Further Expanding "Marcedi":
A crop price information application for market participants in rural Ghana

ICT4D

Group 12

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Abstract— In this paper, a second expansion of a voice application primarily designed for farmers in Ghana named Marcedi is discussed. Users can access information about the current market prices of crops on several different markets using only a cell phone. This system proposes solutions to the current problem that farmers in Ghana face who do not have access to convenient and time efficient market price information.

I. INTRODUCTION

When focusing research and practical efforts related to the field of information and communication technology on developing countries, this usually falls within the domain of ICT4D. ICT4D is a relatively young field of study which is concerned with global development and is more often than not targeting the least well off in the societies living in these developing countries (Walsham, 2017).

A developing country facing several socio economic challenges is Ghana. Poor healthcare facilities, high unemployment rates, rising economic- and gender inequality and troubling poverty levels are a few examples of these challenges (Graham, 2016). Even as Ghana, and West-Africa as a whole, has shown positive GDP growth on an annualized basis for several years, this economic growth did not translate to a significant reduction in poverty levels in the region (World Bank, 2018; WATTnet, 2016). In 2016, the Institute for Economic Affairs in Ghana reported results from a survey among 1500 young respondents in Ghana which showed that poverty is perceived as being among the top three issues facing the country today (IEA, 2016). Ghana has, however, also been described as 'the rising star' in West Africa by a report released by the Overseas Development Institute, but this title was later criticized by economists and rewritten as 'the rising star of inequality'. This explains the relation between the fact that poverty levels have remained virtually unchanged while GDP has risen consistently over the past two decades.

One of the key targets for inclusive development as set out by the think tank network in West Africa is the development of regional trade. Regional trade allows countries to benefit from trade efficiency rules, exploit economies of scale and integrate and possibly start benefiting from global trade as a consequence of this reduction of the 'thickness' of the border (OECD, 2012). However, for regional trade to have a positive effect on all communities living in Ghana, the field of ICT4D should look into possibilities to enable the lower and middle class to participate in the trading system. This project will therefore attempt to design and build an application for mostly rural areas in Ghana, enabling trade participants to obtain price information about crops relevant for the agricultural sector, using a bottom-up approach. Crop price information is relatively difficult to come by, and farmers had recently expressed their need to know these prices beforehand and at any given time and location. The application is not only relevant for the farmers, however, as any market participant, like sellers of crops, could also benefit from knowing information about crop prices in a more convenient manner.

The current expansion to the original has caused certain changes in the infrastructure and functionality of the application, some based on feedback from the ICT4D community and others through our own evaluation process. These changes are discussed throughout the paper. In this expansion, the largest additions include two new software tools and a deployment plan including a time line for 2019.

II. USE CASE DESCRIPTION

For the description of the use case, we follow the ICT4D 3.0 approach. This approach was developed and validated in rural West-Africa from 2009 to 2015 and is compatible with international development standards.

A. NAME

The name Marcedi was chosen because it combines the English word market with the local currency in Ghana named the Cedi, making it both easy to remember and pronounce.

B. SUMMARY OF KEY IDEA

Market participants and especially farmers living in communities in rural areas in Ghana have great interest in knowing the prices of specific crops. In order for them to retrieve these prices, they have to either go to the market directly or talk to the designated market leader, who sets the prices for the crops for a given period of time. The village chief sometimes also knows these crops prices. This

method of information retrieval is both inconvenient and time consuming for the farmers. For example, when a farmer wants to sell a batch of honey, he or she has to first travel to the market either with or without the goods and find out what today's prices are on arrival at the destination market. If the prices set are not in line with what the farmer had in mind, the trip wasted both time and effort which could be spent on more productive activities. Furthermore, because there is only one (potentially two, including the village chief) person who knows todays prices, all market participants will have to turn to the same person, which causes conceivable communication inefficiencies.
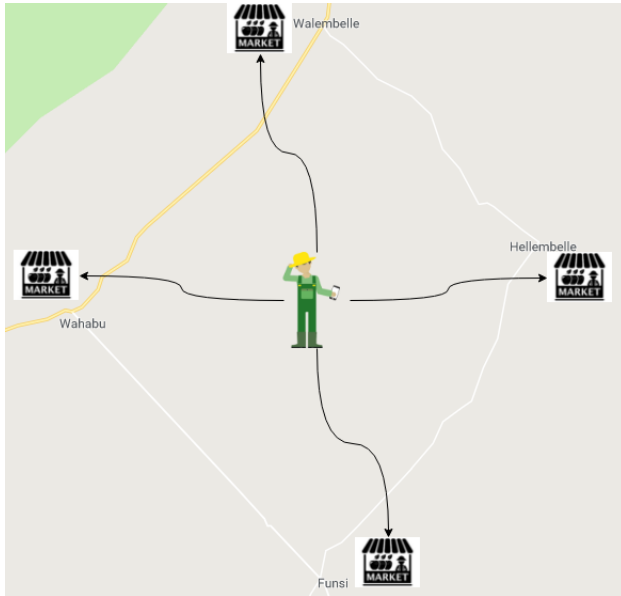

Fig. 1. Farmer Located Favourably Between Several Different Markets In North Ghana

We therefore propose an application which uses voice based communication methods to retrieve crop prices through the use of mobile phones from a central database containing information about all markets. The prior version of our application could not differentiate between markets, however, and was linked to one market only. In the current version, we added the extra functionality of asking the user for which market he or she wants to obtain crop price information, added market price averages and a crop price information entry tool, on which we will elaborate later. The main advantage of extending the scope to multiple markets lies in the fact that it will allow farmers to know beforehand which markets might be most attractive and profitable, before travelling to one of them. What is still unknown to us, however, is whether only certain farmers located favourably between several markets (see figure 1) or all farmers will benefit from this added feature, as we do not know how dispersed the markets are from one another or selling crops on different markets is something they would even consider doing. To investigate this further, we propose this to be one of our main questions to ask during the user evaluations, where the specifics about these questions will be discussed in

section 4. Also, the system now supports multiple languages, as opposed to the prior version which only supported English. The application now supports Dutch and French, where French can be of particular interest when future versions might be built for neighbouring countries like Ivory Coast for example, where the main spoken language is French.

C. ACTORS AND GOALS

TABLE I
ACTORS AND GOALS

ACTOR	GOAL
Users	Retrieve price information
Central Communication Person	Gather and Input price information
User (including Farmers)	Express Own Prices

D. Context and Scope

1) Network Configuration: The following diagram illustrates the interactions between the different actors and agents involved. As is shown, the central communication person gathers information about a variety of market items, and puts this in the Marcedi system. From this point onward all users can use their mobile phone to request information on current crop prices and in the latest version also on average monthly prices.
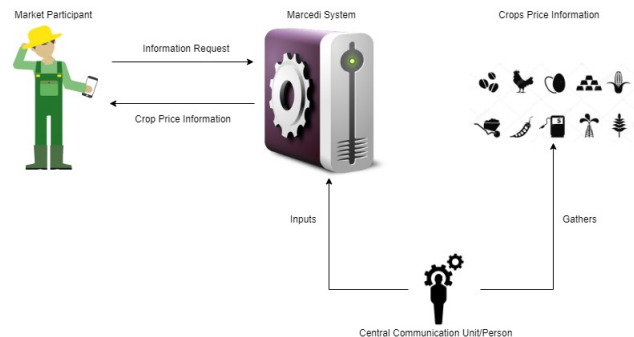

Fig. 2. Interactions Between Parties Involved

2) Stakeholders: The stakeholders of Marcedi are farmers, market salesmen, the market leader, village leaders, and market consumers. The primary concern regarding Marcedi for all of these different actors is that the prices given by the system reflect the true prices on the market. This requires the prices in the system to be updated frequently, and accurately. In addition, all farmers that are associated with a given market should be able to share their own price with the price maker, to ensure that a fair price will be made. The market and village leader have the additional concern that the system is adaptable enough to process sudden fluctuations in prices quickly. Moreover, it is in their interest if the prices they set for market goods are also adhered to by the market salesmen. Therefore, it is of significant importance that the communication of price information occurs effectively.

3) Scope: The scope of the project in prior versions was limited to the end user. The project has now been extended as a new tool for the persons who input the information into our system has also been designed. This could be the market leaders themselves, the village chiefs or other central communication individuals.

4) Performance Indicators:
- Frequency of phone calls made to Marcedi
- Frequency of users that do not reach a terminal state in Marcedi (drop-out rate)
- Information perceived as meaningful and useful by the end user (qualitative metric)

5) Assumed (pre)conditions:
- We assume users have a mobile phone in their possession, whereby no specific software or hardware requirements are needed except for the functionality to make a call.
- The central communication unit is assumed to be connected to the server in order for price information to get occasional updates.

E. Use Case Scenario Script

In this section an example use case of a farmer that wants to know the market price of maize is presented:

> User: Calls Marcedi.
> Application: Please select the desired market.
> User: Selects Wahabu market.
> Application: Please select crop.
> User: Selects maize.
> Application: Tells current market price of maize in measuring bowls.
> Application: Closing message.
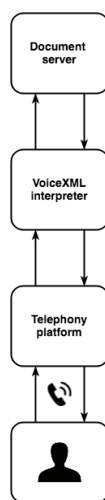> User: Ends call.

F. Interaction and Communication

Fig. 3.   Marcedi Sequence Diagram

Figure 3 illustrates the sequence of events that occur when using Marcedi. On the bottom of the diagram there is the user, who can use his/her mobile telephone to make a call.

This occurs through a telephony platform, which connects the user to a VoiceXML interpreter. This interpreter allows the VXML code - which is stored on a document server - to be run and converted to audio. This audio is then sent back to the mobile phone of the user through his/her telephony platform.

Figure 4 illustrates the relationships between farmers, market leaders, and market salesmen. This highlights the central position of the market leader as price maker.

Fig. 4.   Relationship Between Actors

G. Technology Infrastructure

In order for Marcedi to run effectively, there needs to be a technological infrastructure in place that allows for the use of mobile telephones, telecom providers and servers. Therefore, it is required that users are able to connect their mobile telephones to their telecom providers (i.e. that users have signal even in remote places), and that servers and laptops can be connected to the internet occasionally. Furthermore, it is preferred to have stable and reliable power sources for all of these components.

H. Cost Considerations

Financing for ICT4D projects recently saw initial pilot funding between 100,000 and 5,000,000 US dollars and is typically in the form of a grant. A potentially interesting fund for this project is the Zambezi Prize for Financial inclusion, where 200,000 US dollars is awarded to projects aimed at increasing financial inclusion in Africa (ICTworks, 2018). Furthermore, IT For Change (2014) stressed the importance that sufficient investment in sustaining and developing a service network where users have the possibility to ask questions and gain continuous support throughout the years is of great importance to the success of ICT projects in developing countries, which they learned from use cases in India. This additional funding required to sustain the project could be financed by yearly support payments by the government or by NGOs. A full overview of the expected costs is given in the appendix.

I. Feasibility and Sustainability

1) Technical Feasibility: As mentioned previously, a relatively low level of technological infrastructure is required for the implementation of Marcedi. A strong assumption underlying this system is that there is a widespread adoption of mobile phone usage amongs farmers in rural Ghana. However, the statistics on mobile phone usage suggest that this will probably not be a problem: in 2016 there were around 36.6 million mobile phone subscriptions for a population of around 28.2 million people in Ghana (National Communications Authority, 2016). In addition, the assumption is being made that users will have the skills and understanding to

navigate through the menu of the Marcedi system. That being said, within the context of ICT for development many different projects have successfully been implemented using a technological infrastructure similar to the one in the proposed project. Next to that, this project has the advantage that all elements of the technological infrastructure are already in place. Therefore, its implementation can be realized with a relatively low amount of capital and technical obstacles to overcome.

2) Business and (socio)economic feasibility and sustainability: As mentioned previously, there is a minimal amount of capital required to initialize this project, and even less capital needed to keep it running. This is not a trivial benefit to Marcedi, as many projects (related to ICT) in a development context fail because of a lack of long-term funding. A more detailed discussion on the sustainability of the project is presented in section six.

3) Goal Conflicts and Dependencies: The amount of profit or loss to consumers, farmers, and market salesmen are all dependent on the prices set by the market leader. Therefore, there is a strong central dependency on this actor by all other actors in the supply chain. It is not the focus of this project, however, to change this pre-set structure, but rather to improve efficiency in the market by facilitating the access to market prices.

III. Description of the Service

After evaluating the feedback on the first and second version of our application, we have made some adjustments to the service. First of all, Marcedi is now implemented using a Django-based XML architecture. The name of the Django app that enables this is Voice Service Development Kit (VSDK), and was created by Andre Baart. In the prior version, Marcedi was hosted on a server provided by Voxeo. The current back-end however, is hosted on a server by Heroku and redirects requests to a Raspberry Pi, which interprets VXML files to a phone connection. One downside of using Heroku is that it is not perfectly suitable for hosting static files, since Heroku overwrites all old versions of your application with every push of a new version. The application is now able to run without the use of an internet connection. Due to this new implementation the application needed some reconstructions and adjustments.

First of all, since text-to-speech is not available anymore due to the lack of an internet connection, all the text segments had to be recorded and added to the application. This was done for the three currently support languages: English, French and Dutch. The VSDK has a built in feature to select the correct language according to the country that the user calls from. The manual process of language selection is therefore not necessary anymore. However, we would still like to implement this feature for the cases where a user prefers another language. We were told that the measuring units are fixed among villages and kilograms are not used to weigh crops. Therefore the option to select between different measuring units was removed from the application. The removal of the two mentioned features caused the system

structure to change a little but also made the service easier to use. An updated version of the call-flow-diagram is shown in Figure 5. Menus and forms are indicated with boxes and user actions are indicated with circles. At any point in the application the user has the ability to go one step back. When a user calls Marcedi, a welcome message will be played and the user will be asked to select the market of choice. Secondly, the user will hear some instructions about the service and is instructed to choose a desired crop. After this, the price of the chosen crop will be given in the local currency and measuring unit. The user can now choose to select another crop or go to the closing message. After the closing message the call will be terminated. As a further extension to our current application, the current version allows users to obtain crop price averages and allows market leaders to easily input data into the system, as will be elaborated upon in section five. Furthermore, the service is currently running live on:

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http://marcedi.herokuapp.com/vxml/
start/2
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The proposed system should provide users in Ghana with an easy to use, low effort application that can be used to solve the problems related to not knowing the current market prices. A demonstration video of our working prototype based on the use case of a Dutch user retrieving price information about maize using Marcedi was created and is available at:
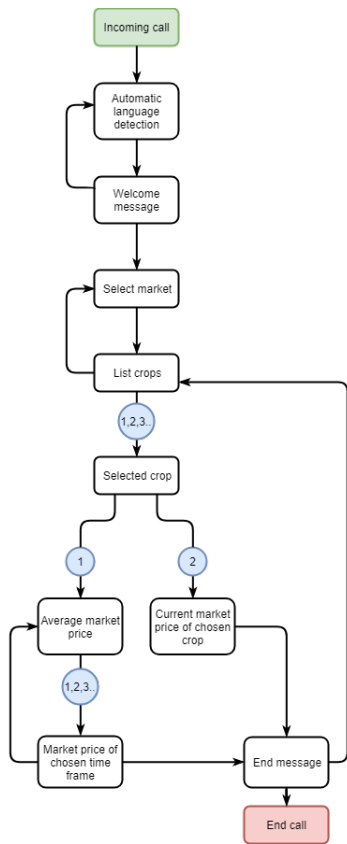
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https://www.youtube.com/watch?v=
cXFxcknS3eA
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Fig. 5. System Diagram
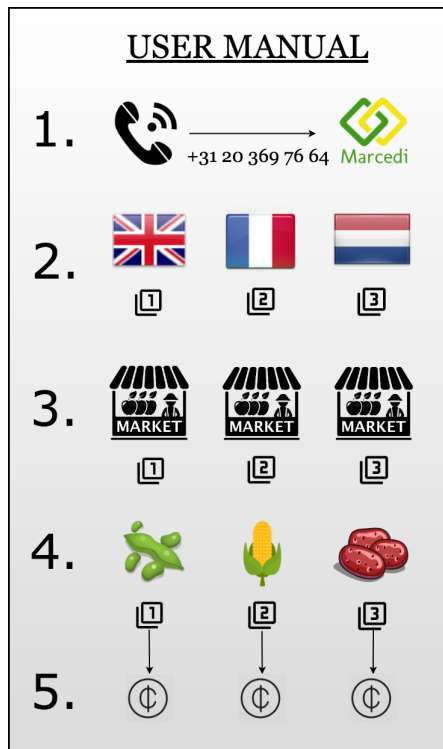
IV. INSTALLATION AND DEMONSTRATION GUIDE

Fig. 6. User Manual aimed at users with low-literacy

The user manual depicted in Figure 6 was created with low-literature users in mind. Through the use of icons rather than text, it aims to guide them through the whole process of using Marcedi. A more comprehensive manual has been written for someone using Marcedi within the role of administrator, and can be retrieved upon request.

Feedback Questions

During the possible future user evaluation rounds, we propose to ask the users the following questions:

1) : What do you think of the functionality of knowing the prices of crops for several different markets? Is this useful to you personally and could you comment on the possible usefulness to other farmers within the region?

As was discussed in an article by Gomez and Pather (2012), more functionality often does not automatically translate into successful and sustainable ICT4D solutions like providing long-term value and productivity increases for users. Furthermore, as was also touched upon earlier in this paper, we do not possess sufficient knowledge about the contextual and geographical aspects of the markets dispersed over Ghana. Therefore, this question feels appropriate to ask as information pertaining to this subject is hard to come by through other sources. Question one can be linked to our third performance metric, as discussed earlier in section 2.

2) : Did you ever have to re-dial the number because the call ended and you did not obtain the desired piece of information? And if so, how often did this occur to you in the last month and could you indicate what you think went wrong?

In her evaluation of an application for midwives in Ghana called mHealth, Velez (2011) reported that low technical self-efficacy was a significant barrier to successful implementation and use of that particular application. Question two aims to decipher how often this is related to this issue and can furthermore be linked to our second performance metric.

V. PRICE AVERAGES AND INPUT TOOL

As an extension to the usability of our application, we created two additional tools; one where the market leader or designated data entry individual can input and update crop price information and a second tool where price averages can be retrieved for a specific month. The latter tool is interesting for any market participant who might benefit from knowing these average prices. One example of this could be farmers who wish to plan ahead with regards to when to cultivate and harvest certain crops. When the average price for a certain crop is ten percent higher in the month of July compared to August, the farmer might decide to make sure he or she has sold all the units of this crop before the end of July, resulting in higher revenues and ultimately net income. While designing the applications we tried to optimize the user experience. A choice menu was created so that users can easily select the available options. Whenever manual input is required, the system will indicate if the input is valid and otherwise ask the user to try it again. Prices are currently stored in a csv file which can be used for further

data analysis. A demonstration video of the input tool and a link to the code can be found here:

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https://github.com/daveebbelaar/
ICT4D---Marcedi
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For both cases, the programming language used was Python (Van Rossum, 2007).

Data Handling: We do not use an external API or database, as the database is filled by entries of the market participants who are related to crop price information themselves. An overview of all the classes is given in figure 7.
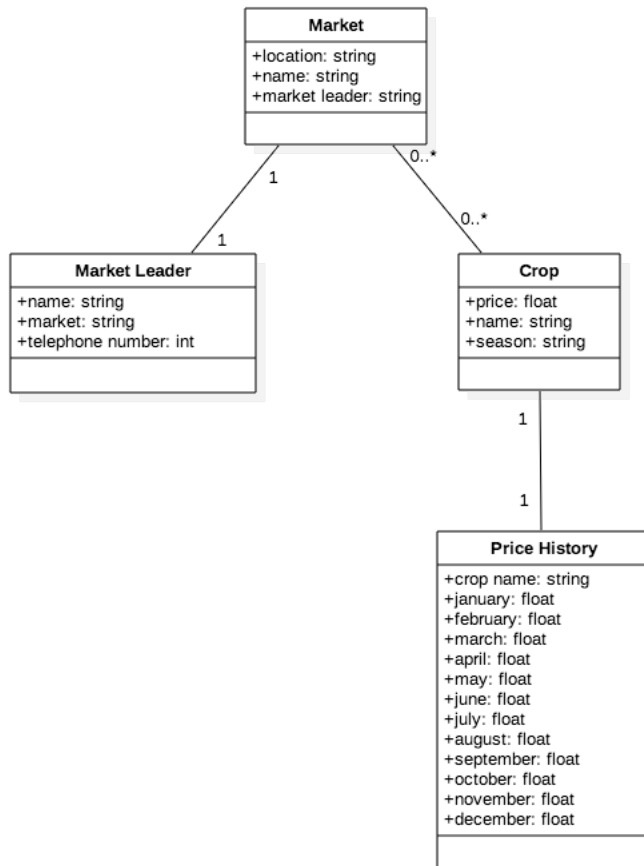

Fig. 7.   Class Diagram

VI. MARCEDI DEPLOYMENT PLAN

The deployment plan of the application aims to provide all stakeholders with project goals and a time line to visualize what everyone will be working on in the pilot year of the application, as incompleteness and lack of performance metrics can lead to partial or complete failures of ICT4D projects (Tongia & Subrahmanian, 2006). Inspiration was drawn from the RICTP-PAF framework whilst creating this plan, which was first described by Osah and colleagues (2014), who also stress the importance of considering and evaluating all life cycle phases of an ICT4D project on a continuous basis utilizing proper assessment criteria to do so.

RICTP-PAF stands for Rural ICT4D Project Process Assessment Framework and has the aim to represent checks which can be made during the process of deploying an ICT4D project in rural areas like Ghana. Furthermore, practical key performance indicators (KPIs) are proposed which we can use to evaluate the project per phase instead of only being able to reflect on the final results. We view these KPIs as the business model variant to the Agile software development strategy in this project, which favours rapid deployment and evaluation of software compared to multi year projects. An overview of the deployment plan and a time line including the project's multiple phases and its corresponding KPIs can be found in the appendix.

A. Phase One: Brainstorming And Preplanning

The first phase of the deployment will mainly consist of finding a suitable and relatively small area somewhere in rural Ghana where we can pilot our application for the first time. Stakeholders have to be in agreement as to where this area might be. Contextual factors, geographical factors and financial matters are discussed during this phase.

B. Phase Two: Building User Base

The second phase already begins whilst the first phase is still ongoing. This allows for more time to build an user base compliant with the KPI of getting at least one hundred participants during the second phase, as set out in the deployment plan. To successfully initiate phase two well in time in Q1, finding a local resident or sending one of our team members to the focus area earlier are among the possible options.

C. Phase Three: Documenting Feedback

The third phase starts in Q3, which means the deployment team has worked on the project for half a year. This is when the documenting phase begins, where all the gathered information and feedback will be summarized and acted upon. In line with our Agile like software strategy, our KPI during this phase will be to have successfully incorporated the received feedback and having developed three updated versions of the Marcedi application.

D. Phase Four: Data Sharing

As using open standards, data and innovation are generally characterized as best practises within the ICT4D literature, the project aims to abide to this principle by making sure all the process made will be well documented and spread across the ICT4D community. By doing so, this allows other prospective ICT4D projects to base important decisions on the lessons learned during this particular project, thereby reducing the chance mistakes of similar nature will be repeated. Furthermore, the deployment of Marcedi itself can benefit from sharing the data as well, as feedback from the international community can be given on the results obtained thus far.

E. Phase Five: Evaluation and Discussion

In the final phase of 2019, the full year will be evaluated and discussed. Which KPIs did we attain? What went good and what went wrong? Identifying room for improvement and setting up a new deployment plan for the following year will be the main goal during this phase.

While the deployment plan and the time line cover the KPIs and general goals of the project, sustainability goals are not included and they will be discussed in the following paragraph.

F. Sustainable Deployment and Partnerships

According to the Organizational Guide to ICT4D (2014), partnerships are essential in order to realize the potential ICT can have in developing communities and are of substantial importance to the sustainability of the project. First, a list is presented with potential partners, where all the entities fall within one of the four categories, them being NGOs, businesses, sponsors or at the top level the government of Ghana. These partners have all worked with ICT4D projects before and could therefore be approached to realize financial and technical needs for the current project, as well as provide valuable advice and feedback to us. Second, sustainability criteria are discussed, drawn from the work of Nawi and colleagues (2013) in Malaysia who developed a sustainability model tailored for ICT4D projects.

Fig. 8. List Of Potential Partners

The sustainability criteria which can be applied to the Marcedi project are based upon several forms of sustainability. Sustainability in the materialistically durable sense will not be discussed here, as this has been touched upon in earlier parts of the paper already. An institutional sustainability criterion will be met when the potential partners listed above are willing and able to commit to the project during its complete life span. This can be achieved by defining clear participatory policies before letting partners join. Economic sustainability will be achieved when the project will be sufficiently funded throughout the whole life cycle. For this to occur, the cost considerations as set out in the appendix need commitment from sponsors and other partners that they are legally obliged to pay their financial share of the total budget. Finally, social and cultural sustainability criteria are met when social exclusion is minimized. As the project progresses, certain individuals might want to reap all the benefits from the project for themselves instead of the whole community doing so. This is not in line with the goal of community development and ICT4D researchers should be watchful when certain parts of the community are not given the chance to comment on the project or are actively silenced by other members of the community.

VII. TECHNICAL IMPLICATIONS AND DOCUMENTATION

During the process of creating the application, we did not encounter any serious technical implications. However, due to the absence of extensive documentation regarding the Kasadaka platform, it was difficult to fully understand the framework in a relatively short period of time. It took us quite some time to figure out how all the components of the system worked together, and testing proved to be more time consuming than we initially thought, as the Kasadaka server for example, would only allow one user at a time to test the voice application.

VIII. EVALUATION, FIDELITY AND DISCUSSION

The set goals of the application prior to building it were largely reached. The application successfully runs on a standalone server and is largely compatible with the infrastructure available in rural Ghana. The desire of the farmers to know crop prices in a more convenient manner than visiting the markets themselves is also fulfilled. In addition, added functionality in the form of an average crop prices per month request tool and a data input tool were also implemented. From a more technical perspective, although the application works, improvements can be made to the integration of the newly created tools into one Marcedi application. In its current from, the data input and extraction tools operate on a standalone basis. Although at the moment this might be for the best as these tools may not run on the relatively simple Kasadaka platform, arguments can be made that integrating these tools in the same platform as the voice application may result in benefits to both the usability and interchangeability of the application. The usability might be positively influenced as the user now only has to work with one, instead of several tools and the interchangeability because changes made to the application will then automatically apply to all tools instead of one at a time. A web based interface, especially for the input tool, would in future versions also be desirable.

Before concluding the research project, some limitations are discussed. First, Marcedi has not been tested in the field and as such, no feedback has been gathered from the users for which this application was created. This is a major drawback

for the project in its current form, and has therefore been given substantial attention in the deployment plan and time line. Second, the success of this project is reliant on a couple of key factors. One of which is access to reliable electricity. Unfortunately, the main single point-of-failure of Marcedi is the Kasadaka system. Even though we could not experience it firsthand, research has shown that a consistent supply and reliable infrastructure of electricity remains a challenge for Ghana, particularly for rural areas (Twerefou, 2014). Power outages are a daily reality for some regions, and could have negative implications for users' trust and reliability on the Marcedi system. Future work could include the integration of renewable energy sources such as solar or wind power, as these could be more reliable, and sustainable energy sources (Gyamfi, Modjinou, and Djordjevic, 2015).

Interesting findings and lessons learned which we did not specifically address in this paper, but can be of importance to other prospective ICT4D researchers are that field research can be out of reach for a long time and therefore Agile software development becomes less practical than it would be when working for a company in a developed society for example. Also, really understanding the context was harder than we initially thought. Partial understanding comes easy, think of infrastructural context, but total understanding of the context is much more difficult. In our project, for example, social sustainability issues were something we completely overlooked during the initial research phase, so be aware of the difficulties related to context in ICT4D projects.

IX. CONCLUSIONS AND FUTURE WORK

In the first and second part of the project we introduced a voice based application with the goal to aid market participants in rural Ghana retrieve crops price information in an efficient fashion through the use of their mobile phones. Ghana is a developing country facing severe socio-economic challenges, where poverty is among one of them. To spur regional trade and its corresponding benefits to inclusive development and attempt to reduce economic inequality in the country, we designed the application keeping the needs and context of primarily lower income societies living in rural Ghana in mind. This is often the focus of ICT4D projects as this target group can gain substantial advantages by utilizing information and communication technologies otherwise not available to them. The first expansion upon the initial version increased the functionality of the application and documented instruction and demonstration content related to the use of the updated application. The second expansion introduced two new tools for both market participants, which can now retrieve average crop price information, and market leaders or other data entry individuals which can now easily store updated prices in a data model. Furthermore, a deployment plan and time line for the pilot year of the application were added.

Future work could look into the possibility of additional features or continue refining the deployment plan. First, the potential partners listed in section six are not approached yet, and this could be a good starting point to continue the work
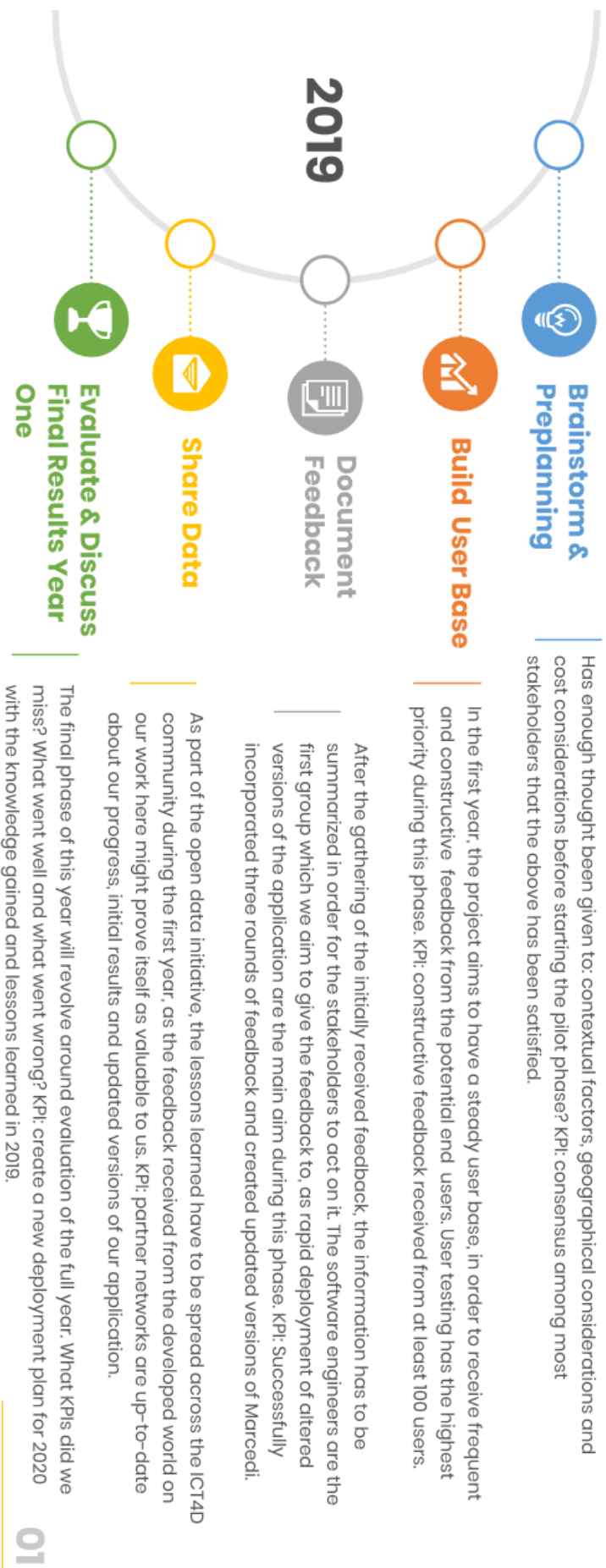
that has been done up until the time of writing. Second, web based interfaces of the two newly introduced tools could be developed. However, due to contextual factors like a lack of access to the internet and general software illiteracy, a detailed assessment has to be made whether creating these web based services are indeed useful and practical for the end users. As discussed in section 3, the addition of a manual language selection would be beneficial for users that prefer a different language from the one selected by the system. This is of particular interest to a country like Ghana, as there are reportedly more than 80 different languages spoken within the country. Lastly, the implementation of a potential revenue calculator could be beneficial to users who lack the skills on how to do basic mathematical calculations.

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MARCEDI DEPLOYMENT PLAN

The aim of this plan is to provide all the stakeholders with an overview of the goals and KPIs for the year 2019.

2019

Brainstorm & Preplanning

Has enough thought been given to: contextual factors, geographical considerations and cost considerations before starting the pilot phase? KPI: consensus among most stakeholders that the above has been satisfied.

Build User Base

In the first year, the project aims to have a steady user base, in order to receive frequent and constructive feedback from the potential end users. User testing has the highest priority during this phase. KPI: constructive feedback received from at least 100 users.

Document Feedback

After the gathering of the initially received feedback, the information has to be summarized in order for the stakeholders to act on it. The software engineers are the first group which we aim to give the feedback to, as rapid deployment of altered versions of the application are the main aim during this phase. KPI: Successfully incorporated three rounds of feedback and created updated versions of Marcedi.

Share Data

As part of the open data initiative, the lessons learned have to be spread across the ICT4D community during the first year, as the feedback received from the developed world on our work here might prove itself as valuable to us. KPI: partner networks are up-to-date about our progress, initial results and updated versions of our application.

Evaluate & Discuss Final Results Year One

The final phase of this year will revolve around evaluation of the full year. What KPIs did we miss? What went well and what went wrong? KPI: create a new deployment plan for 2020 with the knowledge gained and lessons learned in 2019.

Cost Considerations Project Marcedi

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Revenues										
Pilot Funding	200.000,00	0	0	0	0	0	0	0	0	0
NGO/Governmental Support	54630	50800	50800	50800	50800	50800	50800	50800	50800	50800
Total	254.630,00	50.800,00	50.800,00	50.800,00	50.800,00	50.800,00	50.800,00	50.800,00	50.800,00	50.800,00
Costs (non-recurring)										
FTE (3 @ 30,000)	90000									
Hardware & Infrastructure	3000									
Software Development (2 FTE @ 40000)	80000									
Training (1 FTE @ 30,000)	30000									
Shipping (From Rotterdam)	830									
Total	203830									
Costs (recurring)										
Project Support (1 FTE)	40000	40000	40000	40000	40000	40000	40000	40000	40000	40000
Repairs & Replacements	800	800	800	800	800	800	800	800	800	800
Project Evaluation	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Total	50800	50800	50800	50800	50800	50800	50800	50800	50800	50800
Result w/o support	-54630	-50800	-50800	-50800	-50800	-50800	-50800	-50800	-50800	-50800
Result with support	-	-	-	-	-	-	-	-	-	-
Cost to supporter	511830									
Cumulative cost project 10 years	711.830,00									

PROJECT TIMELINE

The deployment overview visualized on a quarterly basis.

20 19

Q1 **Brainstorm & Preplanning**

Q2 **Build User Base**
Note: reach out to potential end users already during phase one

Q3 **Document Feedback**

Q4 **Share Data**

20 20

Q1 **Evaluate & Discuss Final Results Year One**