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TABLE OF CONTENTS

PREFACE AND SUMMARY

This VOICES Deliverable D1.1 gives an extensive discussion of the *use case scenarios and requirements* that inform the envisaged pilot deployment in West Africa of the VOICES tools and toolbox that is now under development.

Our work on use cases and requirements is, as reported, strongly based on extensive *field research* carried out by different VOICES partners in different African countries. Without taking the various specific African *contexts* into account, use cases and requirements wouldn't mean much if it comes to systems development. Therefore, this deliverable pays ample attention to the actual field context in which the VOICES pilots are required to be successful as a specific form of the "Living Labs" concept of experimentation and innovation.

As a result, we have structured this deliverable in different parts as follows:

PART I: General notes on use case and requirements analysis methodology used;
PART II.A: Report on field research (Mali, Burkina Faso, Ghana) for the m-agro pilot
PART II.B: Use case and requirements analysis for the m-agro pilot in Mali
PART III.A: Report on the field research (Senegal) for the m-health pilot
PART III.B: Use case and requirements analysis for the m-health pilot in Senegal

First, we outline the state-of-the-art background concerning requirements engineering (Part I) that methodologically underlies the reported work, the field research done as well as the ensuing use case and requirements analysis.

Parts II.A and III.A give an account of the field research carried out, including the field visits, requirements elicitation workshops, sessions with prospective users, etc., out of which valuable use case scenarios have been extracted, including crucial deployment as well as usage context requirements. Part II.A does so for the m-agro knowledge sharing pilot (VOICES WP5) and Part III.A for the m-health pilot (VOICES WP4). These parts give extensive background information on, and explanation and justification of the use cases and requirements.

Furthermore, they provide (together with Appendices A and B) initial source material on the future generalizability (possibility of replication elsewhere) and sustainability of the VOICES service toolbox and the use cases for it.

Parts II.B and III.B then provide a further analysis of the use case scenarios that seem to be the most promising, for VOICES WP5 and WP4 respectively, according to a shared method and format. This provides the baseline information for the currently ongoing technical development and implementation of the VOICES pilots.

Hans Akkermans and Anna Bon, editors

PART I: General Notes on Use Cases and Requirements Methodology

1. STATE OF THE ART REQUIREMENTS ENGINEERING

This Part I provides some general background and pointers on state-of-the-art methodologies in use in Requirements Engineering. As will be discussed, the VOICES field research and use case scenario and requirements analysis have been carried out following a pragmatic version of state-of-the-art requirements engineering methodology.

Aspects of and Stages in Requirements Engineering

The IEEE Guide to the Software Engineering Body of Knowledge (SWEBOK, online available) describes the field and practice of requirements engineering as follows.

Types of Requirements

A requirement is defined as a property that must be exhibited in order to solve some real-world problem. A software requirement is a property which must be exhibited by software developed or adapted to solve a particular problem.

The problem may be to automate part of a task of someone who will use the software, to support the business processes of the organization that has commissioned the software, to correct shortcomings of existing software, to control a device, and many more. The functioning of users, business processes, and devices is typically complex. By extension, therefore, the requirements on particular software are typically a complex combination of requirements from different people at different levels of an organization and from the environment in which the software will operate.

An essential property of all software requirements is that they be verifiable. It may be difficult or costly to verify certain software requirements. For example, verification of the throughput requirement on the call centre may necessitate the development of simulation software. Both the software requirements and software quality personnel must ensure that the requirements can be verified within the available resource constraints.

Requirements have other attributes in addition to the behavioural properties that they express. Common examples include a priority rating to enable trade-offs in the face of finite resources and a status value to enable project progress to be monitored. Typically, software requirements are uniquely identified so that they can be subjected to software configuration control and managed over the entire software life cycle.

Functional requirements describe the functions that the software is to execute; for example, formatting some text or modulating a signal. They are sometimes known as capabilities.

Non-functional requirements are the ones that act to constrain the solution. Nonfunctional requirements are sometimes known as constraints or quality requirements. They can be further classified according to whether they are performance requirements, maintainability requirements, safety requirements, reliability requirements, or one of many other types of software requirements.

Some requirements represent *emergent* properties of software—that is, requirements which cannot be addressed by a single component, but which depend for their satisfaction on how all the software components interoperate. The throughput requirement for a call centre would, for example, depend on how the telephone system, information system, and the operators all interacted under actual operating conditions. Emergent properties are crucially *dependent on the system architecture*.

Requirements Elicitation

Requirements elicitation is concerned with where software requirements come from and how the software engineer can collect them. It is the first stage in building an understanding of the problem the software is required to solve. It is fundamentally a human activity, and is where the stakeholders are identified and relationships established between the development team and the customer. It is variously termed "requirements capture," "requirements discovery," and "requirements acquisition."

One of the fundamental tenets of good software engineering is that there be *good communication* between software users and software engineers. Before development begins, requirements specialists may form the conduit for this communication. They must mediate between the domain of the software users (and other stakeholders) and the technical world of the software engineer.

A number of techniques exist for requirements elicitation, the principal ones being:

- **Interviews**, a "traditional" means of eliciting requirements. It is important to understand the advantages and limitations of interviews and how they should be conducted.
- **Scenarios**, a valuable means for providing context to the elicitation of user requirements. They allow the software engineer to provide a framework for questions about user tasks by permitting "what if" and "how is this done" questions to be asked. The most common type of scenario is the use case. There is a link here to the topic of Conceptual Modelling, see below, because scenario notations such as use cases and diagrams are common in modelling software.
- **Prototypes**, a valuable tool for clarifying unclear requirements. They can act in a similar way to scenarios by providing users with a context within which they can better understand what information they need to provide. There is a wide range of prototyping techniques, from paper mock-ups of screen designs to beta-test versions of software products, and a strong overlap of their use for requirements elicitation and the use of prototypes for requirements validation.
- **Facilitated meetings**. The purpose of these is to try to achieve a summative effect whereby a group of people can bring more insight into their software requirements than by working individually. They can brainstorm and refine ideas which may be difficult to bring to the surface using interviews. Another advantage is that conflicting requirements surface early on in a way that lets the stakeholders recognize where there is conflict. When it works well, this technique may result in a richer and more consistent set of requirements than might otherwise be achievable. However, meetings need to be handled carefully (hence the need for a facilitator) to prevent a situation from occurring where the critical abilities of the team are eroded by group loyalty, or the requirements reflecting the concerns of a few outspoken (and perhaps senior) people are favoured to the detriment of others.
- **Observation**. The importance of software context within the organizational environment has led to the adaptation of observational techniques for requirements elicitation. Software engineers learn about user tasks by immersing themselves in the environment and observing how users interact with their software and with each other. These techniques are relatively expensive, but they are instructive because they illustrate that many user tasks and business processes are too subtle and complex for their actors to describe easily.

Requirements Analysis and Conceptual Modelling

The process of analyzing requirements aims to:

- Detect and resolve conflicts between requirements
- Discover the bounds of the software and how it must interact with its environment
- Elaborate system requirements to derive software requirements

The traditional view of requirements analysis has been that it be reduced to **conceptual modelling** using one of a number of analysis methods such as the UML, discussed in the next chapter.

The development of models of a real-world problem is key to software requirements analysis. Their purpose is to aid in understanding the problem, rather than to initiate design of the solution. Hence, conceptual models comprise models of entities from the problem domain configured to reflect their real-world relationships and dependencies. Several kinds of models can be developed. These include data and control flows, state models, event traces, user interactions, object models, data models, and many others.

Note that, in almost all cases, it is useful to start by building a model of the software **context**. The software context provides a connection between the intended software and its external environment. This is crucial to understanding the software's context in its operational environment and to identifying its interfaces with the environment.

The issue of modelling is tightly coupled with that of methods. For practical purposes, a method is a notation (or set of notations) supported by a process which guides the application of the notations. There is little empirical evidence to support claims for the superiority of one notation over another. However, the widespread acceptance of a particular method or notation can lead to beneficial industry-wide pooling of skills and knowledge. This is currently the situation with the UML.

Architectural design is closely identified with conceptual modelling. The mapping from real-world domain entities to software components is not always obvious, so architectural design is identified as a separate topic. The requirements of notations and methods are broadly the same for both conceptual modelling and architectural design. IEEE Std 1471-2000, *Recommended Practice for Architectural Description of Software Intensive Systems*, suggests a multiple-viewpoint approach to describing the architecture of systems and their software items, see further below.

Requirements Validation

Requirements documentation is always subject to validation and verification procedures. The requirements may be validated to ensure that the software engineer has understood the requirements, and it is also important to verify that a requirements document conforms to company standards, and that it is understandable, consistent, and complete. Different stakeholders, including representatives of the customer and developer, should review the document(s).

The aim of Requirements Validation is to pick up any problems before resources are committed to addressing the requirements. Requirements validation is concerned with the process of examining the requirements documents to ensure that they are defining the right system (that is, the system that the user expects). It is subdivided into descriptions of the conduct of requirements reviews, prototyping, and model validation and acceptance tests.

Requirements Reviews. Perhaps the most common means of validation is by inspection or reviews of the requirements document(s). A group of reviewers is assigned a brief to look for errors, mistaken assumptions, lack of clarity, and deviation from standard practice. The composition of the group that conducts the review is important (at least one representative of the customer should be included for a customer-driven project, for

example), and it may help to provide guidance on what to look for in the form of checklists.

Prototyping is commonly a means for validating the software engineer's interpretation of the software requirements, as well as for eliciting new requirements. As with elicitation, there is a range of prototyping techniques and a number of points in the process where prototype validation may be appropriate. The advantage of prototypes is that they can make it easier to interpret the software engineer's assumptions and, where needed, give useful feedback on why they are wrong. For example, the dynamic behaviour of a user interface can be better understood through an animated prototype than through textual description or graphical models. There are also disadvantages, however. These include the danger of users' attention being distracted from the core underlying functionality by cosmetic issues or quality problems with the prototype.

Model Validation. It is typically necessary to validate the quality of the models developed during analysis. For example, in UML object models, it is useful to perform a static analysis to verify that communication paths exist between objects which, in the stakeholders' domain, exchange data. If formal specification notations are used, it is possible to use formal reasoning to prove specification properties.

Acceptance Tests. An essential property of a software requirement is that it should be possible to validate that the finished product satisfies it. Requirements which cannot be validated are really just "wishes." An important task is therefore planning how to verify each requirement. In most cases, designing acceptance tests does this. Identifying and designing acceptance tests may be difficult for non-functional requirements. To be validated, they must first be analyzed to the point where they can be expressed quantitatively.

2. CONCEPTUAL MODELLING: THE UNIFIED MODELLING LANGUAGE UML 2.0

In different stages of requirements engineering and particularly analysis, so-called structured modelling and specification methods are used. There are many of them, but the most widely adopted set of methods is the industry standard known as UML, the Unified Modelling Language.

Viewpoint-based Modelling and Analysis

Modern requirements and systems engineering holds the view that a system and its context (e.g. stakeholder concerns, user interactions, technical deployment environment) is to be modelled from different *viewpoints* (see e.g. [Leffingwell & Widrig, 2000], [Kotonya & Sommerville, 1998]). Viewpoints express different relevant aspects of a system and its environment.

There are many possible viewpoints, but commonly used viewpoints in requirements engineering include:

- Stakeholder and actor goals (e.g. used to explain wherein the *value* of a system lies), to understand the business case or business scenario for an envisaged system.
- System context activities in which the system plays a role (e.g. business processes the system users are involved in, or the information concepts and structures they work with), to gain an understanding of different aspects and relationships of the so-called functional requirements of a system.
- Also, a perspective can express a certain concern such as a scalability, flexibility, or security concern related to the system at hand (i.e., intended to understand different so-called non-functional requirements).

These viewpoints should be expressed in terms of a modelling language. Sometimes, an informal language is used for that, such as English. However, using an *informal* language has some serious drawbacks, such as noise (irrelevant information), silence (omission of important information), over-specification, contradictions, ambiguity, forward references, and wishful thinking. The use of a more *formal* language allows for a precise specification and thorough analysis, e.g. by using software support.

So, we need a (semi-)formal language to represent information systems from multiple stakeholder perspectives and concerns. However, the specification language should also allow for easy communication between stakeholders. Complex ICT systems are usually not developed by a single person, but rather by a team. This team needs a communication mechanism, to talk with each other about the information system requirements, and to communicate with the users and stakeholders of the system at hand. To allow for such an easy communication with and between stakeholders, a language with a *graphical* syntax is preferred. The Unified Modeling Language 2.0 (UML 2.0) is a widely-used industry standard to describe an information system from (1) multiple viewpoints, (2) is sufficiently formal (e.g. many software tools such as diagram editors, model analyzers and reporters are available), and (3) has a graphical syntax.

The UML 2.0 comes with a number of graphical diagram techniques to support information system design and specification. More specifically , the following diagrams are part of the UML 2.0:

- Use case diagram: this diagram shows actors (persons or other systems), and expresses the interactions between actors and the system under study. Usually, it is the diagram that is made first during a UML modelling effort.

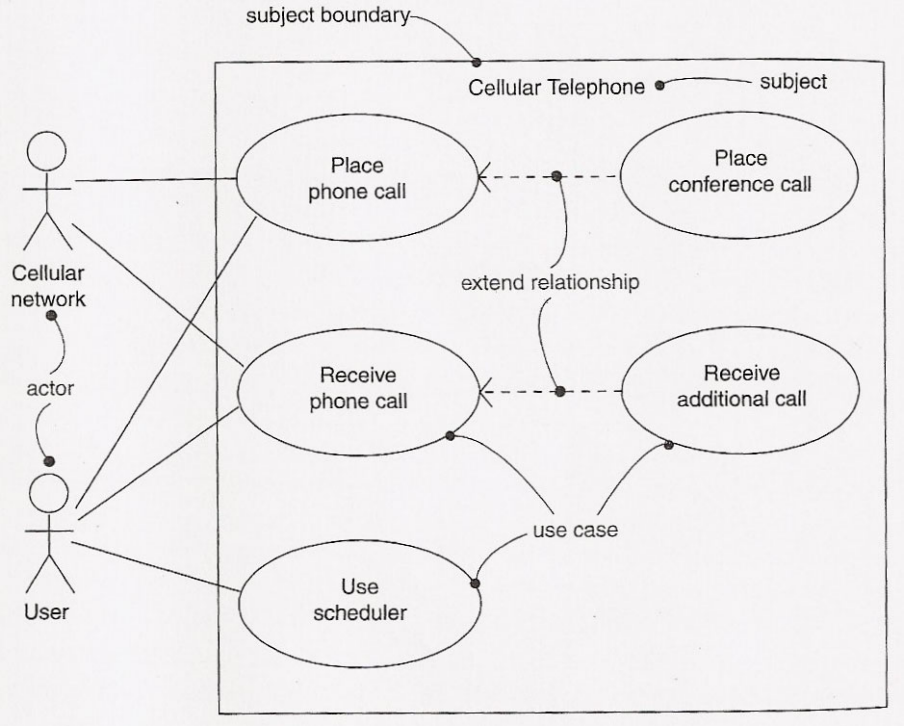
- Class diagram: this diagram shows entities (as classes), their relations, interfaces to the rest of the worlds, and collaborations with others. It is one of the most used UML diagrams.
- Activity diagram: this diagram shows the structure of a process as a flow of control and data. So, the diagram can be used to show how an activity is carried out, possibly by multiple participating actors.
- Deployment diagram: this diagram shows the configuration of the runtime situation: specifically processing nodes, software components running on these nodes, and communication between nodes.
- Other UML 2.0 diagrams, not directly used here, but available in the standard, include the sequence diagram, communication diagram, state diagram, and component and package diagrams.

In the following sections, we briefly review the selected diagrams.

Use Case Diagram

Use case diagrams are often used as a point of departure for a project using the UML as a modelling technique. Briefly, a use case describes the interaction of a *subject* (usually users of the system under development) with its environment, at a fairly high abstraction level. Other diagram types, such as the activity diagram and the sequence diagram can then be subsequently used to further detailing and understanding of this interaction. A set of use cases for a system under development can also be seen as a set of *requirements*. Use cases describe from the outside of a system what the system should do (the requirements), and not yet how this should be realized (technical solution).

The diagram below shows an example of a use case diagram.



Example use case diagram (taken from [UMLUserguide05]).

The *use case* itself is set of sequences of actions, as performed by the system under development. These actions result in an observable result to an actor. An *actor* is a coherent set of roles, played by users while interacting with the system under

development. Although the actor is depicted as a sort of human, an actor can equally well be a hardware device, or a software component.

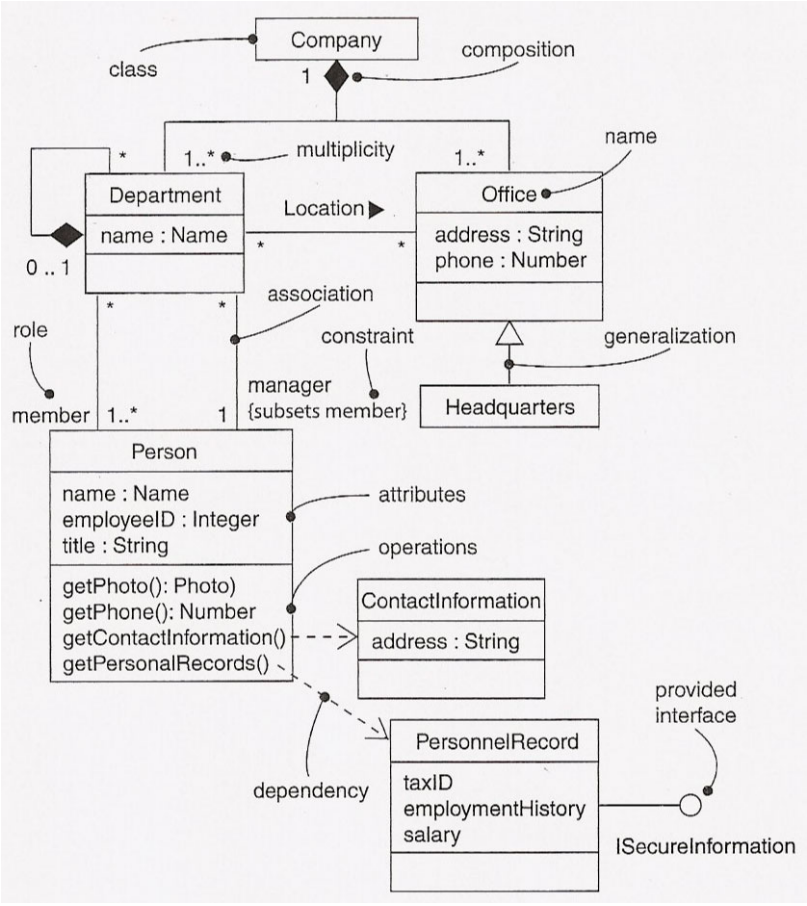
Actors are connected to use case by *associations* (graphically depicted as lines). Such an association represents interaction between an actor and a use case. Actors can be related to each other via *generalization* relations (depicted as arrows). For instance, a user can be seen as a generalization of a business user.

Uses cases themselves can also be related, e.g. via the aforementioned generalization relation. Other possibilities are the *include* relation (use case A includes the behaviour of use case B; use case B does not exist independently), and the *extend* relation (under certain conditions, case A includes the behaviour of use case B).

Class Diagram

The class diagram is perhaps the most often used UML diagram. Class diagrams provide a *static information viewpoint* on the system under development. This view captures the functional requirements, as a list of the services the system should provide. Related services are grouped into a class, and several classes describe a complete system. Class diagrams can also be seen as the vocabulary of the system at hand. Stating the vocabulary of a system is about deciding which abstractions are part of the system, and which ones are not. Services, and classes these services belong to, usually work together to accomplish some more complex behaviour. To a certain extent, this behaviour can be modelled as collaborations in class diagrams. Finally, since a class diagram represents a vocabulary, it is often uses as the foundation for a conceptual schema for a database.

The diagram below shows an example of a class diagram.



Example class diagram (taken from [UMLUserguide05]).

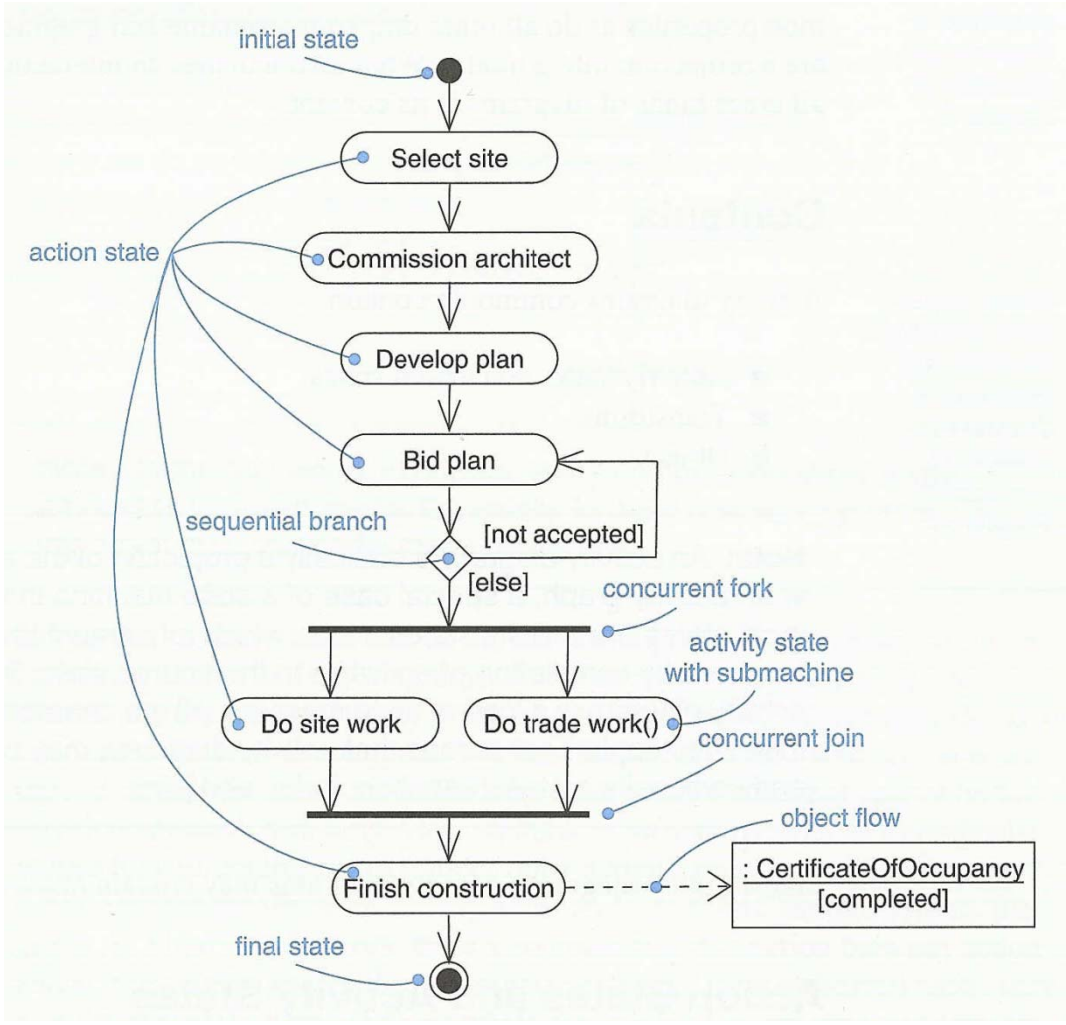
A *class* is an abstraction of set of similar *things,* or *instances*. For instance the *class* car may contain all cars in the world. A class groups things with similar properties (e.g. each car has a price). A class may have *attributes*. An attribute is a property, with a range of values. For instance, a car has the property colour. Furthermore a class can have *operations*. Operations are actually the behavioural part of the class. For instance, an operation of a car can be to *ride*. Operations can be grouped in an *interface*. These are the operations, which are exposed to the outside world by the class.

An important feature of classes is that they can be related to each other. For instance, a car (class) has (association relation) wheels (class). Various types of relations exist. For instance, a *generalization* relationship between a car (super-class) and a truck (sub-class) expresses that a truck is a car, meaning that truck has at least all the attributes and operations the car has. In other words, the sub-class inherits all attributes and operations from the super-class. The *association* relation between two classes states that instances of the two classes are connected to each other. For instance, a car is owned by a person. Associations have two or more *roles*. *Owned by* is a role, played by the car. The other way around, *owns*, is a role played by a person. Finally, the *aggregation* relation represents that something *is-part-of* something else. For example, an engine is-part-of a car.

Relationships can be *constrained*, meaning that not every instance can be related to another instance, but just a subset. The constraints indicate the subset. A *cardinality* constraint indicates how many instances can be related to another instance. For instance, a car is owned by *one* (cardinality constraint) owner, but an owner can have *multiple* (cardinality constraint) cars. The UML is not particularly strong in expressing constraints in a precise *and* graphical way. Non-graphical constraints can be expressed using the Object Constraint Language (OCL) of the UML.

Activity Diagram

An activity diagram is used to model *dynamic* aspects, i.e the viewpoint of how the information processing goes. It shows the flow of control and data from the one activity to another activity. An activity diagram may show concurrency as well as branches of control. The diagram below shows an example of an activity diagram.



Example activity diagram (taken from [UMLUserguide05]).

An activity diagram contains an *initial state.* This initial state is the point of departure for walking through the diagram. If the initial state is reached, the *control* is passed to an *action*. The flow of control is indicated by a solid arrow. An action is an atomic computation. The action is represented by means of a rounded box. Actions can not be decomposed into smaller actions; they are the smallest unit of operation. After an action completes execution, the flow of control immediately passes to the next action (as indicated by the control flow). The *final state* indicated completion of the control flow.

A simple flow of control is just sequential. However, a control flow may have a *sequential branch*, indicating that a selection has to be made along which the flow continues. The sequential branch has *guard expressions*, which indicate how this selection is made. A *sequential merge* does the opposite; here two paths of control are merged together. A *concurrent fork* spawns off a single control flow into two or more concurrent control flow. A *concurrent join* is used to represent synchronization of two or more control flows. In the flow of control, objects may be stated. Then actions will produce or consume such objects.

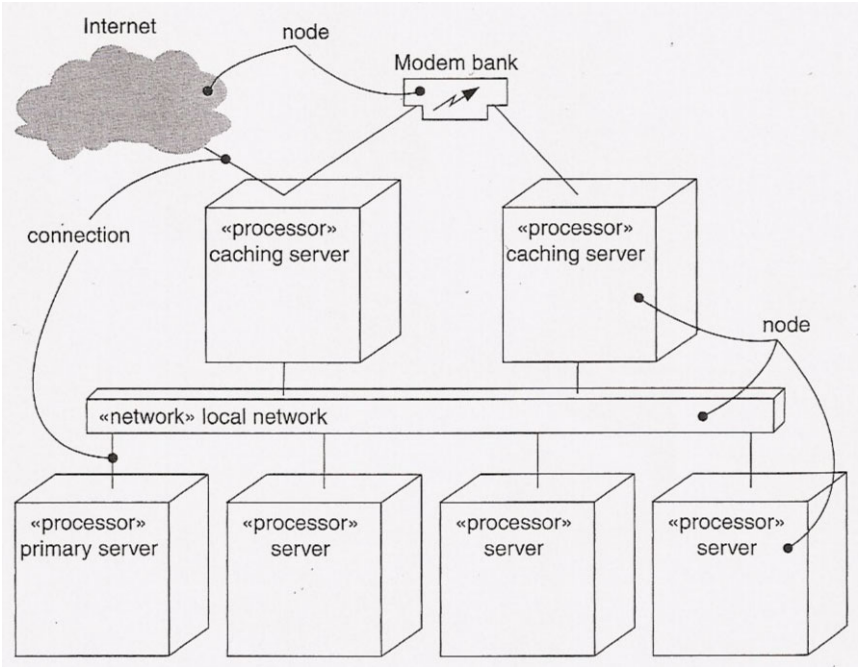
Finally, actions and flows may be assigned to *swimlanes*. Usually, a swimlane indicates a business or organization responsible for carrying out the assigned part of the control flow.

Apart from system interaction activities, activity diagrams are also often used as a simple mechanism to model business processes and workflows.

Deployment Diagram

A deployment diagram covers the viewpoint of the static technical deployment of the system under development. It shows the technical architecture and distinguishes hardware, software components running on this hardware and physical communication structures.

The diagram below shows an example of a deployment diagram.



Example deployment diagram (taken from [UMLUserguide05]).

Nodes execute *artefacts*. A node is a physical element, representing a computational resource (e.g. a computer). Graphically, it looks like a cube. Nodes can be organized with the usual UML abstraction mechanisms (such as generalization and association relations). An artefact is a physical part of a system that exists at the level of an implementation platform (e.g. a .Net component). The artefact is represented as a rectangle, drawn in the interior of a node. This way, it is represented that a node executes an artefact. Nodes have *connections* with each other. These connections allow for physical communication.

3. INFORMATION AND ENTERPRISE ARCHITECTURE

Architecture is currently a very active field in the Informatics and Information Systems disciplines that is still much under development. As new ICT technologies emerge, so do new frameworks and types of information architectures. Therefore, this field is to date only partly standardized. There are differing perspectives on what architecture should cover: for example, one can distinguish between more technical software systems oriented perspectives and a more business value and process oriented emphasis in the discipline. Also, standards have to be continually updated in view of emerging ICT technologies: a case in point being Web Services and Service-Oriented Architecture (SOA).

Definition

There are many proposals and ongoing debates regarding the best definition of the notion of information architecture. Here, we give the definition of architecture as it is found in the IEEE Standard 1471-2000 (see http://www.iso-architecture.com/ieee-1471/):

> *Architecture is the fundamental organization of a system embodied in its components, their relationships to each other and to the environment and the principles guiding its design and evolution.*

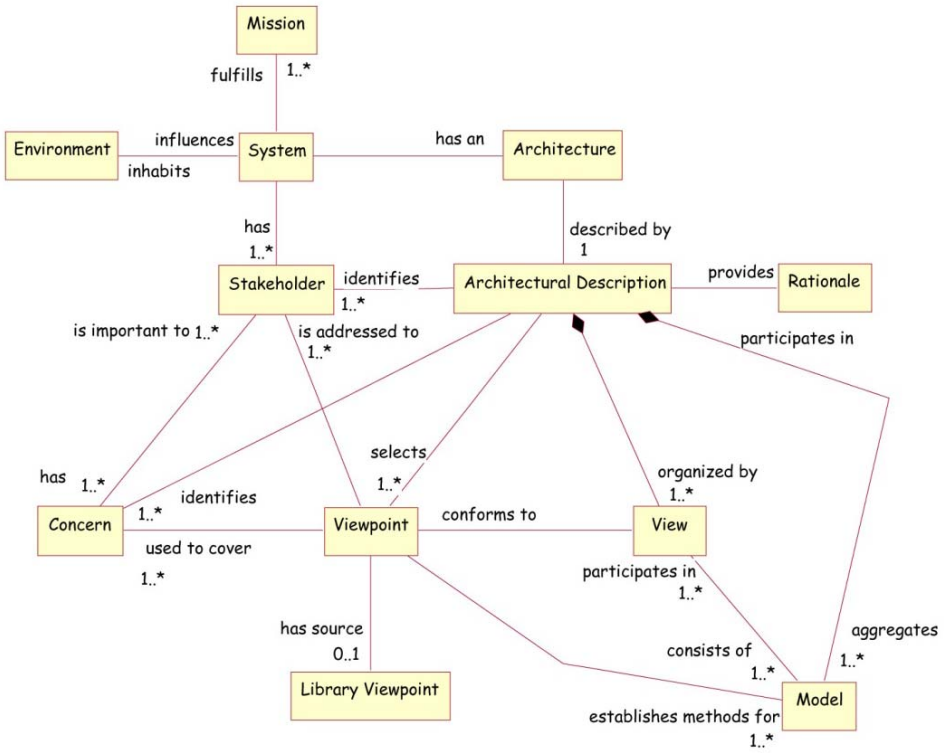
ANSI/IEEE Standard 1471-2000 is the Recommended Practice for Architectural Description of Software-Intensive Systems, developed by the IEEE's Architecture Working Group (AWG) under the sponsorship of the Software Engineering Standards Committee of IEEE. It was formally adopted in September 2000. Clearly, the focus of the IEEE standard is software-intensive systems and so has a predominantly technical software flavour and background. As authors from the AWG state, ANSI/IEEE 1471 is the first formal standard to address the content and organization of architectural descriptions. The standard defines the structure and content of an architectural description (AD) and incorporates a broad consensus on best practices for such descriptions. A wide variety of architecture frameworks exist as de-facto standards in particular communities, but ANSI/IEEE 1471 is the first formal standard in the sense of being a product formally approved by a recognized standards body.

A useful overview and discussion of the ideas and principles behind this IEEE standard concerning enterprise information architecture is [Maier *et al.*, 2004]. As these authors emphasize, architecture in general has three important characteristics:

1. Architecture itself is a *conceptual* abstraction of a system (whereas architectural descriptions and models are concrete artefacts).
2. It captures (only) the *fundamental* characteristics, in other words the essentials, regarding the static and dynamic *organization* of a system (which is not the same as the top level within a hierarchical decomposition).
3. Architecture inherently includes and therefore must capture the *external context* in which the system is used.

A key concept of IEEE-1471 is (again) the notion of *viewpoint*. An architecture is to be described in terms of multiple viewpoints that in essence reflect (and answer) key concerns of different *stakeholders* related to the system. Users, developers, managers, customers etc. are all different stakeholders that have different needs, interests, and expectations regarding what a prospective system is supposed. Thus, stakeholders will always look with different eyes to the same system. Essentially, stakeholders with their varying concerns together define the *context* of a system. The different concerns need to be made explicit as viewpoints within an architecture, and addressed or solved in architectural descriptions made during systems development. These elements underlying

the definition of enterprise information architecture are brought out in more formal detail in the UML class diagram below.



Conceptualization of the IEEE-1471 definition of architecture in the form of a UML class diagram (taken from [Maier et al., 2004]).

As Maier et al. (2004) point out, this definition of architecture is motivated by the case of civil architecture: architecture is articulated from the viewpoints of its stakeholders, their interests determine its fitness for purpose, and this is all to be understood in its environmental context. A viewpoint must therefore define stakeholders [who] and concerns addressed [what], and define modelling language(s) and other analytical techniques [how] used to construct a conforming view. Placing the stakeholders and their concerns in a central position helps in subsequent analysis activities. By having the concerns explicit there is a natural way to identify the quality factors of interest, and thus the appropriate subjects of analysis.

Various examples of viewpoints are found in industry-shared efforts and de facto standards pertaining to architectural frameworks that are rooted in specific industry sectors. For example, RM-ODP, the ISO/IEC Reference Model – Open Distributed Processing [ISO/IEC, 1998], employs a five-viewpoint structure (i.c., enterprise, information, computation, engineering, technical viewpoints).

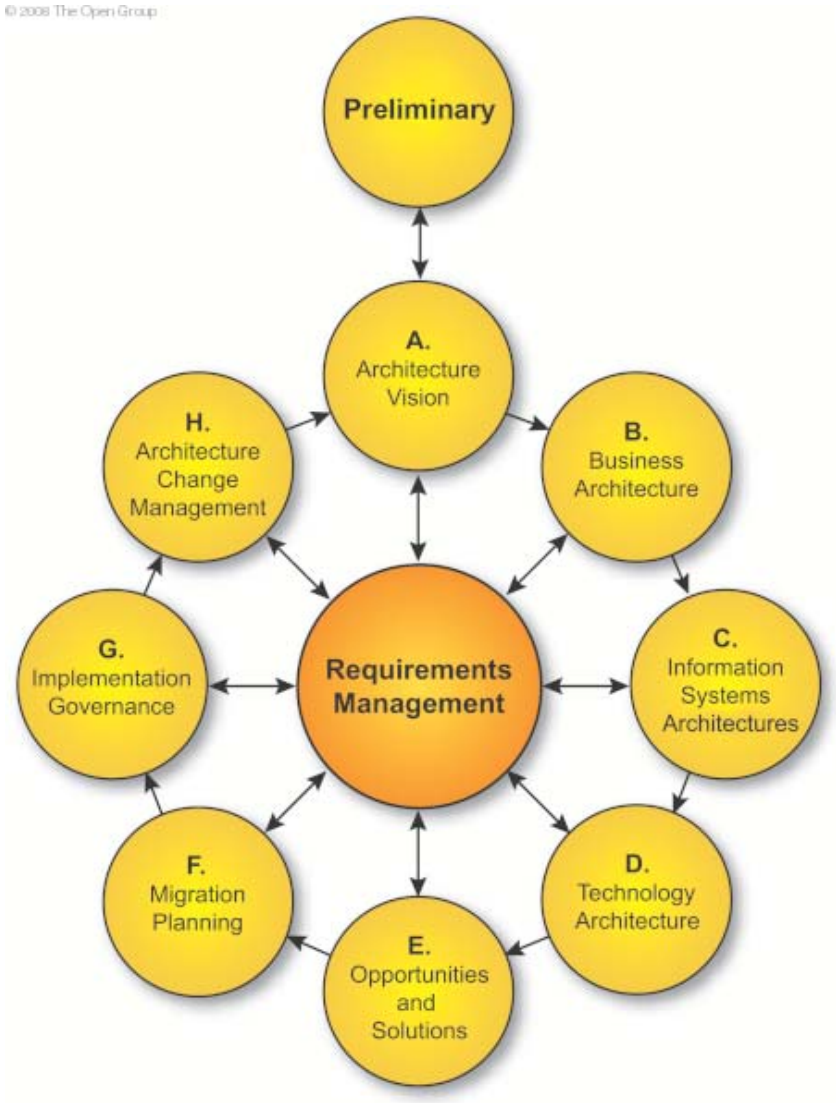
A fundamental tenet of the ANSI/IEEE Standard 1471 is that it does *not* incorporate or require specific architectural methods. It was designed to be *method-neutral*, and therefore intended to be useful with existing architectural methods. Similarly, ANSI/IEEE 1471 does not assume or prescribe the life cycle context within which concepts of architecture are to be applied. Therefore it is also *process-neutral*, and may be applied within various system life cycles.

More specifically, how does IEEE 1471 relate to the Unified Modelling Language (UML, discussed above)? As it is method-neutral, IEEE 1471 does not prescribe nor is committed to the use of UML. On the other hand, it recognizes that the Unified Modelling Language provides a family of useful notations, many of which can, and have, been used for architectural description. Many organizations use one or more of the UML notations to

address one or more architectural concerns. Under IEEE 1471, these notations may be made part of a viewpoint and used to create an architectural description. By defining these practices as viewpoints, an organization can use the UML while creating architectural descriptions conforming to IEEE 1471 [Maier et al. , 2004].

Architecture Development Methodology

As stated, the IEEE-1471 architecture standard does not contain any commitment regarding a specific development methodology or process for enterprise information architectures. This is left to the architectural project team that, however, is expected to explicate these decisions based on the specific purpose and context of the project. Several existing architectural frameworks do propose further recommendations for development methodology. Notably, the Open Group Architecture Framework (TOGAF), an open international industrial consortium that aims at sharing and promoting best practices for enterprise information architecting, has proposed a methodology and process for architecting called Architecture Development Model (ADM) [TOGAF, 2009]. This ADM is depicted in the figure below.



The TOGAF Architectural Development Model (ADM), whereby requirements management is based on the successive development of specific viewpoint-oriented models (taken from [TOGAF, 2009]).

The Open Group Architecture Framework [TOGAF, 2009] has been harmonized with IEEE 1471, and employs architecture vision/principles, business, information systems, and technology as separate viewpoints (A-D in the figure). As is seen from the ADM picture, the TOGAF methodology sees requirements management as a central process to control and integrate architecture development. It furthermore defines and employs the aspects of architecture vision/principles, business, information systems, and technology architectures as separate viewpoints, and moreover, uses these viewpoints as separate and successive steps in architectural model development (notably, steps A-D). Some viewpoints have a further decomposition into smaller viewpoints (e.g. the information systems architecture has sub-architectures for data structures, application views etc. that for example may be modelled by the use of UML).

The TOGAF Architectural Development Model evidently takes a broad and comprehensive approach to requirements management, and so is compatible with many different specific requirements management methodologies. It shares this high-level character with the above-mentioned IEEE standards and guides (such as SWEBOK), and must therefore be complemented with more hands-on methodologies and practices to be of pragmatic use.

This is what we turn to now.

4. USE CASE AND REQUIREMENTS METHODOLOGY IN VOICES

In sum, central tenets of modern requirements engineering are:

A. System requirements are modelled according to different *viewpoints* – which are expressed through different modelling techniques such as found in UML.
B. The notion of *use case* itself represents a central viewpoint, as it focuses on the outside-in perspective how users interact with the system and what the results of this interaction are from the user's perspective. It represents the collection of mutually related (functional) requirements expressing what a system does with and for the user.
C. Capturing the external (and mostly non-technical) *context* has become prominent, which has led to increasing attention for modelling stakeholder goals, business considerations, user concerns, and other relevant social and economic aspects as an integral part of requirements engineering (reflecting an increasing recognition that information systems are *socio-technical* systems).
D. For a successful *process* of requirements engineering the *direct involvement of stakeholders and users* has to be catered for in order to solicit and gain support. Increasingly, *requirements are elicited through co-creation* by stakeholders and users, with the help of informal, qualitative methods such as workshops, brainstorm sessions, interviews, storyboarding, scenario methods.
E. Relatedly, *documentation* of requirements follows a mixed-method approach (i.e. not solely a technical specification approach), whereby *understandability, transparency and traceability of requirements for stakeholders and users*, within the context they operate, are important criteria.

Pragmatics of Requirements Engineering

These tenets are reflected in the methodology used in VOICES.

It follows corresponding recent practitioners-oriented methodology based on industrial experience, as laid down e.g. in *Managing Software Requirements* by Leffingwell & Widrig, Addison-Wesley, 2000. This source gives practical guidelines, work methods (such as user workshops), templates and techniques how to do all stages of requirements engineering. Other useful resources include [Sommerville & Sawyer, 1997], [Kotonya & Sommerville, 1998], [Soft Systems Methodology], see further the bibliographic notes below.

Accordingly, the VOICES development and documentation of uses cases and requirements has been based on extensive field study in interaction with stakeholders and users, using elicitation techniques including workshops, interviews, etc. The account of this is found in Parts II.A and III.A of this document. These provide detailed insights into the stakeholder/user context in which the VOICES tools and pilots have to work (tenet C above) and into the (co-creation involvement) process through which use cases and requirements have been reached (tenet D).

The description of the field work furthermore gives the background of the VOICES use cases and requirements such that understandability for non-technical stakeholders/users, transparency (why are uses cases and requirements put forward and what is their explanation/justification) and traceability (who/what is the source) of posed use cases and requirements are catered for (tenet E).

This is also important information for the future VOICES pilots (which are carried out according to a "living lab" experimental learning approach), because assessing the pilot results in a test plan will heavily refer to and be measured by the stakeholder/user value

of business processes and workflows and use cases-in-context as provided by Parts II.A and III.A of this document.

A Pragmatic Format for Use Cases and Requirements Description

In this document, the VOICES use case scenarios and requirements resulting from and explained by the field research of Parts II.A and III.B are described in a uniform format.

This is done in Parts II.B and III.B which are more focused on acting as a specification baseline for technical development, but as far as possible in a way that is understandable to end users. It thus follows a mixed-method approach (tenet E), where both informal methods (short narratives, scenario scripts) are combined with semi-formal technical ones (UML diagrams). Namely, use case scenario descriptions and corresponding requirements analysis are ideally carried out such that:

- Their essentials are understandable by everyone, also by stakeholders outside the project.
- They provide a clear narrative for the future users (who usually have a non-ICT background).
- At the same time they provide an information baseline that is useful for and can be gradually extended by technical developers (especially for the pilots technical specifications).
- They provide a simple, but shared information basis and reference point for all VOICES participants in different activity areas (e.g. work packages, WPs) and tasks, in a uniform format.
- They are compatible with architecture, system, and development international standards (to be) adopted in VOICES.
- Each use case scenario has a limited size (say, a document of about 10 pages), and requires no more than a few work days to develop (e.g, 1 workshop/brainstorm meeting and 1 structured write-up, to achieve a first-cut version).

The set-up proposed below is such that it is simple but does the job, at the same time being compatible with guidelines, standards, and requirement and IS development methodologies concerning the development of information architectures.

Thus, Parts II.B and III.B particularly intend to cater for requirements tenets A and B mentioned above. The different slots as listed below take the use case as the central viewpoint (in particular slots 0, 4, 5 below), but make it possible to express other related and relevant viewpoints as well (namely, in slots 1-3 and 6-9, it's not difficult to recognize various viewpoints that correspond to the TOGAF ADM method, stages A-D, see the corresponding picture above).

0. Name

A characteristic, understandable, and distinctive label as unique identifier each use case scenario.

1. Summary of key idea

What's the key (business) idea and why is it valuable or of interest to consider? (Short abstract, in a few sentences)

2. Actors and goals

Who are the actors in the scenario and what are their role/responsibilities and goals? (Can be given in the simple form of a Table).

3. Context and scope

This can be described by answers to a checklist of questions such as:

a. What is the layout or network configuration of the interactions between the parties involved in the scenario?

b. Who are the (external) stakeholders and what are their concerns?

c. What is the scope of the scenario (especially, what is outside it, not considered, system boundary)?

d. What are success or performance measures for the scenario (especially in relation to what a pilot demonstration should be able to show)?

e. What are important (pre)conditions that must be or are assumed to be satisfied for the scenario (context features, e.g. needed resources or infrastructure or other characteristics of the environment)?

4. Use case scenario script

The central storyline (just like in a movie, video clip storyboard, animation, or demo; the script might for example be given in the form of a Powerpoint or Flash animation showing the event-state chain of the actors' activities and interactions).

The main scenario is given in a well-structured narrative, e.g. through a limited number of steps (commonly 5-10), of the following type:

<actor1> <(inter)action> <actor2>.

Not all possible sub-scenarios, just the main and typical one is needed as a first step.

5. Interaction and communication

Further script information, e.g. in the form of a few UML sequence, state or activity diagrams. (This gives some info about dynamics, interaction and control flows).

6. Information concepts

Further script information, e.g. in the form of a few UML class diagrams showing the meaning of important concepts. (This gives some info on static data structures).

7. Technology infrastructure

What are the consequences of the above for technologies and technology components (Internet/Web, mobile, information, communication, voice services, both hardware and software) that must be (made) available in order for the scenario to work?

8. Cost considerations

What are estimated associated costs (operational, investment, development, in/outsource) for these technology infrastructure and components? Who carries these costs?

9. Feasibility and sustainability

Previous sections must be as factual as possible. This section is the start of assessment and judgment. The following checklist of questions needs answers:

a. What is the technical feasibility of the scenario (e.g. [project] risk analysis, technical obstacles to overcome, system-level impacts)?
b. What is the business and (socio-)economic feasibility and sustainability of the scenario?
c. What are possible goal conflicts and dependencies in the collaboration between the actors in the scenario?
d. Are there important general preconditions for the scenario to work, and is it sufficiently interoperable with the wider context both in a business process and a technical sense?

10. Key requirements

So-called MoSCoW list of requirements (Must have, Should have, Could have, Won't have) as a starting point for further architecture design, and system and component development.

This structured format is followed for the VOICES use case scenarios described in Parts II.B and III.B of this document.

PART I BIBLIOGRAPHICAL NOTES

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[2] P. Loucopoulos and V. Karakostas, *Systems Requirements Engineering*, McGraw-Hill, 1995.

[3] [Sommerville & Sawyer, 1997] I. Sommerville and P. Sawyer, *Requirements Engineering: A Good Practice Guide*, John Wiley & Sons, 1997.

[4] [Kotonya & Sommerville, 1998] G. Kotonya and I. Sommerville, *Requirements Engineering: Processes and Techniques*, John Wiley & Sons, 1998.

[5] [Leffingwell & Widrig, 2000] Dean Leffingwell & Don Widrig, *Managing Software Requirements*, Addison-Wesley, 2000.

[6] [Soft Systems Methodology] P. Checkland and S. Holwell, Information, Systems, and Information Systems, John Wiley, 1998.

[7] Jaap Gordijn and Hans Akkermans. *Value based requirements engineering: Exploring innovative e-commerce ideas*. Requirements Engineering Journal, Vol. 8(2):114-134, 2003.

Recently, the "living labs" approach has risen in prominence; if applied to information systems, it may be seen as an *in-situ*, stakeholder/user-oriented and iterative, *field experiment approach* to requirements engineering and validation. The VOICES pilots will have such a character, cf. :

[8] LLISA, Living Labs in Southern Africa, http://llisa.meraka.org.za/index.php/Living_Labs_in_Southern_Africa

[9] Hans Akkermans, Nana Baah Gyan, Anna Bon, Wendelien Tuyp, Aman Grewal, Stéphane Boyera and Mary Allen: *Is (Web) Science Ready for Empowerment?* In Proceedings ACM Web Science Conference 2011 (WebSci2011), Koblenz, D, 14-June2011. http://www.websci11.org/fileadmin/websci/Papers/74_paper.pdf

References on Information Architecture

In the IS/IT area a lot of work has been carried out on how to specify and validate enterprise and information architectures: e.g. the Zachman and TOGAF frameworks for enterprise and business architecture, RM-ODP as an ISO/IEC standard for Open Distributed Processing systems, OMG's Model-Driven Architecture (MDA) for middleware, and the IEEE SWEBOK guide for software engineering.

[6] IEEE Standard 1471, *Recommended Practice for Architectural Description of Software-Intensive Systems*, September 2000, http://www.iso-architecture.com/ieee-1471/

[7] M.W. Maier, D. Emery, and R. Hilliard: *ANSI/IEEE-1471 and Systems Engineering*, Systems Engineering journal, Vol 7, No. 3, 2004, 257 – 270.

[8] ISO/IEC 10746-1, *Open Distributed Processing – Reference Model* (RM-ODP), ISO/IEC, Geneva, CH, December 1998.

[9] [TOGAF, 2009] The *Open Group Architecture Framework* (TOGAF), Version 9, 2009.
http://pubs.opengroup.org/architecture/togaf9-doc/arch/index.html

References on UML

A good, short and very accessible introduction to the UML 2.0 standard is:

[10] [UMLDistilled03] M. Fowler: *UML Distilled*, 3rd Ed., Addison-Wesley, Boston, MA, 2003

[11] [UMLUserguide05] Grady Booch, James Rumbaugh, and Ivar Jacobson, Unified Modeling Language User Guide, The (2nd Edition), The Addison-Wesley Object Technology Series, 2005.

[12] [UMLReference04] James Rumbaugh, Ivar Jacobson, and Grady Booch, The Unified Modeling Language Reference Manual (2nd Edition), The Addison-Wesley Object Technology Series, 2004.

[13] *The OMG formal standards* (see www.omg.org)
[UMLstandard07] Unified Modeling Language specification, version 2.1.1. This specification consists of:

- UML 2.1.1 Superstructure Specification
- UML 2.1.1 Infrastructure Specification
- UML 2.1.1 XMI file
- UML Diagram Interchange Specification
- UML OCL Specification

PART II.A: Report on the Field Research in Mali, Burkina Faso and Ghana for the m-Agro Regreening Knowledge Sharing Pilot

5. VOICES-W4RA FIELD TRIP 14-26 JANUARY 2011: OVERVIEW

This Part II.A reports on the first activity for the m-Agro Knowledge Sharing Pilot of the VOICES project [1], Work Package 5, which took place in January 2011, and W4RA Project. Work Package 5 leader is VUA with participation of Sahel Eco and World Wide Web Foundation. The W4RA project [2] has a broader spatial extension within the re-greening initiative. In the W4RA project-planning meeting held at VU Amsterdam on 22-25th of November 2010*, it was decided that VU and WF would jointly undertake a road show in January 2011 across Ghana, Burkina Faso, Senegal and Mali. The primary objective of this road show would be to demonstrate services envisioned under the W4RA project. All the key learning's from the road show would then be pooled in, to crystallize a set of services, which would then constitute the core of W4RA technology offering.

Road show target audience included African project partners, NGO partners, agro extension agents and ICT practitioners. Field research included conducting focus group discussions related to the technology demonstration(s) with extension agents, farmers and ICT practitioners. Qualitative data and usability feedback to be collected at each demonstration site and would then be pooled in during subsequent brainstorming sessions to finalize the technology services offering for the W4RA project.

This report highlights the technology demonstrations, key takeaways, use cases gathered and overall description of the workshops held during the road show in Mali, Burkina Faso and Ghana from 14-26th January 2011. During the field trip we visited several farmers on their fields, especially those who are involved in *Regreening* [3] [4] activities, also referred to as RNA (régénération naturelle assistée), or FMNR (farmer managed natural regeneration). R*egreening* is a central theme for the farmers in the Sahel. Moreover, knowledge sharing is an essential aspect of the *regreening* activities.

We visited several local community radio stations. Radio is an important voice channel for information exchange in this region. Radio not only generates voice content, but also acts as a local hub for information sharing [5] [6]. Six workshops were conducted at different locations, with participation of the relevant stakeholders (farmers, radio people, NGO's, local ICT entrepreneurs, farmer organizations, civil society organizations). The VOICES team members' demonstrated possible applications of voice services involving simple

* https://private.webfoundation.org/partner/Program/WiS/agriculture/W4RA/Meetings/ams102010.html

mobile phone and radio applications. The local participants were invited to share their thoughts on the usefulness of innovative voice services that could benefit their lives and work.

We were able to gather extremely useful insights related to how farmers, extension agents, community radio stations, farmer cooperatives and NGO's generate and consume information. We also gathered interesting use cases that have been elaborated further in this report. Overall Radio is the de-facto king of information across the Sahel. People use it for a variety of purposes. These can range from broadcasting information related to lost or missing animals to more general info-tainment purposes. Farmers, farmer representatives, extension agents, community workers, young and old all have mobile phones. They use it for variety of purposes. A milk seller in Tominian calling her clients to know the quantity needed, or re-greening farmers in Mali calling for help in case someone is seen cutting trees. Women in Bolgatanga in Ghana actually share their mobile phones with other women in the community who cannot afford the total cost of ownership.

Pilot Implementation

Voice technology demonstrations along with an interactive Q&A session were very helpful in developing a baseline understanding of what we should develop as a pilot initiative.

Baseline Functionality

Technology services have to be robust and simple. Easy to use and manage. Remote install and maintenance should be possible. Help desk services should be provided. Local people should also be able to troubleshoot so that travel is not required as it will not be feasible.

Location

Mali is the target country selected for the m-Agro Knowledge Sharing Pilot WP-5. However, the pilot may be extended to similar rural environments in Burkina Faso and Northern Ghana. There are three pilots envisaged:

A. Radio voice messages management system (no internet) pilot

B. Farmer organization/innovative farmers information sharing (no internet) pilot

C. Sahel Eco www.reverdissement.org website- social network with voice/mobile access pilot (internet access)

Radio SENO Bankass: no Internet, no computers, many listeners

6. ROADSHOW TECHNOLOGY DEMONSTRATIONS

The Web Foundation team led by Stephane Boyera and Aman Grewal along with Nana Baah Gyan from VUA presented a set of voice-based demos to the target audience during the workshops (discussed below) to give participants an idea what might be possible with the technology, and so trigger use case elicitation.

A brief snapshot of the technology demos is as below[†].

The farmer Yacouba Sawadogo from Burkina Faso, known as "the man who stopped the desert", in front of the forest he created in the Sahel

Voice-based Demonstrations

- **Synopsis**: the demo is a portal that offers 3 services:
  - listening a broadcast program alacarte which offers a song and broadcast on agriculture in Mali in French language
  - recording a message to be broadcasted
  - retrieving the messages that have been recorded (only 5 messages recorded)
- **Goals**: the demo shows how voice services work through normal phone. In the field we also added an FM transmitter that demonstrated that a recorded message could be directly transmitted on the radio and received by people with their own radio-sets
- **Access and tests**
  - French Demo:

    USA Domestic +1-857-293-0048 USA Toll Free PIN Access +1-800-289-5570 then PIN: 9991482462

    Skype VoIP +99000936 9991482462

    SIP VoIP sip:9991482462@sip.voxeo.net
  - English Demo:

    USA Domestic +1 857-293-0046 USA Toll Free PIN Access +1-800-289-5570 then PIN: 9991482460

    Skype VoIP +990009369991482460

    SIP VoIP sip:9991482460@sip.voxeo.net
- **Technical bits**: It is possible to build a local platform to run the demo. Such platform is built on:
  - Asterisk

[†] Source: http://public.webfoundation.org/2011/01/demo_w4ra.html

- Voxeo Prophecy

and uses a mobigater mini for answering local call. In terms of VoiceXML, there are 4 parts:

- A portal that the user reaches when calling in
- Three different services attached to the portal.

GIS Demonstration

- **Synopsis**: a very simple demo which is based on a hacked version of Ushahidi that shows how what can be done with online maps (and this works offline too)
- **Access**: an online link to the roadshow demos is available via the W4RA private pages [Resource note].

7. M-AGRO REGREENING FIELD TRIP DAY-TO-DAY ACCOUNT

Itinerary from 14 to 26 January: Bamako – Segou – Tominian – Bandiagara – Bankass – Ouahigouya – Gourcy – Ouagadougou – Tamale – Bolgatanga – Ouagadougou.

W4RA-VOICES roadshow/field trip itinerary (indicated in yellow)

Workshop in Bamako, Mali, Grand Hotel, Saturday 15 January 2011

Participants

Thirteen guests from several organisations attend this meeting:

Radio representatives, (Organisation Radio Télé du Mali, Union des Radios et Televisions Libres du Mali, Radio Liberté, Radio Bèlèkan Kati) Farmer organisations at national level (AOPP Association des Organisations Professionnels Paysannes, CRCR Comité Régional de Concertation des Ruraux, FENAFER Fédération Nationale des Femmes Rurales, CNOP Coordination nationale des organisations paysannes du Mali), ICT entrepreneurs (Rib_ml Informatique, Internet et Télécommunications).

VOICES team

VUA: Hans Akkermans, Chris Reij, Nana Baah Gyan, Wendelien Tuyp, Anna Bon, Bruno van Moerkerken (filmmaker) ; from Sahel Eco : Mary Allen, Abdoulaye Sow ; from Web Foundation [7] Stéphane Boyera, Aman Grewal.

First W4RA workshop at Grand Hotel in Bamako: f.l.t.r. Hans Akkermans (VUA), Mohamed Dicko, Seydou Coulibaly, Ousmane D. (ICT-business Rib_ml)

Introduction and demos

Mary Allen (Sahel Eco) introduced the VOICES and W4RA projects to the workshop participants.

A demo by Nana Gyan (VUA) showed the possibilities of recording a voice message and retrieving it from the computer. Stéphane Boyera (WF) demonstrated voice message recorded from a mobile phone to the computer and then broadcasted on the radio, to give an idea of the integration of voice-mobile telephony-radio in an offline setting (no internet available).

Aman Grewal (WF) gave a presentation on Farmer Helpline, a project in rural India, where exchange of knowledge amongst farmers is enabled through an expert network and an operated knowledge base.

Discussion on use cases and sustainable business models

The discussion started after the demos. The farmer organisation representatives (at high national level) see a problem in making voice services sustainable, because they cannot imagine a business model in which people in rural areas are prepared to pay for a voice-based service.

The ICT people present (Rib_ml) did not show high motivation to participate in the co-development of Voice Web services. Apparently they are involved only in webhosting and data storage and not in the development of innovative web services.

One radio director explained the background of radio in this country: Mali has 13 local languages. Only two out of 13 is written. Mali has actually 13 million inhabitants, out of which only one million speak French. Therefore local languages and voice communication are extremely important here. Bambará is the widest spoken language in Mali. Radio content is broadcasted in many different languages. Radio is an important medium to inform and reach people.

On the road towards Segou

Visit to Radio Segou (FM 96.8), Saturday 15 January 2011, evening

Participants

We meet Mr. Fousseyni Diarra, program maker at Radio Segou.

Background about Radio Segou

This radio is part of the national radio broadcasting company ORTM, which also provides part of the funding for this radio. There are few computers at this radio station, but no internet connection. This radio has a coverage radius of 150 km. The listeners of this radio are young and old, men and women. Basically everyone listens to radio every day. Every household in the region owns a radio (powered on battery when there is no electricity).

Discussion on use cases

Sahel Eco runs a project together with Radio Segou on market information. Price information and names and phone numbers of sellers of Shea butter and honey (two common products in this area) are collected verbally, in 20 villages in the environments of Segou. A person from Sahel Eco collects this info verbally, from the villagers, going around by motorcycle. This information is collected on a monthly basis and stored in an Excel file on a local laptop. The paper print is given to Radio Segou by Sahel Eco. Radio Segou regularly broadcasts this price information on the radio. Three times a day a phone number is broadcasted to encourage people to ring and provide more price info, themselves. This service is inefficient, because incoming voice messages are not recorded or stored digitally. However, the information broadcasted is highly appreciated by sellers and buyers of the products. It is necessary to scale this information sharing system up to a more efficient level.

A voice based service as we suggest will be welcomed by the people from Radio Segou and Sahel Eco. Such a system has the potential to increase efficiency by enabling storing

and retrieving voice content. Moreover, it will enhance the quality of the radio programming, while reducing work and therefore costs for the radio.

A solution has still to be found for payment of the message broadcast fee, before the radio can efficiently start accepting phone messages from listeners.

Another interesting service delivered by radio Segou is the phone-in-and-leave-message or request for music. A list of 40 songs is broadcasted and people can select the one they want to hear on the radio. People can phone on Sunday and talk live on the radio on a 1.5 hour programme. The number of incoming calls for music requests or to leave messages is much higher than the actual attended calls by the radio people. The problem is that the radio can only attend live calls during the program hour, because they are not able to record a phone message and broadcast it later.

The revenues of radio Segou

Income from fixed contribution by the national radio organization ORTM.

NGO's (like e.g. Sahel Eco) who pay the full price for announcements

Non-commercial announcements (1000 F CFA) by listeners.

Visit to Radio Moutian in Tominian (FM 105.3), Sunday 16 January 2011

Radio Moutian

Background about Radio Moutian

This radio was founded in 2008. Investments were provided by a European development agency. Stéphane Boyera is interviewed for the radio. "What is the Web…?"

The director of Radio Moutian and Hans Akkermans meet and shake hands before video.

Gustave Dakouo, staff member from this radio joins the group and comes to Bandiagara with us to attend the workshop. The coverage of Radio Moutian is large, even in Burkina Faso people can receive this radio station. For licence reasons they cannot tell us the real coverage area of the radio. Electricity is often a problem for this radio (goes down frequently).

Discussion on use case

The programs broadcasted by this radio provide information about agriculture, education, health, civil & legal information, (provided by NGOs) but also entertainment and music. The radio receives 200 calls a day from listeners who react on programs and leave messages. Non-commercial messages are broadcasted for 500 FCFA each. A short commercial announcement costs 2500 FCFA.

Radio Moutian in Tominian

Visit to regreening fields

After lunch we visit the fields of Abdulah Tangara and Sounka Lobugou. Natural farmer-managed Regeneration (RNA) is applied here since 2007, encouraged especially by Sahel Eco. Cash crops are sesame, ground nuts, black eyed beans, sorghum millet. The farmer won a price for his regreening activities. He owns a phone, but does not use sms.

Visit to Regreening Fields of Farmer Moussa Sangara, Monday 17 January 2011, morning

Background about the farmer

Moussa Sangara speaks Bambará, no French. He started applying regreening (RNA) in this region, 5 years ago. Currently 200 villages in this region are applying RNA. Trees are important, according to Moussa. When a person comes and starts cutting or burning trees, the farmers organize social sanctions through mobile phone, to put pressure and apply social exclusion on the culprit. This community punishment usually works well. Fortunately here, farmers and herders go along well. The herder's cows and goats graze the fields and leave manure that fertilize the soil, and provide seeds. As long as the herder does not cut trees, it is fine to let his animals graze here. Moussa Sangara uses his phone and listens to the radio every day. Radio provides info about regreening techniques, provided by Sahel Eco and other NGOs.

Soil conditions for farming

The degraded soil conditions in this part of Mali are a first of all a consequence of human induced deforestation, but also of climatological conditions and the composition of the underlying crystalline basement. Under wet tropical forest cover crystalline basement weathers into a plastic mass of clay minerals. During denudation (man-made deforestation) the weathering mantle of quartz-rich basement (granite, gneiss, and quartzite) may be completely removed by run-off water until the emergence of the unweathered basement. On top of this a layer of resistant residual components remains, mainly quartz pebbles, resistant heavy minerals and lateritic debris: the so-called desert pavement. Above quartz-poor Fe- and Mg-rich basement the weathering mantle may become wholly or partly covered by concretionary laterite forming crusty soil of even a rock-like carapace. [8-9] Weathered Fe-rich basement gives better agricultural soil than quartz-rich basement. Under such conditions farming techniques like ZAI [4] are especially fruitful.

Visit to Radio Baguiré (FM 92.9 and 103.8), Monday 17 January 2011, morning

Background about Radio Baguiré

Radio Baguiré was founded in 1994. We talk to program maker Salif Aly Guindo. This radio works like a franchise company for ORTM. The small scale programming of local news is a main reason for its success. The radius is 150 km. Staff number is 7. Language of broadcasting is Dogon and Bambará. Very little French. This radio is self supporting, thanks to several NGOs who buy radio airtime. A solar power installation in the backyard provides energy for the radio.

Discussion on use cases

The programs with the biggest impact are those on agriculture and health. There are weekly programs where people can call and leave messages. These are very popular. Themes are social interaction and agricultural topics. E.g. farmers phone to the radio to inform about the actual amount of rainfall on their land. Radio collects this info by writing it down, and then broadcasting it. People pay a fee (500 FCFA) to have their messages broadcast.

Workshop in Bandiagara, Hotel Togona, Monday 17 January 2011, afternoon

Participants

There are 14 participants. Representatives from community radios: Radio Segou, Radio Moutian, ORTM Mopti, Radio Seno Bankass, Radio Baguiré, and seven farmers from Bankass, Tominian, Soungalobougou, Gongon, and Yawakanda.

From VOICES/W4RA: Stéphane, Aman, Hans, Anna, Wendelien, Nana, Mary, Bruno.

Workshop in Bandiagara

Introduction and demos

After the introduction by Mary and the demos by Nana, Stéphane and Aman (similar to the ones in Bamako) a vibrant discussion starts. Translated from English to French to Bambará.

Discussion on use cases

From the discussions we learn that there is enthusiasm amongst farmers and radio people for innovative voice services accessible through mobile phone. Unlike the national farmer umbrella organizations in Bamako, these participants (farmers and radio people) can imagine useful application of voice services. They mention voice services integrated with radio, voice directory services that can identify experts on certain subject (e.g. agriculture), voice messaging services, question & answer services, updated price information about agriculture market products etc. In time of vaccination of the herds, (an activity which engages many farmers), vaccination events can be easily organized using voice services, says herder Idrissu Sangué. Voice based information about health (e.g. for pregnant women, how to treat malaria etc.) is also useful. One participant mentions what could be named a "Voice Forum", a voice based system where people can leave messages and react on each other's messages, on a certain topic, within a certain group or community.

Thoughts on business model

They have thoughts about the business cases necessary to pay for voice services. They believe that people will be prepared to pay for a service that will save travel time, or will provide information about e.g. prices. People like to exchange information without having to travel around or having to phone may people, telling them the same message over and over again. The payments have somehow to be integrated in the billing system of the phone.

Field Trips in the Yatenga region, Burkina Faso, Wednesday 19 January 2011, morning

After meeting our Burkinabe partners in Regreening, Adama Beleviré and Mathieu Ouedraogo (Réseau Marp), we visit the fields near Gourcy of farmer innovators Ousseini

Kindo and Yacouba Sawadogo. (The latter is Mark Dodd's protagonist in the award-winning documentary "The man who stopped the desert"). Yacouba Sawadogo and Ousseini Kindo are well known farmers-innovators. They started more then 20 years ago their regreening techniques and have now restored a broad area of land and converted it into agro-forest fields.

Discussion on use case

Both Yacouba Sawadogo and Ousseini Kindo receive many phone calls per day and are regularly visited by farmers and farmer organizations who want to learn more about regreening techniques and innovative agricultural practices. These two farmers are really considered great experts on agriculture and especially on regreening.

The fact that Yacouba and Ousseini do not read or write, and do not speak French, supports the urgency of deploying voice based services to collect and store spoken knowledge in local language in a voice-based knowledge base.

Visit to the field of Ousseini Kindo

In Ouahigouya, Stephane, Aman and Nana buy a solar chargeable Samsung phone for about 40 EUR. SIM-cards ("des puces") are sold for 500 FCFA, but only presenting your passport or ID-card. (Whereas in Senegal you buy "des puces" on every street corner.)

Visit to Radio La Voix du Paysan, Ouahigouya, Wednesday 19 January 2011, morning

Burkina Faso Radio La Voix du Paysan

After the field visit, the radio station "La Voix du Paysan" (i.e. "the voice of the farmer") in Ouahigouya is visited. A radio interview is broadcast live with Stephane Boyera, Mary Allen, Anna Bon about the VOICES project and the development of voice services.

Programming at Radio La voix du Paysan is done on paper

Workshop in Gourcy, Wednesday 19 January 2011, afternoon

Participants

About 18 participants from farmer organisations (innovative farmers from the Yatenga region, this region) and seed producers at national level in Burkina Faso.

Farmer and seed producer representatives around the table.

Discussion on use cases

The Burkinabé seed producers are united in a large organization which is responsible for certification of seed products. They operate at four levels: national, regional, provincial, community level.

The process of seed certification was initiated and financed in 2009 by a project by FAO (Food and Agriculture Organization of the UN), but has finally to become self-supporting, financed by the end-producers of seeds at community level. End-producers actually pay a fee to have their seed products certified.

One problem is that producers never provide info on the size of their seed stock.

The whole process of collecting information of the seeds at community level is now done by hand on a paper-based system, and is collected by extension agents from the national seed producing organisations, who go to the villagers. This whole process could be facilitated by using phone and voice channels, especially if there would be a way to collect the certification data of the seeds by phone as well as making the payments through mobile phone.

Thoughts on business models

The organization of innovative farmers is concerned about the costs of voice services. However, if the payments that the seed producers make to certify the seeds can be done through a mobile payment, this would increase efficiency of the information collection and the certification.

Despite the questions on the feasibility and the business models for voice based services, the participants are sympathetic towards the idea of voice based services.

Workshop in Ouagadougou, Hotel Ricardo, Thursday 20 January 2011, morning

Participants

Adama Belemviré, Mathieu Ouedraogo, from NGO Réseau Marp, Prof Oumarou Sié, Professor in Information and Communication Technology at Université de Ouagadougou and member of ISOC, and Mr. Mousssa Ouedraogo, program maker from the Ouahigouya Radio La voix du paysan (the radio reporter who interviewed us the previous day).

Backgrounds

Réseau Marp is an NGO in Burkina Faso, with a similar mission as Sahel Eco has for Mali: to assist and promote RNA. Réseau Marp is also one of the partners of CIS-VUA's regreening expert Chris Reij in the African Regreening Initiative.

Réseau Marp is promoting RNA in rural environments, by facilitating knowledge exchange between farmers, and especially with assistance of farmer innovators like Yacouba Sawadogo and Ousseini Kindo. Réseau Marp wants to monitor the impact and scale of the actual regreening activities, e.g. number of trees, over a longer period of time.

Discussion on use cases

We discuss the same subjects concerning voice-based services for farmers, radios and NGOs. Mathieu Ouedraogo and Adama Beleviré from Réseau Marp show enthusiasm for voice services in order to support information diffusion on regreening activities, and collection of information from farmers. Especially the web-based Geographic Information System, as described by Stéphane, in which any kind of information could be plotted, on an OpenStreetMap site, be it visual (pictures, video) or be it voice info, could be very useful for Réseau Marp. It will make possible to keep track of regreening activities in the fields, in its spatial context, according to Adama.

Especially NGO organisations like Réseau Marp are interested in mapping spatial data, and in an interface between Voice based services with the World Wide Web. An idea of having such a thing as a "voice-based social network", analogue to e.g. Facebook, is also welcomed.

Thoughts on business models

There are several options to make a voice-based system financially sustainable; or people have to pay a fee for each phone call, which they will do if they benefit from the given info; or sponsors should be found.

The possibility of applying for sponsoring of radio stations by telecom providers is discussed. When radio stations really start to collect and exchange voice content through a phone-based system, they will increase the network traffic and therefore the revenues for the telecom operators. If this implies that radios become voice *content-providers,* they could apply for some kind of sponsorship or support by the Telco's. (This is common practice in the internet business). However, this has to be discussed with the local Telco's, e.g. starting by a chat with our own VOICES-partner Orange (France Telecom) in Mali.

Team debriefing meeting in Ouagadougou, hotel Ricardo, Thursday 20 January 2011, afternoon

Members present: Aman Grewal, Stephane Boyera, Mary Allen, Wendelien Tuyp, Anna Bon, Nana Baah Gyan, Prof Hans Akkermans.

Summary of discussions

Technology demos key learning: The key learning's and use cases will lead to the technology pilot and service architecture. Content will ride on top of technology that we decide to pilot.

Use cases: We have to decide on which use cases (of the ones collected) we should focus on. Mary's description of use cases is very helpful. As of now the two broad categories of use cases are: a. announcements and broadcasts by people and b. ability to call in live during the time of radio broadcast using mobile phone. Specific use cases that have to be incorporated as pilot service(s) to be decided. Hans suggested writing down the list of use cases: at least 15. Then select a few for implementation.

Implementation: We have to start thinking of implementation tasks. Check after compiling all the documents if we have all the information to start the above two steps and also what assumptions to make. For the implementation scenario develop only baseline functionality and keep it simple to deploy, use and maintain. Examples cited: Radio Stations in Mali: ORTEM Bandiagra / Bankass. During the discussions it emerged that Bandiagra can be a good pilot location. Mary Allen informed that this radio station is much more stable in terms of infrastructure and resources like electricity and approach. Also we need a champion to move the pilot locally hence limit the pilot to one location. *(As things have moved forward on this point subsequent to the meeting we will update this section on a continuous basis in the team space).*

(a) Service Architecture: Hans was of the view that the service offering should related to farmer groups + NGOs + Cooperative groups so that it is more inclusive. Location Mali. Stephane and Hans were of the view that existing processes that can be enhanced have a better chance of success i.e. select use case that has direct benefit to the above target group.

(b) Baseline Functionality: Technology services have to be robust and simple. Easy to use and manage. Remote install and maintenance should be possible. Help desk services should be provided. Local people should also be able to troubleshoot so that travel is not required as it will not be feasible.

Role of ICT developers: Hans was of the view that we should forget the ICT developers for the pilot phase. It was observed that we did not meet the right sample of innovative entrepreneurship oriented ICT developers. They can act as good contractors and hence can act as good resource / support staff to projects that would be focused on radio stations. Training of local ICT staff: Stephane stressed the importance of sorting key ICT professionals during the training session on mobile entrepreneur's to be held in Accra in February. Hans suggested that some sort of pre-screening might be helpful in such a scenario. The first training session under the Project is not due till 2012 and it may be too late for the pilot deployment. Key decision made was that we would invite key contacts of Mary Allen / Sahel Eco for a 4 day workshop in Mali and pick the best ones.

Deciding Monitoring and Evaluation formats: While developing the pilot phase it is important to keep an eye on what we would need to take from the pilot usage data. So M&E formats should be designed parallel to development / deployment phase.

Infrastructure: Stephane informed that Orange will provide the connectivity and telecom infrastructure required for the pilot. Hans was of the view that we should keep one telecom operator only for the pilot phase to reduce complexity.

Workshop in Tamale, Ghana, Modern City Hotel, Saturday 22 January 2011

We are welcomed by prof. Saa Dittoh, from the University of Development Studies (UDS) Tamale. Prof. Saa organized the workshops and field trips for us in Ghana.

Participants

ICT developers

Staff members for University of Development Studies (Tamale)

Representative from the Ministry of Food and Agriculture

Radio stations: Savanna, SIML, GBC (Ghana Broadcasting Company)

NGOs: Trax, Groundwells, World Vision.

Prof. Saa Dittoh opens the workshop and introduces the VOICES team. He gives a short outline on the work of the UDS (University of Development Studies). UDS has a multi-disciplinary approach to (rural) development issues based on the PBL (problem-based learning) methodology. Students of UDS are sent to the field every year of their study, to learn and get acquainted with the reality of rural areas and communities.

Discussion on use cases

The discussion focuses first on the technical aspects of a voice based system. ICT people want to know details, and are concerned with the technical aspects, because ICT technical and organizational maintenance is considered a problem here in Ghana.

The NGOs show some reservation because they have heard about e.g. other ICT projects in East-Africa that were apparently not successful, although conditions were very different then in the VOICES project.

The NGOs in this meeting are more convinced of the necessity of bringing information to the rural people they work with then in the encouragement of exchange of local content by rural people themselves, as we propose with the Voice-based systems. This latter option is a new approach, for the NGOs.

The literacy problems of farmers are mentioned, and the possibility to use local languages in voice services is stressed by the participants.

A presentation is given by one of the NGOs about an ICT project on agriculture market products in Ghana named ESOCO (started as Tradenet). The pilot is still running in Ghana and Liberia. It is mainly sms-based. Farmers received mobile phones, financed by the project. They were asked to send information on their products by sms. If farmers were illiterate, they could bring their children, who usually know how to operate a phone with sms.

The envisaged development impact of the ESOSO pilot was: (1) improvement in access to market information by the participating farmers and (2) these farmers easily communicate among themselves.

Encountered challenges were: information is not updated frequently by the farmers; not any farmer can participate in the project, only a selected group of farmers that has been trained and.

The system is difficult (user-unfriendly) for less trained people; the set up of this market information system is large-scale in terms of spatial coverage, so not all info is relevant for all participants. There are also many technical problems with the system. The system is often off-line. The costs are high. Payment is a problem. It is sponsored at this moment. Sustainability on the long run is not evident.

Patrick Aalangdong. From Dataworks, offers ICT support if a voice-based system is to be hosted for the VOICES or W4RA projects. He mentions that technical support is often a problem in Ghana.

Peter Gubbels from NGO Groundwells mentions an idea for an application for voice-services: An emergency alert-system for farmers what to do in case of drought or an early warning system.

Abukaari a Fatawu, Simli Radio:

Simli radio has a program to train farmers, when to plant certain crops. In Partnership with NGO AFRI they trained how to plant neem trees, and have information on food preservation. People could call in and leave questions & answers during a programme. They also did collection of market information. One of the problems was that market people sometimes didn't want to share their info with the radio people.

Thoughts on business models

The NGO representatives question the proposed business model, because they are concerned that there is no input finance involved by a donor organization. They haven't thought of a model in which people pay a fee to get information that they really want to access.

After the workshop and lunch we have a short tour around the agro-facilities and regreening-related activities at the UDS campus, guided by Prof. Saa Dittoh; afterwards, we pay a visit to *radio Savannah*.

Field visits near Bolgatanga, Ghana, Sunday 23 January 2011

World Vision, an NGO active in promoting farmer managed natural regeneration (RNA) introduces us in two villages, near Bolgatanga where the regreening project has been being implemented since 2008.

Yameriga

This village is one of the few that was selected by NGO World Vision and is actively supported to implement RNA. They started regreening activities in 2008. Trees are now no longer removed from the fields. Slash & burn of the fields is no longer practiced. Stone lines have been improved by contouring. The village produces mainly Shea butter of good quality. The product is sold on the local markets.

Arriving by bus, we are welcomed by about 50 singing and dancing women, and next by a circle of about 150 villagers, men and women and the chief of the village. The dialogue is translated between English and the local language. Many people wear Regreening T-shirts from World Vision. After the welcome ceremony and protocol we ask questions about mobile telephony, regreening and knowledge sharing. Afterwards we make a tour over the surrounding fields and watch the young Shea tree sprouts that are being protected.

Discussion on use cases

About 1 out of 10 villagers own a phone. Amongst them there are also 4 women. Phone is used for social interaction, and for business. People need market information and therefore the phone is very useful. Women here also own lands and have their own crops and rights to their land. A payment service based on mobile telephony is very much needed, especially for women who want to save money.

Women of Yameriga

Next we visit another regreening village which is supported by World Vision.

Tongo-Beo

Discussion on use cases

We sit in the chief's cabin and talk to him about the voice based services. The chief is very supportive of this initiative. Unfortunately, an accident happened to a family member, so the moment to discuss the project is less appropriate. Despite the bereavement of the chief and his family, he kindly offers a goat to Prof. Hans Akkermans as a sign of appreciation for the W4RA project [10].

The chief of the Tongo-Beo village presents the goat to Hans Akkermans

Workshop in Bolgatanga, EX-TEE Crystal Hotel, Monday 24 January 2011

Participants

People from MOFA (Ghana Ministry of Food and Agriculture)

Single Mother's Organisation

Farmers

ACDEP – Association of Church Development Projects (also working on agriculture)

TRAX – NGO that works with deprived rural communities

Ghana Broadcasting Company

World Vision – NGO on Regreening

Discussion and use cases

The MOFA representatives are more concerned about the information that will be exchanged then with the voice channel itself. Two farmer representatives react on the MOFA representative by stating that the government is not supporting information sharing by farmers at all.

The business cases are questioned because most of the participants assume that there has to be some input finance from government or from a development agency.

Saa replies that the pampering should stop, and that people should take their own responsibility.

Akayeti, comment on the number that one needs to call, and the notion of using the local language, which is very useful. Problem: who pays for it? Nana: if the info is relevant for the farmer he or she will call. Aman: train the farmer to use the system, that is part of our pilot and we will explore what is the most useful and simple for them (quick, simple and in their language). We are not promoting one medium, but a mixture of media, using your voice.

Voice services could also be applied for cases of emergencies: People already use the phone for help. If you could extend this with a system that beeps (flashes) a list of people so these people can phone into the system and hear an emergency message (bush fires, others cutting trees on your field).

Norbert from World Vision:

We try to use radio as a medium to diffuse RNA, normally on local radio. We go to radio station and people can call in and we answer. Information on market prices would be very welcome.

D Sedem from ACDEP

We send sms messages to key farmers, to inform them about products, which has limitations because many farmers don't read or know how to operate sms.

Single Mothers Association

We process rice; we go to markets looking for rice. We would be interested in this voice based system to get the prices through phone instead of going to farmers.

Thought on business models

A long discussion about the payment of voice services. Is it the Telco operator, the NGO or the government who is going to pay for such a service?

Hans explains that subsidies might be useful at the start, however for sustainability of any innovation it is better not to rely on subsidies. Only if people have an interest in a new system, they will use it and they will be prepared to pay for it. Another business model is to have private sponsorships, commercial announcements (e.g. the one Google uses for its search engine).

8. SUMMARY OF ELICITED M-AGRO USE CASE IDEAS

As an outcome of the field trip and roadshow as reported in the previous Chapter, a significant number of possible use cases have been elicited from different sources and in different regions. Below a summarizing list is given of use cases resulting from the field trip.

Examples of current use of mobile phone and radio plus mobile phone

- Live phone-in programmes. For example at ORTM Segou Monsieur Diarra selects songs numbered 1 to 40; listeners call in and choose a song number; if they are the first to select that particular number they are briefly interviewed live by Diarra who then plays the tune. Very popular. Similar listener phone-in programmes on other radio stations. Used for entertainment (music, greetings) but also for debates on a given topic. Callers pay for phone call. Radio Seno was the only one without the equipment to do this satisfactorily (they had tried).

- Market information system (pilot) for producers of non-timber forest products (e.g. honey, Shea nuts and butter) in 20 villages in Tominian. Funded by Tree Aid UK to July 2011. Mobile phones used to communicate (verbally) information to Sahel Eco Coordinator in Tominian. Information (product, quantity, price, contact phone number) is typed up, saved on USB key and then sent via internet (from a cyber cafe 20km away in the town of San) to 3 radio stations for broadcast (ORTM Segou, Koutiala, ORTM Mopti). A hard copy of the information is given to Radio Mountian in Tominian. Potential clients either phone Sahel Eco to be put in touch with the producers or phone the producer directly (phone numbers are broadcast) for more product/price information and to negotiate.

- Milk seller in Tominian: instead of walking from house to house selling her milk she comes into the Sahel Eco office compound, sits down and phones all her potential clients to take their orders. She makes up the orders (milk is measured into plastic bags) and then delivers them and collects the money

- Regreening farmers in Mali use phones to help protect their trees. If one finds someone cutting trees he uses his mobile to inform other villagers who come out to help him. In Ghana a similar system is (could be) used to alert people to bush fires and call volunteers to put it out.

- Leaders and members of all farmers organisations met (CNOP, AOPP, Barahogon, seed producers coop, herders association etc.) use mobiles to: organise meetings and events ; send information to members (vaccination dates; dates of seed certification visits; date and places to collect produce for group sale); receive and reply to technical queries (e.g. banana producers phone Melamine for advice). Compared to costs of organisation and holding the annual *Bourse de cereals* in Mali, a voice+internet based "grain market" would offer considerable savings

- Small scale savings schemes using mobile banking (buy credit) being piloted by CARE in Tamale, Ghana.

- Market information systems based on SMS (Ghana)

Ideas for VOICE based services

- Radio station services
    - Phone in and record questions on a topic: use these to make a broadcast where an expert or local people, answer a selection of the questions.
    - Questions are broadcast and listeners phone in with answers; could go out live and/or the recording used to put together a broadcast.
    - Questions and answers saved and sorted to build a knowledge data base which callers can access by mobile and voice in local languages
    - Phone-in announcements service (need to include payment to be viable)
    - Access to externally made broadcasts and/or announcements via mobile phone; broadcast saved locally and retransmitted (for radio stations without internet access)
    - A call-back service offered to farmers when a reply from an expert is available.

- Farmer organisation services:

    - Contacting and organising members; leaders sending out announcements to all or to mailing lists of members or to members with particular profiles (grow both x and y; use plough etc.);
    - member to member: grouped voice messages to mailing list(s) for example fire alerts; wood cutting alerts; meeting announcements and information to group members; (for pastoralists) information about availability of grazing & water; obstructions to livestock corridors ; border crossing; health alerts/disease outbreaks etc. ; (for farmers) locust attacks
    - Organising group purchases (e.g. certified seeds; sesame, Shea butter, honey) & making payments to individual producers who don't have bank accounts.
    - Market information system linking individual or grouped producers to buyers; from small to large scale (from Bankass milk coop; Tominian sesame producers; nation- wide Shea nut/butter producers (to NTFP in general); to nation-wide cotton producers etc.
    - advice help line ; farmer to expert and farmer to farmer communications and advice services; technical and legal advice;
    - voice operated savings and banking services for rural peoples (NB farmers need system for small scale payments when far from rural credit and savings banks or don't have account)

- NGO Services (web based voice services in addition to static website & social networking);
    - Services similar to those of farmer/producer organisation - information to and from leaders and members of community and producer organisations

(training, visit and meeting announcements, extension messages, advice helpline etc.)
  - Recordings of information/documents in local languages (best practices, technical advice, laws etc.) to share with other development practitioners
  - Monitoring and Evaluation: Map (GIS?) of location and numbers of re-greening farmers, honey producers with contact info etc. Could possibly be extended to include carbon monitoring retorting and verification (MRV) services in collaboration with local research orgs (e.g. in Mali the Rural Economy Institute – IER)
  - "Forest watch" phone in service -> anti-corruption and legal advice

- Other
  - Use Voice and other Web Foundation technology to enhance Famine Early Warning System (FEWS) which is in place across the (francophone) Sahel. For example by a) improving data collection and b) providing advice back to communities on actions to take, adaptive strategies (e.g. short season seed varieties and where available) etc.

PART II.A BIBLIOGRAPHIC NOTES

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PART II.B: Use Case and Requirements Analysis for the m-Agro Regreening Knowledge Sharing Pilot in Mali

9. m-Agro Long List of Pilot Use Cases

In this section we present a *long list* of the situations and key ideas corresponding to all of the relevant and interesting use cases. The list is selected from the previous travel-report Chapters according to the use-case analysis format as chosen for D1.1.

1. m-Milk ordering & delivery service of Tominian – milk producers and NGO
2. m-Tree protection alert service Sahel Eco – farmers and NGO
3. mobile-web Event organizer for vaccination of herds – farmer org
4. m-Farmer-expert directory service – farmer org
5. NGO info-line about legal issues in several languages – Sahel Eco
6. leave announcement or select your favourite song - Radio Segou –
7. Shea butter & honey trading service – Radio & Sahel Eco
8. Radio – Access radio programs and announcements on your phone - Radio
9. Gourcy seed producers seed certification service – Farmer org.
10. Radio questions & answers about agricultural issues - Radio
11. m-collective purchase organizing service
12. m-GIS regreening service – Sahel Eco
13. m-Farmer social network – Sahel eco
14. mobile-web larger scale market system, where several local m-services are accessible – Farmer org
15. Sahel Eco portal to Regreening and access to m-services
16. M-event organizer for re-greening events

1. m-Milk ordering & delivery service of Tominian – milk producers and NGO

Currently situation: milk sellers go from door to door to sell milk to potential customers.

Key-idea: Customers phone to a certain number and place their order for milk. How much milk they want, their name and delivery address.

The orders (in voice messages) are recorded.

The milk distributer phones into the voice system and retrieves the messages and (asynchronously) listens to them and then delivers the milk. The NGO facilitates the service and the website where the order can be retrieved. The milk seller gets a phone-alert when a new milk order is placed.

Actor	**Operational goals**
NGO (or other org who can host the system)	To facilitate the voice/web service
Milk seller	Efficiency in milk order collection
Customer	Easy placing orders by phone

2. m-Tree protection alert service Sahel Eco – farmers and NGO

Current situation: when there is a threat to the trees, one farmer phones to others to alert them.

Key-idea: Farmers in Mali who do FMNR use phones to help protect their trees. If one finds someone cutting trees he uses his mobile to inform other villagers who come out to help him. A similar system is (could be) used to alert people when there are bush fires, to call volunteers for help. There is one alert phone number that reaches a group of people. The same number can be phoned back by the members of the group to hear the alert message again. The phone numbers of the members of the alert group are known. It is a closed group.

Actors	Operational goals
Farmers using FMNR	Protect trees against illegal felling and prevent spread of bush fires
Community members	Help farmers in extinguishing fire and preventing strangers from cutting their trees
NGO or other org	To facilitate the voice service

3. mobile-web Event organizer for vaccination of herds – farmer/ NGO

Current situation: Cattle have to be vaccinated in certain periods of the year. People have to find out for themselves when their herds have to be vaccinated. This goes through word of mouth.

Key-idea: A registered number of herders and farmers in a certain region (e.g. Tominian area, Mali) is notified by a voice message about time and place of a vaccination event. The "call for vaccination message" is issued by the farmer-livestock owners' org (or NGO) in collaboration with the veterinary agent. Livestock owners (or anyone else) can phone back and retrieve the info-message asynchronously. The message is issued in several languages.

Actors	Operational goals
Livestock owners and herders	Follow vaccination schemes; know about the venue of vaccination events. Find info about veterinary services.
NGO or farmer organization providing the vet. Service	To reach all farmers with their veterinary regulations and services.

4. m-Farmer-expert directory service – farmer org

Current situation: people have difficulty in finding an expert on a certain subject. E.g. farmer Moussa Sangara has started planting shea trees, but he wants to know how to prune them. He is looking for a person who can advise him.

Key-idea: A voice service exists where farmers and other professionals in the Tominian area can phone in and get the name and number of an expert on a certain subject. He wants to talk to another farmer who can give him tips and best-practices about shea trees. He phones into a service which connects him with the right person or expert.

Actors	Operational goals
Farmers who want to contact to an expert on a certain subject	Get in touch with another farmer or subject expert who speaks his language and can give him the right information about a specific subject.
NGO or other org who holds a list of experts, their fields of expertise, the languages they speak, if and at what time they are willing to provide information to someone.	To connect people with the same fields of interest/expertise. To help farmers find an expert.
The experts who are willing to provide the service.	To receive some kind of payment or reward, status, goodwill etc. for the information they provided.

5. NGO info-line about legal issues in several languages – Sahel Eco

Current situation: People are often poorly informed about their rights, rights on trees, land rights etc. NGOs are looking for channels to inform more people about their legal rights. Radio broadcast is currently the preferred channel.

Key-idea: Sahel Eco provides an information telephone line where people can get some spoken information. They can choose (press 1 for French, 2 for Dogon 3 for Moré etc) which language they want to hear. There are several subjects they can choose. The message is spoken and can be played back again. The payment of the service should be done by the information requester, through his/her mobile, or could be (partly) subsidized by the organization (NGO, government) who wants to spread the information. This service could also involve a radio station who broadcasts the info about legal issues, together with the phone-number of this info-line.

Actors	Operational goals
Communities	They want to have access information on legal issues.
NGO e.g. Sahel Eco	The NGO has a program to inform people about their rights and e.g. about the protection of trees.

6. Radio –leave announcement or select your favourite song – Radio

Current situation:

The community radio Senou has a music program where listeners can phone in and choose from a list of songs. The current service is highly appreciated by listeners but not efficient. Users can only phone in during the broadcast hour. The phone is often overloaded and gives an occupied tone. People send announcements in writing to the radio station or come in person so that radio staff can write down the message and read it out loud on the broadcast. The capacity of handling the incoming messages at the radio station is limited and people spend time and money getting the message to the radio station. Payments are currently made in cash when the message is received at the station (500 FcFA per announcement).

Key-idea

Listeners phone to the radio station and leave a voice message.

There are two type of messages:

a) An announcement to be broadcasted on the radio. (Voice message: "Cow lost in the Diallassagou area; red coat with white star on forehead; white feet. One broken horn. If you see it please contact…")

b) Request for a song. (choose from a list and digit the number: e.g. song No. 26)

The voice message is automatically recorded and stored in a database. The radio can play and select an audio message and broadcast it later.

Payments by phone are preferable.

Actor	Operational goals
Radio station SEGOU	Efficient handling of incoming requests. Efficient play back of messages during the radio programs
Radio listeners	Greater time window to leave message. Efficiently do payment of the request.

7. Segou - Shea butter & honey trading service – Radio & Sahel Eco

Current situation

An extension worker collects weekly market information about shea butter and honey producers in 20 villages near Tominian (product, quantity, price, and contact phone number) in an Excel sheet on his laptop. The excel sheet is sent by email from a cyber cafe to 3 radio stations (ORTM Segou, Koutiala, ORTM Mopti). A hard copy of the information is given to Radio Mountian in Tominian (has no internet). The radios broadcast this info including the phone numbers of the producers.

Potential customers either phone Sahel Eco or phone the producer directly.

Key-idea

Producers call directly to a service and leave info about the product they sell, price, their name and address.

Sahel Eco processes the information from voice messages and creates summaries and frequent updates. The updates are accessible on a phone number and also broadcast by the radio.

Actors	Operational goals
Producers of shea butter and honey from 20 rural villages near Tominian	Efficiently sell at best price
Potential customers of honey and shea butter	Buy cost effectively and pay good price
Radio ORTM Segou, Koutiala, Mopti, Radio Mountian	Broadcasts updates on price and producers
Sahel Eco coordinator (extension worker)	Collects/processes information from producers
(Tree AID UK)	(Pilot funding (currently until July 2011))

8. Access radio programs and announcements on your phone - Radio

Current situation: Community radio has many relevant information programs.

Key idea

People can phone in and hear the broadcasted program asynchronously on their phone. They can choose in which language they want to listen and which program they want to hear. (Several option, short radio messages or summaries of programs).

Actor	Operational goals
Radio station	Provide several channels for information (radio and mobile info service)
Radio listeners	Listen to radio info whenever they want, in their preferred language

9. Gourcy seed producers seed certification service – Farmer org.

Current situation: Seed producers have to allow certification of their seeds if they want to sell through the national seed organization or get a premium price from other customers. The certification is all done by hand and information about the seed producers, the production, contact data etc. is registered on paper. It is then collated by hand at regional and national levels. The whole system is inefficient and cumbersome.

Key idea:

A mobile-web system could facilitate the seed production sector by offering a mobile channel to collect info from seed producers and a web channel for the national organization to keep track of the total production, the contact details of producers and customers and the production chain. This could possibly be combined with a web-based GIS system.

Actor	Operational goals
Seed certification organizations	Certify seed Collect information about seed production from producers at community level. Organise grouped purchases
Seed producers at community level	Contact seed certification extension workers; Have their seeds certified; Communicate to organization about their products. (Amount of seed, location, contact details etc.) Organise grouped sales

10. Radio questions & answers about agricultural issues - Radio

Current situation: People are looking for information and phone to the radio. Some people want to provide information and phone to the radio to inform about rainfall etc. Questions and answers are interesting, but volatile and can't be stored or retrieved later.

Key ideas:

(i). People phone to radio to ask information about a certain topic. The message is recorded. The radio broadcasts the question. Others phone in to m-radio service and leave an answer to the question. (A. info requesters are phoned back with an answer, B. info requesters are alerted and can phone in and access the answer to their question, C. the Q&A are broadcasted during a radio program).

(ii). People phone in and give news about e.g. rainfall, weather conditions, harvesting etc.

The voice messages are recorded. The radio processes the information and makes it available by phone and broadcasts the interesting news.

Actor	Operational goals
Radio station	Provide several channels for information exchange of their listeners (radio and mobile info service). Broadcast m-radio: a phone based voice info service
Radio listeners	Find answers to several questions. Share experience/expertise Hear relevant local news

11. m-collective trading organizing service through a voice forum

Current situation: There is no systematic way to organize a grouped purchase or sale. People just phone around and ask people they know.

Key idea: A group of people all have phones and know each other's phone numbers. One group member sets up a new session and leaves a voice message: "We have a client who wants to buy 10 tonnes of good quality shea butter? Who wants to join the group sale?" Or "We want to buy fertilizer for cotton. Who wants to join the group purchase?" All group members receive the message one by one and can reply if they are interested. Their message is added to the end of the message, as a "voice forum".

Actor	Operational goals
Community members with a mobile phone	Organize a grouped sale or purchase by contacting all members and collecting their messages.
Organization who provides the service	Facilitate group discussions

12. m-GIS regreening service – Sahel Eco

Current situation: Regreening activities are difficult to monitor, because there are no public geographic information systems where this information can be stored and retrieved.

Key idea: People can phone to a number and leave information about the situation on their fields. They leave name, location and topic. The info is plotted on a web accessible GIS system (e.g. Ushehidi) and kept by the NGO for monitoring (e.g. Sahel Eco).

Actor	Operational goals
Farmers performing FMNR	Provide updates on the situation of their fields.
Extension workers	Support farmers, inform communities about proceeding regreening activities Keep track of regreening updates
NGO E.g. Sahel Eco, Réseau MArp	Collect spatal info about regreening; Plot it on a GIS sytem Provide info about regreening to inform policymakers, researchers, donors etc.

13. m-Farmer Sahel Eco social network

Current situation: many young people in Mali are very fond of Facebook. People without access to the Internet can't access social networks. Sahel Eco would like to facilitate such a service based on voice.

Key-idea Farmers have access to an m-web service hosted at Sahel Eco. They can invite friends to join, by leaving their phone number. They have a user profile with their phone number and preferred language, and links to friends. This is also accessible on Sahel Eco website.

Sahel Eco provides news updates to its members.

Actor	Operational goals
Farmers and other stakeholders of Sahel eco	Get all types of news and information from Sahel Eco. Be in touch with a group of colleagues or friends.
Extension workers	Be in contact with farmers and community members. Be updates about news.
NGO E.g. Sahel Eco, Réseau MArp	Provide info and social network service to its stakeholders.

14. mobile-web larger scale market system, where several local m-services are accessible – Farmer org

Current situation: There is no system where market information is stored and can be retrieved.

Key idea: At higher level (national or regional level) a website collects all small scale m-market services as described in the previous examples. This is a large-scale database of market info, accessible through phone or internet.

Actor	Operational goals
Small scale producers	Have a channel to offer their products, find customers.
Potential buyers	Have access to market information on a central place, accessible online and by phone
NGO ; farmer organisations, etc	Facilitate trade of agriculture products

15. Sahel Eco portal for Regreening and access to m-services

Current situation: There is no system that can act as a portal for farmer organizations to access all m-services

Key idea: Sahel Eco website and mobile-web large scale membership information/organisation system, where several m-services are accessible – Farmer organisation. This central website provides a social networking site including all m-services as described in the previous examples. It is accessible through phone or internet.

Note: rather being than a really separate use case, upon closer inspection this use case might turn out to be a variant or combination of others.

Actor	Operational goals
Farmers involved in RNA	Have a channel to offer their products, find customers.
Sahel Eco	Have access to market information on a central place, accessible online and by phone
Other stakeholders	Facilitate communication and access to info on regreening

16. m-event organizer for Regreening events

Current situation: Sahel Eco organizes events and workshops to create awareness about regreening, farmer to farmer visits etc. Sahel Eco sometimes finds difficulty in making known to the people when the events take place. This goes often through word of mouth.

Key-idea: A registered number of farmers in a certain region (e.g. Tominian area, Mali) is notified by a voice message about time and place of a re-greening 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.

Actors	Operational goals
Farmers	Learn about regreening. Meet others who (already) practice regreening.
Sahel Eco	Reach all farmers and organize events. Train people about regreening.

10. M-AGRO USE CASE SHORTLIST SELECTION FOR PILOT

In this Chapter we present the three use case scenarios selected for the pilot in Mali. The argument for selection out of the longlist of use case scenarios is based on a 2D-matrix of (i) the difference in value it makes versus (ii) complexity of implementation (a further development by VUA from what is originally Cisco's client-oriented methodology in e-business project portfolio management, see http://www.e3value.com and search for e3-boardroom).

The m-agro pilot longlist of 16 use cases has been analysed based on several aspects. To decide which three use cases to select, as a starting point for WP5, a comparison was made between the different use cases, based on the following criteria:

A. Each of the 16 use cases against the following conditions: yes/no (x=yes)

- Involvement of a radio station in the use case
- Involvement of Sahel Eco as service provider
- Involvement of an other NGO or farmer organization

B. And against the following technical requirements yes/no (x=yes)

- A web page will be associated with the m-service
- The m-system must be hosted by a (local or remote) hosting service
- Internet connectivity is required for the end-users of this service

C The 16 use cases will have the following functionality: yes/no

a) An automated phone dialogue system with several options
b) Recording and storing m-user entered audio/voice info
c) Alert phone-call or sms-alert to call back a person
d) Group alert phone-call or sms to alert a group of phone numbers
e) Retrieve m-info: dialogue to retrieve voice-info by phone
f) Advance payment: possibility of making an advance payment for a phone-call
g) Voice forum; adding m-info to an existing file
h) Language support: dialogue to ask for language, several languages
i) Database management: A (web-based) database of voice-info will be created/managed
j) GIS tagging: user-provided voice-info will be plotted on a map
k) Content tagging: possibility to attach tags to certain info
l) User profile: A user profile containing phone number, language info and other user-preferences

Based on the criteria A and B, the assessment matrix is (x=yes):

	Radio	Saheleco	other NGO	Web page	system host	internet required
1. m-Milk ordering & delivery service of Tominian – milk producers and NGO			X		X	
2. m-Tree protection alert service Sahel Eco – farmers and NGO			X		X	
3. mobile-web Event organizer for vaccination of herds – farmer org					X	
4. m-Farmer-expert directory service – farmer org		X			X	
5. NGO info-line about legal issues in several languages – Sahel Eco		X	X	X	X	
6. leave announcement or select your favourite song - Radio Segou –	X				X	
7. Shea butter & honey trading service – Radio & Sahel Eco	X	X			X	
8. Radio – Access radio programs and announcements on your phone - Radio	X				X	
9. Gourcy seed producers seed certification service – Farmer org.			X	X	X	
10. Radio questions & answers about agricultural issues – Radio	X				X	
11. m-collective purchase organizing service					X	
12. m-GIS regreening service – Sahel Eco		X		X	X	X
13. m-Farmer social network		X		X	X	X
14. mobile-web larger scale market system, – Farmer org		X	X	X	X	X
15. Sahel Eco portal for regreening and access to m-services		X		X	X	X
16. m-event organizer for Re-greening events		X			X	

Based on the criteria listed under C, the MoSCoW assessment result for the longlist of use case scenarios reads as follows (MoSCoW = the Must have / Should have / Could have / Won't have prioritized list of requirements):

	dialogue syst	store user-info	alert phonecall	group alert	retrieve info	advance pay	voice forum	Languages	database managm	GIS tagging	content tagging	user profile
1. m-Milk ordering & delivery service of Tominian – milk producers and NGO	M	M	S		M							
2. m-Tree protection alert service Sahel Eco – farmers and NGO	M	M		M	M	S	S					
3. mobile-web Event organizer for vaccination of herds – farmer org	M	M		M	M	S		C				S
4. m-Farmer-expert directory service – farmer org	M				M			C	M			
5. NGO info-line about legal issues in several languages – Sahel Eco	M				M	S		C	M		M	S
6. leave announcement or select your favourite song - Radio Segou –	M	M					S	C				
7. Shea butter & honey trading service – Radio & Sahel Eco (Radio Marché)	M	M			M			C				S
8. Radio – Access radio programs and announcements on your phone - Radio	M				M			C	M			
9. Gourcy seed producers seed certification service – Farmer org.	M	M		M	M	S		C				
10. Radio questions & answers about agricultural issues - Radio	M	M			M			C	M		M	S
11. m-collective purchase organizing service	M	M		M	M	S	S					
12. m-GIS regreening service – Sahel Eco	M	M			M				M	M		S
13. m-Farmer social network	M	M						C	M		M	S
14. mobile-web larger scale market system, – Farmer org	M	M	C	M	M	S	C	C	M	C	M	S
15. Sahel eco portal for regreening and access to m-services	M	M		M	M	S		C				
16. m-event organizer for Re-greening events	M	M		M	M	S		C				S

M=Must have
S=Should have
C=Could have

As a result of these assessments, the three following use cases have been selected as most promising for the m-agro pilot.

	dialogue syst	store user-info	alert phonecall	group alert	retrieve info	advance pay	voice forum	Languages	database managm	GIS tagging	content tagging	user profile
7. Shea butter & honey trading service (‘*RadioMarché*’)– Radio & Sahel Eco	M	M			M			C				S
15. Sahel Eco portal for regreening and access to m-services	M	M		M	M	S		C				
16. m-event organizer for Re-greening events	M	M		M	M	S		C				S

7. Shea butter & honey trading service - Radio & Sahel Eco. This pilot has the advantage that it already works in the field, (although paper-based). All stakeholders (radio people, extension agents, shea butter and honey producers) already use an information channel to share this. Radio Segou and Sahel Eco already collaborate and radio Segou owns a computer (but no Internet connection). This process can be improved by introducing an m-system. This project was named *RadioMarché.*

15. Sahel Eco portal for regreening and access to m-services. Sahel Eco needs a website to inform all stakeholders about regreening activities. This website will have a social network facility where users can sign up and receive RSS updates, emails and alerts about new events. Find info in several languages about regreening (and in the future other relevant subjects.)

As soon as m-services become available through W4RA and VOICES, this functionality will be added to this website. The starting point is a web portal, which will be extended to an m-site.

16. m-event organizer for regreening. This will be the first m-service for re-greening. This pilot is very similar, technically, to no 3 – M-event organizer for vaccination of herds. However, W4RA and Sahel Eco give priority to regreening, since this has greater (rural, social, environmental) impact than vaccination.

In the following chapters, we detail the use case scenarios for the market trading service *Radio Marché* and for the *mobile event organizer* (the Sahel Eco website and its subsequent extension to an m-portal will be realized as baseline infrastructure for the m-agro knowledge pilot as a whole for all use cases).

11. USE CASE A – RADIO MARCHÉ

Segou - Shea butter & honey trading service – Radio & Sahel Eco

Current situation

An extension worker collects weekly market information about shea butter and honey producers in 20 villages near Tominian (product, quantity, price, and contact phone number) in an Excel sheet on his laptop. The excel sheet is sent by email from a cyber cafe to 3 radio stations (ORTM Segou, Koutiala, ORTM Mopti). A hard copy of the information is given to Radio Mountian in Tominian (has no internet). The radios broadcast this info including the phone numbers of the producers.

Potential customers either phone Sahel Eco or phone the producer directly.

Key idea

Producers (or their representatives) call directly to a service and leave info about the product they sell, price, their name and address.

Sahel Eco processes the information from voice messages and creates summaries and frequent updates. The updates are accessible on a phone number and also broadcast by the radio.

Actors and goals

Actors	Operational goals
Producers of shea butter and honey from 20 rural villages near Tominian	Efficiently sell at best price
Potential customers of honey and shea butter	Buy cost effectively and pay good price
Radio ORTM Segou, Koutiala, Mopti, Radio Mountian	Broadcasts updates on price and producers
Sahel Eco coordinator (extension worker)	Collects/processes information from producers
(Tree AID UK)	(Pilot funding (currently until July 2011))

Context and scope

a. Network configuration

In the diagram below an overview is given of the system.

Sahel Eco staff member fills in web form with information received previously by sms from the farmer's representatives (MIS), containing info about offer, quantity, quality, price etc. name of the seller, village, phone number. The collection of the info in the villages is outside the scope of the current system. The sms info is entered manually into the system.

The information is processed to a voice-based message and sent as (automatic generated) voice content through phone to the radio, and also by email, as an audio message.

The radio station receives the "communiqué" and broadcasts it directly on the radio. The radio is paid a fee for the broadcast.

The potential buyers listen to the community radio and contact the sellers to buy. This is outside the scope of the system.

b. Performance measures:

The audio quality of the voice communiqués over mobile has to be such that it can be broadcast over the radio.

c. Scope and context:

The scope of the system is the information going from Sahel Eco as voice message to the radio station for broadcasting. The data collection in the villages, the aggregated data sent to Sahel Eco and the posterior trading of sheabutter and honey between sellers and buyers, after the radio broadcast, is left outside the current scope of the system. This is kept for further study at a later stage.

The context is a rural environment, where people communicate through voice, using simple mobile phones and where community radio is an important information hub.

d. Stakeholders:

Villagers from 20 villages in the surroundings of Tominian, selling honey and sheabutter.

The person who aggregates the offers per village (a local extension worker or middle man MIS)

Sahel Eco who aggregates all offerings from the middle man from each if the 20 villages

The local community radio stations who broadcast the messages

The potential buyers – listeners of the community radio

e. Preconditions

Some radios don't have computers nor internet and must broadcast directly from the phone

Some radios have computers but no internet

Internet connectivity in Mali is of poor quality

Used phone lines must be local lines

Story board/Script

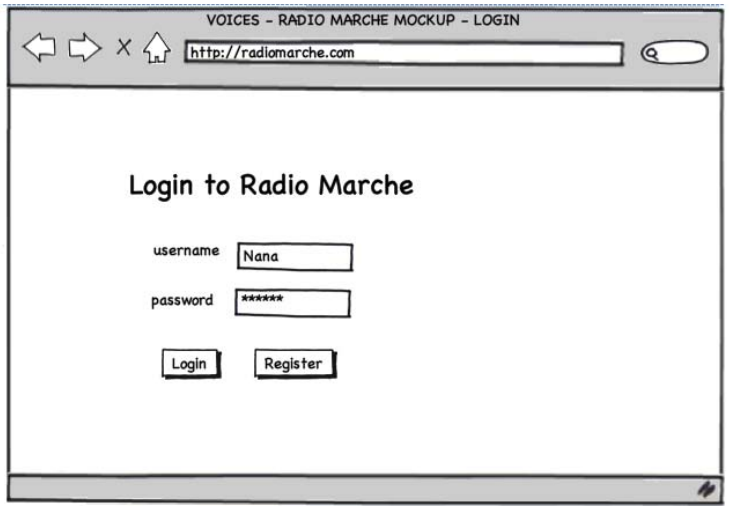
Step 1

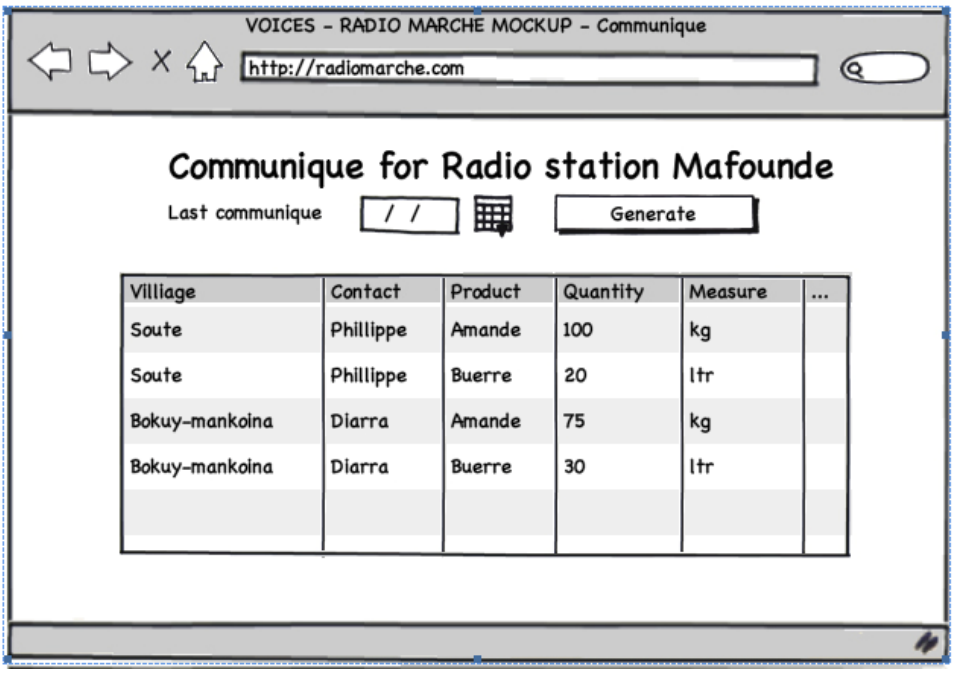
Sahel Eco receives offering by sms from a middle men from a village with offerings

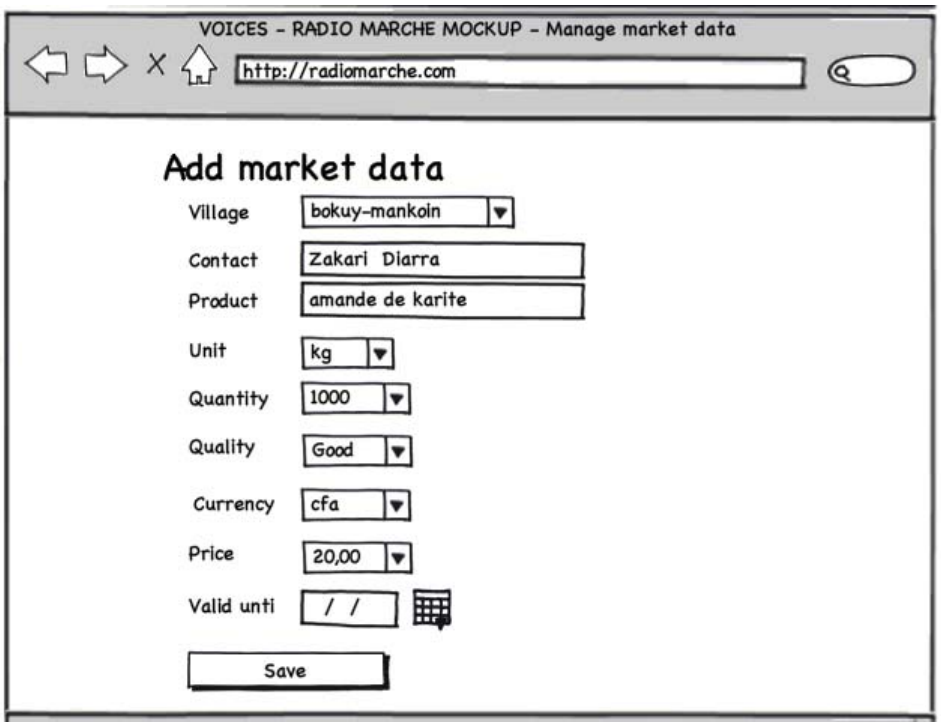
Step2

Sahel Eco enters manually the information on a web form for the Radio Marché system, on her computer

In the figures below an impression of the web form is shown:







Step3

The voice message is sent to the radio through the phone;

Step4

The radio station records the voice message and stores it;

Step5

The radio station broadcasts the message on the radio.

Interaction and communication structures

In the following diagrams interaction and communication is displayed for the stakeholders of the Radio Marché Use Case.

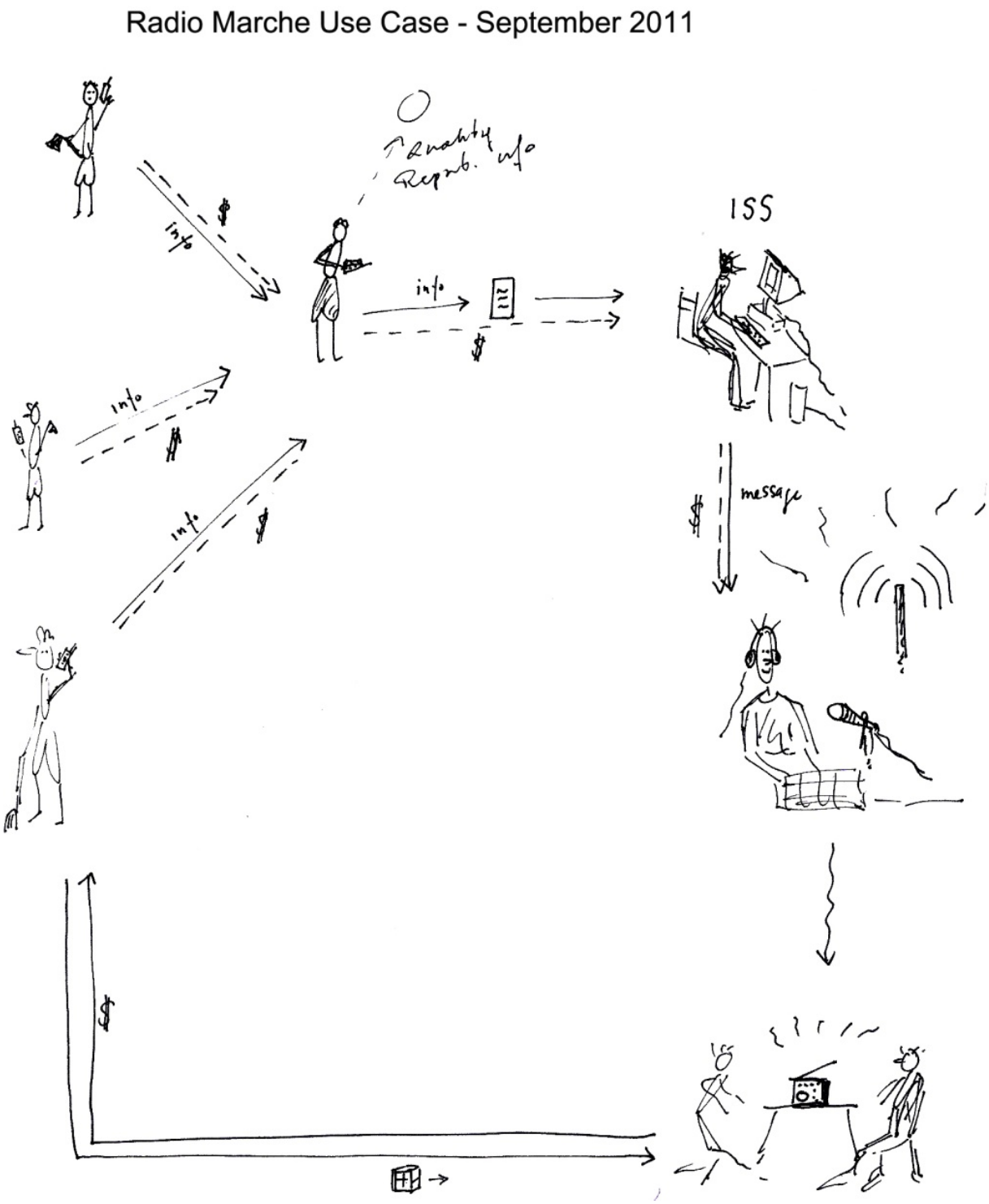
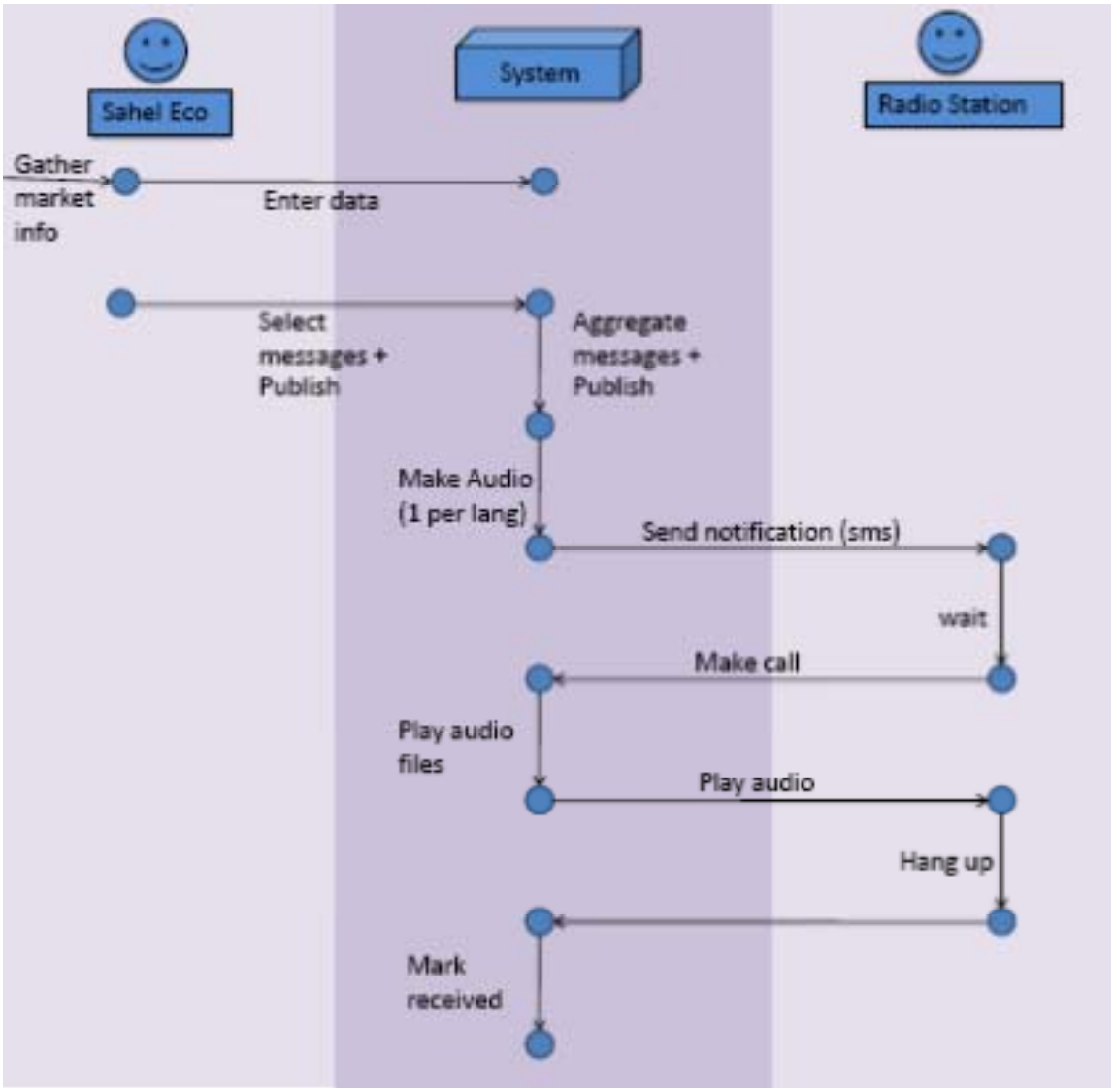
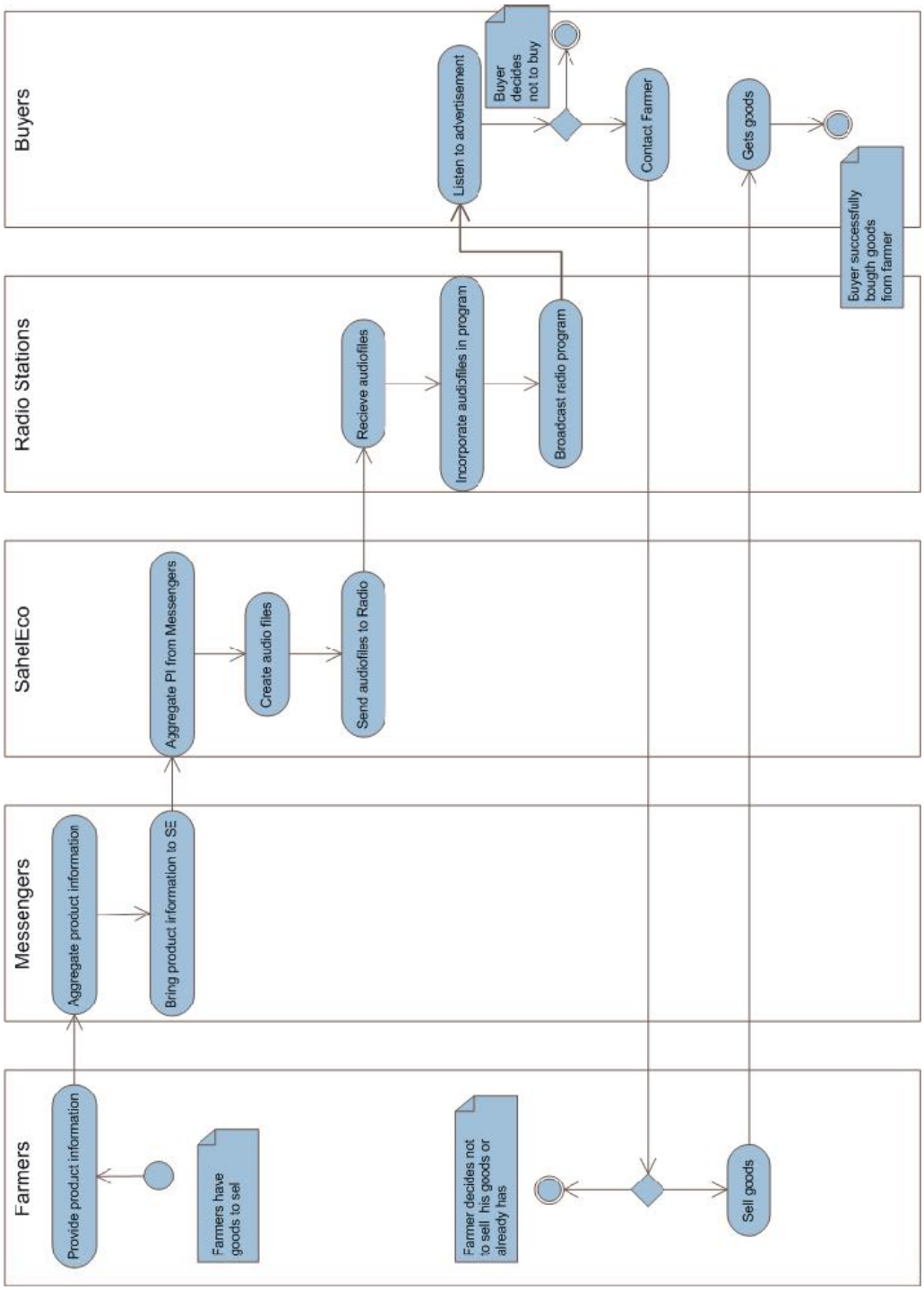
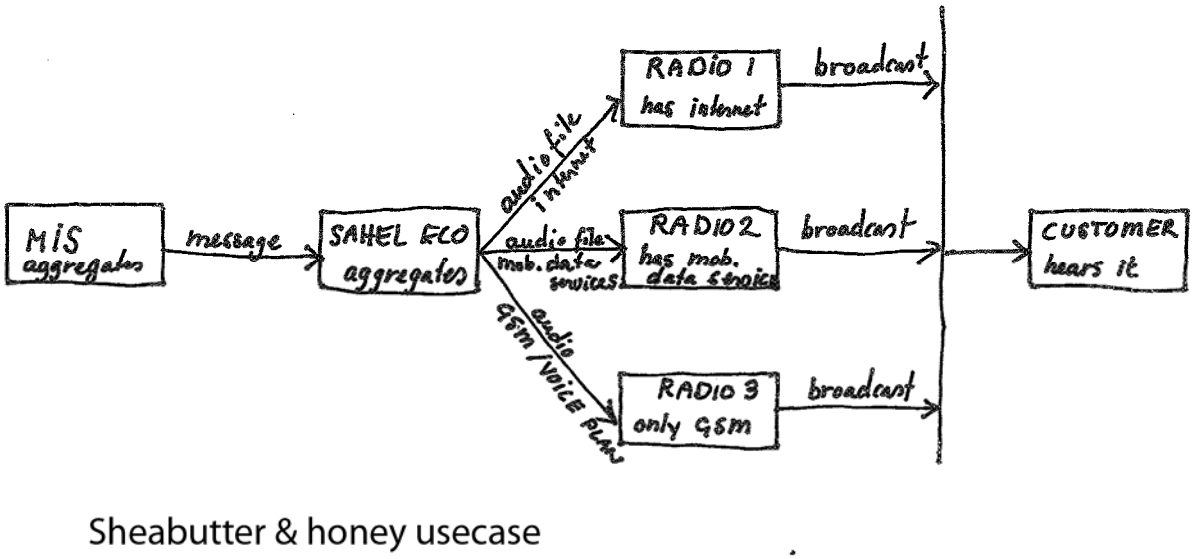


Diagram showing the total scope of the RadioMarché use case. In our system only the right part of the picture is chosen for the first-cycle piloting.


Sahel Eco
System
Radio Station
Gather market info
Enter data
Select messages + Publish
Aggregate messages + Publish
Make Audio (1 per lang)
Send notification (sms)
wait
Make call
Play audio files
Play audio
Hang up
Mark received



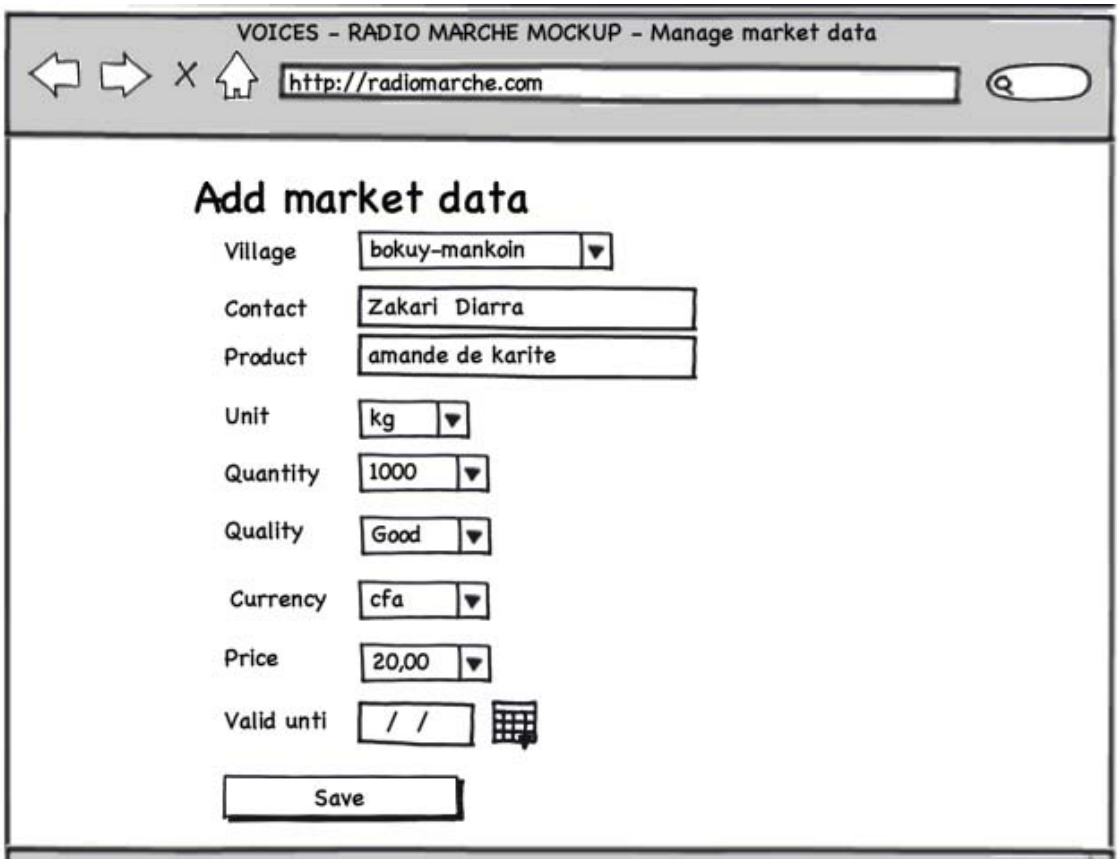
Activity diagrams with swimlanes for the Radio Marché ("Sheabutter and Honey") pilot project.



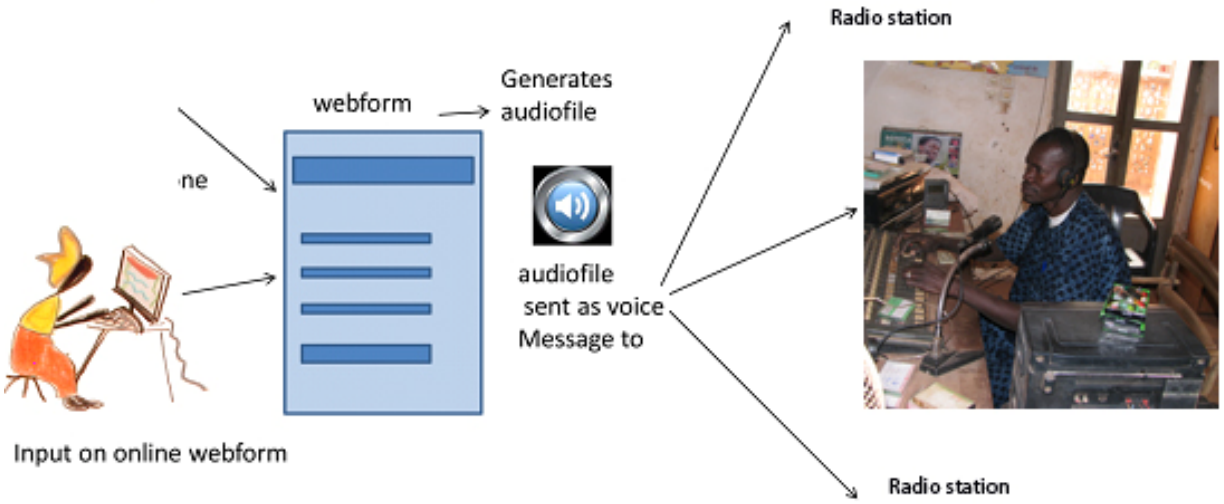
Sheabutter & honey usecase

UML Activity Diagram for the sheabutter & honey use case, which is now named the RadioMarché project

Information concepts



Technology infrastructure



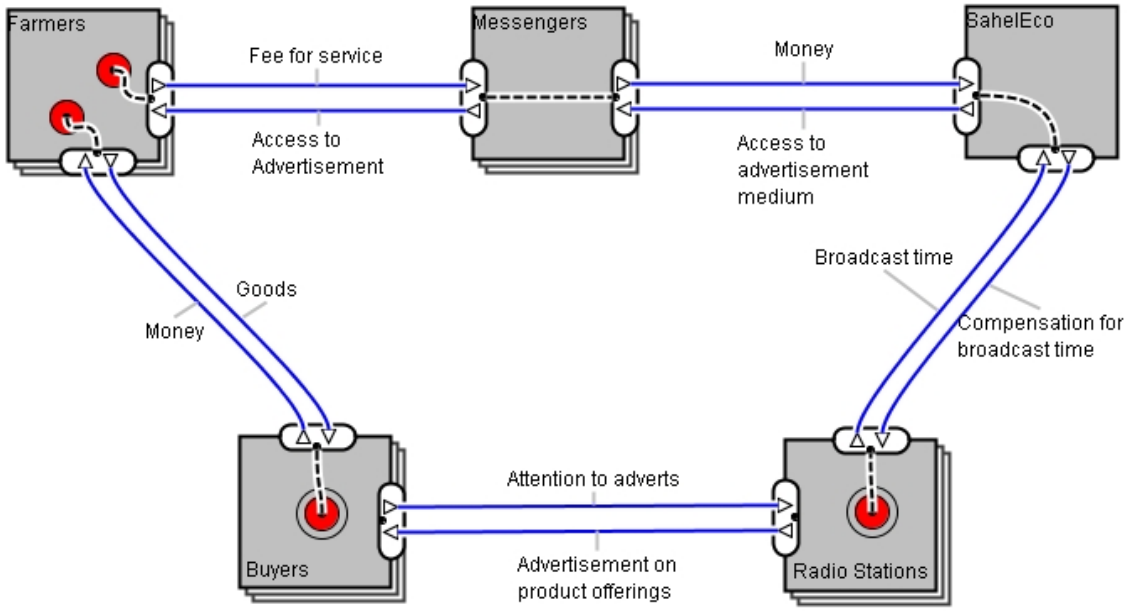
The Radio Marché system runs on a server or PC, which can be hosted locally, e.g. at Sahel Eco. The server has a

- Phone interface (hardware) with a simcard and a local phone number
- A PBX platform (Asterisk) that controls incoming and outgoing phonecalls
- A Voice Browser (Voxeo Prophecy) to generate voice content from text

The Radio Marché system consists of several modules:

- A module to enter data online about the offering
- A module that produces a JSON-file containing the offering
- A voice browser that produces an audio-file using TTS and concatenating pre-recorded African voice audio elements.
- A PBX platform that streams the audiofile over the phoneline

Cost considerations; Feasibility and sustainability



The above diagram shows the *e3value* networked business model for the Radio Marché market mechanism.

Key requirements

Must have:

The Radio Marché server must have phone access on a local line in Mali. The phone lines have to be local, to save costs.

The system has to provide a web-based input-form for the person who enters the offer.

The web-form has to be user friendly according to the requirements set by Sahel Eco.

The so created "communiqué" has to be issued through voice in more then one language (France and Bomu). It has to be sent by email and over the phone.

A database to store all the offerings entered.

A module to create voice content from the entered data.

A module to send audiofiles as phonecalls to a certain phonenumber.

The phone connection must allow recording of the message for later broadcast.

The message has to be accessible for a certain period through phone, by phoning a local number.

The audio quality of the voice communiqué must be such that it can be broadcast over the radio

User support

Hardware + software maintenance

Should have:

Server should have internet access so that data can be entered remotely;

A reliable data-backup facility;

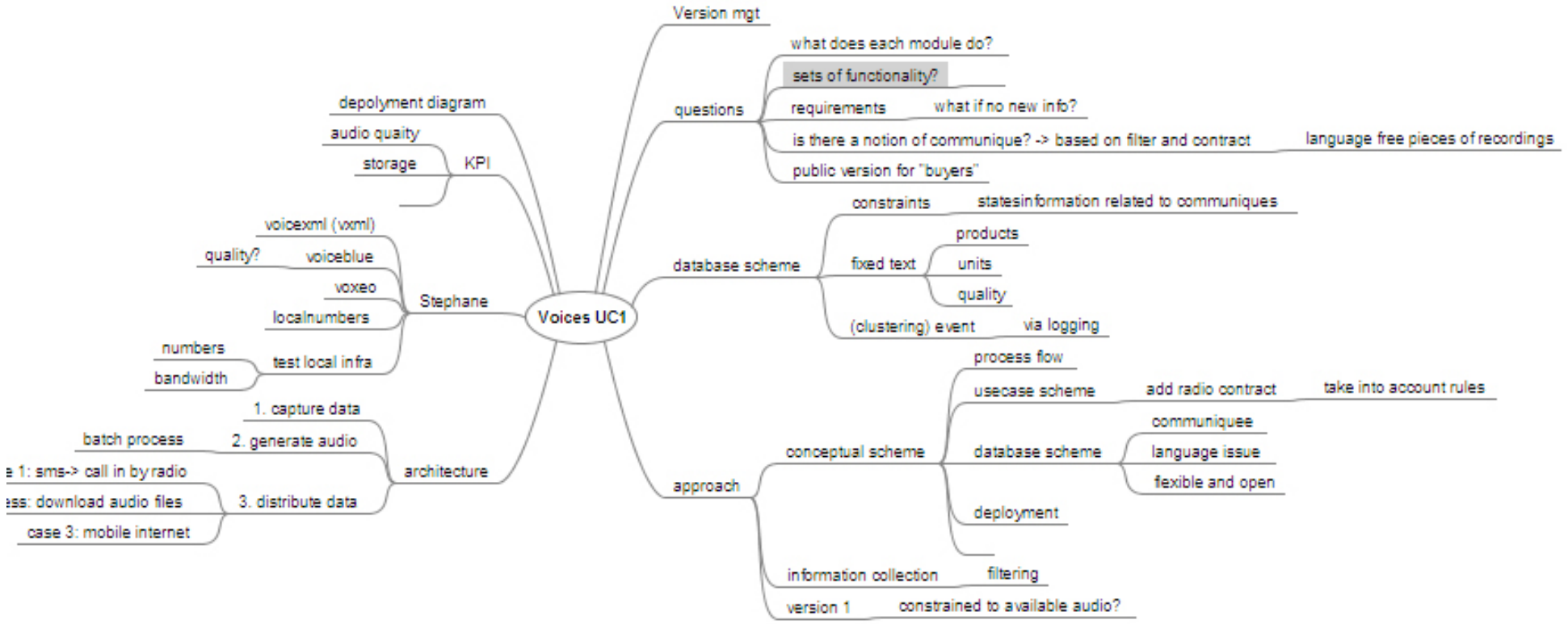
APS and backup power supply;

The voices used to generate the message should sound familiar (local accent) in this region.

Could have:

Language support for Bambara and Bomu, as to create voice messages in these languages.

Support for sending and receiving sms



Mind map, visualising the process of development of the Radio Marché use case.

12. USE CASE B: M-EVENT ORGANIZER FOR REGREENING EVENTS

Current situation:

Sahel Eco organizes events and workshops to create awareness about regreening, farmer to farmer visits etc. Sahel Eco sometimes finds difficulty in making known to the people when the events take place. This goes often through word of mouth.

Key idea

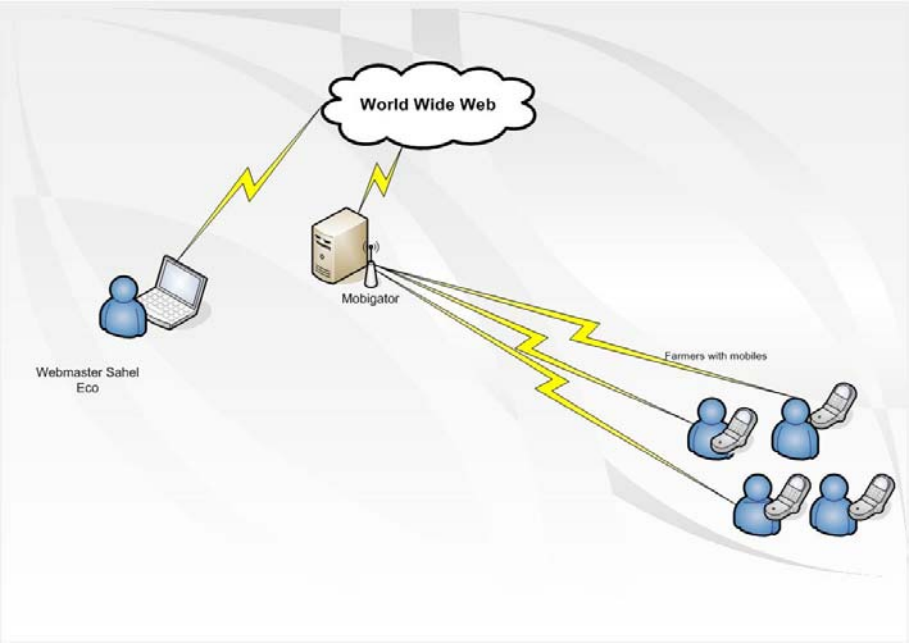
A registered number of farmers in a certain region (e.g. Tominian area, Mali) is notified by a voice message about time and place of a re-greening event. The "call for regreening event" is issued by Sahel Eco. Farmers can phone back and retrieve the info-message asynchronously. The message is (optionally) issued in several languages.

A staff member from Sahel Eco prepares a voice message telling about the event and a list of farmers, including their phone numbers. The Sahel Eco member then issues the voice message. All farmers who are onb the list receive a phone-call with the message. They can listen to the message again, and leave a message. They can phone later to this phone number to retrieve the message again.

Actors and goals

Actors	Operational goals
Farmers	Learn about regreening. Meet others who (already) practice regreening.
Sahel Eco	To reach many farmers and organize events to inform farmers more about re-greening techniques etc.

Context and scope



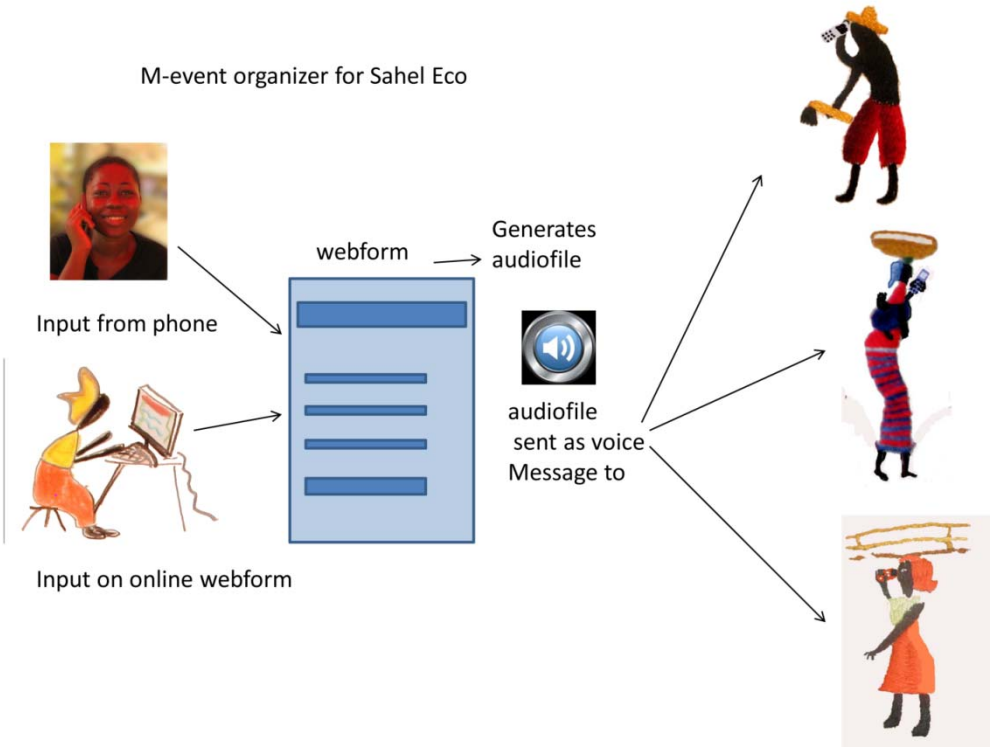
Layout of users/systems interaction

a. In the above diagram a simplified network configuration for the m-event organizer is given. A micro-server has both Internet access and mobile access. The m-event organizing person (e.g. the Sahel Eco Webmaster) creates a message convocating farmers for a Regreening event. She 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.

b. Success or performance measures:

p.m.

c. Scope, system boundary



The scope of the system is a web-based environment with both internet, web text-based and mobile, voice-based interaction. In this particular use case it is a pilot for Sahel Eco to create a channel to communicate with her group of re-greening farmers through mobile phone. Online (internet) access to the system is left outside the scope of the system.

d. Stakeholders and concerns

Stakeholders: Sahel Eco (staff and extension workers) and RNA farmers, other participants of SE events.

Concerns: reach the people with a message they can understand. Be able to change the message easily.

f. Preconditions

System allows phone access and has a reliable internet connection, reliable power supply.

Local phone lines are used, to avoid expensive international calls.

Good system maintenance (hardware & software maintenance, data backup, APS, emergency power supply, end-user support, high uptime (>99%).

Storyboard in ten steps

- Organize a regreening event:

SAHEL ECO

Sahel Eco is organizing a meeting on Wednesday 20th of July

in Tominian for farmers about regreening.

Sahel Eco has a list of 25 farmers and their phone-numbers.

A number of these farmers don't speak French, only Bomu.

Sahel Eco can make 25 phonecalls or issue a W4RA m-event
organizing Message.
How does this work?

Aisha, staff member at Sahel Eco is going to use the m-event system.

Step1: Access m-event application

- Aisha, a staff member from Sahel Eco opens the m-event application and presses the m-event button
- (Her computer has a soundcard and a microphone and soundrec. software)

Step2: Enter users

Aisha is prompted by the system to enter
users and phone-numbers, from the people that will receive her voice message…
Step 3: Aisha enters user-list:

- Moussa Sangara, 23345565, Bambara
- Sidonie Mounkoro, 23268638, Bambara
- Jean-Batiste Dembele, 23566254, French
- *###*

Step 4: Aisha enters voice message

- *<<How many languages do you want to enter?>>*
- 2
- *<<Now enter your voice message in the microphone of your computer>>*

Aisha records message after the beep, press # to finish:

- "Bonjour, iI y aura un atélier pour vous informer sur le reverdissement du Sahel, le mercredi, 20 juillet à 20 heures, dans le bureau de Sahel Eco, Rue de la République, à Tominian."
- *Enter the same message in the second language, press # after you finish*
- "……. "

Step 5: Aisha issues the mobile message

- *Press <send> button to send the voice message to the phone-list*

- "Your message has been sent successfully!"

Step 6: farmers receive message in their own language

Jean-Batiste Sidonie Moussa



The system asks them

- "Will you attend the meeting, please press 1"
- "Are you not attending the meeting, please press 2"
- "Leave your message after the beep…"

..and the system logs this..

- Moussa – message delivered 12:30:45
- Sidonie – message delivered 12:30:45
- Jean-Batiste – <<phone switched off, message will be sent again in 6 hours>>

Step 7: User retrieves the message, later
Now Fatoumata calls to this
Sahel Eco phone-number to
hear the message as well.
She was not on the user-list,
but heard from Sidonie
who gave her the phone-
number to call.

Step 8: Language selection

- The system receives Fatoumata's phonecall and records her phone-number in the user list.
- Fatoumata's call is answered by the system
- "do you speak Bambara?' press 1
- "parlez-vous français?, touchez le 2"

Step 9: Fatoumata's user profile is created

- Fatoumata hears the message in Bambara
- "there will be a regreening event, etc.

- Leave your message after the beep…

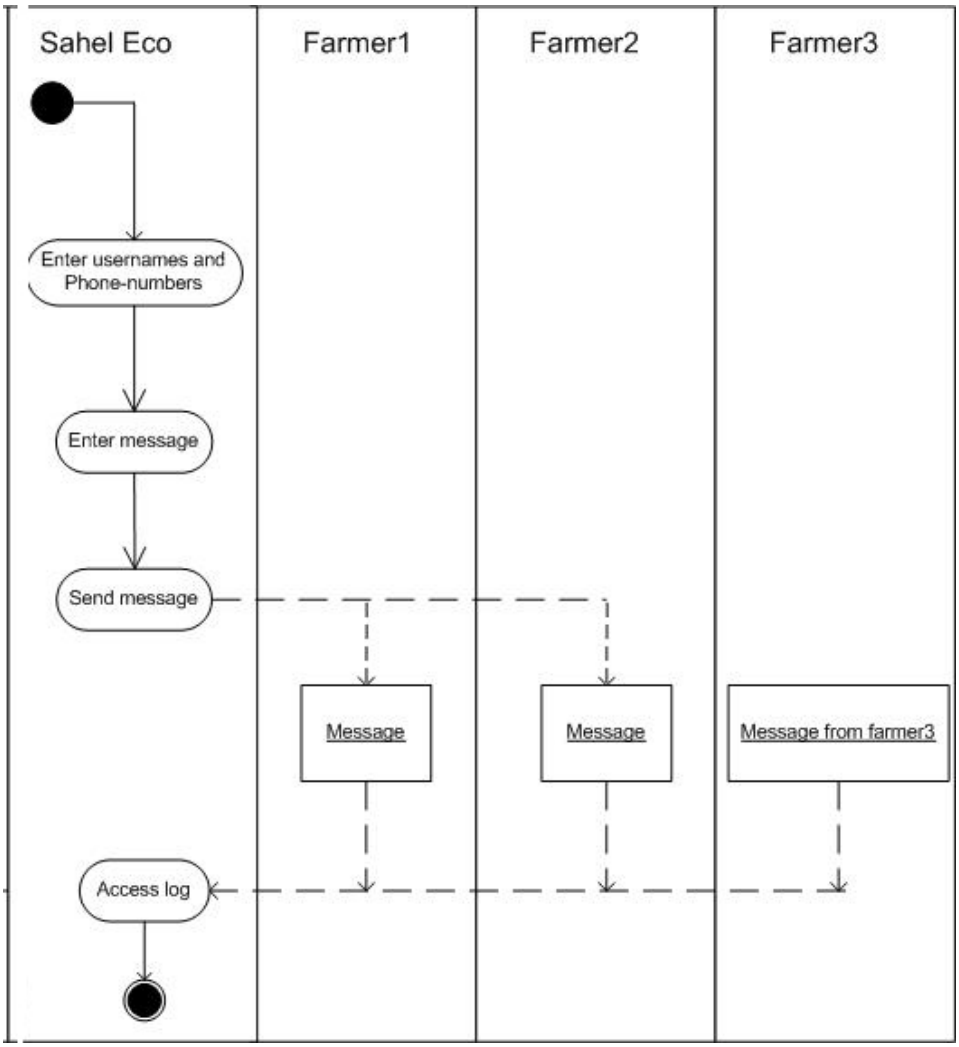
- Fatoumata's message is recorded:
- "my name is Fatoumata Traore from Finfini village. I will be at the workshop…"
-

Step10: Aisha, the webmaster of Sahel Eco accesses the system, next day

- Finds the new user Fatoumata,
- her phone-number
- The time when she called
- Her language
- Her voice message in an audiofile
- Aisha will also look at the user-list
- To see who else has been reached by the message

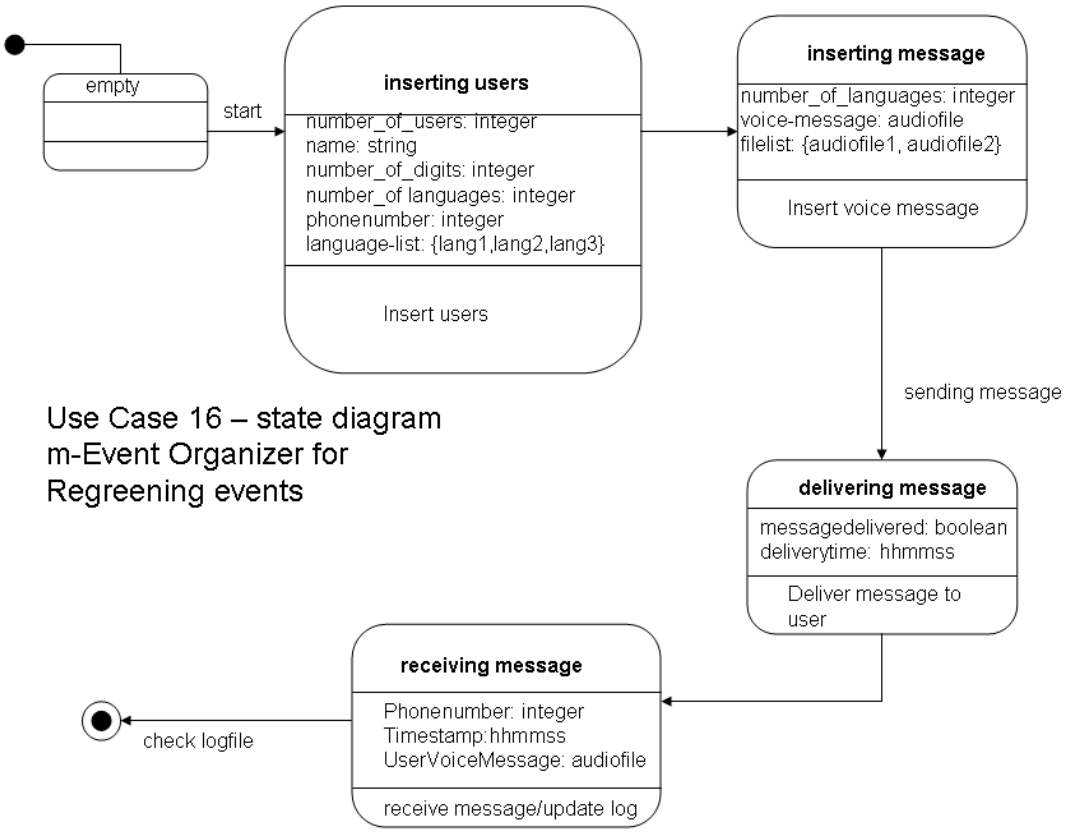
Interaction and communication structures

In the next figure, an activity diagram is shown for the use case. The different activities, both internal (Sahel Eco) and external (communication with the farmers) are shown.



Activity diagram

In the following State Diagram the changes in the different states of the system are visualized.



Use Case 16 – state diagram
m-Event Organizer for
Regreening events

Information concepts: see the above state diagram for the m-event use case

Technology infrastructure

The m-Event software is supposed to be accessible by phone. It therefore uses a platform with both an online accessible web interface and a mobile interface for voice phone access. The voice platform can be built on a "microserver" i.e. a computer with internet access, and a phone interface, e.g. Mobigator or a PCI-card with a sim-card slot. The voice platform has the following software components: Open Source PBX software (such as Asterisk) to manage the incoming and outgoing phonecalls, a Voice Browser (e.g. Prophecy), to manage the voice communication over the phone-line, to allow TTS and ASR, and to access the audio files. Communication is through voice, text and DTMF and possibly, but not necessarily also sms.

Cost considerations

The voice-platform provides both phone-access and internet access. To keep phone line costs inexpensive and local, the system is hosted in Mali.

During the VOICES project, it is initially planned that we should use the Emerginov platform, provided by Orange Labs, and France Telecom from WP2. After the end of VOICES, it is not certain if this test platform will remain freely available. This will influence

the sustainability of the business model. Alternative platform options are being explored: local, decentralised, and feasible solutions for a voice-platform, on top of which the voice services can be deployed.

Feasibility and sustainability

a. Technical feasibility: the following questions must be considered during the first-cycle:

Is it technical and financial feasible to host the system locally in Mali?

b. business and socio-economic feasibility

What are the advantages of the system for the end-users?

What are the cost-reductions due to he use of the system\

Are there non-material benefits?

Are users willing to use the system?

c. system-level impacts

Is the sound quality high enough?

Is the system working in French, Bomu and Bambara at he same quality?

How is the user-interface in text and in voice?

Key requirements

Must have:

- The system is accessible by mobile phone by calling a number;
- Your phonecall is answered by the voice system;
- Sahel Eco (or webmaster) can create a voice message, delete the message, change the message;
- It is easy to a create a user-list and enter user-names and their attributes (phone-numbers and optionally language prefs, group name);
- Easy to enter voice message through both web-based and phone-based;
- Dialogue system is in place to phone in and retrieve message;
- Optionally: The message is issued in a default language and in a second language; through DTMF it is possible to select the (second) language to hear the message.
- French and Bambara support

Should have:

option to leave a message

Could have:

support of Bomu

PART II.B RESOURCE NOTES

[1] VOICES Project WP-5 Team List at team-voices-wp5@webfoundation.org
[2] W4RA Team List at w4ra@webfoundation.org
[3] Team space for documents etc. at
https://private.webfoundation.org/VOICES/Media/WP5/ ;
Refer to https://private.webfoundation.org/VOICES/System/ for *how-to-do* for this team space

PART III.A: Report on the Field Research in Senegal for the m-Health Pilot

13. VOICES FIELD TRIP M-HEALTH PILOT, 21–25 MARCH 2011, SENEGAL: OVERVIEW

This Part III.A reports on the field trip organised in the context of m-health Pilot of the VOICES project (Work Package 4) which took place from 21-25th March 2011. The goal of this work package is to show that mobile ICT services may have great value both in improving epidemiological surveillance and training of laboratory technicians in Senegal.

The primary objective of the field trip was twofold: 1/ to meet end-users and all stakeholders in order to understand their work, expectations and needs, 2/ to generate use cases that could be relevant to the pilot.

Field research included conducting audio-taped interviews, group discussions, pictures taking, video recording and participation to internal meetings. This report describes the course of the field trip; user-needs and expectations identified, and use cases that have been generated.

During the field trip we met the Senegalese partners involved in the National Network of Laboratories (RNL), and we visited three different laboratories: one regional laboratory and two laboratory districts. We interviewed laboratory technicians and doctors in order to understand their work, their needs and expectations. This trip allowed us to meet potential end-users (laboratory technicians, medical doctors) and gather useful information about their activities, the tools they use, the problems they meet, the hierarchical structure of the laboratories.

Two workshop-like meetings were conducted, with participation of the relevant stakeholders (Network of laboratories, Sonatel and ESMT). The goal of these meetings was to define and discuss needs that have to be addressed in the pilot and how voice and mobile phones can meet these needs. These workshops also helped us to generate different uses cases regarding epidemiological surveillance and training/technical assistance. We also had the opportunity to attend the reporting of the activities of the network of laboratories in Senegal. This meeting, which was held in the Ministry of Health, was an excellent occasion for us to understand more deeply the activities of the network of laboratories. It was also an opportunity to meet and discuss with the director of epidemiological surveillance in Senegal.

14. M-HEALTH FIELD TRIP DAY-TO-DAY ACCOUNT

Preparation of the Field Trip: Dakar, 21 March 2011

Participants

National Network of Laboratories (RNL): Prof. Iyane Sow, Rokhaya Diagme, Papa Moussa Diallo, Mohammed Habib Seek, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

The first meeting took place in Fann Hospital at the virology department, where we met the Senegalese medical team which is involved in the National Network of laboratories (RNL) in Senegal. The goal of the meeting was to present the voices project, to explain the objectives of the WP4 pilot and to organise the trip.

Meeting in Fann hospital

It was decided to visit three laboratories: the first one is located in Khombole, the second in Kaolack and the third near Dakar.

Description of the trip.

Type and organisation of Senegalese laboratories

The organisational structure of the national health care system in Senegal is divided in three levels:

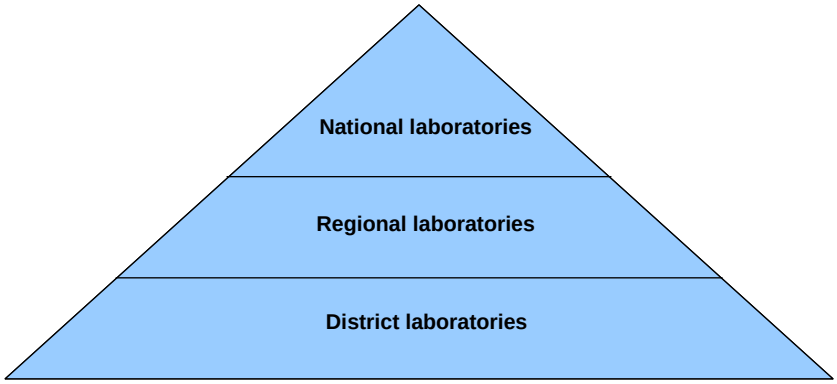
1. Regional Hospitals

2. District Health Centres (Centre de Santé) which includes medical units and equipments, and is supervised by a medical doctor who has overall responsibility of the management of the centre.

3. Health Posts (Poste de Santé)

Health posts (Postes de santé) are located in rural regions and depend on district health centres. Health posts have about health workers but no medical doctor working. The number of health posts per health centre is depending on the size of the district and its population density. The main duties carried out in health posts are consultancy and treatment of patients, rapid HIV and malaria tests, assistance in birth giving, vaccination, monitoring of children's and babies health, distribution of medicaments and quick clinical tests (malaria and HIV).

Laboratories are represented in the health ministry and are organised in three main levels: 17 national level laboratories, 15 regional level laboratories, 90 district level laboratories. One of the main differences between national laboratories and the other two laboratories is that the first ones are localized in Dakar. The main activity performed in these laboratories are tests which are done on clinical specimens in order to get information about the health of a patient as pertaining to the diagnosis, treatment, and prevention of disease.



Structure of laboratories in Senegal.

District laboratories are localized in district health centres. Each laboratory is headed by a doctor or an experienced laboratory technician who control and validate biological tests performed by the personal, which comprises laboratory technicians and, sometimes, community health workers (Assistants de Santé Communautaires). The main difference between an assistant and a laboratory technician is that the latter has a degree in biological sciences whereas the former has no qualification. Regional laboratories are localized in or near hospitals.

Recently, a Network of Laboratories (RNL) has been created in Senegal and in two other African countries (Mali and Burkina Faso). The main goal of this network is to improve people's health in these countries. Three areas of activities are covered by this network: training of laboratory technicians/health workers and medical biologists, the management of quality in local laboratories (quality of equipments, procedures, results, etc.), and epidemiological surveillance of specific diseases. The objective of the network is to strengthen these areas in each country under the supervision of national (ministries of health) and external entities, particularly Mérieux foundation which is the project

ownership of the network. Regarding the third area, that is epidemiological surveillance, the RNL is currently watching nine diseases: brain fever, cholera, shigelloses, tuberculosis, malaria, syphilis, HIV, measles, poliomyelitis.

Different activities are performed in regional and district laboratories, particularly the following ones: biological testing prescribed by doctors, and collecting and reporting epidemiological information. The transmission of epidemiological information must be sent to the Networks of Laboratories (RNL). More precisely, peripheral laboratories have to fill in and send two forms or documents: one form, which is in French, is used to collect information about diseases that are prioritized (e.g. cholera, see figure below) on a weekly basis. This form comprises different data: the ID of the laboratory, diseases that have been detected, name of the patient, date of swab, date of reception (of swab) in the laboratory, quality of swab, pathogens that have been detected, date of delivery of the result, date in which the document has been sent to the RNL.

République du Sénégal
Ministère de la Santé et de la Prévention
Réseau National de Laboratoires

FICHE DE COLLECTE DE DONNEES DE LABORATOIRE POUR LA SURVEILLANCE DES MALADIES PRIORITAIRES

Laboratoire: _____ District : _____ Région : _____

Mois : _____ Année : _____ Date d'envoi : _____

Numéro d'identification PPP-RRR-DDD-YY-NNN (same format as AFPstools) PPP = Pays RRR= Région, DDD = District, YY = Année, NNN = Numéro d'ordre durant l'année)	Maladie : - Choléra - Diarrhée Sanguino-lente (Shigellose) - Méningite - Autres	Numéro d'identification du labo	Nom du Patient	Date du prélève-ment	Date de réception au labo	Etat du produit pathologique 1 = Bon 2 = Mauvais	Agents pathogènes isolés - *Vibrio cholerae 01* - *Shigella dysenteriae Type 1* - Autres Shigelles - Méningocoque - Autres pathogènes - Pas d'isolement de pathogène	Autres résultats	Date d'envoi des Résultats au District/ ou niveau National	Date d'envoi au Réseau National de Laboratoires

NB : cette fiche doit être remplie chaque semaine et envoyée avec diligence au Coordonnateur du Réseau National de Laboratoires

Weekly form

The second form, which is also in French, is used to collect information about all diseases that are closely watched, including prioritized ones (see figure below). This form must be sent on a monthly basis. This form comprises the following data: type of form (culture and antibiogram or no culture), the ID of the laboratory and the person who filled out the form, type and number of diseases that have been detected, nature of swab, whether swab has been collected by national laboratories, pathogenic agents that have been detected.

REPUBLIQUE DU SENEGAL
MINISTERE DE LA SANTE ET DE LA PREVENTION
RESEAU NATIONAL DE LABORATOIRES

FICHE MENSUELLE DE COLLECTE INTEGREE DE DONNEES DE LABORATOIRE

▪ Type de fiche : ☐ 1.Culture et antibiogramme ☐ 2. Pas de culture

▪ Nom du Laboratoire : _____ (|_|_|_|)

▪ Niveau labo : ☐ 1. Labo .PS ☐ 2. Labo.DISTRICT ☐ 3. Labo. REGIONAL ☐ 4. Labo. NATIONAL
☐ 5.Labo. DE REFERENCE. ☐ 6. . Autre à préciser : _____

▪ District : _____ (|_|_|_|_|) ▪ Région : _____ (|_|_|)

▪ Mois de : _____ ▪ Année : _____ ▪ Effectué par (nom & Fonction) _____
_____

C1 N° LM	C2 ▪ Maladies	C3 ▪ Nature prélèvement	C4 ▪ Collecte effectuée ?	C6 ▪ Nombre total	C8 ▪ Niveau Labo.(indiqué)	C7 ▪ Résultats
01	Méningite	LCR	☐ Oui ☐ Non ☐ NA	Total : |_____| Dont : Microscopie: |_____| Latex : |_____| Culture : |_____|		- Méningo A : |___| - Méningo C : |___| - Méningo B : |___| - Méningo W135 : |___| - Pneumocoque : |___| - Hib : |___| - Diplocoque à Gram (-) : |___| - Diplocoque à Gram (+) : |___| - Bacilles à Gram (-) polymorphes : |___|
02	Choléra	- Selles liquidiennes	☐ Oui ☐ Non ☐ NA	|_____|		- V.Cholerae O1 : |_____| - V.Cholerae O139 : |_____|
		- Autres aspects	☐ Oui ☐ Non ☐ NA	|_____|		- Bacilles mobiles polaires, incurvés à Gram (-) : |_____|
03	Shigelloses	- Selles glairo-sanglantes	☐ Oui ☐ Non ☐ NA	|_____|		- *Shigella dysenteriae 1* : |_____| - Autres shigelles : |_____| - Bacilles immobiles à Gram (-) |_____|
		- Selles liquidiennes	☐ Oui ☐ Non ☐ NA	|_____|		
		- Autres aspects	☐ Oui ☐ Non ☐ NA	|_____|		
04	Tuberculose	- Expectorations	☐ Oui ☐ Non ☐ NA	|_____|		- TPM + nouveaux : |_____| - Total TPM + : |_____| - Total TPM ++ : |_____| - Total TPM +++ : |_____|
05	Paludisme	Sang (GE ; Frottis)	☐ Oui ☐ Non ☐ NA	|_____|		- *Pl. falciparum* : |_____| - Autres espèces : |_____|

Monthly form

These forms are received by Dr. Lamine Dia who is in charge of collecting epidemiological data sent by regional and district laboratories. These data are aggregated and treated by the network of laboratories. A quarterly bulletin (bulletin de liaison) containing a synthesis of epidemiological information reported by the laboratories (regional and districts) is sent to all of them every three months (see below, upper figure). This bulletin also includes educational information called information of the month (lower figure below). Epidemiological data sent by the laboratories are very important for the Network of laboratories because it is used to produce country's health indicators (statistics about diseases and illness) which are reported to international governmental agencies,

particularly the World Health Organisation. The production of these indicators is crucial for the country because the obtaining of funds is mainly based on these data.

DONNEES DE LABORATOIRES Données collectées par Dr M. Lamine Dia, Biologiste

REPUBLIQUE DU SENEGAL
MINISTERE DE LA SANTE ET DE LA PREVENTION
RESEAU NATIONAL DE LABORATOIRES

FICHE DE COLLECTE DE DONNEES (EXTRAIT)

*N° Fiche :*_____

FICHE MENSUELLE DE COLLECTE INTEGREE DE DONNEES DE LABORATOIRE

■ Type de fiche : ☐ 1.Culture et antibiogramme ☐ 2. Pas de culture

■ Nom du Laboratoire : _____ (|__|__|__|)

■ Niveau labo : ☐ 1. Labo /PS ☐ 2. Labo.DISTRICT ☐ 3. Labo. REGIONAL
☐ 4. Labo. NATIONAL ☐ 5.Labo. de REFERENCE.
☐ 6. . Autre à préciser : _____

■ District : _____ (|__|__|__|__|) ■ Région : _____ (|__|__|)

■ Mois de : _____ ■ Année : _____

■ Effectué par (nom & Fonction) _____

DONNEES DU QUATRIEME TRIMESTRE 2008

	Oct.	Nov.	Déc.
MENINGITES			
N. meningitidis B	00	00	01
N. meningitidis W135:	00	00	00
S. pneumoniae :	02	03	00
H. influenzae	00	01	00
Diplocoques à Gram (+)	01	00	00
Diplocoques à Gram (-)	00	00	00
CHOLERA			
V. cholerae O1:	27	08	01
SHIGELLOSES			
Shigella dysenteriae :	00	00	00
Autres shigelles :	05	07	00
TUBERCULOSE			
TPM+ :	03	05	06
TPM++ :	13	02	00
TPM+++ :	06	05	05
PALUDISME			
Pl. falciparum :	154	139	115
Autres plasmodies :	00	00	00

	Oct.	Nov.	Déc.
IST			
Syphilis (Sérologie) :	05	09	07
Candida albicans :	126	164	118
Trichomonas vaginalis:	15	19	13
N. gonorrhoeae :	01	00	00
Chl. trachomatis (Direct)	00	02	04
Chl. trachomatis (Séro)	45	56	22
SHISTOSOMIASES			
Sch. haematobium :	03	01	03
Sch. mansoni :	00	00	02
VIH			
VIH-1 :	10	22	23
VIH-2 :	01	01	05
VIH-1+2 :	01	03	00
Autres Pathologies virales			
Rougeole :	00	00	00
Poliomyélite :	00	00	00

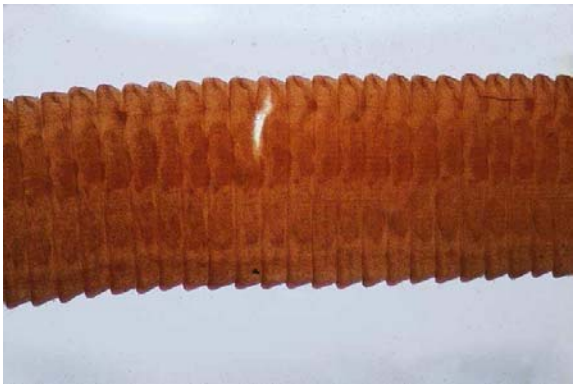
Les données notifiées proviennent des Laboratoires suivants :

- CHR de Kolda
- Labo. Régional de Kaolack
- CHR de Louga
- CHR de Saint-Louis
- CHR de Ziguinchor
- CHNU de Fann, Dakar
- Institut Pasteur, Dakar
- CHNU Albert Royer

NB : Il est instamment demandé aux responsables des autres Laboratoires de faire parvenir rapidement et régulièrement les données.

Reso Labo-Sn N°2 (Page 4)

Excerpt from the quarterly bulletin.



Anneaux d'Hymenolepis nana

Example of educational information included in the quarterly bulletin.

Needs and expectations

Prof. Sow reported that only few district laboratories report epidemiological information Regional laboratories are the main laboratories that send the epidemiological forms. It seems that the main reason why some district laboratories do not report epidemiological information is that because these laboratories do not have computers and an internet access.

He explained that two issues would be worth to explore in the context of voices project:

1. Improving and facilitating the reporting of epidemiological information, especially from "silent" laboratories that is laboratories which do not report diseases being kept under watch to the networks of laboratories.

2. Assisting laboratory technicians in accomplishing their tasks (for example, in performing biological tests), and facilitating the learning of existing or new technical procedures.

Visit to the District Laboratory of Khombole, 21 March 2011

Participants:

RNL: Papa Moussa Diallo, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Khombole's Health Centres: Dr. Aissatou Seck (assistant doctor), Biram Sarr Diaw (senior laboratory technician)

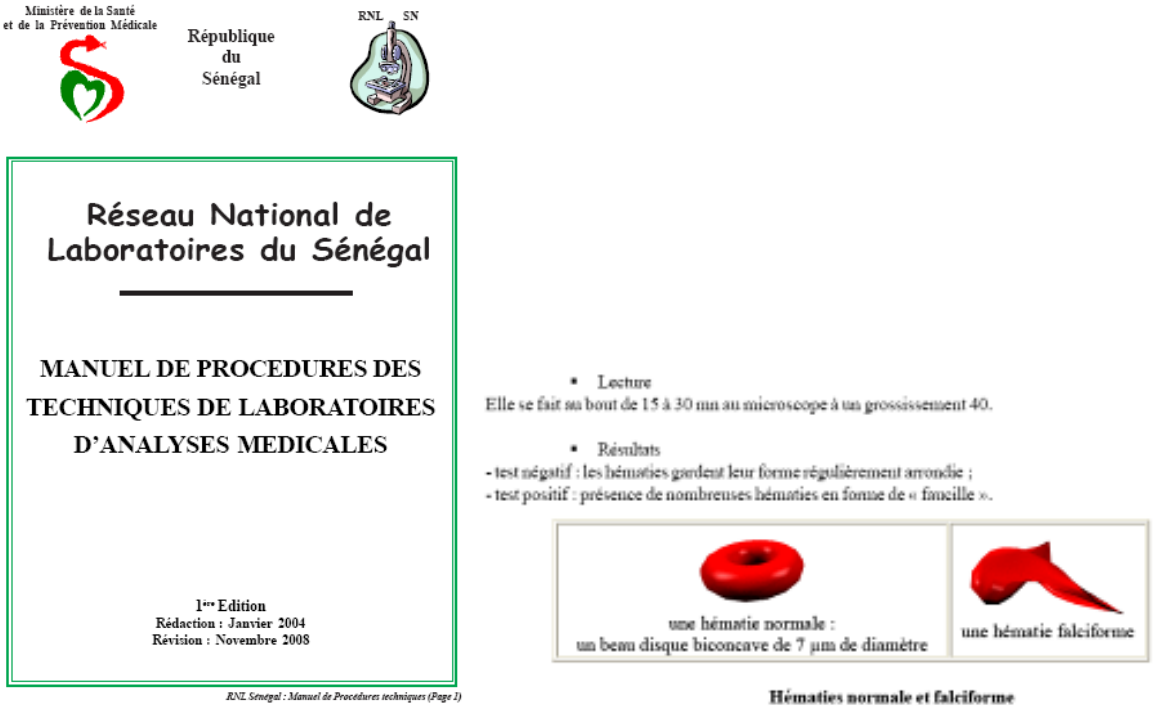
This laboratory is located in the health district centre of Khombole. This centre comprises: a maternity hospital, a laboratory, a radiology unit, a hospitalisation ward, a dentist's surgery, and a surgical unit. This centre is in charge of 16 health posts. We met one of the assistants of the director (which is a doctor) of the health centre, and the laboratory technician.

Five persons work in the laboratory: one senior laboratory technician and four health community workers. The laboratory is equipped with a laptop and has an internet access (WiFi). The centre pay for all communication expenses (telephone and internet access). Different types of tests are performed in this laboratory: Biochemical tests, Haematology, Serology, haemostasis, bacteriology, Parasitology, Microscopy, etc. These tests are performed by all the personal working in the laboratory. The senior laboratory technician validates and supervises the tests and health community workers' activities. Regarding the reporting of epidemiological data, the laboratory technician sends the weekly and monthly epidemiological forms by e-mail to the networks of laboratories. He said that this reporting is "part of his job". He mentioned a lack of feedback on the quality of his reports. For example, he would like to know whether the forms are correctly filled out and feedback on the quality of reported data.

During the interview, a discussion revealed that one of the main reasons that may explain why the majority of district laboratories do not report epidemiological data is the lack of computer and internet access. Another reason is a lack of time to fill out the forms and motivation because these laboratories may not clearly understand the utility of collecting and sending these data.

We learned that there is a focal point in each district. The role of the focal point is to report epidemiological information regarding specific viral diseases that are closely watched (e.g. measles, poliomyelitis) to the ministry of health (actually, to the person who is in charge of epidemiological surveillance at the national level).

We also explored topics related to training and technical assistance during the interview. The laboratory's personal have at their disposal a manual describing medical tests. This document is provided by the networks of laboratories (see below, upper figure), and include the minimal bundle of activities that a each kind of laboratory (districts, regional, national) should be able to perform, minimal equipment required to achieve these activities, and core technical procedures. When the technician needs information about a test or a disease, he contacts other national laboratories, depending on the circumstances. A number of documents describing technical procedures are stuck in the wall in places (benches) where corresponding tests are performed (see below, lower figure).



RNL's textbook of technical procedures.

Example of procedures stuck on the wall.

The main problems mentioned are: electricity cut offs, lack of feedback from the network of laboratories.

Different potential areas of application of voices have been discussed, regarding two topics: the way the reporting of epidemiological data to the networks of laboratories can be facilitated, the health posts may be involved in the diffusion of epidemiological information, how to facilitate the sending of medical results to patients, especially pregnant women living in rural areas and who have to move to the centre several times in order to get their results.

Visit to the District Laboratory of Kaolack, 22 March 2011

Participants:

RNL: Papa Moussa Diallo, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Kaolack's regional laboratory: Dr. Marianne CISSE (director of the laboratory)

This laboratory is located close to Kaolack's regional hospital. Eight persons work in the laboratory: two senior laboratory technicians which perform tests and supervise the activities of the assistants, one nurse assistant (in charge of taking swabs), one pharmacist assistant who prepare cultures and colourings, three health community workers, a cleaner and the director of the laboratory who is in charge of quality assurance, the validation of all tests performed in the laboratory, and is involved in other activities (e.g. supervision of districts laboratories which are under, training of laboratory technician). The epidemiological forms are filled out and sent to the RNL by the director of the laboratory by e-mail (the laboratory is equipped with a laptop and has an internet access).

The laboratory's personnel have at their disposal the textbook of technical procedures. This document is provided by the networks of laboratories. When the technician needs information about a test or a disease, he contacts other national laboratories, depending on the circumstances. As in the Khombole district laboratory, a number of documents describing technical procedures are stuck in the wall in places (benches) where corresponding tests are performed.

Visit to the District Laboratory of Diamniadio, 23 March 2011

Participants:

Senegalese medical team: Papa Moussa Diallo, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Diamniadio's district laboratory: Mrs NDONG, MENDY, DIEDHOU

This laboratory is located in the vicinity of Dakar, in a health district centre which was formerly a military hospital. This centre comprises: a maternity hospital, a laboratory, a hospitalisation ward, a paediatric unit, and a dentist's surgery. We met one of the assistants of the director (which is a doctor) of the health centre, and the laboratory

technician. Three doctors work in this district. The health district is in charge of 11 health posts.

The personal working in the laboratory comprises: three senior laboratory technicians, three laboratory technicians and three health community workers. Different types of tests are performed in this laboratory: Biochemical tests, bacteriology, Parasitology, Serology, Haematology, Microscopy, rapid HIV tests, etc. These tests are performed by all the personal working in the laboratory under the supervision of the senior laboratory technician who is in charge of the laboratory. Regarding the reporting of epidemiological data, the laboratory does not send the weekly and monthly epidemiological forms to the networks of laboratories because they do not have a computer and an internet connection.

As in the other laboratories, the laboratory's personal have at their disposal the textbook of procedures. A number of documents describing technical procedures are stuck in the wall in places (benches) where corresponding tests are performed. When the technicians need information about a test or a disease, they contact experts (e.g, depending on the circumstances. The interviewee told us an example: a few months ago, they detected Trichomoniasis (sexually transmissible diseases) in urines, they were surprised by this because the patient was young (14 years old), then they called an expert in order to know whether this case was normal. The main issues raised by the interviewee are the lack of computers and an internet connection, and the lack of continuing training. She said that they really need lifelong learning.

Meeting at the Ministry of Health: 24 March 2011, morning

Participants:

National Network of Laboratories (RNL): Prof. Iyane Sow (Chief of RNL's staff), Rokhaya Diagme, Papa Moussa Diallo, Mohammed Habib Seek, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Ministry of health (Secretary general): Mr Moussa MBAYE

+Other participants.

We have been invited by Prof. Sow to attend a meeting during which he reported on the activities of the RNL in Senegal. This meeting was an excellent opportunity to understand the activities of this network. Ralph presented the Voices project. We had also had the opportunity to interview Dr. BA, the chief of the epidemiological surveillance department located in the ministry of health. This interview allowed us to better understand the management of epidemiological surveillance at a national level.

First Team Debriefing Meeting, 24 March 2011, afternoon

Participants:

National Network of Laboratories (RNL): Papa Moussa Diallo, Mohammed Habib Seek, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Sonatel: Médoune Kane

The objective of this meeting was to discuss end-user needs that have been identified during the trip and to begin the elaboration of use cases. Two kinds of needs have been identified:

- Need of computers and internet access in laboratories
- Need of assistance: laboratory technicians often call in and ask specialists questions about their activities: biological tests, procedures, results, how to operate an equipment, etc. The specialists are not always available at the moment of the call.
- Need to facilitate the reporting of epidemiological data to the RNL. We have seen that the main problem is that some laboratories, particularly those located in health districts; do not report epidemiological data to the RNL, especially because the personal have neither a computer nor an internet connection. The goal is then to ensure a better and quicker transmission of epidemiological data from district laboratories to the RNL.

Second Team Debriefing Meeting, 25 March 2011

Participants:

National Network of Laboratories (RNL): Prof. Iyane Sow (Chief of RNL's staff), Rokhaya Diagme, Papa Moussa Diallo, Mohammed Habib Seek, Dr. Mouhamadou Lamine Dia

Mérieux Foundation : Dr. Christophe Longuet (Medical Director)

ESMT : Jean-Marie Preira

Orange : Ralph Ankri, Emmanuelle Boyer and Moustafa Zouinar

Sonatel: Médoune Kane

OBS: Mbakahane Diop

TNO: Jenny de Boer

In this meeting, we worked on *use cases* with Prof. Sow. Jenny helped us to organize the discussion on different topics (actors, key idea, context, etc.). Médoune Kane from Sonatel, showed how mobile phone, and more particularly SMS, can be used to collect and broadcast epidemiological data.

Outcomes are documented in the next two chapters.

PART III.B: Use Case and Requirements Analysis for the m-Health Pilot in Senegal

15. USE CASE A: M-SURVEILLANCE

The goal is to test mobile phones and voice technology (TTS and IVR) as way to enhance epidemiological data collection and to support laboratory technicians' training.

Current situation: District and regional laboratories have to send the weekly-based epidemiological form to the RNL by e-mail. Laboratories which are not equipped with computers and internet access cannot transmit epidemiological data.

Summary of key idea

A mobile service can facilitate the reporting of epidemiological data. We have planned to test two types of interfaces: voice and widget. The Voice interface is an IVR that will not involve automatic speech recognition; system inputs will use DTMF (Dual-tone Multi-Frequency, which is a mechanism for navigating voice user interfaces using the phone's numeric keypad) and outputs will use TTS. The widget interface will graphically collect the data from the user and send them to the server via sms. The idea is to compare which mobile interface (i.e. voice, widget) is the most effective in terms of accuracy, speed and user experience. The goal is to see whether mobile devices and voice improve the efficiency and effectiveness of data collection in resource-poor environments. The language of the speech interface will be French. Data collected will be stored in a data base, in the Emerginov platform. A web-based portal will allow the RNL to see the data transmitted via mobile phones. It will be possible to visualize data in tables, charts, graphs and maps.

Expected benefits:

- to collect more data from district laboratories, particularly in rural district areas where Internet services are still unavailable
- faster data collection
- track diseases outbreaks in real time

Actors	Operational goals
Laboratory technician	To transmit epidemiological data
National network of laboratories	To collect epidemiological data

Context and scope

a. What is the network configuration?

The network configuration will be based on the emerginov platform. It includes a server which has both Internet access and mobile access.

b. What are the success or performance measures for the scenario?

Success measures for the present use case are qualitative (in terms of users' reactions and satisfaction, impact of the usage of the system on laboratory technicians' daily work and on the RNL) and quantitative measures (in terms of speed and accuracy of data collection, number of cases of watched diseases reported via the system by laboratories, frequency of use).

c. What is the scope of the scenario (esp. what is outside it, not considered, system boundary)?

The question of whether the system will improve response to disease outbreaks is outside the scope of the study.

d. Who are the (external) stakeholders and their concerns?

Laboratory technicians' concerns: to be able to transmit epidemiological via mobile-phone

RNL's concerns concerns: to collect epidemiological data via mobile-phones

e. What are important (pre)conditions that must be or are assumed to be satisfied for the scenario (e.g. certain characteristics from the regulatory framework or industry/market organization, or key technological enablers).

The use case scenario is dependent on the availability of the emerginov platform, and on good system maintenance.

Use case scenario script - Widget

Salima, laboratory technician at Damniadio is going to use the m-surveillance system in order to transmit epidemiological data to the RNL.

Step1: Salima opens the m-surveillance application on her mobile phone by clicking on a widget.

Step2: The system welcomes her and prompts her to enter the disease that has been detected (a list of diseases is presented, including the item other. The user will use DTMF to select the disease. If the user selects "other", she will be prompted to enter the disease by using the mobile phone's keyboard): "Enter the disease. Press 1 for cholera, Press 2 for malaria, etc."

Step 3: Salima selects a disease

Step 4: The system prompts her to enter the name of the patient: "Type the name of the patient".

Step 5: Salima enters the name of the patient

Step 6: The system prompts her to enter the date of the swab: "Enter the date of swab"

Step 7: Salima enters the date of swab

Step 8: The system prompts her to enter the date of reception of swab in the laboratory: "enter the date of reception of the swab"

Step 9: Salima enters the date of reception of swab in the laboratory

Step 10: The system prompts her to enter the quality of the swab, using DTMF: "Enter the quality of the swab. Press 1 if swab is good, Press 2 if swab is bad"

Step 11: Salima presses "1"

Step 12: The system prompts her to enter the pathogen agent that has been detected (a list of pathogen agents is presented, including the item other. The user will use DTMF to select the pathogen agent. If the user selects "other", she will be prompted to enter the pathogen agent by using the mobile phone's keyboard): "Enter the disease. Press 1 for Vibrio ncholerae, Press 2 for Shigella, etc."

Step 13: Salima selects a pathogen agent

Step 14: The system and prompts her to enter any other result by using the mobile phone's keyboard.

Step 15: The system prompts her to enter the date of delivery of the result to the district

Step16: she enters the date of delivery of the result to the district

Step 17: The system asks her whether she wants to report another case: "press "1" to report another case, press "2" to finish"

Step 18: Salima presses 2

Step 19: The system thanks her for reporting epidemiological data to the RNL

Step 20: The system sends data to the emerginov database.

Step 21: The system displays the following message: "Your message has been sent successfully!"

Use case scenario script – IVR

Salima, laboratory technician at Damniadio is going to use the m-surveillance system in order to transmit epidemiological data to the the RNL.

Step 1: Salima calls to a phone-number to report epidemiological data.

Step2: The system welcomes her and prompts her to enter the disease that has been detected (a list of diseases is presented, including the item other. The user will use

DTMF to select the disease. If the user selects "other", she will be prompted to enter the disease by using the mobile phone's keyboard): "Enter the disease. Press 1 for cholera, Press 2 for malaria, etc."

Step 3: Salima selects a disease

Step 4: The system prompts her to enter the name of the patient: "Enter the name of the patient".

Step 5: Salima keyboards the name of the patient

Step 6: The system prompts her to enter the date of swab: "Enter the date of the swab"

Step 7: Salima enters the date of swab

Step 8: The system prompts her to enter the date of reception of swab in the laboratory: "Enter the date of reception of swab"

Step 9: Salima enters the date of reception of swab in the laboratory

Step 10: The system prompts her to enter the quality of the swab, using DTMF: "Enter the quality of swab. Press 1 if swab is good, Press 2 if swab is bad"

Step 11: Salima presses "1"

Step 12: The system prompts her to enter the pathogen agent that has been detected (a list of pathogen agents is presented, including the item other. The user will use DTMF to select the pathogen agent. If the user selects "other", she will be prompted to enter the pathogen agent by using the mobile phone's keyboard): "Enter the disease. Press 1 for Vibrio ncholerae, Press 2 for Shigella, etc."

Step 13: Salima selects a pathogen agent

Step 14: The system prompts her to enter any other result by using the mobile phone's keyboard.

Step 15: The system prompts her to enter the date of delivery of the result to the district

Step16: she enters the date of delivery of the result to the district

Step 17: The system asks her whether she wants to report another case: "press "1" to report another case, press "2" to finish"

Step 18: Salima presses 2

Step 19: The system thanks her for reporting epidemiological data to the RNL

Step 20: The system sends data to the emerginov database.

Step 21: The system broadcasts the following message: "Your message has been sent successfully!"

16. USE CASE B: M-LEARNING

The second set of use cases refers to the usage of mobile phones and voice for learning and training. This set comprises two use cases. One refers to a quiz application. The second, called "information of the month", is about broadcasting educational information in the form of voice messages.

Expected benefits: to improve the access to educational information

The use cases will have the following functionality

- A automated phone dialogue system
- TTS
- Alert phone-call or sms-alert to call back a person
- A web-based interface to create and manage educational content.

Context and scope

a. What is the network configuration?

The network configuration will be based on the emerginov platform. It includes a server which has both Internet access and mobile access.

b. What are the success or performance measures for the scenario?

Success measures for the present use case are qualitative (in terms of users' reactions and satisfaction) and quantitative measures (in terms of laboratory technicians' participation rates)

c. What is the scope of the scenario (esp. what is outside it, not considered, system boundary)?

d. Who are the (external) stakeholders and their concerns?

Laboratory technicians' concerns: to improve their knowledge of technical procedures

RNL's concerns: to improve laboratory technicians' knowledge of technical procedures

e. What are important (pre)conditions that must be or are assumed to be satisfied for the scenario (e.g. certain characteristics from the regulatory framework or industry/market organization, or key technological enablers).

The use case scenario is dependent on the availability of the emerginov platform, and on good system maintenance.

B.1 Quiz

Current situation: Laboratory technicians would like more continuous training.

Summary of key idea

A staff member from the RNL creates a quiz using a dedicated web interface. He enters the questions and answers, selects the appropriate voice and then listens to the quiz. He then issues it. All laboratory technicians who are on the list receive a notification inviting them to call a specific number in order to listen to and make the quiz. They can phone later to this phone number to make the quiz again. This scenario will include TTS functionality and DTMF.

Actor	Operational goals
Laboratory technician	To improve his/her training.
RNL	To give laboratory technicians continuous training.

Use case scenario script

Creating and broadcasting a quiz

Step 1: Access application

- Ali, a staff member from the RNL, opens the application (His computer has a soundcard and a microphone)

Step 2: He creates a quiz

He enters the question, the answers and explanations; he then selects the appropriate voice.

Step3: He tests the quiz (he listens to it)

Step 4: Ali selects the laboratory technicians (phone list) that will receive the quiz

Step 5: Ali issues the quiz to the phone list

Making a quiz

Step 1

A laboratory technician receives sms from the RNL, the message invite her/him to make a quiz by dialling a specific phone number

Step2

The laboratory technician dials the number

Step3

The system welcomes the technician and invites her/him to make the quizz

Step4

The system presents the quiz (questions and answers) NB. The user can listen to the question and answer again

Step5

The technician selects an answer using a telephone keypad

Step 6

If the answer is correct, the system congratulates the technician and

If the answer is wrong, the system indicates the right one, with explanation. NB. The user can listen to the question and answer again

B.2 Information of the month

Current situation: The quarterly bulletin includes educational information called "information of the month". This information is not accessible to all technicians, particularly in laboratories which are not equipped with PCs and have not an internet access. Moreover, this information is mainly visual.

Summary of key idea

A staff member from the RNL prepares a voice message about a disease or a laboratory procedure through a web interface. He enters the message through a dedicated interface, selects the appropriate voice and then listens to the message. He then issues it. All laboratory technicians who are on the list receive a notification inviting them to call a specific number in order to listen to the message. They can listen to the message again. They can phone later to this phone number to retrieve the message again.

Actor	Operational goals
Laboratory technician	To improve his/her training.
RNL	To give laboratory technicians continuous training.

Use case scenario script – Information of the month

Creating and broadcasting an information of the month

Step 1: Access application

- Ali, a staff member from the RNL opens the application
- (His computer has a soundcard and a microphone)

Step 2: He enters the information of the month. He then selects the appropriate voice.

Step3: He tests the quiz (he listens to it)

Step 4: Ali selects the laboratory technicians (phone list) that will receive the information

Step 5: Ali broadcasts the message to the phone list

Listening to the information of the month

Step 1

A laboratory technician receives sms from the RNL, the message invites her/him to listen to the information of the month by dialling a specific phone number

Step2

The laboratory technician dials the number

Step3

The system welcomes the technician

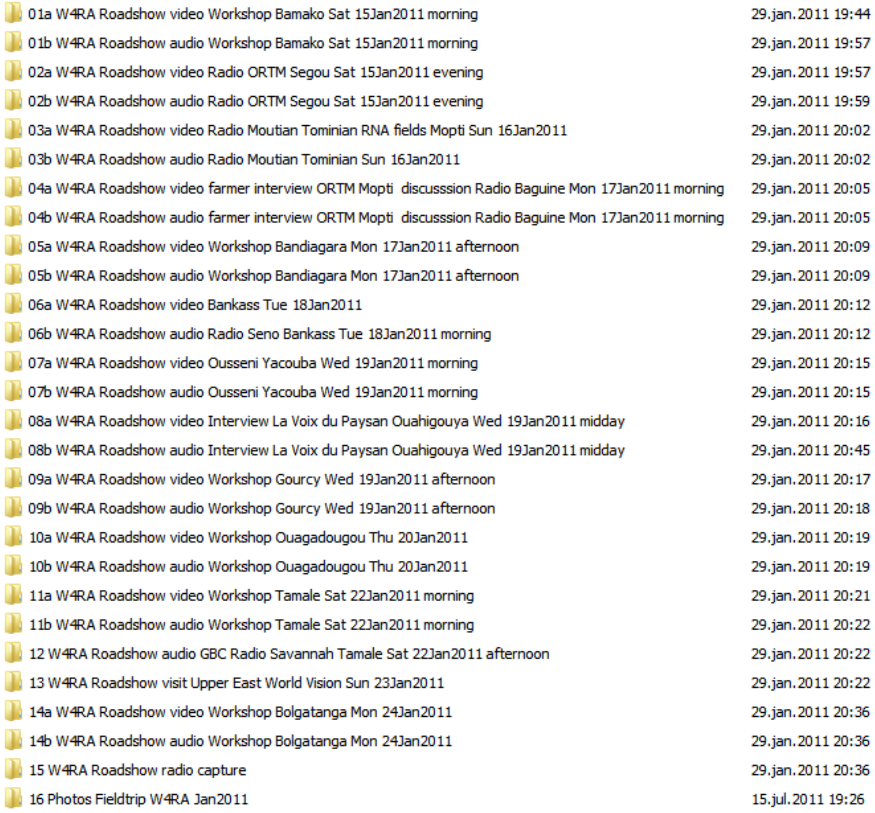
Step4

The system plays the voice message. NB. The technician can listen to the message again.

APPENDICES

APPENDIX A: FIELD RESEARCH ONLINE RESOURCES

The field research as described in Part II.A (m-Agro regreening knowledge sharing) has been extensively videotaped as well as audiotaped. These original video and audio resources are available online at ftp://akmc.biz/ShareSpace/W4RA-VOICES/W4RA-VOICES_Roadshow_West-Africa_14-26Jan2011/ (note: about 30 Gb in total):



01a W4RA Roadshow video Workshop Bamako Sat 15Jan2011 morning	29.jan.2011 19:44
01b W4RA Roadshow audio Workshop Bamako Sat 15Jan2011 morning	29.jan.2011 19:57
02a W4RA Roadshow video Radio ORTM Segou Sat 15Jan2011 evening	29.jan.2011 19:57
02b W4RA Roadshow audio Radio ORTM Segou Sat 15Jan2011 evening	29.jan.2011 19:59
03a W4RA Roadshow video Radio Moutian Tominian RNA fields Mopti Sun 16Jan2011	29.jan.2011 20:02
03b W4RA Roadshow audio Radio Moutian Tominian Sun 16Jan2011	29.jan.2011 20:02
04a W4RA Roadshow video farmer interview ORTM Mopti discusssion Radio Baguine Mon 17Jan2011 morning	29.jan.2011 20:05
04b W4RA Roadshow audio farmer interview ORTM Mopti discusssion Radio Baguine Mon 17Jan2011 morning	29.jan.2011 20:05
05a W4RA Roadshow video Workshop Bandiagara Mon 17Jan2011 afternoon	29.jan.2011 20:09
05b W4RA Roadshow audio Workshop Bandiagara Mon 17Jan2011 afternoon	29.jan.2011 20:09
06a W4RA Roadshow video Bankass Tue 18Jan2011	29.jan.2011 20:12
06b W4RA Roadshow audio Radio Seno Bankass Tue 18Jan2011 morning	29.jan.2011 20:12
07a W4RA Roadshow video Ousseni Yacouba Wed 19Jan2011 morning	29.jan.2011 20:15
07b W4RA Roadshow audio Ousseni Yacouba Wed 19Jan2011 morning	29.jan.2011 20:15
08a W4RA Roadshow video Interview La Voix du Paysan Ouahigouya Wed 19Jan2011 midday	29.jan.2011 20:16
08b W4RA Roadshow audio Interview La Voix du Paysan Ouahigouya Wed 19Jan2011 midday	29.jan.2011 20:45
09a W4RA Roadshow video Workshop Gourcy Wed 19Jan2011 afternoon	29.jan.2011 20:17
09b W4RA Roadshow audio Workshop Gourcy Wed 19Jan2011 afternoon	29.jan.2011 20:18
10a W4RA Roadshow video Workshop Ouagadougou Thu 20Jan2011	29.jan.2011 20:19
10b W4RA Roadshow audio Workshop Ouagadougou Thu 20Jan2011	29.jan.2011 20:19
11a W4RA Roadshow video Workshop Tamale Sat 22Jan2011 morning	29.jan.2011 20:21
11b W4RA Roadshow audio Workshop Tamale Sat 22Jan2011 morning	29.jan.2011 20:22
12 W4RA Roadshow audio GBC Radio Savannah Tamale Sat 22Jan2011 afternoon	29.jan.2011 20:22
13 W4RA Roadshow visit Upper East World Vision Sun 23Jan2011	29.jan.2011 20:22
14a W4RA Roadshow video Workshop Bolgatanga Mon 24Jan2011	29.jan.2011 20:36
14b W4RA Roadshow audio Workshop Bolgatanga Mon 24Jan2011	29.jan.2011 20:36
15 W4RA Roadshow radio capture	29.jan.2011 20:36
16 Photos Fieldtrip W4RA Jan2011	15.jul.2011 19:26

For presentation, learning/teaching and dissemination purposes, we have developed some videoclips based on footage from the W4RA-VOICES field trip and road show. Videoclips in different formats (incl. Android and iPod) are available from: ftp://akmc.biz/Public/W4RA-VOICES-videoclips/.

Moreover, a one-minute trailer can be watched via YouTube, see http://www.youtube.com/watch?feature=player_profilepage&v=gX5nc_Wf6GA.

For a short (6 minutes) documentary of the m-agro regreening field trip and roadshow, see Vimeo at http://www.vimeo.com/26520353 (Bruno van Moerkerken).

Another videoclip focussing more on the role of radiostations and online media for rural knowledge sharing is online available at http://vimeo.com/29659533. (It was initially made for the International Press Institute, for presentation at its World Congress in Taiwan).

APPENDIX B: THE ROLE OF ICTS IN KNOWLEDGE SHARING WITHIN RURAL COMMUNITIES IN GHANA

Nienke Akkermans

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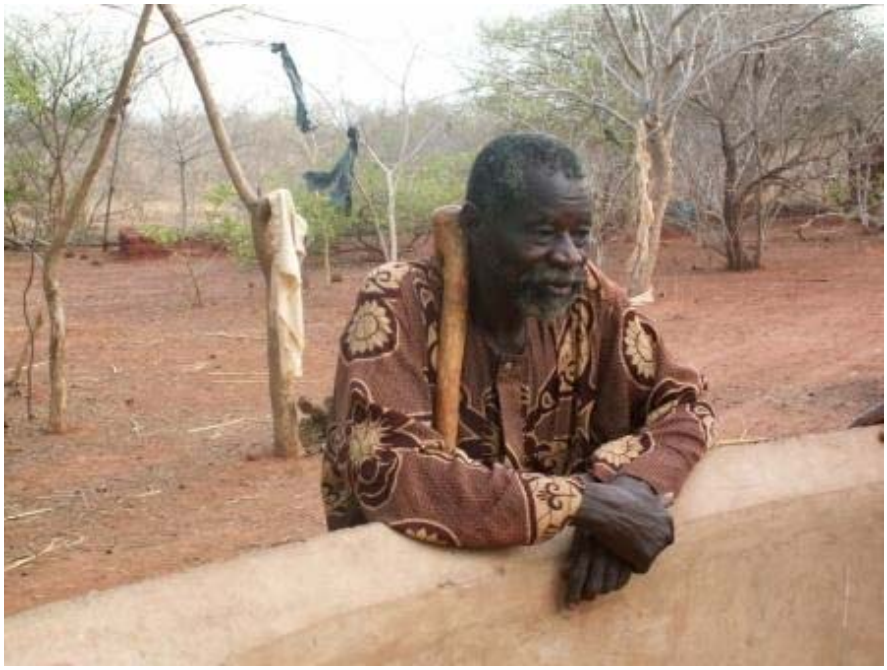
1. Field Study Set-up and Preparations

Initial Context. On October 20th, 2009, I attended a symposium at VU University Amsterdam on Regreening the Sahel Initiatives and with the World Wide Web Foundation that my father was organizing that day as a part of the Dies Natalis of the university. At this symposium I got excited about the work done by one of the participating organizations at the symposium: the Centre for International Cooperation (CIS) of VU University Amsterdam. The symposium on the World Wide Web and social development told the story of Yacouba Sawadogo (see picture below), an innovative farmer from Burkina Faso.[‡] In the 1970s and 1980s the Sahel region in West-Africa experienced extreme droughts and famines, and many people left the region to find a better place to live elsewhere. Yacouba Sawadogo was one of the farmers that stayed behind and worked on the land. He improved the traditional 'zai' technique of digging pits in the ground and adding manure to improve the soil and he taught other farmers about this technique. This turned out to be successful in rehabilitating large areas of degraded land and in achieving significantly higher yields for the farmers. As a result, many of the people that had left returned to their villages and are able to provide for themselves now.

[‡] More information on the symposium and on Yacouba Sawadogo can be found on http://www.vu.nl/nl/nieuws-agenda/agenda/2009/okt-dec/yacouba_sawadogo.asp.



"The man who stopped the desert": Yacouba Sawadogo on his farm in Burkina Faso

Initial Itinerary. On June 7th, 2010, I would fly Schiphol Airport to the International Airport in Accra, Ghana, to begin my adventure in Ghana. Together with Ms. Tuyp I would then travel to Cape Coast. After a stay in Cape Coast, I had scheduled to leave for Tamale where I was expected by Professor Dittoh of the University of Development Studies on Saturday June 19th. Then, from Sunday June 27th until Saturday July 3rd I was invited to join Stephane Boyera and his team of the World Wide Web Foundation –one of the partners of CIS in different projects –on their meetings in Accra. Since Accra is the capital of Ghana and most national and international governmental and non-governmental organizations are based there, I planned to stay in the capital to finish my research until I had to fly back to the Netherlands on July 17th.

Background and Context of Regreening and W4RA. In the 1970s and 1980s periods of drought deteriorated the living conditions in rural areas in West-Africa severely. Today, the soil conditions and vegetation have improved due to the work of innovative farmers as Yacouba Sawadogo in small rural communities using simple yet effective farming techniques. An area of over 5 million hectares has been restored and converted into fertile land. One of the factors in the success of these 'regreening' activities can be found in the exchange and spread of knowledge of the local knowledge amongst large numbers of farmers. Knowledge on how to effectively and sustainably manage the lands, how to preserve trees, how to enhance soil fertility, and how to improve crops and herds is crucial for the people in these rural communities, whose livelihoods depend on agriculture and livestock. One great source of information for farmers is the radio, since radio stations broadcast programs for farmers in local languages. Another source of information is the mobile telephone. In Burkina Faso, where the project has started with a target community, mobile phones are used by farmers for example to check market prices in town, and to negotiate with potential customers about prices of commodities. In the target village up to 98 percent of the households own a radio and have a mobile phone. The benefits of the radio and the mobile phone are worth the costs, because they provide essential information for the live and business of people in the village.

Combining existing radio content with new ways for voice-based access to the Web and other mobile ICT services makes it possible to increase the speed and amount of information and knowledge sharing between rural communities. The objective of the project is to improve and facilitate the local exchange of knowledge through the use of ICTs. This is to be done through, first, the development of new innovative ICT tools and services which are adapted to local content, and, second, capacity building of local software developers and entrepreneurs on how to create sustainable ICT services. The W4RA initiative has officially started in 2010 and in the first week of February, 2010, a first World Wide Web Foundation Workshop on Mobile Web and Social Development took place in Burkina Faso.

The Assignment. I was given the assignment to do a first research in Ghana on the use of ICTs within rural communities and make first contact with stakeholders that might play a role in the project in the future. The assignment VUA (CIS) gave me was to do research in Ghana on the role of ICTs in rural communities. The increasing use of ICT over the world is influencing the ways people are communicating with each other. Even in the most remote rural communities in Sub-Saharan Africa mobile telephony is used as a communication tool. The Regreening Initiatives aim at stimulating the development of ICT tools for the dissemination of knowledge amongst farmers in rural communities in Sub-Saharan Africa. For my internship and research in Ghana we formulated the following research question:

What is the role of ICTs in communication and knowledge sharing within rural communities in Ghana?

To answer this question, different relevant stakeholders were interviewed and the local situation in Ghana was observed. The outcomes of the field research [Ch.2] are presented on the basis of the following questions:

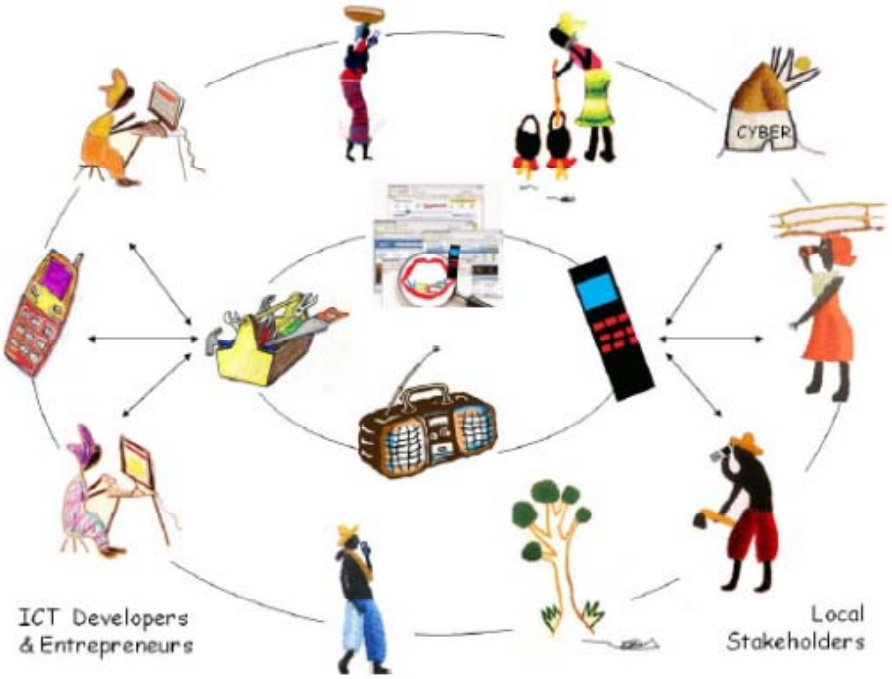
- How is the current situation of the access to and use of mobile telephones and computers and internet in rural communities in Ghana? [Ch. 3]
- What are the main challenges faced with the use of these ICTs for rural development in Ghana? [Ch. 4: infrastructure and connectivity, literacy and education, costs, electricity, languages]
- What is the role of different stakeholders in supporting the process of ICT service delivery to rural communities? [Ch. 5: universities, NGOs, ICT service providers and software developers, Agricultural Extension Officers, radio stations, internet cafés, government]

After the outcomes of the field research in Ghana, recommendations are given for the Web Alliance For Regreening Africa (W4RA) to start a successful project in Ghana to help the development of ICTs in order to improve the livelihood of farmers in rural communities in Ghana [Ch. 6].

Contact persons in Ghana

In Ghana several key contact persons will co-supervise the MA student and bring her in contact with the relevant stakeholders, who will be then be interviewed by her:

- Prof. Saa Dittoh, University of Development Studies, Tamale
- Prof. John Victor Mensah, Institute for Development Studies, University of Cape Coast
- Dr. Moses Setiga, ICT coordinator, University of Cape Coast



2. Field Research Account

Cape Coast

I started my research in Cape Coast which is situated at the Gulf of Guinea, some 165 kilometers west of the capital Accra (for a map of Ghana see Appendix II). At the north of the city lies the campus of the University of Cape Coast (UCC). From the international airport at Accra, Wendelien Tuyp, her associate Mike Roberts and I were driven to the UCC campus where Ms. Tuyp and Mr. Roberts were to visit the Institute of Development Studies (IDS) for a project they have been working on together. The idea was that Ms. Tuyp would introduce me to some Ghanaian PHD-students who are employed by VU University to do research in Ghana and who are writing their dissertation at the moment. Ms. Tuyp and Mr. Roberts would stay in Cape Coast for three days and after that I was supposed to find my way around myself.

Accommodation. One of the PhD students, Joseph, helped with finding accommodation for me to stay during my visit in Cape Coast. Since CIS was not able to assist me financially during my internship, I had to keep the costs as low as possible. Joseph and I looked at the possibilities and I decided to stay in a student hostel for 5 Ghana Cedi a night.[§] Because of the summer holiday most students had gone home to visit their families and the hostel was rather quiet. The students remaining at the hostel for the summer were 'national service students": graduates that have to work as national service for one year after their Bachelors. I stayed alone in a room at the ladies' floor (see picture below). The hostel was new, one part was still under construction even, and a cleaning crew came to clean the bathrooms and hallways every morning. I went out and got some cleaning materials and cleaned the room before I moved in the room. I was rather pleased with the

[§] The national currency of Ghana is the Cedi (GHC or ¢) which is divided into one hundred pesewas. One Cedi equals approximately 0.50 Euro or 0.70 US Dollar.

price of my residence and the space and cleanliness of my room and the bathrooms, but when I went to sleep that first night, I got anxious since I realized that I was starting an adventure I did not know where it would lead to.

My room in the SRC Hostel at the campus of the University of Cape Coast

Getting to Know Ghana. The next couple of days I had to take my time to adjust to Ghana and the Ghanaians. Before leaving the Netherlands I had searched the internet for Ghana and Ghanaian customs, but in reality it was very different from anything I had done before. I took my hostel and the Institute for Development Studies as starting point and walked around to get somewhat familiar with the surroundings. Soon I had found a couple of places where I could by drinks, food, and other groceries, I figured out how the system of shared taxis in Ghana works, and I met some people to talk to. Joseph had sent one of the followers of his church, Albert whose nickname was "Kwabena" –born on Tuesday in Akan –to check up on me every once in a while because he was residing in the same hostel as I was. Kwabena was friendly enough to lend me his bucket so I was able to fetch water for bathing and washing cloths. At the inner courtyard of the hostel there were three large water reservoirs where I would get water to take upstairs to one of the washrooms to bath. After a day or two I felt more comfortable in my new living environment. Every morning I walked to IDS to start my day from there. I visited Joseph briefly every day and made some contacts for my research.

Elmina. The third day in Cape Coast Ms. Tuyp and Mr. Roberts had the afternoon off before leaving for Accra and invited me to come to visit the town of Elmina nearby (see picture below). Elmina is famous for the Castle built by the Portuguese in 1482 as a trade settlement on the Gold Coast as Ghana used to be named. São Jorge da Mina, as the castle was called by the Portuguese, later became one of the most important stops in the trade of slaves from West-Africa to the Americas, especially when the Dutch took over the Castle from the Portuguese in 1637. This castle is one of the most popular places to visit in Ghana and both foreigners and Africans came to visit the castle to learn about the horrifying history of the slave trade.

Fishing boots at the coast of Elmina.

"Mingling". After this valuable trip to Elmina Ms. Tuyp and Mr. Roberts left Cape Coast and left me by myself. I had already realized that the low-budget way of staying in Ghana would help me in doing my research. The majority of foreigners that come to Ghana reside in hotels that are very expensive and, in addition, closed off from local people. By mingling with local people as much as possible I would be able to get a good idea of the way of living of Ghanaians and I figured this would be an advantage for the research reporting. I noticed that just by talking to Ghanaians I already learned a lot about Ghana and Ghanaians and I made it an effort to talk to as much people as possible. This was not that difficult, since I was the only white person around and people would just come up to me to talk to me. The majority of these conversations were rather superficial, but still they gave me a better impression about the country and its people. Some conversations developed more in depth and in these conversations I could easily bring up the project I was working for and talk about ICTs for rural development in Ghana.

Ghanaian pace. Another thing I learned is that the pace of living in Ghana is very different from what I was used to in the Netherlands. During the preparations I had already noticed that Ghanaians are not that strict in making appointments. One of the reasons it took some time to figure out a travel plan for Ghana, was that the Ghanaian contacts said it was fine for me to come and told me or Ms. Bon to let me get in contact once I was in Ghana. At UCC it was hard to make an appointment with a professor, because most professors preferred you just come walking in and see if the professor was in. And if you had made an appointment, it could take hours of waiting, sometimes even days, before you could meet the professor. On the other hand, even the professors that were very busy made time to talk to me. Some of the interviews lasted for fifteen minutes, others stretched out to over an hour. I concluded that Ghanaians like to talk and especially when I told them I wanted to interview them for my research, the people were very perceptive and talkative.

Interviews. Because of my lack of experience in field research, I wrote down a number of topics I wanted to know more about for the project and I thought of questions I could ask to get the right answers. In total I spend half of my time in Cape Coast. I interviewed a number of people there; experts on ICT, on development in Ghana, on agriculture, on extension workers, on government policy, on Ghanaian languages. In the interviews and during the conversations with some of the people I had met, we discussed the level of development in Ghana, the challenges for Ghana in further development, the role of the government, universities, and NGOs on rural development. Also, I used the interviews as starting point for further research. For example, when I learned in a conversation that there are many different languages spoken in Ghana, I visited the Department of Ghanaian Languages to get further information on the different languages and dialects spoken in Ghana and the problems this could bring for development. I tried to speak to as many people as possible to get their views and to see if there where commonalities. A selection of the interviews at UCC was with:

- Dr. Festus Annor-Frempong, director of the Department of Agricultural Economics and Extension
- Mr. Joseph Boateng-Agyenim, progress made in developing Ghana
- Prof. Stephen B. Kendie, the main issues for rural development in Ghana
- Dr. John Victor Mensah, director of the Institute for Development Studies
- Prof. Dr. Nii Quaynor, ICTs and the World Wide Web for development
- Dr. Moses Setiga, ICT coordinator of the University of Cape Coast
- Mr. K. A. Tuffuor, Ghanaian political structure and its influence on development
- Dr. Ishmael bin Yahya, the role of agricultural extension officers in rural development

From Cape Coast to Tamale. After spending some time in Cape Coast, I emailed my contact in Tamale, the capital city of the Northern Region, prof. Saa Dittoh of the University of Development Studies. Ms. Bon from VUA-CIS had asked him to receive me in Tamale for the research and we had agreed I would travel to Tamale on the 19th of June. Via email professor Dittoh told me I could join him on a field trip he was undertaking for another project if I would be able to come sooner. Since the field trip sounded very interesting, I left for Tamale the next day. Early the next morning I took the bus from Cape Coast to Kumasi and from Kumasi to Tamale. Because I felt I had not finished my work I Cape Coast yet, I made arrangements to come back to the campus at the end of my stay. I took one bag with me and left the other with Joseph and made sure I could return to my room with the manager of the hostel.

Tamale

Accommodation. Since I would arrive in the evening, professor Dittoh had booked a room in a guest house for me to stay in for the first night. We would see if we could find accommodation for the rest of my stay later. I was a bit insecure about where I was supposed to stay and when I met a student representative of the University of Development Studies (UDS) on the bus, I discussed with him the possibilities. I told him about the hostel I had stayed in at UCC and asked him if he could help me with finding similar accommodation in Tamale if necessary. He told me that would not be a problem and we exchanged telephone numbers to get in contact later. After the first night in Tamale the professor took me along on a field trip he was undertaking together with two fellow researchers of UDS; Margaret Akuriba and Conrad Weobong. When returning from the field trip we discussed accommodation for me in Tamale. I told them I was trying to

arrange a hostel at the campus, but Margaret was kind enough to invite me to stay with her. She lived alone and had an extra room in her house in a compound with three other houses.

From South to North. While traveling by bus from Cape Coast to Tamale I noticed the big differences in Ghana between the North and the South. In Tamale, a city of approximately 300,000 citizens, the situation was completely different than in Cape Coast. Tamale lies 600 kilometers North of Cape Coast and the climate is significantly dryer than in the South. In Ghana the rainy season starts in April, but while in the South I had experienced rainfall already, in the North it had not rained yet until I arrived in half June. The three regions in the North of Ghana –the Northern Region, the Upper West Region, and the Upper East Region –are not only the driest but also the poorest regions of the country. The farmers in these regions are struggling to survive. As the largest city in the North of Ghana, Tamale was a good place to start my field research on ICTs in rural Ghana. Professor Dittoh sent his son Francis to help me with my research.

Data Gathering. In Tamale I wanted to get insight on the use of ICTs at the moment and the possibilities to use ICTs for rural development in the future. Together with Francis, I visited the radio stations, cyber cafés, NGOs working in rural communities, software companies, and ICT training centers in the city. We interviewed a lot of people of these organizations, or made appointments to come back later for an interview. Here I gathered a lot of usable information for my research and learnt that there are many challenges for developing ICT tools for rural development. For example, the speed and stability of the internet in Tamale is a serious issue. In Europe we are used to incredibly fast internet connections. In Cape Coast I had already learnt that the internet is very slow in Ghana. In Tamale the situation again was totally different; the internet is very slow and instable, often connections are down for days.

Upper West and Upper East Region

From city to rural area. Not only the differences between North and South were striking; I also started to notice the differences between the cities and the rural areas. During the field trip we traveled to the Upper West Region and the Upper East Region where the climate clearly was even more severe and poverty was extremely high. For the field trip we visited four rural communities: Kaleo near Wa, Goziiri and Tankara in the facinity of Nando and the border with Burkina Faso, and Kandiga near Bolgatanga. Since it is not appreciated to come unannounced, the visits were carefully prepared by Conrad and contact persons of the communities. The primary purpose of the field trip was to look at community initiatives in the framework for sustainable land development. For example, the Goziiri (see picture below) had taken up the initiative not to burn the bush near the village and not to burn debris on their land. The non-burning rule has contributed to the growth of the forest which brings shade and shelter for people and animals in the neighborhood. Burning debris on an appointed place instead of on the land where you grow crops, improves the soil and benefits the farmers.

Meeting the Chief and his Elderly in Goziiri.

The Meetings. The meetings were very formal and started with introductions. First the professor would introduce us and tell a bit about the reason of our visit. Then, the chief and the Elderly were introduced by a spokesperson of the community. There were interpreters present, because in Ghana many different languages are spoken and especially in the North there is a lot of variety of languages and dialects. At the end of the meeting, the professor would introduce me and asked if it was possible that I asked a couple of questions for my research. I started with my questions on mobile telephony. I asked, for instance, if the Chief and Elderly possessed a mobile phone and what they used mobile phones for. The popularity of mobile phones in Ghana combined with the fact that a white girl was asking the questions, made the people of the community very receptive in answering my questions. During the field trip, I gathered a lot of useful information for the research and I used the communities as examples to illustrate my research report (see for example page 8 of the research report in Appendix IV on the Goziiri and access to the World Wide Web).

Between Times. For the field trip, we used the professor's four wheel drive as means of transportation. He had hired a driver to drive us to all the communities. At night we searched for a guest house to stay in. Guest houses are small hotels that are subsidized by the government. The professor and his crew told me they wanted to take care of my expenses for the trip and would net let me pay for one meal or drink the whole trip. It was very educational for me to see how they conducted field research and I enjoyed being a part of the team. While traveling and after meetings, we talked about Ghana and about the differences with the Netherlands. Also, the FIFA World Cup 2010 was organized in Africa for the first time and both Ghana and the Netherlands were performing well in it. Almost all Ghanaians wanted to watch the matches of their Black Stars and Ghana came furthest of all African countries. So, football was also a very important topic to discuss during my stay in Ghana. Another topic to discuss was Ghanaian food. I took the effort to try as much of the Ghanaian kitchen as possible and quickly started to have favorites. However, I allowed the opportunity to eat dog meat, a specialty in some Northern parts of Ghana, to pass.

Accra

From Tamale to Accra. From Tamale I traveled to Accra, the capital of the country. In Accra I would join the team of the World Wide Web Foundation who were for a first visit in Ghana on a different project on Mobile Entrepreneurship in Africa.[**] In Accra I had arranged to stay in a student hostel in the city centre with the help of a friend I made in Cape Coast. When the bus from Tamale approached Accra, it was already dark. So I got out off the bus earlier than planned to be picked up by Priscilla, the girlfriend of my friend in Cape Coast. I stayed with her and her sister in their uncle's house in a village on the outskirt of Accra. The next day Priscilla and I traveled further to the city to search for the hostel. Unfortunately, we could not find the hostel and the girl that was my contact did not answer her phone. The Web Foundation team was staying in the Novotel in the center of the city and for logistical purposes I wanted to stay close by. Walking around with Priscilla, I found a small hotel with rooms available for 23 Ghana Cedi and I decided to stay there for the night. The room was very small and there was no running water, but the hotel was clean and at least I had a place to stay.

Accommodation. On Monday the meetings with the Web Foundation started early. From my hotel I walked to the Novotel for breakfast and we all left together from there to the first meeting. After a full day of meetings I finally got in contact with the girl of the hostel and she gave me directions to the hostel. This hostel was only a couple hundred meters across the street from the Novotel, so I could walk back and forth easily. However, this student hostel was by far not as nice and clean as the hostel in Cape Coast. To be frank, I did not dare to touch anything in the room and in the bathrooms, even after we cleaned the room together.

Project: Mobile Entrepreneurship. During this week I got to know the capital Accra better. As member of the Web Foundation team I participated in all the meetings they had scheduled. We talked with potential stakeholders: ICT companies (e.g. SoftTribe, BusyLab, Cisco), business sector (e.g. NCS, GASSCOM), telecom operators (Vodafone), universities (e.g. GTUC, Ashesi University, AAU), professional training institutions (Kofi Anan ICT Center), mobile entrepreneurs (e.g. BSystems, Rancard), students, and NGOs (e.g. IFPRI, Keycredit MicroFinance, Constant Capital). Even though I have no degree in mobile technology or entrepreneurship, I learned a lot from the meetings. The differences between South and North and between city and rural area became extremely apparent in Accra, for example in the level of ICT development in the capital compared to the rest of Ghana. At the same time, I could teach the other members of the team some things about Ghana and Ghanaians in general since I had been traveling the country for a while now. Our program started early in the morning and most days ended late in the evening. One of the sponsors of the project, Vodafone, had provided a car with driver to guide us through the city. This was no luxury in a city with more than three million people trying to make their way through. Accra was very crowded and the atmosphere and the environment were not as friendly as in Cape Coast, let alone the North of Ghana.

[**] See http://www.webfoundation.org/projects/mobile-entrepreneurs/ for this project and a detailed description of our fact finding mission in Accra.

Scenes from the city of Cape Coast.

3. Access to and Use of ICTs in Rural Ghana

Mobile Telephony

Currently (2010), five mobile telephone operators are delivering services in Ghana: Vodafone, MTN, Zain, TiGO, and Kasapa. According to the External Officer of Vodafone Ghana the penetration of mobile telephony in Ghana is 55 percent. This means that 45 percent of the population of Ghana is not subscribed to a mobile telephony network. Figures as these are hard to verify since there is no official, independent data collection center in Ghana. Most figures on mobile penetration in Ghana are based on the number of subscriptions to the different mobile phone operators (see table 1). However, since many people have multiple SIM cards, mobile subscription is different from mobile penetration. The main reason for people to have multiple SIM cards is that telecom providers offer discounts to calls within the network and it is therefore beneficial to buy SIM cards from different providers. For example, in Ghana mobile telephone numbers beginning with 024 and 054 are MTN numbers and MTN offers 5 to 95 percent discount to calls made from MTN to MTN, in different time slots during the night and day. Vodafone also offers a discount for calls between Vodafone numbers ("30 minutes for 30 pesewas").[††]

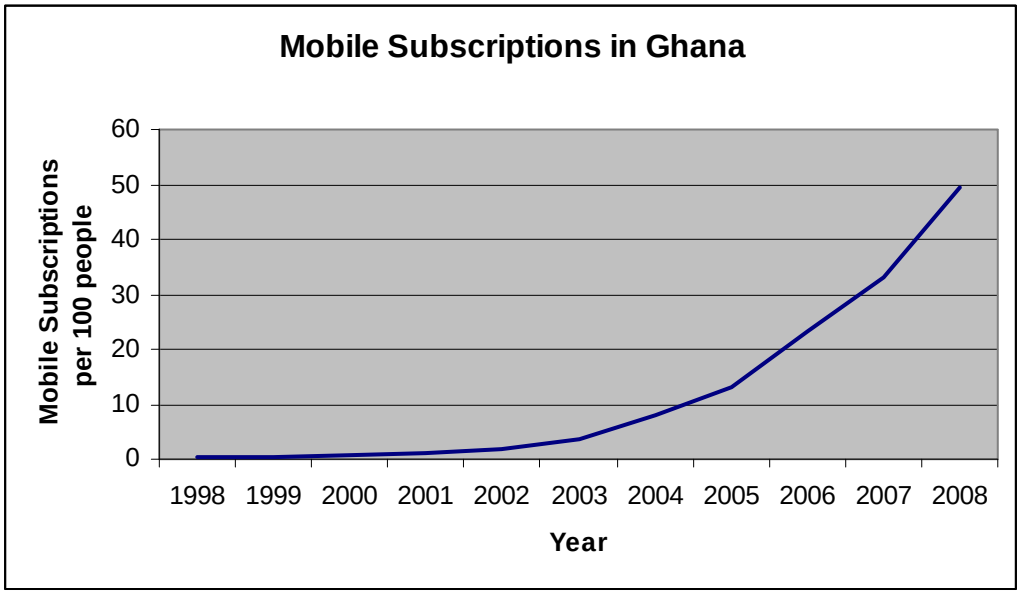


Table 1: Mobile Subscriptions per 100 people in Ghana[‡‡]

The field research conducted for this report shows that there are major differences in mobile penetration between the urban areas and the rural areas of Ghana and between Southern and Northern Ghana. In the urban areas in the South of Ghana, especially in the capital Accra, nearly every person is in possession of a mobile phone with at least one SIM card. In the rural areas in the North of Ghana the situation is different and by far not every person owns a mobile phone. However, it seems that even in the less developed,

[††] The national currency of Ghana is the Cedi (GHS or ₵) which is divided into one hundred pesewas. One Cedi equals approximately 0.70 US Dollar or 0.50 Euro.

[‡‡] Data collected from International Telecommunication Union as provided by Worldbank.

poorest areas of Ghana every person can have access to a mobile phone. For example, in Kaleo, just North of the city Wa in the Upper West Region, it is common that every household owns at least one mobile phone, and there are houses where four or five phones are owned. In the Upper East Region, in the village Kandiga a similar story is told; it is estimated that 90 per cent of the households is in possession of a mobile phone, and people that do not possess a mobile phone will not have trouble with accessing one. The situation is slightly different in the communities that are even further remote, like the village Tankara between Nandom in the Upper West Region and the border with Burkina Faso, where a mobile phone is present in only half of the households. In this village, however, there is no electricity and the network coverage is very poor due to the proximity to Burkina Faso, which makes it less beneficial for farmers to invest money in purchasing a mobile phone.

The mobile phones are used by everyone, from the youngsters to the elderly of the villages. The main purpose the mobile phones are used for is communication. First, contacts with relatives are entertained through the use of mobile phones. Not only for relatives in other villages, but also relatives that live overseas are contacted by mobile phone. Also, within and between the communities the phones are used extensively to communicate with each other, for example to mobilize the chiefs for a meeting or to announce funerals. One of the chiefs in Kaleo tells that mobile telephones are used by farmers to get in contact with Extension Officers for setting appointments. Apart from communication, mobile phones are very helpful in problem solving. When a farmer is having a problem somewhere on his land, he can contact the right persons from there to ask for possible solutions. Or when it is harvest time, a farmer can call his son who is in Kumasi for his education and he can arrive the next day to help harvesting.

The mobile phones are predominantly used for making phone calls. SMS text messaging is being used, but not much. A 2003 study showed that only 3 percent of the sample group had sent an SMS within the last three months.[§§] A 2005 study showed that in major towns almost 54 percent of the sample group sent 1-4 SMSs per week and 11 percent sent 10-14 messages a week.[***] Presently, these numbers are likely to have increased, but there is still relatively little use of SMS in Ghana. The normal way to get in contact with people is to call them on their mobile phone. When meeting a person it is most common to exchange phone numbers to get in contact perhaps later. It is almost rude not to answer your mobile phone, so during meetings it is normal for people to turn away to answer their mobile telephone quickly. And students will call their professor on his mobile phone to ask how long it will take for him to have finished grading their papers, for instance.

Although increasing, SMS is not used as extensively in Ghana as it is in for example Europe. Especially the uneducated adults in rural areas are not used to text messaging. The main reason for this is the lack of education; to make use of SMS one has to be literate. Also, there is little knowledge on how to use the mobile phone for this purpose. Most people in rural communities will have memorized a couple of numbers and know how to dial these numbers to make a phone call. This way, the more complicated saving of contact numbers is not necessary. The use of SMS is an even more sophisticated feature

[§§] McKemey et al. (2003), cited by Boadi et al., "Preliminary Insights into M-Commerce Adoption in Ghana," 257.

[***] Frempong and Stark (2005), cited by Boadi et al., "Preliminary Insights into M-Commerce Adoption in Ghana," 257.

and most people do not know how to send a text message. While adult have difficulties discovering the possibilities of the mobile phone, it seems the youngsters, if literate, will figure out for themselves how to work with the mobile phone. The vast majority of SMSs send in Ghana are therefore send by educated young people. An additional obstacle for the lack of SMS usage is the price of sending text messages. The discounted phone calls make the use of SMS rather expensive for most Ghanaians.

Alltogether, it seems mobile telephones have become rather common and popular –as an employee of the ICT Center of the University of Cape Coast said: "people fancy mobile phones" –and the benefits of mobile telephony are acknowledged by Ghanaians, mainly for social purposes, but increasingly also for business purposes. For example, the farmers in Kandiga, Upper East Region, use mobile phones to get information on prices of crops and cattle on different markets. If, for example, a child of the farmer goes to the market to sell rice or a fowl, the child can call home to ask if the price that is offered is an appropriate price. And the Goziiri in Upper West Region explain they use mobile phones to ask each other about how to effectively use fertilizers. However, these are the only examples given by farmers in rural Ghana on using mobile telephony for knowledge sharing. Knowledge sharing within rural communities is still predominantly done physically. Thus, even though mobile telephones are used to mobilize the Chief and Elderly of communities, the actual exchange of information and knowledge is done in the meetings.

Currently there is a mobile application for farmers in Ghana to get information on the prices of crops on different markets, called ESOKO.[†††] It is an SMS based service where farmers can text a code for the commodity and a code for the market to a certain number. However, none of the farmers interviewed for this report had heard of this application, let alone made use of it. Even stronger, none of the people working on rural development or ICT interviewed for this report knew of ESOKO. Only a few software developers in Accra knew of the existence of the application, mainly because they know the developer of ESOKO, Mark Davies. The unfamiliarity of the application can be partly explained by the fact that the service is rather complicated to use, because of the many different codes that are to be used and, in addition, the service is only available for MTN numbers at the moment.[‡‡‡]

Computers and Internet

As widespread as the mobile phone is in Ghana nowadays, as rare is the owning of a personal computer. According to a research study in 2005, per 1000 Ghanaian inhabitants 5.2 personal computers were owned.[§§§] While the access to computers and the internet is growing, especially among students of whom a significant amount owns a laptop, computers remain absent in rural communities. In the villages visited during the field research not one of the villagers was in the possession of a personal computer. The main reasons for the lack of computers in Ghana are the high costs of hardware, the lack of electricity, the poor internet connectivity, and the lack of knowledge on how to work with computers and how to surf the internet.

[†††] See: www.esoko.com.

[‡‡‡] See Appendix III for an example of the SMS codes used for ESOKO.

[§§§] International Telecommunication Union (2007), cited in Raymond A. Boadi, Richard Boateng, Robert Hinson, and Robert A. Opoku, "Preliminary Insights into M-Commerce Adoption in Ghana," *Information Development* 23 (2007): 253.

In 2002, a forward-thinking ICT strategy ICT4AD (Information and Communications Technology For Accelerated Development) was created in Ghana.[****] From this strategy, policies to roll out the national ICT infrastructure, e-education, and e-governance were developed. However, the implementation of these policies is still lagging behind. The prices of internet access are still extremely high and the speed and stability of the internet connection remain very poor. The main reason for the problems with internet access is the scarcity of competition in the market. The last decade, the state-owned telecom provider Ghana Telecom had the monopoly on internet connection through the underwater fiber-optic cable in the Atlantic, SAT-3, that supplies land-based internet access in Ghana. Controlled by the official national telecom providers of West African countries, this cable has long been the only connection of West Africa to the internet. Only recently, Ghana Telecom (since July 2008 turned into Vodafone Ghana with 70 percent ownership for Vodafone and 30 percent for the Ghanaian government) has given up its monopoly on selling bandwidth in the country and allowed other parties to lay optic fiber cables. In June, 2010, a second fiber cable, the MainOne cable from a consortium of different African investors, reached Nigeria and Ghana from Portugal. A third submarine fiber cable is being laid at the moment by GLO, which is owned by the Nigerian telecom provider Globacom, to increase competition on internet access in Ghana further.

Because of the presence of internet cafés in cities in Southern Ghana, like Cape Coast and Takoradi, and especially in the capital Accra, accessing the internet is relatively easy and cheap. In Tamale, the capital of the Northern region and with 300,000 citizens the largest city in Northern Ghana, the situation is already very different. In Tamale there are around twenty internet cafés that struggle to survive, because their customers are not returning because the internet connection is slow and unstable and sometimes even down for days. The only successful internet café in Tamale is the Vodafone Internet Café, which is three times as expensive as the others (90 pesewas per 30 minutes, while the normal price is 30 pesewas per 30 minutes) but offers fast and stable internet. When asked for the reason for the stability and speed of the Vodafone Internet Café, the manager explains that his café uses a dedicated connection which is very expensive but will transfer data up to 40 Mb per second, while all the other internet cafés use a shared internet connection. The internet cafés acknowledge they are struggling to survive and blame Vodafone for this. They seem to put their hopes on GLO to break the monopoly of Vodafone in the North and make everything better for them.

According to Vodafone, the optic fiber cable derived from SAT-3 ends at Tamale. Beyond Tamale, internet access is even more difficult, expensive, instable, and slow. In Wa, the capital of the Upper West Region of 80,000 inhabitants, there are a couple of internet cafés where it is possible to surf the internet for 50 pesewas per half hour. Internet cafes are having a difficult time of surviving, since the revenues for selling internet time are relatively low and the customer base is not that large. In the even more remote rural villages access to the internet is completely absent. If the Goziiri want to use a computer to surf the internet, they have to go to the nearest town, Nandom, where there is one internet café with six computers and a very poor internet connection. One possibility to access the internet without being dependent on these internet cafés is through mobile phones that support internet access on the telephone. In Ghana there are a number of

[****] More information on government policy on ICT for Accelerated Development can be found on http://www.ict.gov.gh .

people in possession of these high-end mobile phones. These phones are very expensive and most people do not access the internet on the phones, but for the people that do, the high costs of the hardware and the high costs of data traffic are worth it, because now at least they have the possibility to surf the internet. For people that own a personal computer or laptop usage of the 'dongle' is very popular; this is a system of internet connectivity provided by mobile telephone companies to use internet on the computer through the telephone network without having to subscribe to an even more expensive private internet connection.

The dongle is predominantly used by professionals that use the internet for research or business purposes. Sometimes these professionals will visit an internet café that has a fast connection, for example to download larger files. The majority of customers of internet cafés are students that have learned how to use a computer at university or youngsters that taught themselves how to use a computer and the internet. Mostly the internet in internet cafés is used to send and receive emails, to chat with friends via programs as MSN Messenger, and to keep Facebook profiles updated.[††††] Also, internet cafés are used by students to make assignments for courses. At university it is common for lecturers to give assignments that involve searching for information on the internet. Finally, internet cafés are sometimes used by young, starting entrepreneurs that have not enough funding for an office with a computer and internet connection and therefore do their work in an internet café.

Conclusion

An overview has been given of the current situation in Ghana of access to and use of mobile telephones and computers and internet. There appear to be large differences between urban areas and rural areas and between the South and the North. Overall, mobile phones are very popular in Ghana and even in the most remote rural villages every person is able to access a mobile phone. Even though mobile phones are used predominantly for interpersonal communication and not for information and knowledge sharing for business purposes, Ghanaians find that the benefits of mobile phones exceed the costs and therefore are willing to invest in buying a phone. On the other hand, due to a lack of knowledge on how to work with computers and the internet and the high costs of hardware and connectivity, the penetration of computers in Ghana is extremely low. The people that know how to use computers usually go to internet cafés to surf the internet for interpersonal communication purposes and for the obtainment of information for personal, educational, and business purposes.

[††††] The popularity of Facebook is Ghana is overwhelming. In almost all conversations on the use of the internet, the checking and updating of the personal Facebook page and keeping in contact other through Facebook is mentioned as one of most important uses of the World Wide Web.

4. Challenges for the Use of ICTs in Knowledge Sharing

Next, the challenges with regard to using ICTs in knowledge sharing within rural communities in Ghana will be explored. The previous section already revealed problems with the infrastructure of the internet network, illiteracy and the lack of education, and the high costs of hardware and internet connectivity. Apart from these challenges for the use of ICTs in knowledge sharing for rural development, other problems that were identified are the lack of stable electricity and the multiple languages that are spoken in Ghana. After discussing the challenges, a short overview will be given of existing ICT applications for rural development.

Infrastructure and Connectivity

To be able to use ICTs for the dissemination of knowledge within rural communities these rural communities need to be connected. The mobile telephone network covers most of Ghana, but in the most remote rural areas there are some problems with connectivity to the different mobile telephone networks. In addition, because of the competition between the different mobile operators, it is difficult to deploy mobile services that can be used by subscribers of the different networks simultaneously. ICT companies that develop mobile applications based on SMS short codes for instance face severe difficulties obtaining the same short code from all mobile operators; the 'text and win' services ("text 'WIN' to 1900") often only work for one or two mobile networks, which means that subscribers to other networks are not able to make use of the services. Another challenge is the connection to internet in rural areas. At the moment, in rural areas, especially in the North of Ghana the infrastructure is basically lacking for rural people to enjoy the benefits of the internet. The infrastructure is likely to be improved in the future by the arrival of internet providers other than Vodafone (previously Ghana Telecom), but then still the speed and

stability of the internet connection pose a challenge for using the internet as a means for knowledge sharing within and between the rural communities.

Literacy and Education

The next challenge that is faced is illiteracy, the level of education, and the lack of knowledge on how to use mobile phones, computers, and the internet among farmers in rural communities. In 2003, the literacy rate of people in Ghana over the age of 15 was estimated at 74.8 percent.[‡‡‡‡] The majority of illiterates in Ghana can be found in the rural areas in Northern Ghana. In the visited communities most of the elderly farmers did not attend primary school and still some youngsters do not see the benefits of getting educated if they are to be farmers in their adult life. Apart from school education, there is the challenge of educating adults on how to use ICTs. Most of the mobile phones owned in the rural communities belong to young people that have been to the South for education. One adult lady farmer of the Tankara community explains that the lack of knowledge on how to operate the phone is not helping the situation, since the youngsters will take away the phone if you as elderly have done something wrong with the phone and will not let you operate it again. So, for internet and mobile SMS applications, illiteracy among people in rural community poses a severe challenge, but even the knowledge on how to operate a mobile phone is challenging already.

Costs

Generally, the costs of purchasing a mobile phone are not identified as problematic. A proper phone can be purchased for approximately 50 Ghana Cedi, but there are also offers from the telecom providers to purchase a mobile phone with SIM card for 20 or 30 Ghana Cedi (a SIM card can already be bought for 1 Ghana Cedi).[§§§§] For the farmers in the poorest areas of Ghana, the three Northern regions, these costs are a problem for buying a mobile phone, but as described in the previous section all farmers have access to a mobile phone if they want to. Another issue is the costs of buying credit. Even most of the Ghanaians that own a mobile phone only receive phone calls and do not make phone calls themselves. To compare, the average monthly income for a worker in Tamale is estimated to be 200 Ghana Cedi, while some farmers in the rural areas have to come by with 40 pesewas per day.

With incomes as these it is difficult to buy a simple mobile phone, let alone buy a personal computer or a laptop. The students that possess a laptop are most of the times coming from wealthier families and the universities often give discounts on laptops for educational purposes. And even in the possession of a laptop, internet remains very expensive. A home connection to the internet costs around 200 Ghana Cedi a month and even the hardware of the dongle costs approximately 65 Ghana Cedi. The use of internet cafés, if

[‡‡‡‡] United States, Central Intelligence Agency (2006), cited by Boadi et al., "Preliminary Insights into M-Commerce Adoption in Ghana," 257.

[§§§§] The Ghana Cedi (GHS or ₵) is divided into one hundred pesewas and one Cedi equals approximately 0.70 US Dollar or 0.50 Euro. In Ghana many people still refer to money in terms of the old cedi which was depreciated in July, 2007, by a factor 10,000. A boiled egg, for example, currently can be purchased for 30 pesewas or 0.30 cedi, but many people will refer to the price of the egg as being 3,000.

they have a proper internet connection, might be a solution to circumvent the high costs of computers and access to the internet.

Electricity

Another major challenge is electricity. With a customer base of 1.4 million in 2005 it is estimated that 45 to 47 percent of the Ghanaians are connected to grid electricity. This includes 15 to 17 percent of the rural population, although the percentages of access to electricity vary significantly between coastal (27 percent) and forest rural zones (19 percent) and the savannah rural areas in the North of Ghana (4.3 percent).[*****] All of the 138 district capitals of Ghana are connected to the national grid, but it is very expensive to extend the reach of the electricity to the remote rural areas, especially if the villagers of these remote rural areas cannot afford to pay to cover the costs of the grid electricity. Electricity in Ghana mainly comes from hydroelectricity produced by dams in the Volta River. In the late 1990s thermal plants have been built to help supply the increasing demand for electricity. The growing demand and shift from hydroelectricity to thermal electricity have driven up the prices of electricity in Ghana.

All together, Ghana has a relatively stable electricity network. Compared to the average of access to electricity in West-Africa of less than 20 percent, Ghana is performing rather well with its 45 to 47 percent. Although electricity is named frequently as problematic when discussing ICTs for rural development, the lack of electricity seems not to be the major issue by farmers in rural communities for the use of mobile telephones. In Tankara where there is no electricity, one needs to travel to the near town of Nandom or to a next village to charge a mobile phone. Often people will use generators or car batteries to charge the batteries of their mobile phones. Recently, some initiatives have started to use solar power for electricity in rural areas. In Tamale a company called Best Solar sells solar chargers with which one can charge different mobile phones but also mp3-players and photo cameras for approximately 25 Ghana Cedi. The development of solar power started only recently in Ghana and barriers are the costs of the solar panels and the fact that technologies for the storage of solar energy are not sufficient at the moment.

Language

In Ghana ten languages are officially recognized: Twi, Fante, Nzema, Ga, Adangbe, Ewe, Gonja, Kasem, Dagbani, and Dagaare.[†††††] Apart from these ten official languages, a substantial number of other languages and dialects are spoken in Ghana. Especially in the North of Ghana many different indigenous Ghanaian languages are found. The exact number of languages spoken in Ghana depends on the definition one uses for 'indigenous language'. Adams B. Bodomo, who has done research on the indigenous languages spoken in Northern Ghana, has classified ten major language groups in Ghana and names

[*****] Resource Center for Energy Economics and Regulation, "Guide to Electric Power in Ghana", retrieved from: http://www.beg.utexas.edu/energyecon/IDA/USAID/RC/Guide_to_Electric%20Power_in_Ghana.pdf .

[†††††] Charles Owu-Ewie, "The Language Policy of Education in Ghana: A Critical Look at the English-Only Language Policy of Education," in: *Selected Proceedings of the 35th Annual Conference on African Linguistics*, ed. John Mugane et al. (Somerville, MA: Cascadilla Proceedings Project, 2006): 77.

61 languages and dialects, to which he refers to as being "some of the individual languages and dialects under these groups".[‡‡‡‡‡] The ten languages that are chosen to be official languages in Ghana do not represent the ten regions of Ghana. The most widely spoken language in Ghana is Akan, under which Twi and Fante are classified. In Northern Ghana, Hausa –although not an indigenous language –is spoken by large number of people and generally seen as the language used for trade. At the Ghanaian Language Department of the University of Cape Coast it is estimated that half of the population of the three Northern regions subscribes to Islam and therefore will speak Hausa.

Since English is the official language in Ghana, all people that have attended school are familiar with the English language. This means that uneducated people are not able to speak or understand English. Because of the many different languages and dialects, especially in the more remote rural areas in Northern Ghana, language poses a challenge for the dissemination of knowledge among farmers in rural communities. To communicate with the farmers in the communities visited for this research, interpreters and translators were used, even by staff of the University of Development Studies. However, most of the Ghanaians interviewed for this research did not see the many Ghanaian languages as a barrier for sharing knowledge for rural development. For example, radio stations in Tamale broadcast programs for farmers in different languages at different times during the day. The farmers that want to listen to the program will know what time to tune in to be able to listen to the language of their choice.

Existing ICT Applications for Rural Development

Currently there are a few mobile services such as mobile banking, mobile payment, and text and win promotions available in Ghana. However, "there are no unique mobile interfaces and applications such as browsers and mobile operating systems designed for any of the networks. The few service models are developed to use the basic SMS functionalities".[§§§§§] With regard to rural development, one available ICT application is ESOKO (formerly Tradenet) which allows farmers and traders to receive market information and make trade negotiations with other African farmers and traders via SMS. All together, the supply of ICT applications and services is very limited in Ghana and focuses on SMS-related service models. At the same time, the available services are not well-known by Ghanaians. The people interviewed for this research that knew of the existence of for example mobile banking, did not use the service themselves.

For the Forum for Agricultural Research in Africa (FARA) an "Inventory of Innovative Farmer Advisory Services using ICTs" has been made.[******] In Ghana a number of initiatives have been taken to use ICTs for rural development. The International Institute of Communication and Development (IICD) based in The Hague, the Netherlands, has been involved in some pilot projects in Ghana in recent years. One example is MAPRONET (Market Access Promotion Network), a project that used the Tradenet/ESOKO platform to

[‡‡‡‡‡] Adams B. Bodomo, "On Language and Development in Africa: The Case of Ghana," *Nordic Journal of African Studies* 5, no. 2 (1996): 35-38.

[§§§§§] Raymond A. Boadi, Richard Boateng, Robert Hinson, and Robert A. Opoku, "Preliminary Insights into M-Commerce Adoption in Ghana," *Information Development* 23 (2007): 256.

[******] See: http://www.fara-africa.org/media/uploads/File/NSF2/RAILS/Innovative_Farmer_Advisory_Systems.pdf.

try to improve market access for farmers.[††††††] The inventory of innovative farmer advisory services gives a long list of projects trying to improve information for farmers in Africa, but the majority of the projects was in the pilot phase and is not followed up. Once the pilot has ended the special conditions set for the pilot project are withdrawn, as are funds, and the projects are not replicated. Therefore, sustainability of a project is a challenge for using ICTs for information and knowledge sharing within rural communities.

5. Stakeholders in ICTs for Knowledge Sharing

In the previous section the different challenges of using ICTs for rural development were discussed: the issues with infrastructure and connectivity in rural areas, illiteracy and low levels of education, the high costs of ICTs, the lack of electricity, the many languages and dialects spoken in Ghana, and the difficulty of developing sustainable ICT applications. In this section the role of different stakeholders in supporting the process of ICT service delivery to rural communities will be handled to be able to give recommendations for the Web Alliance For Regreening Africa (W4RA) Project in the following section.

Universities

Evidence-based research conducted by universities and research institutions is often used to develop and to support government policy on development. It is common for Ministries to give research institutes the assignment to do research into a specific topic in order to base developing policy on that research. In addition to the government, also private companies and NGOs make use of the research done by universities. However, many researchers feel that the linkage between research outcomes and policy implementation is disconnected. The research outcomes are used by the government as a basis for policy development, but the developed policies are often not implemented successfully. Apart from conducting scientific research, universities could be helpful in reaching out to the targeted communities to support the implementation of policies with regard rural development, since they already have a lot of knowledge of and connections with the rural communities.

Non Governmental Organizations (NGOs)

The role of NGOs in rural development in Ghana is twofold: on the one hand, the people are dependent on the contribution of NGOs for basic needs to survive as relief aid and health care, on the other hand, NGOs often do not reach the goals they have set out for themselves and leave a community without having made a difference in the life of the people –as a professor at the University of Cape Coast referred to the work of NGOs as "bread and butter projects": ad hoc, short-term, and not sustainable. Ghanaians seem to have little faith in NGOs. They see NGOs as organizations that pretend to have the Ghanaians in mind first, but in reality primarily provide for themselves. Often the picture is sketched of a couple of white people driving around in brand new, air-conditioned, four-wheel-drives that come around to set up a project of which most profits disappear in their pockets instead of ending up in the targeted community.

However, there are a number of NGOs that are respected by the Ghanaians for the work they do for and in rural communities. **CARE International** is an NGO that has the

[††††††] See: http://www.iicd.org/projects/ghana-mapronet.

mission to reduce poverty in rural areas, especially among women. They have partnerships with local NGOs, the Ministry of Food & Agriculture, and the University of Development Studies. Besides relief aid, CARE International is working on the implementation of agricultural policies that benefit farmers in rural areas. For this organization the farmers themselves are central and the idea is to cooperate with different facilities to achieve an interdisciplinary way of working. In the projects, all different stakeholders are tried to be involved to achieve the best result possible, but participation obviously is on voluntary basis. One of the things CARE International is occupied with is the training of "Community Based Extension Workers" to let Ghanaians teach themselves on indigenous knowledge on farming to improve the lives of the farmers. Communication and knowledge sharing are major issues in projects as these.

Another NGO that works with farmers in rural communities is the Association of Church Development Projects: **ACDEP**. The agriculture program of ACDEP focuses on sustainable livelihood, so on knowledge sharing about farming, crops, and cattle for rural households. Market access and the involvement of farmers in the value chain is a second major topic within agricultural programs to reduce poverty among farmers. This NGO already works with IICD (International Institute of Communication and Development, based in The Hague, Netherlands) on a project to establish multi-media information centers to build capacity for farmers on the ground. Through this project, links are also made with GINKS (Ghana Information Network for Knowledge Sharing) and the problems faced are mainly with technical assistance and funding.

A third NGO that is active in the poorest rural areas of Ghana is **World Vision**. In the Talensi district in North Ghana this NGO is working on a pilot project on Farmer Managed National Regeneration (FMNR) and the idea is to let farmers exchange knowledge amongst themselves to improve the soil and thereby the revenues for the farmers. Recently farmers in the pilot have made a journey to Burkina Faso to share knowledge on farming techniques with farmers there. Even though the pilot has started only last year, it already is successful since the farmers are encouraging non-pilot farmers to use the techniques they have learned about in the project. A fourth NGO mentioned positively a number of times, is **ActionAid**, but at the moment no contact has been made with this organization yet.

ICT Service Providers and Software Developers

For the development of ICT applications for purposes of communication and knowledge sharing within rural communities in Ghana it is important to include local ICT service providers and software developers, since they have knowledge of the needs of the farmers in the rural communities. Unfortunately, outside the capital Accra and the city of the technology university Kumasi it is difficult to find ICT service providers and software developers that actually occupy themselves with providing and developing ICT services. In Tamale a number of software developing companies are registered, but since there is no demand for the developing of software, most of these companies are currently engaged in the selling and/or repairing of hardware. The expertise for providing ICT services is present, for instance in the Tamale-based IT solutions company Dataworks Ghana Limited, but not organized as for example software developing companies in Accra are in GASSCOM (Ghana Association of Software and IT Services Companies).

Agricultural Extension Officers

A large amount of the information that reaches farmers at this moment is provided by Agricultural Extension Officers. In Ghana the ratio from extension workers to farmers is estimated to be 1 to 2000, but in recent years the number of Agricultural Extension Workers has been going down, while the numbers of farmers is growing. This means the role of the extension workers in the dissemination of knowledge within rural communities is diminishing. The use of ICTs to support the work of the Extension Officers might be beneficial for the development of the agricultural sector. The Department of Economics and Extension of the University of Cape Coast is doing research on the influence of ICT in rural development, but since Extension Officers in general are very low-educated and the level of illiteracy among farmers in rural areas in Ghana is high, knowledge sharing via the internet or SMS-based mobile applications is challenging.

Radio Stations

Most radio stations in rural Ghana devote airtime to reach out to farmers and educate them on for example farming techniques or newly introduced crops. **North Star Radio** in Tamale (92.1 FM) for example has special programs for farmers aired in five different languages. The broadcasting times are early in the morning and late in the evening, because during the day farmers will be out on their land to work. Every month the staff goes out on field research to gather information on agriculture and listen to the comments of farmers on previous shows and the issues and problems they are facing, so this information can be tackled with in a next program. Often, professionals are invited to discuss certain topics in the studio. This radio station gets a part of its funding from a fertilizer company. **Radio Savannah GBC** (91.25 FM) is a government funded station that broadcasts many development programs, not only for farmers but also targeted at women or children. "Social airtime" is sold to organizations that want to have a program on social development.

Radio is a very effective tool to reach out to farmers and disseminate information and knowledge. A small radio set costs 12 Ghana Cedi and the strong sense of communalism within Ghanaian farmer communities makes that farmers will group together to listen and discuss the program and sometimes call in to share their comments. The effectiveness of radio is the reason why NGO WorldVision buys up airtime from local radio stations for the FMNR pilot project to broadcast discussion programs, messages from chiefs, and radio drama. However, buying up airtime is very expensive and WorldVision is only able to broadcast because of the subsidized fee it has to pay to the radio stations.

Internet Cafés

Because they provide computers and an internet connection, internet cafés are of influence to knowledge sharing in Ghana. Without internet cafés the vast majority of Ghanaians would not be able to access the internet. Yet, a minimum level of literacy and education is required to make use of the services of an internet café. The internet cafés in the remote rural towns often also provide ICT lessons for customers to learn how to operate a computer and how to surf the internet. In the larger cities in rural Ghana, ICT lessons are not provided by internet cafés, but by specialized ICT training centers. For example in Tamale, there is one ICT training center where weekly trainings on computer and internet use are given at a charge. In general, internet cafés will assist new customers

that are experiencing difficulties with obtaining information on the internet or using email services.

Government

Obviously, the Ghanaian government plays an important role in the development of the country and in rural development in particular. However, the role of the government in development is ambiguous; on the one hand, the Ghanaian government develops good policies to stimulate development and the opportunity for ICTs to contribute to development, on the other hand, these policies are not implemented successfully by the government. The lack of funding, bureaucracy, corruption, but especially rivalry between the two main political parties can be identified as being obstacles for development in Ghana. The lack of funding for example makes it difficult for government officials to pursue ICT policies while there are people dying of starvation in the country.

The rivalry between the two main political parties, the NDC (National Democratic Congress) of the current President John Atta Mills and the NPP (New Patriotic Party), stagnate implementation of policies. Every five years there are government elections in Ghana and there is fierce competition for votes. In the remote rural areas, where people are struggling to survive and are not educated, politicians will come and hand out money to secure votes in the next elections. After a change in government, the policies formulated and partially implemented by the previous government, that is the other political party, are abolished, whether or not it are good policies. For example, the previous government in Ghana introduced the policy that all children get a warm meal at lunch time when attending school. This promoted school attendance and helped the nutrition of children of poor families. After the change in government, this policy was abolished when the rivaling party came to power. Nowadays children receive a school uniform to stimulate them to come to school.

6. Recommendations

As shown in the previous chapters, there are a number of challenges for a project to support the development of ICT services and applications for purposes of communication and knowledge sharing within and between rural communities in Ghana. Below recommendations are given for W4RA to be as successful as possible in achieving its goal of improving the livelihood of farmers in rural Ghana.

The field research conducted for this report has shown that Ghanaians and perhaps Africans in general are rather hesitant towards projects initiated by Western [white] people to help develop the country. In the framework of W4RA a first legitimate question therefore is whether farmers in rural communities are interested in sharing knowledge with other farmers to improve their livelihoods and revenues. Some of the interviewees suggest that it might be the case that farmers are not interested in growing more crops or getting a better price for them, for example because they only cultivate land to feed their own family. However, when discussing the focus on local content, involvement of relevant stakeholders and inclusion of the whole community, especially in combination with using mobile telephones to benefit farmers in rural areas, people turn around and get interested in W4RA.

The significant differences in Ghana between urban and rural areas and between the North and the South mean for rural development that the concept of 'local content' differentiates not only between Western content and Ghanaian content, but also within Ghana content is differentiated. To address the farmers in the poorest, remote rural areas of Ghana, a software developing company based in Accra will not have the same input as a software developing company from a rural area. Since there are very few ICT service providing companies in the rural areas of Ghana, it is perhaps possible to form a group of software developers from and around the city Tamale that together will have a proper understanding of the local situation for farmers and the technological skills to develop ICT services targeted at rural development.

It is recommended to stimulate these ICT service providers to develop ICT applications on rural development and to support them in this process. Since many projects on ICT services are not successful in the long term, the sustainability of a developed ICT application is essential if the project wants to be effective for the livelihood of Ghanaians. By developing a set of tools within W4RA that can be used by ICT service providers and software developers to develop new ICT applications and services, the project will be able to have an impact in the long run. In order to make a profitable ICT application it might be an idea not to focus directly on the farmers in rural areas, at least at first. As shown in this report, there are many challenges that need to be dealt with before farmers themselves are able to use ICT applications and benefit from them. It might be more effective to target the farmers indirectly through intermediate channels. The development of ICT applications for communication and knowledge sharing that Agricultural Extension Officers and NGOs can work with could be a good starting point.

The livelihood of farmers in rural communities is likely to improve most from the W4RA Project if the farmers are targeted through different channels. The recommendation here is to make use of the already existing networks of communication and knowledge sharing

in Ghana. Apart from the Agricultural Extension Officers and NGOs working with rural farming communities, a proper intermediate channel could be radio stations. Radio stations are imbedded in the transfer of knowledge towards farmers because of their large listener base among farmers and their programs on farming. In addition, universities, for example the University of Development with branches in Tamale, Wa, and Navrongo, are a good channel to reach out to rural communities for educational purposes. On a different level, it is recommended to include the Ghana Information Network for Knowledge Sharing (GINKS) in the project. Through the coordinator, Ibrahim Inusah, a large and extensive network of Ghanaians working on information and knowledge sharing through ICTs can be reached.

Next to using intermediate channels to target farmers in rural areas, it is recommended to deploy different ICT services and applications within the framework of W4RA and beyond. The World Wide Web is a fantastic medium for communication and knowledge sharing and web applications can use the audiovisual component to disseminate knowledge on for example farming techniques. However, at the moment the internet is only used by literate, educated people and the access to computers and an internet connection in Ghana is challenging. Apart from making web applications accessible through a mobile phone, it might be an idea to set up a physical location in the form of a resource center for farming that Extension Officers and farmers can visit to access the internet and watch videos. The popularity of mobile phones in Ghana gives opportunities to roll out mobile ICT applications successfully. Text based mobile applications are a possibility for literate Extension Officers and farmers, for example to get an overview of market prices of crops. Voice based mobile applications are easily accessible for farmers, feel natural to the farmers, and can circumvent the challenge of language differences and illiteracy.

In conclusion, there are opportunities for W4RA to have an impact on the livelihood of farmers in the rural areas of Ghana, even –or perhaps especially –after the project has ended. The recommendations in this report are to develop a set of tools that Ghanaian ICT service providers and software developers can use to develop ICT services and applications, to focus on deploying different ICT services and applications for different users and purposes, and to use different intermediate channels to improve the lives of the farmers in rural communities.

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[18] Example of SMS Codes for ESOKO, source: ESOKO (http://www.esoko.com/?co=country#sid=115;m=sms).

Code	Commodity
Cereals	
CRNW	Corn (White)
FONI	Fonio
MAIF	Maize (Flour)
MAIY	Maize (Yellow, Grain)
MAIZE	Maize (White, Grain)
MILA	Millet (Sounna, Grain)
MILF	Millet Flour
MILO	Millet (Sanio, Grain)
MILT	Millet Finger
RICI	Rice (Imported)
RICL	Rice (Local)
SORR	Sorghum (Red, Grain)
SORW	Sorghum (White, Grain)
WHEG	Wheat Flour
Agroinputs	
AMIN	2,4-D Amine (720g/l)
CYRN	Cypermethrin(50g/l)
GLYP	Glyphostate(360g/l Or 480g/l IPA)
LAZN	Atrazine(500g/l)
MZEB	Mancozeb (80%)
PNIL	Propanil (35% W/w)
PPNL	Propanil(260g/l)+2,4 D-Isoctyl Ester (175g/l)
PQUA	Paraquat (200g/l)
SAZN	Atrazine(800g/l)
Livestock	
BEBG	Berlier BaliBali (Gros)
BELG	Bélier
BELM	Bélier (Moyen)
BELP	Bélier (Petit)
BEUG	Boeuf (Gros, +450 Kg)
BEUM	Boeuf (Moyen, 350-450kg)
BEUP	Boeuf (Petit, 300-350 Kg)
BOUG	Bouc (Gros)
BOUM	Bouc (Moyen)
BOUP	Bouc (Petit)
BULA	Bull (Live, 5-8 Yrs)
BULY	Young Bull (Live 3-4 Yrs)
CHEG	Chèvre (Gros)
CHEM	Chèvre (Moyen)
CHEP	Chèvre (Petit)

Code	Market
ABOA	Aboabu
ACHI	Achiase
AGBO	Agbogbloshie
AGON	Agona Swedru
AODA	Akim Oda
AKNO	Akwapim North
AKSO	Akwapim South
AKSO	Akwapim South
AKSO	Akwapim South
AKYS	Akyem Swedru
AMSM	Amasaman
ANYA	Anyaa Market
ASAF	Asafo
ASAN	Asankragua
ASEN	Asenema
ASHA	Ashaiman Main Market
BTMA	Bantama
BAWK	Bawku
BKUM	Berekum
BERK	Berkwai
BIMB	Bimbilla
BOLE	Bole
BOLG	Bolgatanga
CTMK	Central Mkt
DAMA	Damango
DANS	Dansoman Main Market
DODZ	Dodze
DONK	Donkorkrom
DORM	Dormaa
EJUR	Ejura
ELMI	Elmina New Market
ELB	Elubo
GOAS	Goaso
HOHO	Hohoe
HOMU	Ho/Kpotoe
HUNI	Huni Valley
JAKO	Jakoban
JAPE	Japekrom
JIRA	Jirapa
KSHI	Kaneshie
KSHI	Kaneshie

Code	Currency
AFN	Afghanistan Afghani
GBP	British Pound
BIF	Burundi Franc
XOF	CFA Franc BCEAO
EUR	Euro
GHS	Ghana Cedi
KES	Kenyan Shilling
MGA	Malagasy Ariary
MWK	Malawi Kwacha
MZN	Mozambican Metical
NGN	Nigerian Naira
RWF	Rwandan Franc
ZAR	South African Rand
SDG	Sudanese Pound
TZS	Tanzanian Shilling
UGX	Ugandan Shilling
USD	US Dollar
ZMK	Zambian Kwacha
ZWD	Zimbabwean Dollar

Code	Country
AFG	Afghanistan
BEN	Benin
BFA	Burkina Faso
CMR	Cameroon
GHA	Ghana
CIV	Ivory Coast
KEN	Kenya
MDG	Madagascar
MWI	Malawi
MLI	Mali
MOZ	Mozambique
NGA	Nigeria
SDN	Sudan
TGO	Togo

[19] Map of Ghana. Source: United Nations (http://www.un.org/Depts/Cartographic/map/profile/ghana.pdf).