VOIce-based Community-cEntric mobile Services for social development

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Final Evaluation

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LIST OF ACRONYMS

KEC	Key Evaluation Checklist
W4RA	Web Alliance for Regreening in Africa
NGO	Non-Governmental Organization
RTD	Research & Technology Development
UML	Unified Modelling Language
URI	Uniform Resource Identifier
VXML	Voice Extensible Markup Language
WP	Work Package
XML	Extensible Markup Language

PREFACE AND SUMMARY

This VOICES deliverable 5.4 contains the end-of-project evaluation of the m-Agro Knowledge Sharing Field Pilot, which is deployed in Mali (VOICES WP5).

This report follows up on the VOICES deliverables D1.1, D5.1, D5.2, D5.3, and D7.3.

In D1.1 a discussion was given of extensive use case and requirements analysis in the rural context of Mali. Two use cases were selected for the pilot systems. The first use case was a local trading system, which resulted in a voice-web based system that was nicknamed RadioMarché. The second use case focused on organizing meetings with rural communities, supported by a voice-web based system called Tabale.

In D5.1 we presented the technical design of the RadioMarché system, as the first cycle 1 of the m-agro pilot. In D5.2 its implementation in the production environment in Mali was described, along with the first phase of user requirements verification and validation. D5.3 covers, as the second cycle 2 of the m-agro pilot, the technical specifications for the Tabale system, basically a mobile/web "event organizer" that sends group voice messages out and collects response messages back. Furthermore, D5.3 presents user-feedback results on both the RadioMarché and Tabale systems. D7.3 presents the various related community-building activities that have been undertaken in association with the deployed field systems and pilots.

This document D5.4 is structured as follows:

In part I we discuss the general evaluation framework that we have employed for the field pilot, and its foundation in state-of-the-art evaluation research and methodology.

In part II we provide the three major sub-evaluations: (i) the process evaluation (assessment of what has happened during the project); (ii) the evaluation of observed outcomes (effects concerning stakeholders and their environment); (iii) outlook assessment regarding future perspectives (beyond the project, in particular generalizability, transferability, sustainability).

Part III gives a concise summary evaluation in the form of a SWOT analysis and highlights some key lessons learned.

The Annexes provide more detailed reports and source data further supporting the conclusions regarding sustainability and generalizability.

PART I: OUTLINE OF EVALUATION FRAMEWORK AND METHODOLOGY

This first part discusses the general evaluation framework that we have employed for the field pilot, and its foundation in state-of-the-art evaluation research and methodology.
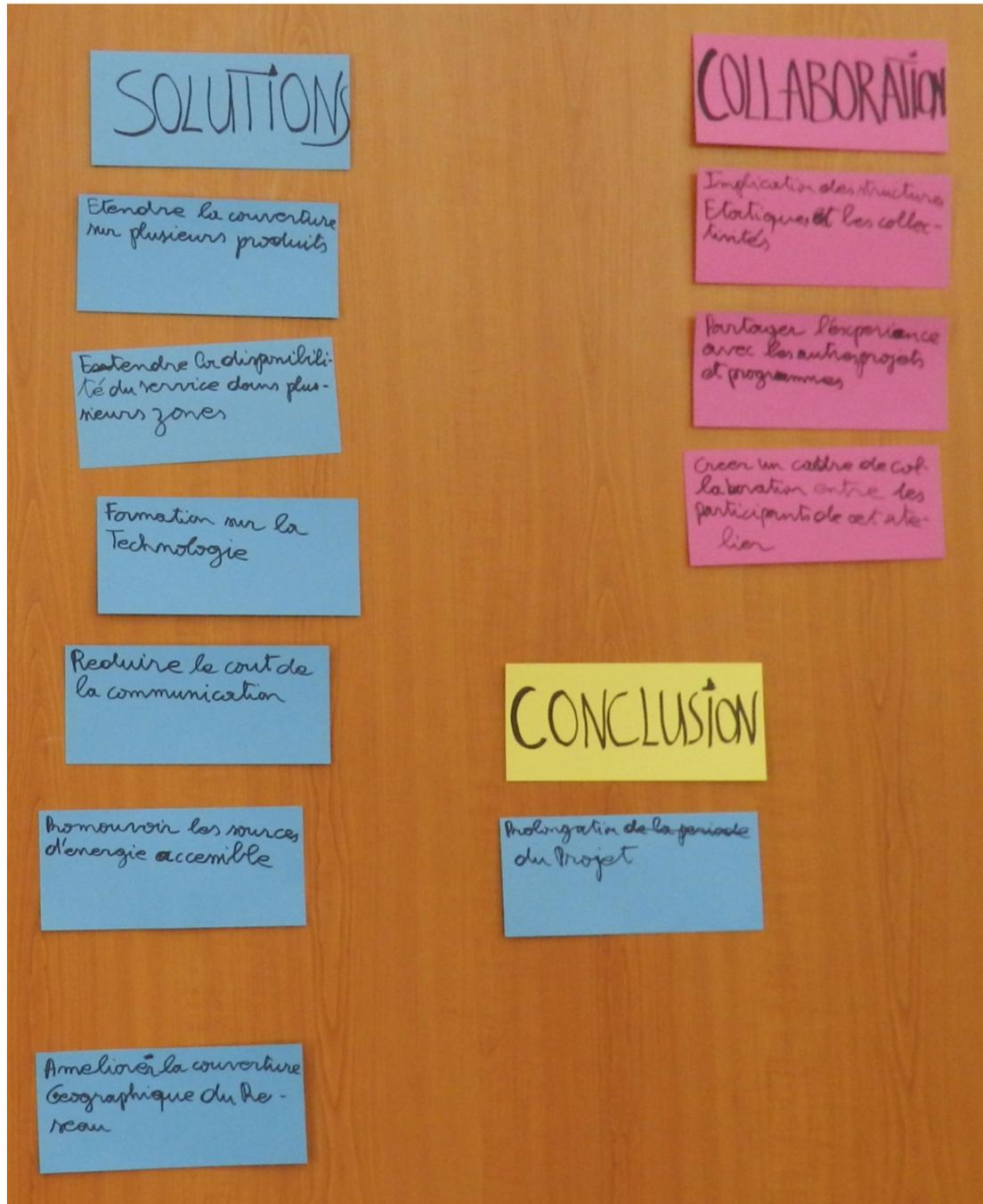
1. Recap: Pilot Rationale

In order to evaluate our research and developed technology and business model we deployed two systems in the field. The *innovation rationale* of the pilot fits the context of the VOICES project ("program or intervention logic").

The first pilot is RadioMarché, a voice-based trading system, also referred to as a market information system, designed for farmers living and working in the area around the village Tominian, in Mali. RadioMarché is meant as a tool to improve communication between the farmers and their potential customers. RadioMarché is designed according to the requirements of the following use case, based on existing procedures.

The second pilot is Tabale, a voice-based event organizer system. A registered number of farmers in a certain region (e.g. Tominian area, Mali) receives an automated phone call by the system letting them know the time and place of a regreening event. The "call for regreening event" is issued by Sahel Eco. Farmers can phone back and retrieve the info-message asynchronously. The message is (optionally) issued in several languages
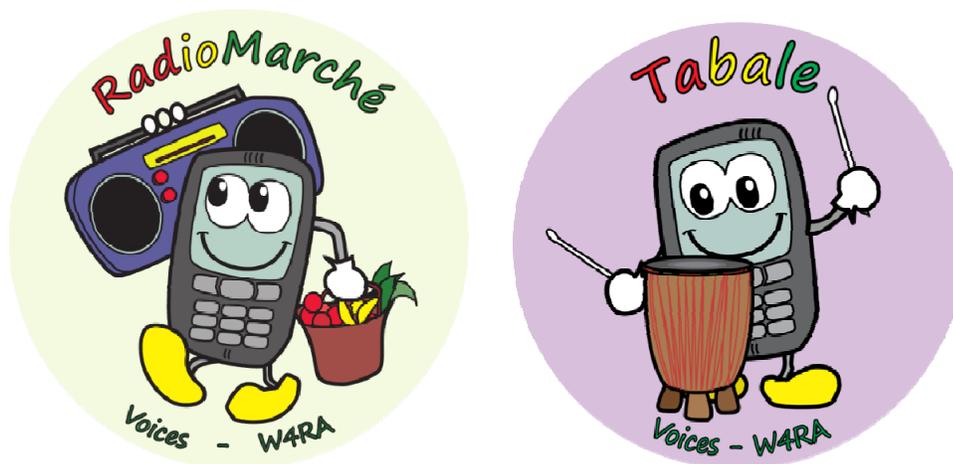
Figure 1: The logos of the RadioMarché and Tabale systems, the two use cases and services of the m-agro knowledge sharing field pilot in Mali that have been developed and deployed in the VOICES project (WP5).

Target groups and downstream stakeholders.

In the case of the WP5 field pilots in Mali, we identified the following stakeholders

- Sahel Eco staff and associated extension workers
- (Innovative) farmer representatives
- Associated rural communities and villages
- Relevant regional community radio stations
- ICT and voice technology organizations and companies

Timeline of the pilots

The start of the pilots was in September 2009 and ended in June 2013. The Tabale and RadioMarché systems are planned to run for another year. The pilots are conducted in three main iterative activities:

1) Field research, including several field trip, use case elicitation and requirements engineering,

2) Development, including phased construction and deployment and

3) business model integration.
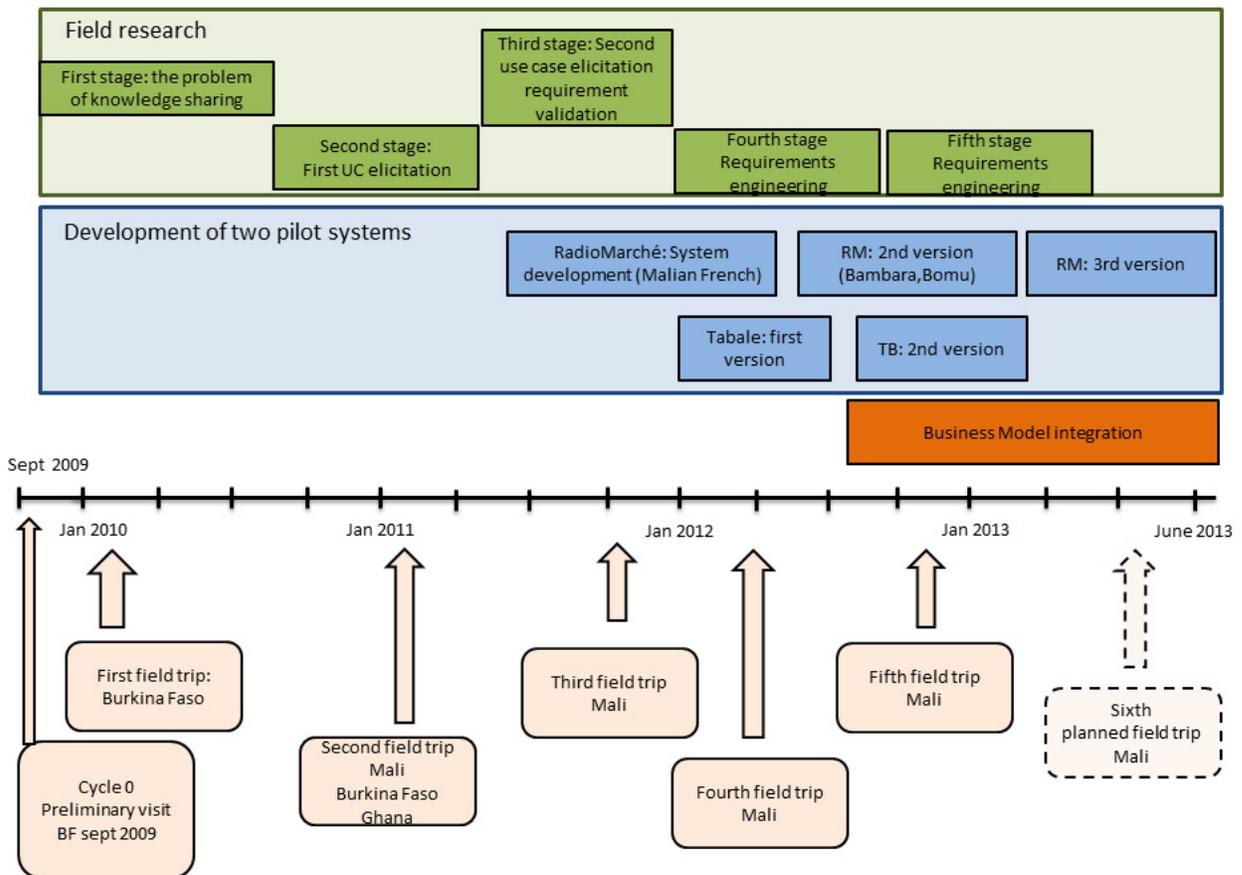
Figure 2: This visualizes several cycles of use case and requirements analysis and spiral, iterative development. The cycles coincide with several visits to the Sahel region. The visits started more than a year before the kick-off of the VOICES project.

Sources of evidence

In order to substantiate the evaluation, we will present 1) a selection of interviews with stakeholders, 2) summary of field visits, 3) technical assessment of the systems, 4) published papers in academic setting and 4) lessons learned.

For example, find below summary of Itinerary from 13 to 17 November: Bamako – Konobougou - Segou – San - Tominian – San- Bamako.
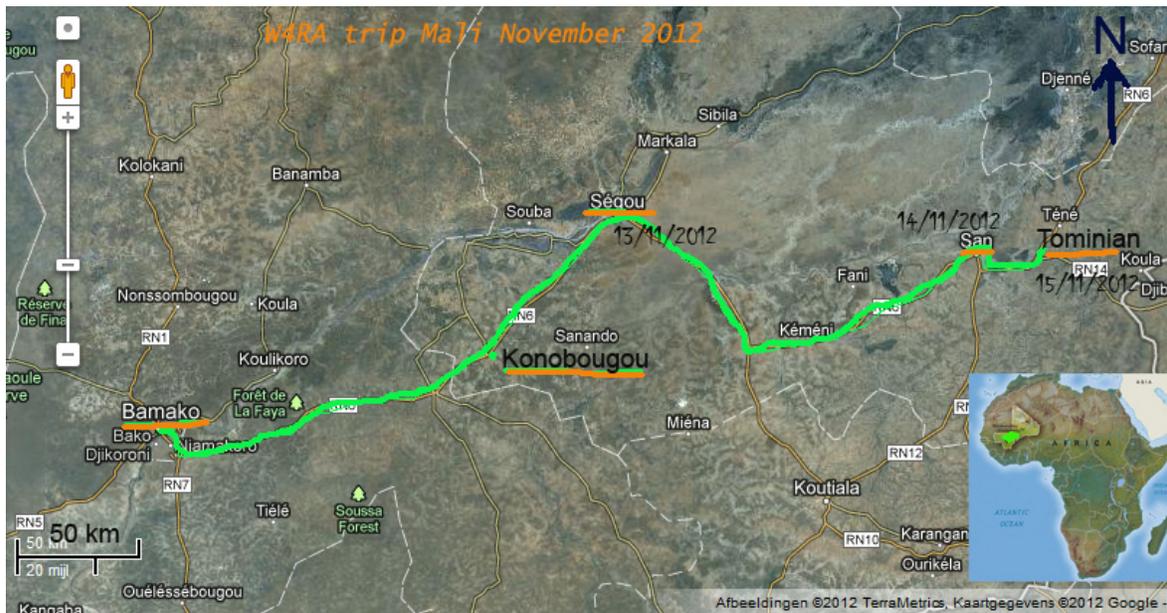
Figure 3: Itinerary of fieldtrip 13-17 November 2012

Summary of trip

Meeting at Sahel Eco Bamako Monday 12 November 2012: reviewing monitoring data (visits + logs); discuss outcome Tangara's visit to 7 radios.

Visit Radio Sikidolo (FM 100.2) Tuesday 13 November 2012

Evaluation of Foroba Blon

Visit Radio Segou (FM 96.8) Tuesday 13 November 2012

Evaluation of RM, FB, recording Emile Keita in Bambara, evaluation of TTS in Bambara

Testing and training Tangara and Mary how the m-event Tabale system works. 14 Nov

Meeting in Ségou, Hotel Indépendence - 14 November

Meeting in San, Hotel Teriya –14 November: Testing and training Drissa how the m-event Tabale system works.

Visit Office Sahel Eco in Tominian – meeting with 5 producers and 1 radio journalist

Visit Radio Moutian (FM 105.3) – 15 November

Testing m-event Tabale with event "participants" (producers, citizen journalists etc)

Recording prompts for Foroba Blon

Recording name of new producer for RM: Emile Keita in Bomu

Evaluation of TTS in Bomu

2. Notes on Evaluation Research and Methodology

According to the branch of social science known as evaluation research [Scriven, 2007; Davidson, 2004], evaluation is the assessment of the merit (or quality), worth (or value) and/or significance (or importance) of something.

Evaluation methodology is to be placed among a wide range of social science research methodologies [Bryman, 2008; Trochim, 2008]. What makes it special is that social science research methods historically have a heavy emphasis (bias) on empirical data-based studies where the researcher is typically positioned as an outside (independent, neutral, even supposedly value-free) observer. In contrast, evaluation as a social-science research field inherently and necessarily makes value-based statements about its object of research. So, evaluation research does not and cannot limit itself to "the facts" (in contrast to empirical social science), but endeavours to interpret these facts into a framework of values - which gives rise to the follow-on research question what these values precisely are and why/how they are or can be explicitly justified.

Historically, evaluation research has its roots (already in the 1950's and 1960's) in big (US) government programs especially in public health and education, where the subsequent natural question emerged whether these programs (often seen as "treatments" or "interventions", in very much the same way as a doctor or therapist treats a patient/disease with a medicine) were indeed effective and worth the money spent. Subsequently, the conceptualization and framing concerning how to do evaluations diffused to other sectors, including international development and cooperation (see e.g. [CIDA, 2001; UNESCO, 2009] but also EuropeAid).

There is a vast literature on evaluation methodology and frameworks, but it is well possible to summarize most of it in what may be called the consolidated *conventional* general framework for evaluation studies, as it has emerged and been published in nowadays standardized evaluation checklists (KEC, see especially [Scriven, 2007]), associated text books (e.g. [Davidson, 2004]), and in scientific journals such as the American Journal of Evaluation.

In brief, the conventional evaluation framework and its checklists can be conveniently summarized in terms of a two-dimensional space. First, it distinguishes a set of important different *components* of evaluation. Second, it recognizes a set of important typical generic evaluation *dimensions or criteria*.

First, standard components of evaluation (typically called sub-evaluations) are:

- *Process evaluation:* this sub-evaluation is addressing the evaluation question what happened during the content construction, design, implementation and roll-out of the "intervention" or "program" and what lessons have been learnt from that. In other words, it addresses the direct outputs of the action.
- *Outcome evaluation:* in contrast, this sub-evaluation is not concerned with the direct outputs or deliverables of an action, but focuses instead on the (observable) effects in terms of outcomes or impacts on stakeholders. Note that these effects may be intended as a goal but also may be unintended, and the latter is also important to include in evaluative studies. In social science research methodology, this is commonly referred to as the issue of "internal validity" of research/knowledge claims or hypotheses.

- *Cost and comparison evaluation:* this sub-evaluation addresses the general question whether the observed effects have been achieved in a cost-effective (resource-economic) way and whether the same effects might have been achieved by alternative means (this also covers the so-called opportunity costs of the action).
- *Beyond-the-current-situation evaluation:* this sub-evaluation addresses the issues of generalizability, transferability, sustainability, exportability, etc. In social science research methodology, this is commonly referred to as the issue of "external validity" of research/knowledge claims or hypotheses.

Second, there is a long checklist of possible evaluative dimensions or criteria that are to be considered. The traditional evaluation research and methodology literature gives the following to consider as important candidates (checklist items):

- Has there been due recognition, analysis and inclusion of the (various) stakeholders' needs - especially when they are currently unmet ("stakeholder *needs assessment* ").
- What are the relevant evaluation criteria that follow from the specific *professional domain*? Namely, in many cases it is pretty clear what is "good" or "not-so-good" once a specific professional domain or focus has been singled out. [Here for example it relates to ICT technology-based innovation.]
- Soundness and consistency of *"intervention/program logic":* actions taken have an (sometimes implicit) underlying rationale, usually of the reasoning pattern or type: if we undertake this-and-this action, it will address (make a change in) these-and-these needs or shortcomings, and that will help alleviate that-and-that performance problem or issue. This action rationale may itself be in need of evaluation.
- *Fit to (local) context:* the evaluation literature furthermore gives a (pretty unassorted) long list of relevant criteria-to-be-considered here including:
  - Legal requirements;
  - Ethical requirements (e.g. privacy);
  - Attractiveness to target groups ("marketability")
  - Organizational, policy, and/or personal development goals;
  - Historical, traditional and/or cultural norms and values.

  In other words, actions must be properly embedded in the specific surrounding context or environment to be successful, and the various and diverse characteristics of this provide key evaluation elements of what counts as success.

The above are standardized checklist items that represent possible criteria of evaluation. The evaluation research literature points out that in each and every case, it is necessary to select the evaluative items and criteria and limit them to those that are actually most relevant and to specialize them to the case at hand.

As noted above, this summarizes the *conventional* general framework for evaluation studies as it has emerged and has been consolidated over the years in the evaluation research field. The consolidation of the discussed evaluation framework dates back pretty much to the 1990's. This is not to say that there is universal consensus: it has come under heavy critical fire from several angles. A number of more recent developments have taken place that attempt to correct a number of observed shortcomings and biases in the conventional approach to evaluation. These newer developments in evaluation research (for hot and sometime even heated debates, see for example [Patton, 1997; Fetterman, 1997; Trochim, 1998; Claremont, 2009]) bear moreover a direct relevance to the evaluation of the VOICES field pilots.

Participatory evaluation (and empowerment evaluation) [Baker & Bruner, 2010; CIDA, 2001; UNESCO, 2009; U Kansas, 2013; CSIR, 2013]. Traditionally, evaluation is considered to be an independent and outside activity (especially Scriven is an outspoken proponent of this view, see [Claremont, 2009]). More recently, much more emphasis has been placed on the desirability or even necessity that the relevant stakeholders themselves are to be in the driving seat as to the evaluation of the outcomes and perceived benefits of a program, intervention or action. This approach is labelled participatory or collaborative evaluation, and an ultimate consequence of this is the view that evaluation is to contribute to empowerment (especially Fetterman is an outspoken proponent of the latter, see [Claremont, 2009]). As a side remark it may be pointed out that this approach has an unnoted but very strong resemblance to the (much older) social science research methodology known as *action research*.

Developmental evaluation [Gamble, 2008]. Traditionally, evaluation is very much seen as a one-shot activity. In the evaluation methodology literature jargon, formative evaluation is basically the same as mid-term review, and summative evaluation is end-of-project review, see [Scriven, 2007; Davidson; 2004]. Another more recent development is that evaluation is to be not just outside criticism, but should be focused on conclusions that can be utilized by stakeholders in a (cyclical) learning or developmental way (especially Patton is an outspoken proponent of this approach, see [Claremont, 2009]).

Technological innovation [Rogers, 2003; Tuomi, 2002]. Evaluation research is a social-science field that is quite remote from technological innovation. Thus, experiences and theory concerning the phases and social factors that govern adoption and diffusion of innovations are not taken into account in the conventional frameworks for evaluation. Neither are recent approaches that aim to experiment with the introduction of innovations in a participatory and developmental (co-creation) way such as *Living Labs* (cf. [CSIR, 2013]) that may be viewed as a form of action research specialized to technological innovation.

Evidently, the evaluation framework used for the VOICES field pilots is not properly framed as conventional evaluation, as it is strongly influenced by the stakeholder-based participatory and developmental approach and by the Living-Labs field-experimental approach to (socio-) technological innovation.

3. Evaluation Framework for the VOICES Field Pilots

Chapter 2 has sketched the general standard framework that is available for carrying out evaluations. As pointed out extensively e.g. in [Scriven, 2007; Davidson, 2004], for each specific case it needs specialization to the domain and task at hand, as well as restriction to those evaluation checklist items that are most relevant to the case under consideration.

In Part II we will apply the following framework to evaluate the VOICES pilots.

Name	Description	Outcomes
Process evaluation	Direct outputs of content construction, design, implementation and roll-out	• Stakeholder needs assessment • Stakeholder involvement • Technological quality features • Fit to local context • Learning experiences and their inclusion
Outcome evaluation	Observable effects in terms of outcomes or impacts on stakeholders.	• Service use • Follow-on effects of service usage • Stakeholder interaction/feedback • Created awareness and other external effects • Comparative effectiveness
Future Perspectives	Perspectives beyond the end of the project.	• Generalizability • Transferability • Sustainability

Figure 4: The VOICES evaluation framework.

PART II: M-AGRO FIELD PILOT SUB-EVALUATIONS

Part II provide the three major sub-evaluations:
(i) Process evaluation (assessment of what has happened during the pilot project);
(ii) The evaluation of observed outcomes (effects focused on stakeholders and their environment);
(iii) Outlook assessment regarding future perspectives (beyond the project: generalizability, transferability, and sustainability).

4. Process Evaluation

Process evaluation refers the assessment of the merit, worth or significance of everything that happens or applies before true outcomes emerge or can be observed [Scriven, 2007]. In the present case it covers the envisioning, content, design, implementation and deployment of the pilot, and focuses on the direct *outputs* delivered.

The key evaluative question here is the *merit of the pilot services as an adoptable and potentially useful innovation.* This central question is addressed by investigating the following aspects or dimensions:

a) The way stakeholders needs have been analysed and addressed ("needs assessment");
b) The way stakeholder involvement during the pilot has been elicited and organized;
c) The technological quality features of the pilot;
d) The appropriateness of the pilot in terms of its embeddedness or fit to the local context;
e) Learning experiences along the way and how they have been integrated into the development of the pilot.

Figure 5: User evaluation in November 2012 at radio ORTM Segou in Mali

4.1 Stakeholder needs assessment.

From 14 – 26 January 2011 we organised a road show in Mali, Burkina Faso and Ghana as the first activity. The primary objective of this road show was to demonstrate services envisioned under the m-Agro Knowledge Sharing Pilot of the VOICES project. All the key findings from the road show were pooled in, to crystallize into a set of services, which then constituted the core of VOICES technology offering.

In this section we summarize per pilot the main needs per stakeholder. This information is collected via interviews.

Stakeholder needs assessment Pilot 1: RadioMarché

Name	Role	Need
Zakary Diarra Naomi Dembélé	farmer, honey producer and entrepreneur from Bokuy-Mankoina, (Tominian region	• Communicate stock information • Negotiate price • Advertise new products, such as Liquid honey
Sahel-Eco (Amadou Tangara)	NGO, Mali	• Stimulate local entrepreneur ship • Organize exchange of stock information • Share argo-economic Data and knowledge
ORTM Segou	Radio station	• Broadcast commercial information

This resulted in system concept allowing to Sahel Eco manually process information from the voice/text messages and create the market communiqués in a web form built for the purpose, from which the spoken (audio) communiqués are automatically generated.

Stakeholder needs assessment Pilot 2: Tabale

Name	Role	Need
Sahel-Eco (Amadou Tangara and his colleague Drissa Gana)	NGO, Mali	• Organize regreening events
Farmer (e.g. Tominian area, Mali)	Participant	• Informed about regreening events • Able to register for regreening events

This resulted in the concept of a system to send out broadcast messages to the phones of members of an event in their own language(s). The platform will be implemented using Web technologies to be used for sending out short messages.

4.2 Stakeholder involvement

Our methodology for developing, testing and deploying systems was based on the Living Labs principles. Living Labs (LL) are experimentation and validation environments of ICT-based innovation activities. They are characterised by the early involvement of user communities, by openness in establishing a close cooperation between developers, users and other stakeholders, and by the creation of rapid learning cycles accelerating the innovation process. LL is a good match for deploying information and communication technologies in rural areas.

Following the living lab approach, we involved stakeholders in several phases of the project, including stakeholder need assessment, requirements analysis, and function design, tests, deployments and end-user acceptance tests.

Stakeholder involvement pilot 1: RadioMarché

The main product focus of the RadioMarché is on shea nuts, shea butter, honey, wild fruits and nuts. The MIS is used to distribute up-to-date market information via community radio in the area. A Sahel Eco staff member receives offerings from local farmer's representatives in the form of an SMS text message, containing information about a product offer: quantity, quality, price, name of the seller, village and phone number.

INFORMATION SUR LES PRODUIT FORESTIER NON LIGNEUX DU CERCLE DE TOMINIAN

Zone de production (commune)	Villages	Nom du produit	Unité de mesure	quantité disponible	qualité du produit	prix au kg en F CFA	contacts
Mafouné	Soutè	amande de karité	kg	1800	amande ébouillantés	200	Mandiakuy Philippe TEL: 76
	Bokuy-Mankoina	miel	Litre	72	miel non brulé	000	Zakari DIARRA TEL: 76
	Bokuy-Mankoina	Beurre de karité	kg	60	beurre issu des amandes ébouillanté	000	Zakari DIARRA TEL: 7
KOULA	Tiéblénikuy	Beurre de karité	kg	165	beurre issu des amandes ébouillanté	200	Gérard TRAORE TEL: 77

NB : Pour plus d'information contactez Monsieur Amadou TANGARA SAHEL ECO TOMINIAN TEL. 79 ou le point focal de la radio que vous écoutez

Figure 6: Example of a communiqué. Phone numbers are blurred for privacy reasons.

The decision for on shea nuts, shea butter, honey, wild fruits and nuts was based on contacts with local farmers, in particular Zakary Diarra, farmer, honey producer and entrepreneur from Bokuy-Mankoina, (Tominian region), see interview in appendix.

The users of Radio-Marché are staff member Amadou Tangara, from Sahel Eco, who enters the market information he receives from the farmers, into the RM system using the web interface (web form). Tangara also maintains the on-going communication with the radio stations about the broadcasts. Radio journalists from Radio Segou and Radio Moutian, are involved in the pilot. ORTM Mopti and radio Jamanan (Koutiala) are also using RadioMarché.

The system is focused on the need of the staff member of Sahel Eco and Radio stations. In detail:

At Radio ORTM Ségou FM 96.8 – During field trip November 2012

- Feedback Fousseyni on generated Bambara communiqué

At Radio Moutian in Tominian (FM 105.3) – During field trip November 2012

- Feedback Bakary and four other Bomu native speakers on generated Bomu communiqué
- Quantitative/Qualitative data in excel sheets from Tangara
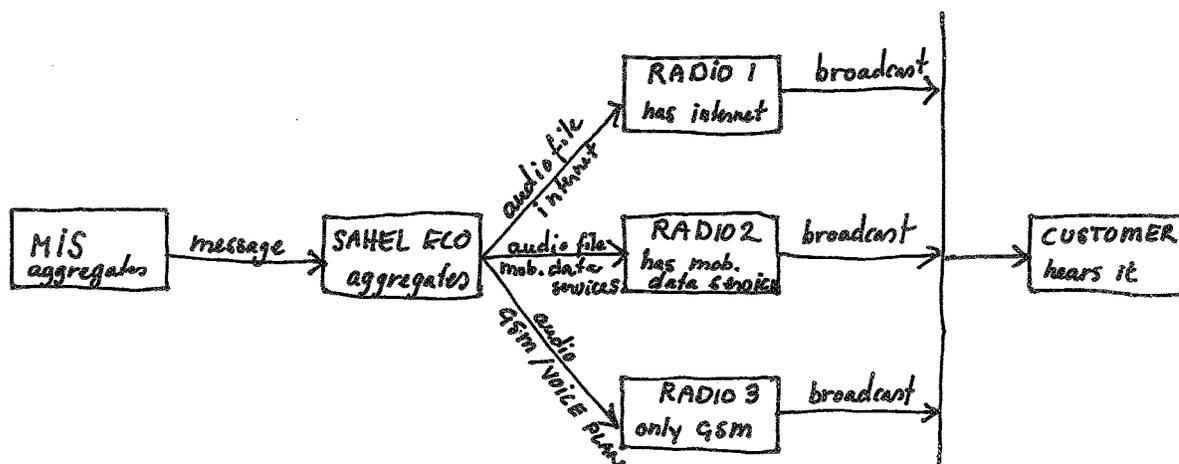
Sheabutter & honey usecase

Figure 7 System architecture composed in collaboration with stakeholders
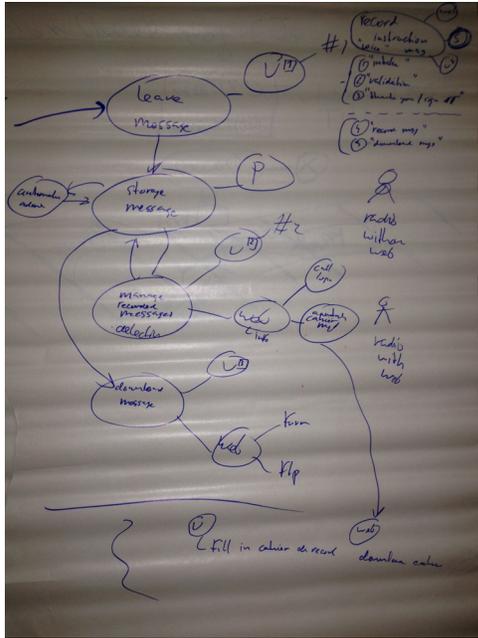
Figure 8: Results (flow diagram) from design assessment.
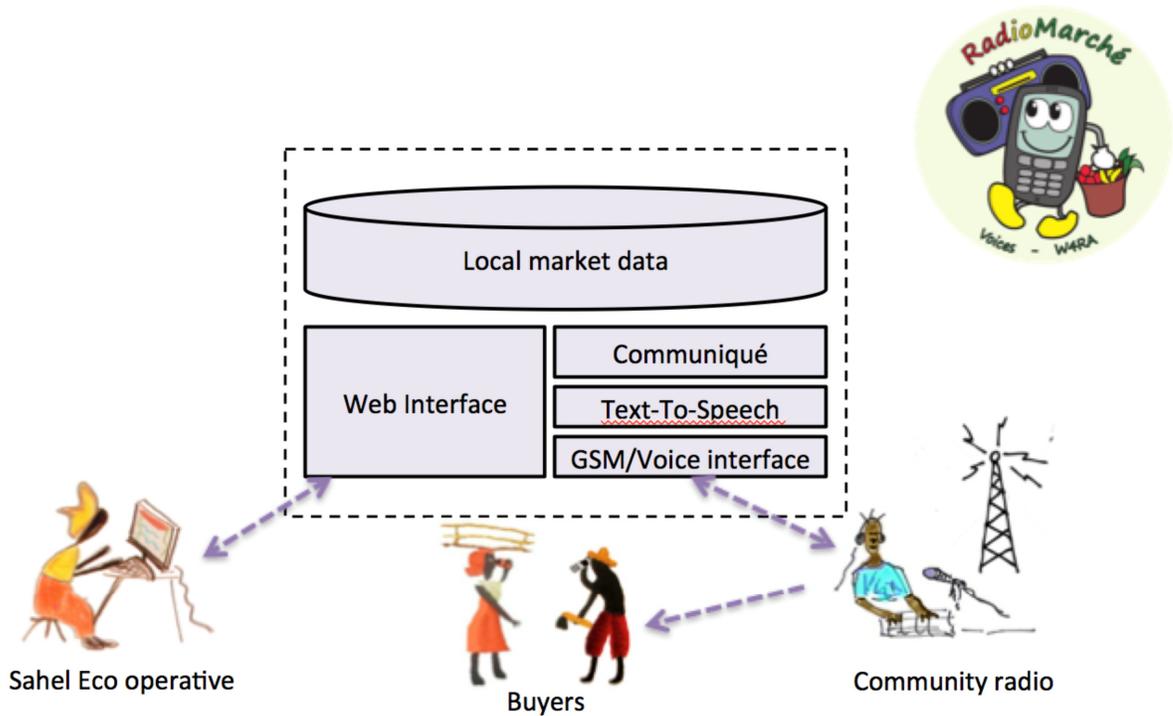
Figure 9: Proposed technical architecture

Stakeholder involvement pilot 2: Tabale

In November 2012 the first phase of the Tabale system was deployed in Mali, tested and evaluated by the end-users. User feedback was collected from: main users at Sahel Eco who work from the capital, Bamako, and five contact persons of Sahel Eco in the distant Tominian region.

The users of Tabale (m-event organizer) are Amadou Tangara and his colleague Drissa Gana . The farmers receiving their messages are also users.
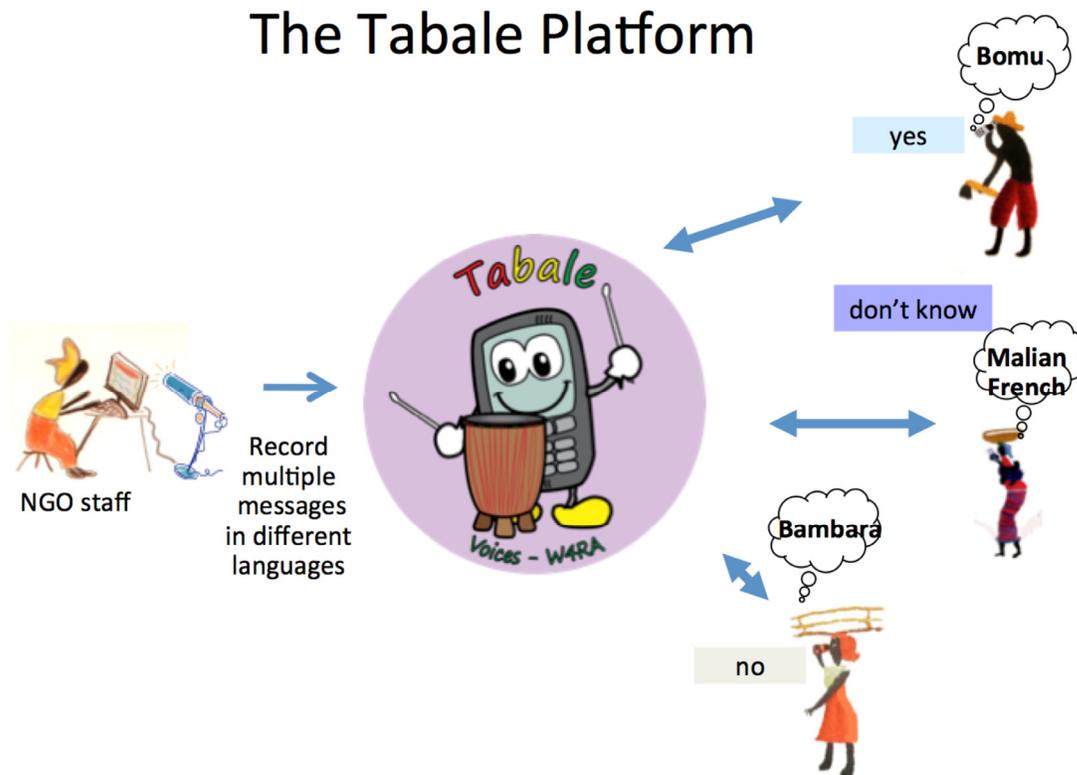
Figure 10: Proposed technical architecture

4.3 Technological quality features

In this section we discuss per system: Design, Result and technical analysis.

Technological quality features pilot 1: RadioMarché

This was a use case on rural farmers in Mali that had a running market information distribution service. The system we built was to mimic the same service through digitizing the information on market offerings per farmer and then making it available both on the Web and sharing it through community radios for broadcast. Among the aims of the system was to make the initial processes more efficient, given the limited time we had under the project. More importantly, we added the ability to provide a digitized version of the information in voice via local GSM telephone networks and thus opening up access to many who are without Internet.

Design

The main product focus of the MIS is on shea nuts, shea butter, honey, wild fruits and nuts. The MIS is used to distribute up-to-date market information via community radio in the area. A Sahel Eco staff member receives offerings from local farmer's representatives in the form of an SMS text message, containing information about a product offer: quantity, quality, price, name of the seller, village, phone number, etc.

In the original situation, the SMS information is entered manually into a collation sheet (Excel in this case). Every week, a communiqué is drafted by the staff member and from a cyber cafe sent to four local radio stations (ORTM Segou, Koutiala, ORTM Mopti, Radio Moutian). Only ORTM Segou is connected to the Internet, Koutiala and ORTM Mopti receives their message by going to a nearby cyber cafe and printing out the email attachment. Radio Moutian has no Internet access whatsoever and so sends over a staff member worker to a nearby cyber cafe to print out a hard copy of the information.
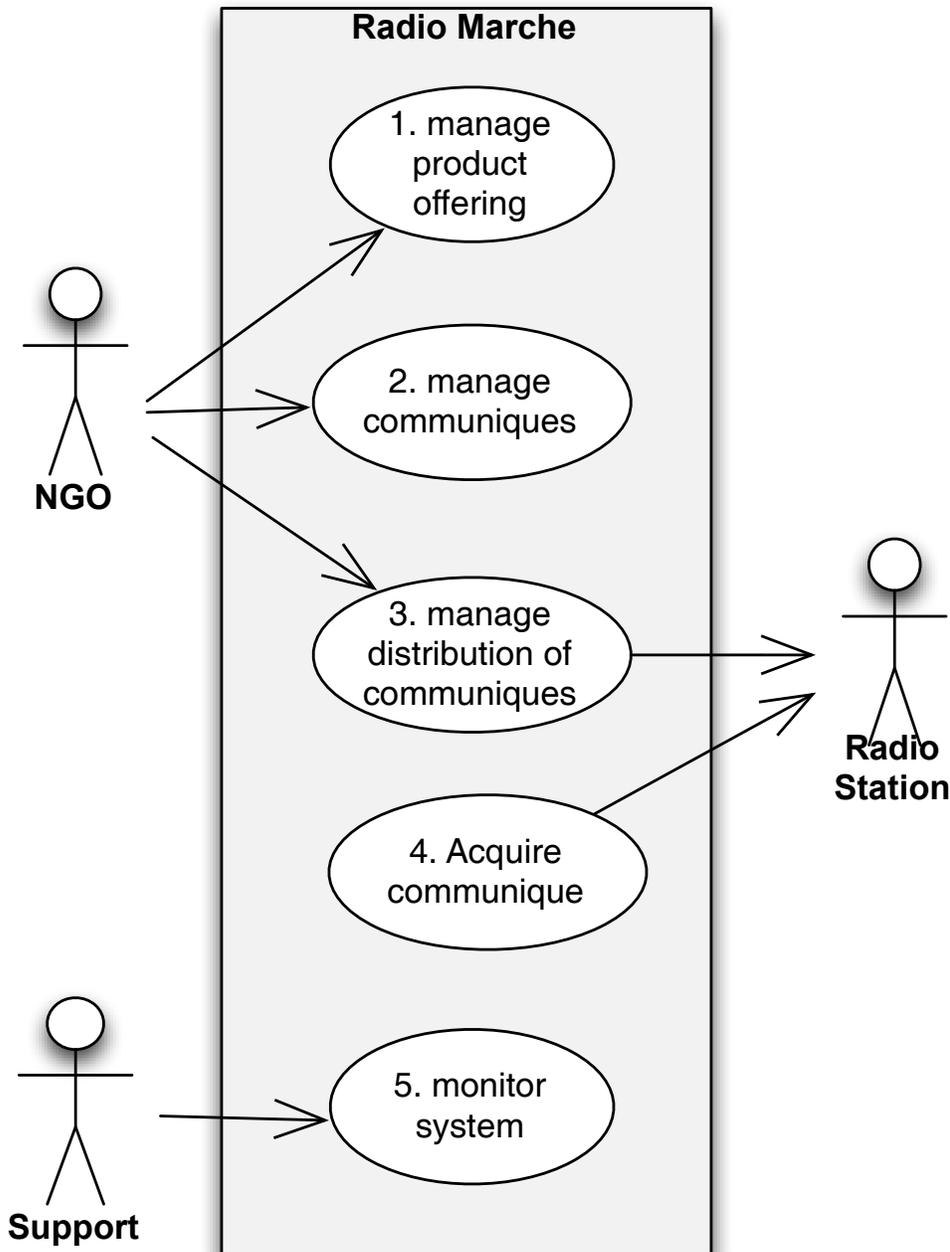
Figure 11: RadioMarché Use case diagram

In the new situation, the system consists of two parts: a web interface and a phone interface. The web interface, among others, provides functionality to authenticate users who can enter new market information data into the system through web forms. The market data can then be composed into audio communiqués, which can then be published onto a voice platform, which has the phone interface. Other functionality includes communiqué archiving and original excel sheet generation as mentioned in the previous section. The voice platform on the other hand provides functionality to (i) generate audio communiqué(s) (ii) publish communiqué(s) for access by the general public (iii) allow users to record audio messages and many others.

Together with partners under the VOICES project, a template for developing text-to-speech (TTS) systems for low resourced languages, the so-called slot-and-filler method, was developed accomplished for the Bomu and Bambara languages in Mali. This allowed the creation of communiqué in native languages.
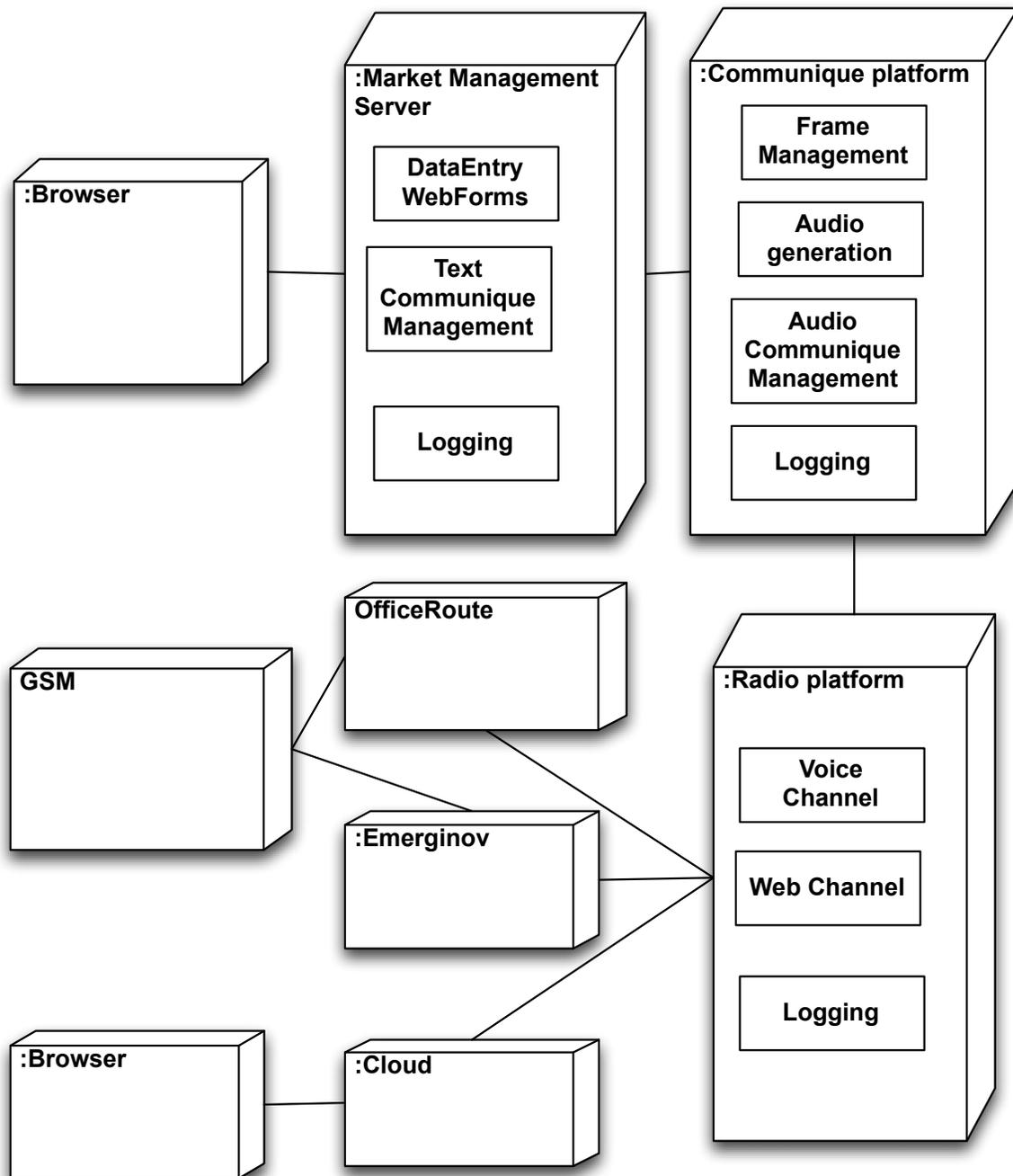
Figure 12: Deployment diagram

Audio communiqué

An audio communiqué is essentially a single audio file (.wav file) that is generated from the concatenation of a number of other pieces of pre-recorded audio files. The pieces of audio that are recorded are dependent on a number of factors, including the following:

- The system of numbering system of the language involved had to be taken into account. We found out that this is not the same for the Bambara language in Mali as it is in French or English.
- The number of products to be used in the system. We dealt with a specific number of products.
- It was important that the generated communiqué represented the natural speaking of a person as much as possible. To that effect, it was not enough to only record words but sentences as well.
- The pre-recorded pieces of audio files were done in Mali in the voices of broadcast journalists who work with the radio stations. This was done because it was necessary requirement that the voices heard on the radio were those that the community was familiar with.

Once a new communiqué has been generated and published, it is served out through the national PSTN to callers. This we accomplished by interactive voice response (IVR) techniques using the open standardized VoiceXML language. Once this is done, the radio station can broadcast the generated communiqué through their phone to the public.

Notification
Channel
Date Sent
Date Received

User
Name
Password
Email
Role

Data Communique

RadioStation
Name
Notification
_Strategy

Voice
Name

Language Frame
Utterance
Date Recorded
Quality

WavFile
Binary

Language
Name

Product Offering
Quantity
Amount
Currency
Price
Date_Entered

Text Communique
Comm_id
Date Generated
URL
State

Contact
First Name
Last Name
Address
Telephone
Villlage
Zone

Product
Name
Quality
Meaure_Unit

1-1 Mapping
Text
Utterance

Generated
Number, Date
Utterance

State
Date downloaded
How

Text2Speech Mapping

Audio Communique
Comm_Id
Language
AudioString
Frames
URL

Processable Text

Speech Frame
Utterance

AudioFile
Binary

Figure 13: Class diagram

Result

The RadioMarché system was realized using two separate technical implementations. In one version, we used cloud-based services (Emerginov) to host the web forms and databases. The local telephone company in Mali provides the system with voice-based access by linking a number of local telephone numbers to this system. This is done using France Telecom Orange Emerginov platform.

The second version of the system is entirely local. This version has the web form and database running on a dedicated laptop. Radio stations that have Internet connection can access this network directly via the Web.

The phone channel in the second instance is provided by a voice browser software (currently using the prophecy VXML browser by Voxeo[*]. and a GSM gateway (2N OfficeRoute) device that allows phone calls to be handled by the RadioMarché system on the laptop. The OfficeRoute is connected to the laptop.

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[*] http://www.voxeo.com
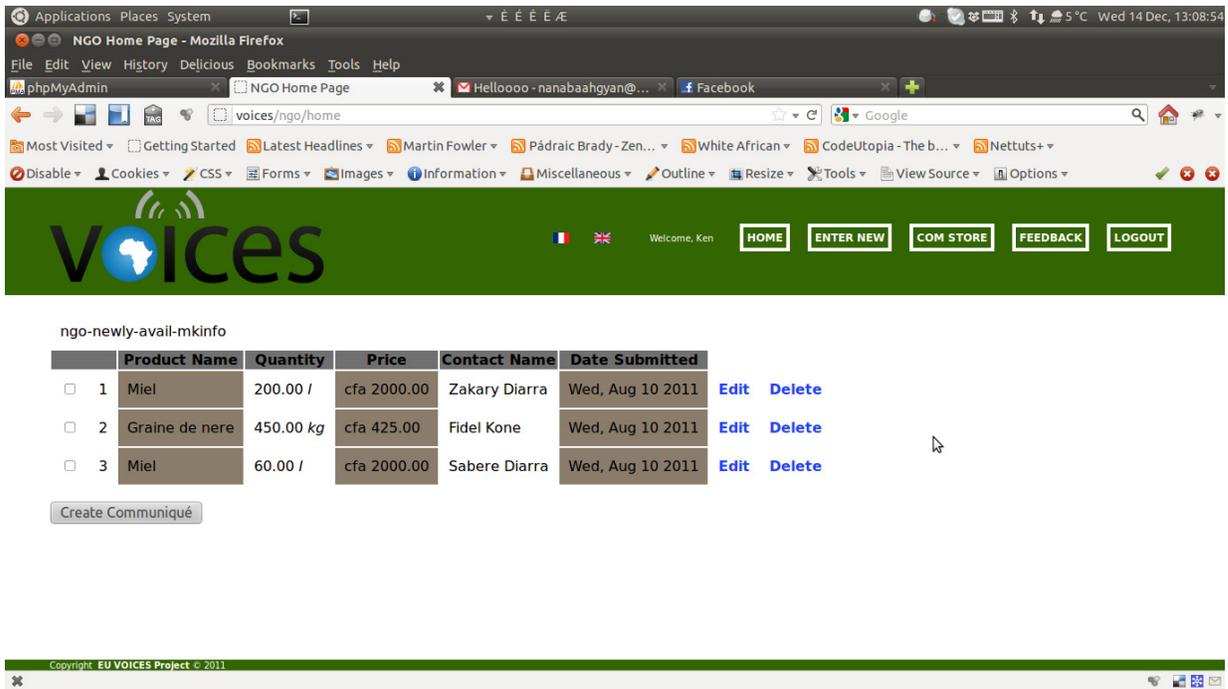
Figure 14 Screenshot RadioMarché system

Technological quality features pilot 2: Tabale

Design

Tabale can be seen as a voice version of popular micro-blogging services on the Internet. Once instances of the services have been deployed at various locations, it provides a quick way of sending out pieces of voice information to different target groups of people on their mobile phones to which they can choose to respond or not. Its broadcast functionality makes it very handy to communicate entire communities very quickly and in their own language.
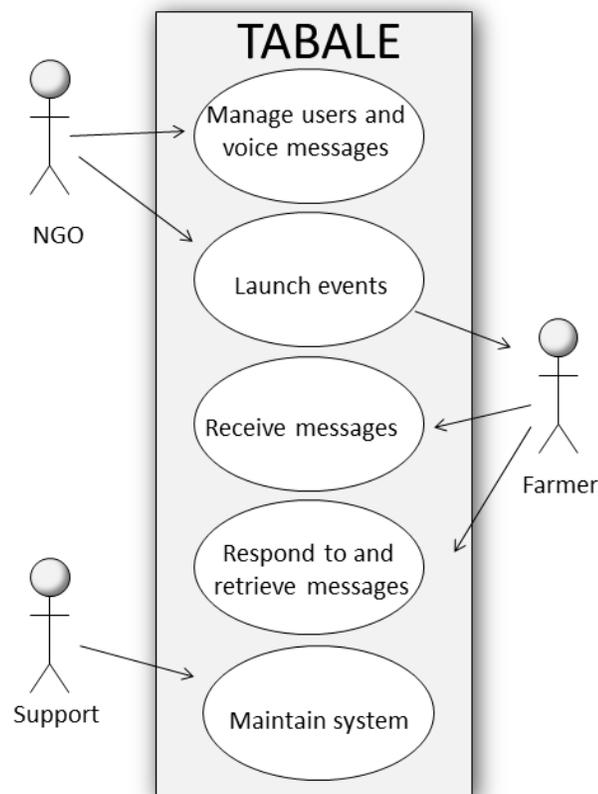
Figure 15: Use case diagram Tabale

The person organizing the event(e.g. the Sahel Eco Webmaster) creates a message for the convocation of farmers for the event. S/he creates a user-list of farmers and their mobile phone-numbers. The message is then issued to the users. Users can phone back later to hear the message again.

A system was then to be built that does a few things. First, it allows a user to a create a user-list and enter user-names and their attributes (phone-numbers and optionally language prefs, group name); Sahel Eco (or webmaster) can create a voice message, delete the message,

change the message in the language of the caller. Secondly, the system can automatically calls all participants who are part of a scheduled event and delivers a voice message left by Sahel Eco; if there is no response on the initial call, the message is left in the participant's voice mail. The message left by Sahel Eco is also accessible by mobile phone by calling a number assigned to it through a phone dialogue interface. Thirdly an optional functionality allows message issued to be delivered in a default language and in also second language. Local French was used as the default.
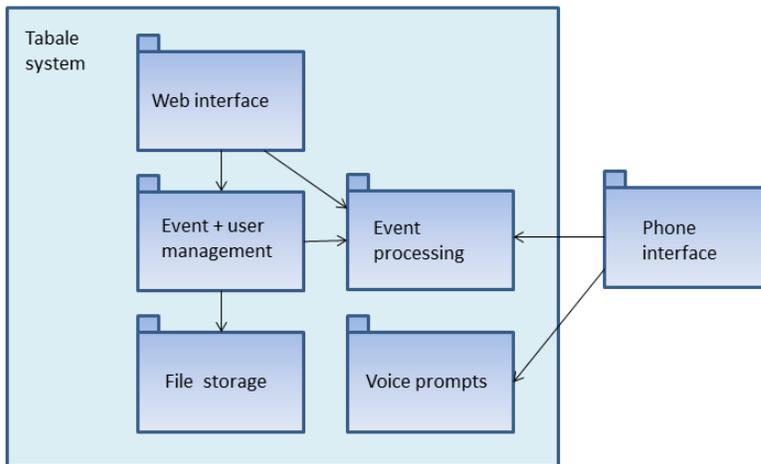
Figure 16: Development view (Tabale)
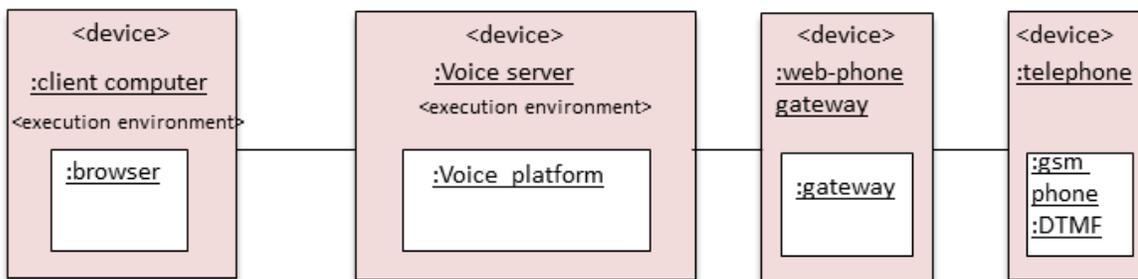
Figure 17: Deployment diagram (physical view) Tabale

4.4 Fit to local context and Learning experiences and their inclusion

Learning experiences Pilot 1: RadioMarché

Perceived usefulness of the system

The feedback indicated that in general it can be said that the RadioMarché system improves the communication between the producer of non-timber forest products (e.g. honey and shea butter) and its customers and therefore their trade. Many potential customers hear the communiqués broadcast on the radio. There have been many phone calls to the producers and to the radio stations by buyers who were interested.

Also, the system interface is easy to use for Sahel Eco who collects the information from the farmers. The automated communiqué creation is simple and effective. The radio stations find it easy to use the RadioMarché web and the RadioMarché phone interface and download the communiqué and broadcast the message. Up to present this has been tested for French language only with plans to add the Bomu and Bambara versions very soon.

RadioMarché essentially is a system built to replace an existing one and to make it more efficient and productive. The idea for the system was conceived after a series of field trips and collaborations with local people, which was an important step because the people for whom the system was built had very little idea of technological solutions an how that could help them improve their business/condition. After a few demonstrations and discussions, the ideas for practically implementable use cases were suggested by the local stakeholders themselves.

RadioMarché provides a means through which locals without access to the Internet could make content available with the help of simple mobile phones. The economically benefiting nature of the content provided by the locals ensures its availability for as long as the service is running. It mimics popular and widely used marketing platforms such as Amazon or eBay. The differences are however that this platform is limited to a few number of products and attached to specific geographical regions. However, the idea behind this have worked quite well with the locals and in some instances created more demands for products than anticipated with it's associated new challenges that never came up for consideration.

Our intervention also gave the NGO a cheap alternative to digitize all market relation information from rural farmers and a means to securely archive this also on the web. Hitherto, all such information was either found on a computer, which was vulnerable to breakdown, theft or computer malfunction. Another important improvement with RadioMarché is the control it gave the NGO over what an audio communiqué actually contained. This was because, they had had instances in the past where the radio people either gave out the wrong information and created inconveniences for people involved.

Currently, not all manual processes in the previous system have been completely removed. For example, the NGO still continues to receive text messages to manually process them with the system. This limitation is however being worked on to the point where the system will allow users to make their available products known on their own without relying on the NGO to do this. Users will therefore have the option to call the system to sell their products with a phone call.

There are a number of drawbacks however with the system that does not make RadioMarché readily scalable. We recognize these drawbacks and see them as incentives to improve the system. A major drawback is the limited number of products that the system uses and the need to record new voices once a new one is added. Though this seems daunting, it is a task that can easily be done when distance is not a problem. When the distance is a real challenge as in our case, then new measures would needed such as ways of recording voices remotely. There are issues also about sustainability and who pays the system. With very low-income levels in these regions, there has been the need to draw relevant sustainability models in order that the service continues to run beyond the pilot. These and many other challenges come up and have not been completely resolved as yet.

Learning experiences Pilot 2: Tabale

Compared with RadioMarché system, Tabale is a relatively new service that has been deployed by us. It is essentially a voice version of popular micro-blogging services on the Internet. Once instances of the services have been deployed at various locations, it provides a quick way of sending out pieces of voice information to different target groups of people on their mobile phones to which they can choose to respond or not. Its broadcast functionality makes it very handy to communicate entire communities very quickly and in their own language.

This ``voice twitter'' service has the added advantage usage regardless of language and literacy in modern systems. The use of simple mobile phones to deploy this service also means that many more people who otherwise could not be communicated with easily could possibly be a thing of the past. It presents many opportunities for governments to communicate in cases of a disaster or for health related initiatives such as mass immunization.

Figure 18: Tababe screenshot

5. Outcome Evaluation

This sub-evaluation addresses the *observable effects (outcomes or impacts)* that the pilot deployment has had on target groups and downstream stakeholders. Note that this may include intended as well as unintended effects. To assess the pilot outcomes, the following aspects or dimensions are considered below:

1. Service use
2. Follow-on effects of service usage.
3. Stakeholder interaction/feedback.
4. Created awareness and other external effects.

5.1 Service use.

RadioMarché results overview.

In October and November 2012 user evaluation studies were performed for RadioMarché that was operational since early 2012. NGO Sahel Eco made a tour through Mali in October 2012 and visited five radio stations and collected feedback on RadioMarché through written questionnaires and talked to buyers triggered by the communiqué announcements and broadcast. In November 2012 the team made another tour in Mali, and held face-to-face interviews, demonstrations, production tests and focus group discussions related to the system. The radio stations were interviewed about the RadioMarché system. Additionally, a number of farmers were asked of their opinion on the usefulness of the RadioMarché system to improve communication and trade.

The feedback received was categorized into two parts namely feedback on usability (voice quality, web and phone interface) and the impact of the system (its usefulness and side effects) since its deployment.

In total, 23 communiqués (see figure 14) were published between December 2011 and October 2012 on the RadioMarché system. A number of factors accounted for this and includes the following:

1. There were periods where as a results of errors discovered, the system had to be taken offline for them to be corrected.

2. There were periods of complete non-production since fruits and nuts were out of season and this can be seen in the steep spike as shown in figure above.

3. Initial adoption was slow as this system was launched at the time when the old manual system was still in place. There was no testing phase before launch of system.

Communique Publishing Trend
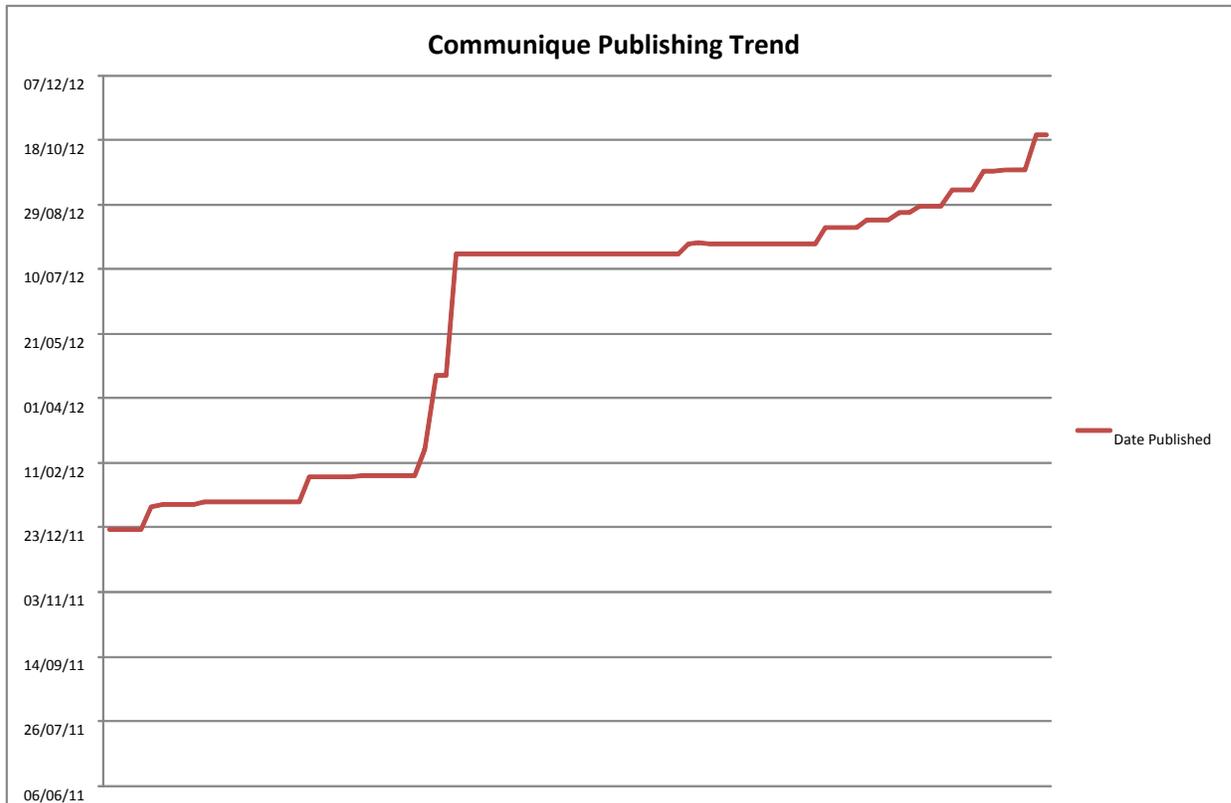
Figure 14 Communiqué publishing trend on the RadioMarché system

Figure 15 below also shows the price ranges of the products sold on the platform within the period. Good quality honey always maintained a high price as there was demand for this. The other prices fluctuated depending on the quality at the time of sale of the product and other
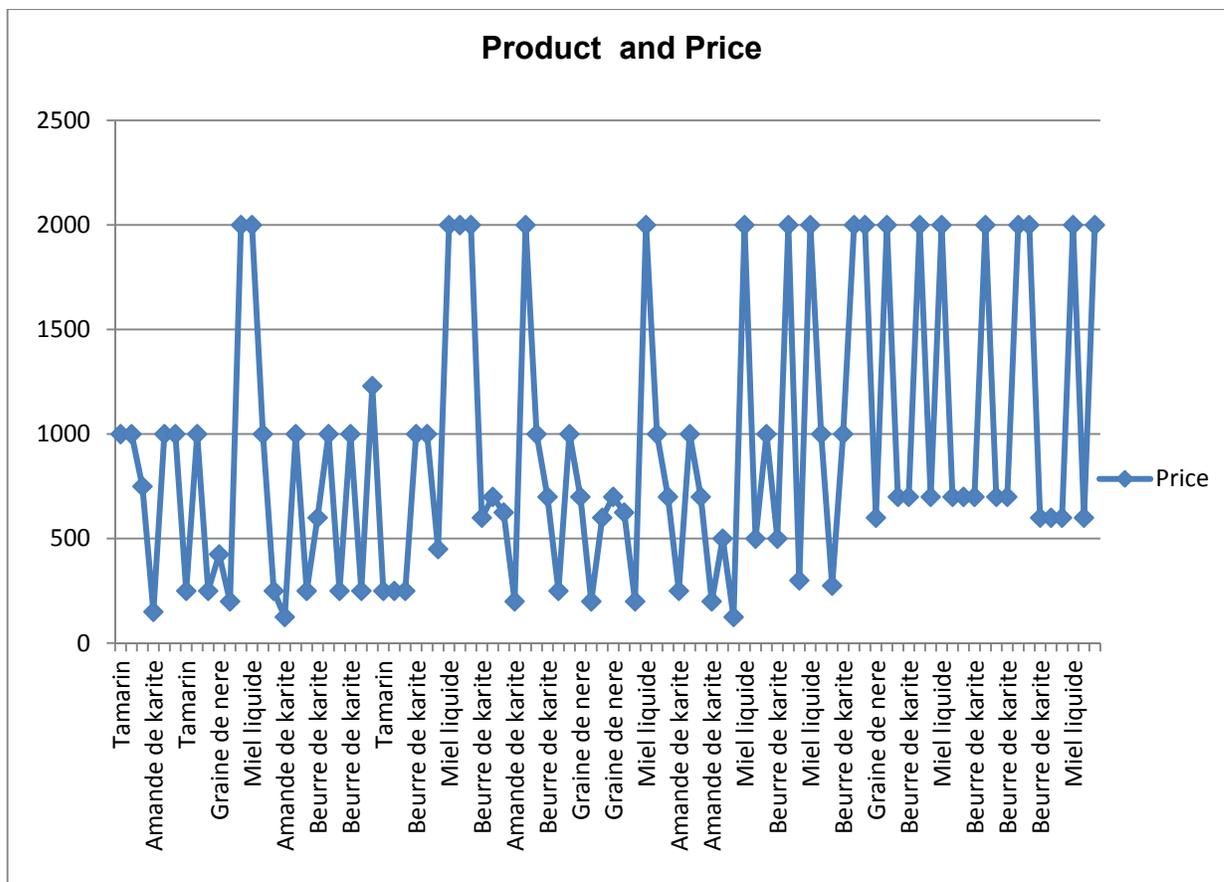
Figure 15 Price trends on the RadioMarché platform

Tabale results overview.

In November 2012 the first phase of the Tabale system was deployed in Mali, tested and evaluated by the end-users. User feedback was collected from: main users at Sahel Eco who work from the capital, Bamako, and five contact persons of Sahel Eco in the distant Tominian region. A number of issues on usage came up after the launch. These bothered mainly on interface design issues both for the web form and the phone interface itself.

Issue: There are three reply options: Yes - attending, No - not attending, Don't know. Don't know can mean either a) the farmer does not know if he will attend or b) the call was not answered yet (no reply, hung up). Request: Different status for: (a) received message but still pending (b) has not received message.

Issue: Many phones switched off for periods due to battery management issues. When voice mail picks up the phone, the system does not register this. Many people here never used their voice mail and don't even know it is there. Request: We would like the system to perceive "no answer" or "voice mail picked up". And sets this as status; then calls again after x hours. If voice mail picked up Tabale should ONLY leave the recorded message because the reply and leave message options do not work.

We immediately knew the importance of the system to Sahel Eco on the day that initial tests were being carried out. Other possible future applications of the service have been suggested.

Logs from the Tabale service are not much for the moment. A number of issues could have accounted for this and that includes the late launch of the service and the many downtimes the plagued the platform. Also, there were a number of suggestions that were made by users that had to be implemented even after its launch. However, the system has been online and the table below shows the latest activity that has been performed on the platform.

Date	Event
17/4/2013	Calling Bernabé DEMBELE about meeting 'voices Tabale usability questionnaire'
18/4/2013	Calling Marcel SANGARE about meeting 'voices Tabale usability questionnaire'.
18/4/2013	Calling bernabé DEMBELE about meeting 'voices Tabale usability questionnaire'.
18/4/2013	Calling bianivo Moukoro about meeting 'voices Tabale usability questionnaire'.
18/4/2013	Calling Tangara about meeting 'voices Tabale usability questionnaire'.
18/4/2013	Calling bianivo Moukoro about meeting 'voices Tabale usability questionnaire'.
22/4/2013	Calling Tangara about meeting 'voices Tabale usability questionnaire'.
22/4/2013	Calling Tangara about meeting 'Conférence VOICES'.
23/4/2013	Calling Tangara about meeting 'Conférence VOICES'.
23/4/2013	Calling bianivo Moukoro about meeting 'Conférence VOICES'.
23/4/2013	Calling Paul Tienou about meeting 'Conférence VOICES'.
23/4/2013	Calling Toure IICEM about meeting 'Conférence VOICES'.
23/4/2013	Calling Paul Tienou about meeting 'Conférence VOICES'.
23/4/2013	Calling conf dolo about meeting 'Fin de la pause'.
23/4/2013	Calling conf dolo about meeting 'Fin de la pause'.
27/4/2013	Calling Kadi Ballo about meeting 'Test Bambara'.
27/4/2013	Calling Laceni Ballo about meeting 'Test Bambara'.
27/4/2013	Calling Moussa Ballo about meeting 'Test Bambara'.
29/4/2013	Calling Abdoulaye Sow about meeting 'Test Bambara'.
29/4/2013	Calling Yobi Guindo about meeting 'Test Bambara'.
7/5/2013	Calling USAID KIATOU about meeting 'Test Bambara'.
7/5/2013	Calling Apolline kamaté about meeting 'Test Bambara'.
7/5/2013	Calling Aiché about meeting 'Test Bambara'.
9/5/2013	Calling seyba about meeting 'Conférence VOICES'.

Figure 19: Part of call log

5.2 Follow-on effects of service usage.

In October and November 2012 user evaluation studies were performed for RadioMarché that was operational since early 2012. NGO Sahel Eco made a tour through Mali in October 2012 and visited five radio stations and collected feedback on RadioMarché through written questionnaires and talked to buyers triggered by the communiqué announcements and broadcast. In November 2012 the team made another tour in Mali, and held face-to-face interviews, demonstrations, production tests and focus group discussions related to the system. The radio stations were interviewed about the RadioMarché system. Additionally, a number of farmers were asked of their opinion on the usefulness of the RadioMarché system to improve communication and trade.

The feedback received was categorized into two parts namely feedback on usability (voice quality, web and phone interface) and the impact of the system (its usefulness and side effects) since its deployment.

Effects of the RadioMarché pilot on local trade

From the feedback, it was gathered that the radio broadcasts of RadioMarché communiqués create a demand of honey that cannot be met by the producers. This same feedback is given by radio Mopti, Koutiala and Tominian. The radios ask Sahel Eco to stop the broadcasts of communiqués about honey unless a stock is readily available. They also suggest to create sales points for honey in the villages of Segou, Tominian etc. to take the burden off the radio stations who are called by buyers interested in buying honey. Sometimes the buyers want 100 litres of honey, but this cannot be delivered at once. The transport of the honey is also an issue.

The value chain behind the system is not yet organized. The demand for *nere* seeds is also good. The demand for high quality shea butter does still not exceed the RadioMarché offerings. The service has therefore provided new business ideas for Sahel Eco such as setting up a selling point and organizing producers in a better way to maximize profits and to help make the system sustainable.

Some first-hand experiences from users

Zakary Diarra farmer, honey producer and entrepreneur from Bokuy-Mankoina, (Tominian region: "

Better food stability then before the project

Better management of my income

I am able to pay schooling for his children

I am able to buy a cart and donkey"

Since this role is highly appreciated in the village, some people even call me Sozakary, this means "Zakary of Honey".

Tabale

Since its implementation and short time of use, other possible application areas for the system have been suggested by local users. Since the platform is essentially a voicemail system, users have suggested many adaptations that could be done in order that new services can be deployed using the same platform. These include

1. A platform for mass communication for vaccination sessions for farmers and cattle herders in the communities.
2. Government agencies that work with rural dwellers that often have the need to disseminate information to the masses on health and other important national issues.
3. Other non-governmental agencies who work closely with rural people and the government on many areas of national life and who often have the needs of information mass information dissemination as well.

From these suggestions, the indication is that users have bought into the idea behind the Tabale system and we hope that, with time, it will produce better results.

Adama Tessougué is a journalist at Radio Sikidolo in Konobougou during the Final Conference in Bamako April 2013:

Foroba Blon montre comment c'est important pour le monde rural. Foroba Blon permet de stocker des messages et on peut les diffuser quand on veut.

Adama explains how Foroba Blon is important for people in rural Africa. The great thing about it is the possibility to store messages and broadcast it whenever you want.

Alou Dolo developer at Yeleman (small ICT company in Bamako)about Tabalé, during the Final Conference in Bamako:

Quand est ce que ce système sera libre et accessible à tout le monde? Je vois des possibilités non seulement pour des organisations dans des zones rurales, mais aussi pour des organisations dans des zones urbaines.

When is the system free and available for everybody? I can see possibilities not only for organizations in rural areas, but also for organizations in urban settings.

Zakary Diarra, farmer, beekeeper and honey producer living in Bokuy-Mankoina in the south-east of Mali. My income from the sale of honey has almost doubled in one year, between 2010 and 2011. I have more food stability than before these projects, I am now able to pay schooling for my four children and I could even buy a cart and a donkey, last year. Zakary refers to the Tree Aid project in combination with the VOICES project.

Mon revenu de la vente de miel a presque doublé en un an, entre 2010 et 2011. J'ai plus de sécurité alimentaire qu'avant ces projets, maintenant je peux payer les couts scolaires de mes quatre enfants et j'ai pu même acheter une charrette avec un âne, l'année dernière. Zakary se réfère au projet de Tree Aid en combinaison avec le projet VOICES.

Naomi Dembele productrice de beurre de karité

Grace à ce système nous, les femmes qui produisent le karité, sommes connues à travers le pays, et chaque fois il y a un besoin de noix de karité on s'adresse à moi. C'est une grande fierté pour moi d'être ciblée à travers le pays.

Thanks to this system we, the women who produce shea butter, are known throughout the country, and whenever there is a demand of shea nuts people will come to me. I am proud that I am known across the country.

Naomi about the continuation of the system :

Le système doit continuer car le réseau change ; avec d'autres acheteurs, les acheteurs changent avec le temps.

5.3 Stakeholder interaction/feedback.

Stakeholder feedback pilot 1: RadioMarché

Feedback on RadioMarché, face-to-face interviews with Fousseyni, animateur at ORTM Segou

Feedback Fousseyni on generated Bambara communiqué for RadioMarché

The written text contains a few grammatical errors. Fousseyni and Tangara corrected this.

About the RM system

Mopti : say they don't like to broadcast Fousseini's voice, the local journalist would have liked to hear his own (he was on first field trip)

Radio Jamana: broadcast French (spoken by Fousseini), then also translates to another local language Mianka, based on a printed sheet Tangara sends them

Foroba Blon interface "there is an echo" <- Only Fousseini complains

About the impact of RadioMarché

"All radio stations say: we generate too much demand (mainly honey and grain de Nere). When people call, the product has been sold already"

"Sometimes buyer and seller dont agree on price or conditions"

"Local buyers are very happy"

"Distant buyers are sometimes unsatisfied" <- shipping, packaging, timing, unknown buyer-seller relation.

"Producers should be organised better"

"We need a sales point in village X"

"Some farmers have expanded their production because of RM"

ORTM Segou feedback:

"We get messages trials or messages about 'rainfall',

"The listeners don't notice the difference."

He is able to understand the spoken communiqué. However, according to Fouseyni and Tangara this is not good enough for broadcasting. There are not enough pauses between the words and sentences. The intonation sounds unnatural. Fousseyni reads the corrected text and we record this.

Stakeholder feedback pilot 2: Tabale

Feedback on Tabalé, face-to-face interviews and hands-on evaluation by Drissa Gana and Amadou Tangara, staff from Sahel Eco.

Detailed feedback on Tabale system

Issue: Dates in the web interface are in US style.

Request: in dd/mm/yy

Issue: Messages are sorted, first on top of the list.

Request: Latest event should be on top of the list of messages

Issue: Usernames

Request: we would like usernames for Mary, Drissa, Tangara etc. so that we know who issued a message

Issue: There are three option: Yes, No, Don't know. Don't know can mean: farmer does not know if he will attend and pressed DTMF option 3. Or message not answered.

Request: Different status for: (a) received message but still pending (b) has not received message.

Issue: When your voicemail picks up the phone, the system does not register this. Many people here never used their voicemail and don't even know it is there.

Request: We would like the system to perceive "no answering phone" or "voicemail picked up". And sets this as status; then calls again after x hours.

Issue: The Tabale system does not give the correct phone number (0003) on the phone display "incoming call". (0000 instead which is the general entry number to FB and RM and TB). This is confusing. People should be able to call Tabale and retrieve the latest message. And leave a message "attending yes/no/don't know.

The importance of the system to Sahel Eco was immediately known to us on the day that initial tests were being carried out. Other possible future applications of the service have been suggested.

5.4 Created awareness and other external effects.

The VOICES technology also enables other use cases and service innovations such as voice-based village reporting and citizen journalism, called Foroba Blon: The alternate name of this project, Foroba Blon, is an idiom from the Bambara language, spoken in Mali.

Foroba literally means "big field" or "collective field" but also, figuratively, "for everyone"; Blon is the vestibule where the chief receives people. Put together the two words depict a space where everyone has the right to speak in front of the chief and the truth can be told, but only if it is done respectfully, and politely.

Figure 20: The Foroba Blon logo

In Mali many rural radio stations exist, some of them state funded and connected to the national broadcasting service ORTM (Office Radio Télévision du Mali[†]), and others privately funded or completely self-supporting. According to their business, funding scheme, size and location, radio stations can own computers and have internet access, or have computers without an internet connection, or do not have any computer facilities at all. However, all radio stations are situated within the coverage area of mobile telephony.

[†] Refer to: http://www.ortm-mali.tv/
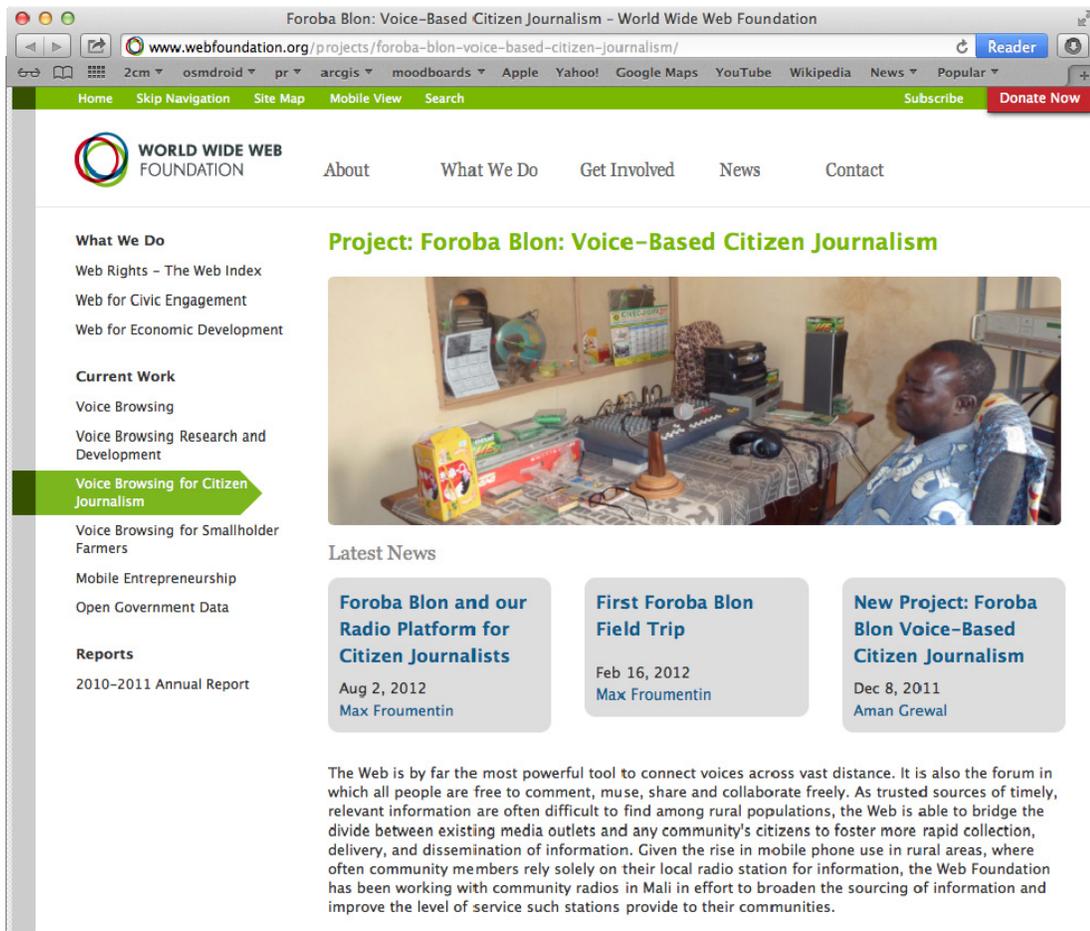
Figure 17 The Website of the project showing news on the Foroba Blon Project

The Malian rural radios have many listeners and the radius of coverage ranges between 100-200 km. The radios create their own programs and broadcast local and regional news, music, informative programs, round table programs and paid announcements. Three radio stations are involved in the project Foroba Blon. These are:-

Figure 18 Blondin Sangara, Fousseyni Diarra and Mary Allen at ORTM Ségou during the discussions

Radio ORTM Ségou, a state owned regional radio station, which has computers and a 2 Mbps fixed line (DSL) Internet connection. Radio ORTM Ségou broadcasts programs mainly in French and Bambara, the most widely spoken languages in Mali.

Figure 19 Radio Moutian Tominian

The second station is Radio Moutian, in Tominian. It is independent and its funding is based on paid airtime for announcements and private gifts. Radio Moutian has a computer but no Internet connectivity. Programs are mainly broadcast in Bomu, a local language in the Tominian region.

The third station is Radio Seno in Bankass. This radio is independent from the Malian state and has only analogue equipment. There are no computers, there is no internet connection here, but the radio has many listeners in the region around Bankass. The main language spoken here is Dogon.

The end-users or customers are usually NGO's that buy airtime to broadcast public announcements about informative and educational topics, such as agriculture and public health information. This type of service is usually based on fixed monthly subscriptions to airtime for recurring broadcasts.

Another set of customers is mainly the non-commercial listeners from the region, who buy few minutes of airtime and pay a broadcast fee per minute airtime. The information is usually brought to the radio, or communicated via phone and subsequently written down on paper by

the radio staff. This service is typically used to announce meetings, marriages and other events, to broadcast description of stolen livestock or goods etc. Some radios have higher tariffs for commercial announcements or income generating events such as a dance organized by a youth group

The third set constitutes journalists or trusted village reporters that phone to the radio and leave local news or interviews on a regular basis.

Further listeners call in during a specific radio broadcast (each radio had at least one example of this) and may leave a message (written down) or be interviewed live to give their reaction to a certain popular topic. Radio ORTM has a weekly broadcast called "letters to the editors" (LTE)' where selections of listener's letters are read.

Foroba Blon consists of a data store containing recorded voice messages and related meta-information.

1. The interface to the Foroba Blon radio platform is either purely voice-based, through mobile phone for entering new content. Users of this interface are the listeners from the region entering letters to the editor (LTE). These people only have mobile phones and no access to the Internet. Their calls are answered by the system with a pre-recorded welcome message in a local Malian voice inviting them to leave their message. For the sake of user-friendliness, the user interface and the dialogue for this category of users is kept as short and simple as possible, since the expected callers will be unfamiliar with interactive voice response systems and may not respond to a complex computer-generated dialogue asking to press buttons etc.

2. Another category of users of Foroba Blon is the trusted reporters calling from the field. They phone in and leave their spoken report for broadcasting. These users are previously registered, having their phone number, name, address and preferred language in Foroba Blon. These users will be trained to navigate the voice-menu, and use the IVR system, asking to press a button on the phone to confirm or answer a question about their current location, subject of the message, etc. The Foroba Blon system always answers the registered caller in his/her preferential language.

3. The voice messages are stored as audio files in the Foroba Blon data store, together with meta-information being the date and time of the call, the length of phone call in seconds, the phone number of the caller. Messages from trusted users are linked to the owner, his/her address, and his/her preferred language.

4. The Foroba Blon Radio Platform also has a "normal" web interface, where internet-connected end-users/customers can access and upload a voice message. Depending of their customer relationship to the radio, they can login to the radio-platform as (i) registered users such as NGOs, and trusted reporters, or (ii) as unregistered users. There is an option to sign up and create a user account by registering the name, phone number, village and preferred language. Unregistered users can access former broadcasts since this is public information.

5. For the radio user, Foroba Blon provides a web-based interface, enabling them to manage the data in the data store. It provides a file list where they can access, listen, broadcast, delete files, and add/update/delete meta-information.

6. The radio station that has no computer or Internet has only a very limited interface to the RP, since this is the constraint of a voice interface. He receives a welcome message asking if the wants to hear the last 10 messages, or if he wants to manage the welcome messages to the end-users.

7. The Foroba Blon radio platform could in theory be physically hosted anywhere in the world, on any webserver, connected to the Internet. However, in actual Malian case this is not possible. Firstly, the radio platform has to be accessible using an inexpensive local Malian phone number. Secondly, the web service accessed over the Internet must be accessible locally. The local connectivity is usually of low bandwidth and high latency, making voice web services hosted in datacentres in the US or Europe, too slow for proper deployment in Mali. For these two reasons, the system has to be hosted locally in Mali. In the absence of good and reliable datacentres or hosting providers in Mali, the radios can decide to deploy the service locally at their premises.
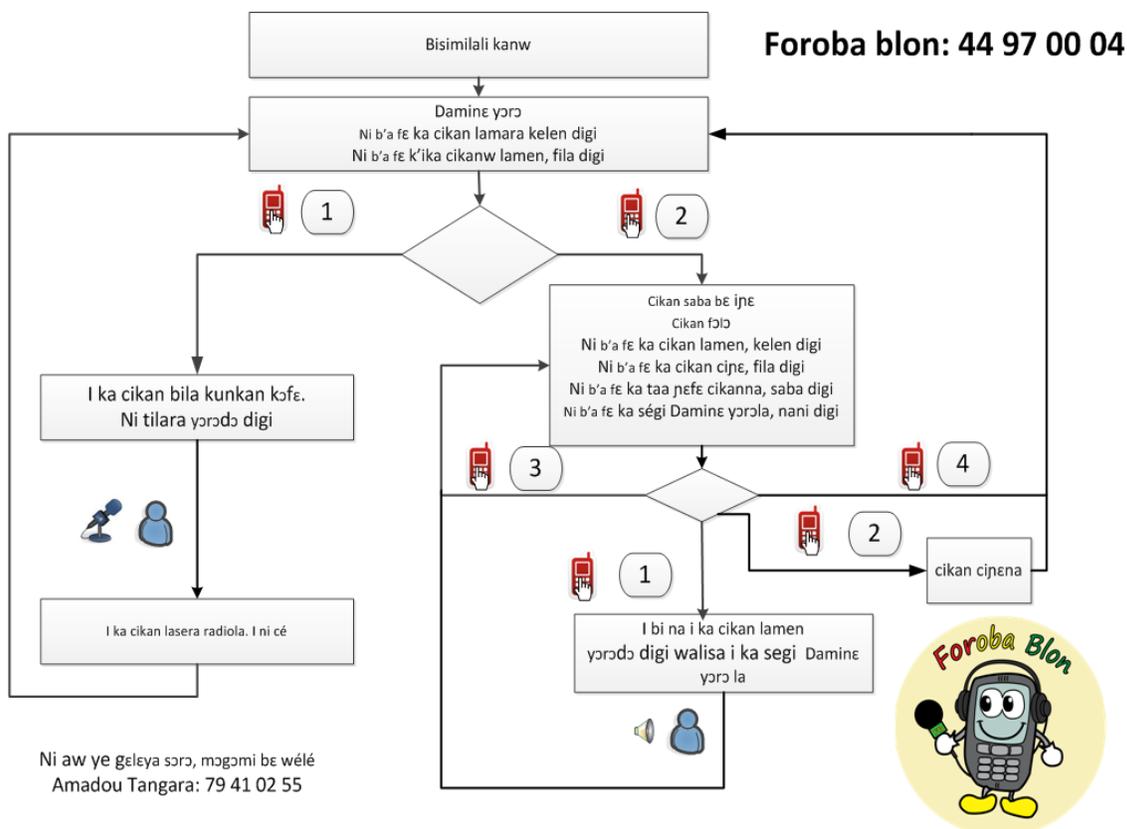

Figure 20 Call flow diagram

Scientific results

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Work by Master students can be found in the Annexes.

6. Assessment of Future Perspectives

Process and outcome evaluation both refer to observable results (outputs and outcomes, respectively) obtainable within the course and duration of the action. In contrast, this chapter provides an evaluation of the *perspectives beyond the end of the project*. Although also this assessment is as much as possible *evidence-based*, presented data will necessarily be more indicative rather than fully conclusive. For the present pilot, the future perspective assessment is addressed by investigating the following aspects or dimensions:

a) Generalizability: the possibility to expand the piloted technologies to other use cases, services, domains, and countries.
b) Transferability: the capabilities made available to transfer required knowledge regarding voice-based service development, maintenance, and use to various stakeholders and interested third parties.
c) Sustainability: the likelihood that developed services will be further adopted and maintained by stakeholders on a continuous basis, beyond their current initial development (project RTD stage).

6.1 Generalizability.

Long term effects of the m-agro WP 5 pilot VOICES can be expected from the extensive community-building activities. This entails long-lasting contacts with NGOs, rural radio stations and farmer organizations, local and global entrepreneurs, ICT and Web developers and donor organizations, as to create community of practices that may further the results of VOICES in this environment on the shorter and longer run.

To ensure the local adoption and exploitation of the VOICES tools and methods beyond the project, VOICES has designed business models for its results in co-creation with local partners and communities. These business models may help local entrepreneurs to create local eco-systems and deploy the VOICES results in a sustainable way.

At a local level in Mali, VOICES has made a step in providing local farmers to access new markets for their products, offering them new opportunities and increased income. VOICES also provided new tools to Sahel Eco to increase its impact and ease its action in the field through the use of new ICT tools. The current services will soon be scaled up to other similar organizations in Mali, Burkina Faso and Ghana. End of 2013, staff members of Sahel Eco and their local partners will be trained on how to deploy and support mobile technologies in Mali so that they will be able to support further extensions of the current services.

At a global level, VOICES has developed a set of tools and methodologies to develop and deploy sustainable voice-based services. More and more initiatives that currently only use SMS are now starting to consider voice-based services as a more appropriate alternative. The products of VOICES are essential in that regards and unique. There are no other similar options that exist today, and in that regards VOICES have lowered the barriers to building such services. The press coverage received by the project from major journals, as well as worldwide

recognitions and awards received by scientific papers published on VOICES results or early adoptions by external actors of some of the project results demonstrate the impact of the project in the domain.
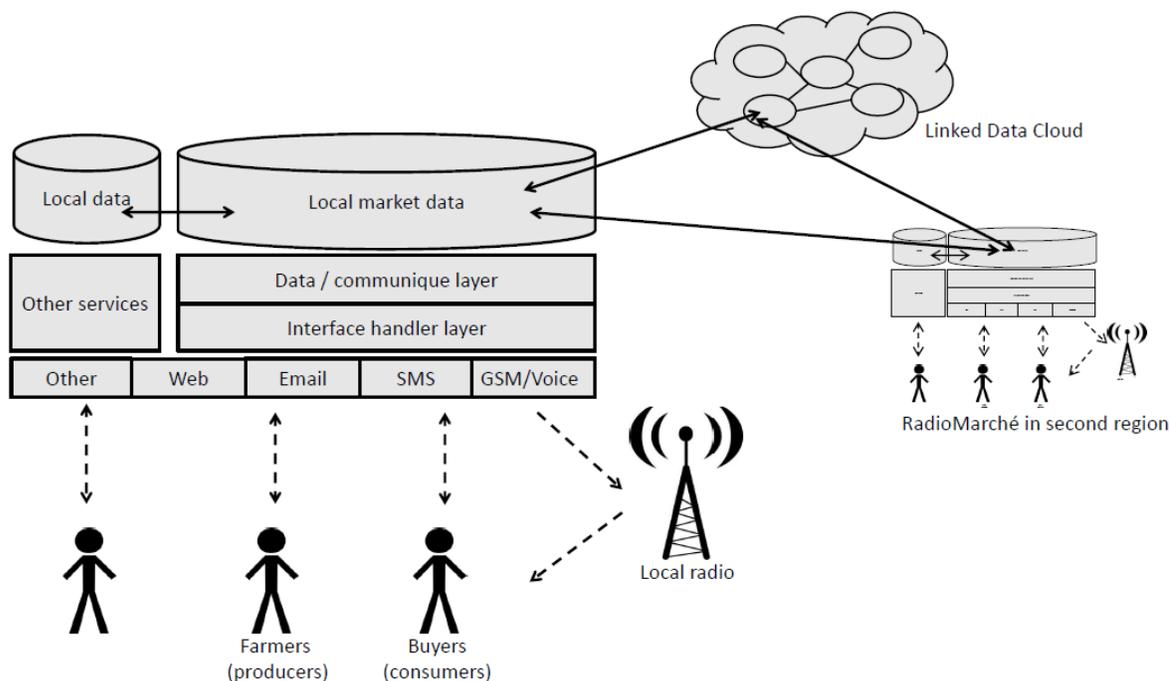
Figure 21 Conceptual design of a generalized Voice-based system. The system provides alternative interfaces based on voice or SMS via phone or radio, enabling a wider audience to consume and contribute content. The data design is optimized for (i) effective aggregation with other RM instances and data sources from other domains in the Cloud; and (ii) reuse by other services.

The interface layer is the technical layer consisting of the actual interfaces channels: each with its own limitations to user interface design. The RadioMarché design foresees multiple interfaces for producing and consuming market information.

1. The voice-based interface allows non-intrusive market information access for all users having a first-generation mobile phone. It allows farmers to navigate a voice-based menu and enter product offerings using a call-in service at a local telephone number. The voice service is available in the local languages relevant to the specific region. For the voice-based interface, we adopt the industry standard VoiceXML. Since we cannot assume that text-to-speech (TTS) libraries are available for the local languages, we currently use pre-recorded phrases in the local languages for the voice menus.

2. The SMS-based interface provides for literate users a more effective way of adding and consuming market data.

3. Through the traditional Web channels or via e-mail, users can get weekly digests of the latest offerings or add their own using a predetermined and machine-readable mail

format. Standard Web access naturally allows for users to access market data using web browsers.

By offering multiple interfaces to RadioMarché, the system is open to contributions from a wider audience of users with less capabilities, both in terms of hardware as well as literacy; hence extending its generativity. The multi-interface approach also ensures that when local development causes new hardware and connectivity to become available to the users, they can access the same system in these new ways.

6.2 Transferability

Tools and services developed under the project are being released to the open source community. Currently the Emerginov software platform has been bundled as an Ubuntu package and the first version has been released in the Ubuntu software repository together with guidelines on its installation and setup.
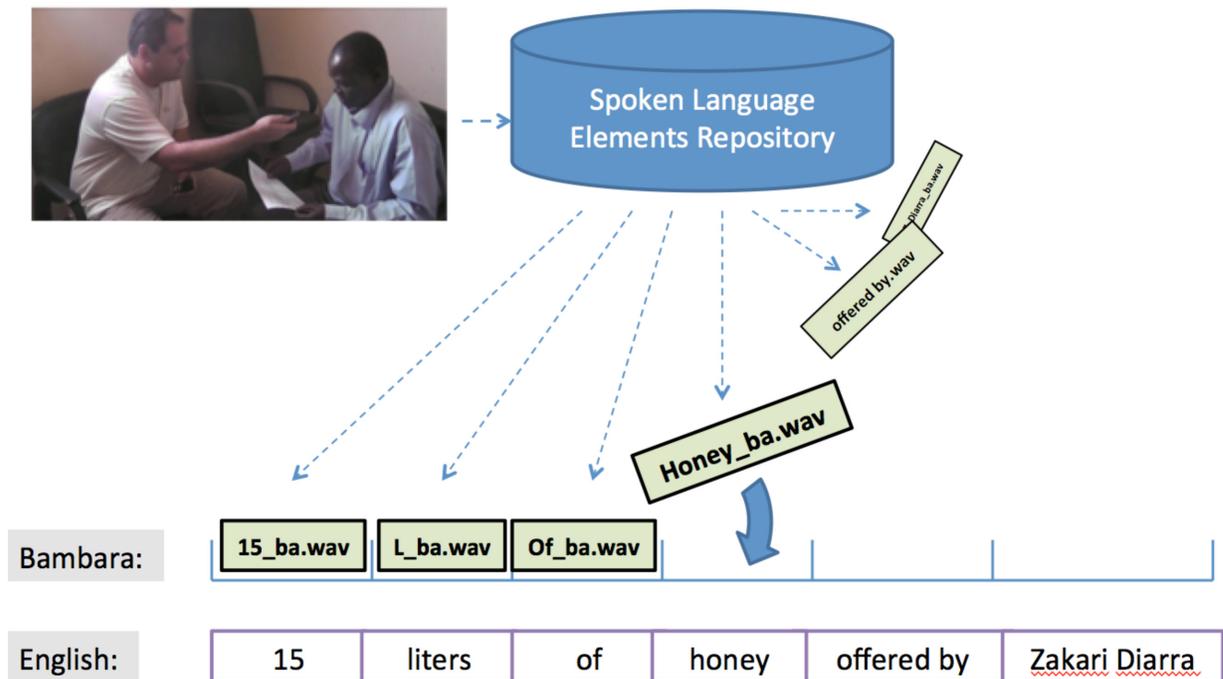
Figure 21: Transferable text-to-speech approach

Also the m-event service has been released to the open source community through GitHub. It also includes the downloadable sources and instructions on its installation and setup. This can be found in the link below:

https://github.com/maxf/tabale
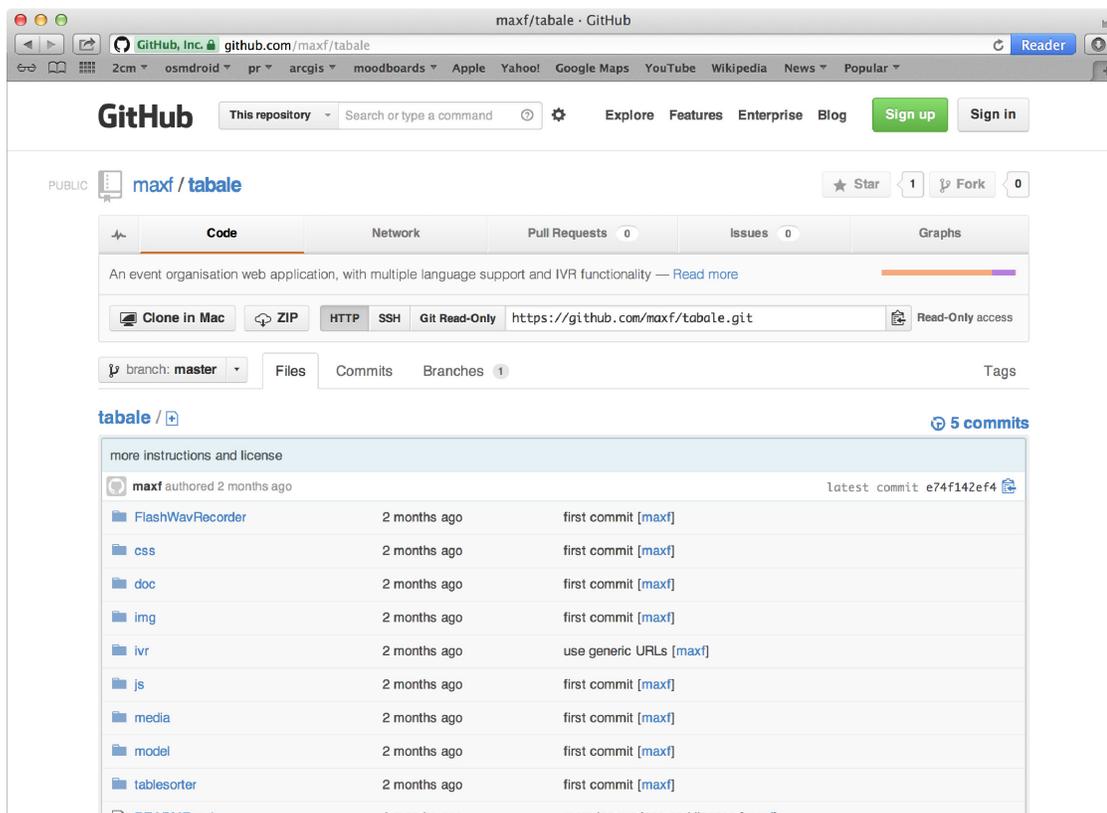
Figure 22 Tabale system on GitHub

Other sources (e.g. RadioMarché) will soon be released on GitHub as open source.

RadioMarché

We like the system it is valuable to us. Easy to use. There are, however several issues in descending priority.

High priority

Issue: Users (CJs) find it difficult to register the first time as users.
Request: One separate call for registration only.
Issue: The user profile is set the first time a CJ calls the FB number. Currently there is no way of resetting the user profile or correct the settings (language, radio).
Request: We wish a web interface for the radioperson to manage users, add/update/reset/remove/block new users.
Request: We want an option at the end of the prompt where the CJ can change or confirm his/her user settings (choice of radio and/or language)

Issue: When the only authorized admin phone is out of reach, we cannot access FB.

Request: We would like more than one authorized phone number for admin user so that several people can access the messages.

Issue: Currently the CJ has to alert the radio of a new message by calling him. This costs him one phone call extra.

Request: An automatic alert call or sms to the radioperson (administrators), as soon as a message has been submitted.

Issue: Currently the phone interface is not good enough audio for broadcasting quality. That is why we use the web interface with the dongle. (76364956 and 76809220 should be admin numbers for FB). Moreover, only the director has a computer. The Phone interface needs to work for the technician and be good quality so the director does not have to be present

Possible solution: use a better phone for accessing. A smart phone gives reasonable audio quality. Additionally, a cable is needed from the phone to the radio broadcast equipment, instead of placing the microphone against the loudspeaker of the mobile phone. This obviously gives much quality loss.

Issue: The actual cost of the system is high for the users, due to many calls (message+alert call+radio accessing the system+broadcast)

Request: Add the alert (see previous request; Could this be integrated into one-off cost or a subscription (une flotte?).

Issue: The (Emerginov) platform went down and then we couldn't access an important message, I called Stephane Boyera, and he fixed it.

Request: If we use this in a production environment, we need to know the uptime of the platform.

Issue: Radio (admin) cannot access all message through phone interface. Only through web interface.

Request: Option on the phone interface to access all messages.

Medium priority

Issue: Sometimes calls are very urgent e.g. a flood, an accident, a death.

Request: a difference in urgency in the notification of the message. (Actually, This issue will be largely addressed if a) there is an alert automatically and b) the technician on duty can access and broadcast messages).

Issue: A CJ can only register for one radio station. Some CJs work for two or more radios. E.g. if somebody lost their animals they might want to call two stations"

Request: Option in menu of FB to submit message/ register as user/ for two or more different radios.

-

Low priority

Issue: Malitel numbers are more expensive to call FB. Some villages don't have Orange coverage.

Request: provide Malitel number for access to FB

Business ideas:

A web interface where people in diaspora can pay (via visa card) supporter subscription, listen to radio and submit/access messages.

A subscription to Orange to get a discount on calls for the radio. (flotte)

An inclusive charge say 1500 FCFA/communiqué paid entirely as Orange call credit by the person wishing to leave the message. Money paid into Radio station account by Orange/Sahel Eco (Foroba Blon) and then from radio Station to Village Journalists (CJ- correspondents). Tessougue (Director) thinks that this will encourage people to send communiqués via Foroba Blon (it feels as if the radio is working for "free[‡]")

Other radios be able to access and re-broadcast our messages, (WebofRadios [§])

Figure 23: Meeting in Konobougou at Radio Sikidolo

Tabale

Tabale or m-event is the system for Sahel Eco to send group voice messages, generated and recorded in several languages, online, and sent to selected phone numbers.

The name Tabale refers to the king's drum, that goes from village to village mounted on a horse. When you hear the Tabale beat, you must gather for an important event, meeting or emergency. This name is suggested by Fousseyni, Tangara and Keita, our driver.

[‡] This should not be not charged until the message is successfully recorded.

[§] It is not said that this idea will generate money but it was suggested as a solution to the issue of wanting to puts some communiqués on several radio stations; It would be a closed group of radios which agreed to collaborate.

This system is tested first with Tangara and Drissa Gana, another staff member from Sahel Eco, who lives in Mopti and works in Mopti and Bankass. Tabale is really cool. Tangara and Drissa think it is very useful. We test it several times, including with the CJs in Tominian.

Figure 24 Testing Tabale system in Segou

Feedback on Tabale

Issue: Dates in the web interface are in US style.

Request: in dd/mm/yy

Issue: Messages are sorted, first one at end of the list.

Request: Latest event should be on top of the list of messages (default)

Issue: Usernames

Request: we would like usernames for Mary, Drissa, Tangara etc. so that we know who issued a message (+password protected login)

Issue: There are three reply options: Yes - attending, No - not attending, Don't know. Don't know can mean either a) the farmer does not know if he will attend and pressed DTMF option 3 or b) the call was not answered yet (no reply, hung up)

Request: Different status for: (a) received message but still pending (b) has not received message.

Issue: Many phones switched off for periods due to battery management issues. When voicemail picks up the phone, the system does not register this. Many people here never used their voicemail and don't even know it is there. Request: We would like the system to perceive "no answer" or "voicemail picked up". And sets this as status; then calls again after x hours. If

voice mail picked up TB should ONLY leave the recorded message because the reply and leave message options do not work.

Issue: on the phone display "incoming call" the Tabale system shows the 0000 number, which is the general entry number to FB and RM. This is confusing. People should see the correct number to call back to Tabale (0003) and be able to retrieve the latest message, respond "attending yes/no/don't know and leave a message.

In general

The North-West University (NWU) is a South African university with campuses in Mafikeng, Potchefstroom and the Vaal Triangle. The NWU came into being on 1 January 2004 through the merger of two universities with very different histories, personalities and cultures: the Potchefstroom University for Christian Higher Education and the University of the North-West.

The Multilingual Speech Technologies Group (MuST) operates on the Vaal Triangle campus of NWU, and is active in research and development of speech technologies for the developing world, with a particular focus on the languages of Southern Africa. MuST has been involved in a number of projects aimed at providing information access in the developing world using speech technology; these include medical applications in Botswana, agricultural applications in India and support for social services in South Africa.

In VOICES, NWU had primary responsibility for the development and evaluation of speech technology. Thus, simple text-to-speech systems were developed for Bambara, Bomu and West-African French, and a speaker- and vocabulary-independent speech-recognition system was created in Bambara; these technologies were integrated and tested in the m-agro knowledge sharing pilot in Mali.

Technology implementation plan for NWU

NWU intends to utilize the tools and resources that were developed in VOICES in three overlapping ways:

- Most prominently, we will continue to develop technologies and applications that can assist citizens of the *developing world* with *information access*, using speech technology. We are involved in a number of initiatives to further improve the performance of these technologies, e.g. by incorporating tonal information, and are in ongoing discussions with parties such as the South African government as well as companies and NGOs in Southern Africa aimed at creating applications of this nature.
- The developments that resulted from VOICES will also be utilized in our attempts to create *commercial applications* of speech technology for *under-resourced languages.* We are currently investigating a number of such ventures using the eleven official languages of South Africa; these include a directory-assistance application and systems for voice analytics in call centres; currently, there are no applications in those categories in any under-resourced language.
- Although the VOICES project demonstrated the potential of speech technology, it is clear that much research remains to be done in order to make these technologies more capable and easier to develop. The tools and resources developed during VOICES will

thus be used as important inputs in our research strategy to continue development in those directions.

Besides these initiatives, technologies developed during VOICES will also play an important role in our educational initiatives. We intend to graduate approximately 2 Ph.D. students and 2 M. Sc students per year for the foreseeable future, and all of those students will benefit from the VOICES outputs. In addition, undergraduate students at our university will be offered short courses and workshops in speech technologies, for which the VOICES technologies will be useful tools.
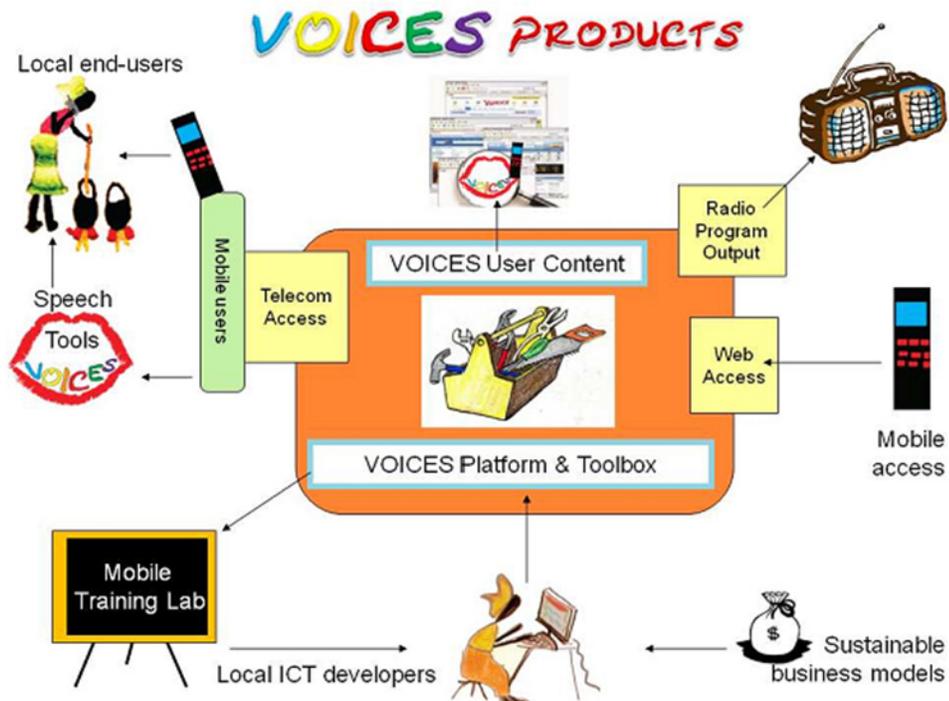

Figure 25: The resulting set of products and outputs envisaged by the VOICES project

6.3 Sustainability.

See also the business model studies summarized in the Appendix.
Continuation of the VOICES WP5 services beyond June 2013

RadioMarché

RadioMarché was also evaluated using evaluation forms and discussion with Sahel Eco operative Amadou Tangara. Here, hosts from four radio stations filled out an evaluation form: Radio Tominian, ORTM Segou, Mopti and Koutiala. The detailed results can be found in the Appendix**.**

Three out of the four radio stations used the Web interface to RadioMarché to retrieve product information. Reasons included ease-of-use and the need for on-the-spot translation. The Tominian radio station used the voice interface, because of lack of Internet connection. This radio host awarded the RadioMarché interface a an average score of 3 on a 5-point Likert scale. The radio host indicated that the instructions were clear enough and the communiqués were short and comprehensible. The voice quality was evaluated positively (4).

The three radio stations using the Web interface awarded it an average score of 3.66 and regarded the voice quality as average (3.0). One Radio station indicated that the audio quality of the communiqué was bad (2) and mentioned this as the source for many observed issues.

We gathered radio specific feedback with an impact on the business model and sustainability for such services as illustrated below:

Specifics for Radio Sikidolo: Business model of "Village Reporters"

Radio Sikidolo has an existing network of more than 50 village reporters who gather broadcast material (usually written text) and revenue (villager's pays a fee as per the broadcast type – 1000 CFA cost for communiqué + 200 CFA phone credit). This was a manual process till the radio started using Foroba Blon services. There was a significant uptake in the same compared to the other two radio stations simply because Foroba Blon was a nice fit in the existing business environment.

Radio Sikidolo further identified a list of additional features to be integrated in Foroba Blon. These include:-

1. A web interface where people can pay (via credit card, mobile money) and access messages.
2. A subscription to Orange to get a discount on calls for the radio.
3. Other radios be able to access and re-broadcast their messages at a fee.

However beyond the initial phase of significant uptake there was a gradual fall off observed. This was primarily cited to the cost of training the village reporters as well as striking the right

balance between the revenue generated and access costs from the field in placing the reports. In the case of Radio Sikidolo the cost of running the services has to make business sense when compared to the revenue generated. According to them a payment system is necessary to make this service work in the long run for them. If such features are integrated Sikidolo will mainstream this service in their daily operations.

Specifics for Radio ORTM Ségou FM 96.8: Targeted services, gradual uptake.

Radio ORTM Segou is a state owned radio. It does not have financing or revenue options to train and maintain a set of Citizen Journalists across its network (unlike Radio Sikidolo). However ORTM Segou works with 4 Citizen Journalists and wants the same to be scaled up to 25-30 Citizen Journalists. The messages are mainly about pluviometric data (rainfall) and they feel this can be monetized. Thus this represents a very specific set of services to kick-start progress towards revenue generation. Further instances of such services will be very specific to the geographic area and the requirements coming in from citizens and Citizen Journalists.

Specifics for Radio Moutian: Low uptake due to phone costs and absence of niche / general services and remote payments

Radio Moutian was not able to use the system beyond the testing phase citing

a. Prohibitive phone call costs owing to no internet connectivity at the radio station. They did not have a revenue stream to provide for call costs both for the Citizen Journalists and the radio itself for broadcast. This is an important lesson while designing the sustainability and business case for such radio stations beyond the testing and pilot phase.

b. Further the radio station was not able to identify key services as in the case of the two radios above that could supplement the revenue streams and cater to the basic telecom costs.

c. In the absence of remote payments for the audio communiqués radio Moutian is unable to scale up Foroba Blon beyond the pilot. This is an essential tool for them to generate revenue and make services sustainable.

It is expected that Internet connectivity will result in greater uptake of such services in the near future. Further in such cases the radio stations also need some business support in identifying general or niche services that they can monetize via Foroba Blon.

Tabale

During this trip we received new info about this topic. Tangara gave much info on the current sales activities through RadioMarché, and gave us lists of recent sales of honey and shea butter. At Radio Sikidolo we learnt about their business model of "Village Reporters". At ORTM Segou we heard about the sales activities related to RadioMarché.

All systems costs of phone and internet

General: 1 minute of calling costs Orange to Orange = ~100 CFA (48CFA 11pm-7am)

General: Cost of an Orange to Orange SMS = ~ 20 CFA

General: Orange Key: 13.500 CFA buys you 2 GB/month download

General: Broadband in Mali (Mopti and Bamako, SE offices) Unlimited: 30.000/month if pay 6 month subscription in advance (incl. telephone if connexion via Orange Livebox)

Figure 22:Tabale as voice-based twitter

PART III: m-Agro Pilot Evaluation Summary

Part III gives a concise summary evaluation in the form of an analysis and highlights some key lessons learned.

5. Final Evaluation Conclusions

The VOICES project has adopted a holistic approach towards enabling the next generation of mobile services based on voice technologies that are accessible, usable and affordable by the rural underprivileged communities of Sub Saharan Africa.

The m-agro pilot in Mali has provided the following results:

- Further integration of Local Community Radios and ICT: Among its features and functionalities, the toolbox has enabled the bridge with local community radios, by offering a Web archiving option and off-line individual voice access, thereby making broadcast audio content widely available to people.
- Better Support of Languages: VOICES has delivered tool support and a methodology for under-researched and under-resourced languages that facilitates the local creation of content in African languages.

To ensure sustainability of the results in the future it is necessary to:

- Transfer the experiences and methodology from the VOICES project to a broad global community of ICT and Web developers, researchers and civil society, and local stakeholders.
- Support scaling up these innovations in the benefit of knowledge sharing for empowerment of the less privileged.

The RadioMarché, Foroba Blon and Tabale Web/mobile services exemplify our approach of making the most of existing technologies to empower people and local communities. Rather than relying on future technologies, or targeting a small part of the population (those connected in 3G and/or possessing high-end handsets), we connect the 2G world. Indeed the existing infrastructure in sub-Saharan Africa is mostly 2G and the migration to 3G (let alone 4G) will not be undertaken soon on a large scale across the continent. In the long term, the three different projects described thus aim at empowering grassroots organizations and local developers to favour the emergence of digital, mobile-centric ecosystems, through 2G-based open source technologies.

Building the web and associated services on locally available infrastructure and technologies aims at reducing the barriers to their adoption in the communities. Training sessions that were organised at some points during deployment were only designed to help them use the specific service that had been built. Generally, the approach here has been that the widespread familiarity with usage of mobile phones should be enough for the adoption of such services. This is to be contrasted with pretty common strategies where entirely new gadgets and devices are introduced, presupposing a certain interest for technology or people who are technologically savvy.

Our experiences continually reveal how important it is to take the context within which the system will operate into account. An example is that, for RadioMarché, it was a hard

requirement to record the voice of the real persons that were known by the community for everyday radio broadcast. As a result, it was not possible to record any other voice(s) for the purpose. This clear limitation was what was traded for user acceptance and usage among local people.

Non-functional requirements play major roles in identifying what needs are to be satisfied among news users. This is especially so when developers of such systems have very little knowledge of the communities within which they will operate. In many of such instances, such projects have been shown to always fail. This can be partly overcome by setting the right environments for local user participation and possible co-creation. By involving as many potential local users as possible right from the beginning of such projects, a lot of context-based factors that have the potential of derailing such projects can be taken care of.

The feedback indicated that in general it can be said that the RadioMarché system improves the communication between the producer of non-timber forest products (e.g. honey and shea butter) and its customers and therefore their trade. The communiqués broadcast on the radio are heard by many potential customers. There have been many phone calls to the producers and to the radio stations by buyers who were interested, the past four months, since the communiqués were regularly broadcast.

Also, the system interface is easy to use for Sahel Eco who collects the information from the farmers. The automated communiqué creation is simple and effective. The radio stations find it easy to use the RadioMarché web and the RadioMarché phone interface and download the communiqué and broadcast the message. Up to present this has been tested for French language only with plans to add the Bomu and Bambara versions very soon.

Compared with the other two systems previously mentioned, Tabale is a relatively new service that has been deployed by us. It is essentially a voice version of popular micro-blogging services on the Internet. Once instances of the services have been deployed at various locations, it provides a quick way of sending out pieces of voice information to different target groups of people on their mobile phones to which they can choose to respond or not. Its broadcast functionality makes it very handy to communicate entire communities very quickly and in their own language.

This ``voice twitter'' service has the added advantage usage regardless of language and literacy in modern systems. The use of simple mobile phones to deploy this service also means that many more people who otherwise could not be communicated with easily could possibly be a thing of the past. It presents many opportunities for governments to communicate in cases of a disaster or for health related initiatives such as mass immunization.

The main results are:

Open and Wider Access: improved voice-based access to content and mobile ICT services through a toolbox for the development of voice services that is made available to local communities and entrepreneurs as Open Source.

Integration of Local Community Radios and ICT: Among its features and functionalities, the toolbox enables the bridge with local community radios, by offering a Web archiving option

and off-line individual voice access, thereby making broadcast audio content widely available to people.

Better Support of Languages: VOICES has delivered tool support and a methodology for under-researched and under-resourced languages that facilitates the local creation of content in African languages.

Long-term Sustainability: To ensure the local adoption and exploitation of the VOICES tools and methods beyond the project, VOICES has created a sustainable architecture and designed business models for its results in co-creation with local partners and communities.

Faster Uptake: VOICES has organized a number of important community-building activities. This included, amongst other initiatives, the delivery and roll-out of a mobile training lab that offers education for local partners and entrepreneurs in developing mobile ICT and Web services, and community of practices that want to further deploy voice technologies in their own environment.

VOICES has proved the fitness of its results and its adaptability to the African context by local pilots and associated community building: this was focused on health services in Senegal, and on agricultural and regreening knowledge sharing in the Sahel countries.

In summary, with the Internet very far from many of these rural regions in the foreseeable future, one needs to rethink and flexibly recombine technologies and do things generally differently in order to attain the goal of increasing the reach of the Web, benefits of information exchange and knowledge sharing. Using bottom-up and partnering/co-creation approaches focused on localized and contextualized use cases is one way to do so.

6. Key Lessons Learned

Community radio stations in Africa are an essential, and often only, source of information for people living in rural regions. They serve as hubs of information, relays of news, and community knowledge sharing agents. However, owing to the challenges associated with limited and poor infrastructure, the interaction between radio stations and their listeners, as well as with journalists in the field is very difficult, resulting in delays in the delivery of timely information.

The recent increase in mobile phone use in rural areas is now offering new opportunities to involve all members of the community with their local radio station, and increase the quality of the service as well as the usefulness of the radio.

Local knowledge and know-how exist in abundance in these regions. Knowledge on traditional methods of farming and best practices on soil and land management has often been handed over from generations through word of mouth and on-the-field trainings with experts. With the advent of communications tools such mobile telecommunication this knowledge sharing could be enhanced and even stored and for future reference and use.

Rural conditions effectively are such that new systems to be implemented only use tools that locals are conversant with and work regardless of the little infrastructure needs available. Mobiles phones fit in well with this scenario because locals have devised means of getting to use these gadgets regardless of the unavailability of electricity. For example, acid batteries in cars are often used to recharge mobile phones in many villages and it is uncommon to see along streets entrepreneurs who offer such services with communities. On the other hand, Telco relay towers are privately and independently built and maintained taking off any burden from locals. This set-up makes mobile telephony together with voice technologies attractive in efforts of reaching many through technologies and offering services that are relevant and contribute as solutions to local needs.

Voice, just like apps, is a new modality for online access. The Web is becoming a web of APIs, which allows new channels at the user's end of things. Specifically, online applications based on speech are growing: Apple's SIRI and Google's voice search are well-known examples.

Fundamental goals of the Web: accessibility to people with low literacy; internationalisation, as the system can easily be adapted to support new languages; and read/write capability, as the system is designed for contribution of content and not just distribution.

- Not being able to satisfy the demand of the customers.
- Some customers are very demanding without buying much.
- The instability of the phone network is annoying when you talk to customers.
- Radio stations have no resource to do recording of broadcasts for archiving
- People might need to be educated on how to use the system.

- Listeners calling in like hearing their voice live. It might be difficult to convince them to leave messages.
- How do you trust callers to report news truthfully, when radio staff isn't there to check the veracity?
- When on air callers tend to forget about the call costs and speak at length. Using an offline message recording service might deter them, or just discourage them to leave long and informative messages.

Merely operationalizing a suite of voice based services accessible via a simple mobile phone is not the only ingredient for success in CJ services like Foroba Blon. There are specific management structures, operational aspects like managing a community of contributors, telecom and access costs, training costs and recurring expenditure to consider while drawing up the business canvas for such services:

1. We have realized that a robust and locally relevant payment mechanism is the need of the hour for deploying such services on a sustainable scale.
2. There is also the aspect of making the content ubiquitously available for all so that there is greater sharing of locally relevant content without much capital expenditure in reproducing the same across radio stations (i.e. the same broadcast if locally relevant can be picked up and broadcast minus the production costs or sourcing from Citizen Journalists).
3. There is also the case of providing sufficient build up time for generating usage and interest in the local community. As evident in the case of Radio Sikidolo there was an existing setup that was in sync with the services offered. However in other cases there is a need for services to mature over a period of time while continuous monitoring and input is required.

While designing such services there is also the need of sourcing a reliable and cheap hosting services. In the case of Foroba Blon these costs were absorbed by the telecom partners, however for greenfield operations such costs have to be sourced for.

There are more services envisaged for this sector that provide new business opportunities for the radio stations specially with the ability to serve more people thereby enhancing sustainability options. Getting Citizen Journalists to contribute more revenue and content is not enough to cover the costs for service providers, civil society organizations and the radio stations. However if there are more services specially the ones that involve diaspora contribution and selling of broadcast time then sustainability is a realistic goal.

Web Foundation replicated the Foroba Blon platform and service in an initiative in partnership with Al Jazeera recently in Ghana enabling Citizen Journalists and NGOs to access news audio clips as well as commenting on the same. It was a success because it catered to a topical use case of elections monitoring. Also the capital and recurring telecom costs were met by Al Jazeera. For Al Jazeera, the cost of the service was low compared to the importance of the information collected at people level, in places not covered by traditional journalists. However for rural and community radios that are already struggling to survive on a minimal budget and low revenues such upfront costs in creating and piloting services is a challenge. If any service entails additional costs for such radios that there will be high chances of failure in scaling up. The usefulness of such services and platform however are beyond doubt.

From a decision makers' perspective the following canvas can provide a good set of ingredients required for the business case citing the example of rural radio stations and Sahel Eco as local implementers.

Bottom-line

We have described a pilot project, deployed in a low-tech, low-resource context in rural Mali. From the experiences obtained during implementation, we have learnt the importance of following key principles:

Realism Understanding the big picture and the real-life environment of e.g. African farmers is crucial to understand the context before identifying use cases. All development cycles must depart from the real-life environment.

Influence The involvement of the users is more than just a user-centric approach. Examples of co-creation are e.g. the recording of Malian speech and voice-prompts in local dialects, by our Malian users. We argue that the only way to develop appropriate systems for this context is by engaging users and have them contribute to development, during all the cycles.

Value and sustainability Only by understanding the local business ecosystems, sustainable solutions can be sought to ensure local deployment.

Openness This is the experience that open communication and trust relationships lead to better solutions. This key principle of Living Lab is built on the idea that requirements are not just hidden information, waiting to be elicited by RE experts, but rather social constructs [8]. We have seen use cases and requirements emerge through creative interaction amongst this multi-cultural and multi-disciplinary team of developers, extension workers, local radio journalists and farmers producing non-timber tree products such as honey and shea butter.

Outlook: The "Web of VOICES"

We envision a Web of Voices as interface to knowledge on the Web.

Voice interfaces are not new - we are aware of fictional talking robots and androids such as Hal, Data, Marvin and of existing software such as personal and interface agents. Recently we have even seen Watson triumphing over human players on the TV quiz show Jeopardy! One of the visions of the Semantic Web is having software agents working for us on the Web. Yet, Watson and other ``intelligent'' entities are still not fully capable of performing vocal assistance with more daily tasks such as advise on agriculture, teaching new tasks, inventing concepts nor motivating people.

How can the Web (be made to) mean something for information sharing even under very constraining conditions?

A lot of knowledge is already available on the Web in machine-readable forms. Access to this knowledge is facilitated by web services that are device driven, e.g. one has to create a query by typing, to click with a mouse pointer or to work with fingers to order results.

The availability of mobile telephones can aid to the promise of World Wide Web availability.

Enabling vocal access and management of knowledge on the Web raises a number of interesting research challenges (1) Voice based information management and (2) Voice based knowledge usage. For every challenge we present possible usages and research directions.

Challenge 1: Voice based information management

Ten years ago hardly anyone had foreseen the impact of mobile telephony and software, world-wide. Almost half a million mobile apps are available for a range of mobile platforms. Most of these apps have a graphical user interface and some form of connection to the Web. The dominant knowledge carriers of the current Web are text based. We made a lot of advances adding semantic infrastructures on top of the text-driven Web. However, the interfacing to these infrastructure are mainly keyword and text-driven. The text on the Web carries style and form of the dominant languages it is written in. At the same time, research into voice based access to the (semantic) web has largely focused on widely spoken languages (English, Chinese).

Speech is the most natural way for humans to communicate and exchange information, knowledge, ideas and feelings. So, rather bringing the Web to a voice device, such as the mobile telephone, we should bring voices to the Web. Many voice- driven systems such as speech recognition, (text-to) speech generation and voice control have been introduced the past decades and they are improving every day. However, can we enable people to create, access, utilize and share knowledge on the Web using only voice? Can we make it work for many small local languages? Can we make systems for people with limited computer-skills?

This implies a number of future interesting research challenges: (1) Can we create Web services that are accessible without hands? (2) Can the text-based Web and Semantic Web be augmented or even be replaced by a voice-based one? (3) How do we create, transfer, manage and query information based on speech? (4) Can we transfer Web knowledge to voice and vice versa? (5) How will we manage the voice-based knowledge on the Web? (6) Can the voice-based Web exist next to the text-based Web? (7) Should we create language- and context-dependent Web content for exchanging general knowledge? (8) Should we create language- and context-dependent Web content for exchanging local and specific knowledge? (9) How do we create automatic language and dialect classification?

Challenge 2: Have a good conversation with the Web

After enabling voice-based management of knowledge on the Web, we have to think about having a conversation with the Web or smart entities representing it. Keyword-based search strategies are too limited and semantic search strategies are fairly complex. Simple questions that involve a form of context, such as time, personal or professional situation, are still very hard to answer for current querying systems.

Typical conversations between peers include:

``what is the best X for me'', ``teach me how to Y'', ``how do I feel better after Z''.

Current querying strategies involve searching for keywords - in this case X, Y and Z - and apply these in queries, ignoring the context.

In order for a system to have conversation with an end-user, it should be able to understand the context of that user. For example, a farmer in the Sahel is likely to have a different conversation than a stockbroker in Amsterdam. Furthermore, the system should be able to ask questions back or ask for feedback in case of uncertainty.

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ANNEXES

1. Business model studies carried out for the WP5 m-agro pilot services

In this section we describe three possible value models for a voice-based service that was built and deployed in Mali. We did some calculation, based on real and estimated costs, and tried to predict feasibility for each of the three models.

The need to explore feasibility of the pilot systems

The pilot services described in the previous chapters address information needs of people living in low-resource environments. The average income in the regions of our pilot is, according to the World Bank[**], between 1 and 2 dollars a day. There is no internet connectivity in most of the villages, and electricity is not omnipresent. Given the novelty of mobile/web technologies in this context, business eco-systems are not automatically in place. It is therefore necessary to explore both technical and economic feasibility of the voice-based technologies that were built in the pilot. The results of this analysis provide insight in potential profitability and sustainability of voice-based services on the longer run, and will give input for further design of mobile/web services.

Value webs

In general, ICT services based on network technologies are provided by collaborating enterprises in a networked constellation, forming a *value web*. Each participating enterprise brings in a different specific core-competency. E-commerce services are examples of value webs. Likewise, the mobile/web systems in the m-agro pilots involve different actors in networked constellations, also forming value webs. These value webs may look different from a high-tech e-commerce setting, as they involve actors such as radio stations, and different types of low-tech intermediaries (e.g. middle-men, local NGOs etc.) and paper-based transactions. The speed of transactions is therefore slower than in internet-based e-commerce, especially by the absence of online payment services. However, we argue that the concept of value web is equally valid in this low-tech rural context, as it is in high-tech e-commerce. We will show this in the next section, presenting three examples of value models for a voice-based radio platform that is deployed in Mali. We found that exploration methodologies for e-commerce are equally applicable to these value webs.

Value webs in the local African context

A farmer in Mali can be interested in a mobile voice-based messaging service that provides her with market information. However, she will only pay for the service, when it creates a real added value for her. Another actor in the value web, an enterprise such as a radio station, may be interested in participating in the future commercial voice-service delivery. However, the profitability of the service for the radio station is not trivial at first sight. A business model described in natural language does not provide sufficient insight in the value transfers for each

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[**] World Bank Africa Development Indicators

actor. For the radio to embark in such an enterprise, he must have an idea about the profitability and the feasibility of the business.

The e3 value model to explore sustainability

To assess commercial feasibility of these multi-actor services it is important to use a systematic modelling approach. We did this for the systems built in the WP5 pilot of VOICES, for the rural context in Malian. We used the e3 value method [Gordijn & Akkermans, 2001].

The e3 value method is a light-weight approach to explore e-commerce ideas in networked value constellations. It visualizes the value transfers for all actors in the networked constellation. Actors can be enterprises or individuals, customers, market segments or (service) providers. Actors are supposed to exchange value objects with each other. The e3-value approach takes the customer's perspective and looks at the business from the customer's needs. The customer's needs can be satisfied by value objects. Only the customer can assigns value to a given object. Without the customer's need, there will simply be no value transfer and no business. The e3 value model is described in detail in [ref].

We have chosen the Foroba Blon mobile/web service to explore its profitability using the e3 value method. Foroba Blon is a platform that supports rural radios and provides them with a tool to easily store, manage and process incoming voice messages from their customers. FB has been used and tested in a production environment by Radio Communautaire Sikidolo, in Konobougou. We received plenty of feedback from this radio about the advantages and issues of the system. We used the feedback to construct three value models, that will be presented in the following section.

Foroba Blon Value Model 1

Before the deployment of FB, the rural radios already received voice messages for broadcasting, but these were usually written on paper, brought physically to the radio station, and read aloud on the radio by the journalist.

FB has improved this process. It allows customers to phone in and send a message that they want to be broadcasted on the radio. It provides the radio journalist a means to receive the voice messages asynchronously, store them as audio files, select, add meta-information, and manage them so that they can be broadcasted at any given moment.

Foroba Blon model 1
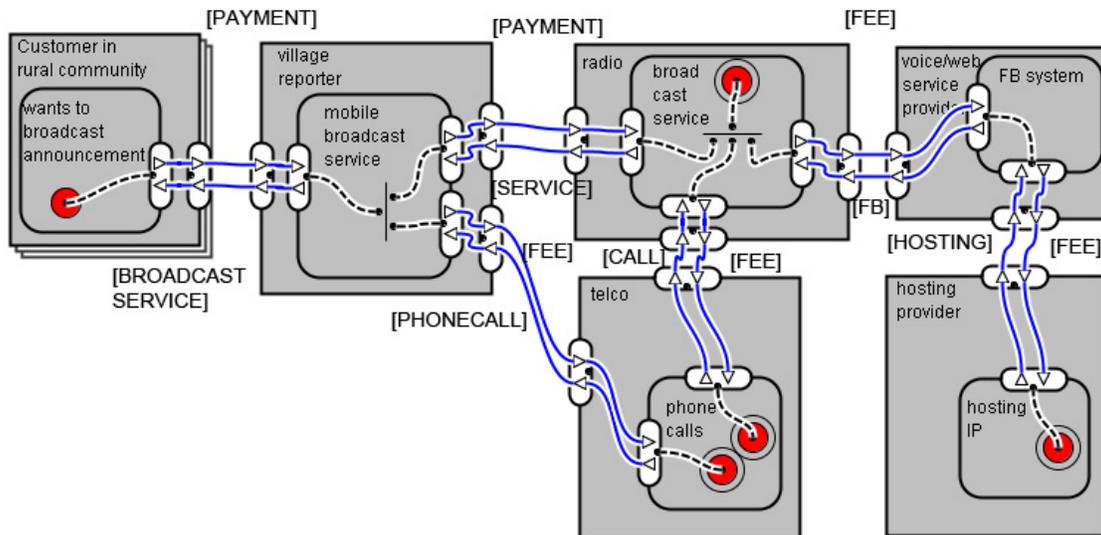
Figure X: A networked business constellation of radio, village reporter, phone company (telco) and the Foroba Blon provider offering a messaging broadcast service to internet-less villagers

The constellation of actors in this small value web consists of a radio station, a village reporter that facilitates the phone call to customer, a provider that offers the Foroba Blon mobile/webservice, a hosting provider, and the telecom company, that provides the phone network and (possibly) a mobile payment service. In the next paragraph we describe the actors, their properties and needs.

Actors:

- Customer: a person in a Malian rural village
- Customer needs: wants to broadcast a short message or announcement over the radio

The customer is a person living in a remote village in Mali (e.g. Konobogou). The customer usually does not own a mobile phone. This person has a need to share information with other people in the region. He wants to broadcast a message on the radio, e.g. because he is missing one of his cows. By reporting this lost animal on the local community radio, the message will be reached by 80.000 people, the listener's base of this small radio Sikidolo, in Konobougou. The chance of someone reporting the cow back is substantial. The customer is willing to pay 1000 cFA for one minute of broadcasting a message on the radio, plus the cost of the phone call (100 cFA per minute) to have access to the FB platform via mobile phone. The alternative would be to travel to the radio station to leave the message personally. The travel to reach the radio station would cost him on average 4000 fCFA.

He therefore asks a village reporter to make the call to the FB system using his phone. He pays a fee for this broad service to the village reporter, speaks the message into the

phone and waits until he will hear his voice reporting the lost cow on the radio, e.g. the next day.

Other actors: service providers forming the Value Web:

Village reporter. This actor works closely with the radio.This person owns a mobile phone and is a "trusted user" to the FB system. He makes the phone call to the Foroba Blon platform and speaks in the message about the lost cow, or allows the customer to speak his voice message. This message will be broadcasted on the radio. The village reporter has an agreement with the radio, to get a percentage (e.g. 10%) of the payment done by the Customer. His phone number and user profile give him access to the FB platform. The village reporter earns an income by facilitating the FB service to people who want to use this FB broadcasting service.

Radio station. The radio journalist accesses, retrieves and downloads the voice message online on the FB platform. He broadcasts the message. He receives a payment for each broadcasted announcement from the village reporter. The radio pays a flat fee to use the FB web service, e.g. a monthly subscription. If the radio does not have an internet connection, the radio pays additionally for each phone call, necessary to access the FB service. Despite the costs, in our model we can see that the radio can have a positive net flow, broadcasting e.g. more than 7 paid messages per day.

Foroba Blon service provider. This actor provides the mobile/web voice service that can be accessed by the village reporter and the radio station. The radio station pays a monthly subscription fee for the use of the FB service. The radio and village reporters also have to pay the phone calls, necessary to access FB, making the telco another actor in this value web.

Hosting provider.This actor hosts the FB system and provides IP transit (internet connectivity and connection to the phone network. We estimate the subscription fee for FB access to be 15000 fCFA, about 22 euro per month.

In a totally internet-less environment, a local instance of the FB platform could be deployed, with only phone access. The novelty of this FB service, using a local hosted voice-platform, is that it provides the possibility of an *internet-less web,* in which the radio becomes his own FB provider. Since this internet-less value model has not been piloted yet in a real-live rural environment, in this paper we present only the scenario in which FB is hosted by an independent service provider, (not the radio itself) and provides both web and mobile access to the platform.

> Costs of phone and internet access in Mali, in 2012:
>
> General: 1 minute of calling costs Orange to Orange = ~100 CFA (48CFA 11pm-7am)
>
> General: Cost of an Orange to Orange SMS = ~ 20 CFA
>
> General: Orange Key: 13.500 CFA buys you 2 GB/month download
>
> > General: Broadband in Mali (Bamako, SE office) Unlimited: 30.000/month (incl telephone conn.)

Interface	Port	Transfer	Occurrence	Valuation	Value	Total
Broadcast.MONEY						
	Out :Broadcast					
	In : MONEY	MONEY	1000	1000 fCFA	1M fCFA	
Phonecall :MONEY						
	Out :MONEY	MONEY	2x 1000	-100	-200K	
	In : Phonecall					
Access to Foroba Blon						
	Out : MONEY	MONEY	1	-15000	-15K	
	In : Access FB		Unlimited			
Total for actor						785K fCFA

Table X: Net value flow sheet for community radio for a period of a month (estimated costs for FB hosting)

Foroba Blon Value Model 2

The second value model for Foroba Blon has a different type of customer. This customer can be an organization that wants to broadcast an announcement or advertisement on one or several radios. This can be a commercial business that want to advertise a product or service, an NGO, or governmental department that wants to send a message to a broad audience, e.g. on health, agriculture, education etc.)

Foroba Blon model 2
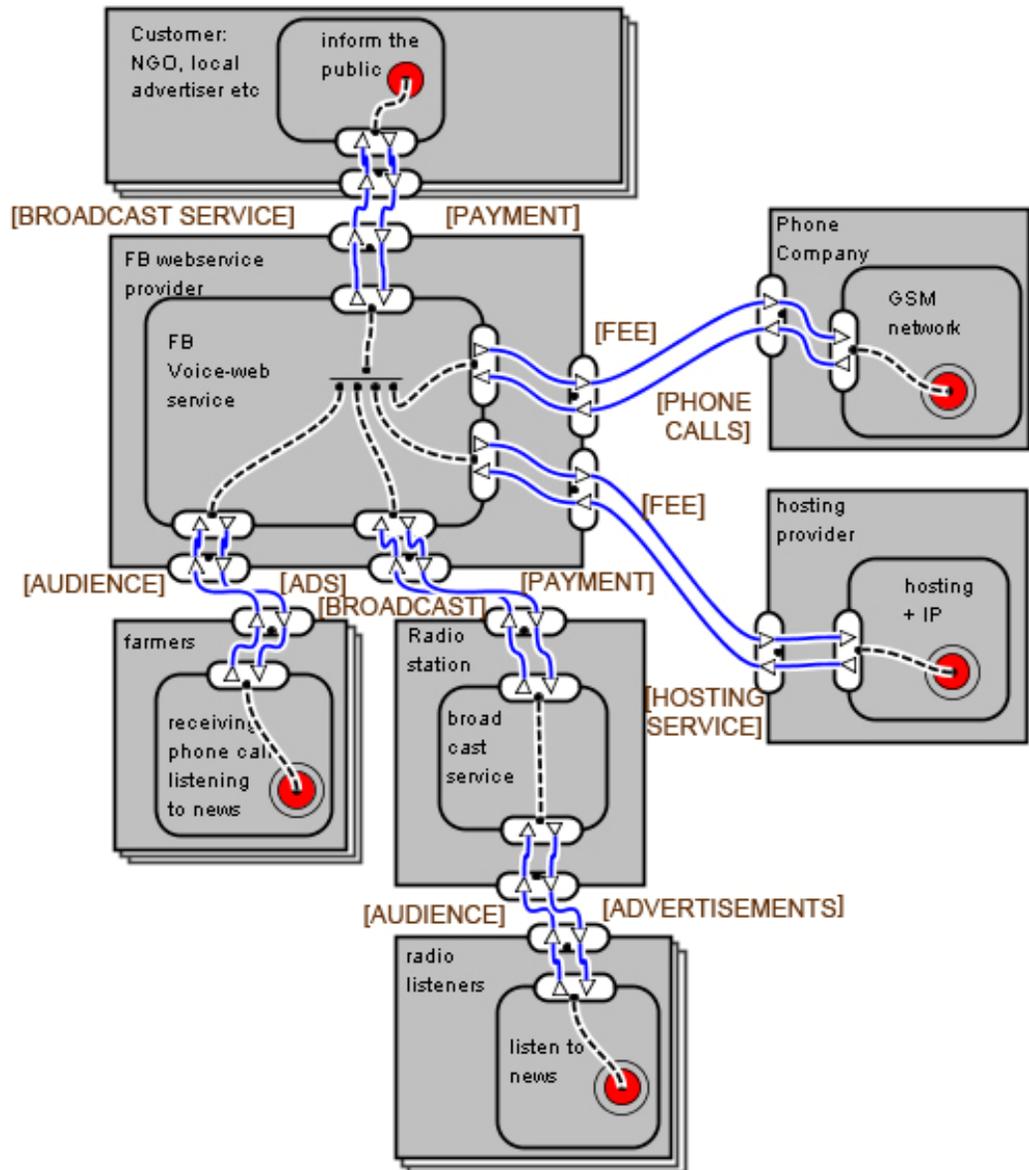
Another networked business constellation of radio, village reporter, telco and FB provider. A business company or an NGO want to pay for multiple broadcasts of one message.

Interface	Port	Transfer	Occurrence	Valuation	Value	Total
Access FB website						
	Out: FB-service					
	In: MONEY	MONEY	10	60K	600K	
Phone calls						
	Out: MONEY	MONEY	100	-100	-10K	
	In: toll free phone call for radio and farmers					
Broadcast service						
	Out: MONEY	MONEY	300	-500	-150K	
	In: broadcast					
Hosting service						
	Out: MONEY	MONEY	unlimited	-150K fCFA	-150K	
	In: IP connectivity					
						290K

Table X: Net value flow sheet for the Foroba Blon service provider

Actors in FB model 2:

Customer: An actor willing to broadcast one message multiple times on the radio. E.g. a NGO, a governmental health service, or a large advertiser.

Need: Push a message to one (or many) radio station in Mali, to inform the public about e.g. health issues, agriculture, or simply advertise a product. Optionnally, push the message to dedicated phones.

Customer properties: The organization has access to the internet, and wants to send information to the general public via radio, using the FB Web voice-interface.

Service: (i) A website of the FB-platform where the spoken or written message can be entered. (ii) The radio who broadcasts the message, according to the arrangements (time, frequency, number of radios, regions etc).

Other actors: service providers forming the FB model 2 Value Web

Foroba Blon Service Provider. This actor offers the voice- based web/ radio service (Foroba Blon) to the NGO or commercial customer. The customer can access a website and pay online for a number of broadcasts. The customer enters the messages, chooses the radio (s) it want to broadcast their message, time, frequency etc. and issues the request online. As shown on the net value flow for the FB provider on the table below, 10 broadcast requests would provide a net cash flow of 290.000 fCFA for this actor, using this business model.

The phone company . This actor who offers phone access and airtime to access the FB platform and received the payment from the FB provider's using a subscription. The outgoing phonecalls for this transaction are payed to the phone company by the FB provider.

Hosting provider (colocation provider/IP connectivity etc). This actor hosts the FB physically. platform and connect to phone network. Currently this is Orange Senegal/Sonatel.

Radio station. This can be one or multiple radio stations. This actor (or these actors) is/are notified by the FB platform about the broadcast request, by email or sms[††]. The radio retrieves the message online or via mobile phone, from the FB platform and broadcasts the message. The radio gets paid for each broadcast per minute or per message or per subscription.
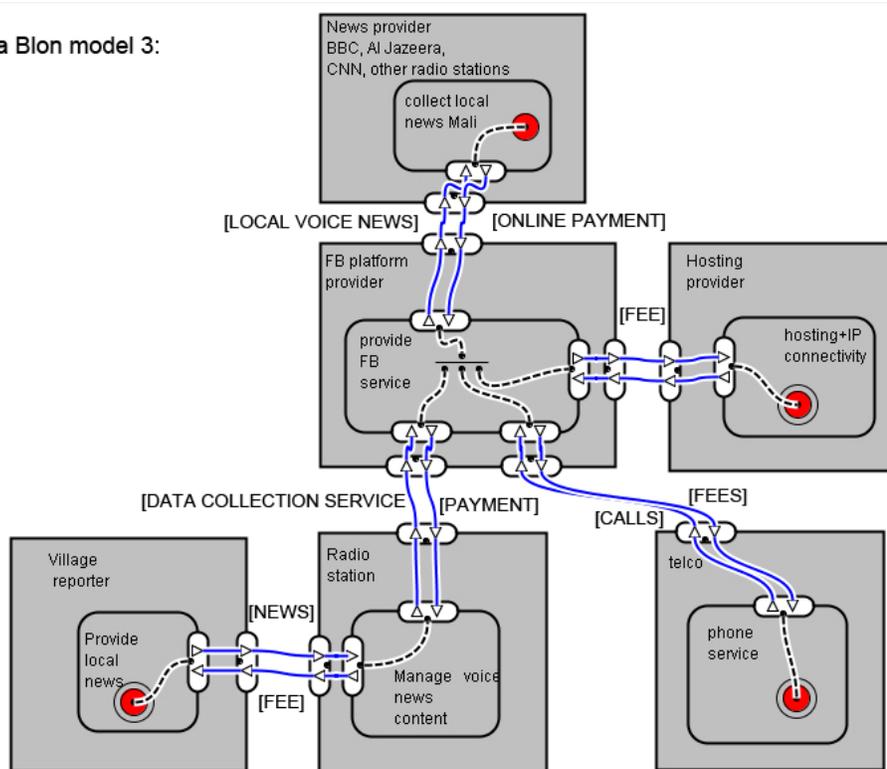
This networked business constellation emerged, as an innovation due to the introduction of the FB service. The customer here is a large media concern such as Al Jazeera. This service has already been provided in Ghana and Kenya to monitor the presidential elections.

[††] As mentioned previously, not all radio stations may have email and internet, so these get an sms alert notifying a broadcast request.

Foroba Blon Value Model 2

In this model the FB platform is used to support citizen journalism in e.g. rural Mali. This model shows an information pull, in which the local news is requested by the customer: a large media company.

Actors:

Customer: A news service such as Al Jazeera, CNN, ORTM, BBC, Wereld Omroep.

Customer needs: The news service has the interest to receive reports on local news and access them online via a dedicated web interface on the FB system.

Customer properties: The customer is a large news service interested in local reports from village reporters. This is especially interesting regarding instable political situation in northern Mali, where incidents may take place, reported by eye-witnesses and village reporters.

Service: consists of the FB platform website where the voice messages from village reporters, organized and enriched with some metadata by the local radio, can be accessed online by the Customer.

Other actors: service providers forming the Value Web

FB Service provider. This actor offers the voice- platform web service Foroba Blon to the customer via a subscription. The customer pays either a flat fee per month to access all messages, or a fee per news audio file.

Phone company. This actor provides the phone access via toll free numbers that can be dialed by the village reporters. The FB provider pays for these calls via a subscription.

Radio station. This actor holds contact with the village reporters in the field. Apart from this, the radio person filters the incoming news messages, and enriches the news messages from the radio journalists with metadata, using FB web interface. The radio station contracts the village reporters.

Village reporter or radio journalist. Only trusted reporters (whose names and phone numbers are known to the FB system) are allowed to leave a spoken news report on the FB voice platform. They receive a fee per message. The radio journalist pays them. They report on the situation in the streets.

Net value flow sheet for FB provider

Interface	Port	Transfer	Occurrence	Valuation	Value	Total
News,MONEY						
	Out: News					
	In: MONEY	MONEY	1000		1000K	
Tollfree phone calls, MONEY						
	Out: FEE	MONEY	1000	100 fCFA	100K	
	In: Tollfree number					
Hosting service, FLAT FEE						
	Out: FEE	MONTHLY FEE	1	150K fCFA	150K	
	In: IP –connect.					
News service, MONEY						
	Out: MONEY	MONEY	1000	0,5 K	500K	
	In: Audio files					
Total for actor						250K fCFA

In this example we assume 1000 messages are entered into the system. The media company pays a fee of 1000 fCFA per news message. (About 2 euros).

Discussion

Firstly, we designed Foroba Blon model 1, based on the input we received from the local stakeholders, concerning their information needs. This model replaces an existing business model, in a cost-effective way. The customer and the radio station experience improved efficiency due to the FB service, as we heard from radio journalist Adama Tessougué, who tested FB, with a number of his village reporters.

The second and third value models are examples of new services that can be launched in the local context, using a platform such as Foroba Blon. The two value models described above, were non-existing previous to the FB deployment. These modles may represent a local innovation that was a consequence of the introduction of this technology in this local context.

In models 2 and 3 the villager (farmer, village reporter) is no longer the customer in the value model, but a service provider or even a market segment. The farmers provide the listeners based, targeted by the customer, who wants to send them information or advertisements.

In models 2 and 3, the radio no longer pays for the FB service, but receives the payment from the FB provider to provide a service. The telecom provides the phone calls to and from the FB platform and receives payment from FB provider, so that villagers can have toll free numbers e.g. to enter information in model 3, or to receive or access information in model2.

A service provider that wants to deploy the FB mobile/web platform in Mali, will try to maximize the profitability of his services and deploy these three services simultaneously. However, many other types of voice-based radio services can be designed and deployed, once the FB service is in place, and the technical obstacles have been solved.

Further work on sustainability of voice-based services in the rural context

In the near future, the above models will be further deplkoyed and tested in the local context, in close co-creation with local stakeholders: radios, NGOs and farmers. Other sustainable value models may emerge, e.g. were remote villagers, e.g. in the diaspora can access the FB platform and retrieve voice-messages via the Web.

The scalability of the Foroba Blon platform is an issue. This has to be assessed, both in terms of web and mobile access capacity, given the limitations of internet in the given regions, and the number of concurrent phone calls that are allowed.

The user interfaces to the system will be improved, in close collaboration with the end-users. Different language packs will be implemented, apart from French, Bambara, Bomu, other languages are requested, such as Dogon. The user friendliness of the interfaces will need improvement.

In Mali phone-based payment services have been introduces lately: Orange money. We have not taken this into account in our models, since many of our stakeholders do not use these mobile payment services at present. Another issue is the low coverage of Orange in the regions of the pilot. The other telco in Mali, Malitel has a slightly better coverage. In future deployments we will further assess the possibilities of using mobile payment to improve the value webs, as proposed in this section.

2. Synopsis of Foroba Blon results

"Foroba Blon" signifies a space where everyone has the right to speak and the truth can be told; but only if you do it respectfully. In early February 2011, the International Press Institute,[‡‡] a global network of editors, media executives and leading journalists dedicated to the furtherance and safeguarding of press freedom, initiated a call for proposals under the IPI News Innovation Contest[§§]. The contest aimed at advancing the future of news by funding new ways to digitally inform communities in Europe, Middle East and Africa. The Web Foundation and its consortium partners were chosen as one of the three winners of the contest.

Foroba Blon is a tool for community radios to gather news or listeners' reactions as submitted by mobile phones. It does so by facilitating incoming communication with remote correspondents submitting information via their mobile phones[***].

People in rural regions don't usually have access to computers or mobile internet access. Instead, they get their news from local community radios. Those radios often find it difficult to communicate with listeners or reporters, and can miss stories or important feedback. However, web technology can help and that's what we seek to demonstrate.

The platform is accessible by calling a local phone number and interacting with a vocal application (otherwise known as interactive voice response system, or IVR). All the functionality offered to listeners, journalists and radio staff is available through simple speech interaction. It is therefore accessible to non-literate people, and doesn't require any platform deployment by the radios.

Listeners or correspondents can leave messages on the platform. They call the system and leave news stories, reactions to programs they've heard, or anything they wish to communicate to the radio and other listeners. The messages are stored on the platform, and anyone at the station can call the system, manage the messages and broadcast selected ones.

The ability to store the messages and manage them offline can greatly help radio presenters by assisting with the often overwhelming task of running a live programme while managing instant feedback.

3. Opening Speech Voices Conference April 23 2013 by Mary Allen, Sahel Eco

Projet de Discours pour la cérémonie d'ouverture de l'Atelier Final de Voices le 23 avril 2013 à l'Azalai Hotel Salam

- Monsieur le Représentant du Ministère de la Communication et des Nouvelles Technologies de l'Information ;
- Madame la Représentante du Ministre de l'Agriculture ;
- Mesdames et Messieurs les Représentants des Partenaires Techniques et Financiers
- Mesdames et Messieurs
- Chers Invités

Permettez-moi au nom de SAHEL ECO et de tous les autres membres du consortium du projet VOICES, représenté ici par la WEB FOUNDATION et l'Université Libre d'Amsterdam, de vous

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[‡‡] http://www.freemedia.at

[§§] http://www.ipinewscontest.org

[***] http://www.webfoundation.org/2012/08/foroba-blon-and-our-radio-platform-for-citizen-journalists/

souhaiter le bienvenu à l'Azalai Hotel Salam et de vous dire jusqu'à quel point nous sommes honorés par votre réponse à notre invitation et votre présence ici aujourd'hui.

Pour ceux qui nous ne connaissant pas, SAHEL ECO est une ONG malienne créée en 2004 par la transformation en structure autonome du programme de SOS Sahel International GB au Mali. Nous œuvrons surtout dans les domaines d'environnement et du développement rural et principalement dans les régions de Ségou et Mopti.

Comme vous verrez au cours de la journée, notre collaboration avec le projet VOICES nous a amené à travailler dans un domaine qui n'est pas du tout – correction n'était pas du tout - le nôtre celui des nouvelles technologies pour le développement – et mieux sur un thème qui est vraiment de l'actualité dans ce domaine – celui des services sur voix.

Au cours de la collaboration nous avons certainement beaucoup appris mais nous avons aussi été agréablement surpris (si vous m'excuser le mot) par la disponibilité et la capacité de nos collègues chercheurs et développeurs de programmes, de nous écouter et d'écouter nos partenaires – les producteurs ruraux et les radios de proximité – et d'apprendre aussi.

Notre objectif en tenant c'est atelier n'est pas de faire ressortir des plans stratégiques ni des recommandations formelles. Pas du tout – détendez-vous!

L'objectif est de partager avec vous notre petite expérience et de recevoir vos réactions, vos analyses et vos idées afin n'ont seulement de mieux faire à l'avenir mais aussi, ensemble, de faire plus.

Nous espérons qu'aujourd'hui sera la première d'une série de conversations au tour de ce thème unissant l'ensemble des parties prenantes réunis ici qui sont des acteurs des NT:

- des groupements de femmes et autres producteurs à petite échelle des communes rurales et leurs organisations faitières
- les radios de proximité
- les ONG, les projets et d'autres structures d'appui au développement
- Les médias et les spécialistes de communication
- les webmasters, programmateurs et développeurs web
- les services techniques et autorités étatiques
- les institutions de recherches nationales et internationales
- les partenaires techniques et financiers

Donc je vous invite tous à contribuer au maximum aux discussions et de tirer le maximum de profit de la présence des spécialistes pendant qu'ils sont à notre disposition au Mali.

Soyez les bienvenus,

Auw bisimilahi.

4. Interview with Zakary Diarra, farmer, honey producer and entrepreneur from Bokuy-Mankoina, (Tominian region), Mali, April 2013

By : Amadou Tangara, Sahel Eco, Tominian, Mali

Date of the interview : 26 April 2013

Name : Zakary Diarra

Age : 39 y

Village : Bokuy-Mankoina

Marital status : Married to one woman

Children : 3 boys and 2 girls, all attending school

1. How did you get involved in the project ?

I have followed the Regreening (by Sahel Eco) project with much interest since 2006 ever since the first meeting in which we became aware of the importance of non-timber forest produce (NTFP). I have been a beekeeper since young age. For me this application of NTFP (Non-timber forest produce) represents an important action towards poverty alleviation.

2. What did you do before being involved in this project ?

In my village I am farmer and beekeeper; every year after the harvest and the work on the fields, my main activity is beekeeping and I also sell the unrefined honey in the nearby village markets.

3. What is your role in the project? What does that imply ? What kind of activities have you done in this project ?

As a member of the group of honey producers, and as contact person for the MIS of this project, (Market Information System) I benefited a lot, especially from the honey revenues. In 2010 I sold 150 kilo of unrefined honey at 500 fCFA per kilo which resulted in a turnover of **75000 fCFA**. In 2011 I sold more than **93L** liquid honey at 1500fCFA resulting in **139500 FCFA**.

I was trained in honey collection and also how to send messages to the system concerning prices and offers of produces.

I also had a training how to make liquid honey out of the unrefined honey. We felt that the rise in income was due to the MIS. As we can summarize the effects:

- o   Unrefined honey has risen from 500 fCFA per kilo to 750 fCFA.
- o   Liquid honey was formerly an unknown product. Today we sell it for a price between1500 à 2000fCFA per litre.
- o   Sheabutter has risen from 350f up to 750 fCFA;
- o   Smoked sheanuts doubled in price from 75f per kilo to 150fCFA;
- o   High quality sheanuts were formerly unknown, and now we sell them 200f – 250fCFA per kilo;
- o   High-quality shaebutter was also new, it is now sold for 1000 FCFA/Kg;
- o   I am very pleased to be a SIM contact person, since this role is highly appreciated in the village, some people even call me *Sozakary*, this means "Zakary of Honey".
- o   I have become a real entrepreneur. My name is known in many villages, as it is often broadcast on the radio, related to the announced product offerings.

4. What did you learn from this project?

I learnt a lot of new things, including :

- o   How to operate the MIS by sending SMS messages of the offerings
- o   How to negotiate with customers
- o   Knowledge of the honey value chain
- o   Knowledge of what the customers like
- o   Knowledge how to set up and run a business
- o   I did study visits.

5. What did you experience as difficulties in the project?

I experienced the following difficulties :

- o   Not being able to satisfy the demand of the customers
- o   Some customers are very demanding without buying much
- o   The instability of the phone network is annoying when you talk to customers.

6. Did the project change your life?

Yes, my life has changed considerably due to the project. I am now able to plan my work and manage my income. This year I was able to buy a donkey and a cart. The project has given me a higher standing in my village and in the surrounding villages.

7. Can you give some comparative images that describe the benefits you have gained during the project ?

These were the benefits I gained due to the project :

o   Better food stability then before the project

o   Better management of my income

o   I am able to pay schooling for my children

o   I was able to buy a cart and donkey

-   I am now appreciated for being a MIS contact person

8. Que feriez-vous si vous n'étiez pas impliqué dans le projet ?

If I would not have joint the project, I would be doing mainly regular farming, and I would have missed this opportunity of selling honey.

9. How do you see the future, and possible future revenues?

I am dedicated towards expanding my number of beehives, and advising others in the village to do the same, so that we together can meet the customers' high demand and increase our honey production and volume of sales.

10. What is your message to the donors of TREE AID who helped set up this project ?

"I am very pleased with this MIS method which improved the confidence and collaboration amongst honey producers and sellers. I would like to thank the donor for this approach, which generated income to us producers."

E. Sales result RadioMarché

Date	village	commune	Prénom et nom de l'animateur	contact de l'animateur	Produit	Prénom et Nom de l'entrepreneur	Contact de l'entrepreneur	Quantité vendue	Prix de vente unitaire	Prénom et Nom du client acheteur	Contact du client acheteur
07/11/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Hekéré Demcélé	76 27 83 91	22	44,000	Bèzoun Karraté	
07/12/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Passoun Dembélé	75083665	11	22,000	Bèzoun Karraté	
14/07/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Wemian Kamaté	75083665	22	44,000	Bèzoun Karraté	
22	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Bethkori Demcélé	70607558	33	66,000	Bèzoun Karraté	
17/07/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Samou Dembélé	76915871	11	22,000	Bèzoun Karraté	
19/7/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Zabert Dembélé		22	44,000	Bèzoun Karraté	
20/07/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Lopo Dembélé		33	66,000	Bèzoun Karraté	
21/7/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Naxoua Dembélé		22	44,000	Bèzoun Karraté	
23/07/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel	Bazourou Dembélé		11	22,000		
25/07/2012	Fon	Koua	Hekéré Demcélé	76 97 83 91	miel						
07/9/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Remy Traoré		11	22,000	Sariabé Demcélé	76832088
08/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Gérard Traoré	727.42.48	10	20,000	Youssouf Coulibaly	77968054
09/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Naxoua Dembélé		50	100,000	Youssouf Coulibaly	77968054
09/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Lopo Dembélé		22	44,000	Sariabé Demcélé	76832088
11/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Béh Traoré		15	30,000	Silvain Traoré	
15/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Dana Traoré	77374294	82	16,000	Sariabé Traoré	
14/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Dana Traoré	77374294	15	30,000	Sariabé Traoré	
14/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Baràwé Déna		11	22,000	Ives Traoré	
16/9/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Miel	Yirassin Dembélé		10	20,000	Ives Traoré	
16/9/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Jéosséhyne Dembélé		10	12500	Bèzoun Karraté	
03/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Marguelitte Diarra		5	6250	Simori Traoré	
05/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Saghani Koné		15	18750	Simori Traoré	
05/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Marie Madeleine Dembélé		15	18750	Patouma Karakodio	
04/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Touman Coulibaly		12	15000	Edwise Coulibaly	
04/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Henrietta Coulibaly		10	12500	Bawa Coulibaly	784466597
06/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Samouhan Coulibaly		10	10000	Christine Traoré	
07/09/2012	Tièclénikuy	Koua	Gérard Traoré	77 27 42 48	Beurre de Karité	Boua'nan Dembélé		8		Christine Traoré	
07/09/2012	Tièclénikuy	Koua	Moudian Keïta	78437947	Beurre de Karité, amade	Déra Dembélé		3	500	Beïgue Théra	50161134
08/09/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Mangananhan Diarra	2 tines		2250	Anacleth Diarra	50161134
08/09/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Schan Dembélé		15	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Anré Kamaté		21	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Awa Dembélé		12	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Antounan Koné		11	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Sikemwa Théra		5	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Anabeth Diarra		22	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Blancine Dembélé		12	500	Beïgue Théra	50161134
14/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Ranzouna Kone		10	500	Beïgue Théra	50161134
21/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Nazmie Demcélé		60	500	Moussa Théra	50161134
21/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Farbe Dehan		10	500	Moussa Théra	50161134
21/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Nacmie Kamaté		10	500	Moussa Théra	50161134
21/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Nazmie Kamaté		14	500	Moussa Théra	50161134
28/08/2012	Sira	Mafouné	Moudian Keïta	78437947	Beurre de Karité, amade	Baressane Kamaté		12	500	Marissan Théra	
28/08/2012	Sira	Mafouné				Nazmie Kamaté		14	500		

F. Feedback by Sahel Eco regarding monitoring system

Sahel Eco evaluated and requested the logging system to monitor the usage and availability of the services RadioMarché, Tabale and Foroba Blon, using one single web interface. This is the mock-up representing the interface. The table below shows only fake data, as an example of the wishes from Amadou Tangara and Mary Allen (SE).

W4RA VOICE Services LOG

session_id	Date	Heure	Numero teleph utilisateur	utiliseur web	Service	Activité	Success	Erreur	langue
#38	2-feb-11	5.00 pm	"+2335447654"	Radio Segou	RM				
					FB	laisser message			Bambara
#52				Sahel Eco	m-event	Creer evenement			BO; FR
#52				Sahel Eco	m-event	enregistrer message			Bomu
					m-event	ajoindre participants			
					RM	Publier communique			
			"+2335447654"		RM	ecouter			
					RM	telecharger	non		
					RM	diffuser		on coupé	
			"+233587575 76"	Jean-Baptiste	FB	Record/Listen/Delete		connecti	
				Radio Moutian	RM	Download			
				Sahel Eco	RM	Create communique			
				Sahel Eco	m-event	Launch event			
				Sahel Eco	m-event	Left message			

G. Stakeholder feedback RadioMarché, October 2012, written questionnaires

Nom de la Radio		Tominian	Ségou	Mopti	Koutiala
Date enquête		30/10/2012	19/10/2012	23/10/2012	22/10/2012
statut de la personne enquêtée					
1. Quelle interface utilisez-vous pour faire les émissions RadioMarché ?	*Internet*		x	x	x
	téléphone mobile	x			x
	pourquoi?	Je ne suis pas connecté à internet	Plus facile, programmable dans grille de diffusion	Les auditeurs préfèrent me voir c'est pourquoi nous préféront prendre le fichier et moi-même je fais le communiqué	Nous faisons les 2, le téléphone pour diffuser la version française, le fichier excel pour faire la traduction en bambara à la demande des auditeurs et en minianka pour d'autres
2. Quelle est votre appréciation de l'interface pour faire l'émission des communiqués RadioMarché?	*Donnez un score (à l'échelle de 5) à l'interface par rapport à l'émission des communiqués RadioMarché*	3	4	3	4
	Justifiez votre score	L'enregistrement n'est pas facile avec le téléphone, la qualité sonore de l'accès téléphone n'est pas bonne	Facile à utiliser, prêt à diffuser	C'est clair mais pour une station, ça devait être faite avec une voix	C'est très facile mais la consommation est trop élevé, le n° n'est pas gratuit
	Quels sont les aspects de l'interface qui rendent difficile l'émission du communiqué sur la radio ?	Le coût de communication est elevé	pas de difficulté	La diffusion à partir du téléphone	La consommation est trop élevée

	Quelles sont vos suggestions/recommandations pour lever les difficultés ?	Il faut des téléphones à haute voix sonore		Faire le communiqué avec ma voix, faire des dépôts de produit à des lieux accessibles, bien organiser les liaisons aux demandeurs	reduire la consommation crédit, développer le communiqué bambara
	Est-ce que l'interface est logique dans sa démarche ?	oui	oui	oui	oui
	Justifications et suggestions	Les instructions sont claires		quand on suit, les étapes sont claires	On comprend, pas de problème pour avoir le message
3. Quelle est votre appréciation de la qualité de la voix des communiqués ?	*Donnez un score (à l'échelle de 5) à la qualité de la voix des communiqués RadioMarché?*	4	3	4	2
	Justifiez votre score et faites des suggestions	On entend, on comprend	La voix générée du communiqué est très bonne	La qualité est assez bonne mais nous n'avont pas de bon téléphone	Le son est surmodulé, il ya du vent sous la voix, nous permettre d'avoir accès au son généré
4. Quels sont selon vous les points de satisfactions et d'insatisfaction de la mise en œuvre jusqu'à maintenant de RadioMarché ?	*satisfactions*	Les communiqués sont courts et compréhensibles	Les auditeurs suivent les communiqués, ils se déplacent pour prendre des infos compléments	Nous donnons de bonnes informations, les communiqués sont écoutées par ce que les commerçants et ce qui ont besoin nous appellent pour des informations complémentaires	Information en temps réel, c'est une formation pour nous, nous sommes plus proche du marché
	insatisfactions	La mauvaise qualité sonore de mon téléphone	Les auditeurs disent qu'ils n'arrivent pas à avoir leur commande de miel	les besoins ne sont pas satisfaits	La qualité du son, la consommation du crédit

5. Faites des suggestions/recommandations pour améliorer RadioMarché?	Doter les points focaux en téléphone de bonne qualité sonnore, faire un point de liaison des produits à Tominian	Faire un point de liaison à Ségou	Il faut faire un point de liaison accessible, bien organiser les liaisons, les producteurs doivent être plus accessible	Etendre à d'autre radio, donner les infos d'autre producteur
6. Est ce que vous avez reçu des commentaires de vos auditeurs concernant RadioMarché? Si oui que disent-ils?	Oui, plus d'eclaircissement	oui, les acheteurs n'ont pas lleur commande	oui on a des appelles, les gens se plaignent de la non satisfaction des besoins, ils disent que les producteurs ne sont pas accessibles	Nous avons donner les numéros aux clients qui sont venus chercher
7. Si les communiqués de RadioMarché s'arrêtèrent, quelles seraient les conséquences pour la radio? Pour les auditeurs?	doit continuer	manque d'infos sur les produits	pas de raisons valables pour arrêter	Pas de raison d'arrêter

H. Feedback on RadioMarché, face-to-face interviews with Fousseyni, animateur at ORTM Segou

Feedback on RadioMarché

The radio broadcasts of RadioMarché communiqués creates a demand of honey that cannot be met by the producers. This same feedback is given by radio Bankass, Mopti and Tominian. They ask to stop the broadcasts of communiqués. They also suggest to create salespoints in the villages of Segou, Tominian etc. to take the burden off the radio stations who are called by buyers interested in honey. Sometimes the buyers want 100 liters of honey, but this is not yet aggregated. The transport of the honey is also an issue. The value chain is not yet organized. The demand for shea butter does still not exceed the offerings.

Feedback Fousseyni on generated Bambara communiqué

The written text contains a few grammatical errors. Fousseyni and Tangara correct this.

He is able to understand the spoken communiqué. However, according to Fouseyni and Tangara this is not good enough for broadcasting. There are not enough pauses between the words and sentences. The intonation sounds unnatural. Fousseyni reads the corrected text and we record this.

Feedback on Tabalé, face-to-face interviews and hands-on evaluation by Drissa Gana and Amadou Tangara, staff from Sahel Eco.

Feedback on Tabale system

Issue: Dates in the web interface are in US style.

Request: in dd/mm/yy

Issue: Messages are sorted, first on top of the list.

Request: Latest event should be on top of the list of messages

Issue: Usernames

Request: we would like usernames for Mary, Drissa, Tangara etc. so that we know who issued a message

Issue: There are three option: Yes, No, Don't know. Don't know can mean: farmer does not know if he will attend and pressed DTMF option 3. Or message not answered.

Request: Different status for: (a) received message but still pending (b) has not received message.

Issue: When your voicemail picks up the phone, the system does not register this. Many people here never used their voicemail and don't even know it is there.

Request: We would like the system to perceive "no answering phone" or "voicemail picked up". And sets this as status; then calls again after x hours.

Issue: The Tabale system does not give the correct phone number (0003) on the phone display "incoming call". (0000 instead which is the general entry number to FB and RM and TB). This is confusing. People should be able to call Tabale and retrieve the latest message. And leave a message "attending yes/no/don't know.

5. User evaluation Foroba Blon

Foroba Blon was used in 2012 by Radio Sikidolo in Konobougou, radio ORTM Segou and Radio Bankass. The application was evaluated through an evaluation form as well as an informal discussion with Sahel Eco operative Amadou Tangara. The aggregated results from this evaluation can be found in Appendix.

In general, radio personnel evaluated the Interface positively (on average 3.66 on a 5-point Likert scale) the interface was evaluated. The audio quality of the voice was also evaluated as positive (3.33). Positive features included speed of communication with remote villages. Negative points include the lack of an interface in local language Dogon and difficulties getting phone credit reimbursed. Radio Sikidolo and ORTM Segou both report that they have received, accessed and broadcast messages from citizen journalists using Foroba Blon, for example about rainfall. Radio Bankass reports receiving messages, but none were selected for broadcast.

Radio Journalists are also mildly positive about the Foroba Blon voice interface (average score of 3.0 for the interface and a 4.0 for the voice quality). 14 out of the 16 interviewed citizen journalists responded that the interface was 'logical'. One found the

interface to be difficult to use and one was not able to use the service at all. For a more detailed evaluation, we direct the reader to Appendix [Saisie des Donnees…xls].

An interesting observation was that the system was included in larger business models. Radio Sigidolo employs cit.journ (CJs) that get paid by people (1000CFA (cost for communiqué) + 200 CFA phone credit) that want to broadcast a message. The CJ then calls Sigidolo. Every week the CJ is payed a percentage of the money he handed in.

Usage and Evaluation

Initially, during the pilot phase scoping exercise, we had planned for three radio stations. However based on the excellent responses and keenness shown by additional radio stations that list has now been extended to four. These include Radio ORTM Segou, Radio Moutian, Radio Sikidolo and Radio Saniya also in Mali. In addition to the radio stations we also engaged with a very successful blogger in Mali, Boukary Konate who maintains the popular blog fasokan[†††] extending the count to five.

Since the inception of the project we have realized the importance of the organizational setup to roll out Foroba Blon suite of services. There has been sufficient buy in from the top, e.g. the radio management as in the case of ORTM Segou or Saniya Communications -- the holding company of Radio Saniya. In addition to this organizational buy-in there also is the need for active correspondents who are linked to such radio stations to gain the real value of such voice based services.

It is expected that where this structure is present the uptake of services would be more due to the catalysing role being played by these correspondents within the local communities. Where such field support is absent the diffusion of real value may take a longer curve. Owing to this organizational learning we decided to drop the general public version of Foroba Blon as it requires extended training, and it is expected that radio stations with a strong correspondent community network will show the best results during evaluation.

Also, during the face-to-face meetings after the launch of the service discussions revolved around several additional features and functionalities for the platform. Some of these that are now to be incorporated in the subsequent iteration are;

•   Sharing of broadcasts (like podcasts) amongst the different radio stations.

•   Diaspora: Sharing the broadcasts for the diaspora.

•   Archiving the broadcasts and making them avail on request.

Discussion on Foroba Blon

[†††] http://fasokan.com

This service was designed such that once a community shows interest in it, all that would be required is registering their various *animateurs* and field workers within the system and taking them through an initial training program.

Community radios play an important role in the regions where Foroba Blon was deployed. For rural dwellers, the system provides an avenue to make their voices heard on everyday community and even national issues. It stimulates user involvement in community building and promotes useful debates and interactions. The essence of this service is much akin to mainstream popular social services such as web blogging. The difference in our instance is the mode of access to such a service and the scope it takes.

Whereas a typical web blog is for all with web access, Foroba Blon is geographically tied to a specific region depending on where it is deployed. However, information from community radios spreads quickly because people in these areas listen to them on almost a daily basis which makes it an important medium of information exchange, a similar advantage that the Internet provides. Providing this service to a number of communities solves a specific problem by facilitating information spread to a specific number of people using the same technologies that are behind the Internet. This service could be expanded to several other communities with similar prevailing infrastructure conditions to form a mesh of information streams from rural community radios.

6. Dump Of Tabale technology
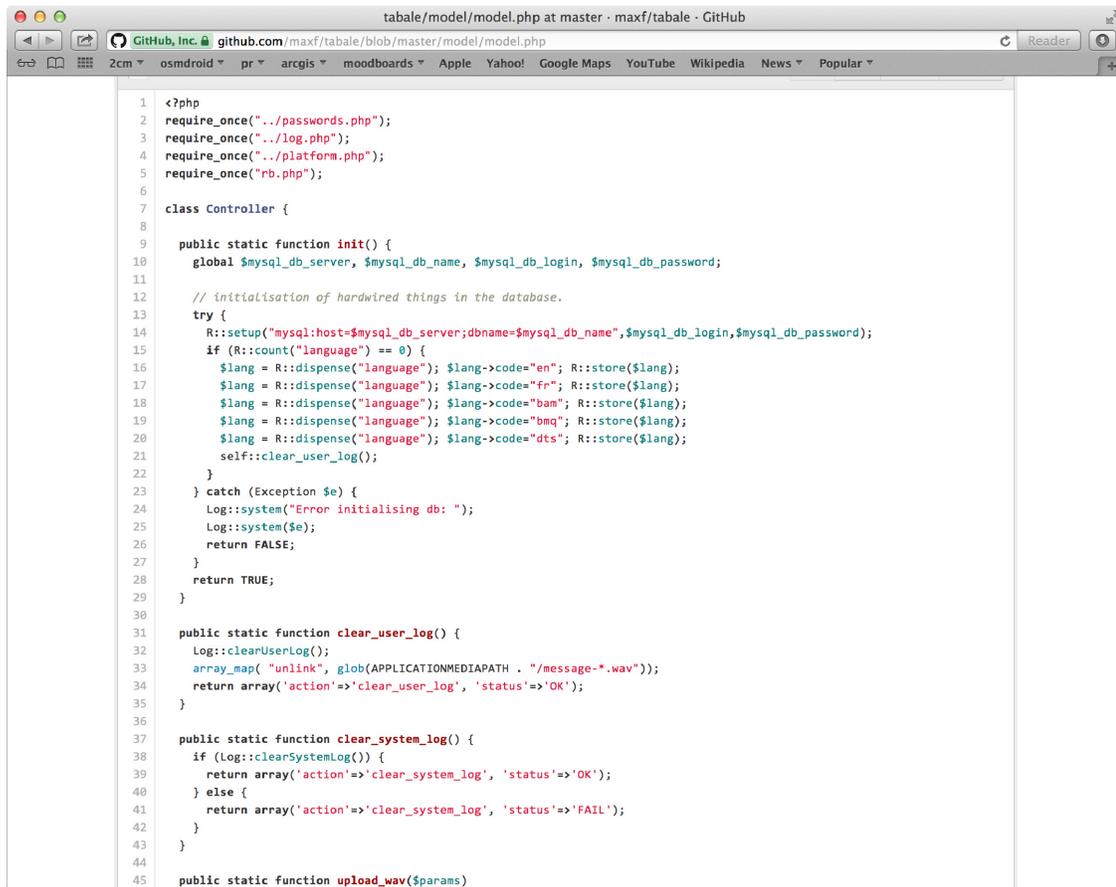
```php
1   <?php
2   require_once("../passwords.php");
3   require_once("../log.php");
4   require_once("../platform.php");
5   require_once("rb.php");
6
7   class Controller {
8
9     public static function init() {
10      global $mysql_db_server, $mysql_db_name, $mysql_db_login, $mysql_db_password;
11
12      // initialisation of hardwired things in the database.
13      try {
14        R::setup("mysql:host=$mysql_db_server;dbname=$mysql_db_name",$mysql_db_login,$mysql_db_password);
15        if (R::count("language") == 0) {
16          $lang = R::dispense("language"); $lang->code="en"; R::store($lang);
17          $lang = R::dispense("language"); $lang->code="fr"; R::store($lang);
18          $lang = R::dispense("language"); $lang->code="bam"; R::store($lang);
19          $lang = R::dispense("language"); $lang->code="bmq"; R::store($lang);
20          $lang = R::dispense("language"); $lang->code="dts"; R::store($lang);
21          self::clear_user_log();
22        }
23      } catch (Exception $e) {
24        Log::system("Error initialising db: ");
25        Log::system($e);
26        return FALSE;
27      }
28      return TRUE;
29    }
30
31    public static function clear_user_log() {
32      Log::clearUserLog();
33      array_map( "unlink", glob(APPLICATIONMEDIAPATH . "/message-*.wav"));
34      return array('action'=>'clear_user_log', 'status'=>'OK');
35    }
36
37    public static function clear_system_log() {
38      if (Log::clearSystemLog()) {
39        return array('action'=>'clear_system_log', 'status'=>'OK');
40      } else {
41        return array('action'=>'clear_system_log', 'status'=>'FAIL');
42      }
43    }
44
45    public static function upload_wav($params)
```

7. Voice XML
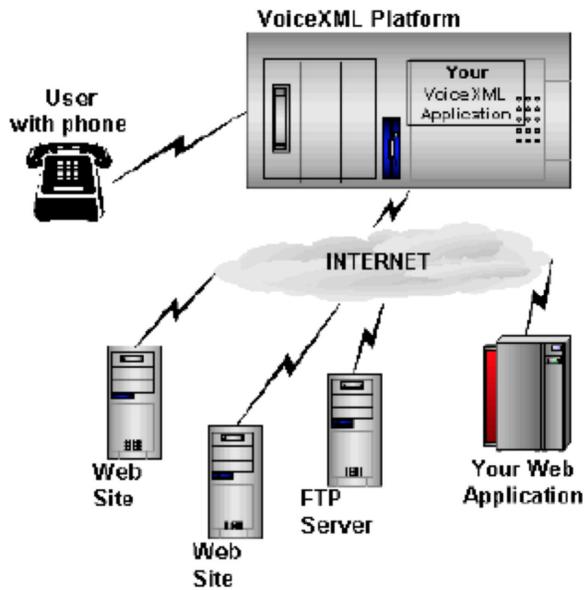
Figure 23: VOICE XML Platform
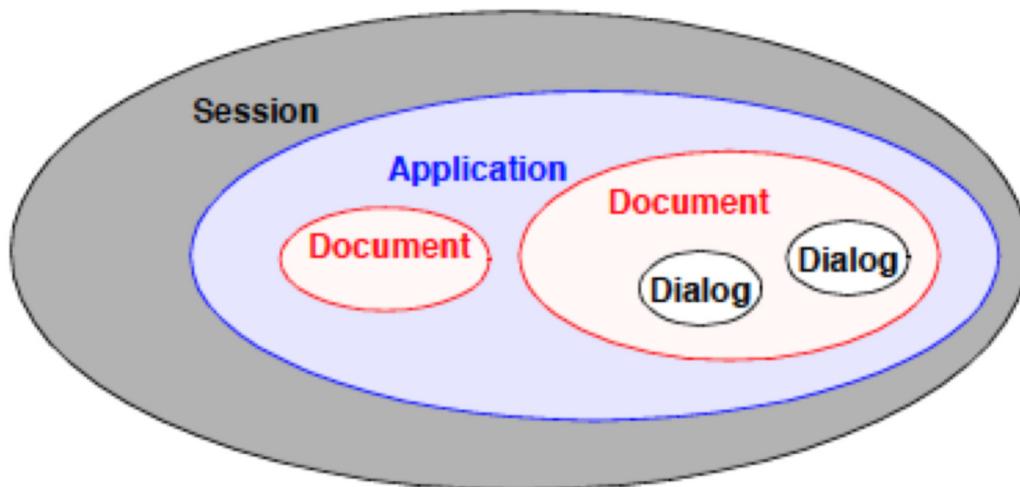
Figure 24: Voice XML Application architecture

```
<?xml version="1.0"?>
<!DOCTYPE vxml PUBLIC "-//BeVocal Inc//VoiceXML 2.0//EN"
  "http://cafe.bevocal.com/libraries/dtd/vxml2-0-bevocal.dtd">

<vxml version="2.0"
  xmlns="http://www.w3.org/2001/vxml"
  xml:lang="en-US">

  <form>
    <field name="selection">
      <prompt>
        Please choose News, Weather, or Sports.
      </prompt>
      <grammar type="application/x-nuance-gsl">
        [ news weather sports ]
      </grammar>
    </field>
    <block>
      <submit next="select.jsp"/>
    </block>
  </form>
</vxml>
```

Figure 25: simple VoiceXML document

8. Marketing of agricultural products in rural areas of northern ghana

Introduction

The data survey conducted in Northern Ghana, which provides empirical data to verify the need for an ICT solution and subsequently obtain specific data needed for requirements of the software showed that the underlying issues in marketing of agricultural products from rural areas are a lack of buyers, low price offers and lack of transportation to sale points.

It further showed that farmers currently sell mostly to individuals and at the local markets, even though the analysis showed that as medium to large scale farmers, they have the capacity and are willing and able to produce more than they currently do. They however have a lack of buyers and no effective means (ICT or otherwise) to advertise.

The current solutions are therefore sales to individuals and at the local market. These solutions are not adequate because these buyers are not sufficient to purchase in large quantities and as such do not reach the full capacities of the farmers. Furthermore, the analysis showed that farmers do not have access to ICT solutions. The findings also showed the availability and use of mobile phones by these farmers. It however shows that rural farmers never use SMS. The data also confirms a willingness to use and pay for a voice-based ICT service for advertising.

Survey

In order to understand issues related to marketing of agricultural products we developed a questionnaire. These questionnaires were administered in three rural

areas in Northern Ghana [19] to medium to large scale farmers. These areas include villages in the vicinities of Yendi, Bolgatanga and Savelugu. This selection is meant to concentrate on rural farmers that have the potential to market their produce.

The three locations chosen within the target area were based on availability of field workers from the various NGOs and organizations that run the survey, in the area which effectively ensured mutually exclusive groups. Farmers within each of these three groups were interviewed randomly based on their availability.

The questionnaire[‡‡‡] was designed based on several hypotheses that theorize the issues surrounding sales of agricultural products from rural areas, what is currently done with regards to selling agricultural products and the current trend of ICT usage by farmers in relation to the topic at hand. This was necessary to confirm findings from the reviewed literature [5] [9] [27], determine those that have not been answered by the review (i.e. mostly context-based issues) and effectively answer the research questions. Some questions, such as type *of crops produced*, *the willingness to use an IVR-based service* and *preferred language*, within these broader topics were meant for requirement elicitation for the prototype in the specific context, while other questions that probed the *ability and willingness to store, package and sell* were meant to assess situations that will have an impact on the business models needed to facilitate an implementation of the developed system.

All data was collected by field personnel with previous experience in questionnaire administration in rural areas. The inability of our respondents to read and write necessitates the use of experienced personnel who can note the right answers as spoken by the farmers. The identities of all participants are confidential. Multiple-choice questions were pre-coded and open-ended questions were post-coded for quantitative interpretation. Data was entered using a customized design template in Microsoft Access to ensure accuracy.

Figure 26: Field survey

Qualitative Data Gathering

Open-ended questions were included in the questionnaire in order to lead the field workers in short discussions on certain key points. Examples are reasons for not selling produce and problems faced finding buyers. These, and other similar factors, are

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[‡‡‡] http://fsd.netau.net/Questionnaire.pdf

analyzed qualitatively as well in an explanatory fashion so as to better understand the factors without forcing predefined answers or limiting the responses.

A combination of interviews with members of the VOICES Project on the RadioMarché Project in Mali [7], secondary information from various NGO-run projects in Northern Ghana and personal experience of the region and context was used as secondary data.

These interviews and open-ended questions led to certain key findings. Firstly, the emphasis on mobile telephony was strong. Experts see mobile technology as the means to any viable solution in rural Africa. Also, the need for a well-structured sustainable model was a recurring concern. It is therefore necessary to create viable software functionalities that may aid this concern. Interviews with NGO personnel showed that most (if not all) NGOs in the region realize the potential of ICT solutions in these areas and are willing to incorporate them into their existing projects and interventions where possible.

Data Analysis and Findings

Demographic Profiles

There were a total of 108 respondents of which 75% were male and 25% female. Respondents ranged from ages 19 to 80 with a mean age of 42.20. A total number of 90 were married constituting over 80%. This is significant, in that majority of them have families and therefore providing a means for them to make financial gain will affect not only them, but a wider range of people. The ability to educate their children due to financial gain will go a long way to improve the livelihood of the entire community and country in the future.

With regards to education, roughly 56% have no formal education with 2.8% having some informal education. A total of 41% have had some education ranging from elementary to tertiary. This is due to Ghana's increasing literacy rate which was 67% in 2010 [23]. This suggests that the issues regarding low education and illiteracy might be slight reduced in the context of Northern Ghana, however, with over a half of respondents having no formal education and the need for a scalable solution, those issues still remain. Languages spoken by the farmers range from Dagbani and Gonja in the Northern Region to Frafra in the Upper East Region. However each locality has only one or two languages that farmers are conversant with. Interviews show that farmers are prolific and adept in their own languages. As such the solution proposed will implement multi-language support for local dialects and consider illiteracy in the design of the interface. This level of literacy coupled with the economic and infrastructural level of the region suggests the absence of smartphone and PC usage and further motivates the use of basic mobile telephony for a solution.
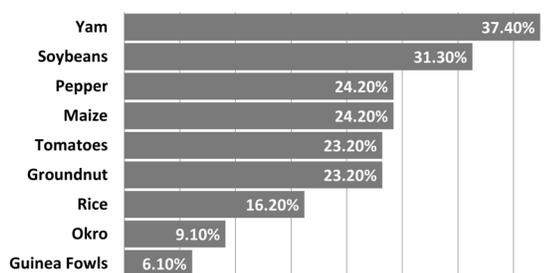
Figure 27: Agricultural Products Sold

Marketing of Agricultural Products

Respondents interviewed consisted of crop farmers (25.0%), animal farmers (2.8%) and farmers that had both animal and crop farms (72.2%). Figure 2 shows the major products sold[§§§]. The data also showed that animals are rarely sold. It is important to determine which products are marketed both for purposes of building good business models around the software and for actual implementation; it is best to limit software menu choices to the most require goals so as to accomplish tasks quickly and easily [6].

With regards to getting buyers for these crops, 37.0% of respondents had no problems with finding buyers but indicated problems of *low price offers*, *lack of transport* and *delays in payments* with *low price offers* being the most occurring. However, it should be noted that a cross-tabulation with the type of buyers they sell to, show that 92.3% of these respondents sell to individuals and at the local market. Moreover, 91.7% of the total respondents indicated wanting access to more buyers. The data on problems with obtaining buyers indicates, as shown in Figure 3, *a lack of buyers*, *low price offers* and *lack of transportation* to sale points as the major issues.

Finally, the data shows that, with access to more buyers, farmers are willing to produce more. Surprisingly, a considerable number of farmers are willing to change the crops they produce to suit buyers (56.5%), willing and able to provide transportation for medium to large scale buyers (42.6%), willing and able to store crops for sale (48.1%) and willing and able to package crops for sale (57.4%). This also gives some insight into creating a good business model for a marketing solution.

Current Trends

Almost all sales currently (January 2013) are to individuals (36.5%) or at the local markets (41.7%). A few of the sales are to high-end buyers (19.2%) which include NGOs, The Government and other companies. This is most likely a result of farmers hardly advertising outside their communities but relying on personal contacts (59.2%) and friends (26.5%).

[§§§] Note: Multiple response analysis will give a total percentage over 100 due to overlapping responses
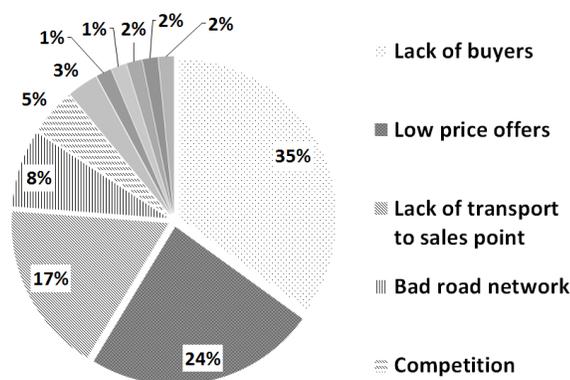
Figure 28: Problems in obtaining buyers

59.3% of respondents indicate avoiding the use of middle-men and among those who have middle-men in their value chain, 86.5% would rather do without them. One should note that considering the nature of value chain in Ghana the "middle-men" as noted by respondents are just but one of the many in a long chain [27]. The profits made by the farmers are still affected by this chain of middle-men and shows in the data obtained; 66.7% of respondents are unsatisfied with what they make from sales with the major reason being *low price offers*.

In order to determine the current use of ICTs within the rural farming community, the questionnaire included questions on the knowledge and use of any ICT solutions and ESOKO was mentioned specifically. 104 respondents, representing 96.3% had never heard of ESOKO and none of the farmers has ever used ESOKO. 92.6% have no knowledge of any current ICT solutions and only 1 respondent has used an ICT solution. This shows that there are no ICT solutions that have been effective enough in rural Ghana as indicated by the available literature.

ICT as a Solution

In light of the above, it is imperative that we determine if an ICT solution will be suited for the region based on the relevant technologies identified for a project in this context.

A total of 76 respondents, representing 70.4% have mobile phones. Using the analysis of a Likert scale [18], which assigns numerical values to ordinal data by giving each a value on a scale (the most common scale is 1 to 5), the mean of frequency of voice calls of mobile phone owners is 3.04 (Regularly) whiles the mean value for the frequency of the use of SMS is 1.37 (Never). This gives a confirmation that mobile telephony provides a good platform for a rural-based application but it must rely on voice technologies. We found a total lack of smartphone users among the respondents, which further solidifies the fact and furthermore rules out the use of mobile web and PCs. Figure 4 shows a contrast between the use of voice and SMS by respondents.

Delving further into the issue, 91.7% of respondents are willing to utilize a mobile-based advertisement service, including farmers who did not have mobile phones.

Encouragingly, 81.5% are also willing to pay for this service and 95.4% are willing to receive calls from buyers.

After a further explanation that the proposed system would utilize Interface Voice Response (IVR) by showing its similarity to the credit recharge voice prompts, 64.2% are still willing to use such a service and 26.4% would consider using it. The Cramér's V [8] value from a cross-tabulation of ethnicity and language preference of 0.868 however shows that (naturally), respondents would prefer the prompts in their own languages.
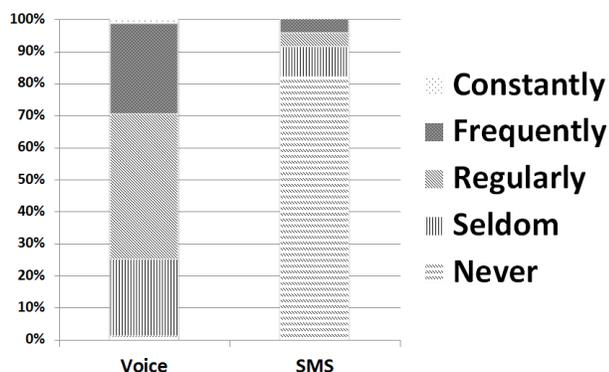
Figure 29: Voice Vs. SMS

From Issues to Requirements

Pertaining to this use case, lack of buyers, low price offers and lack of transportation are the prominent issues within the target group. A combination of lack of reach to large-scale buyers, lengthy value chains and poor infrastructure respectively are the underlying factors behind these issues. The intended software solution should link rural farmers to more buyers and effectively reduce the value chain.

The current situation with regards to the use case involves sales to individuals and sales at the local markets which are insufficient for the marketing needs and potential of these farmers and moreover resulting in low price offers. Unfortunately, there are no means of advertising, although farmers are willing and able to produce more, and no effective ICT solutions in the region. The system should therefore provide a means of advertising and hopefully result in increased production by farmers.

On a more general note, there is an availability of mobile phones, enough to facilitate the running of a mobile-based system. Farmers almost never use SMS and as such a solution must be voice-based. In addition, there is a willingness to utilize such technology and a willingness to pay for its use. An ICT solution is therefore suitable but requires local language integration to be effective.

A non-SMS system should be able to support local language support to mitigate the low levels of literacy. Due to the specific need of advertisement on the World Wide Web in the proposed system, it requires *periodic access* to an online database and a

Web Interface and should have a local database. Interviews with experts in ICT4D have indicated that local voices for IVR are normally preferred by rural users.

Support for registration and the use of a toll-free number for the service could be used to aid its financial sustainability; however this requires more assessment during deployment. Support for obtaining market prices and ads aired on radio could also be beneficial for local farmers who use the system.

Furthermore, based on the nature of the platform, it is not possible to view entered data from the local user end. As such the system must be reliable enough to insure that any entry made by a local user is transferred to the database.

This system is meant to serve as a bridge between local farmers and the rest of the world. To do that, it is imperative that it is compatible with as many systems and platforms as possible. For the same reason, local users must find it affordable and the system must remain sustainable financially.

The information gathered from these possible stakeholders gave a very good basis for the various requirements for the proposed system. It was however still necessary to complete the process with the development of a prototype.

Functional Requirements

Resulting from the requirement elicitation as described, the following key requirements were obtained for the system. These are mostly context-specific and may not all be generalizable.

The system must be accessible by mobile phone through a local number to allow farmers to call in at optimum cost. The phone call must be answered by the voice system using Interactive Voice Response (IVR) with DTMF. Furthermore, the system must support the integration of local languages, utilize an online database for data storage and be accessible online by means of a Web Interface.

It would be advantageous to use familiar voices and/or local accents for the needed voice prompts, have a local database for offline data storage and provide privileged access to an administrator. Optionally, the system could have support for registration and registered users and utilize a toll-free number for calls from users. It could also have support for accessing market prices and provide ads as voice communiques for call-in buyers or radio stations.

Non-Functional Requirements

Table 1 lists some of the most pertinent requirements.

Maintainability	The success of this project relies heavily on the ability for local developers to have the ability to maintain, adapt and replicate the system with relative ease.

Scalability	The system must have the ability to scale on different levels; • Simultaneous users - Hardware used must enable simultaneous access by multiple users to the system. • Languages - The system must have the ability to incorporate new languages with as little effort as is possible. An outline of steps to add new languages is therefore necessary.
Reliability	The system must ensure that all data successfully inputted is stored in the database and is accessible from the web interface. This non-functional requirement is directly linked to some aspects of the functional requirements.
Robustness	The conditions of the targeted location require robustness of both hardware and software. The hardware used must be robust enough to stand the conditions of heat, dust and possibly recovery from power-cuts. Software must tolerate unpredictable and/or invalid input by use of error handling.
Compatibility	This requirement is automatically met within the local user group due to the technologies being used. However it must also be met within the external user group (World Wide Web); the database must be compatible with most technologies so as to maximize the reach and use of the system. This also ensures reusability.
Cost-Effectiveness	This requirement applies more to hosting than to the cost for the end user. It however has an impact since the whole system must work together to be financially sustainable. The cost of the service; voice platform, local server, web access and power must be handled.

Table 1: List of Selected System Requirements

9. Rural system design
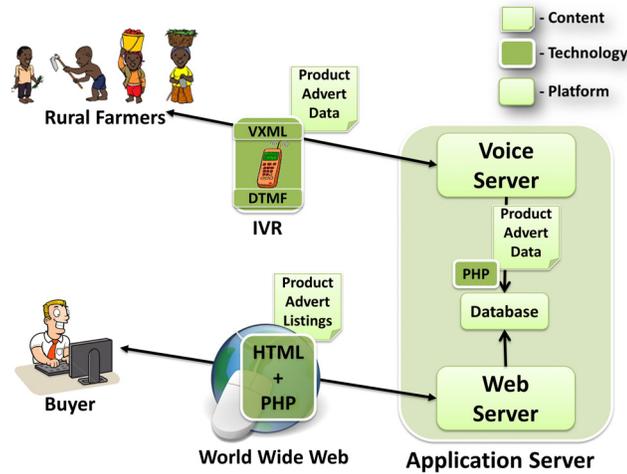
Figure 30: System Design (Concept)

10. Set-up Local Voice-based system

Find below script to install office-route on site
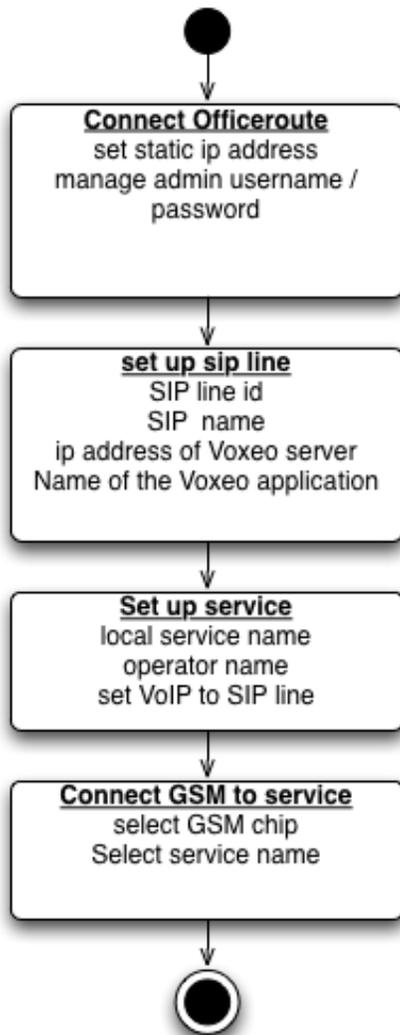
Figure 31: Set-up Office route

11. The Emerginov platform

Emerginov[****] is a software solution produced by Orange Labs. It incorporates multiple open source software components and enables the development of applications based on SMS or on vocal interfaces.


Figure 32: Emerginov architecture

[****] http://www.emerginov.org
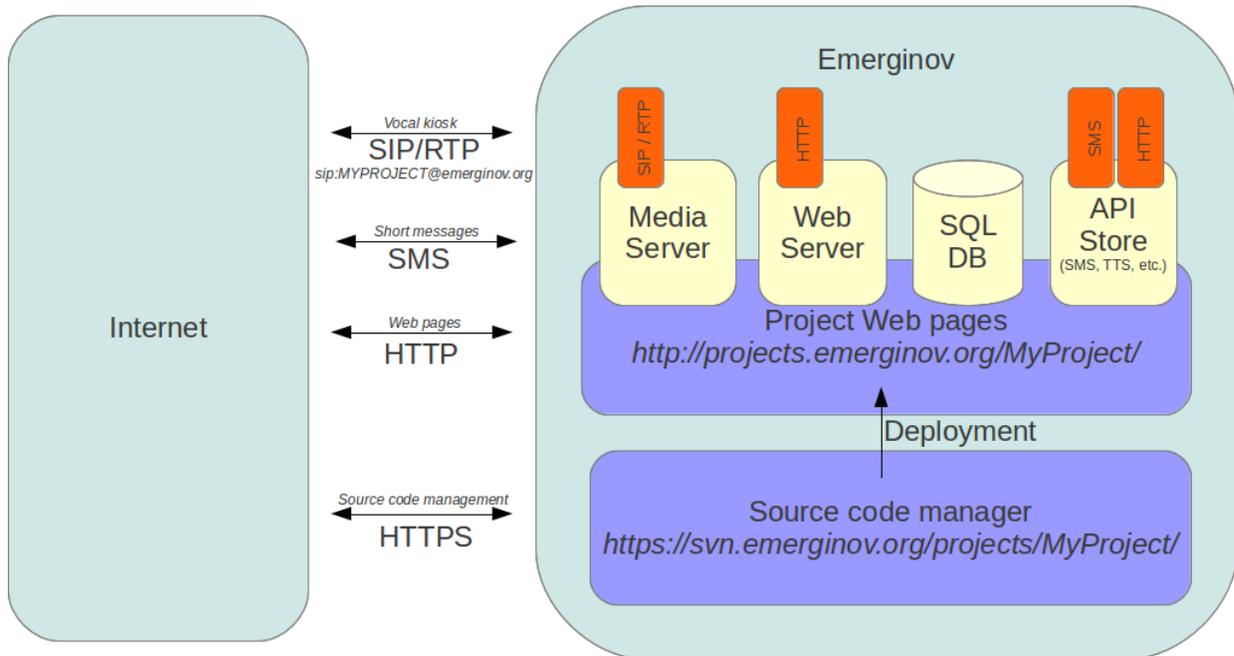
12 .Business Model Canvas for voice-based systems

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Sahel Eco: An NGO in Mali engaged in working with rural radios since the last 3 years.	**Services for Rural Radios:** Linking Rural Radios with voice-web interface for serving customers **Services for NGOs/Govt Depts/Private Companies:** Providing a voice-web interface for * Public Service Messages * Advertisements * Campaigns **Value Added Services:** Additional services for NGO's (e.g. Q&A services, voice based market research) Additional services for private companies (Market survey / Crowdsourcing) Consulting services for NGO's and private companies Consulting services for MNO's	Greenfield: First ever such provider in Mali **Simple Technology:** - No complex installations required either on client or business side. - Application hosted in the cloud accessible by simple mobile phones or a simple web interface **Sustainability for Rural Radios:** We add new revenue streams while enhancing the existing ones for Rural Radios who do not have the capacity to develop and host voice-web services	Paying Customers:For year 1-3 NGO's Government Departments and Private Organizations are the paying customers. From year 3 onwards Radio Stations start paying a fixed subscription fee to XXX to maintain and upkeep the voice-web services	Rural Radio Stations NGOs Government Departments Private Organisations

Key Resources

- Technical
- Marketing: Sahel Eco

Channels

- Mobile Based Voice Services
- Web Based Access for Rural Radios

Revenue Streams

Sales to NGOs, Private Organisations, Government Departments
Services:
Voice feeds for radio station broadcast
SMS services
VAS Services
Consultancy Services

13. Program final Voices conference

VOICES Composante 5 : m_Agric

Atelier Final, le 23 avril 2013, Azalaï Hotel Salam, Bamako

Programme final

Heure		Responsables
08.30	Inscription des participants;	Abdoulaye Sow, SAHEL ECO
09.00	Ouverture Officielle	Bianivo Mounkoro, Sahel Eco Mary Allen Ballo Sahel Eco Ministre des Postes et NT
09.15	Suspension de Séance – départ des officiels	Bianivo Mounkoro, Sahel Eco
09.20	Mise en place de Présidium	Bianivo Mounkoro, Sahel Eco
09.25	Présentation de participants	Mary Allen Ballo, Sahel Eco
09.30	Contexte – La Technologie pour le Développement	Stephane Boyera Web Foundation
	Présentations suivi de Questions & Réponses	
09.50	1. Les cas de Sahel Eco : Introduction	Mary Allen Ballo, Sahel Eco
10.00	a) L'Organisation Paysanne (TABALE)	Amadou Tangara Sahel Eco Nana Guyan VUA
10.30	PAUSE CAFÉ	
11.00	b) La Participation Citoyenne (FOROBA BLON)	Stephane Boyera Web Foundation
11.30	c) L'appui aux Chaines de Valeur (RADIO MARCHE)	Amadou Tangara Sahel Eco Nana Guyan VUA
12.00	2. Le cas de Radios Rurales Internationales : La Campagne Radio Participative, un service de conseil technique sur mobile et radio	Modibo Coulibaly RRI
12.30	Opportunités et contraintes ; pistes de solution et les axes de collaborations future : Discussions en sous-groupe (par table)	Mary Allen Ballo Sahel Eco
13.00	PAUSE DEJEUENER	
14.00	Suite discussions en sous-groupes	
15.00	Conclusions et Recommandations : présentation des groupes ; discussion	Président de Séance
16.00	Clôture de l'atelier	
16.15 à 18.00	Session technique : Questions et Réponses	Équipe VOICES

VOICES Composante 5 : m_Agric

Atelier Final, le 23 avril 2013, Azalaï Hotel Salam, Bamako

Discussions en Sous-Groupe

Les groupes sont constitués des personnes assises à la même table. Le groupe n'a pas besoin de se déplacer. Les discussions se feront sur place au tour de la table.

Les organisateurs veilleront à ce qu'il y à une bonne mélange d'expériences et domaines d'expertise au tour de chaque table afin de promouvoir les discussions et les échanges interdisciplinaires.

OBJECTIFS

L'objectif général des discussions en groupe est d'échanger d'une manière le plus large possible sur les expériences présentées de services sur voix dans le domaine agricole. On ne demande pas aux groupes d'arriver à un consensus ou à une décision quelconque mais plutôt on souhaiterait capturer toute la diversité des expériences et des points de vues ainsi que toutes les idées innovatrices proposées

Pour guider les rapporteurs nous proposons que vous regroupiez les points essentiels sur des grandes feuilles de papier sous les quatre grands chapitres suivants :

1. Les OPPORTUNITES d'exploitation des services sur mobile- web voix dans le domaine agricole et d'autres
2. Les CONTRAINTES au développement et mise en œuvre des services sur voix mobile web au Mali
3. Les PISTES DE SOLUTION - pour faire face aux contraintes identifiées
4. Les AXES DE COLLABORATION FUTURE – pour saisir les opportunités d'exploitation des services sur mobile- web voix dans le domaine agricole et d'autres

Fin de travail en groupe 15:00

PRESENTATIONS

A la fin des travaux chaque groupe, collera l'ensemble des ses feuilles sur le mur de la salle et une personne fera une présentation sommaire des discussions (5 minutes maximum par groupe)

14. Results from Discussion en Sous-Groupes
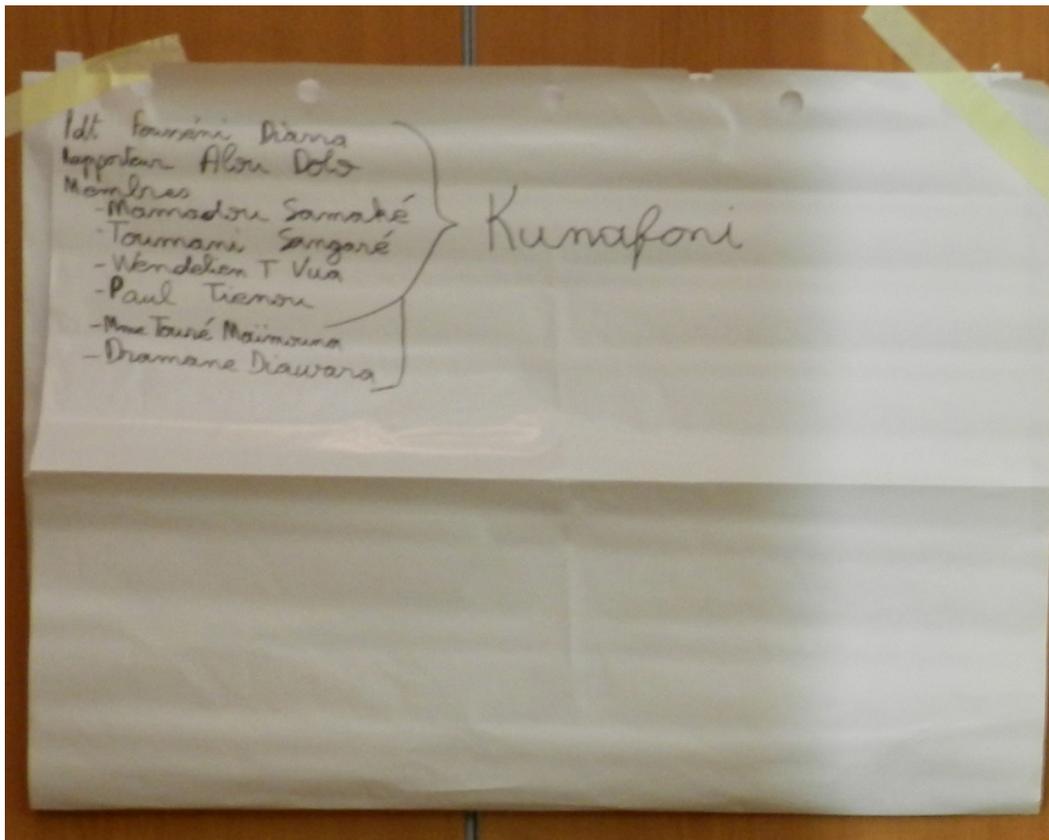
Figure 33: Group 1
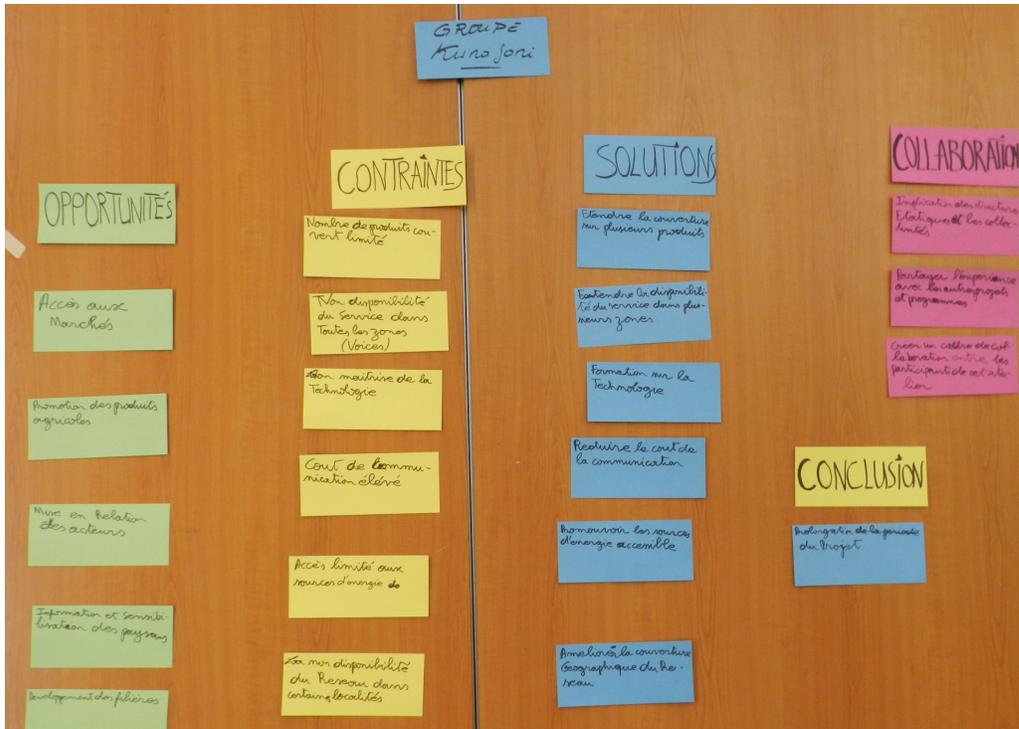
Figure 34: Group 2
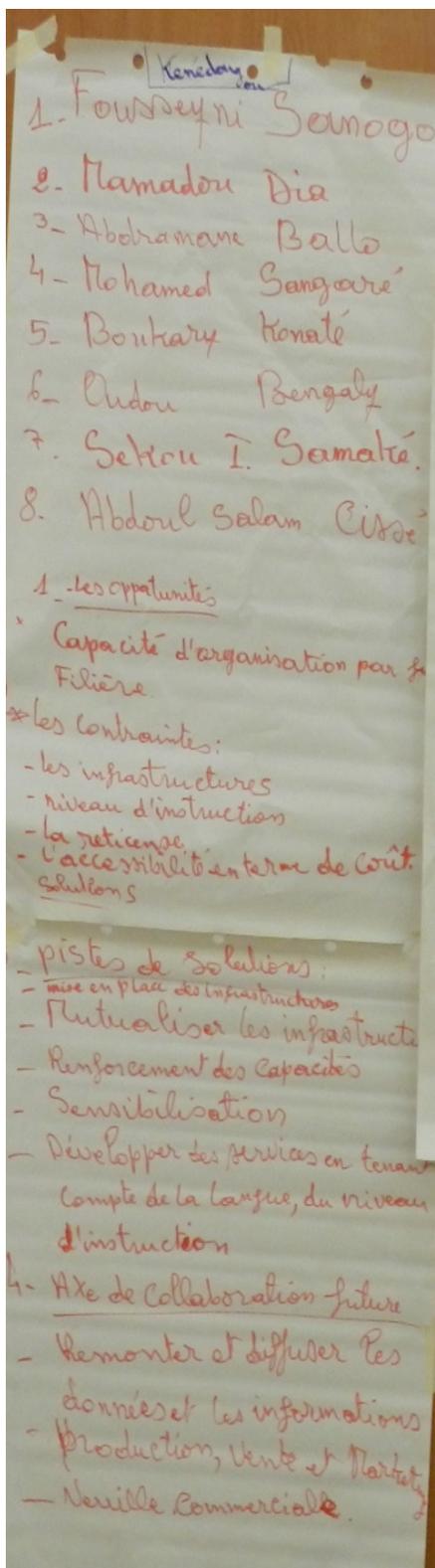
Figure 35: Group 3

Figure 36: Group 4
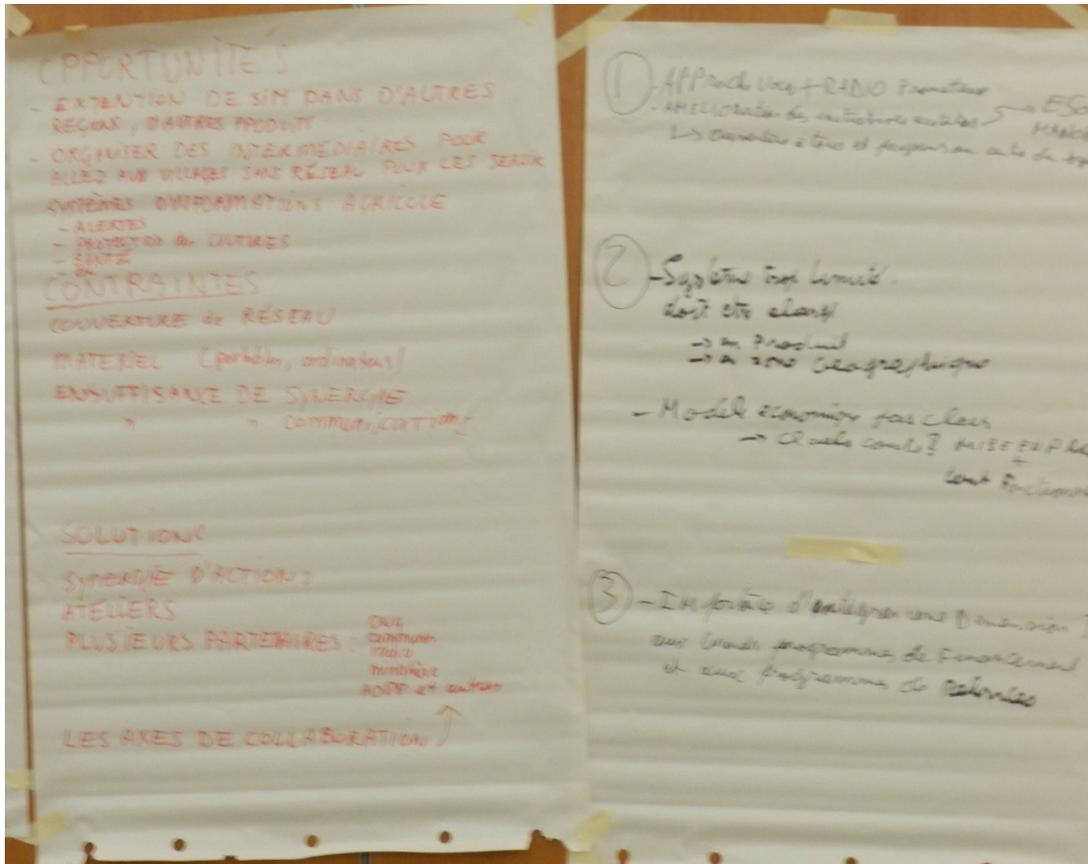
Figure 37: Group 5
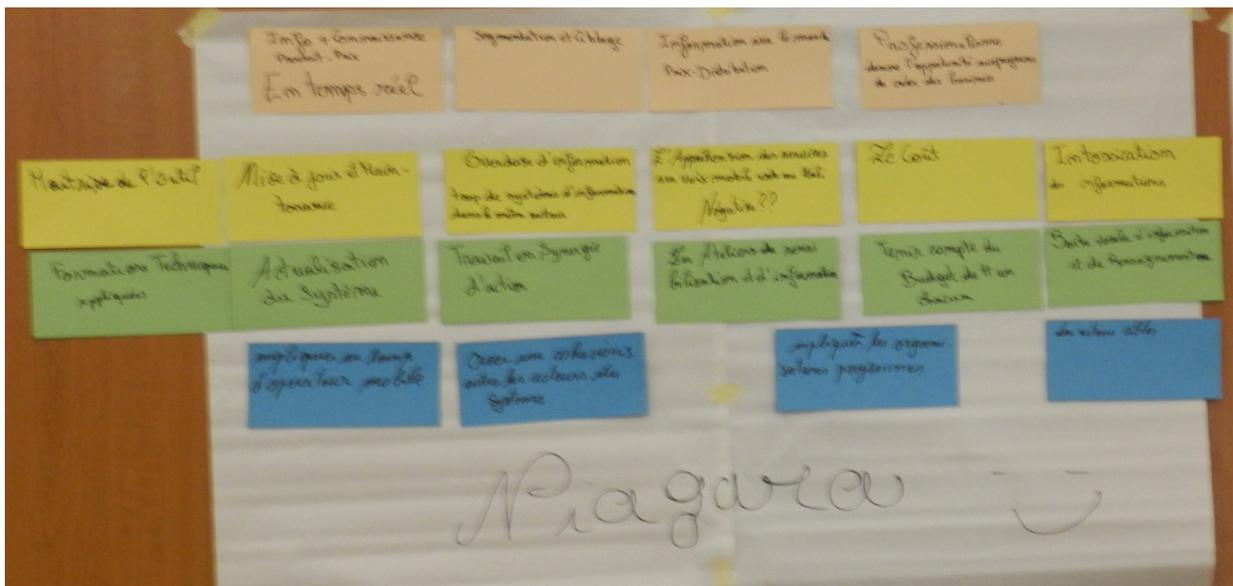
Figure 38: Group 6

15. Questions related to RadioMarché and Tabale from Stakeholders

Questions RadioMarché

1. Mariam Koné : dans le village de SAGABALA, les éleveurs n'arrivent pas à vendre leur lait. Est-ce que vous pouvez déployer RadioMarché pour eux ?
2. Samba Togola : comment accéder au système RadioMarché ? RM est vraiment spécifique et pas facile a repliquer. RM est fait suivant la structure de SE. Il y a plusieurs éléments dans le système. Il y a 5 produits : beurre de karité, amandes, miel, tamarinde, néré. Il y a des differences par produit. Puis il y a la partie filière et le coté technologie. En therme de filière il y a des défis, pour le miel, karité et sésame.
3. Madame THERA ; pourquoi vous ne partez pas dans toutes régions ? Le choix pour les régions est lié avec le travail de SE dans ces zones. Pourquoi Sikasso : làbas il y a des organisations paysannes déjà assez dynamiques.
4. Comment la voix de Fousseni a pu être automatiquement générée ? Compliqué à expliquer, Stéphane explique le systmee automatique. Ce n'est pas facile à étendre.
5. Madi Sidibé (AOPP) ; comment étendre le système aux autres organisations paysannes ? Ce n'est pas facile a étendre. Une des limitations c'est d'ajouter des nouveaux chaines de valeurs car il faut enregistrer des nouveaux mots dans toutes les langues utilisées.

Commentaire de Dramane DIAWARA (ORANGE MALI) : Orange MALI offre des services internet dédié spécifiquement aux stations radios

Questions Tabalé

1. Yassine Sadki (Malitel) : Quelle est la capacité d'appel simultanée ?
2. Alou DOLO : quant est ce la fonctionnalité sera libre et accessible à tous ?
3. Christophe Coulibaly : quel coût pour l'appelant et l'appelé ?
4. Sissoko AOPP ; à quel cout peut on se procurer de cette plate forme ?
5. Est-ce qu'il y a un interface vocale pour organiser les événements ?

16. ICT4D Course

The ICT 4 Development course (ICT4D) was offered to VUA Computer Science students for the first year and I feel it was a success. The course, which was a collaboration between the Computer Science department and the Center for International Cooperation of the same university, aimed to teach students how one should go about designing and deploying ICT projects in developing areas.

To this end, the students learned about the importance of considering local socio-economic contexts but also got to experience two technologies often used for development projects. The students received a crash course in the Sugar operating system for the XO laptop from the One Laptop Per Child project and were presented with a tutorial on VoiceXML for developing voice-based applications. Students formed groups and chose either one of these technologies to solve a real-world problen in its development context.

The course ended today with student group presentations. Three groups presented an XO deployment. One of these included an agricultural program in Namibia that involves teaching children about growing local food next to their schools. The XO laptop can assist this education by providing tips for growing the crops. Two other presentations focused on XO deployments in neighbouring countries Iran and Iraq and included mockups and prototypes for XO programs (activities) that assist children both inside and outside school. There is even a good chance that the program in Iraq will actually be deployed and one of the teachers (who happened to be one of the student's mother) was present at the presentation.

The fourth group developed an additional voice module for the RadioMarché system currently deployed in Mali, allowing local farmers to call in with their mobile phones when they want to sell produce. A voice menu enables them to tell the system how much of a specific product they have to offer and how much money they want in return.

All in all, this trip around the world showed how much the students have learned. We hope some of the projects will actually lead to real deployments and are looking forward to teaching the course again next year.

17. Screenshots RadioMarché

Newly Created Communiqué(s)

ID	Date Created	Audio		
1	2011-12-09 10:32:11	Listen	Save	Print
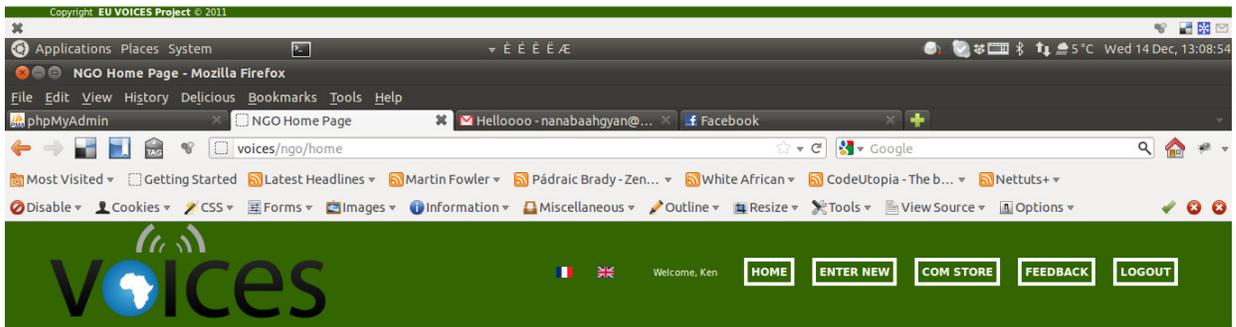
ngo-newly-avail-mkinfo

		Product Name	Quantity	Price	Contact Name	Date Submitted		
☐	1	Miel	200.00 *l*	cfa 2000.00	Zakary Diarra	Wed, Aug 10 2011	Edit	Delete
☐	2	Graine de nere	450.00 *kg*	cfa 425.00	Fidel Kone	Wed, Aug 10 2011	Edit	Delete
☐	3	Miel	60.00 *l*	cfa 2000.00	Sabere Diarra	Wed, Aug 10 2011	Edit	Delete

Create Communiqué

18. Screenshots Tabale

19. Designing the Open Voice Platform: A Multi-lingual, Crowd-sourced, and OpenPlatform to enable thec reation of Voice Based Applications for use in Internet-deprived environments

*Master thesis: August 2012 By Rokhsareh Nakhaie*

In today's world, many people are intensively dependent on the Internet. Many technologies and services that work with the Internet are influencing these people's lives. Still, 4.5 billion people do not have access to the Internet, and are thus deprived form accessing updated information. Main barriers in this way are lack of internet infrastructure, illiteracy and lack of computer-skills, availability of major portion of information in few common languages and multilingualism. Availability of mobile telephony has enabled the use of voice technology as an alternative for the Web-based Internet. Voice applications can be developed to provide information in specific domains and languages. Using crowd-sourcing, motivated volunteers can collect requested voice fragments by application developers. An Open Voice platform has been proposed that implements this solution. This platform forms a common place for application developers to request the required voice fragments and volunteers to collect them, uttered by native speakers. This work studies the requirements, design and success factors of such a platform.
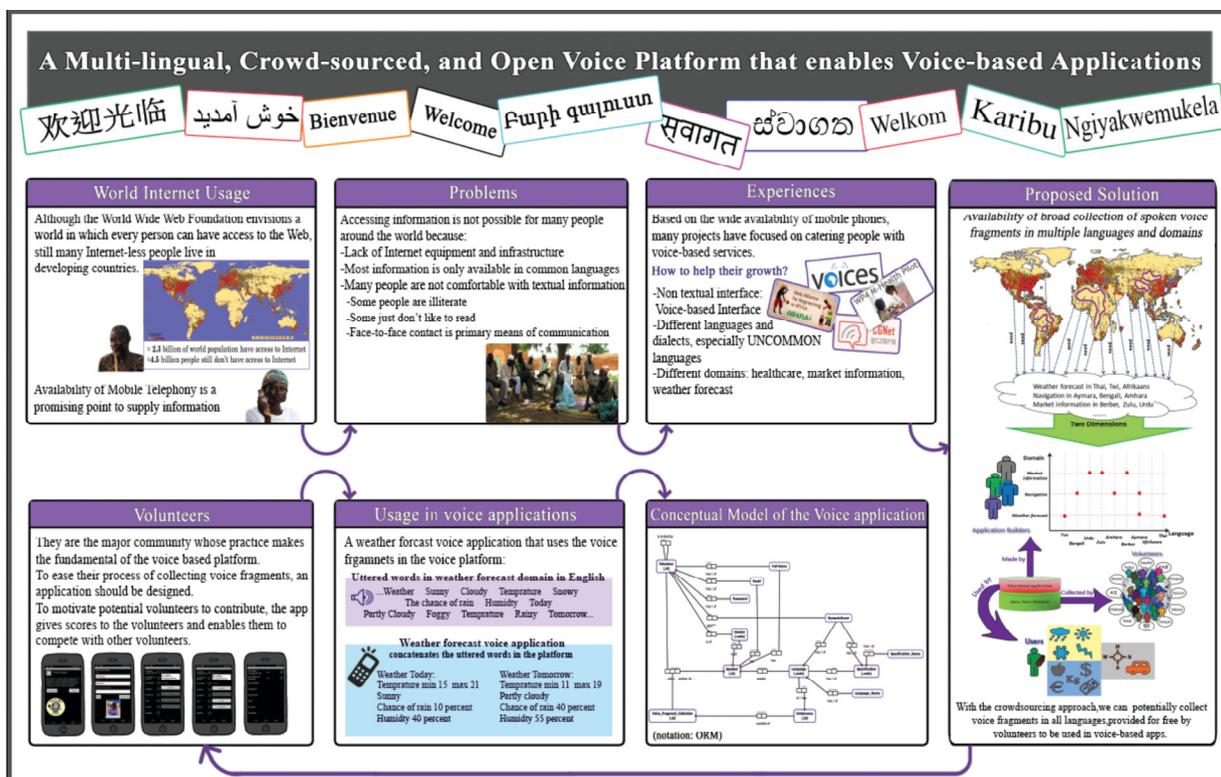
20. Nichesourcing: a case study for pluvial data digitization for the Sahel

Master thesis 2012: By Binyam Tesfa

We describe a Nichesourcing case research for digitizing pluvial data from the Sahel region in Africa. Crowdsourcing is a popular approach to digitize documents on the web; however it also has limitations with respect to maintaining highly motivated participants and handling complex user tasks. In order to deal with the limitations of Crowdsourcing and based on 'the task and its complexity', 'the product' and 'the resource pool' we identified Nichesourcing as suitable approach for this project. Nichesourcing is a variation of Crowdsourcing that targets specific niche groups instead of targeting the general crowd. We developed and published a Nichesourcing application on the web and evaluated its success in terms of attracting dedicated participants and digitizing considerable amount of digital data. With one week release of our Nichesourcing application, we have produced more than 5000 cells of structured digitized pluvial data. We also found that the anticipated niche (people with African affiliation) dedicatedly participated in the digitization. However, the project run only on a small scale and it will be necessary to perform further research to prove that Nichesourcing suits this type of projects.

Sample hand written pluvial data forms from Mali.

Africa App home page showing the 5 types of digitization tasks (main content), logged in user digitization points (Left bar top) and Top Regreeners list (Left bar bottom).

21. Voice User Interface Design for m-Event Organizer

Master thesis 2012: By Deepak Chhetri

Information and Communications Technologies provide a lot of options for information access by literate users but there is much less opportunities for information access by illiterate users. Implementing effective Voice User Interface in rural community of developing world requires addressing a number of important challenges. The recent market penetration of mobile phone and its impact in developing regions has gained lots of interest from Voice User Interface Designers.

In this research, I will present literature reviews on Voice User Interface Design with reference to low literate users in developing regions of the world. I will also describe the knowledge and experience I gained from each review and its implication to my research. Based on these literature reviews, I will present a framework that can be used to check the most important aspects required in designing an appropriate VUI for low literate users. The research ends with successful paper prototype VUI for m-Event Organizer. This research will be helpful to other designers during the process of designing a VUI prototype for low literate users.

Aspect	Researchers
Design Considerations	
Enhance the existing system	2, 4
Involving with the user	1, 2,6,7,9
Mobile Usage culture	1, 7,8
IVR	
Different user interface for different user group.	6
Error Recovery	1,4,5, 6,9
Dialogue Flow:	1, 2, 3, 5,6,9
Input modality	2
Prompt Style and	2
Use of sound Effect	2
Keep it Simple	2
Provide multiple language support	1,2,3,7
Implementation Aspects	
Navigation	3, 4,6, 8
Persona	1, 3
Prosody	5
Voice Commands: *Speed,orderly,brief,relevant and Persistence.*	5

*A framework consisting of aspects which are essential when designing VUI for low literate users.*
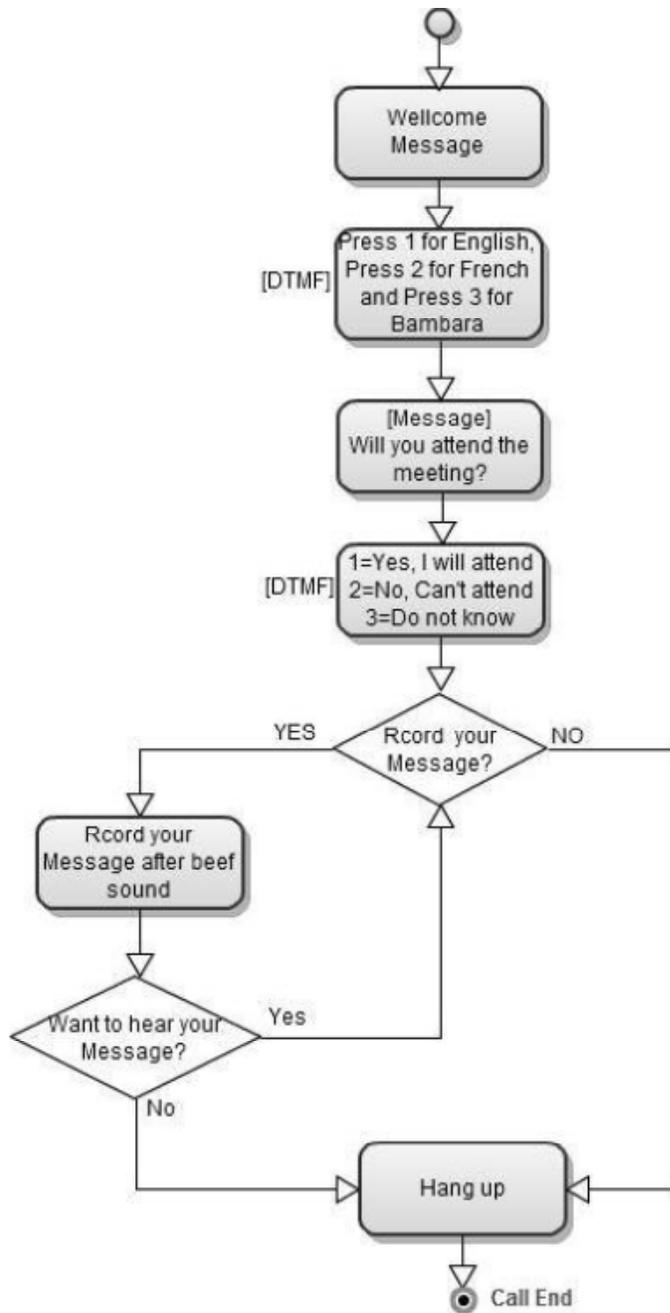
Improved version of m-Event VUI Design.

22. Ecomash: Linked Market Data for Sahel Eco

Master thesis 2012 by Henk Kroon

We introduce an information mashup called Ecomash that is based on RadioMarché (RM), a Web-based Market Information System (MIS) operational in the Malian Tominian region. The design of our application is challenged by environmental factors such as multiple dialects, poor literacy rates and poor IT-infrastructure. Ecomash is designed to combine the market data from RM with various Web resources providing (semantically codified) data related to localization, product knowledge and geography. We illustrate how Ecomash can reduce the effort of NGOs in monitoring the local markets and help them sharing this information significantly. Ecomash can be used by the NGOs to plot local product offerings on an interactive map. This way of visualizing the market data can be useful when a NGO needs to collect market statistics which it can use as a basis for discussion and collaboration with its partner organizations.
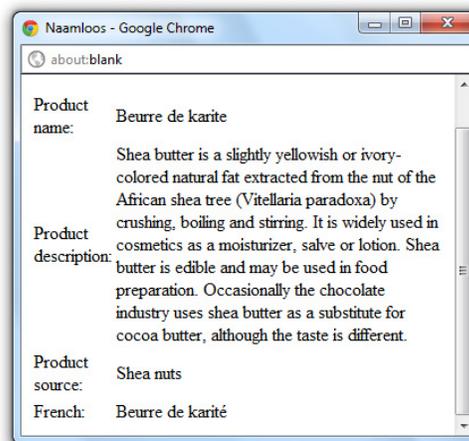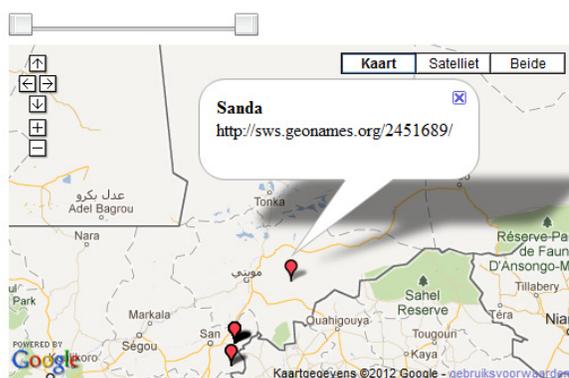
Product offering information for the village of Sanda:

ID	Product name	Quantity	Unit of measure	Price	Currency	Date of delivery	Date of entry	Product quality	Contact person first name	Contact person last name	Contact person telephone number
67	Beurre de karite	200.00	Kg	1000.00	CFA	2012-02-01 10:54:57	2012-02-01 00:00:00	Beurre issu des amandes ébouillantées	Iréné	Keita	78 25 84 13

The key UI-components of Ecomash. The top-left corner contains a date filter in the form of a slider with the interactive map below. The top-right corner shows a pop-up screen which has been activated by clicking the product name.
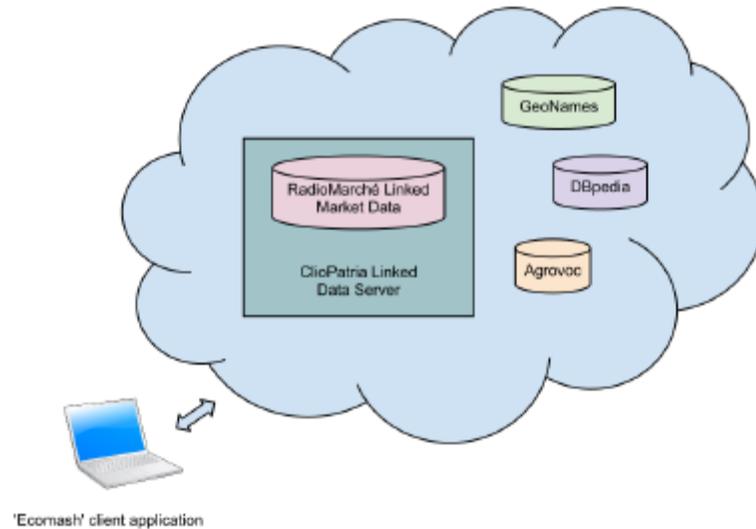
This diagram provides an overview of the repositories in the Linked Data cloud which are used by Ecomash. The Linked Data cloud is depicted by the cloud and the cylinder shapes represent the data sources which provide the input data for Ecomash.

23. Developing ICT Solutions for Marketing Agricultural Products in Rural Ghana

Master thesis 2013 by Francis Dittoh

This research looks into the underlying issues on marketing agricultural produce from rural Ghana, assesses what ICT solutions exist, reasons for their inadequacies and finally assesses if an ICT solution is best suited for the region. The research includes literature reviews mainly from the field of Agriculture in Ghana and ICT4D, inferential quantitative analysis of a field survey and qualitative data from interviews with farmers, NGO field workers and some experts in the field of ICT4D for rural Africa. Results show a combination of storage, transportation, access to buyers and a long value chain that robs the farmer of much needed profits, as the pertinent issues. We also find a lack of means to advertise and a lack of ICT solutions in the region. The findings however indicate that the region is appropriate for an ICT-based solution based on the wide-spread use of mobile telephony and the willingness to pay for an ICT-based marketing service. It also suggests the need for a good business model to mitigate the effects of the other pertinent issues and to create a financially sustainable solution. A software design and prototype was developed based on requirements derived from these findings to facilitate marketing of produce on the World Wide Web. Development of the prototype shows the ability for existing technologies to merge with basic technologies in rural areas to provide ICT solutions and evaluation shows the prototype meets all key requirements and is ready for field deployment. The end result of this research suggests that ICTs developed in a context-based manner, with the existing technologies, has the capacity to aid issues of rural development. It shows that mobile telephony has the potential to provide web access to rural areas, albeit in a different form/manner than we are used to. This suggests careful context-based research in

the development of software for rural areas. We recommend more research into replication of this for other developmental issues and deployment in the field.