

ICT for Basic Service Delivery - Case Study: Water Sector in Uganda

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Abstract

To be completed

1 Background, research hypotheses and objectives

Should include defined and justified objective (point2), problem definition (point3) and a short introduction of project description (point4) and the institutional framework and partnership (point9)

(Simon: I added two temporary list just for myself)

Temporary: Bigger Picture

1. Provide better water service through mobile ICT in rural Uganda
2. Collect data (context, location, text) from mobile users in rural Uganda

Temporary: Objectives

- (i) an analysis of the current situation (who are the people using phones, current phone penetration and usages, barriers to usage, type of phones used, frequency of ICT communication, forms of communication related to water issues)
- (ii) the design of the communication channels to provide the bottom-up information on water: nature of the message (sms, mail, voice), the language used, the actions required (forms, dialed-in choice selection, special number-to-action, voice messengers)
- (iii) the design of the response with the same problems and criteria as for (ii)
- (iv) the ability to test for the information effectiveness and efficiency of the different response/feedback solutions proposed
- (v) the ability to test for some social incentives, through peer pressure or some forms of "gamification"

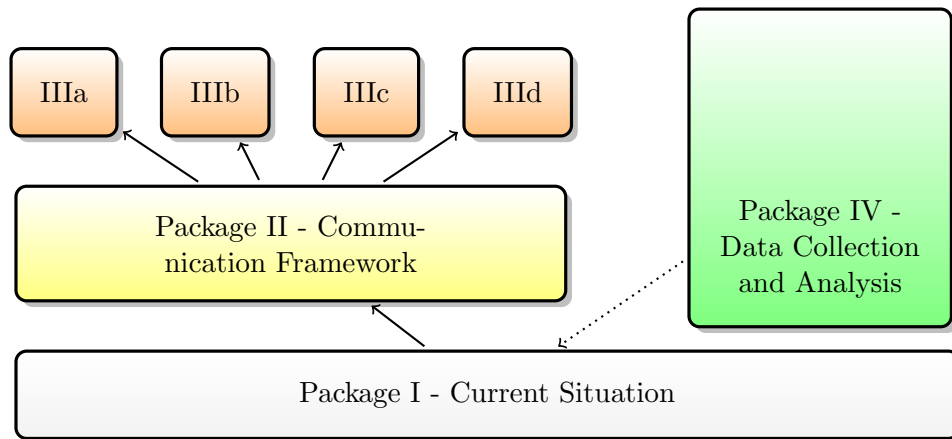


Figure 1: Research packages hierarchy

2 State of research in the field

Should cover state of research and references (point3), and innovativeness of research/ research methodology (point4) + corresponding logical framework (whatever that is)

(Simon: To Do)

- jana formerly txteagle
- FrontlineSMS
- RapidSMS
- ushahidi
- h20initiative
- rwsn.ch
- m4water.org
- waterpointmapper.org

3 Methodology

3.1 Methodology

Should give in full details the methodology to be used (point4)

Champanis and Rivett [5] state:

“Based on our experience and focus on rural environments, our approach to ICT development has been that the investigation of the local context and solutions responding to local needs are more valuable and sustainable than a

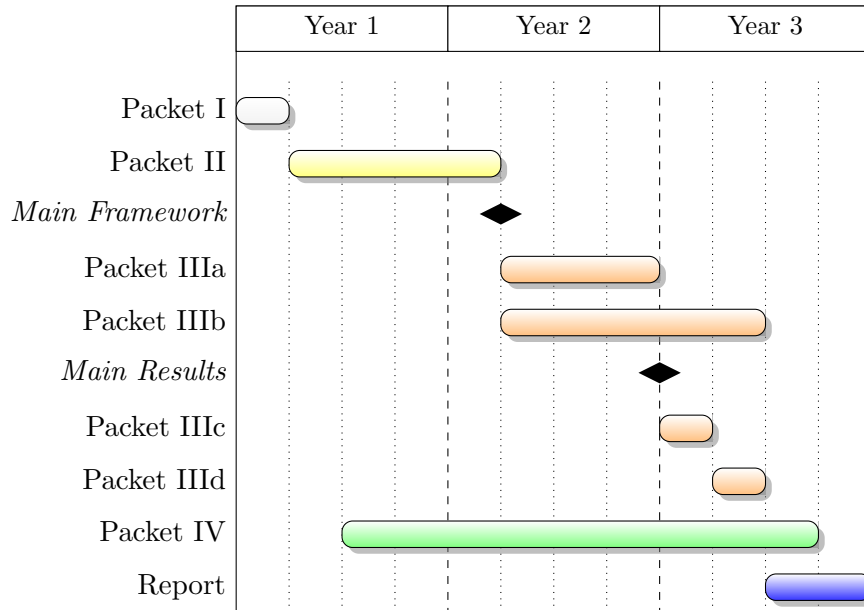


Figure 2: Workplan

general one-size-fits-all design. Whilst this speaks against the notions of scalability, which is usually a desired outcome for IT solutions, we believe that rural and under-resourced environments require a more detailed and customised solution.”

A set of research packages is presented that allows to build up a well tailored but still scalable solution that - beside of helping people directly - gives space to investigate on research relevant questions in the field of computer science and further sociology, development aid and economics.

Figure 1 explains the research packages hierarchy: The small Package I analyses the context. In Package II the main framework for future project plug-ins is designed. The actual scientific part from a computer science perspective is done in Package III whose subpackages can be implemented individually. Package IV is a parallel ongoing process that profits from improvements in Packages I&III.

Package I: Analysis of the current situation

Goal Get an overview of mobile ICT usage and water management in rural Uganda

Method In the field of mobile ICT information is aggregate from cooperation with governmental institutions, local service provides and by detailed literature study:

1. Distribution of cell phones (by model, user age, area)
2. Usage distribution (by time, frequency and service)
3. Analysis of finances (income per user, cost of different services per user, money spent for different services per user)

4. Analysis of technology (cellular network standards, cell sizes, user per cells, quality of service, future investments, availability of electricity)
5. Analysis of hindrances for a more frequent usage (finances, easy of use, illiteracy, privacy concerns)

In the field of drinking water additional input comes from partnership with local NGOs.

1. Analysis of the drinking water need amongst population and its challenges
2. Further data will be collected during the project as a result of Package IV

Package II: Design of a communication channel

Goal Design a inter-user communication channel that is user friendly, low-cost, reliable, secure and information rich

Method A first substep evaluates different communication channels. Text-, graphical- and voice based methods are compared on different generations of phones. Depending on their connection standards (GSM, GPRS, 3G) and application platforms supported (SMS, Java Me, Android) best possible options are chosen. Challenges occur in the following areas:

- Low cost feature phones (“a modern low-end mobile phone that is not a smart phone” [Wikipedia]) are widely available in Uganda. Their drawback is that software has to be implemented manufacturer depending and in general allows just limited functionality [5].
- Access to provider data (calls with user id, text messages, cell info) is difficult to obtain. A possible solution is to use just mobile data services and transfer messages based on an extra developed service.
- Literacy rate of Uganda is around 66 percent [Wikipedia]. Tailored solutions for illiterates have successfully been implemented [4]. By developing special input methods, one has to be aware that a very important reason for people to buy a phone is due to its associated status and not its features [7].
- Low cost transmission is necessary to achieve a high user participation. Prices for SMS make up a higher percentage of the monthly budget than in high income countries. An alternative approach is to provide hardware and airtime to selected user group in order to conduct studies.
- Free hardware and airtime is likely to be misused. Champanis and Rivet report that “Users would fill up the phone with music and video downloads” [5] to an extend that it is not usable for the experiment anymore.
- User trust and information security is one of Africas biggest challeng, this due to weak privacy laws, user awareness, political instability and not maintained software [6].

In a second substep we analyse the information flow needed to provide a water quality information and monitoring network. The implementation (third substep) completes Package I. To the moment it remains an open question if a self designed device for data transmission over the mobile network would fulfil this purpose even better than a cell phone based service.

The success of such an system is unpredictable. Hence we suggest an iterative approach based on trial and error method. Lessons learned from other projects are considered and results reported to the community.

Package IIIa: Quality control

Goal Achieve high quality information collected at a centralised agent but also sent to individual receivers

Method According to [2] supervised and unsupervised machine learning methods are feasible to classify manually generated data in health surveys in Tanzania and Uganda. Widely used machine learning algorithms could be modified in order to not just classify but rather rate user message according to a scale of trust. Additionally the knowledge of the crowd is used to label messages and hence a supervised learning on initially unlabelled data is performed - similar to a supervised spam filter. Out of this, a general trust giving and learning (human and machine based) distributed network could be generated.

This contains the following areas of risk:

- The reported lack of data quality in surveys in low income countries could also be the result of the normally used top-down approach [2], whereas a bottom-up approach (where users have a personal interest on the quality of the data) might not even, or at least less face this problem.
- The question resides if a machine learning solution for such a difficult task is an actual benefit for a country where human workforce is cheap (and jobs needed) and technology expensive. We would not be surprised if a mixed solution - highlighting suspicious messages machine- and final classification human based - might be the best solution.

Package IIIb: Context analysis

Goal Gather context data of users and messages and provide information accordingly

Method Four different fields of study can be divided:

User context Albeit low cost feature phones provide just limited sensor functionality, they allow nevertheless access to basic context information like position (cell site or GPS), time and number of contacts (address book). Out of this, additional contextual information like weather condition can be added.

Message content and context To get a meaningful information transfer on water quality between humans and a machine it is mandatory to understand the content of a message either by the use of a specific questioning and answer mechanisms (e.g. input form) or by mining data out of generic messages. Later is current field of

research, e.g. in the area of text messages [1]. This gives a high degree of freedom to test, redesign and evaluate state of the art algorithms. Once functioning methods are available, they can be used as well to support subfield one (User context) by mining additionally user context information out of the exchanged messages.

Context information provision Having filtered data, most relevant information is provided to the users (e.g. closest working water source, closest available mechanic, water shortage in specific area, water preparation information). The task is either done by a machine- or human agent for which a specific interface would be designed.

Contextual information presentation The gained context information can be used to present the information in more readable way, e.g. by using specific graphics.

Risks in this package are low since goals and functionality are scalable depending on success of basic experiences.

Package IIIc: Water mapping

Goal Map water status information on the web

Method Together with local partners¹, an interface is designed that allows spacial mapping of water information on a web platform.

Package IIIId: Incentives and gamification

Goal Analyse methods to get more user participation

Method The so far described intelligent network is improved by testing and comparing different incentives and gaming approaches. Knowledge from Package IIIb is used to create social incentives. Comparative studies similar to [3] are performed.

(Simon: @Jonathan: Maybe you can add here some content, this is definitely not (yet) my field of expertise)

Package IV: Data collection and analysis

Goal Use the built system to collect data and improve it accordingly

Method

- If successful, the platform from Package II and the modules from Package III provide a large amount of data that can be used even outside the scope of the water sector and computer science. Data accumulation is a parallel ongoing process from the beginning of Package II.
- The interface to a centralised human agent (introduced in Package IIIb) can be used to conduct surveys for cases where the data accumulated from the bottom-up network does not provide the necessary information.

¹<http://www.spacialcollective.com>

- Information collected on water access (average distance travelled for water access, pump durability, water well users profile) can be used to improve Package II&III.

3.2 Chances and risk associated with selected methodology

Critical assessment of chances and risks (points8)

(Simon: Is actually included already in Section 3.1, i.e. merge Section 3.1 and 3.2)

4 Organization

Should describe in details the institutional framework and the partnership, explaining the contribution of all involved partners (point 5). Clear presentation of the supervision and backstopping (point 6).

5 Expected results

Expected results and strategy for their implementation (method or product to be developed and its relevance to end users) (point9)

6 Budget

Detailed budget for each year of the scholarship, differentiating all funding sources including those of the ETH chair and partner contributions (financial or in-kind) (point10)

References

- [1] Charu C Aggarwal and ChengXiang Zhai. *Mining text data*. Springer, 2012.
- [2] Benjamin Birnbaum, Brian DeRenzi, Abraham D Flaxman, and Neal Lesh. Automated quality control for mobile data collection. In *Proceedings of the 2nd ACM Symposium on Computing for Development*, page 1. ACM, 2012.
- [3] Sean M Blaschke, Peter P Carroll, Daniela Rojas Chaves, Michael G Findley, Madeleine C Gleave, Robert N Morello, and Daniel L Nielson. Extrinsic, intrinsic, and social incentives for unicefs crowdsourcing development information in uganda: A field experiment.
- [4] D. Brown, G. Marsden, and U. Rivett. Water alert!: using mobile phones to improve community perspective on drinking water quality in south africa. In *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development*, pages 230–240. ACM, 2012.
- [5] M. Champanis and U. Rivett. Reporting water quality: a case study of a mobile phone application for collecting data in developing countries. In *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development*, pages 105–113. ACM, 2012.

- [6] Seymour Goodman and Andrew Harris. The coming african tsunami of information insecurity. *Communications of the ACM*, 53(12):24–27, 2010.
- [7] H. Knoche and J. Huang. Text is not the enemy-how illiterates use their mobile phones. In *NUIs for New Worlds: New Interaction Forms and Interfaces for Mobile Applications in Developing Countries-CHI2012 workshop*, 2012.