APPENDIX A

Table A1: Examples of Prior Empirical Research on ICT Implementations in Developing Countries

Article	Context	Catalysts	Challenges
Bada (2002)	ICT implementation in a Nigerian Bank	– Local adaptations • Conceptual adaptations • Operational adaptations	
Barrett and Walsham (1995)	ICT implementation in a Jamaican insurance company		Interplay among organizational culture, learning, and leadership style
Bailure (2007)	Telecenters implementation in India	Stakeholder (e.g., villagers, community workers, government officials, project team members) support	Hidden interests of stakeholders
Braa and Hedberg (2002)	Health information systems implementation in South Africa	– Local control of information and computing resources	– Integration and control of information at local levels – Lack of usage of collected data – Incompatible and competing standards
Braa et al. (2007)	Health information systems implementation in developing countries	– Creating attractors – Adaptive to the local contexts	
Brown and Thompson (2011)	ICT innovation implementation in Jamaica	– Knowledge building through national ICT policies and plan – Knowledge deployment – Subsidy – Standards – Innovation directives – Mobilization	
Cecchini and Scott (2003)	ICT implementation in rural India	– Fostering competition – Role of small entrepreneurs – Regulatory mechanisms – Grassroots intermediaries – Community involvement – Awareness raising and training	Access to information infrastructure
Ciborra (2005)	E-government implementation in Jordan		– Emerging risks – Technology incompatibility – Complexity of analysis – Change management
Chin and Fairlie (2006)	Technology penetration in developing countries	– Income – Human capital	

		– Youth dependency ratio – Telephone density – Legal quality – Banking sector development	
Ewusi-Mensah (2012)	ICT diffusion in Ghana		– Unstable and erratic power supply – Unreliable telecommunications – Inadequate computing resources – Lack of human and financial resources to tackle the challenge
Gibbs et al. (2003)	E-commerce diffusion in developing countries	– Policies such as trade and telecommunications liberalization – Pressure on firms to adopt e-commerce to compete	Inadequate protection for both buyers and sellers
Grazzi and Vergara (2011)	ICT implementation in Paraguay		– Cultural barriers – Language barriers
Gutierrez and Gamboa (2010)	ICT implementation in Colombia, Mexico, and Peru		– Lack of education – Income
He (2004)	ERP implementation in China		– Cost – Complexity – ICT infrastructure – Lack of well-trained workers – Lack of incentives – Corporate culture
Kenny (2000)	Internet expansion in rural areas in Africa	– Liberalization of telecommunication sector – Subsidies to local entrepreneurs	– Cost of internet service provision – Number of rural access points
Krishna and Walsham (2005)	Public ICT implementations in India		– Detailed effort and attention to the involvement of multiple groups – Innovative organizational structures – A people-orientation in project selection – Persistence over time, backed by committed and knowledgeable leadership
Ngwenyama and Morawczynski (2009)	ICT expansions in five Latin American countries	– Deregulation – Economic factors – Human capital – Geography	

		– Civil infrastructure	
Odedra-Straub (1993)	ICT implementations in African countries		– Poor infrastructures – Lack of foreign exchange to buy spare parts – Poor supplier service – Scarce education and training facilities – Lack of skilled personnel – management commitment, and cooperation
Okoli et al. (2010)	E-business initiatives in Latin America and Sub-Saharan Africa	– Policies targeted specifically toward e-business – ICT infrastructure	
Richardson (2011)	ICT implementation in Cambodia		– Hardware incompatibility – Complexity – Language barriers – Lack of electricity, computers, and internet access – Inability to understand the advantages of these technologies
Sahay (1998)	Geographical information systems (GIS) implementation in India		– Development of systems that were not considered relevant by users – Lack of continuity in project management practices – Inappropriate co-ordination between the various agencies.
Sayed and Westrup (2003)	ICT implementations in Egypt	– Government support and national initiatives – Policies to promote ICT usage	– Lack of intellectual property laws – Lack of skilled labor – Retention of skilled IT professionals
Schuppan (2009)	E-government initiatives in developing countries	Institutional, cultural, and wider administrative contexts	– State failure – Lack of capacity
Silva and Figueroa (2002)	ICT implementation in Latin America	Favorable government policies and deregulations	– Education – Income – Lack of entrepreneurship – Infrastructure
Silva and Hirschheim (2007)	Strategic information systems implementation in Latin American public organizations		– Inadequate planning – Lack of leadership

			– Organizations lacking the necessary skills for designing and implementing ICTs – Neglecting changes in the organizational structure – The political timing of organizations
Steinmueller (2001)	Alleviate digital divide between developed and developing countries		– Acquisition of specific skills and adaptation of equipment – Market conditions needed for equipment and knowledge exchange – Need to acquire complementary technologies and capabilities – Downstream integration requirements to achieve the necessary market development
Straub et al. (2001)	ICT transfer to the Arab World		– Arab cultural beliefs
Urquhart et al. (2008)	ICT project success in developing countries	– Social capital – Knowledge management	
Walsham and Sahay (1999)	Geographical information system (GIS) implementation in India	– Network of aligned interests of technology, developers, and users – Data sharing at higher political levels – Change education process for administrative officials – Enroll stakeholder groups to align their interests with the technology	

Note: We focused on journal articles that empirically examined catalysts and challenges of ICT implementations in developing countries.

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APPENDIX B
Traditional Challenges and Emergent Catalysts in India

In this appendix, we provide a brief background on the traditional challenges and emergent catalysts that organizations in developing countries are likely to face as they implement ICTs. We focus on India as we explain these challenges and catalysts.

Traditional Challenges in India

Prior research and United Nations (UN) reports have suggested the following key barriers to ICT implementation in developing countries: poverty, lack of reliable infrastructure, lack of technological knowledge, language skills, and the digital divide (Dagron 2000; UNCTAD 2003; UNESCO 2002; Venkatesh 2010). We classify these and other related barriers into four broad categories: (1) *physical barriers* deal with obstacles related to infrastructure (2) *socio-economic barriers* are related to societal and/or economic pressures that hinder successful implementation of ICT (3) *cultural barriers* are obstacles related to specific norms and practices, (4) *institutional values* are contextual factors that characterize the institutional context in which organizations operate in developing countries.

A first-order barrier identified by the UN is the *physical barrier* of infrastructure and access (UN Millennium Project 2005). A reliable infrastructure includes a stable government and the availability of power, telephone lines, satellite links, and access equipment (e.g., personal computers). A stable government is of particular importance because government policies can facilitate or obstruct implementation of ICTs. Despite its democratic form of government, India has had about ten different central[1] governments since 1991. In addition to an unstable government, unreliable electric power and a relatively low number of telephone lines per capita are major physical barriers in India (TRAI 2010). Lack of sufficient telecommunications and a networking backbone in the form of a high-speed media, such as fiber optic cable, is another physical barrier. Although urban centers have seen significant improvement, rural areas continue to struggle with infrastructure problems (Rajeev 2008). As a result, India has performed poorly on the *Digital Divide Index*, a measure of the uniform diffusion of ICT across geographical regions and groups of people (Hanafizadeh et al. 2009; UNCTAD 2006; see Venkatesh and Sykes 2013 for a review).

Major *socio-economic* barriers that India is facing include a low literacy rate, high rate of brain-drain, and low GDP and per capita income. India ranks 134th in the world on the human development index, a measure that includes life expectancy, adult literacy and GDP (UNDP 2009). India's *Education Index* is 64 compared to 97 for the U.S. (UNDP 2009). India also has a high rate of *brain drain*. To illustrate, in the 1990s, despite producing one of the highest numbers of science and engineering graduates in the world, India had a very significant shortage of skilled technical workers. Further, India's GDP is about 7% of that of the U.S. but the average cost of a computer/Internet connection was approximately the same as it was in the U.S., thus making ICT a very expensive purchase in India (Morrison and Kronstadt 2003). Despite India's tremendous progress in recent years, most of these problems persist (Shah 2013).

The *cultural barriers* India faces include inadequate English literacy, computer literacy, and a complex caste system. Only about 23% of Indians are English-literate (Wikipedia 2013) making language a key barrier for ICT diffusion. Secondly, majority of India's population has limited exposure to computers and may not appreciate the benefits of ICTs (Venkatesh and Sykes 2013). 1F0inally, one of India's unique challenges is the existence of castes, norms, and caste-based cultural traditions that govern the learning opportunities for traditionally underprivileged castes, a fact that is confirmed by India's high power distance index (Hofstede 2013). Such norms and cultural practices make it difficult to provide effective access to education on and use of ICTs across all strata of society.

Another traditional challenge, namely *institutional values*, can potentially affect ICT implementations in India. One of the core values of organizations in India is *conservatism*. These range from the way in which loans and investments are made to the responsiveness to change. This has limited their interest in competing with the many foreign banks

[1] Equivalent to the Federal Government in the U.S.

that operate in India. Another unique characteristic is the focus on a broader range of goals that include serving citizens via products and services that reach the masses and serving as a major employer instead of efficiency and profit. Employment at Indian banks is accompanied by *high stability, steady growth* (often based on experience and not solely on merit), and *high job security*. Overall, such a mindset has resulted in *strong labor unions* that help employees achieve growth and security.

Emergent Catalysts in India

Like many other developing countries, India has undergone recent transformations that aim to alleviate many of the traditional *physical*, *socio-economic cultural* and *institutional barriers* (Gupta 2005; Pandit 2005; Rajan 2005; Siriginidi 2009; Zakaria 2006). In 1991, the government adopted an open economy policy and began various economic reform programs in the areas of capital and product markets, corporate and individual tax regimes, land, intellectual property, labor, and judiciary (Pandit 2005). As a result, India is now one of the fastest growing economies and is expected to be the second largest economy in the world by the year 2040 (Scherer 2010; Zakaria 2006).

In order to combat the *physical* barriers to ICT implementation, the Indian government passed the *Information Technology Act of 2000* that provided private companies the right-of-way to install communication cables normally impeded by immovable property. It has made large investments to improve and modernize transportation systems, airports and seaports, and has encouraged public and private organizations to participate in these projects (Gupta 2005). Technological leapfrogging—i.e., the practice of less technologically developed countries adopting established advanced technologies developed by other countries without having to go through the various middle stages of development—is also helping India. For example, in 2000, India's *National Stock Exchange* went from being a paper-based system to a more modern Internet-based system that could be accessed throughout the world similar to stock exchanges in developed countries. India's ranking in the *Networked Readiness Index* has also been improving steadily over the years (Dutta and Mia 2010; World Economic Forum 2005).[2]

India has shown a marked improvement in the past several years in overcoming several *socio-economic* barriers. It is currently the global leader in providing IT outsourcing services and is expected to become the global leader in the software industry by 2020 (Gartner 2010; NASSCOM 2010). With many multinational corporations having a significant presence or outsourcing their business processes to India, ICT professionals may not have to go abroad to find lucrative and challenging jobs, thus effectively reducing and even reversing *brain-drain* (Majumder 2006). The Indian government has also been actively fighting to increase the national literacy rate with a goal to have an 80% literacy by 2017 primarily focused on females.

Cultural barriers are being addressed in several ways. The Indian government operates under the secular ideal of equal rights. It has many programs to alleviate gender, status, and caste biases. Women's literacy rates have improved a great deal based upon the census of 2011. Census provided a positive indication that. Growth in females literacy rate is 11.8% compared to 6.9% in males. To improve equality among the castes, the government uses a reservation system, similar in concept to US *Affirmative Action* that allocates a certain percentage of openings in colleges and government jobs to people belonging to historically oppressed castes (Sekhri 2011). The language barrier is being addressed in two ways. First, there is a greater possibility of native designers developing software and web pages in Indian languages as Indian ICT professionals have become more skilled over the years (Kannan 2012), with a steady increase of web sites and web pages in major Indian languages (e.g., Hindi, Tamil). Second, with the large influx of foreign companies and business process outsourcing to India, formal education in English has increased greatly over the years as more students and young citizens have become eager to be more English literate in order to become a part of this fast-paced and highly rewarding industry.

Institutional values are changing slowly as many western organizations now have operations in India and employed a large number of Indians (Majumder 2006). Although a majority of Indians still believe in conservatism, traditionalism and long-term career orientations, younger individuals who are working in the private sector including MNCs and

[2] India ranked 45th in 2003 and 43rd in 2004.

NGOs are much more receptive to the notion of individualism and short-term career goals. They are willing to take risks to advance their career quickly and change jobs frequently for better opportunities. Further, due to global economic uncertainties and recessions in most developed countries, many Indians who used to work and live in developed countries have returned to India and started working in MNCs or developing their own businesses. Emergence of such communities has affected the traditional institutional values in India (Pandit 2005).

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