Communications of the Association for Information Systems

Volume 34 Article 11

1-2014

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Recommended Citation
Sæbø, Øystein; Sein, Maung K.; and Thapa, Devinder (2014) "Nepal Wireless Networking Project: Building infrastructure in the mountains from ground up," *Communications of the Association for Information Systems*: Vol. 34 , Article 11.
DOI: 10.17705/1CAIS.03411
Available at: https://aisel.aisnet.org/cais/vol34/iss1/11

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Nepal Wireless Networking Project: Building infrastructure in the mountains from ground up

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Abstract:

Teaching cases can be instrumental in developing skills of critical analysis, problem solving and strategic thinking in students, especially in specific contexts such as Information Systems (IS). While cases are widely used in the curricula of graduate and undergraduate programs in developed countries, there is a lack of teaching cases set in developing countries, particularly in the area of information and communication technology for development (ICT4D). In this paper, we address this gap by telling the story of the Nepal Wireless Networking Project (NWNP) and its effort to connect villages in remote areas of Nepal to the outside world. Despite lack of access to proper equipment, lack of technical competence and the difficult terrain in the Himalayan mountains, Mahabir Pun, the initiator of NWNP, succeeded in bringing Internet access to these villages, contributing to improvements in education, health services and income generating activities. The case describes the development of NWNP from inception until today, the stakeholders involved, services provided, current challenges and ideas for future improvements. Furthermore the case illustrates the importance of the champion, the process of getting commitment important stakeholders, the importance of contextual understanding, and the challenges while scaling up from pilot projects to wider implementations in the context of developing countries.

Keywords: Teaching case, ICT4D, Developing countries, Champions, Stakeholders, Mountain Communities

Editor's note: A teaching note for this case can be obtained from Oystein.sabo@uia.no- Only active Management Information Systems (MIS) faculty who are currently listed in the Association for Information Systems (AIS) Faculty Directory are eligible to receive the teaching note.

Volume 34, Article 11, pp. 241-256, January 2014

I. INTRODUCTION

A teaching case is based on real-life events, aiming to present a balanced, multidimensional representation of context, participants and reality of situation [Merseth, 1996]. It contributes to the learning experience of students by developing their skills of critical analysis, problem solving and strategic thinking [Doyle, 1990]. A number of benefits of teaching cases have been enumerated by McDade [1995]:

- model critical thinking
- emphasize the process of analyzing information
- improve students' awareness of contextual understanding
- challenges student's own beliefs
- encourage alternative thinking considering strengths and weaknesses
- integrate practice to theory and theory to practice
- improve skills to develop and test theories
- contribute to collaborative learning and alternative ways of thinking, and,
- facilitating the consideration of different perspectives by discussing with other students.

For all these reasons, teaching cases have become an integral part of the pedagogy in a vast array of disciplines including information systems (IS). Almost all institutions of higher learning use teaching cases and even exclusively case-based teaching especially in graduate programs. This is particularly true in North America and Europe and other parts of the so-called developed world. Several of these institutions develop teaching cases which can be purchased for teaching purposes. Prominent among these repositories are the Harvard Business School and the University of Western Ontarios's Ivey School of Business in North America and European Case Clearing House (ECCH) (n.d.) in the UK: http://www.ecch.com/educators/). Text books also contain a number of teaching cases that contextualize the concepts introduced in the individual chapters.

The majority, if not all of these cases are, however, set in the "developed world" and focus on companies or organizations from there. Even when the context is other parts of the world, such as Asia, they involve large organizations which are less suitable for students in the underdeveloped world [Pitt and Watson, 2011]. This shortage of cases is a severe shortcoming in efforts to educate students not only from the underdeveloped or emerging economies, but also for students from the developed world who would be working in these countries. In this global economy, acquiring contextual knowledge is vital for practitioners and as academics it is our duty to facilitate this.

The problem is particularly acute in the area of ICT for Development (ICT4D). Many of the initiatives that design, develop and implement Information Technology (IT) and IS in the developing world are funded and led by agencies and "experts" from developing countries. There is much local involvement in these initiatives. A good example is the Health Information Systems Programme (HISP) initiated and spearheaded by the University of Oslo in Norway [Braa et al., 2007]. It develops and implements Health Information Systems in countries such as Mozambique, Tanzania and India. Many graduate students from these countries have been at the core of HISP and in the process have gained masters and doctoral degrees. Consequently, there has been transfer of knowledge to these countries.

Yet, their valuable experience is seldom propagated to ICT4D students in other parts of the world. The same applies to other doctoral work in institutions such as Örebro University in Sweden and the University of Manchester in UK, two of the more prominent actors in ICT4D education. Teaching cases out of these projects would be an ideal medium through which to educate students. That we have few such cases has been a continuous lament in many panels on teaching ICT4D in conferences and workshops such as the 2011 conference of the International Federation for Information Processing - Working Group (IFIP W.G.) 9.4 held in Nepal and AIS Special Interest Group on ICT and Global Development (SiGGlobDev) workshops at Phoenix in 2009 and at the Americas Conference on Information Systems (AMCIS) in Detroit in 2011.

In this paper, we aim to at least assuage this lament. To do so, we first reproduce verbatim a teaching case that we presented at the International Conference on Information Systems (ICIS) 2012 in Orlando [Sein et al., 2012]. It is based on original research carried out by one of the authors as part of his doctoral work. The other two authors supervised him. The research outcomes have been presented in other more traditional academic publication outlets

[Thapa & Sæbø, 2011; Thapa et al., 2012]. Here our objective is to support our arguments for the vital need for teaching cases in ICT4D. At the same time, our teaching case aims to "create in the classroom realistic laboratories for applying research techniques, decision-making skills, and critical- thinking analysis" [McDade, 1995, p. 9].
The rest of the paper is organized as follows: in Section II, we reproduce the case from ICIS 2012 proceedings and in Section III, we discuss and reflect on the implications of our paper.

II. THE CASE: NEPAL WIRELESS NETWORKING PROJECT

Prologue

Mahabir Pun leaned back, knitted his eyebrows, and smiled wanly at the visitor sitting across the table piled high with all manners of papers. The diminutive dynamo thought awhile before answering the visitor's question which was "How did you singlehandedly bring the Internet to this isolated remote mountain region of Nepal? What drove you to do this? Why of all places Nangi?" He was proud of what he had achieved which was no less than bringing in the outside world to the remote mountain villages in the shadow of the towering peaks of the Himalayas.

It has been an uphill climb, and a struggle for a decade against overwhelming odds, much like scaling the majestic peaks that surrounded him. From a small classroom in a small village called Nangi, with one band-aided computer from donated parts, the Nepal Wireless Networking Project (NWNP) as it is now known has spread to 150 villages. Through the network, villagers could now keep in regular touch with their relatives working in the Middle East; the sick could reach doctors from large national hospitals located in Kathmandu, the capital; school children could read text books and even get lessons on the computer; the youth could organize social events and announce these events electronically; traders could buy and sell their goats or vegetables to people living in other villages (some sold paper products even to Australian buyers); and an enterprising group could manage their innovative yak-cow cross-breeding project without trekking up 3000 meters to the ranch itself.

It was impressive, Mahabir admitted. It was not just his feeling, nor the praise he got from others, including academics such as today's visitor. In 2007, he received the Magsaysay Award, Asia's equivalent of the Nobel Prize. Yet, he was not sure how to answer his visitor's query. He had not planned the whole thing, nor any major part of it. To use the old cliché, it was one project at a time. That was why he was thinking carefully on his response. He wanted the visitor's help for his next project – bringing e-Learning to the villages under NWNP through a multicasting network.

He finally looked up, smiled at the visitor, and said, "it all started when I just wanted to check my e-mail". Then he began to tell the NWNP story. At the same time, it was also Mahabir's story.

Background of Nepal Wireless Networking Project (NWNP)

The landlocked country of Nepal lies on the southern slopes of the Himalayas sandwiched between two giants, India and China. Its total area of 147,797 sq. km. is split into the Tarai in the south (17% of the total land), the central mountain region (64%), and the Himalayan region (19%) in the north. Administratively, Nepal is comprised of 5 development regions, 14 zones and 75 districts. The Village Development Committees (VDC) are below the district level, and are further divided into wards, which are the lowest administrative unit. Essentially though, Nepal's 3914 VDCs form the basic unit of the developmental work. Nepal's 28 million inhabitants live mostly in rural and remote areas with urban population comprising only 25%. About 31% of the population lives below the poverty line. While the literacy rate in Nepali, the national language, is an impressive 82%, only about 18% are literate in English. Ownership of computer in Nepal is still 2.80 per hundred, and telephone lines is 3.5 per hundred [European Network for Rural Development (ENRD), 2009; Merseth, 1996]. The poorest and least developed part of the country is the mountain region, which has the lowest human development index (HDI) scores [United Nations Development Programme (UNDP), 2004]. The disparity between regions has contributed to conflicts among different communities and political institutions. The result has been a steady erosion of the social capital that existed within communities (the binding elements of trust) and has severely disrupted indigenous forms of social networks and institutions (the bridging elements). The NWNP is situated in this region with Nangi village at its center.

Inception of the NWNP

In 1996, Mahabir was working as a schoolteacher at Himanchal Higher Secondary School in Nangi. He had completed his primary education in a village school. Teachers in the school were mainly unqualified retired soldiers who were untrained and had a very basic knowledge. In remote schools such as this, it was also difficult to obtain papers, pencils, and textbooks. Each student had a wooden board blackened with charcoal, and a soft marble stone from a nearby cliff to write with. Mahabir remembered when he got his first paper and pencil – he was in the seventh grade. Textbooks came even later, in his eighth grade. His father, who was a retired army person, had dreamt of his

son going on to higher education. Realizing it was an impossible dream, he did what numerous others before him had done: he moved the Pun family to a city near the southern plain of Nepal.

There, Mahabir completed his high school education, and worked as a teacher for about 12 years. In 1989, he received a scholarship to the University of Nebraska at Kearney, from where he graduated in 1992 with a degree in Science Education. He returned to teach at Himanchal Higher Secondary School at Nangi (see Figure 1). It was an eye-opening experience. The gulf separating the comforts of the richest country in the world and one of the poorest was vast. Yet, Mahabir had ideas about how, at least at the local level, his countrymen could climb out of poverty. At first, the villagers were skeptical about his ideas on development. They thought he would return to the US after a while. Proving them wrong, he became involved in educating school children and community people from 1993 to 1996. At the same time, he also started working on rural development programs. His efforts gradually won over the support of community groups, mothers' groups, youth groups, retired army personnel, school management committees, and district development committees.

The district	Nangi Village	Wooden Box Computer
		

Figure 1. Pictures from NWNP

Nangi though, is isolated. It is so remote that it took a 5-hour hike to the nearest road to catch a bus for the 4 hour ride to the nearest big town of Pokhara which was better connected to the world. Being a tourist destination, it had Internet connection, albeit slow. Pokhara was another 6-hour bus-ride to the Nepalese capital Kathmandu.

Mahabir felt trapped in this remote and isolated village. He knew about the Internet and so he started making the arduous trip to Pokhara just to check his e-mail and to browse websites. He began to read more and more about the potentiality of information technology in bringing socioeconomic development. He realized that wireless Internet connection is one way to connect the mountain villages to the outside world. In 1996, with the help of a US professor, he created a website for Nangi village, and briefly described the village school. The presence of a remote village on the Internet attracted some foreign volunteers to come and teach in the school. Others who came to know about Nangi school donated books, teaching materials, and money. Mahabir also installed two small hydro-generators with the help of community people in the village to provide electricity to the school.

In 1997, some students from Australia donated four used computers. Mahabir used them to teach basic computer applications at his school. Later, the school received more donated computers from international volunteers. He now began to dream about connecting the village to the outside world through the Internet.

It was a pipe dream then. Nangi had no telephone lines, no electricity beyond what the hydro-generators provided, and a few computers. To make matters worse, Nepal was then in the midst of a decade-long Maoist insurgency. It was very difficult to set up wireless Internet in the mountain regions because the import of wireless equipment was banned. In fact, it was illegal to install anything wireless. Mahabir was not discouraged. Undeterred, he went ahead and assembled a wireless network flouting regulations. As he liked to say "It's better to be crazy than to die."

Exploration of Idea to Install a Wireless Internet Station

In 1998, a telephone line was installed in the village, raising Mahabir's hopes. However, the quality of the telephone connection was not good. He started thinking about different technical solutions. A satellite connection was one possible solution, but this was not affordable. Still dreaming of bringing Internet services to remote communities, he once again returned to the US, this time to complete his Master's Degree in Educational Administration.

On his return in 2001, Mahabir's dream received a jolt. He was stunned by the yawning gap between the Information and Communication Technology he was used to at Nebraska and the stone age level that he now had at Nangi. Instead of brooding over "his fate", he had an inspiration and on an impulse, sent a message to the British Broadcasting Corporation (BBC), asking for ideas to connect such remote villages to the outside world through the

Internet. BBC broadcast it on their famed and popular World Service and published it on their website. The response was overwhelming. The e-mail was read by many foreign students and volunteers who were eager to contribute to the mountain village through voluntary services. Within days, offers of help began to arrive. It started as a trickle; a used PC here, a server there. Soon volunteers began to show up at Nangi mostly to teach English, mathematics, and science subjects to school children. It was 1996 all over again.

Mahabir then started extending his network through e-mails with international volunteers; in particular, graduate students from western countries helped to bring computer equipment, set up the network, and taught basic computer skills to the villagers. Gradually, people in the community were taught by volunteer students to assemble donated computer parts in wooden boxes. By now, Mahabir began to realize that his dream was intact, but he alone could not do the job: he needed several other individuals and organizations. He started to look around for like-minded actors.

Pilot Test of NWNP

In 2001, with the help of a technical team, Mahabir established a non-governmental organization (NGO) called E-Networks Research and Development (ENRD, 1997). The purpose of this NGO was to conduct ICT research and development in remote areas. The NGO provided initial technical support to install wireless stations in Nangi. In 2002, Mahabir, along with people in the community (see Figure 2), the NGO, international volunteers and a technical team from an Internet service provider (WORLDLINK), conducted a pilot test. They tried to connect the Mohare relay station, near Nangi with the Pokhara base station, where the server was located. They used antennae and dishes (see Figure 3), donated by international volunteers, which were placed in tall trees. All the equipment was carried and installed by the villagers themselves. Through trial and error, they succeeded in setting up a wireless connection between the base station at Pokhara and the one at Mohare located near Nangi. Soon after, they extended the network to Nangi itself and a few other villages using basic wireless technologies.

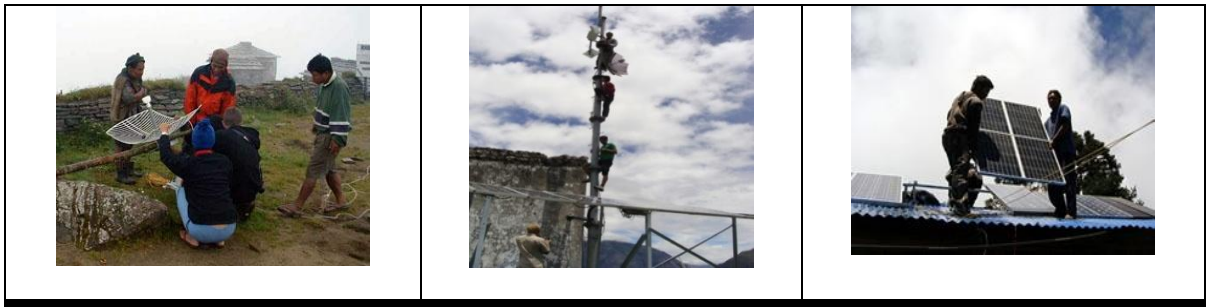


Figure 2. Community people installing necessary equipment

In 2003, Mahabir formally established the Nepal Wireless Networking Project (NWNP) with the stated aim of providing Internet services in the mountain regions (see Table 1). The technology used during this period was desktop and laptop computers, Internet telephony equipment and high-resolution network cameras. This equipment was used to operate distance teaching and telemedicine services. In addition, NWNP acquired resources to build the network infrastructure, which included wireless devices, a network server and associated software, and power generation equipment at the relay stations. NWNP was gaining in popularity in Nepal and other parts of the world. Individuals and businesses, such as the Himalayan Bank and Solutions Consultant from Nepal, started donating computers and equipment. International donors from the USA, Canada, the Netherlands, Germany, Singapore, Australia, and Japan joined in. Tourists and volunteers coming to Nepal also brought unused computer parts such as motherboards, memory cards, hard disks, and video and sound cards. These parts were then assembled in the mountain villages inside wooden computer casings made by the villagers (see Figure 1). Local committees, such as the Mustang District Development Committee and Himanchal Higher Secondary School, provided administrative and financial support to run and maintain the wireless project in the districts of the region.

Mahabir Pun with Dish antennas	Relay Station
	

Figure 3. Antennas and relay station

Extension of NWNP Services in the Mountain Districts

During 2005 and 2006, NWNP further extended its network into other districts and expanded the coverage of the Internet services (see Figure 4). They replaced old network devices with new and more robust equipment. International organizations such as the International Telecommunication Union (ITU) and World Bank granted funding through the Poverty Alleviation Funds of the Government of Nepal. Funding was supplemented by a grant from the International Center for Applied Studies in Information Technology (ICASIT) at the George Mason University School of Public Policy, USA, to print handbooks for training and publicity. NWNP also collected funds from village development committees and schools for user training, network administration, and to provide salaries to its support staff.

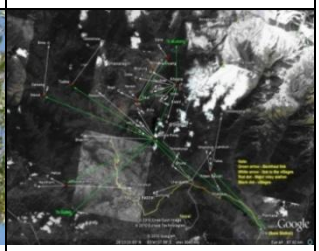
NWNP in 2003	Antenna on trees	NWNP in 2011
		

Figure 4. Trajectory of NWNP from 2003 to 2011

In 2006, the political situation in Nepal reached a turning point when Maoist rebels signed a peace deal with the Government. With the political situation now more favorable, NWNP organized a seminar in Kathmandu with government ministers, political leaders, government bureaucrats, and Internet service providers to discuss existing regulatory and legal issues. Mahabir lobbied the government to put the remote communities on the priority list of IT policy in 2010. Consequently, the Government de-licensed the 2.4 GHz and 5.8 GHz bands. In addition, it allocated some funds to all village development committees to introduce computer and Internet- based education in schools.

International Collaboration of NWNP

In 2009, NWNP was registered with the Ministry of Industry's Office of Company Registrar as a not-for-profit company. During that year, NWNP implemented projects supported by Asia Pacific Telecommunication (APT). These projects connected 14 villages through wireless technology. At that time, services to other villages could not be extended due to financial and technical limitations. To raise funds for a further extension of project services, Mahabir initiated a 'One Dollar per Month' campaign. The idea was to collect one dollar per month from Nepalese citizens and the diaspora to implement the wireless project. Table 1 presents a timeline of NWNP from its inception to the current state.

Table 1. NWNP: From Inception to Extension		
Time	**Events**	**Other Key Actors**
1989	Mahabir Pun received scholarship and left for US for undergraduate study	University of Nebraska at Kearny
1992-1996	Mahabir returned to Nepal and started teaching and social work	Community people, school teachers
1996	First website of Nangi village and Himanchal school set up	Volunteer professor from US
1997	Himanchal school received 4 used computers	Visiting volunteer Australian students
1998	Nangi village got a telephone line	Nepal telecom
1999	Mahabir left for US for graduate study	University of Nebraska at Kearny
2001	Mahabir finished master's degree and returned to Nepal. Wrote an e-mail to BBC	BBC
2001	E-Network Research and Development (ENRD) established	Some technical experts from Nepal
2002	Pilot test of the Nepal Wireless Networking Project (NWNP) conducted between Pokhara and Nangi.	ENRD, ISP, Volunteer students
2003	NWNP services fully operationalized between Nangi and Tikot villages	School teachers, community people, ENRD
2005-2006	NWNP extended to other villages	World Bank, ITU, ICASIT
2006	NWNP lobbied the government and achieved reduction in license fee and allocation of budget to village development committees for computer education	Government ministers, political leaders, ISPs
2007	NWNP collaborated with OLE, Nepal Mahabir won Ramon Magsaysay Award	OLE, Ministry of education
2008	NWNP initiated telemedicine project	Om Hospital, Kathmandu Model Hospital, Health workers, Doctors
2008	NWNP created Haat Bazar website, a local intranet ecommerce service tested virtual ATM machine	Gandaki engineering college, thamel.com
2009	NWNP registered as a non-profit sharing company, extended internet services to 14 more villages; in addition, started one dollar per month campaigning	APT, The Nepali diaspora
2009-2011	Several local development projects initiated by NWNP and villagers, such as: Yak farming, Cheese production, building trekking routes, building lodges, Virtual ATM, etc.	JIIA, ITUA-J, KDDI, AIT, community people
2011	NWNP extended to 150 villages … and continues to connect many more villages	Collective action of all the actors involved mentioned above

Gradually, NWNP extended its collaboration with various international organizations to extend its wireless Internet services. For instance, Japan International Information and Communications Technology (ICT) Association (JIIA) of Tokyo provided technical support to select appropriate technology by sending their experts to Nepal. Similarly, the International Telecom Union Association of Japan (ITUA-J) helped to develop links with Japanese partners and supporters, and provided technical support and guidance. In addition, the Japanese telecom operator, Kabushiki Gaisha (KDDI) Corporation, donated 85 laptop computers to the wireless project. They also provided their expertise to install telemedicine services in the remote villages. NWNP is also working on environmental monitoring projects with the Asian Institute of Technology (AIT), Thailand. The project involves working with the Kaski Association of the Blind to introduce computers and Internet services for visually impaired people.

As shown in Table 1, from 2009 to 2011 NWNP started making its presence felt both nationally and internationally. The wireless project not only built up a physical infrastructure, but also a huge social network. The structure of the network was composed of many stakeholders, such as local schools, local governments, community people, hospitals, governmental and non-governmental organizations, businesses, and other international actors.

By 2011, NWNP had already built networks in around 150 villages in Myagdi and other districts. It has also gradually enrolled local, national, and international actors in the formation and extension of the wireless project and its services. Mahabir received many prestigious awards, including the Overall Social Innovations Award (2004) and, in 2007, an honorary degree as Doctor of Humane Letters (2007) from the University of Nebraska, Kearny, and the Magsaysay Award (the Asian equivalent of the Nobel Prize).

Services offered by NWNP

NWNP is located in mountain villages of which Nangi is a typical example. The average population of these villages is between 800 and 1,000. Except for four villages, they are not accessible to motor vehicles by road. Historical reasons mean that the inhabitants of these villages are predominantly composed of people from the Magar ethnic community. However, there are other minority groups as well. Although the area has become better connected via roads that are open to motor vehicles, the geo-political configuration has confined them to traditionally formed strong ties or bonding social capital. The communities make most of their local decisions in the presence of village development community chairpersons.

Most of the young people from these villages migrated to urban places to search for employment, leaving behind retired army personnel and elderly people. Joining the British or Indian army is preferred in many mountain regions, as it does not require a high level of education. It is the prime recruiting ground of the legendary Gurkha regiments. The villagers still practice shamanistic rituals and shamans are respected as traditional doctors and healers. Medical services are still in a dire state. One young social activist ironically stated that:

> *"The place has become a dumping site for disabled and elderly people. Educated people are not staying in the village; they are migrating to urban places"*

Before NWNP was initiated in Nangi, communication technologies were primitive if they existed at all. There were neither mobile telephones nor Internet access. On the need and usefulness for the project, Mahabir expressed his optimism:

> *"One of the reasons I got involved in this project is because I have seen that this has good potential to provide some very basic services to the rural community, like health and education services…because there is no way the Nepali government is going to build hospitals and bring doctors to the rural areas … as it costs so much money to do that… also you can see a lot of good schools and colleges are in the urban areas… students are getting the opportunity to get quality education there but students in rural areas are not. So there is a huge education gap…therefore, I think ICT can help to close this education gap. Similarly, to make this project sustainable we have to generate income; that's why we are working in e-commerce projects and Internet telephony "*

NWNP provides communication (Voice over Internet Protocol (VOIP), e-mail, bulletin boards, etc.), education (distance teaching, e-learning), healthcare (telemedicine), business (e-commerce, e-tourism, local marketing, remittance) and employment opportunities in the mountain region (See Figure 5). The central office of NWNP is the Nangi telecenter, which is run by Himanchal Higher Secondary School. This telecenter coordinates the whole wireless network, which covers the different villages of the Myagdi, Parbat, Mustang, and Baglung districts. Specific services offered by NWNP are described below.

Telemedicine	Community Information	Communication
		

Figure 5. NWNP Services in the mountain regions

Educational services

Nangi, like all villages in Nepal, had primary schools, but the quality of teachers and the educational material were low, resulting in a high percentage of dropouts already at the primary level. Teachers were (and still are) often retired military personnel without proper pedagogical training. Books, if they do exist, were often outdated, and lacked the material that students needed. There were no educational institutions above primary schools forcing whole families to move to urban areas in search of appropriate educational opportunities.

NWNP's services were consequently to provide the infrastructure and equipment needed for Internet access at schools (see Figure 6). The infrastructure also provided Internet access to the villagers in the afternoon and early morning, who could then use computers and online services.

Students and teachers were offered e-mail accounts through the project, while a bulletin board for local news, local advertisements, announcements, and urgent messages were offered. A school teacher commented on the usefulness of getting access to Internet in the following way:

> *"There are a lot of benefits to using computers in this village. There are many places in Nepal where children have not seen computers. But in our remote village, children are able to use and feel the new technologies".*

He went on to add:

> *"They are able to read updated news, and some are busy playing games. To enjoy playing games on a computer is also a breakthrough achievement for them"*

The people from the villages who are working abroad use e-mail to communicate with their families back home and to extend their social networks. The principal of the school commented:

> *"By using e-mail, we can meet people from other villages. We can exchange our information and put news on the homepage. We can easily find out about any events. It has facilitated the resource exchange. Through the Internet, we can also connect inside and outside of our country"*

Teachers and students obtain access to educational materials on the project's intranet, allowing them to search and share information, which is perceived helpful by the students:

> *"It helps us in our study. For example, to understand history, the course book is not enough. Now, we may download additional information to get to know more. It's helping me to receive external information related to my studies"*

Schoolchildren and teachers seem more motivated to study and learn, and students living in the villages are suddenly able to communicate with others:

> *"…in the case of students it has been drastically changed. They are using social networking services to make a lot of friends. Likewise, we have a lot of volunteers from other countries with different nationalities and cultures. We can have cultural exchanges, building friendships with them. The dimension of communication has been altered"*

Mahabir soon realized that access alone was not enough to improve the educational level; what was needed was localized educational material in Nepali. He started to look for a likely partner to develop this content. Help was not too far away. Rabi Karmacharya had just returned to Nepal, leaving behind a successful career in a software development firm in US. With a master's degree from Massachusetts Institute of Technology, Rabi had a bright future in the US. Yet, he yearned to give something back to his country. He returned in 2007 and established an NGO in Kathmandu called Open Learning Exchange (OLE), Nepal. Rabi's vision was to transform Nepal's public education by integrating technology in the classroom and giving children the tools and platform necessary to learn and excel. OLE developed online educational content in the Nepali and English languages for students. The contents are based on the government curriculum from grade two to grade six. In addition, OLE developed e-library content that is available online for the students and villagers. Since 2008, NWNP and OLE have been in a testing phase of using the network for online-based learning. OLE made educational material for children in the rural areas of Nepal; however they were not able to distribute the material to the mountain regions. NWNP provided the infrastructure to implement educational materials in the mountain regions, whereas OLE, in return, provided teaching material to schoolchildren. Thus, the OLE project is now an integral part of the NWNP. Rabi stated:

"The other thing technology can do is from the communication aspects, it improves the access, so now they [students in rural and remote areas] can go to school and access a lot of quality education materials. Many places every year in remote areas don't even get the textbooks, sometimes the books arrive when the academic year is over, so we are facing a lot of these challenges. By introducing technology we can update and send the materials immediately, and easily access the materials"

Yak-Cow Cross-breeding Project	Online Education	Haat Bazar
		

Figure 6. Extension of NWNP services in the mountain regions

Telemedicine

The primary health care system in these villages was provided by "village ladies" (also known as "health sisters"). They received at best a few weeks of basic health care training. The nearest doctor was several kilometers away, and hardly any specialist doctor would come to villages like Nangi.

In 2008, NWNP initiated a partnership with Om Hospital at Pokhara, Nepal Medical College and Kathmandu Model Hospital to provide telemedicine services to various remote communities. The core of the telemedicine services consists of web-conferencing equipment installed in the villages as well as in the hospitals, allowing real-time interaction between local health workers and specialist doctors through the video-conferencing services. The health workers of these villages can now communicate with doctors in the urban center of Pokhara and Kathmandu to obtain medical assistance. Every morning, they meet through a video-conferencing system where they discuss patients and common diseases and consequently learn from the doctors. Thus, the doctors who were reluctant to travel to those villages could serve poor communities from their own hospitals. Saroj Dhital, a doctor at Kathmandu Model Hospital, stated:

"Daily video conferences can provide continued training to the health workers in the remote area. And secondly, at the time of emergency, they can bring patients before the camera. Our aim is that health workers here in the village become efficient. The people in this village should trust them more, and ultimately it will benefit the village people"

These daily virtual meetings enable consultative medical care where expert knowledge from doctors in national hospitals combines with the contextual knowledge of local primary healthcare workers. A health worker said:

"Telemedicine means, here we have a small clinic, where two sisters [nurses] are working. If they find any difficulty or some emergency cases then they directly connect to Kathmandu or another 4 – 5 main hospitals and consult with them"

The interaction between patients and doctors is indirect through health workers. The patient communicates with the local health worker who communicates with the doctor. Still, it has a beneficial effect. A doctor associated with this project commented:

"Particularly in the villages, people are afraid of diseases. When they see a doctor in front of the camera prescribing medicines to them, they feel psychologically confident"

Mahabir commented on the project in the following way:

"It is difficult to get specialist doctors in remote places; in this situation we are using this technology to access doctors from remote places. The people who have not seen doctors can see the doctors through this technology. These are the main focuses of our project. So wherever we are going we are connecting schools and health post stations"

The village health sisters also receive distance training and education programs through the telemedicine project. Doctors give lessons online, and the health workers present their cases to other health workers and doctors. The participants in these online sessions actively engage in discussions about topical issues and practice making diagnoses. A health worker said:

> *"[The] objective [of telemedicine service] was to involve and empower women, for example, health workers. Therefore, this [telemedicine] clinic was not only for treatment purpose, but it also provides training to the village women. They also trained health workers from other villages, who are women"*

Income Generation Activities

Employment opportunities are rare in remote mountainous villages such as Nangi. Exodus to urban centers is a common phenomenon. Those who remain are mostly farmers, not surprising since every family produces food and products needed for their own survival. Farmers sell their meager surplus, mainly agricultural products, but also livestock such as goats and cows at local markets. Walking several kilometers to the nearest urban areas is difficult, especially with livestock in tow. There are others who need income generating activities. Other than non-farmers, there are those who have returned to the villages after failing to obtain work in the urban areas to where they had migrated.

To help generate income-earning activities, NWNP started working with Gandaki Software Engineering College, Pokhara to develop an intranet e-commerce platform, known as Haat Bazar. On Haat Bazar websites, villagers could advertise local products for sale, such as cows, buffaloes, goats, chickens, vegetables, and cheese. Mahabir described Haat Bazar as follows:

> *"They can use it [Haat Bazar] for advertisements in the village. Thanks to the Internet, we can promote local products such as Doko, Namlo, Nepali spices, mushrooms, and cattle. Anyone who wants to sell their products may use services like Haat Bazar on the Net. They contact the Internet operator, who will put the information online for other people to see and buy that product"*

NWNP then found a partner to collaborate in its web endeavor. The partner was a web portal called Thamel.com, which sells goods online, chiefly targeting the expatriate Nepalese who could purchase gifts to be delivered to an address in Nepal.

The company grew rapidly after their story of selling goats was published on a BBC website. The director of thamel.com, Bal Joshi, and Mahabir came together when Joshi was exploring business opportunities in mountain regions and Mahabir was looking for his e-commerce platform. In 2008, they conducted a pilot test of virtual ATM machines to operate credit card transaction services for tourists on different trekking routes. Current plans for extension include a remittance service in remote areas, since many family members from remote communities go to work abroad.

The community of Nangi is also running a cross-breeding project between yaks and cows. The ranch is located at a remote site 800 meters above the village. The management committee can communicate via a net meeting to make appropriate decisions regarding the project without making long trips. The communication services allow for planning, ordering of supplies and management of the projects. Mahabir is excited by a newly initiated remittance service:

> *"Remittance services are going to start soon in this village. By using this service, family and friends in foreign countries and in the big cities may transfer money easily, which is clearly beneficial for the community"*

Current challenges

It has hardly been smooth sailing for NWNP. It also faces a number of challenges. It has not been easy to get farmers involved, especially the older ones, due to a lack of understanding of the importance of learning to use computers, a lack of education, and a lack of time and effort to participate in training to increase their ICT competence. Another major challenge is the literacy rate and the lack of online context based on the Nepalese language.

A major challenge is the lack of skilled manpower to maintain and develop the project further. Local youth are trained to become technicians who can solve very basic technical problems, but there is a need for certified engineers. One technician argued:

"We are not using the computers for complex tasks, therefore, we don't have any problems. But we will face difficulties if we start using them for more complex tasks... If the computers are out of order, there is no one to fix them. We have just one technician and he is not perfect. He works according to the instructions given by Mahabir Pun by phone. Otherwise, if the problem is bigger, then Mahabir needs to come"

Based on what he has done with the NWNP, Mahabir Pun is well respected at all levels in Nepalese society. This gives him access to the corridors of power, including the ministries in Kathmandu. At the same time, he is also maintaining and managing the whole network, by buying, installing and maintaining the equipment such as servers, which are still located in his private house. A villager commented on Mahabir's role:

"Mahabir has done this entire thing. He is the one who brings computers and Internet to this village. All the credit goes to him. As long as Mahabir is with us, there is no fear. However, in his absence we are a little doubtful"

Another villager had a different perspective:

"In other villages, people from foreign countries and government agencies invest in development projects, but in our village there is no spokesperson who can speak on our behalf. There are some clever people here, but they don't want to stay in this village"

Power shortages, combined with poor infrastructure, hinder the quality of telemedicine services in the villages. With power shortage in most parts of Nepal, and unreliable power supply due to the mountainous terrain, NWNP is dependent on solar power systems. Such systems are expensive and not always reliable during the rainy seasons. Mahabir observed:

"The only constraint to make voice over IP telephone calls to the villages from abroad using the extension number is that they don't have enough Internet bandwidth from the ISP. People are using Skype and Yahoo! Voice Chat in the morning or evening, when acceptable Internet bandwidth is available"

Small-scale businesses to generate income are initiated and are still in the testing phase. According to the director of the Nepal Telecommunication Authority, the private sector is uninterested in remote locations:

"The major challenge for the private sector is the lack of a business model in remote places. In the liberal economic system, a business model is very important, we have so far not been able to design the correct sustainable business model"

Due to insufficient roads and lack of infrastructure it is difficult for farmers to transport local products to nearby cities. Moreover, the lack of infrastructure also hampers the tourist industry, since it is difficult and time-consuming to transport tourists into the mountain areas. Thus, more tourism and better use of natural resources is inhibited by the lack of roads. Tourism is also hindered by the difficult political situation, where ten years of Maoist insurgency, the massacre of the king's family, and a fragile government, have yielded an unstable political situation and lack of government support. The political situation challenges NWNP in several ways. For example, despite the allocation of money to facilitate the development of telecoms infrastructure in remote areas, the funds have not been used due to the political instability and delayed bureaucratic processes. A head teacher offered an example of the practical difficulties due to the difficult political situation:

"We sent our computer teacher to Kathmandu for one month of training in hardware. Due to the Nepal Banda [strike] and other political movements, he received just 15 days of training instead of one month"

Epilogue

"That is NWNP in a nutshell", said Mahabir with his ever present smile, "that is how it happened". The visitor looked up. He has been listening with rapt attention for two hours as Mahabir described the project that his host was clearly proud of. He also sensed a hint of concern in Mahabir's voice. "You have done well, Mahabir. NWNP is spreading and the villages are now part of the greater world. Is there anything you are worried about?"

Mahabir looked out of the windows at the snow-capped peaks shimmering in the far horizon. "We have now reached 150 villages and we want to reach more. Can we do it? We have done well in many villages, but there have been others where things have not gone well. You know these villages may look the same, but they are not so. Not all are from one community, some seem to want the things we offer, others not that much. Some of the groups in some

villages – you know the mother's society, the youth society – are more enthusiastic than in other villages. I can't be everywhere." He spread his hands.

Then he said, "I want to do so much more. I want our planned multicasting system to work, where the main idea is to provide Math, English, and Science education to students in the remote villages through online and real-time communication. Qualified teachers from the urban schools can lecture online for students in the mountain areas who don't have such teachers. At the same time, they can ask question through online chatting or audio systems, through the interactive and real-time learning management system. " He smiled his wan smile and asked, "How can you help us do this"?

III. DISCUSSION

Our story ends here, long before the conclusion and termination of NWNP are known. Mahabir Pun and his colleagues continue in their efforts to improve the villagers´ life in the mountain areas of Nepal. They strive to provide more and better services for health-care and teaching, and, improve income-generating services. Our teaching case allows readers and students to analyze and speculate on possible solutions and conclusion [McDade, 1995]. By presenting statements of conditions, attitudes and practices at a specific time, our narrative story is introduced to gain understanding and examine patterns of actions to discuss potential answers and consequences of choices made [Pitt & Watson, 2011].

The NWNP teaching case is our attempt at "converting research into relevant, usable material enabling the researcher to teach from research and the student to profit from the rich and ever expanding IS research base" (Willcocks & Sauer, 2011, p. 1). Our case touches upon contextual challenges in developing countries such as providing services in a country where the necessary power and telecommunications foundations are poor, or in some cases absent [Heeks, 2008]. It also addresses some of the themes suggested by Pitt and Watson [2011] that teaching cases set in developing countries (they use the term "emerging economies") can focus on:

- How to build and implement systems in resource- constrained environments? Countries such as Nepal not only lack funding, but also skilled personnel, stable political systems infrastructure and technology-awareness.
- How to practice frugal IS? By developing information systems with minimal resources to meet the pre-eminent goal of the clients, to provide the poor with the information that is critical to their quality of life.
- How to design systems for illiterate or semi-literate populations? How can interfaces that use symbols or voice help in this regard?

While this case is on ICT and development, it can be adopted in IS courses in general. It can be useful to explore such issues as the champion's role, scalability, the importance of contextual understanding while developing services, and the need for commitment and focus on stakeholders involved. Depending on the particular course, one or more of the following teaching objectives can be emphasized.

(1) To explore how (and if) ICT can foster development in underdeveloped countries.

(2) To explore ways of meeting the challenges of scaling up from pilot projects to wider implementation specifically in the context of developing countries.

(3) To explore the challenges faced when introducing modern technology (e.g. Internet based services) where such services are not known beforehand.

(4) To understand the importance of contextual knowledge to develop ICT based services.

(5) To understand the role and importance of champions in projects.

(6) To explore the role and influence of different stakeholders involved in a project and their influence.

As we elaborated in the Introduction section, our aim in this paper is to add to the small repository of cases set in the developing world in general and on ICT4D in particular. We are also motivated to make our case widely available without cost to our main audience, namely the developing world. We believe that CAIS is the ideal forum for this. Still, much remains to be done. More teaching cases of this type are urgently needed. We hope that our paper will encourage our colleagues to take up the pen (or the keyboard to be more accurate).

Ultimately though, one should read the story of NWNP because it is fascinating. A local social worker, Mahabir Pun, decided to take on daunting challenges related to health care services, education and lack of business opportunities by introducing the Internet to mountain villages in Nepal. From the inception of the project until today, NWNP has faced numerous difficulties. The decisions made to meet these challenges influenced the project and it emerged through this interaction. Our teaching case aims to tell this story, and in doing so, challenge the readers to reflect on the alternative solutions and the consequences of the choices made, as well as the potential consequences of the alternatives not taken and choices not made.

ACKNOWLEDGMENTS

We are indebted to Dr. Mahabir Pun for making it possible to carry out our research upon which this case is based.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
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Communications of the Association for Information Systems

ISSN: 1529-3181