—in fact, Venkatesh and Sykes (2013) found that most of the kiosk use in the village in India that they studied was proxy use. Against this backdrop, we conceptualize ICT use, consistent with Venkatesh and Sykes (2013), to include both direct and proxy use by heads of households. The ultimate outcome of interest in this work, like in the work of Venkatesh and Sykes (2013), is economic outcomes—here, [increases in] income—that accrue to citizens.

Advice Networks Influence Pathways in an ICT4D initiative

Although individual-level ICT adoption is a rich area of research in the IS field (see Venkatesh et al. 2007; Venkatesh et al. 2016b), an examination of competing ICT alternatives in evaluating the adoption and use of an ICT, including staying with the status quo, has been under-researched (see Bekkering et al. 2009). Even as ICT4D initiatives are launched to promote economic or other forms of community development (e.g., better health outcomes), direct and proxy ICT use by citizens is an important intermediate outcome that leads to broader societal benefits, such as higher income (Venkatesh and Sykes 2013). Direct and proxy ICT use in an

ICT4D context is influenced not only by technical and individual characteristics, such as type of ICT (Kraut et al. 1996, 1999) and individual interests and household dynamics (Katz and Rice 2002; Selwyn et al. 2005), but also by individuals' social networks (Agarwal et al. 2009; Venkatesh and Sykes 2013). Among the many types of social networks—e.g., advice, friendship, hindrance—advice networks have been identified as especially consequential for promoting direct and proxy ICT use and economic development among citizens in villages in developing countries (Venkatesh and Sykes 2013). In ICT4D initiatives in these contexts, advice networks are an important driver of citizen ICT use, either direct or proxy, because of the novelty of the project, local power structures, high levels of collectivism, low literacy rates, and availability of social support (Venkatesh et al. 2016a; Venkatesh and Sykes 2013). Specifically, these advice networks are sources of power, influence, information, and other resources that can promote a citizen's ICT use. Studying an ICT4D initiative in a village in India, Venkatesh and Sykes (2013) identify two distinct pathways through which a head of household's advice network influences his or her economic well-being. The first pathway, termed the behavioral pathway, represents the influence of a head of household's advice network on their economic outcomes by promoting the head of household to actively use the ICT, either directly or with the aid of a kiosk attendant, provided by an ICT4D initiative. The advice network is a source of trusted information and knowledge that can motivate, educate, and pressure the citizen to use the ICT provided by an ICT4D initiative. The second pathway, termed the informational pathway, represents the direct influence of a head of household's advice network on their economic impacts without the direct or proxy use of the ICT to seek information. The logic is that members of the advice network are better informed on economic opportunities and how to seize them because (some) members of the advice network use the ICT, either directly or through assistance from kiosk attendants, and

being connected to many others who use the ICT will allow a citizen to get access to useful information even if the citizen does not engage in direct or proxy use of the ICT.

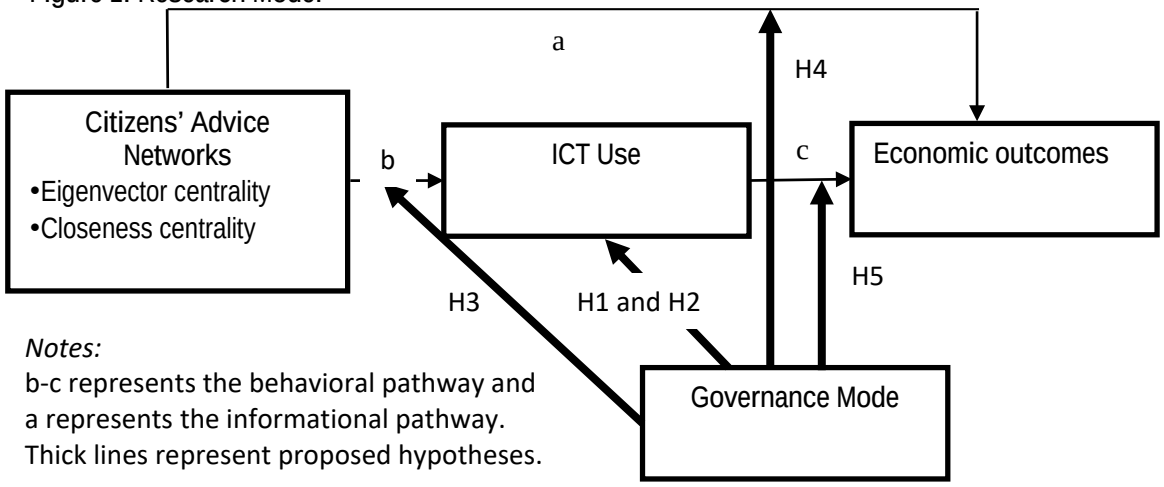
MODEL DEVELOPMENT

We focus our model development to understand the impacts of an ICT4D initiative's governance mode on ICT use and economic outcomes in the context of the knowledge that citizens can access through their advice networks and also the role of governance in affecting pathways by which local resources—i.e., advice networks—affect key outcomes. Figure 1 shows the proposed model. The baseline model on which we build is, as noted earlier, from Venkatesh and Sykes (2013). The model in their paper is shown in regular line weight in Figure 1. The behavioral pathway is represented by the casual flow from advice networks to economic outcomes mediated by ICT use. The informational pathway is the direct link from advice networks to economic outcomes.

We propose three extensions to their work. First, we examine how governance modes influence ICT use and postulate that a hybrid governance mode will lead to greater ICT use than a homogenous governance mode. Second, we propose that, of the two hybrid governance modes, a local government-technology sponsor sequential leadership (LG-TS) governance—i.e., an LG governance in the pre-launch stage and a TS governance in the post-launch stage—will lead to greater levels of ICT use compared to ICT use in the technology sponsor-local government sequential leadership (TS-LG) governance mode—i.e., a TS governance in the pre-launch stage and an LG governance in the post-launch stage. Finally, we propose moderating effects of hybrid governance modes and theorize that the local government-technology sponsor sequential leadership (LG-TS) governance mode strengthens the behavioral pathway—i.e., where knowledge obtained through advice networks affect economic outcomes through ICT use such

that advice networks promote ICT use that enhances knowledge that in turn leads to economic outcomes—and the technology sponsor-local government sequential leadership (TS-LG) governance mode strengthens the informational pathway—i.e., where knowledge obtained through advice networks affect economic outcomes directly.

Figure 1: Research Model



Notes:
b-c represents the behavioral pathway and a represents the informational pathway.
Thick lines represent proposed hypotheses.

Relative Effects of Homogeneous and Hybrid Governance Modes on ICT Use

We propose that hybrid governance modes lead to greater ICT use as they are more suitable than homogeneous governance modes in overcoming different types of access barriers. Specifically, van Dijk (1999) and van Dijk and Hacker (2003) highlight that an ICT4D initiative has to overcome four types of access barriers: *mental*—related to the lack of interest in ICT, aversion to new ICT, and computer anxiety; *material*—related to not having physical access to computer and other ICTs; *skills*—related to lack of education and computer self-efficacy; and *usage*—related to restricting inappropriate use of the ICT. Specifically, we note that overcoming the skills barriers could promote direct use but overcoming the other barriers, i.e., mental, material, and usage, is not only necessary to promote direct use, but also valuable in promoting proxy use.

Effective governance of an ICT4D initiative can increase the likelihood of ICT use by providing the means to overcome all of these barriers—to offer users not only the physical access to the ICT, but also the necessary confidence, skills, support and best practices on ICT use. Effective governance can establish appropriate institutional structures to overcome the barriers inhibiting citizen's ICT use in a rural, less developed country context. Through these institutional structures, activities can be managed to give meaning to the ICT, enhance understanding of the ICT and the initiative amongst citizens, validate the ICT4D initiative's compliance with values and goals, and promote digital work routines among citizens (Rai et al. 2009). However, neither governance by an LG nor a TS alone is sufficient to establish institutional structures and manage activities to overcome all barriers; rather, an ICT4D initiative requires hybrid governance modes—that uses a mix of an LG and a TS governance—across the pre- and post-launch stages because the two perform complementary roles.

LGs offer important social and organizational structures that ensure an ICT4D initiative is well-understood by different local bodies, complies with social norms, is acceptable to cultures and local ethos, and follows the local, state and national laws and rules. By implementing appropriate processes to promote assimilation in the local context, LGs can enhance citizens' ICT use by removing access barriers. For example, through its relationships with providers of complementary services (e.g., phone and Internet connections) and knowledge of the local bodies and regulations (e.g., procedures to apply, and obtain approvals, for permits), local governance ensures compliance with the local rules and laws, and establishes the necessary resources for an ICT4D initiative. Therefore, governance by LGs helps remove material access barriers that hinder the quick and effective setup and deployment of the ICT that underlies the initiative. However, an LG is not capable of removing all access barriers because it often lacks

the required ICT expertise. Hence, it is imperative to employ a TS governance for those processes most appropriate to overcome other barriers, such as the skills barrier. A TS's motivations and capabilities to impart ICT training and feedback can enhance citizens' computer self-efficacy and reduce citizens' computer anxiety. Because computer anxiety can limits citizens' interest in an ICT4D initiative, promoting citizens' computer self-efficacy by enhancing their ICT-related knowledge and skills during the pre-launch stage is important to promote ICT use (Wei et al. 2011). In sum, in an ICT4D initiative, both—the localized capabilities and motivations of an LG and the ICT motivations and capabilities of a TS—are necessary to overcome the four barriers that inhibit citizens' ICT use. Thus, we hypothesize:

H1: ICT4D initiatives governed by a hybrid governance mode—i.e., both an LG and a TS—across pre- and post-launch stages will lead to greater citizen ICT use than initiatives governed by a homogenous governance mode—i.e., an LG or a TS only—in both pre- and post-launch stages.

Relative Effects of Hybrid Governance Modes on ICT Use

Besides arguing for the use of a hybrid governance mode, we argue that the effects of a hybrid governance mode on citizens' ICT use vary based on the sequence in which an LG and a TS take leadership for the pre- and post-launch stages in an ICT4D initiative. Specifically, we suggest that an LG-TS hybrid governance mode (i.e., LG for pre-launch, TS for post-launch) will be more effective than a TS-LG hybrid governance mode (i.e., TS for pre-launch, LG for post-launch) in enhancing ICT use (see Table 2). We argue that an LG governance is more appropriate for overcoming access barriers in the pre-launch stage, whereas a TS governance is more suited to overcoming the access barriers in the post-launch stage. In an ICT4D initiative, some barriers need to be overcome before others. Specifically, mental access barriers (by creating interest and awareness, and alleviating computer anxiety) and material access barriers (by enabling access to computers and networks) need to be overcome before skills barriers and

usage barriers (van Dijk 1999; van Dijk and Hacker 2003). Overcoming mental barriers will not only promote direct use, but also proxy use by getting citizens to visit the kiosk to seek out information. Addressing the access barriers makes the ICT physically accessible to citizens and develops the willingness for them to engage in ICT use, both direct and proxy.

Table 3: Activities across Stages of an ICT4D Initiative

ICT4D Initiative Stages	**Activities in an ICT4D Initiative**
Pre-launch	✓ Outreach activities ✓ Local community relationship building activities ✓ ICT implementation activities ✓ ICT procurement activities ✓ Workforce and hiring activities ✓ Relationship building activities ✓ Vendor management and procurement activities
Post-launch	✓ Training activities ✓ Activities of assimilating ICT with local rules and work routines ✓ Maintenance and continued funding activities ✓ ICT redesign activities ✓ ICT contracting and maintenance activities

In the pre-launch stage of an ICT4D initiative, especially in a developing country, the LG is critical to overcoming mental and material barriers. Due to their awareness of the local problems and their greater reputation, relationships and political support in the local context, LGs may be able to better manage activities to overcome mental barriers in the pre-launch stage (see Table 3). The pivotal role of leadership (e.g., top management) in shaping opinions and championing IT projects is well established (e.g., Rai et al. 2009). Similarly, championing of ICT use by local leadership—i.e., the LG—helps overcome mental barriers to adopting a ICT that is being introduced through an ICT4D initiative. The LG can enact processes that leverage political support and give meaning to the ICT in ways that cultivate awareness and interest in the ICT and legitimize its use (see Srivastava and Teo 2009; Warkentin et al. 2002). Further, because the introduction of an ICT4D initiative may re-orient political power in less developed countries,

initial resistance to such an initiative is often high and may lead to attempts to sabotage the ICT. For example, local money lenders who perceive that, by facilitating farmer's direct access to bank loans, the ICT threatens their livelihood, they are likely to attempt to sabotage the ICT4D initiative by curbing use of the ICT (Cave 2013). Due to their intricate understanding of local customs, rules and relationships, the LG is more suited to thwart these sabotage attempts and enable the physical setup of computers and networks that must be accomplished in the pre-launch stage. Those who are in important roles in the LG may also be lenders and their early involvement may help them see how they can create a working model to create revenue sources for themselves and possibly prevent them from being threatened by the ICT. In contrast, because a TS may lack knowledge regarding intricate local context and political dynamics, a TS governance will not be able to enact processes that align incentives, enable physical setup and awareness of the ICT in the pre-launch stage.

Beyond the pre-launch stage, processes associated with a TS governance are likely to be effective in facilitating both direct and proxy ICT use by removing the barriers that hinder the use of the ICT that has been installed, tested, and deployed. Specifically, in the post-launch stage, mental, skills and usage barriers need to be overcome—and, as noted earlier, overcoming these barriers can promote both direct and proxy use. Defining the digital capability divide and the digital outcome divide as stages following the digital access divide, Wei et al. (2011) assert that ability to use the ICT and realize knowledge and skills outcomes are key to bridging the digital divide. TSs possess the capabilities and motivations to fill these particular gaps (see Table 2). Because of their intricate knowledge of the ICT and experience with ICT deployment and training, a TS can teach citizens about the effective use of ICTs to include how citizens can leverage the proxy users to fill their information needs. For example, due to their greater

technological expertise, TSs can help build citizens' instrumental skills—i.e., train citizens to learn ways to use the hardware and software—and informational skills—i.e., enable citizens' use of information from ICTs for achieving personal goals (van Dijk and Hacker 2003). Across ICT4D initiatives, variance in ICT use arises due to differences in age, income, gender and education of users (Pew Research Center 2015). Because of this variability, it is imperative to offer technical training that builds citizen's skills for using ICTs and also teaches them about the type of information available through government portals and other sources. Building computer self-efficacy is key to developing these skills (see Wei et al. 2011). Also, because of their specialized technical knowledge, a TS governance is most suitable to plan and offer oversight of training processes that enhance citizens' direct and proxy use of ICTs. Because of their lack of familiarity with the ICT associated with an ICT4D initiative, LGs are less suited to provide the specialized ICT training that will be necessary to facilitate citizens' direct and proxy ICT use. Therefore, in the post-launch stage, compared to an LG governance, a TS governance leads to greater ICT use.

In addition, due to its in-depth technical knowledge, a TS is capable of implementing appropriate processes for resource allocation and contract reinforcement, while disseminating skills to engage in both direct and proxy use of the ICT. Such skills are crucial to enhance post-launch use and may not be effectively championed by an LG governance. For example, in comparison to an LG governance, a TS governance is more suited to structure processes that scout the right talent to manage ICT training and skill development, offer detailed reviews and feedback to citizens about their ICT use, develop comprehensive manuals for ICT use in local work routines, and establish effective procedures to adapt and maintain the ICT. Similarly, in comparison to an LG governance, a TS governance has greater motivation and better capabilities

to deploy its own technical resources and contract with ICT vendors to provide skill training to facilitate both direct and proxy use, and adapt and maintain the ICT. As a TS has better developed processes to provide tailored ICT skill training and adapt the system to meet the needs of citizens in a given context, it is more likely to effectively integrate technical expertise with local resources to adapt the skills training and the system based on citizens' experiences and feedback. Using its processes to work with partners, a TS may be better able to select vendors and monitor their performance in assisting with the training program. It can also leverage its established licenses and relationships with ICT partners to adapt the system to the local context. Overall, in the post-launch stage, a TS governance will perform better than an LG governance in promoting both direct and proxy ICT use.

Because of the superiority of processes in both the pre-launch and post-launch stages, in comparison to other governance modes, the LG-TS governance mode will have a stronger positive effect on ICT use. Thus, we hypothesize:

H2: In comparison to other modes of governance across pre- and post-launch stages, ICT4D initiatives governed by local government-technology sponsor sequential leadership (LG-TS) will have the strongest positive effect on ICT use.

Moderating Effects of Governance Mode

We propose the moderating effects of governance modes, whereby the type of governance mode influences the salience of advice networks in an ICT4D initiative. Specifically, we theorize that the governance mode moderates the two pathways—i.e., behavioral and informational—by which citizens' access to local knowledge resources through their advice networks affect an ICT4D initiative's benefits.

Governance Mode and Behavioral Pathway

The behavioral pathway symbolizes citizens leveraging their advice networks to focus on ICT use, either direct or proxy, to realize superior economic outcomes (see Venkatesh and Sykes 2013). In an ICT4D initiative, advice networks associate greater social status with and offer greater information about the benefits of directly using the ICT or accessing information through proxy use by the kiosk attendant or others who have the skills to directly use the system. We argue that the governance mode of an ICT4D initiative influences the strength of the behavioral pathway, as it affects how local resources, specifically information and knowledge that are accessed by citizens through their advice networks, are utilized during the course of an ICT4D initiative. Specifically, the LG-TS governance mode enacts decision processes that give meaning, legitimize, and regulate advice networks' discussions about both direct and proxy ICT use in the pre-launch and post-launch stages. The combination of an LG governance in the pre-launch stage and a TS governance in the post-launch stage abets the behavioral pathway as an LG governance favors advice networks encouraging citizens' direct or proxy ICT use in the pre-launch stage, whereas a TS governance abets advice networks that encourage direct or proxy use in the post-launch stage.

In the pre-launch stage, the ability of advice networks to enhance both direct and proxy ICT use increases if the governance mode helps overcome user resistance, anxiety, suspicion, and lack of interest in the ICT4D initiative. An LG's governance processes are more suited to leverage citizens' advice networks in the local community to achieve these goals. In an organizational context, Sharma and Yetton (2007) posit that individuals' ICT use is influenced by their cognitions regarding ICT application and business context knowledge, and inter-individual cognitions related to transactive memory systems and collaborative task knowledge. Lacking such cognitions, individuals targeted with an ICT4D initiative are likely to resist either

direct or proxy ICT use. Individuals often resist new ICT because they perceive additional costs, such as those that occur due to adverse changes in power structure (DeSanctis and Courtney 1983; Jiang et al. 2000; Krovi 1993) or poor technical quality (Hirschheim and Newman 1988). Also, a status quo bias prevents exploration of the new ICT by individuals if they perceive a net inequity in adoption, indicating that the inputs (or costs) exceed the outputs (or benefits) (Kim and Kankanhalli 2009). Through its motivations and capabilities, an LG can alleviate these reasons for citizens' resistance to direct or proxy use. For example, an LG can champion educational activities in the local language and establish promotional programs that build trust and increase the participation of the local community in the ICT4D initiative. Because of their deep familiarity with local context, people and customs, an LG's capabilities are more suitable to lead these activities. Hence, through educational activities, LGs help develop citizens' interest in the direct and proxy use of the ICT that in turn can increase the likelihood of their seeking and heeding advice from their advice networks on ICT use. Besides developing individuals' cognitions through educational activities, an LG influences discussion in citizens' advice networks about both direct and proxy ICT use. For example, through its outreach processes, an LG may champion evening resident meetings to contextualize meaning of the new ICTs. Hence, by championing initiatives encouraging ICT exploration, an LG creates positive predispositions to information advocating ICT use that flows from advice networks to citizens. In summary, in the pre-launch stage, governance processes implemented by an LG, compared to those implemented by a TS, will make citizens' advice networks on which they rely to access trusted information and knowledge more influential in promoting both direct and proxy ICT use.

Unlike the pre-launch stage, in the post-launch stage, a TS's motivations and capabilities, as compared to an LG's motivations and capabilities, are more suited to enact governance processes

that champion ICT use, both direct and proxy, in the broader local community. As discussed earlier, the post-launch stage focuses on ICT use. The effectiveness of advice networks championing use is greater if an ICT4D initiative's governance processes encourage, promote and offer feedback on citizens' direct and proxy use of the ICT. This is because learning-by-doing and learning-by-using play important roles in how ICT is used (Attewell 1992; Sharma and Yetton 2007). Advice networks could encourage use by offering information and enable discussions about ways to use the ICT. A TS's governance processes are more appropriate than an LG's governance processes to complement the information flows to citizens from their advice networks motivating and championing how the ICT can be used either directly or through proxy. For example, a TS is likely to implement effective processes to provide help and feedback on the direct and proxy use of kiosks, analyze usage logs to assess citizens' deficiencies in learning how to use the system both directly and through assistance of the kiosk attendants, seek feedback from citizens including kiosk attendants on improvements to the kiosk stations, and offer solutions to citizens' problems with the direct and proxy use of the ICT. Besides enabling learning, these processes that are likely to be implemented by a TS can elaborate understanding of the specific ways to use ICTs either directly or through the assistance of kiosk attendants, thereby amplifying the influence of the information flows to citizens from their advice networks, thus encouraging ICT use in work routines. However, ICT use, be it direct or proxy, is not static and can be developed through effective governance. Such development of ICT use requires that the entity responsible for these governance processes solicit and process feedback from direct and proxy users and adapt the ICT and accompanying technological support resources including kiosk attendant skills based on this feedback. A TS is more suited to enact such governance processes that adapt ICTs in response to citizens' requests. By enabling ICT responsiveness, a

TS can create positive citizen attitudes toward both direct and proxy use that, according to Hsieh et al. (2008), enhances citizens' continued use intentions of the ICT provided through an ICT4D initiative. As citizens develop greater abilities to using the ICT both directly and by proxy and realize economic benefits post-use, the discussions around both direct and proxy ICT use gain momentum in advice networks. In turn, such advice network discussions trigger positive externalities resulting from others using the ICT, thus strengthening the behavioral pathway. Thus, we hypothesize:

H3: Heterogeneous governance modes for an ICT4D initiative will moderate the effect of a citizen's advice network on his or her economic outcomes through ICT use—i.e., behavioral pathway—such that the behavioral pathway will be most salient for the local government-technology sponsor sequential leadership (LG-TS) governance.

Governance Mode and Informational Pathway

The informational pathway characterizes citizens accessing information through their advice networks. In the informational pathway, the focus is not on the effectiveness of advice networks in promoting citizens' ICT use either directly or through proxy; rather, the advice networks enhance economic benefits by leveraging the information gained through others' ICT use. The TS-LG governance mode catalyzes this pathway characterized by citizens harnessing their advice networks for economic outcomes, while not engaging in ICT use, be it direct or proxy. The informational pathway gains prominence over the behavioral pathway when citizens are anxious or disinterested in the ICT during the pre-launch stage and/or lack the skills and knowledge to engage in either direct or proxy use in the post-launch stage.

We suggest that the TS-LG governance mode is more effective than the other modes in complementing the positive economic impact of the information that flows to citizens from their advice networks as a result of the ICT4D initiative. Specifically, the TS-LG governance mode aids citizens' exploitation of information accessed through their advice network for their

economic well-being rather than citizens' leveraging information from advice networks to promote their direct or proxy use of the ICT. The TS governance processes in the pre-launch stage are focused on ICT design and implementation, thereby emphasizing system quality and information quality. For example, a TS may enforce processes that correctly configure applications (for weather forecasting, pricing quotes for farmer's products or health care information) through the choice of most appropriate databases, networks, and other ICT components. A TS governance mode in the pre-launch stage brings a technologist's mindset and related processes to establish a reliable technological system for delivering high quality information in a timely manner. However, because of the greater ICT focus and little local expertise, a TS may not fully exploit the local community resources in the form of their advice networks. Specifically, a TS may not facilitate broader citizen participation to use ICT and many barriers related to skepticism about the project may persist. Due to these barriers, although citizens are informed of the benefits of an ICT4D initiative, their anxiety and resistance in engaging in direct and proxy use of the ICT may remain unaddressed.

The use of an LG governance in the post-launch stage further strengthens this focus on the exploitation of information in one's advice network, instead of a focus on actual direct or proxy use of the ICT, to realizing an ICT4D initiative's benefits. To successfully engage in direct or proxy ICT use, citizens need to acquire specific skills related to ICT use or search for information using ICT. Further, citizens' ICT use in the post-launch stage are shaped by the extent to which the project leader offers meaningful feedback about their use and enables individual sense-making relating ICT use to their work contexts (Jasperson et al. 2005). However, an LG lacks the motivation and capabilities to enable such use dynamics. By default, an LG's motivation is to enhance local development—for example, by improving economic

well-being and health care. Further, an LG lacks the technical ability needed to develop individual direct and proxy use—for example, an LG may not be able to set up effective processes to offer feedback on how citizens can adapt ICT use given their skills, information needs, and work routines. As a result, little information flowing through citizens' advice networks where an LG governs the post-launch stage focuses on promoting ICT use or adapting ICT use to citizens' skills, information needs, and work routines. Instead, under an LG governance of the post-launch stage, information in citizens' advice networks focuses on exploiting information for their economic well-being. With this governance approach, a few advanced and motivated users become information sources and drive citizens' behaviors to directly harness the information that diffuses through the social system. Because of their understanding of the local context, an LG's decision processes leverages local community resources to increase awareness that citizens can access useful information that spreads through the social system to enhance economic outcomes from selected individuals, without encouraging broad use of the ICT. Of course, these informed individuals will be heterogeneously distributed across citizens' advice networks. Considering these arguments, we propose that, due to the lack of governance processes encouraging exploration and direct or proxy use of the ICT, the TS-LG governance mode encourages citizens' efforts in leveraging their advice networks for accessing and directly exploiting information for maximizing outcomes. Thus, we hypothesize:

H4: Heterogeneous governance modes of an ICT4D initiative will moderate the direct positive effect of a citizen's advice network on his or her economic outcomes—i.e., informational pathway—such that the informational pathway will be most salient in a collaborative ICT4D initiative using the technology sponsor-local government sequential leadership (TS-LG) governance.

METHOD

In this section, we describe the ICT4D setting and initiative, participants, data collection procedure, and measurement.

Setting and Initiative

Our study was conducted in 10 villages in rural India where an ICT4D initiative—here, an Internet-enabled information kiosk program—was being implemented. An additional 10 villages, where there was no such kiosk program, each paired with one of the study villages based on physical distance of less than 10 kilometers, were used as a control group. The Internet-enabled information kiosk program was being implemented in an effort to increase economic development in these underdeveloped areas. The kiosks were designed to provide information regarding best agricultural practices, up-to-date market pricing of agricultural produce, and local weather information. Each village in our study implemented one kiosk for every 100 families. Training sessions were offered to villagers for the first month after roll-out of the kiosks. These training sessions were designed to explain the benefits of the information kiosks, the types of information they could provide, and the procedures related to direct and proxy use of the kiosks. All training sessions were conducted in each village's local language. Up to 10 assistants were available in each session to demonstrate the use of the information kiosks. Training sessions occurred every day for the full month and villagers were encouraged to attend as many sessions as they wanted. Once live, the kiosks were open and staffed for 16 hours of every day. Staff members were there to help villagers use the kiosks or to use the kiosks as proxy users and give the villagers the information they requested (see Parikh and Ghosh 2006; Venkatesh et al. 2016a; Venkatesh and Sykes 2013). Given the low literacy rates and lack of computing experience on average in these rural areas, proxy use, more than direct use, was particularly important (Parikh

and Ghosh 2006; Venkatesh et al. 2016a; Venkatesh and Sykes 2013). Use of kiosks, either direct or through proxy, was logged for each citizen at the kiosk stations.

Participants

The sampling frame for our study was the list of the heads of households in each of the families residing in the 10 study villages. Given the social norms of these rural areas, heads of households, who were all farmers, were most likely to be the main bread-winners in the households. In each village, a roster of all heads of households was created. Although the size of the villages varied, the number of households in each village was about 300 with a total of 3,221 families across the ten villages in which the information kiosk programs were introduced. Of these, 2,980 heads of households participated in the entire study. Over 80% of the heads of households in each village participated. Over 90% of the respondents were men, consistent with the estimates of heads of households in the rural Indian population (Census of India 2011). The average age of the participants was approximately 41 years. Most participants (>80%) were married. The demographic profile of the control group villages did not significantly differ from the profile of the villages where the kiosks were implemented. The 10 control group villages consisted of a total of 3,410 households, with 3,050 heads of households across the villages and more than 80% of the heads of households in each village participating in the study.

Data Collection Procedure

The study comprised two waves of data collection: pre-launch and post-launch. Pre-launch served to provide baseline economic information for each of the participating households as well as advice network data in each of the villages. As noted earlier, the pre-launch stage lasted up to 2 years, to include activities ranging from bringing electricity to the village to the installation of the kiosks and included the official launch (go-live) of the kiosks where they were made available for direct use and also for proxy use through assistance from kiosk attendants. The

baseline economic outcome data were gathered before the start of the training. Due to the inherent low literacy rates, interviewers were employed to collect the data. Interviewers visited each participating household and administered the questionnaire by asking respondents to answer the various questions in the local language. This process took approximately 2 hours to complete per household due to the involved nature of the social network portion of the survey where each head of household was asked to respond to his or her getting advice from each of the other heads of household in the village. Respondents were offered 200 Indian Rupees for their participation. This was equivalent, in most cases, to several days' earnings. Participation in this study was completely voluntary.

Following the first phase of data collection, training sessions, which were discussed earlier, were conducted every evening for a month. The second wave of the data collection occurred approximately one year after the first wave was completed. In this phase, data concerning use of the information kiosks and economic data were gathered. During the first year after implementation, detailed use logs were kept for each kiosk and these logs were used to create the ICT use data. Economic data were gathered from the heads of households and local government offices. The same data (except ICT use, which was not applicable) in the same time period were also gathered from the control group of villages.

Measurement

Governance

In our study, the decision rights for the governance of pre- and post-launch stages were classified as either an LG (referred to as a Panchayat[4]) or a TS (the ICT firm that was participating in the initiative as part of its corporate social responsibility activities). The pre-

[4]Panchayat represents the local administration body managing governance processes in Panchayat Raj—the oldest form of local government in South Asian countries.

launch governance processes included licensing, selecting the facilities where the kiosks would be installed and negotiating the rental agreements, obtaining electricity connections for the facilities (that required coordinating with the state government and/or electric company), selecting the personnel to staff the kiosks, configuring the kiosk, training the kiosk personnel, holding public awareness and promotional sessions, installing and testing the kiosks, and training citizens. In summary, all processes leading up to, and including, go-live. The post-launch governance processes included ongoing maintenance of the facilities and ICT, addressing technical problems, installing and upgrading software, addressing users' queries when they visited the kiosks, and promoting discussion among citizens on the use of the kiosks.

The TS was interested in learning how best to govern ICT4D initiatives in less developed countries. It wanted to evaluate the implications of assigning leadership roles for pre- and post-launch implications to either the TS or the LG. The LGs of the 10 villages also agreed that (1) they were quite similar in their motivations and capabilities for governing the pre- and post-launch activities and (2) it would be useful to evaluate different governance possibilities. Eventually, the *espoused* governance mode for the ICT4D initiative at a village was agreed to by both the TS and the LG, and included at least two villages with each of the governance modes (Table 4).

To evaluate if the espoused governance mode that was agreed to by the TS and the LG corresponded to the *enacted* governance mode at each of the villages, we followed an elaborate process that included interviews with different stakeholders—i.e., the LG, TS, villagers, infrastructure providers, and kiosk personnel—and examination of archival documents. We interviewed the leader of each village's LG—i.e., Panchayat leader—and the TS—i.e., project manager—on the respective roles of the LG and the TS in the governance processes at the pre-

launch stage—i.e., staffing kiosks, negotiating building leases, obtaining Internet connections, procuring and installing computers, and citizen training—and the post-launch stage—i.e., maintenance schedule decisions, upgrading and configuring the ICT, and disseminating information on best use practices. As only the leaders make decisions at the pre- and post-launch stages, we interviewed the LG's and the TS's managerial personnel (typically 3-4 of each for a village) to determine the LG's and the TS's espoused roles for governance processes in the pre- and post-launch stages. We asked each of the LG's and the TS's managerial personnel what their role was for specific governance processes at the pre- and post-launch stages and also what the role of the partner was—i.e., we wanted to obtain a view from both perspectives on the roles played by a given partner. To go beyond espoused roles to enacted roles, we studied the detailed project archives to determine which party—i.e., LG or TS—played the leadership role for governance processes in the pre- and post-launch stages. For example, for the pre-launch stage, we examined the staff selection, lease negotiation, Internet connection, and promotional and awareness-building documents to determine if these governance processes were *actually* managed by the LG or the TS. Similarly, for the post-launch stage, we examined the documentation related to the administration of training, approvals for kiosk maintenance and configuration changes, and dissemination of the success stories and best practices on the use of kiosks by citizens. Finally, we conducted interviews with the villagers, operational personnel hired to staff the kiosks, the building owners, and the telecommunications providers to determine the roles played by the LG and the TS in dealing with them through the pre- and post-launch stages. Based on these data, we observed that for each village, one party—i.e., LG or TS—was assigned the rights for governing the activities in the pre- and post-launch stages. Based on the governance choices for various activities, we coded the governance mode for each of the 10

villages and had at least 2 villages in each governance mode. Our coding of the enacted governance modes corresponded to the espoused or agreed upon governance modes that were established at the start of the initiative. In our study context, the pre- or post-launch stages were managed exclusively by either the LG or the TS with no shared governance. Table 4 shows the distribution of the governance modes across the 10 villages.

Table 4. Distribution of Villages across Governance Modes

Pre-launch / **Post-launch**	Local Government (LG)	Technology Sponsor (TS)
Local Government (LG)	Local Government *Only* Leadership (LG-LG) (3 villages; 910 heads of households)	Technology Sponsor-Local Government Sequential Leadership (TS-LG) (2 villages; 602 heads of households)
Technology Sponsor (TS)	Local Government-Technology Sponsor Sequential Leadership (LG-TS) (2 villages, 573 heads of households)	Technology Sponsor *Only* Leadership (TS-TS) (3 villages, 895 heads of households)

Advice Network Centrality

Advice network data were gathered by providing a roster of all heads of households within a given village to each participant, where the participants were asked to identify all individuals that provided them with advice and the amount of advice (on a Likert-type scale from 1 to 5). If no advice was obtained from an individual on the roster, the participants were asked to leave the row blank. The roster method of soliciting social network data is considered beneficial in that it helps to alleviate concerns that an individual will forget about a potential tie. We dichotomized the network using tie strengths of 4 and 5 to represent the presence of a tie. This approach to data collection and coding of advice network data is consistent with the broader social networks literature (e.g., Hanneman 2001) and prior IS research (e.g., Sykes 2015; Sykes et al. 2009;

Sykes et al. 2014; Sykes and Venkatesh in press; Venkatesh et al. 2011; Venkatesh et al. 2016a; Venkatesh et al. 2013).

Both advice network centralities—i.e., eigenvector centrality and closeness centrality for heads of households—were calculated from the advice network data using UCINET 6.29 (Borgatti et al. 2002). Eigenvector centrality takes into account not only the number of ties, but also the quality of said ties in that more weight is given to a tie to an individual who, in turn, is connected to well-connected individuals. Eigenvector centrality (Bonacich 1972) is defined as the principal eigenvector of the adjacency matrix defining the network. The defining equation of an eigenvector is: $\lambda v = Av$; where A is the adjacency matrix of the graph, λ is a constant (the eigenvalue), and v is the eigenvector. The equation lends itself to the interpretation that a node that has a high eigenvector score is one that is adjacent to nodes that are themselves high scorers. UCINET calculates eigenvector centralities in a range of 0 to 1. We multiplied this score by 100 to get a range from 0 to 100. Closeness centrality represents how close a focal node is to the rest of the nodes within the network. It is the inverse of the sum of all distances between the focal node and all other nodes within the network. Closeness centrality is used to show how quickly information can be disseminated to the rest of the network in a sequential manner (Wasserman and Faust 1994).

ICT (Kiosk) Use

Use of the kiosks was calculated as the number of times each head of household used the kiosk in the time frame of the study—i.e., one year. Using frequency as a measure of ICT use is consistent with prior research (Venkatesh et al. 2008; Venkatesh et al. 2016a). In order to test H1 and H2, we collected two additional measures of kiosk use: percentage (and number) of heads of household using the kiosk and average duration per visit including both direct use and proxy use.

Economic Outcomes

The economic outcomes data collected were amount of produce harvested, amount sold, price for produce obtained, and overall annual household income. These outcomes are appropriate as all the heads of households were farmers and, as mentioned earlier, these outcome data were obtained from the heads of households. We also triangulated on this using records from the local government offices. This approach also allowed us to enhance the accuracy of our data as sometimes the farmers sold to intermediaries and not always at government markets. Ultimately, we used annual income data as our dependent variable.

Control Variables

We controlled for several demographic and contextual variables: gender, age, marital status (single or married), family size, education (no school, primary school attended, primary school completed, middle school attended, middle school completed, high school attended, high school completed), cell phone use (years), previous year's income, and training sessions attended (see Venkatesh and Sykes 2013).

RESULTS

We used UCINET 6.29 (Borgatti et al. 2002) and hierarchical regression analysis (HRA). We used UCINET to model the network data and calculate the network variable scores. SPSS (version 20) was used to perform the HRA. Specifically, we conducted a subsample analysis broken down by each cell of the governance modes. We then ran Chow's (1960) beta differences tests to test our hypotheses. Such an approach is suggested when testing for moderation by categorical variables (see Carte and Russell 2003). We further conducted a comparison of effects using a bootstrapping approach and examined (1) the confidence intervals for the presence of 0 to assess significance and (2) non-overlap in confidence intervals to test for the significance of

differences (see MacKinnon et al. 2004; Mooney and Duval 1993; for an example, see Lambert 2011). For the purposes of the correlational analysis, we also created 3 dummy variables, Gov1, Gov2 and Gov3 that allowed us to represent the 4 different governance modes as follows—0, 0, 0: LG-LG; 0, 0, 1: LG-TS; 0, 1, 0: TS-LG; and 1, 0, 0: TS-TS.

Table 5 shows the descriptive statistics and correlations for the entire dataset. Based on this table, consistent with Venkatesh and Sykes (2013), we can see that the social network constructs correlated with both ICT use and economic outcomes. Likewise, ICT use and economic outcomes were also correlated, and the strongest correlate for economic outcomes was previous year's economic outcomes. The correlations of the governance mode dummy variables with both ICT use and economic outcomes generally confirmed the pattern of the hypotheses (finer grained analysis and associated results are discussed in conjunction with the model tests).

Table 6 shows use and average income broken down by village and by governance mode. We conducted paired mean differences tests using ANOVA (Games Howell for unequal variances) and a Tukey HSD test across various pairs of villages and also across villages grouped by governance mode. Based on the results shown in Table 6, we can see support for H1 that greater use is observed in the hybrid governance modes compared to the homogenous governance modes. H2 is supported in that villages using an LG-TS governance mode saw the greatest levels of kiosk use followed by villages using a TS-LG governance mode. When this finding is overlaid with the income gains, villages using a TS-LG governance mode gained most in terms of income, thus suggesting that the informational pathway was likely having a strong effect in this governance mode and also it is likely that because of an LG governance in the post-launch stage, there is better support for how information can be leveraged in the local context—i.e., more effective use in terms of economic benefits.

Beyond the preliminary support for H3 and H4 that the above patterns offer, we present a series of model tests and a comparison of effects in Tables 7 and 8 respectively. Table 7 shows that the effects of both the informational and behavioral pathways are stronger in the hybrid governance mode villages. Table 8 shows the various effects related to the behavioral and informational pathways and the associated calculations for indirect and total effects. As shown in Table 8, H3 is supported in that the LG-TS governance mode has the strongest behavioral pathway effects. This can be seen in terms of all of the effects in the LG-TS governance mode: the use to economic outcomes link is the strongest, the indirect effects for eigenvector centrality and closeness centrality are the strongest, and the multiplicative total effect of the two centralities on economic outcomes mediated by use is the highest. This was confirmed by a bias-corrected bootstrap test of confidence intervals for the four different groups—there was no overlap in the confidence intervals for the LG-TS vs. each of the other three groups (see MacKinnon et al. 2004; Mooney and Duval 1993; for an example, see Lambert 2011). Also, as shown in Table 8, H4 is supported in that the TS-LG governance mode has the strongest informational pathway effects. This can be seen in that both centralities have a significant positive effect on economic outcomes, whereas none of the others was significant. This pattern of support was also confirmed from the confidence intervals for the four different groups—there was no overlap in the confidence intervals for the TS-LG vs. each of the other three groups (see MacKinnon et al. 2004; Mooney and Duval 1993; for an example, see Lambert 2011).

Table 5. Descriptive Statistics and Correlations

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Gender (0: men)	1	NA	NA														
Age	2	42.80	11.25	-.22***													
Marital status	3	NA	NA	.05	.20**												
Family size	4	5.12	1.57	.08	.20**	.13*											
Education	5	NA	NA	-.24***	-.08	.05	.06										
Cell phone use	6	1.60	0.88	-.17**	-.25***	.09	.04	.20**									
Previous year's income	7	17968	5140	-.23***	.23***	.10	.08	.26***	.05								
Training sessions attended	8	1.30	0.48	-.20**	.07	.03	.10	.31***	.02	.25***							
Eigenvector centrality	9	25.80	8.91	.15*	.15*	.13*	.17**	.23***	.01	.26***	.07						
Closeness centrality	10	-30.51	10.99	-.21***	.22***	.14*	.20**	.22***	.05	.29***	.07	.40***					
Gov1	11	NA	NA	.03	.02	.04	.04	.03	.06	-.17**	.03	.03	.05				
Gov2	12	NA	NA	.05	.03	.05	.05	.03	.02	-.15*	.04	.05	.06	.02			
Gov3	13	NA	NA	.01	.07	.05	.07	.05	.05	-.19**	.05	.10	.06	.05	.07		
ICT use (duration)	14	44.69	8.02	-.30***	-.25***	.07	.04	.26***	.07	.47***	.26***	.30***	.28***	-.32***	-.25***	.35***	
Economic outcomes	15	20400	5759	-.34***	.30***	.08	.02	.15*	.10	.57***	.30***	.30***	.31***	-.25***	-.23***	.33***	.44***

Note: * p<.05; ** p<.01; *** p<.001; NA: not applicable.

Table 6. Comparison of Villages in Terms of Kiosk Use and Income

		LG-LG				TS-TS				TS-LG			LG-TS		
		1	**2**	**3**	**Control group**	**4**	**5**	**6**	**Control group**	**7**	**8**	**Control group**	**9**	**10**	**Control group**
1	**% of citizen users**	11.2	11.7	11.3	NA	9.9	10.1	10.3	NA	17.7	18.4	NA	15.0	14.8	NA
2	**Frequency of use (per month) among users**	2.11 (0.42)	2.30 (0.28)	2.42 (0.21)	NA	1.30 (0.25)	1.56 (0.17)	1.33 (0.29)	NA	4.17 (0.71)	4.43 (0.69)	NA	3.28 (0.70)	3.35 (0.66)	NA
3	**Duration of use in minutes (per visit)**	38.45 (5.31)	41.68 (6.12)	41.77 (5.89)	NA	31.30 (6.10)	31.75 (5.55)	32.38 (5.98)	NA	61.75 (9.20)	65.58 (11.13)	NA	51.27 (10.44)	51.79 (11.20)	NA
4	**Pre-launch annual income (in Indian Rupees)**	17,145 (5,016)	18,280 (5,015)	17,129 (4,790)	17,010 (4.883)	18,089 (5,160)	17,289 (5,109)	18,880 (5,380)	16,884 (5,330)	17,645 (5,222)	18,777 (5,123)	15,002 (5,302)	18.120 (5,280)	18,330 (5,306)	17,840 (5,210)
5	**Post-launch annual income (in Indian Rupees)**	16,920 (4,910)	17,555 (5,111)	17,101 (4,812)	16.660 (4.912)	19,400 (5,840)	18,890 (5,910)	20,669 (6,073)	16,420 (5,172)	22,330 (6,444)	23,120 (6,137)	15,228 (5,480)	24,170 (6,010)	24,190 (6,140)	17.330 (5,108)

Notes:

1. For variables, 2 through 5, the numbers shown are means (standard deviations).
2. The pre-launch annual income represents the pre-initiative measure.

Table 7. Model Tests

	LG-LG						TS-TS						TS-LG						LG-TS					
	ICT use		Post-impl income				ICT use		Post-impl income				ICT use		Post-impl income				ICT use		Post-impl income			
R^2	.30	.34	.34	.38	.38	.38	.27	.31	.33	.37	.37	.37	.26	.37	.33	.41	.43	.48	.30	.46	.34	.42	.51	.51
Gender	-.16**	-.13*	-.22***	-.17**	-.17**	-.15**	-.15**	-.12*	-.22***	-.16**	-.16**	-.13*	-.12*	-.11*	-.22***	-.15**	-.16**	-.12*	-.13*	-.11*	-.23***	-.14**	-.16**	-.12*
Age	-.13*	-.10*	-.17**	-.13*	-.15**	-.12*	-.12*	-.08	-.16**	-.14**	-.15**	-.11*	-.08	-.05	-.17**	-.14**	-.15**	-.08	-.09	-.07	-.15**	-.13*	-.12*	-.11*
Marital status	.08	.06	.04	.03	.04	.03	.07	.05	.07	.05	.04	.02	.04	.02	.03	.02	.03	.01	.07	.05	.08	.05	.06	.03
Family size	.10	.06	.04	.03	.04	.02	.08	.06	.09	.06	.05	.04	.05	.03	.03	.02	.02	.01	.06	.04	.05	.04	.04	.02
Education	.24***	.20**	.16**	.12*	.08	.06	.23***	.19**	.15**	.11*	.10	.05	.20**	.16**	.13*	.08	.09	.04	.23***	.19**	.15**	.11*	.12*	.07
Cell phone use	.10	.04	.04	.02	.01	.02	.08	.06	.09	.06	.05	.04	.06	.03	.07	.04	.05	.02	.04	.03	.09	.06	.07	.04
Previous year's income	.35***	.32***	.53***	.44***	.44***	.43***	.34***	.31***	.52***	.46***	.46***	.42***	.35***	.30***	.53***	.44***	.46***	.40***	.38***	.29***	.55***	.50***	.49***	.41***
Training sessions attended	.16**	.12*	.20**	.14**	.16**	.12*	.17**	.13*	.19**	.15**	.16**	.11*	.15**	.12*	.17**	.14**	.15**	.09	.16**	.11*	.16**	.15**	.14**	.05
Eigenvector centrality		.14*		.12*		.04		.13*		.12*		.08		.20**		.22***		.16**		.35***		.20**		.07
Closeness centrality		.08		.03		.02		.07		.08		.06		.23***		.23***		.17**		.29***		.17**		.05
ICT use					.15*	.12*					.14*	.12*					.35***	.30***					.49***	.44***

Note: * p<.05; ** p<.01; *** p<.001; Shaded/grayed cells are not applicable.

Table 8. Comparing Effect Sizes: Testing H3 andH4

		LG-LG	TS-TS	TS-LG	LG-TS
Behavioral pathway (note 1)	Eigenvector centrality (EVC) → Use (b1)	.14*	.13*	.20**	.35***
	Closeness centrality (CC) → Use (b2)	.08	.07	.23***	.29***
	Use → Economic outcomes (b3)	.12*	.12*	.30***	.44***
	Indirect effect of EVC: b1 * b3	.0168	.0156	.0600₹	.1540₹
	Indirect effect of CC: b2 * b3	.0096	.0084	.0690₹	.1276₹
	(b1 * b3) + (b2 * b3)	.0264	.0240	.1290₹	.2816₹
Informational pathway (note 2)	EVC → Economic outcomes	.04	.08	.16**	.07
	CC → Economic outcomes	.02	.06	.17**	.05

Notes:

1. Controlling for the effect of both centralities on use.
2. Controlling for the effect of use on economic outcomes.
3. ₹: Bias-corrected confidence intervals did not include zeros, thus indicating significant indirect effects.
4. * p<.05; ** p<.01; *** p<.001.

DISCUSSION

We set out to examine the role of governance modes in ICT4D initiatives between LGs and TSs. To do so, we conceptualized governance modes by focusing on whether the LG or the TS has the decision rights for activities in the pre- and post-launch stages. We compared (1) how the use of a hybrid governance mode, as opposed to a homogenous governance mode, influenced citizens' ICT use, and (2) how the sequence of the LG and the TS governance for the pre- and post-launch stages matters. The LG-TS governance mode was the most effective governance mode in strengthening the behavioral pathway through which citizens' advice networks promote direct and proxy ICT use and, consequently, economic benefits, whereas the TS-LG governance mode was the most effective in promoting the informational pathways through which citizens' advice networks are directly exploited to yield economic gains. Our findings have theoretical implications for IS research in general and ICT4D work in particular. Our work also offers various practical implications that relate to the pursuit of the MDGs and SDGs.

Theoretical Implications

Our research contributes to the understanding of how ICT4D initiatives in developing countries can be governed effectively. Specifically, we integrate concepts on governing IS implementation with concepts on citizens' social networks to elaborate on our understanding of citizens' ICT use and economic outcomes resulting from ICT4D initiatives (Agarwal et al. 2009; Dewan and Riggins 2005; Hsieh et al. 2008; Rice and Katz 2003; Selwyn et al. 2005; Venkatesh and Sykes 2013). Initiatives to create ICT access in less developed countries are often collaborative, with an LG and a TS coming together to combine an LG's local knowledge, social connections, and political power with a TS's technological expertise and financial and managerial resources. Although the collaboration between an LG and a TS has the potential to be synergistic, it poses challenges given the diversity in their motivations and capabilities. By

evaluating different governance modes for the pre- and post-launch stages and identifying the governance modes for an ICT4D initiative that are more/less effective, our work contributes to the understanding of how governance modes affect citizen's ICT use and economic outcomes, and the influence of citizens' advice networks on ICT use. Our work thus complements prior work that has focused primarily on the impact of individual-level variables and the network characteristics of individuals on ICT use.

Given the limited work on governing ICT4D initiatives, we draw on and extend the literature on governance of IS projects, ICT resources and ICT initiatives (e.g., Sambamurthy and Zmud 1999; Xue et al. 2008). Considering which party—i.e., LG or TS—is responsible for the processes in the pre- and post-launch stages, we identify the two homogenous governance modes—i.e., LG only or TS only governance modes for both the pre- and post-launch stages—and two hybrid governance modes—i.e., LG-TS and TS-LG governance modes for the pre- and post-launch stages, respectively. Our classification of the governance modes recognizes that the decision rights for pre- and post-launch activities can reside with one party or can shift from one party to the other given the challenges of an implementation stage and considerations of parties' motivations and capabilities. The idea of shifting decision rights from one party to another across stages during the course of an initiative is an important contribution to how we can envision the governance of ICT4D initiatives and, more generally, complex IS initiatives that require the collaboration of multiple stakeholders with different motivations and capabilities (Dong et al. 2009). Related to this, we note that, in our context, the activities in the pre- or post-launch stages were managed exclusively either by an LG or a TS. However, in other contexts, each stage may be shared across these stakeholders and the extent to which the responsibilities are shared and what responsibilities are shared may vary. The overlap between an LG and a TS is thus a

potentially interesting idea that could be the focus of future research. Future research may also assess how performance of an ICT4D initiative is influenced by the commitment and shirking behaviors of an LG or a TS.

Our work uncovers differences in citizen outcomes—i.e., ICT use and economic well-being of participants—resulting from the alternative governance modes that differ in how well the allocation of decision rights to a party aligns with its motivations and capabilities. We contribute to the understanding of managing ICT4D initiatives by unraveling how an LG's knowledge of the local context, political power, and social connections and influence, and a TS's ICT expertise need to be aligned with the rights for governance of activities in the pre- and post-launch stages. Although organizational IS projects are complex and involve diverse stakeholders, a ICT4D initiative is marked with even more diverse objectives and actors, and calls for outreach into widely different groups. The two key actors in a ICT4D initiative—i.e., LG and TS—differ from the key actors, such as top management or IT professionals (see Xue et al. 2011), in an organizational IS project. In addition, barriers that challenge an ICT4D initiative especially in less developed countries, such as ICT access and high skepticism about ICTs, are quite distinct from the barriers that challenge organizational IS projects. By determining the specific governance modes that are more/less effective, we contribute to our understanding of how ICT4D initiatives should be governed to promote ICT use among disadvantaged citizens and generate economic benefits for them. We thus elaborate our understanding about governance of an ICT4D initiative by contextualizing prior governance research to differentiate between the motivations and capabilities of an LG and a TS, and the party responsible for leading the pre- and post-launch stages (see Alvesson and Karreman 2007; Johns 2006).

Our work makes a contribution to how the governance mode interacts with the information and knowledge resources that are situated in citizens' advice networks to affect how they use the ICT provided by an ICT4D initiative and benefit from the ICT4D initiative. Past work at the firm level has revealed that governance mode interacts with competition intensity that varies across industries and firm size to determine firm performance (Ho et al. 2011). Similarly, prior research on governance of ISD projects has shown that it is the interrelationships among governance modes, ICT, and contextual customer knowledge—and not just their direct effects—that affect outcomes (Tiwana 2009). Generalizing to software platforms, Tiwana et al. (2010) proposed the need to focus on the interactions among ICT architecture, governance, and environmental dynamics. Our work draws on and extends these arguments to evaluate how governance modes interact with resources—specifically, information and knowledge—that flow to citizens from their advice networks in influencing direct and proxy ICT use and economic outcomes in the context of an ICT4D initiative. Prior research by Venkatesh and Sykes (2013) highlighted the pathways by which advice networks influence individual use and/or economic outcomes in the context of ICT4D initiatives. We extend their research by showing that governance modes can determine which pathway—i.e., informational or behavioral—becomes more salient in an ICT4D initiative depending on the governance mode. The LG-TS governance mode is ideally suited to promote the behavioral pathway, whereas the TS-LG governance mode is the preferred choice to promote the informational pathway. Choosing one of the two hybrid governance modes—i.e., TS-LG or LG-TS—prioritizes where to place greater emphasis of governance in complementing the influence of citizens' advice networks—citizens' direct and proxy use of ICT for economic well-being or leveraging of information accessed from advice networks that can be exploited for economic well-being without involving direct or proxy use. A future research

direction that can complement our variance theory approach is one that takes a process theory approach in order to garner insights into episodes of success and failure. Further, in our research, the ICT4D initiative was launched almost in parallel in various villages. However, as launches are completed, a TS may learn and be able to develop its governance motivations and capabilities and that could affect future deployments. Likewise, if there is information sharing across LGs, better outcomes should result over time. Such learning and its impact on success could be a focus for future research. Although our field study itself was elaborate and included data on a large number of heads of households, we were limited to data about 10 villages with the ICT4D initiative and thus had only 2 or 3 villages in each type of governance mode. Future research can replicate this work more widely to establish generalizability.

Our work contributes to the broader IS literature in important ways. First, we complement and extend knowledge on how social context can play a critical role in learning and knowledge transfer (e.g., Warkentin et al. 2011). Future research can leverage the theoretical lens we have used to complement other theories in this domain, such as social learning theory. Second, there is a growing body of research on e-government that has suggested a variety of macro- and micro-level factors that could affect e-government success (e.g., Srivastava 2011; Srivastava and Teo 2010, 2011). We draw on these general ideas and contextualize them to ICT4D initiatives that are one of the most critical types of e-government activities as they seek to achieve socio-economic equality and better quality of life for the poorest citizens in developing countries. Finally, the rich body of ICT adoption research (Venkatesh et al. 2003; Venkatesh et al. 2016b), which has largely focused on the new ICT, can benefit from a perspective that considers the incumbent system or approaches that are already in place (see Bekkering et al. 2009; Venkatesh et al. 2011).

Practical Implications

This work alerts sponsors and other stakeholders of ICT4D initiatives that a homogenous governance mode—i.e., restricting governance to either an LG only or a TS only in both pre- and post-launch stages—although appealing on surface due to ease of management, administration and for political reasons is the least effective. Although both an LG and a TS have a common goal—i.e., to overcome the ICT access barriers—their motivations and capabilities differ dramatically. In strategizing about ICT4D initiatives, it is important to consider a hybrid governance mode comprising both an LG and a TS. Such a hybrid governance mode aligns the assignment of responsibilities for processes with the motivations and competencies of an LG and a TS.

Project sponsors should also carefully consider the sequence in which an LG and a TS assume responsibilities to govern ICT4D initiatives across pre- and post-launch stages. Project champions targeting greater direct and proxy use by citizens are likely to be effective in achieving this objective by adopting a LG-TS governance mode. They should recognize that an LG is likely to be more effective in establishing the conditions for greater use by taking responsibility for the pre-launch processes because an LG is better equipped than a TS to (a) establish reliable Internet connections for the kiosks (which can be a major challenge in rural parts of developing countries), (b) develop awareness and favorable initial perceptions among villagers through town hall meetings and informal channels, and (c) overcome obstacles and sabotage attempts from information brokers who can view the ICT as a threat to their power and livelihood. In contrast, a TS is likely to be more effective than an LG in promoting greater use by taking responsibility for the post-launch processes because a TS is better positioned to (a) provide training, (b) observe, document, and disseminate best practices for both direct and proxy

use, and (c) reconfigure the ICT based on user experiences with direct and proxy use with facilitation by a kiosk attendant.

Project sponsors with the objective to promote citizens leveraging information accessed from advice networks for economic development should use a TS-LG governance mode. During pre-launch, a TS will need to assume responsibility for installing and testing the ICT but will need to lean on the LG to overcome certain obstacles in the local context. During post-launch, an LG can promote discussions on how information accessed through advice networks can be best leveraged by citizens, and can use its political power and social influence to remove political and infrastructure barriers that prevent citizens from using the information effectively.

Limitation and Future Research

Our theory development was contextualized to India and, as such, given the socio-economic disparity in India, this context is important. However, some of the ideas and mechanisms could generalize to other developing countries, such as China, but such new contexts are likely to require consideration of their unique elements (see Johns 2006) and future research is necessary to understand the resulting implications for effective governance of an ICT4D initiative in those settings. For instance, the distinctive characteristics of a context may call for the introduction of new constructs, identification of new mechanisms through which governance affects the outcomes of ICT4D initiatives, or consideration to different base rates in term of ICT use.

Additional research is needed to examine when certain governance modes are more or less effective given that contingencies and access to complementary resources can determine the effectiveness of a governance mode (Ho et al. 2011; Xue et al. 2011). We call for future research that considers the characteristics of the local context and the partners to understand how a

governance mode, together with other resources (e.g., advice networks), can be combined effectively in ICT4D initiatives.

We used a careful qualitative approach to gathering data about and the coding of the key variable in our model—i.e., governance. Future research can use other approaches, including a survey methodology, that can examine the level of agreement among various stakeholders using quantitative metrics to triangulate our measurement approach and findings (see Venkatesh et al. 2013). In addition, types of governance mechanisms used by the TS or the LG during an ICT4D initiative can influence the success of the ICT4D initiative, and how advice networks influence citizens' ICT use and use of information accessed from advice networks for economic purposes. Some approaches to conceptualize and measure specific governance mechanisms that have been used in prior research and that may be relevant include the use of contractual and relational governance, and formal and informal controls (e.g., Poppo and Zenger 2002; Rai et al. 2009)

Although one of the strengths of our work is the extensive research design in terms of number of villages studied, control group of villages used, data collection approach, and consequent high response rate, we only studied a one-year window of time. It is possible that homogenous governance modes could achieve the same positive results as the hybrid governance mode or perhaps even better and sustainable results, albeit over a longer timeframe. This can only be established through studies conducted over a longer timeframe, such as 3 or even 5 years. Considering that some ICTs, even in organizational settings, in developed countries yield benefits after such longer timeframes, such future research will be valuable. Such work should consider time in a central role in the theory development (Ancona et al. 2001; Venkatesh et al. 2006). In such a context, such future work will complement our recent work on other problems

related to quality of life—e.g., infant mortality (e.g., Venkatesh et al. 2016a). Such problems are likely to be better understood via studies of networks of women.

CONCLUSIONS

This research conceptualized and tested the impacts of different governance modes in ICT4D initiatives, where the TS or the LG is responsible for the governance of pre- or post-launch activities. Juxtaposing the impacts of homogenous and hybrid governance modes, we demonstrated the superior impacts of the latter on ICT use by and economic outcomes for citizens. We show that two types of hybrid governance modes—i.e., TS-LG and LG-TS governance modes for the pre- and post-launch stages—differently affect how citizens leverage their local information and knowledge resources from their advice networks to benefit from the ICT4D initiative. Although the LG-TS mode is effective in leveraging advice networks to promote direct and proxy ICT use, the TS-LG mode is effective in leveraging advice networks for economic gain. Both in scientific and practical terms, we contribute to the body of knowledge on the success of ICT4D initiatives by focusing on the critical role of a more macro-level factor compared to the focus on micro-level, e.g., individual, factors in prior research and how it complements and mobilizes local community resources, namely advice networks.

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