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## Enhancing communications in developing countries using SMS technology: the case of agricultural value chains in Cambodia

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**Abstract:** This paper reports on a pilot project that was undertaken in 2006 to develop the use of SMS technology to enhance communication in agricultural value chains in Cambodia. The project worked closely with farmers, traders, silo managers and Ministry of Commerce officials to develop an electronic marketing communication system (EMCS) based on text messaging. The EMCS demonstrated a successful proof-of-concept and showed SMS as a robust and cost-effective technology. Future projects will explore the wider scale implementation of this SMS system in Cambodia and address the broader issues of cost, training and user literacy levels.

**Keywords:** Cambodia; SMS; mobile phones; agriculture; farmers; information and communication technology; ICT; communication.

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## 1 Introduction

It has become commonplace to assert that information and communication technologies (ICT) transform the way people communicate and exchange ideas. While we all might agree that the more digitally connected amongst us are experiencing significantly different ways of working together, you might be less convinced about the transformative effects for ordinary folk. One thing we can perhaps all agree on is that in both developed or developing nations, there is widespread media fascination with technology and its effects, whether it be debates about how to meet the needs of Generation Y, the images of Hole-In-The-Wall projects originally developed in India to give communities access to the internet or the media images of young children talking on a mobile phone. In *The Wealth of Networks*, Benkler (2006) moves beyond the rhetoric and associated hype to advance an economic case for the potential of ICT to engage citizens in new opportunities for social and peer production, opportunities that he believes have the potential to create a more humane and just society. The networked information economy he argues has the potential to support a form of production that is not as tied to industrial models that advocate market-based and propriety forms of production. In developing countries, there is a burgeoning interest in the application of ICT to support social and economic development goals with this broad field of interest often referred to as ICT4D (ICT for Development). In this context, the prime focus is on how to apply robust and scalable technologies to improve the social and economic conditions of people in the developing world. The Asia-Pacific region is home to two-thirds of the world's poor and the World Bank has identified ICT as playing a key role in both promoting economic growth and reducing poverty (The World Bank, 2006).

Mobile technology is one ICT experiencing rapid development with predictions that by 2011, there will be nearly four billion users worldwide with the Asia Pacific region accounting for nearly 50% of these users (Portio Research, 2007). In developing countries, the reality is that the reach of mobile technologies often extends much further than internet technologies. However, while there are a number of ongoing projects exploring the application of mobile technologies in developing countries, reports of those projects have mainly been the subject of press media releases and donor agency reports.

The project reported on in this article takes the research conclusions as a starting point and describes a pilot project for the use of text messaging services to promote market communication and exchange between farmers and traders in western Cambodia. Cambodia represents a particularly important case study for this ICT given the lack of a fixed line communications infrastructure following its civil war.

Text messaging or SMS is a feature of Global System for Mobile (GSM) communications networks. Alphanumeric messages of up to 160 characters can be sent and received using a GSM handset via a network operator's message centre. The technology that underpins SMS is often referred to as 'store-and-forward' and it is this protocol that ensures SMS is a relatively cheap, robust and reliable technology to use. A GSM network uses a networking centre to coordinate the sending and receiving of messages. In store-and-forward systems, messages are not sent directly to the receiving mobile phone but routed through a number of network nodes or cells. The Mobile Switching Centre (MSC) determines whether a device is in (or out of) range and the messages stored in the network are delivered at the next opportunity. It is precisely this store, and then forward when in range feature, that makes SMS perfectly suited for areas of patchy coverage such as those found in rural areas. Text messaging is burgeoning, with

figures from the UK-based Portio Research showing that over the last ten years it has developed into a \$35B US industry with estimates that by 2012 we will be exchanging about 3.7 trillion text messages per annum (Portio Research, 2007).

## **2 Literature on mobile phones and SMS**

Certainly there is growing interest in mobile technology; however, it has not received the same level of interest and attention as the new media and internet technologies (see Goggin, 2007). There is a small body of literature on text messaging which has explored its role in: building 'presence' amongst physically separated groups; enhancing the connectivity of social networks; creating new media forms; and enabling private communication especially the covert exchanges necessary to many forms of social action. Rheingold's (2002) discussion of the role mobile phones played in the downfall of the former Philippine President Joseph Estrada has become a touchstone for the potential of this technology to empower ordinary citizens to engage in social action. Other literature shows that mobile phone users are building on the versatility of the device to create new media forms (Ling, 2004) and engaging in highly individualised and private forms of communication that have the potential to expand social networks (Ling, 2004; Pertierra, 2005). Uy-Tioco's (2007) study of Filipino workers (often working outside the Philippines) showed how women used text messaging to create presence and help them maintain family relationships to bridge the tyranny of distance and physical separation. Youth, in particular, use SMS to create social presence and connect themselves and their peers to their current physical location and place – sometimes known as the 'wish you were here' or postcard exchange (Ito and Okabe, 2005; Hjorth, 2005; Lin and Tong, 2007). While much of the exchange of information via SMS is informal (Ito and Okabe, 2005), Goggin (2004) reminds us that text messaging represents a new cultural form of communication that is more than just about the transfer of information.

Robert Jensen from the John F. Kennedy School of Government at Harvard University has studied how fishermen and wholesalers from Southern India used mobile phones to address gaps in the market information system (Jensen, 2007). From his economic analysis of data collected over a five year period Jensen found that the use of mobile phones worked to reduce price dispersion and increase fishermen's profits by facilitating timely access to market information resulting in benefits for both producers and traders.

The most comprehensive review of literature on mobile phones in developing countries can be found in Donner's (2008) work. While only a small portion of these studies actually focused specifically on the use of text messaging, Donner characterised his review of 200 studies in terms of two key dimensions. The first relates to mobile use and covers areas such as:

- key factors associated with the adoption of mobile technology
- impact of mobile use on communication and practice
- Interrelationships between mobile technologies and their users.

The second dimension relates to a much smaller set of studies that examined the role mobile technology plays in the support of economic development goals. From his review, Donner identifies three potential areas for further research:

- 1 Bringing the communication ‘use’ studies together with the socio-economic studies. Donner sees much of this work as involving a tighter integration between development work (ICTD) and the communication/recreational use of mobiles work (non-ICTD).
- 2 Comparing and contrasting the ways rich and poor use text messaging in order to understand the linkages and opportunities.
- 3 Developing more complex and nuanced understandings of how mobile phones work to reconfigure social relationships and networks.

In summary, the field of mobile phone research is emerging and there is a need to move beyond simple technical impact studies and understand the device in context. McLelland (2007) also sees this as a process of moving away from a hegemonic Western view of the world, to develop a more nuanced understanding of the way mobile technologies, and text messaging in particular, function in specific social and cultural contexts and in the lives of ordinary folk.

### **3 SMS in developing countries**

The use of SMS technology in a developing country context is relatively new, though there are some successful prototypes in Africa and the Philippines. In the KwaZulu-Natal region of South Africa, SMS technology is being used to help small-scale farmers improve their sugar cane crops. Using a sophisticated crop simulation model, the South African Sugar Research Institute collects weather data and generates irrigation advice that is automatically sent to local farmers by SMS.

In the Philippines, the Pinoy Farmers’ Internet Project is using an SMS-based contact centre to support small-scale rice farmers. Farmers can receive automated price and weather information or request information on demand by texting keywords to an SMS server. The SMS server also allows farmers to text questions that are answered by agricultural experts. Those questions and answers form the basis of what they refer to as ‘Technotips’ resource.

In Africa, the non-profit organisation Kiwanja Foundation leads a number of technology projects that focus specifically on the challenges facing developing countries. Set up by founder Ken Banks, its mission is ‘... to encourage the development of high impact, innovative, replicable and sustainable technology-based solutions to support positive social and environmental change throughout the developing world’. One of its projects involves the application of SMS technology (frontline SMS) developed specifically for NGOs to allow field workers and offices to communicate via SMS.

The use of SMS technology in developing countries appears to have considerable potential as a low-cost ICT where, as is so often the case, fixed line telecommunications infrastructure is limited. This is certainly the situation in rural Cambodia, to which we now turn for the case study.

## **4 Case study in Cambodia**

### *4.1 Background*

The Kingdom of Cambodia borders Thailand, Laos, Vietnam and the Gulf of Thailand. It has a relatively young population (median age of only 22.6 years) and 80% of Cambodia's 15 million people live in rural areas where subsistence-farming is the dominant activity. Inadequate healthcare, poor roads and limited communications infrastructure significantly impact on the quality of life in rural areas. While Cambodia has made significant economic progress since its civil war days, nearly 35% of the population still falls below the poverty line (~~US 1 \$ per day~~) with this rate being much higher in the poorer rural areas (CDRI, 2007). There has been an increasing diversification in Cambodia with the agricultural, industrial and service sectors accounting for 35%, 30% and 35% respectively of total production. However, agricultural activities still dominate the lives of rural Khmer people.

Central to the Royal Government of Cambodia's (RGC) 'Pro-poor trade strategy', is the development of an export-oriented agricultural sector that encourages rural and regional development. Cambodia has considerable potential comparative advantage in agriculture but this potential is not being realised because of such constraints as post-harvest inefficiency, inadequate information flows, high transportation costs, illegal checkpoints and lack of external markets. The pilot project reported in this paper was conducted as part of a larger project funded by the Australian Centre for International Agricultural Research (ACIAR) entitled 'Improving the marketing system for maize and soybeans in Cambodia'.

Cambodia's fixed line telecommunication infrastructure is generally in poor condition and non-existent in rural areas. Without the legacy of landline infrastructure investment, wireless technologies have presented a viable alternative. In fact, by 2000, mobile subscribers had reached a point where Cambodia was known as the world's most wireless country (ITU, 2002). In recent years Cambodia has continued to enjoy a rapidly developing mobile telecommunications sector. From 2000 to 2005, Cambodia experienced a 52.1% rise in mobile subscriptions reaching over one million in 2005 with mobile networks covering nearly 90% of the population (The World Bank, 2006).

Access to accurate and timely information is crucial to the operation of an efficient and equitable market system. Mobile technologies, including short messaging services, offer a relatively cheap and reliable means for keeping producers connected to buyers. Recent developments around the integration of mobile and internet technologies now allow for the seamless exchange of information across different networks. The integration of a content management system into this information flow provides a base from which additional information resources can be developed. The general objective of the pilot project was to investigate the feasibility and viability of establishing an electronic marketing communication system (EMCS) using SMS technology to facilitate communication and exchange between farmers and traders in remote regions of Cambodia.

#### 4.2 *Evolution of the EMCS pilot project*

The key participants in this pilot project were farmers, traders, government agencies and researchers. The EMCS was intended to be a vehicle for providing improved market information and hence lead to better decision-making. Currently, the main (often only) source of market information for farmers is the trader, but the trader has a potential conflict of interest. Hence the EMCS may help farmers by offsetting the information asymmetry between them and traders. However, traders can also benefit from the EMCS by allowing access to timely information on product quality and quantity that helps them plan future purchases and deliveries ultimately helping them compete in larger markets. Government agencies such as the Ministry of Commerce's (MOC) Price Office already collect price information from around the region and the EMCS was intended to offer them another vehicle for disseminating this data and monitoring pricing trends. At the provincial level, the local Chamber of Commerce can access these data and apply their local knowledge to make sense of regional trends. Through SMS logs, researchers in particular, have a way of making a transactional information network that is normally highly localised and often effectively hidden from public view, visible by collecting data that can help them map and visualise transactions. The Activity Theorist Engstrom (1999) believes the process of mapping such networks, which he refers to as visualisation, helps reveal contradictions and gaps in human activity systems which is the first important step to process improvement. He explains that resolving contradiction is an important feature of all learning and opens up the possibility for what he calls an 'ethnography of transformation'.

The first step in the evolution of the EMCS was background research comprising numerous interviews with supply chain participants and a workshop held in Battambang Province in June 2006. Applying action research methodologies, our workshop included representatives from the Ministry of Commerce, the Ministry of Agriculture, Forestry and Food, a consular official (Trade) from the Thai Embassy, the Provincial (Battambang) Chamber of Commerce, traders, CP Foods (a multinational food processing company based in Thailand) and managers of the four major grain drying/storage facilities in western Cambodia. During the workshop, the main concerns of supply chain participants (along with credit concerns) were:

- lack of access to markets (i.e., due to poor or non-existent relationships between buyers and sellers)
- lack of marketing information (on price, quality requirements and alternative buyers).

These concerns can be summarised as the single constraint of poor communications between different levels of the supply chain. At the workshop, the authors discussed the application of mobile technology in other countries and presented a tentative proposal to develop an EMCS using SMS technology. It was clear from the ensuing discussion that while there is wide use of mobile phones amongst the workshop participants, the use of SMS was more limited with about 25% of workshop participants being regular users.

The proposal was very well received. Specific comments and feedback from the workshop participants are summarised below:

- Accurate and timely information will be central to the success of the EMCS.

- Quality information is crucial as is the provision of external market information from countries such as Vietnam and Thailand.
- In the Battambang region market information is very limited.
- EMCS appears to have the potential to improve outcomes for both farmers and traders.
- There is a need to ensure adequate access to information at the town, region and farmer level. Farmer literacy levels may limit their capacity to work with text-based information. There may be a need to develop a simple code system matched to a skills and education program.
- The EMCS may appeal more to younger participants in the value chain. Some farmers explained that their children who are studying English would be able to help them with the EMCS. A young silo manager explained that many of his peers are already frequent users of mobile technologies and that it may only be a problem for the older silo managers.
- It might be more productive to implement the project with silo managers and traders in the first instance.
- The EMCS could be used to provide related information such as crop production.

At the conclusion of the Battambang workshop, stakeholders encouraged us to address these issues through the ongoing development of the EMCS. When asked whether the participants were interested in this project someone commented 'How could we not be interested? How can we not be involved?...We all know that to survive we must know more about the area.' There was enthusiastic and unanimous support for the development of the EMCS. As a result, we undertook a pilot project to develop a basic proof-of-concept.

#### *4.3 Operational aspects of the EMCS pilot project*

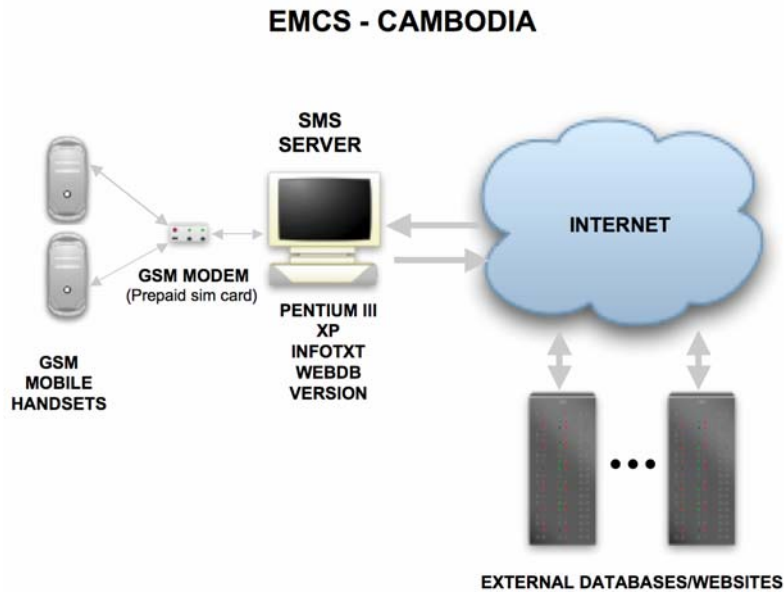
At the heart of the EMCS is the SMS server which is discussed in detail beginning in the next paragraph. In January 2007, we trialled the EMCS with members of the research team, a few silo managers and traders. Basic market information was collected by officers from the MOC Price Office. This allowed users to retrieve information by sending predefined keywords to the SMS server via text messages. The system has proven relatively easy for MOC officers to use and administer.

The SMS server is built around a propriety software application called *Infotxt* that was developed by the Philippines-based, GiveMeUnlimited. This messaging platform has been used extensively in similar projects working with rice farmers in the Philippines. The system uses GSM modem and SIM-based software where users can send and receive SMS messages via a PC (Pentium 3) running XP Professional with internet services installed. It also allows text broadcasting or group texting and incorporates a phonebook that is accessible by multiple-users over an intranet or the internet. The platform supports the ability to specify auto-reply content allowing what is referred to as Info-on-Demand based on SMS keywords sent by the requesting mobile user, the computer automatically recognises the keyword, retrieves the information from the built-in database and automatically sends the requested information to the user. This ability to send and



retrieve information to/from any website, web application or any industry compliant database within an intranet or the internet adds significant functionality. The modem we used was the iTegno 3000, a portable USB powered dual band auto switching device (EGSM 900/DCS 1800) with embedded antenna. The main function of the SMS server was to provide a two-way flow of information allowing both PUSH and PULL functionality. Through this, users can retrieve information 24/7 (Information on Demand) that can draw on existing internal or external databases and websites.

**Figure 1** EMCS SMS server (see online version for colours)



#### 4.4 *Current and planned future developments*

We have tested a basic example of how the SMS server could extract data from another web-based database and return it via text message to a user. The capacity to extract data from various 'authoritative' web databases will be an important feature of any future work developing a market information system. We are currently working with traders and producers to identify key market information providers to ensure accurate and timely information. Some of this work requires the development of manageable protocols and work flows via the MOC Price Office. However, based on feedback we received from a workshop in August 2007, it became clear that traders and producers are keen to share their knowledge of market information – in effect to act as price collectors. These workshops will address training/educational needs of the project both in terms of the technical skills required for stakeholders to use the system and their understanding of the 'limits' of market information and will be supported by a series of help guides in English and Khmer.

As we move on to the next stage of our project and expand our user base there will be many issues to be addressed if we want to involve all stakeholders, particularly farmers.

User literacy levels, support for Khmer fonts, physical and economic access to appropriate technology, technical skills and culturally appropriate models of learning and development will all need to be considered. Our initial work with farmers will provide an important starting point for understanding some of the issues related to linking farmers to markets. It will be equally important to 'push the envelope' as well while still working with all stakeholders capacities. The telecommunications landscape is changing rapidly in Cambodia and the Khmer people are demonstrating their tremendous capacity to adapt and adopt new technologies to their own purposes. In this respect our project is very timely. Various NGOs have expressed their interest in our work and a desire to explore ways of collaborating with us on future developments in western Cambodia. While we have initially chosen to work with silo managers to create communications hubs for their constituents, further research could help us build relationships in these hubs (i.e., silo managers to farmers to farmer groups). One area for further consideration is what we refer to as 'blended applications' of the SMS project. For example, one farmer (or village/commune leader) might serve as a communication node for a small group of semi-commercial farmers channelling market information via text message and displaying this information on a community notice board. In another example, a village leader might use the SMS system to create a simple services directory connecting providers and clients, again using a similar 'low tech' bulletin board system.

We have a number of issues to be addressed to ensure the continuing smooth operation of the system. First, electrical power to the MOC building is shut down each evening following Government policy on 'official' blackouts to conserve energy. The office has undertaken to install a dedicated electricity supply for the server. Second, the administration panel of the SMS server was initially accessible via web-interface but only from within the MOC network. The provision of a public IP address to the SMS server would also allow us to administer and monitor the server via the internet. Given that we want to expand the functionality of the server to include integration with a content management system, such access will be important.

The pilot project was concerned with providing a vehicle for improved market information for farmers and traders. However, our background research and discussions with stakeholders have suggested a suite of other potential uses for the SMS technology. They include:

- Provision of information on farm processing methods and value adding ideas via an automated message reply system.
- Question and answer services to address specific information needs and to develop this knowledge into a technical database.
- Expansion of the EMCS beyond the Cambodian borders (e.g., to facilitate new linkages with and obtain price data from Thailand).
- Provision of information (including updates) on relevant government policy and regulations. Even with the inherent 160 character limit per message of SMS, this could serve to help keep important information 'front-of-mind' for users.
- Provision of other information services including weather reports, news reports, health alerts (e.g., bird flu warnings) and basic crop information.
- Surveys and polls.

We propose to explore the potential for these as part of planned future developments. Earlier this year we were successful in securing additional funding from ACIAR to move this project from its proof-of-concept phase to an implementation phase. It is our intention to research the technical, educational and economic dimensions of SMS in a more substantial project. The specific objectives of the second phase of the SMS project that has now just begun will include:

- research on the communication and information needs of producers and buyers in the region
- the development of a small-scale information system that meets these needs
- the provision of training and development for stakeholders on the use of these systems
- feasibility, analysis and investigation as to the scalability of this project to broader nationwide applications.

## 5 Summary and conclusions

The key strength of the EMCS as implemented in our pilot project is that it is a robust technology using a simple interface. There are very basic system requirements and the system gives the operators at MOC a high degree of control and flexibility. The SMS server is accessible by any mobile network in Cambodia and it appears to be cost effective for both users and the SMS hub manager. The main weakness of the pilot project has been its restriction to the research team, some traders and silo managers (and the exclusion of farmers). Our current and proposed work will address this by working directly with farmers (and in some cases their children) to address cost, access, language and literacy levels.

The project to date has demonstrated a basic proof of concept both in terms of the technology and user interest. The future innovation of our current work is to integrate the SMS technology with a CMS and implement this technology with stakeholders using action research-based approaches. In our proposed project the CMS website will allow varying levels of stakeholder access. Thus, for example:

- The MOC Price Office may be permitted to update a part of the website on price information (with access open to the public). This information may be received by farmers (and other participants in the supply chain) on their mobile phone using SMS technology.
- A farmer (or village leader) might serve as a communication node for a small group of subsistence farmers by channelling market information via text message and writing this information on a community blackboard.
- A village leader might use the SMS system to create a simple services directory connecting providers and clients again using a 'low tech' bulletin board system.
- A buyer and seller may have private access to a part of the website (governed by passwords) to conduct an exchange by private treaty.

- A supplier may be permitted to update a part of the website that relates to information on its available supplies (with access limited to potential buyers).
- A micro credit institution in a particular region may wish to advertise its program to farmers in the area by sending a message via its PC to the dynamic website and from there to the mobile phones of registered farmers by way of an SMS text message.

Based on this pilot project we have secured extension funding from ACIAR. The next stage of the project will trial the broader implementation of the system and develop the requisite monitoring processes to examine the cost and the long-term viability of such a system. The project will consider the possibility of funding this work in the future by the introduction of a levy system on farmers, cooperatives and buyers. In the future we will work with other agencies to explore the application of SMS communications hubs to meet their communication and development needs.

Our work continues to be motivated by the need to develop more transformative understandings of *users and technologies in context* and ensure mobile phones and SMS applications make a difference to lives of those in greatest need.

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