A Collaborative Approach to Creating ICT-based Sustainable Development

Full Paper

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Abstract

A large number of ICT-based development projects don't survive beyond the initial implementation stage and fail to deliver the promised outcome. This report addresses the critical research question of how to create sustainable development through the use of ICT. Using a case study research method, we investigate a telemedicine project implemented by OTTET, a non-governmental organization, to deliver healthcare to the rural poor. OTTET Telemedicine showcases the benefits of the public private partnership (PPP) model in implementing ICT-based sustainable development. OTTET leveraged this partnership to successfully implement a comprehensive strategy that combined IT implementation with development of skilled human resources at the local level, and poverty alleviation through stimulation of micro-entrepreneurship. Effective collaboration between the state government and OTTET is a key to the success of OTTET Telemedicine. Lessons learned from the telemedicine project are presented and their implications for implementing ICT-based projects for sustainable development are discussed.

Keywords

ICT4D, Sustainable development, Rural health delivery, PPP Model, Telemedicine

Introduction

The widespread use of information and communication technologies (ICT) in bringing about development has been well documented (Walsham and Sahay 2006). They have been used to implement e-Government, and to expand the reach of healthcare and education to underserved populations living in resource starved regions around the world. The critical role of ICT for development (ICT4D) is evident from the fact that nearly 3 out of 4 developmental projects approved by the World Bank Group between 2003 and 2010 involved an ICT component (IEG 2011). However, a major concern about developmental initiatives in general and ICT-based developmental projects in particular is that many of these projects don't survive beyond the initial implementation stage. They fail to deliver the anticipated benefits, and in many occasions the project loses funding after the initial implementation stage. 70% of the projects supported by the World Bank Group in the area of public sector governance had their ICT components delayed, modified and/or cancelled (IEG 2011). The IEG report characterized the ICT application component of the project as having a "high risk/ high reward profile" (IEG 2011, pp. xvi) – they carry a high risk of failure but deliver significant benefit when implemented successfully. Creating ICT-based sustainable development is a major challenge facing ICT4D researchers as well as agencies involved in global development activities.

The research question addressed in this report is how to create ICT-based sustainable development. We argue that taking a comprehensive view of development beyond focusing on IT implementation is critical for long term successful outcome. A multipronged approach that targets local human resource development through IT skill building and engagement of local micro entrepreneurs leading to employment generation and poverty alleviation is more likely to lead to sustained success of the project. Active collaboration between the implementing agency and the local government is critical to successful implementation of this strategy. We illustrate this approach to creating ICT-based sustainable development through the case study of OTTET, an organization engaged in bringing healthcare services to medically underserved population living in rural India. OTTET's telemedicine project exemplifies the

power of the public private partnership (PPP) model and active engagement of local level stakeholders, thus creating the environment for long term success. While attempting to deliver healthcare to the rural poor, it also generates employment opportunities and promotes economic growth in resource starved regions. It, thus, contributes to two of the sustainable development goals set by the United Nations, namely, Goal 3: ensure healthy lives and promote wellbeing of all, and Goal 8: promote inclusive and sustainable economic growth, employment and decent work for all (UN 2016).

The remainder of the report is organized as follows. The next section reviews the research literature on sustainability and ICT for development. It is followed by a discussion of the research method. The case study is then presented and the results analyzed. Finally, the paper is concluded with a discussion of the limitations of the study.

Sustainability and ICT for Development

ICT plays a critical role in global development. Three areas where ICT's role has been preeminent are e-government, education, and healthcare. E-Government initiatives have been responsible for enhancing access to public services in both developed (Cordella and Tempini 2015) and developing countries (Minto-Coy et al. 2015). They have been instrumental in promoting transparency in government (Bertt et al. 2010), rooting out corruption (Srivastava et al. 2016), and bringing financial inclusion to people living in remote locations (Leonardi et al. 2016). E-Government projects, however, are known to have high failure rates, some of the reasons being design-reality gap, bad planning, and poor project management practices (Anthopoulos et al. 2016).

ICT's role in improving access to education and facilitating lifelong learning for both educators and students is well known. It helps create a flexible learning environment that can be customized to the learning style and schedule of the learner. UNESCO is promoting innovative use of ICT to create universal access to education and to remove educational disparities through its ICT in education prize (UNESCO 2016). A yearlong study conducted by the Columbia University Teachers College on integrating ICT in secondary school education in rural schools in sub-Saharan Africa found that investing in physical infrastructure and ICT infrastructure are critical for successful use of ICT in education. Scalability and sustainability of these projects depend on continuous engagement and development of teachers in ICT-based education. They recommend using the public private partnership (PPP) model for infrastructure development and teacher skill upgradation.

ICT play an important role in expanding the reach of healthcare and reducing health disparities in resource starved regions around the world (Hailemariam et al. 2010; Srivastava et al. 2015; Venkatesh et al. 2016). Telemedicine connects patients in remote locations with physicians, and health information systems enable administrators make decisions by having real time access to population health data. While ICT's role in development is without any doubt, ICT-based development projects are known to be plagued by high rates of failure (IEG 2011). Lack of long term sustainability is a major concern for these projects. Braa et al. (2004) analyzed the problem of lack of sustainability of health information systems in developing countries and recommended that ensuring scalability and addressing the political agenda of stakeholders are critical to building sustainable health information systems. Heeks (2002) attributed failure of ICT-based development to two reasons: (1) design-actuality gap caused by the remoteness of the system designer from end-users, and (2) hard-soft gap due to the difference between the rational western view of IT and the political perspective of local implementers in developing economies. Vaidya et al. (2013) assigned responsibility for the failure of information systems for rural agricultural markets to a lack of trust among various stakeholders, including, farmers, traders, and government agencies.

A comprehensive assessment of factors influencing sustainability of ICT-based development projects identified five groups of factors: Political/institutional, Financial, Technological, Cultural/social, and Environmental (da Silva and Fernandez 2016). According to this report, lack of strong sponsorship, misalignment of goals and interests among various stakeholders, and asymmetric relationship among stakeholders resulting in user disengagement can negatively impact project sustainability. Furthermore, lack of trust in managing financial transactions and preferential treatment of the vendor by the donor agency can undermine the role of the host institution, thus leading to project failure in the long run. Technological factors that impact sustainability include design-reality gap, lack of technical capacity and inadequate user involvement in providing feedback during system design and enhancement. Mismatch in

organizational and/or national cultures of the various agencies involved in the project can be a cause for concern and may lead to dysfunctional relationships. Finally, with ICT's increasing environmental footprint, it is important to consider the environmental impact of the project in order to ensure sustainability (da Silva and Fernandez 2016).

Several of the sub factors identified by da Silva and Fernandez (2016), pertain to management of roles, expectations, and relationships among various stakeholders of the project, and thus, are influenced by the governance strategy. The PPP model, which envisages collaboration among governmental and non-governmental organizations, and corporate entities, offers one approach to implement developmental projects (Buse and Harmer 2007). While Singapore's experience demonstrates the effectiveness of the PPP model in transforming its healthcare landscape (Lim 2005), other researchers caution about the limitations of this model (Richter 2004). In light of the dismal sustainability records of ICT-based developmental projects, it is enlightening to analyze OTTET's Telemedicine project, which stands out as an exemplar PPP initiative to implement ICT-based projects that are scalable and sustainable.

Research Context and Design

Orissa Trust of Technical Education and Training (OTTET) is a non-profit organization based in the state of Odisha in India. Its mission is to bring education and health services to the poor. We used the case study research method to examine the implementation of the telemedicine project by OTTET. The case study research design is appropriate for exploring a contemporary phenomenon in a field setting, and answering "Why" and "How" questions (Yin 2014). It is extensively used in ICT4D research studies (see for example, Jha et al. 2016; Leonardi et al. 2016). Since the objective of our research is to get a deeper understanding of the telemedicine project implemented by OTTET and address the research question of how to create sustainable development, we found the case study research design to be most appropriate. Data were collected from multiple sources, including interviews with senior management and various stakeholders, published and unpublished reports about OTTET's operation, and field visits to telemedicine centers operated by the organization. Both the founder of OTTET and its Head of Technology and Operations, sat down with the authors of the manuscript in multiple hour long sessions to discuss the vision, mission, operations, and future plans of the organization. Published and unpublished reports provided a second source of data. Both authors visited a telemedicine operations center run by OTTET to get a firsthand experience of the telemedicine facility and its operations. During this visit they conducted interviews with the owner/operator of the telemedicine center and the resident medical officer of the government hospital that housed the telemedicine center. Transcripts of these interviews provided a third source of data for the study. We first present a brief overview of the state of rural healthcare in Odisha to put the discussion in context.

The state of rural healthcare in Odisha

The study was conducted in the state of Odisha, located in eastern India. It has an area of 60,000 square miles (155,000 sq. km.), and a population of about 42 million, of which 83% live in rural areas, according to the 2011 census (Census of India 2011). The state of healthcare delivery in India is very poor. According to a report by the World Health Organization, India had 6.5 medical doctors per 10,000 people (compared to 24 in the US) in 2009 (WHO 2016). Since most qualified healthcare professionals prefer to live in urban areas, receiving healthcare is a significant challenge for people living in rural India. The public health system run by the state government is the primary provider of health services to the rural poor. It is organized using a 3 tier system (Dasgupta 2013). At the bottom tier is the sub health center, which caters to the healthcare needs of 5 to 10 villages. A sub health center is staffed by a male health worker and a female auxiliary nurse midwife. In the next level is the primary health center (PHC) headed by a medical doctor that serves the population covered by 10 to 15 sub centers. The PHC has limited in-patient facility. The community health center (CHC) located in the top tier operates a 30 bed hospital and provides specialized care. It acts as a referral unit for 12 to 15 PHCs. Tertiary care, such as cardiology, oncology, etc., is available only at major hospitals located in large cities. Considering the fact that 4 out of 5 people in Odisha live in rural areas, quality healthcare and specialized care are scarcely accessible to a large segment of the state's population. Thus, expanding the reach of quality healthcare to rural areas is a critical need for the wellbeing of the state and a top priority of the state government.

OTTET Telemedicine

The telemedicine project was started in 2009 using the Public Private Partnership (PPP) model (Lim 2005) between OTTET and the Government of Odisha with the goal to bring quality healthcare to the villages of Odisha and create employment opportunities for the rural youth. The plan was to augment the public health system by linking it to specialty private and public hospitals located in large cities and metropolitan areas using ICT at no additional cost to the state government. Technical support for the project is provided by the School of Telemedicine at SGPGIMS, a super-specialty teaching hospital located in Lucknow, India. OTTET is responsible for planning, execution and overall program management. It recruits and trains unemployed youth and women to operate telemedicine centers, and develops the network of providers who offer teleconsultation services. The state government oversees the program and facilitates the whole process by providing support, as needed, through its various executive branches.

Figure 1 presents an overview of the operation of OTTET Telemedicine. Teleconsultation services are available at the Telemedicine Operations Center (TOC), which is collocated with a government owned health center, such as a CHC. It is equipped with a laptop with a video camera, and appropriate software to create and maintain patient health records and to conduct video consultations. Medical diagnostic devices, such as blood glucose meter, heartrate monitor, etc. are also available. The telemedicine technician collects the vitals of the patient and creates a patient health record. This is subsequently sent to OTTET's data center, where it is stored for future retrieval. A store and forward technique is used to transmit patient data to deal with poor connectivity, which may prevent real-time data transfer in some locations. The physician in a consulting hospital may make a diagnosis offline based on the patient record data or set up a real-time video consultation, if desired. Consulting hospitals include government owned specialty care hospitals and privately owned tertiary care (super specialty) hospitals that have signed an agreement with OTTET to provide teleconsultation services. A typical TOC located in a CHC requires a capital investment of INR 600,000 to 800,000 (approximately US$ 9,000 to 12,000) and creates employment opportunity for telemedicine technicians. The TOC is financed and operated by a micro entrepreneur, who benefits from the revenue generated through fees charged to patients for consultation and diagnosis services.
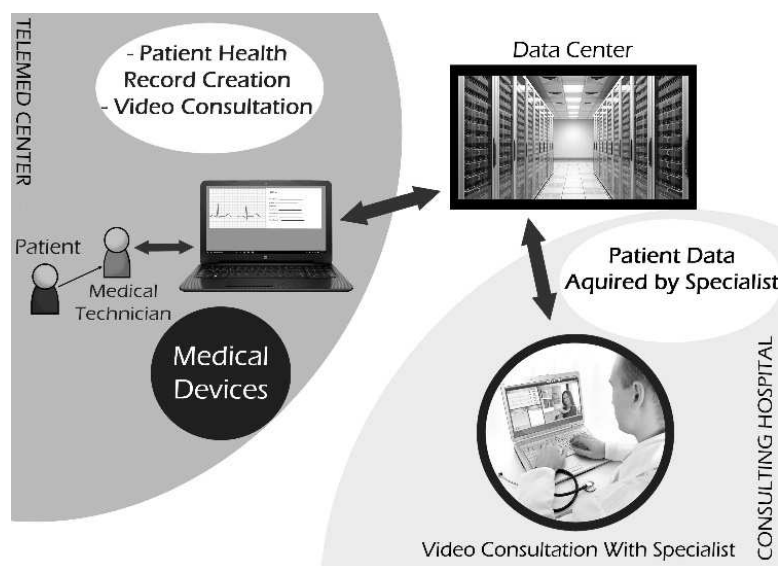

Figure 1. OTTET Telemedicine Operations

Sharing the building space with the local health center is mutually beneficial to both the TOC and the CHC. Patients visiting the CHC are first examined by the telemedicine technician, who takes their vital measurements, such as body temperature, etc., and creates their electronic patient health records before they visit the attending physician at the CHC. This enables the physician to spend more time to examine the patient to diagnose the illness as he/she is saved the effort of recording the patient's vitals. It also creates a digital patient record for archival purpose, a facility not available in many government run

hospitals. Digital patient health records are helpful in chronic care management and in analyzing and reporting population health data. The TOC also augments the diagnosis facility at the CHC by offering additional diagnostic tests, if recommended by the physician. In return, the TOC is compensated for its services, which generates additional revenue for its owner/ operator. Thus, OTTET, in addition to providing telemedicine services, also contributes to enhancing the quality of care provided by the government owned health centers.

Discussion

To answer the main research question, whether OTTET offers a viable model for sustainable development, we focus our analysis on two issues: growth of telemedicine services and sustainability of OTTET Telemedicine.

Growth

Since its inception in 2009, OTTET Telemedicine has set up 127 telemedicine centers, and trained about 900 telemedicine technicians. It has signed collaboration agreements with several super-specialty hospitals in India, including some elite hospitals, namely, SGPGIMS, Lucknow, the Narayana Hrudayalaya Group, Apollo Hospitals, Asian Institute of Gastroenterology, Hyderabad, and the All India Institute of Medical Sciences, Bhubaneswar. About 500,000 patients have so far benefitted from the services provided by OTTET Telemedicine.

Any assessment of the growth of telemedicine services offered by OTTET would be incomplete without an appreciation of the challenges posed to the adoption of telemedicine services by the rural population. We identified the following challenges based on our interviews with the senior management of OTTET, the attending physician at the CHC, and the owner/operator of the TOC.

The biggest hurdle to extending telemedicine services is resistance from patients in adopting teleconsultation services. Patients are used to in-person consultation with a physician. Therefore, in spite of the benefits afforded by teleconsultation services, there is some reluctance to use it. "*They would rather travel a little for face-to-face consultation than use telemedicine services*," according the TOC owner/operator. Identification of the real cause of patient resistance is still an unresolved issue. However, recommendation from the attending physician at the CHC has been found to be effective in facilitating adoption of telemedicine services by patients.

Inadequate technology infrastructure, including electrical power outages and lack of high speed broadband services, is another hindrance to the expansion of telemedicine services in rural areas. OTTET Telemedicine relies on both real-time connectivity, and store and forward mechanisms for data transfer to deal with poor telecommunication infrastructure.

Some of the services offered by OTTET Telemedicine fall under the umbrella of public health services and are paid for by the state government. Bureaucratic delay in processing payment sometimes causes financial distress to the owner/operator of the TOC.

A final challenge is expanding the physician network for teleconsultation services. Due to the significant shortage of physicians, especially specialists, in India, specialty care physicians usually have a very heavy workload. The busy schedules of specialists often pose a challenge to coordinate and set up teleconsultation sessions between the patient and the consulting physician.

In light of the significant challenges posed to the adoption of telemedicine services, the growth of OTTET telemedicine may be considered satisfactory. Furthermore, all our interviewees sounded very enthusiastic about the future of OTTET Telemedicine and strongly believed that the significant benefits offered by telemedicine services to the rural poor will help facilitate its growth and rapid adoption.

Sustainability

Is OTTET's model scalable and sustainable? The answer, according to our analysis, is in affirmative. It is evident from the fact that, despite the challenges to the growth of telemedicine services discussed in the previous section, OTTET continues to expand its operations by opening new telemedicine operations centers and by adding new partners to its list of specialty care providers. As elaborated in this section, the sustainability of OTTET Telemedicine is engendered by its governance model, which successfully addresses three of the critical factors that influence sustainability, as outlined in da Silva and Fernandez (2016), namely, Political/institutional factors, Technology related factors, and Financial/economic factors.

OTTET Telemedicine is governed using the PPP model shown in Figure 2. OTTET, the non-governmental organization, is responsible for conception, planning, execution, and management of the telemedicine project. It is involved in the day-to-day operation of telemedicine services, recruitment and training of telemedicine technicians, payment processing, and expansion of the network of teleconsultation service providers. SGPGIMS, which is a federal government supported institution with expertise in telemedicine technology, provides the technical support. The project is executed in active collaboration between OTTET and the state government of Odisha, which has regulatory oversight of the project and supports it by extending cooperation through its executive branch.
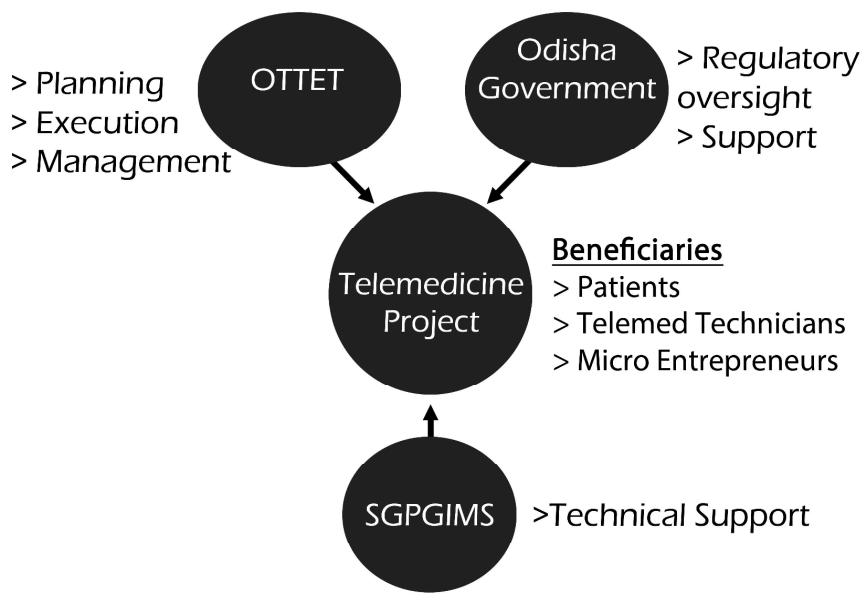

Figure 2. OTTET Telemedicine Governance – the PPP model

Providing healthcare to its citizens and creating jobs are two primary goals of the state government of Odisha. Expanding health coverage, especially in rural areas, poses two major challenges. First, it requires significant financial investment to set up and staff medical facilities. Second, skilled healthcare professionals prefer to live in urban areas, and are thus scarce in rural areas. OTTET's mission is to provide "Education for all and healthcare for all," according to its founder. Thus, there is perfect alignment between the goals of OTTET and the state government. Such goal congruence among partners is critical for sustainability of development projects (da Silva and Fernandez 2016). The telemedicine project needs strong sponsorship of the state government in order to be successful. The government allows telemedicine centers to operate in government owned health centers. It sets the price of various services offered by the telemedicine center, and mandates the use of some of the services, such as creation of the patient health record, thus guaranteeing revenue streams for the telemedicine center. It has also

instituted the legal framework that enables OTTET to recruit and train technicians for operating the telemedicine centers. These technicians are recruited from among the unemployed youths from nearby villages, thus addressing the shortage of skilled manpower in rural areas. OTTET Telemedicine, thus, helps the state government realize its twin goals of providing healthcare and generating employment while saving it the trouble of having to make significant financial investment in rural health projects.

A third key collaborator in the implementation of the telemedicine project is the School of Telemedicine at SGPGIMS, which has extensive experience in the telemedicine sector. It provides technical know-how regarding technology development and implementation. It also develops the curriculum for training and certifying telemedicine technicians. Thus, it helps mitigate technology related risks that are known to lead to failure of ICT-based projects.

Promoting micro-entrepreneurship at the local level is a key aspect of OTTET's telemedicine implementation strategy. Large projects require big donors. When the donor leaves, the project fails because it is unable to self-sustain due to a lack of local ownership. Rural areas have limited financial as well as skilled human resources. The financial model of the telemedicine operations center promotes local ownership and develops human capital in the form of trained telemedicine technicians at the local level. This precludes the need for large investment by a donor agency and allows incremental growth, thus, ensuring scalability of the project. Local ownership also reduces the risk of capital and human resource flight from rural to urban areas, which has been the bane of many projects implemented in rural areas. This guarantees long term sustainability of the project.

Thus, OTTET Telemedicine exemplifies the power of the PPP model in creating ICT-based sustainable development. The key lessons learned from this analysis are (1) goal congruence between the partners are critical to the success of the PPP model, (2) local ownership and local investment resulting from the development of micro entrepreneurs in rural areas lead to scalable and sustainable development, and (3) developing local talents by training and employing rural youth fills the skill gap and creates a stable work force in rural areas, which is essential for the long term growth and sustainability of ICT-based development projects implemented in resource starved regions.

Conclusion

ICT-based development holds enormous potential to bring education, healthcare, and open government within the reach of people living in resource starved regions of the world. However, they also run the risk of not realizing their full potential due to high risk of failure. In this context, OTTET Telemedicine showcases a viable approach to incremental and sustainable implementation of ICT-based development projects based on local ownership and the PPP model of governance. We used the case study research method with a single case design to study this phenomenon. While the case study research design used in our study provides a deeper level of analysis of a contemporary phenomenon in a field setting, the findings are less generalizable. This limitation must be considered while interpreting the results of our study. For example, factors such as, governmental policies, cultural beliefs about healthcare practices, etc. are likely to influence the adoption and growth of ICT-based healthcare delivery systems. Thus, there is a need to conduct more studies to understand the contingent conditions that lead to sustainable development through ICT-based projects. OTTET Telemedicine certainly offers a significant data point in this stream of research, and shines a light on the path to sustainable development.

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