Technology Stewarding method for Knowledge Mobilization in Agriculture Communities of Practice

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Abstract

A critical challenge facing the ICT for development (ICT4D) field today is how to promote sustainable approaches for scientific and indigenous knowledge mobilization. They must go beyond a supply-side driven diffusion of technology and to encourage grassroots, or "inclusive innovation" that builds capacity within communities through collaboration, particularly those residing in the lowest socio-economic category known as 'base of the pyramid' (Mansell, 2012; Heeks et al, 2013 and 2014). In the context of agriculture, our research is anchored on the question: "can a Technology Stewardship approach be a catalyst for sustainable knowledge mobilization in ICT-enanced agriculture communities of practice?" The project conducted a series of field experiments termed as "campaigns", involving agriculture communities, were conducted in the Kurunegala, Matale, and Batticaloa Districts in Sri Lanka. Farmers identified various knowledge mobilization activities, ranging from exchanging local crop price information, to alerting on elephant attack, to disease control, general inquiries, announcements, so on and so forth. Data were collected at various times during the campaigns using a mixed method approach. The results of this study suggest that a technology stewardship model can be usefully conceived of as a micro-level innovation system. This is an important starting point for directing resources to more effectively promote the adoption and use of new communications services and as a step toward creating local capacity for ongoing collaboration to promote inclusive innovation in a developing country context.

KEYWORDS – Inclusion, Innovation, Knowledge, Poverty, Agriculture

Introduction

Knowledge mobilization in support of sustainable agriculture has been identified as a vital activity that faces numerous challenges today (Aker, 2010). Constraints and limitations on traditional agricultural extension methods as well as high costs of information provision have been cited as barriers to improving the livelihood of farmers in developing countries, particularly those residing in the lowest socio-economic category known as 'base of the pyramid' (De Silva et al., 2013, LIRNEasia, 2012, Rivera and Sulaiman V, 2009). Mobile phones play an important role in advancing this approach, particularly in an agricultural context where collaborative work is commonplace across the value chain (De Silva et al, 2013; Duncombe, 2012, Qinag et al, 2011, and Wold Bank, 2012).

Recent attention in the ICT4D community has also turned toward the importance of promoting change at the grassroots level with direct participation of technology users in what Heeks' has termed 'inclusive innovation.' Heeks' defines inclusive innovation as a process that empowers users to participate directly in the conceptualization and implementation of new ICT initiatives (Heeks et al, 2013), which may in turn encourage individual users of technology to further innovate using ICTs in ways that will fit their own needs (Pant and Hambly Odame, 2009). This approach shares features with 'participatory design' movement in the field of community informatics (Carroll and Rosson, 2007).

Technology stewardship is a promising strategy to promote inclusive innovation by identifying an individual 'with enough experience of the workings of a community to understand its technology needs, and enough experience with or interest in technology to take leadership in addressing those needs' (Wenger et al, 2009). The role of the technology steward involves introducing technology into a community in a way that is

responsive to the needs of that community. There is also a reciprocal role in collaborating with the community to build capacity for further innovation.

In applying the technology stewardship model, the research team investigated concepts of user centered design, action research, and rapid prototyping. These three areas share common traits on emphasizing methods, processes, outcomes that are collaborative, formative, contextual, and applied. An integrated action research approach was developed adopting from Interaction Design Model (Preece et al, 2007). Rapid prototyping, namely virtual and actual pilot testing, precedes the productization, standardization, and benchmarking of any technological solution. Experimentation and learning, testing and proofing, communication and interaction, synthesis and integrations, scheduling and markers are milestones of the rapid prototyping and integrated action research approach (Tripp and Bichelmeyer, 1990).

In a developing country context, technology stewardship can be supported through the availability of Free and Open Source (FOSS) platforms that support text messaging (FrontlineSMS), crowdmapping (Ushahidi), and interactive voice response (Freedom Fone) systems. The preliminary study is confined to a set of campaigns that used a technology stewardship model for text messaging with the FrontlineSMS platform. It should be noted, however, that the project team has extensive experience working with all of the platforms mentioned above. The project is now moving into a second round of campaigns involving Freedom Fone interactive voice response system.

The study was carried out as part of a larger partnership development project looking at the use of low cost communication technologies to enhance knowledge mobilization for agricultural communities of practice. This paper presents results from a project study assessing a technology stewardship model in promoting the adoption and use of text messaging for agricultural extension work with rural farmers in Sri Lanka. More specifically, the purpose was to better understand influential factors that contribute to collaboration within micro-level inclusive innovation systems.

Research Design

The micro-level innovation model being considered, namely the technology stewarding or stewarding technology model, involves the influence and collaboration of four key actors: Technology, Sponsor, Technology Steward, and Community. The technology in this instance would be the FrontlineSMS text-messaging application. Sponsor is essentially an Organization with a vested interest in community development. Technology Steward is an individual (or individuals) with a, relatively, high degree technology uptake (i.e. resembling a “gadget geek” per se) and closely affiliated with the community to understand their practices. The community, within the theme of the project, is a group of individuals sharing common farming practices and goals.

The first step was to recruit interested participants. The project held a national workshop, at the Wayamba University (Gow et al, 2013), that brought together relevant Government, Non-governmental, and Private Organizations. They were introduced to the technology stewarding methods and exposed to rapid prototype techniques with the text-messaging, crowdmapping, and interactive voice response systems. Eight organizations (Figure 1) expressed a liking for adopting the model and was interested in further interacting with the project. Thereafter, a series of consultations with the organizations and community meetings took place where the research team collaborated with participants to identify a specific focus for each of the campaigns.

Three Sponsoring Organization, namely Janthakshan (Batticaloa District), Rangiri Radio (Matale District), and Department of Export Agriculture (Kurunegala District), were committed in going forward with the limited duration campaigns. As part of the community consultation process, a technology steward was identified by each of sponsoring organizations and trained by a member of the research team to design and implement a campaign using FrontlineSMS. Training included suggestions on how to promote the communication campaign with the community as well as a set of guidelines to help the stewards to engage their community in collaborative inquiry to

assess the text messaging service and to explore other ideas for it. The plans for the campaign elements and community profiles are listed in Table 1.

Figure 1: Communities where pre-campaign rapid prototyping was held

Table 1: Campaign design and Community profiles

Sponsor	***Community***	***Farming Families***	***Community practices***	***Campaign activity***
Janathakshan	Verugal	~150	Vegetable, legume, and rice farmers with some live stock.	Crop prices Elephant control Flash flood alerts
	Kathirveilli	~300	Vegetable, legume, and rice farmers with some live stock.	Crop prices Elephant control Flash flood alerts
DOEA Kurunegala	North: Damahera, Madahapola, Omaragolla, Panliyaddha	300	Ginger and Pepper farmers	General messaging and announcements: land & seeds subsidies, training, disease control
	South: Paragoda, Hewanpola, Madithiyawa	220	Pepper and Pineapple farmers	General messaging and announcements: land & seeds subsidies, training, disease control
Rangiri Radio	Island-wide	Ambiguous	Radio listener groups	Request and dedicate songs

Verugal and Kathirveilli communities are still recovering from the ethnic war that lasted nearly three decades in Sri Lanka. They are of the minority Tamil race with predominantly youth farmers who were given arable land by the government to build their livelihoods. Communities affiliated with DOEA are Sinhalese speaking farmers forcing mainly cultivating agriculture produce for the export market. Government has various subsidy schemes to incentivice them to grow export crops. Rangiri Radio caters to the entire nation with their broadcast services. The station broadcasts several agriculture related programs.

Method

The evaluative framework for the stewardship model considered several factors (Wenger et al, 2009): The involvement and role of the sponsoring organization and the technology steward in promoting the campaign and supporting community members during the campaign; the level of readiness of the community and its response to the communication campaign as measured by their messaging practices before and after the campaign; the appropriateness of the technology platform chosen for the campaign in terms of meeting the objectives of the campaign and its sustainability beyond the time frame of the study.

The research team incorporated semi-structured interviews with four technology stewards and their sponsoring organizations, a structured survey on adoption and use of ICTs within the participating communities, group meetings with farmers from the participating agricultural communities, and analysis of usage data from messaging software deployed for the campaigns.

Central to our overall objective is a participatory design method intended to foster inclusive innovation through rapid prototyping. This method draws from and shares features with Blake's 'Socially Aware Software Engineering' approach (Blake and Tucker, 2006), but is distinct in that our project is not focused on software coding per se but instead adopts the user-friendly Free and Open Source (FOSS) platforms

FrontlineSMS (text messaging), Ushahidi (crowdmapping), and Freedom Fone (interactive voice response) as its starting point.

Results

Preliminary results are drawn from a set of communication campaigns conducted at five different locations in Sri Lanka using an action research approach with active collaboration between researchers and participants (Reason, 2002).

Categorical messaging volume logs

Messaging logs from the FrontlineSMS software were examined at various stages of the campaign. They were categorized as for a farmer self-subscribe “to join” a farming group (e.g. ginger farmers' group), “Technology Steward Sent” (T.Steward Sent) messages (e.g. crop prices), and Farmer Sent messages (e.g. request plant/seed information).

Table 2: Category of messages and message volumes

	Messaging volumes		*Percentage of message types*		
Campaign	***Sent***	***Received***	***To Join***	***T. Steward Sent***	***Farmer Sent***
Janathakshan (Kathirveilli/Verugal)	569	54	1%	84%	15%
DOEA North	693	45	5%	94%	1%
DOEA South	150	67	24%	65%	11%
Rangiri Radio	0	7670	NA	NA	NA

Campaign messaging time-series and volumes

The categorical messages and their volumes were plotted in a time-series to determine the messaging patterns. The patterns involve times and volumes of farmers self-subscribing to a farming group (e.g join ginger farming group), technology steward sending notifications (e.g. flash flood warning or elephant threat) to farmers, technology steward sending other general messages to farmers (e.g. requesting the preparation of land to approve subsidies), and farmers exchanging messages (e.g. price of the crop sold in neighboring towns).

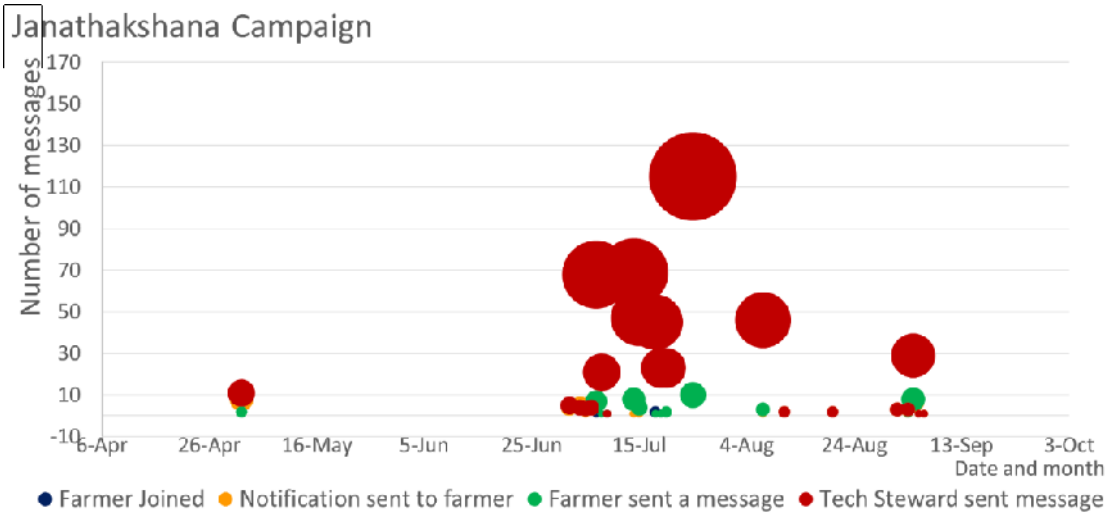

Figure 2: Janathakshan campaign text messaging patterns

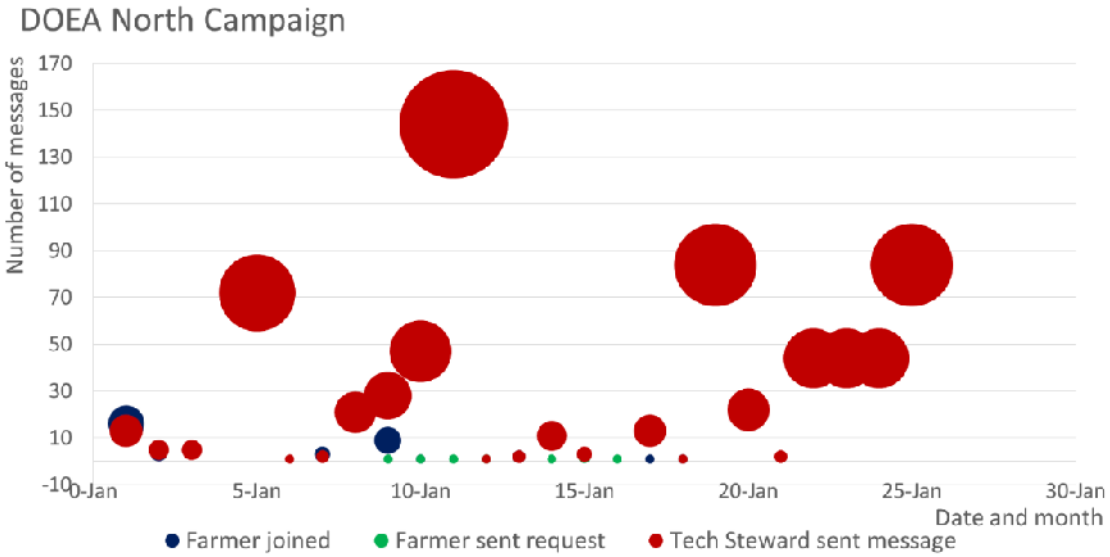

Figure 3: Janathakshan campaign text messaging patterns

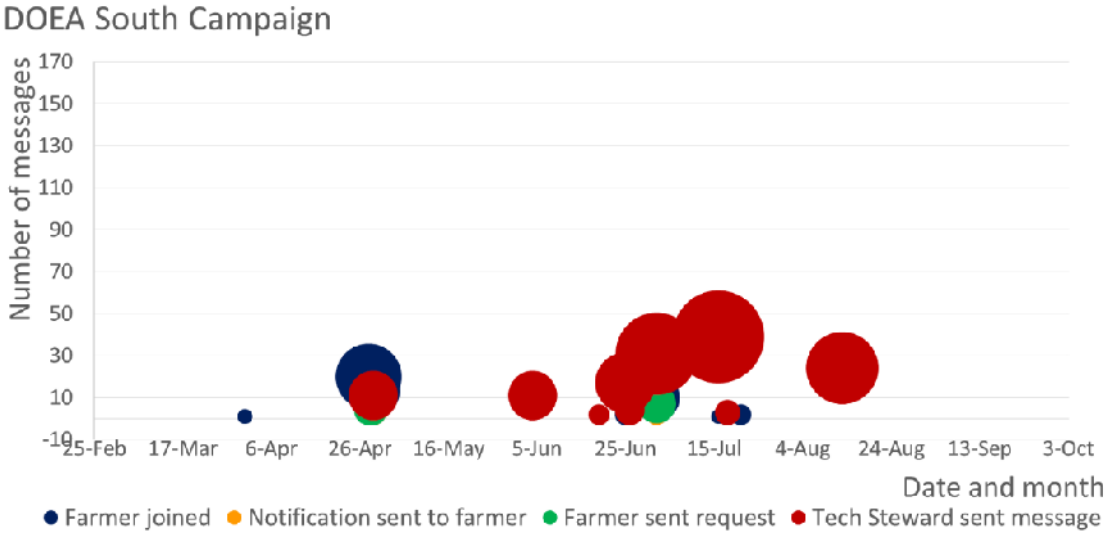

Figure 4: DOEA South campaign text messaging patterns

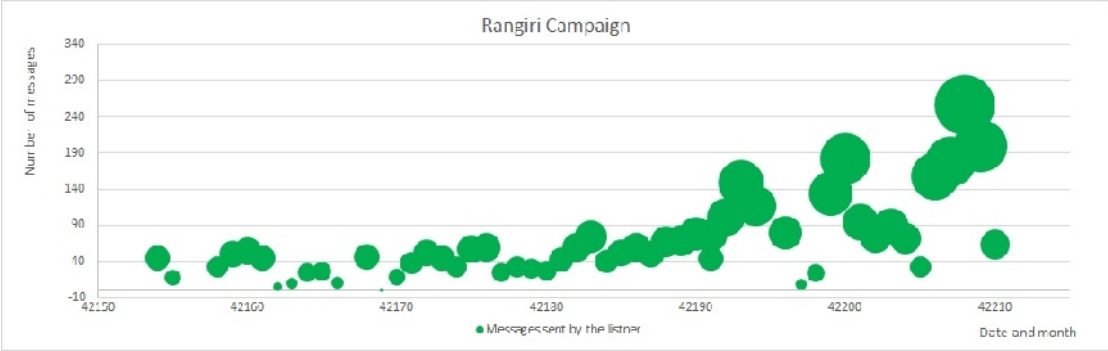

Figure 5: Rangiri campaign text-messaging patterns

Actor Influence Metric

The actor influence metric illustrates the proportional influence (effort or engagement) by the community, technology steward, and sponsor in planning, executing, and evaluating the campaigns. The research team developed a simple Likert scale indicated in the Figure 5. An actor would vary influencing the campaign very negative level to a dominant level.

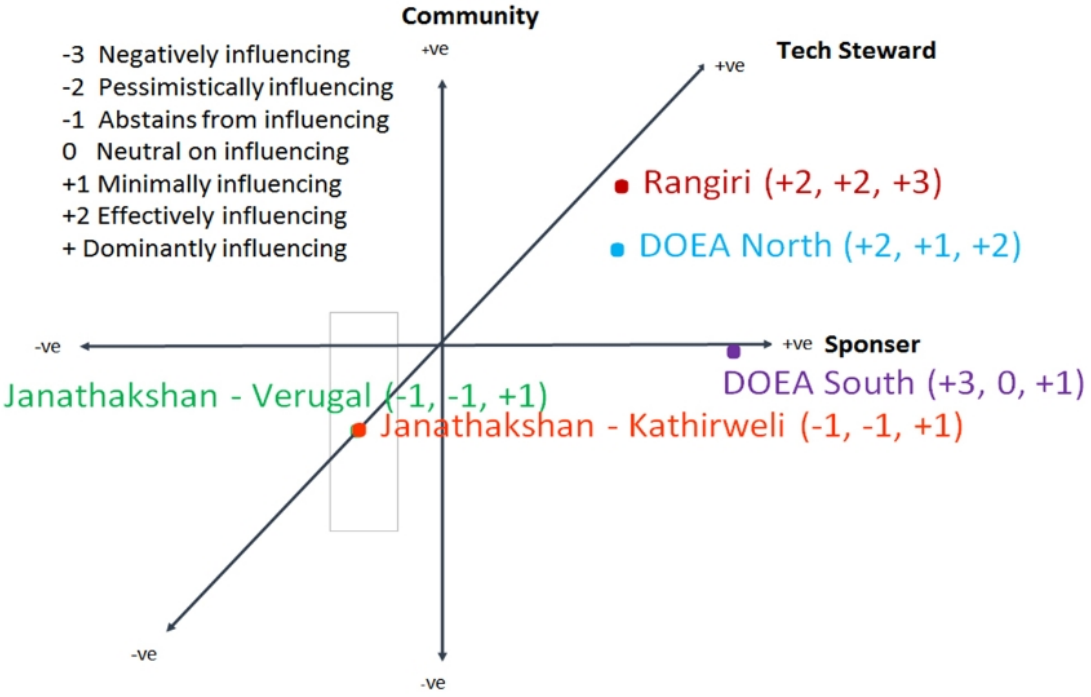

Figure 6: Actor Influence Metric (AIM)

Discussion

The project completed the planning, execution, and evaluation of the campaigns between the months of January 2014 and September 2015. The project had anticipated the duration to be shorter with one month for planning/training, two months execution, and one month for evaluation. However, there were substantial delays caused at the organizational layers and dedicating time beyond their routine actives that took precedence over the project's expectations. These observations have forked a subsequent study in examining the causes to the effects of distractions and subdued effort by the actors. This study may realize other policy implications that must be considered with the frame of the technology stewarding model.

Rapid prototyping

The research met with communities to discuss their knowledge mobilization needs. During the meetings, concurrently while discussing the issues, the team was able to configure the software to rapidly prototype and demonstrate the ICT-enhanced knowledge mobilization activity. This allowed for the community to realize the potential of the technologies available for running the limited duration campaigns and subsequent adoption of the technology. This is an alternative approach to the traditional development methods; whereby, the software developers would gather the requirements and attempt to tailor a software solution. Instead, the technology stewarding model calls for using low-cost readily available and configurable FOSS-enabled ICTs to rapidly prototype. Such low-cost technologies have a higher chance of replication than high-invest or mid-complex custom solutions (Banks, 2014) Although the project confined to three such products, namely FrontlineSMS for text-messaging, Freedom Fone for interactive voice response, and Ushahidi for crowdmapping; there are a multitude of similar free to use and customizable solution available in the public domain (ICTWorks, 2015).

One of the key observations emerging from our rapid prototyping activities is that while the FOSS platforms are important to the participatory design process, by themselves they are not sufficient to foster the development and deployment of new

services and the research team soon recognized the need for intermediaries to engage communities in the process. Intermediaries play a role in part because of their familiarity with the kinds of social practices prevalent within their community (Shove et al, 2012). This is an important consideration in light of recent studies that have shown that adoption and use of digital information services is closely related to how well these services align with the everyday social practices of people (De Silva et al, 2013; Zainudeen and Rathnadiwakara, 2011). To foster this alignment, we sought to enroll competent ‘community knowledge workers’ (Grameen Foundation, 2010) or ‘technology stewards’ as key participants in the communication campaigns.

Outcomes of the campaign messaging practices

The Janathakshan campaign was a single FromtlineSMS instance shared by Verugal and Kathirveilli communities. Although the campaign was scheduled to begin in April 2014, Figure 2 shows the messaging to cluster withing the months of July and August, 2014. This coincides with the South East monsoon rains and the planting and harvest season. A realization that it is not essential that the messaging system be operational every minute throughout the year. The community can decide on the active duration of the system in harmonizing with the timing of their activities and knowledge mobilization needs. This is a contrasting relative to the more active and consistent spread of messaging throughout the campaign periods for DOEA North (Figure 3) and Rangiri Radio (Figure 5).

DOEA-North campaign was possibly the outstanding among all. The Technology Steward was skilled and dynamic. Moreover, he realized the efficiency gains and cost benefits of using text-messaging in his work. Interviews with the Technology Steward revealed that communication activities such as inviting farmers to a meeting, informing them of available government schemes, so on and so forth, previously, communicated through snail mail or informing a village leader and expecting her/him to relay the information could be done simply through a multi-casting of a text-message.

The technology stewarding, within the inclusive innovation system, recommends that the campaigns start with a simple and easy to implement activity. Although Rangiri Radio was expected to carry out the campaign within the context of farming practices and agriculture, their first simple implementation was engaging the community with the radio station by text-messaging song requests and dedication of songs to family and friends. This proved to be a successful approach for engaging the community and adoption of the intervention.

This of course opened up the question concerning situations in which a technology steward uses a system in ways not initially intended by the sponsor or the research team. Provided of course the uses are consonant with the wider community of interest, it may be important to let the technology steward explore innovation in ways that may not immediately respond to a particular need but instead lay the ground to prepare the community for the introduction of other campaigns.

Messages initiated by farmers remain significantly lower than those initiated by the technology stewards, shown in Figures 4 through Figure 5. The relatively older farmers were reluctant to type text messages and were comfortable with using voice calls. A project conducted pre-campaign survey, on the use and uptake of technology in farming practices, also revealed that the farmers would rather initiate a phone call over using short-messaging service as a technology choice. Whenever there was a need to use text-messaging they would rely on their children to assist them. Youth in Sri Lanka are more prone and have adopted text-messaging. Other reasons are the use of phones with latin scripting keypads, which they would improvise by typing sinhala or tamil words in fanatic using the English alphabet.

Actor Influence Metric

Results from the study suggest that effectiveness of the technology stewardship model is associated with the relative influence of factors examined with the evaluative framework. These factors can be conceptualized an inclusive innovation system residing at the local community level (van de Hilst, 2012).

Within this system each factor has a relative influence on the outcome of the campaign, with the technology steward playing a key role. For example, where community readiness is weak because of literacy challenges or other pre-existing conditions, the technology steward will have to invest more time and resources in the campaign. In some cases the technology platform itself will need to be reconsidered (e.g. using a voice service instead of text messages).

While the qualitative dimensions of these interactions within the inclusive innovation system (illustrated in Figure 6) are essential to a full understanding of the model, we are also exploring a method for measuring the summative influence of these factors by assigning each a value and creating a metric that allows us to compare the relative effectiveness of the stewardship model across varied campaigns.

Figure 6 includes a Likert scale applied to rank the influence of each of the key factors being assessed in the campaigns (sponsor, steward, community). Our preliminary ranking is based on an initial review on data collected during the campaigns as described above. Although the orthogonality or interdependency of the three actors: sponsor, technology steward, and community readiness remains to be proven, the three dimensional diagram helps visualize the influence of these factors relative to each other. The favored situation is for all factors to be ranked positive, as illustrated in the upper right cube, or the sum of the three values to be positive. This is an indicator of a high potential viability for the campaign, suggesting that further efforts can be targeted to specific deficiencies in the system. On the other hand, results in the bottom left quadrant, with three influencing factors being negative or the sum of the three actor influence values being negative, then the viability of the campaign is questionable. Further efforts will need to be directed more broadly at reassessing the technology steward's role, overall community readiness, and the appropriateness of the technology platform strategy. The value of this metric provides us with the ability to compare results across campaigns while also assisting development practitioners to determine the overall viability of a campaign and to

identify the specific strengths and weaknesses impacting the collaborative potential of the system for further innovation.

For example, both the Rangiri Radio and DOEA-North sponsored campaigns demonstrated well-qualified and active technology stewards, working with supportive sponsors. Both campaigns show evidence of initiating new messaging practices, even if their community had little prior experience using text messaging (as with DOEA-North). By contrast, the DOEA-South campaign closely corresponded to its DOEA-North counterpart campaign in all respects with the exception that the technology steward role in the South campaign was divided between two individuals. This resulted in a split in responsibilities, with one steward in charge of the text messaging system and the other steward responsible for promoting the service within the community.

In the case of the Janathakshan-sponsored campaign, the tech steward had comparably little support from the sponsoring organization in part due to changes that took place with the sponsoring organization in the midst the campaign. However, he was able to send out a large number of messages initially in an effort to get farmers to self-subscribe to the system but had modest uptake from the community, which had intended to use the text messaging as peer-to-peer system for sharing market price information for their produce. This outcome may be partly explained by survey data that we collected on use and adoption of technology in the community that showed a relatively low level of prior use of text messaging. This was compounded by social and economic challenges stemming from post-war conditions in this northern region of Sri Lanka, as well as literacy barriers for Tamil speakers trying to understand messages composed in phonetic Tamil using the limited character set available on their mobile phones

Policy implications

Improved technology steward training regime

The project partnership: Wayamaba University of Sri Lanka, University of Guelf, University of Alberta, and LIRNEasia is considering the possible benefit of designing a more formal training program for technology stewardship. The Department of Export Agriculture has expressed interest in expanding the campaigns to include other Extension Officers in other districts. As such, there is an opportunity to examine how the research partners could play a role in developing and delivering a stewardship curriculum that addresses both technical and community engagement aspects in its curriculum, all with a view to building community capacity for local innovation with low cost ICTs.

Supporting technology stewardship

From a policy perspective there are several implications from our study: organizations must support technology stewards by giving them time and resources, including training open source software is an important consideration, so the adoption of FOSS tools is a policy consideration community readiness to adopt and use digital technology remains a wider issue related to policies for digital literacy and ICT use.

Conclusion

DOEA (North) and Rangiri Radio expressed interest in continuing with the project and expanding beyond FrontlineSMS to begin experimenting with the Freedom Fone interactive voice response system. Technology stewards in both cases remain actively involved in a broker role as they liaise with their communities to introduce this new service. In the less successful cases, our initial analysis suggests that we need to examine more closely two key considerations: if and how technology stewardship can be effective as a shared responsibility within a community, as in the case of the DOEA South campaign; and to what extent a technology steward may need to engage in preparing a community for the introduction of a new service through basic technology literacy workshops and training as in the case of the Janathakshan campaign. This kind of training can also be helpful to identify and address unforeseen systemic issues

in the adoption and use of the technology by the community. It has been recommended that such differentials can be evaluated by applying the 'diffusion of innovation theory'. The results of this study suggest that a technology stewardship model can be usefully conceived of as a micro-level innovation system. The viability of the system is linked to the relative influence of several key factors. This is an important starting point for directing resources to more effectively promote the adoption and use of new communications services and as a step toward creating local capacity for ongoing collaboration to promote inclusive innovation in a developing country context.

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